
WP-MIRROR 0.7 Reference Manual

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WP-MIRROR 0.7 Reference Manual

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Abstract

The [Wikimedia Foundation](#) offers wikipeidias in nearly [300 languages](#). In addition, the WMF has several other projects (e.g. [wikibooks](#), [wiktionary](#), etc.) for a total of around 1000 wikis.

WP-MIRROR is a free utility for mirroring any desired set of these wikis. That is, it builds a wiki farm that the user can browse locally. Many users need such off-line access, often for reasons of mobility, availability, and privacy. WP-MIRROR builds a complete mirror with original size media files. WP-MIRROR is robust and uses check-pointing to resume after interruption.

By default, WP-MIRROR mirrors the [simple wikipedia](#), the [simple wiktionary](#) (Simple English means shorter sentences), and the [wikidata wiki](#) (a centralized collection of facts usable by all other wikis). The default should work ‘out-of-the-box’ with no user configuration. It should build in 200ks (two days), occupy 100G of disk space, be served locally by virtual hosts <http://simple.wikipedia.site/>, <http://simple.wiktionary.site/>, and <http://www.wikidata.site/>, and update automatically every week. The default should be suitable for anyone who learned English as a second language (ESL).

The top ten wikis are the [en wikipedia](#), followed by the [de](#), [nl](#), [fr](#), [it](#), [ru](#), [es](#), [sv](#), [pl](#), and [ja](#) wikipeidias. Because WP-MIRROR uses original size media files, these wikis are too large to fit on a laptop with a single 500G disk. When higher capacity hard disk drives reach the market, this list may be shortened. But for now, a desktop PC with ample disk space and main memory



is required for any of the top ten, unless the user does not need the media files (and this is configurable).

The [en wikipedia](#) is the most demanding case. It should build in 1Ms (twelve days), occupy 3T of disk space, be served locally by a virtual host <http://en.wikipedia.site/>, and update automatically every month.

This project's current Web home page is <http://www.nongnu.org/wp-mirror/>.

This document was generated on April 10, 2014.

Features

WP-MIRROR has been designed for robustness. WP-MIRROR asserts hardware and software prerequisites, skips over unparsable articles and bad file names, waits for Internet access when needed, retries interrupted downloads, uses check-pointing to resume after interruption, and offers concurrency to accelerate mirroring of the largest wikis.

WP-MIRROR issues a warning if [MySQL](#) is insecure (e.g. has a root account with no password), or if a caching web proxy is detected. WP-MIRROR warns if disk space may be inadequate for the default (a mirror of the [simple wikipedia](#), the [simple wiktioary](#), and the [wikidata wiki](#)), and gracefully exits if disk space runs too low.

WP-MIRROR normally runs in background as a weekly [cron](#) job, updating the mirror whenever the [Wikimedia Foundation](#) posts new dump files.

Most features are configurable, either through command-line options, or via the configuration file [/etc/wp-mirror/local.conf](#). Wikis can be added to the mirror, or dropped from it. If an user makes an hash of things, and wants to start over, just execute

```
root-shell# wp-mirror --restore-default
```

which drops all WP-MIRROR related databases and files (except media files). This option is used regularly during software development and debugging. An user who wishes also to delete the media files, may execute:

```
root-shell# cd /var/lib/wp-mirror-mediawiki/images/  
root-shell# rm --recursive --force *
```

That said, a good network citizen would try to avoid burdening the Internet by downloading the same files, over and over.

Troubleshooting

If WP-MIRROR fails or hangs, please take a look at the log files [/var/log/wp-mirror.log](#). Alternatively, try running

```
root-shell# wp-mirror --debug  
root-shell# tail -n 1000 /var/log/wp-mirror.log
```

The last few lines in the log file should provide a clue.

Developers should select some of the smaller wikis (e.g. the [cho](#), [xh](#), and [zu](#) wikipedias) to speed up the test cycle.

WP-MIRROR was written and is maintained by Dr. Kent L. Miller. Please see [§1.8, Credits](#) for a list of contributors.

Please report bugs in WP-MIRROR to [<wp-mirror-list@nongnu.org>](mailto:wp-mirror-list@nongnu.org).

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Chapter 1

General Information

The [Wikimedia Foundation](#) offers wikipedias in nearly [300 languages](#). In addition, the WMF has several other projects (e.g. [wikibooks](#), [wiktionary](#), etc.) for a total of around 1000 wikis.

WP-MIRROR is a free utility for mirroring any desired set of these wikis. That is, it builds a wiki farm that the user can browse locally. WP-MIRROR builds a complete mirror with original size media files.

WP-MIRROR is free software: you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the [Free Software Foundation](#); either version 3 of the License, or (at your option) any later version.

The following list describes some sections of particular interest in this manual:

- **Installation.** If you wish to build a wiki farm, then you will need to install WP-MIRROR and a number of other utilities as well. Presently, the easiest way to manage dependencies is to install from a [DEB](#) package. See [§2.2, Installing WP-MIRROR on Linux](#).
- **Default.** In its default configuration, WP-MIRROR mirrors the [simple wikipedia](#), the [simple wiktionary](#) (Simple English means shorter sentences), and the [wikidata wiki](#) (a centralized collection of facts usable by all other wikis). This should:
 - work ‘out-of-the-box’ with no user configuration,
 - build a complete mirror in 200ks (two days),
 - occupy 100G on an hard disk drive,
 - be served locally by virtual hosts <http://simple.wikipedia.site/>, <http://simple.wiktionary.site/>, and <http://www.wikidata.site/> for web browsing, and
 - update automatically every week.

If the default configuration is what you want, then you need read no further.

- **Configure a wiki farm.** Mirroring a set of wikis requires some configuration. This could be easy or hard depending on how large the selected wikis are. Therefor, before attempting to build your own wiki farm, please read [§2.4.3, Configuration of a Wiki Farm](#) and [Chapter 3, System Planning and Configuration](#), as it may save you weeks of effort. Really.
- **Mirror a top ten wiki.** The ten largest wikis are judged to be too large to fit on a laptop PC equipped with a single 500G hard disk drive. The top ten wikis are: the [en wikipedia](#) (the largest at about 3T), followed by the [de](#), [nl](#), [fr](#), [it](#), [ru](#), [es](#), [sv](#), [pl](#), and [ja](#) wikipedias. When higher capacity drives reach the market, this list may be shortened. But for now, a desktop PC with ample disk space and main memory is required for any of the top ten, unless you can make do without the media files (and this is configurable). See [§3.3, Desktop Planning and Configuration](#).

1.1 About This Manual

This is the Reference Manual for WP-MIRROR, version 0.2, through version 0.7.

This manual is not intended for use with older versions of WP-MIRROR due to the many functional and other differences between WP-MIRROR 0.2 and previous versions. In particular, WP-MIRROR 0.1 was written as a proof of concept.

The Reference Manual source files are written in \LaTeX format. The other formats are produced automatically from this source. For more information about \LaTeX , see <http://www.latex-project.org/>.

This manual was originally written by Dr. Kent L. Miller in 2012. It is maintained by Dr. Kent L. Miller.

1.2 Typographical and Syntax Conventions

This manual uses certain typographical conventions:

- *Text in this style* is used for directory names, file names, file types, database names, and table names.
- *Text in this style* is used for software utility names.
- *Text in this style* is used for options (command line and configuration file options).
- *Text in this style* indicates command line input.
- *Text in this style* is used for variable input for which you should substitute your own value.
- *Text in this style* is used for emphasis.
- URLs are formatted like <http://www.nongnu.org/wp-mirror/>.
- E-mail addresses are formatted like [<wpmirrordev@gmail.com>](mailto:wpmirrordev@gmail.com).

Command-line interface (CLI) sessions are indicated as follows:

```
shell$ indicates a shell command
root-shell# indicates a shell command entered as root
mysql> indicates a mysql statement
```

Command-line interface sessions involving SSH name the remote host as follows:

```
shell$ ssh remote-host
remote-host$ indicates a shell command entered on the remote host
remote-host$ exit
shell$ indicates a shell command entered on the local host
```

Configuration file contents are indicated as follows:

```
config line 1
config line 2
config line 3
```

1.3 Overview of WP-MIRROR

1.3.1 What is WP-MIRROR?

- **Mirror building software.** The [Wikimedia Foundation](#) offers wikipedias in nearly [300 languages](#). In addition, the WMF has several other projects (e.g. [wikibooks](#), [wiktionary](#), etc.) for a total of around 1000 wikis. WP-MIRROR is a free utility for mirroring any desired set of these wikis. That is, it builds a wiki farm that the user can browse locally.

Many users need such off-line access, often for reasons of mobility, availability, and privacy. WP-MIRROR builds a complete mirror with original size media files.

- **Robust and efficient.** WP-MIRROR is stable even in the face of: corrupt dump files, corrupt media files, incomplete downloads, Internet access interruptions, and low disk space. WP-MIRROR uses check-pointing to resume after process interruptions.

WP-MIRROR automatically configures software dependencies, such as [apache2](#), [cURL](#), [MediaWiki](#), and [MySQL](#), to improve performance.

If disk space runs low (below 5G), WP-MIRROR gracefully exits.

- **Easy to install, configure, and use.** WP-MIRROR offers a default installation that ‘just works’. It mirrors the [simple wikipedia](#), the [simple wiktionary](#) (Simple English means shorter sentences), and the [wikidata wiki](#) (a centralized collection of facts usable by all other wikis). It should build in 200ks (two days), occupy 100G of disk space (which should fit on most laptops), be served locally by virtual hosts <http://simple.wikipedia.site/>, <http://simple.wiktionary.site/>, and <http://www.wikidata.site/>, and update automatically every week. The default should be suitable for anyone who learned English as a second language (ESL).

The user may select any desired set of wikis with just one line in a configuration file.

WP-MIRROR runs as a weekly [cron](#) job updating the mirror. Once WP-MIRROR is installed and configured, there is nothing more that the user needs to do.

WP-MIRROR sets up virtual hosts such as <http://simple.wikipedia.site/>, <http://simple.wiktionary.site/>, and <http://www.wikidata.site/>, one for each wiki in the set, which the user may access with a web browser.

- **Free software.** The WP-MIRROR software is released under the [GNU General Public License](#) (GPLv3).

The [Free Software Foundation](#) uses the following [definition](#), which reads (in part):

A program is free software if the program’s users have the four essential freedoms:

- The freedom to run the program, for any purpose (freedom 0).
- The freedom to study how the program works, and change it so it does your computing as you wish (freedom 1). Access to the source code is a precondition for this.
- The freedom to redistribute copies so you can help your neighbor (freedom 2).
- The freedom to distribute copies of your modified versions to others (freedom 3). By doing this you can give the whole community a chance to benefit from your changes. Access to the source code is a precondition for this.

<http://www.gnu.org/philosophy/free-sw.html>, accessed 2012-12-19

- **Free documentation.** The WP-MIRROR Reference Manual (this document) is released under the [GNU Free Documentation License](#), version 1.3. A copy of the license is included in the section entitled [GNU Free Documentation License](#).

1.3.2 History of WP-MIRROR

Summer of 2010 the author decided to build a mirror of <http://en.wikipedia.org/>. Having mirrored other sites, the author did not think it would be too challenging. The pet project, however, encountered a morass of corrupt dump files, unsupported utilities, dismal database performance, thousands of corrupt media files, stalled downloads, proxy malfunctions, system crashes, and hardware failures.

By Summer of 2011, most problems were in hand.

Up to this point, the project did not have a name, and it only built a mirror of the [en wikipedia](#). It would later be named WP-MIRROR 0.1.

On 2011-Nov-22, the author ran into Richard Stallman of the [Free Software Foundation](#), who encouraged the author to release the software under the [GNU General Public License](#) (GPLv3). The name WP-MIRROR was selected for the project. The code was refactored in order to mirror a set of wikipedias (i.e. build a wikipedia farm).

On 2011-Dec-25, WP-MIRROR 0.2 was released under GPLv3, and hosted by the [Free Software Foundation](#) at <http://www.nongnu.org/wp-mirror/>.

On 2012-Feb-12, the author submitted an intent to package (ITP) to the Debian bug tracking system [BTS](#) (bug [#659640](#)).

On 2012-Mar-04, WP-MIRROR 0.3 was released as [DEB](#) and [RPM](#) packages. During Summer of 2012, user experience revealed that: configuration of dependencies was a barrier to adoption. Therefore, automation of the dependency configuration became the main design objective for the next release.

On 2012-Nov-12, WP-MIRROR 0.4 was released as a [DEB](#) package. User feedback indicated that most were using Ubuntu. Therefore, increasing the number of distributions and platforms, for which WP-MIRROR worked ‘out-of-the-box’ became the main design objective for the next release.

On 2012-Dec-14, WP-MIRROR 0.5 was released as a [DEB](#) package. It works ‘out-of-the-box’ on Debian 7.0 (wheezy) and Ubuntu 12.10 (quantal). WP-MIRROR 0.5 is ‘feature complete’ and deemed ‘beta-ware’. User and WMF feedback suggested numerous improvements. Therefore, performance and reliability became the main design objectives for the next release.

On 2013-Jun-02, WP-MIRROR 0.6 was released as a [DEB](#) package. It builds the [en wikipedia](#) in 80% less time, using 75% less DRAM. WP-MIRROR 0.6 also builds wikis from other WMF projects (e.g. [wikibooks](#), [wiktionary](#)). During the months following its release, page rendering deteriorated materially. Interlanguage links, infoboxes, and most templates disappeared with only scattered red links to mark their absence. The problem was due to dependency on the [DEB](#) package for [MediaWiki](#) 1.19 LTS, which is unable to render features developed by WMF during 2013. Therefore, repackaging [MediaWiki](#) and making use of the [wikidata](#) project became main design objectives.

On 2014-Apr-02, WP-MIRROR 0.7 was released as a [DEB](#) package. It depends on the [DEB](#) packages [wp-mirror-mediawiki](#) and [wp-mirror-mediawiki-extensions](#) which track the development version that WMF uses to render their pages. In most cases, a page rendered by the mirror now looks very similar to the same page rendered by WMF.

1.3.3 The Main Features of WP-MIRROR

Functionality:

- **Access.** WP-MIRROR creates virtual hosts, so that the user may access mirrored wikis locally using a web browser.
- **Mirror.** WP-MIRROR can run in two modes. In mirror mode, it builds a mirror of one or more wikis, the choice of which may be set in a configuration file, or as a command-line option. Wikis can be added and dropped from the mirror dynamically.
- **Monitor.** WP-MIRROR when running in monitor mode, reports on the state of the mirror and the building process. Information may be displayed in three ways:
 - **GUI.** State information is displayed as a set of colored progress bars in a separate window, if the host has a suitable windowing system such as [X](#).
 - **Screen.** State information is displayed as a set of ASCII art progress bars in a terminal (or console).
 - **Text.** State information is displayed in a terminal (or console) and scrolls upwards. This last display method is most often used for debugging purposes.

Efficiency:

- **Concurrency.** Multiple instances of WP-MIRROR can run concurrently. This is done to accelerate the mirroring of the largest wikis (such as the [en wikipedia](#)).
- **Dependency configuration.** An order of magnitude performance increase is possible by careful configuration of [MySQL](#).
- **HTTP/1.1 persistent connections.** Large numbers of media files can be downloaded using a single [HTTP](#) connection.
- **Profiling.** WP-MIRROR keeps track of the time spent by various functions.

Robustness:

- **Assert hardware.** WP-MIRROR, when launched, first asserts adequate DRAM, adequate disk space, and Internet connectivity. This is because: a large DRAM improves [MySQL](#) performance, and ample disk space must be available for downloaded media files (e.g. [simple wikipedia](#) requires 100G, [en wikipedia](#) requires 3T, as of year 2014).
- **Assert minimum disk space.** WP-MIRROR periodically asserts minimum disk space, and gracefully exits if disk space runs low.
- **Assert software.** WP-MIRROR, when launched in mirror mode, first asserts the configuration of dependencies such as [apache2](#), [MediaWiki](#), [MySQL](#), and others.
- **Automated database maintenance.** WP-MIRROR automatically performs database schema updates. This assures that database schema changes, that accompany new releases of [MediaWiki](#) and its extensions, are soon propagated to the mirror.
- **Automated dependency configuration.** WP-MIRROR automatically configures dependencies such as [apache2](#), [MediaWiki](#), [MySQL](#), and others. For the default case (a clean install of the [simple wikipedia](#), the [simple wiktionary](#), and the [wikidata wiki](#) on a laptop) everything should ‘just work’.
- **Check-pointing.** WP-MIRROR may be interrupted (user closes laptop, power fails, cat walks across keyboard) and resumed later. This is important because building a mirror of one of the top ten wikis could take weeks to complete, a process that one should be loathe to repeat.
- **Retry failed tasks.** WP-MIRROR keeps track of the failed tasks. After all other tasks have run to completion, WP-MIRROR retries the failed tasks.
- **Retry interrupted downloads.** WP-MIRROR uses [wget](#) for file downloads. [wget](#) retries interrupted downloads and, if possible, continues downloading the file from the offset where the interruption occurred. This eliminates the problem of partial downloads.
- **Skip over bad file names.** Many media files have names containing control characters. Such file names pose a security risk to shell scripts (because they may insert malicious shell commands) and to [SQL](#) commands ([SQL injection](#)). Such files are not downloaded.
- **Skip over unparsable articles.** Dump files of each of wiki, are posted online by the Wikimedia Foundation. These dump files are in [XML](#) format, and are updated monthly, more or less. Unfortunately, about one per million articles are corrupt, and cause the [XML](#) parser to fail. WP-MIRROR copes by splitting each dump file into small chunks of ten thousand articles each. These chunks are called [xchunks](#). The processing of each [xchunk](#) is forked as a separate process. So, when an unparsable article is encountered, the failure is limited to that [xchunk](#).
- **Wait for Internet access.** WP-MIRROR performs a number of tasks that require Internet access (and many that do not). When WP-MIRROR encounters a task that requires Internet access, it first asserts connectivity. If the assert fails, WP-MIRROR sleeps for 10 seconds, and tries again. When Internet connectivity is restored, WP-MIRROR resumes.
- **Warnings.** WP-MIRROR issues warnings if [MySQL](#) is insecure (e.g. has a root account with no password), if disk space may be inadequate, or if a caching web proxy is detected.

1.4 WP-MIRROR Development History

Features, ordered by the version in which they were implemented, are summarized in the [Table 1.1, WP-MIRROR Development History](#).

Table 1.1: History of WP-MIRROR Features

Version	Feature
0.7	Database schema for wikis automatically updated Hugepages automatically detected Installs ‘out-of-the-box’ on virtual machine MediaWiki repackaged to track development version used by WMF MediaWiki extensions packaged to track development version used by WMF

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Version	Feature
	Rendering of wiki pages served by mirror now very similar to rendering by WMF URL rewriting, e.g. http://simple.wikipedia.site/wiki/John_Adams_wikidatawiki now added to mirror
0.6	<p>Command-line options <code>--add</code>, <code>--drop</code>, <code>--delete</code>, <code>--dump</code>, and <code>--update</code> enhanced for multiple wikis</p> <p>Command-line option <code>--profile</code> displays performance data</p> <p>HDD write-caching for disks underlying InnoDB now configurable</p> <p>HTTP/1.1 persistent connections used for downloading media files</p> <p>Media files now stored in a directory tree like that used by the WMF</p> <p>Media dump tarballs may be downloaded</p> <p>Interwiki links all moved to Navigation Bar</p> <p>Performance improvements (less wall clock time) in all areas</p> <p>Protocols for downloading dump files expanded to: http, ftp, and rsync</p> <p>Site that serves WMF dump files now configurable</p> <p>Reliability of dump file download from http sites enhanced by using <code>wget</code></p> <p>Wikis from other projects (e.g. wikibooks, wiktionary, etc.) can now be mirrored</p> <p>Virtual hosts created for all WMF projects (e.g. wikibooks, wiktionary, etc.)</p> <p>wikix removed</p>
0.5	<p>Command-line option <code>--add</code> lets user add wikipedia to mirror concurrently with building</p> <p>Command-line options <code>--dump</code> and <code>--update</code> ease database maintenance</p> <p>Concurrent adding, building, and dropping of wikipedias is permitted</p> <p>GUI mode opens and closes windows dynamically as wikipedias are added and dropped</p> <p>Interwiki (interlanguage) links now appear in browser navigation sidebar</p> <p>Virtual host renamed to http://simple.wpmirror.site/</p> <p>WP-MIRROR logotype and favicon now appear in browser</p>
0.4	<p>Assert minimum disk space for media files and InnoDB</p> <p>Automated default configuration for dependencies</p> <p>Command-line option <code>--restore-default</code> lets user start over</p> <p>Shell commands and scripts now POSIX-compliant</p> <p>Warn if MySQL is insecure or disk space low</p> <p>WP-MIRROR Reference Manual provided in TeX and PDF format</p> <p>WP-MIRROR Reference Manual released under GFDL 1.3</p>
0.3	<p>Build DEB from source using <code>pbuilder</code> clean-room</p> <p>Released as DEB and RPM packages</p> <p>Scheduling algorithm rewritten</p>
0.2	<p>Mirror a set of wikipedias</p> <p>Media files processed with built-in alternative to wikix</p>
0.1	<p>Assert hardware and software prerequisites (at start)</p> <p>Check-pointing to resume after interruption</p> <p>Concurrency to accelerate mirroring of largest wikipedias</p> <p>Disable write-caching for disks underlying InnoDB</p> <p>Mirror a single wikipedia</p> <p>Monitor mode to display state of each mirror</p> <p>Skip over bad media file names</p> <p>Skip over unparsable articles</p> <p>Validate media files and sequester those that are corrupt</p>

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Version	Feature
	Wait for Internet access when needed
	Warn if proxy detected

1.5 What Is New in WP-MIRROR

This section complements §1.4, [WP-MIRROR Development History](#). For each WP-MIRROR version, this section lists the: development phase, packaging options, licensing, features added, features deprecated, and features removed.

1.5.1 What Is New in WP-MIRROR 0.7

Phase	beta
Packaging	DEB and tarball
License	GPLv3

Features added:

- **Database schema:** The database schema for each wiki is now automatically updated.
- **Hugepages:** Hugepages are now detected. If none are found, a warning is issued.
- **MediaWiki:** WMF uses the development version of [MediaWiki](#) to render pages at WMF sites. This version is now provided as a DEB package. Moreover, the development version of over forty [MediaWiki](#) extensions are also provided as a package. The result is a significant improvement in page rendering. In most cases, a page as rendered by the mirror looks very similar to the same page as rendered by WMF.
- **Performance:** Missing media files are now identified much faster (90% less time).
- **URL rewriting:** Wikis now accessed with http://simple.wikipedia.site/wiki/John_Adams rather than http://simple.wikipedia.site/index.php?title=John_Adams.
- **Virtual machine:** WP-MIRROR now installs ‘out-of-the-box’ on a virtual machine.
- **Wikidatawiki:** Now added to mirror. Infoboxes now appear, and are populated with data drawn from [wikidata](http://www.wikidata.site/). The virtual host is <http://www.wikidata.site/>.

Features deprecated:

Features removed:

- **FSM:** One function in the Finite State Machine has been removed:
 - [fsm-database-interwiki](#) removed.

1.5.2 What Is New in WP-MIRROR 0.6

Phase	beta
Packaging	DEB and tarball
License	GPLv3

Features added:

- **Command-line options:** The `--add`, `--drop`, `--delete`, `--dump`, and `--update` options take a wider range of arguments to facilitate handling of multiple wikis.
- **Command-line options:** The `--profile` option displays how much time each of the Finite State Machine functions are consuming. It may be run concurrently with adding, building, and dropping wikipeidias from the mirror. This is used for performance analysis.
- **HDD write caching:** The degree of Durability (the ‘D’ in ACID) of COMMITted transactions is now configurable. To achieve the greatest possible Durability, WP-MIRROR’s database transactions must be written to disk immediately after they are COMMITted. However, modest performance gains (22% less time) are seen by flushing transactions to disk once per second (default).

- **HTTP/1.1 persistent connections:** The downloading of media files now takes advantage of [HTTP/1.1](#) persistent connections [\[RFC2616\]](#). Significant performance gains (64% less time) are obtained.
- **Media:** Now stored in a directory like that of WMF. Now `/var/lib/mediawiki/images/<project>/<language-code>` was `/var/lib/mediawiki/images/[0-9a-f]/`.
- **Media dumps:** Media dump tarballs can now be downloaded and extracted.
- **Interwiki:** Previously at the bottom of each article there was a mass of ‘red links’ (inter-language links to articles in wikis not a part of the mirror). These links have now been moved to the Navigation Bar.
- **Monitor:** In `--gui` mode, WP-MIRROR now displays aggregate information in a single window.
- **mwxml2sql:** A new utility from WMF is used to convert [XML](#) dump files into [SQL](#) files which are easier to import into the database. Some performance advantage.
- **Performance:** Significant gains in all areas. Building the [en wikipedia](#) now takes 80% less time.
- **Reliability:** Downloading dump files and media files from [http](#) sites is now far more reliable. This was accomplished by using [wget](#), which has an automatic retry feature, instead of [cURL](#), which often leaves partial files. This obviates the need for media file validation which was a CPU intensive process.
- **Sites:** Dump files can now be downloaded from alternative sites, and using a number of protocols ([http](#), [ftp](#), and [rsync](#)).
- **Virtual host:** Virtual hosts are now created for all WMF projects (e.g. [wikibooks](#), [wiktionary](#), etc.)
- **WMF projects:** The WMF has several projects besides the [wikipedia](#) (e.g. [wikibooks](#), [wiktionary](#), etc.) etc.). WP-MIRROR can now mirror their wikis.

Features deprecated:

Features removed:

- **wikix:** The [C](#) language program [wikix](#) generates shell scripts that download media files. These scripts contain “bashisms” that do not work with the Debian Almquist SHell [dash](#). [dash](#) is a POSIX-compliant implementation of `/bin/sh`, which has become the default `/bin/sh` for Debian.
- **FSM:** Many functions in the Finite State Machine have been removed:
 - `fsm-file-import` replaced with `fsm-file-mwxml2sql`,
 - `fsm-file-scrape` replaced with `fsm-file-list-missing`,
 - `fsm-file-shell` replaced with `fsm-file-wget`,
 - `fsm-image-count`, `fsm-image-chown`, and `fsm-image-rebuild` removed
 - `fsm-image-validate` and its database table `wpmirror.image` removed.

1.5.3 What Is New in WP-MIRROR 0.5

Phase	beta
Packaging	DEB and tarball
License	GPLv3

Features added:

- **Command-line options:** WP-MIRROR 0.5 adds several new run-time options:
 - The `--add language-code` option lets an user add a wikipedia to the mirror by providing the language-code on the command-line, rather than by editing `/etc/wp-mirror/local.conf`.
 - The `--dump language-code` option lets an user dump the database, for a given wikipedia, to a file. The dump file is written to `xxwiki.sql` (where `xx` stands for the language-code) and stored under `/var/lib/mediawiki/image/wp-mirror/`. If the language-code is `template`, then the empty database `wikidb` will be dumped to `database_farm.sql`.

The `--info` option lets the user see the values of all the parameters that can be configured in `/etc/wp-mirror/local.conf`.

The `--update language-code` option lets an user update the database for a given wikipedia to the latest `MediaWiki` database schema. This option is useful after a major upgrade, because `MediaWiki` upgrades often involve changes to the database schema.

- **Concurrency:** WP-MIRROR 0.5 now permits concurrent adding, building, and dropping of wikipedias. In `--gui` mode, WP-MIRROR dynamically adjusts the number of windows as wikipedias are added and dropped from the mirror.
- **Interwiki:** WP-MIRROR 0.5 now has interlanguage links displayed in the browser Navigation Bar. These links allow the user to switch from an article in one language to the corresponding article in another.
- **Logotype:** WP-MIRROR 0.5 now has logotype and favicon displayed by web browser.
- **Virtual host:** WP-MIRROR 0.5 creates the virtual host `http://simple.wpmirror.site/` (for prior versions it was `http://simple.mediawiki.site/`). Consistency of naming was the motive. Now cron job, documentation, log files, logotype, packaging, program, and virtual host all have names like ‘wp-mirror’ or ‘wpmirror’.

Features deprecated:

- **wikix not POSIX compliant:** The `C` language program `wikix` generates shell scripts that download media files. These scripts contain “bashisms” that do not work with the Debian Almquist SHell `dash`. `dash` is a POSIX-compliant implementation of `/bin/sh`, which has become the default `/bin/sh` for Debian. Using the built-in alternative to `wikix` is now recommended.

Features removed:

- **Verbose error messages:** It can happen that one or more assertions fail. This was especially true for WP-MIRROR 0.3 and earlier versions, when the configuration of dependencies was not yet automated. At that time it was thought that highly verbose error messages would be an aid to early adopters and to software development. See [Chapter D, Error Messages](#).

In WP-MIRROR 0.4, these error messages were relegated to the log files `/var/log/wp-mirror.log`. In WP-MIRROR 0.5, they were eliminated entirely.

Verbose error messages were removed for two reasons: 1) Given that user configuration is no longer needed, the user interface should be far less verbose, ideally one line per checkpoint; and 2) Given the availability of the Reference Manual (this document), the log files would no longer need to be highly verbose.

1.5.4 What Is New in WP-MIRROR 0.4

Phase	alpha
Packaging	DEB and tarball
License	GPLv3

Features added:

- **Assert minimum disk space (periodically):** WP-MIRROR 0.4 adds protection against low disk space. Disk space is periodically asserted. If the assert fails, WP-MIRROR exits gracefully.
- **Automated default configuration for dependencies:** Before WP-MIRROR 0.4, the user was required to do quite a bit of post-install configuration of the binary dependencies, such as `MySQL`, `MediaWiki`, and `apache2`. The advantage was that power users could obtain an order-of-magnitude performance increase. The disadvantage was that it deterred potential users who want everything to ‘just work’ without having to read documentation. This is a valid concern for those who learned English as a second language (ESL). WP-MIRROR 0.4 installation now provides default configuration of its dependencies.

- **Command-line options:** WP-MIRROR 0.4 adds a new run-time option `--restore-default`. This option is intended for users who have messed up their configuration (e.g. those trying to mirror the [en wikipedia](#)). Running this option let the user start over with the default installation, namely, a mirror of the [simple wikipedia](#).

This option is a bit dangerous and comes with a warning message because it: drops all WP-MIRROR related databases, deletes all WP-MIRROR working files, and deletes all WP-MIRROR related configuration files (including those intended for WP-MIRROR's dependencies).

- **Documentation in [TeX](#) and PDF format:** WP-MIRROR 0.4 includes a Reference Manual in [PDF](#) format (this document), built from [TeX](#) source. This new document features improved browsing using [hyperrefs](#), and improved content and layout. Before WP-MIRROR 0.4, the documentation was available only in text format—a lengthy [README](#), and a [man](#) page.
- **Shell commands and scripts now POSIX compliant:** WP-MIRROR gets much of the work done by forking shells to run shell commands or even large shell scripts. Some of these commands and scripts previously contained “bashisms” that did not work with the Debian Almquist SHell [dash](#). [dash](#) is a POSIX-compliant implementation of `/bin/sh`, which has become the default `/bin/sh` for Debian.
- **Warnings:** WP-MIRROR 0.4 issues warnings if [MySQL](#) is insecure (e.g. has a root account with no password) or if disk space is inadequate. These warnings are intended as a convenience for the system administrator.

Features deprecated:

- **wikix not POSIX compliant:** The [C](#) language program [wikix](#) generates shell scripts that download media files. These scripts contain “bashisms” that do not work with the Debian Almquist SHell [dash](#). [dash](#) is a POSIX-compliant implementation of `/bin/sh`, which has become the default `/bin/sh` for Debian. Using the built-in alternative to [wikix](#) is now recommended.

Features removed:

- **Command-line options:** Before WP-MIRROR 0.4, some command-line options existed for the purpose of generating files during the build process. For WP-MIRROR 0.4, we have:
 - **Build options removed:** `--config-default`, and `--config-local`. The files, previously generated by WP-MIRROR using these build options, are now simply included in the package.
 - **Build options retained:** `--copyright`, `--help`, and `--version` are still used to generate files during the build process.

1.5.5 What Is New in WP-MIRROR 0.3

Phase	alpha
Packaging	DEB , RPM , and tarball
License	GPLv3

Features added:

- **Build from source using [pbuilder](#) clean-room:** Debian imposes a number of requirements that must be satisfied before a [DEB](#) package will be considered for inclusion in any Debian distributions (such as [sid](#)). One such requirement is that the package be built from source in a ‘clean room’ using [pbuilder](#). WP-MIRROR 0.3 implements a [Makefile](#) that passes this test.
- **Documentation:** [README](#) updated.
 - **Dependency:** Build dependencies and binary dependencies are listed.
 - **Installation:** Installation and post-install configuration instructions for Debian GNU/Linux 6.0 (squeeze), and tarball.

- **Scheduling:** WP-MIRROR forks a great number of tasks. While many can be run concurrently, some must be done in a particular order. Prior to WP-MIRROR 0.3, the sequencing of tasks was handled by hundreds of lines of ‘spaghetti code’. This was a debugging and maintenance issue. WP-MIRROR 0.3 implements a new scheduling algorithm, using very little code, that looks up the sequence in a LISP list named `*type-state-priority*`. Basically, it is a Finite State Machine (FSM).

Features deprecated: none.

Features removed:

- **Command-line options:** Before WP-MIRROR 0.3, many command-line options existed for the purpose of generating files during the build process. WP-MIRROR 0.3
 - **Build options removed:** `--changelog`, `--cron`, `--changelog-Debian`, `--debian-control`, `--localsettings-wpmirror`, `--logrotate`, `mw-farm-importdump`, `--mw-farm-rebuildimages`, `--mw-farm-update`, `--thanks`, and `--virtual-host`. The files, previously generated by WP-MIRROR using these build options, are now simply included in the package.
 - **Build options retained:** `--config-default`, `--config-local`, `--copyright`, `--help`, and `--version` are still used to generate files during the build process.

1.5.6 What Is New in WP-MIRROR 0.2

Phase	pre-alpha
Packaging	<code>tarball</code>
License	<code>GPLv3</code>

Features added:

- **Media:** WP-MIRROR 0.2 adds a built-in alternative to `wikix`.
 - **PRO:** The built-in alternative generates smaller shell scripts that capture more media files and throw fewer `HTTP 400` and `404` errors than `wikix`.
 - **CON:** The built-in alternative takes longer to run than `wikix`, and `wikix` does download some media files that the alternative does not.
- **Mirror farm:** WP-MIRROR 0.2 adds the capability to mirror a set of wikipedias (e.g. `meta`, `simple`, `zu`). The choice of wikipedias may be set in a configuration file, and otherwise defaults to the `simple wikipedia`.

Features deprecated: none.

Features removed: none.

1.5.7 What Is New in WP-MIRROR 0.1

Phase	proof of concept
Packaging	<code>tarball</code>
License	was never released

Features added:

- **Assert hardware and software prerequisites (at start):** WP-MIRROR asserts hardware prerequisites and software prerequisites. Hardware prerequisites include: adequate DRAM, adequate disk space, and Internet connectivity. Software prerequisites include dependencies, such as `MySQL`, `MediaWiki`, and `apache2`, as well as their configuration.
- **Check-pointing:** WP-MIRROR stores its state information in an ACID compliant database. This state information is read at each point where WP-MIRROR must decide what task to perform next. This state information is Durable (the ‘D’ in ACID), which permits WP-MIRROR to resume after interruption.
- **Concurrency:** WP-MIRROR stores its state information in an ACID compliant database. This state information is read at each point where WP-MIRROR must decide what task to perform next. Multiple instances of WP-MIRROR accessing the state information are Isolated (the ‘I’ in ACID) from each other, which permits concurrency. Concurrency is used to accelerate the mirroring of the largest wikipedias (such as the `en wikipedia`).

- **Mirror:** WP-MIRROR can run in two modes. In mirror mode, it builds a mirror of a single wikipedia, the choice of which may be set in a configuration file.
- **Monitor:** WP-MIRROR can run in two modes. In monitor mode, it reports on the state of the mirror building process and the mirror. Information may be displayed in three ways:
 - **GUI:** State information is displayed as a set of colored progress bars in a separate window, if the host has a suitable windowing system such as `X`.
 - **Screen:** State information is displayed as a set of ASCII art progress bars in a terminal (or console).
 - **Text:** State information is displayed in a terminal (or console) and scrolls upwards. This last display method is most often used for debugging purposes.
- **Retry failed tasks:** WP-MIRROR keeps track of the failed tasks (an example of the state information kept by WP-MIRROR in an ACID compliant database). After all other tasks have run to completion, WP-MIRROR retries the failed tasks.
- **Skip over bad file names:** Many media files have names containing control characters. Such file names pose a security risk to shell scripts (because they may insert malicious shell commands) and to `SQL` commands (`SQL` injection). Such files are not downloaded.
- **Skip over unparseable articles:** Dump files of each of wikipedia, are posted online by the Wikimedia Foundation. These dump files are in `XML` format, and are updated monthly, more or less. Unfortunately, about one per million articles are corrupt, and cause the `XML` parser to fail. WP-MIRROR copes by splitting each dump file into small chunks of a thousand articles each. These chunks are called `xchunks`. The processing of each `xchunk` is forked as a separate process. So, when an unparseable article is encountered, the failure is limited to that `xchunk`.
- **Validate media files:** Many media files fail to download completely, and some are corrupt to begin with. If your Internet access passes through a web-caching proxy (such as `polipo`), a great number of bad media files turn out to be error messages written by the proxy. So, WP-MIRROR validates every downloaded media file, and sequesters the corrupt ones into a `bad-images` directory where the user may later inspect them.
- **Wait for Internet access:** WP-MIRROR performs a number of tasks that require Internet access (and many that do not). When WP-MIRROR encounters a task that requires Internet access, it first asserts connectivity. If the assert fails, WP-MIRROR sleeps for 10 seconds, and tries again. When Internet connectivity is restored, WP-MIRROR resumes.
- **Warn if Proxy Detected:** WP-MIRROR examines the configuration files of `bash`, `cURL`, and `wget` for evidence of a proxy. If such evidence is found, a warning is issued.

Features deprecated: none.

Features removed: none.

1.6 WP-MIRROR Information Sources

1.6.1 Project Home Page for WP-MIRROR

The WP-MIRROR project home page can be found at <http://www.nongnu.org/wp-mirror/>.

1.6.2 Downloading WP-MIRROR

WP-MIRROR packages can be found online on the main GNU server at <http://download.savannah.gnu.org/releases/wp-mirror/>.

1.6.3 Documentation for WP-MIRROR

Documentation for WP-MIRROR can be found online on the main GNU server at <http://download.savannah.gnu.org/releases/wp-mirror/manual/>.

1.6.4 Mailing Lists for WP-MIRROR

WP-MIRROR has several mailing lists to which you may subscribe or unsubscribe.
Definitions:

upstream , a., of or pertaining to the code, documentation, and features of WP-MIRROR.

downstream , a., of or pertaining to the packaging of WP-MIRROR.

WP-MIRROR has the following upstream mailing lists:

- <https://lists.gnu.org/mailman/listinfo/wp-mirror-announce/> is used to announce releases.
- <https://lists.gnu.org/mailman/listinfo/wp-mirror-devel/> is a closed list for developers and testers.
- <https://lists.gnu.org/mailman/listinfo/wp-mirror-list/> is used to discuss most aspects of WP-MIRROR, including development and enhancement requests, as well as bug reports.

WP-MIRROR has the following downstream mailing lists:

- TBD

The author may be contacted directly using [<wpmirrordev@gmail.com>](mailto:wpmirrordev@gmail.com).

1.7 How to Report Bugs or Problems

Before posting a bug report about a problem, please try to verify that it is a bug and that it has not been reported already:

- Start by reading the online documentation at <http://download.savannah.gnu.org/releases/wp-mirror/manual/>. In particular, please take a look at §1.5, [What Is New in WP-MIRROR](#), because your problem may have been solved in a recent version.

Upstream bugs and feature requests may be reported to <https://lists.gnu.org/mailman/listinfo/wp-mirror-list>

Downstream bugs may be reported as follows:

- **Debian.** Bugs should be reported using the `reportbug` program (see <http://www.debian.org/Bugs/Reporting> for documentation).
- **RPM.** TBD
- **tarball.** Bugs should be reported to <https://lists.gnu.org/mailman/listinfo/wp-mirror-list/>.

1.8 Credits

1.8.1 Contributors to WP-MIRROR

The following people have helped with WP-MIRROR code and/or features.

- **Guy Castagnoli.** Testing [HTTP](#) redirect. Submitting bug reports. Reading the code and providing numerous comments. Submitting feature requests.
- **Jason Cooper.** Testing on virtual machine. Submitting bug report and patch. Recommending hosting of own Debian repository. Advising on [DEB](#) package naming.
- **Gnosygnu.** Advising on [MediaWiki](#) extensions (e.g. [scribunto](#), [wikidata](#)). Construction of thumb dumps. Advising on template expansion.
- **Benjamin Goldsmith.** Testing on Debian GNU/Linux 6.0 (squeeze). Submitting bug reports.
- **Tylery Khai.** Recommending color scheme for monitor mode (`--gui` option).
- **Jason Skomorowski.** Testing on Ubuntu 12.10 (quantal). Submitting bug reports. Recommending performance enhancements.

The following people have helped with access to wikimedia dump files.

- **Christian Aistleitner**. Advising on dump file access.
- **Jeremy Baron**. Advising on dump file access. Advising on [git](#) repository access.
- **Kevin Day**. Improving accessibility of <http://ftpmirror.your.org/>. Providing [rsync](#) access to media dump tarballs. Fixing [HTTP](#) redirect issues with [IPv4](#) and [IPv6](#).
- **Ariel Glenn**. Providing dump files. Advising on dump file access. Writing and maintaining [mwxml2sql](#). Advising on [git](#) repository access.
- **Frederico Leva (Nemo)**. Advising on [importDump.php](#) and [mwxml2sql](#).
- **Platonides**. Advising on media file validation.

1.8.2 Documenters and Translators

The following people have helped with WP-MIRROR documentation.

- **Guy Castagnoli**. Commenting on version 0.7 of this manual.
- **Tylery Khai**. Proofreading early drafts of this manual.

Chapter 2

Installing and Upgrading WP-MIRROR

2.1 General Installation Guidance

This section describes how to choose, download, and verify your WP-MIRROR package. Subsequent sections describe how to install your choice of WP-MIRROR package on different platforms.

2.1.1 Operating Systems Supported by WP-MIRROR

This section lists the operating systems on which WP-MIRROR is known to run.

Table 2.1: History of WP-MIRROR Support for Operating Systems

WP-MIRROR Version	Operating System	Architecture			
		amd64	armel	i386	ia64
0.7	Linux	3.2.0			
0.6	Linux	3.2.0			
0.5	Linux	3.2.0			
0.4	Linux	3.2.0			
0.3	Linux	2.6.32			

WP-MIRROR has been reported to build successfully on the above operating systems. See [Table 2.1, History of WP-MIRROR Support for Operating Systems](#).

2.1.2 GNU/Linux Distributions Supported by WP-MIRROR

This section lists the GNU/Linux distributions on which WP-MIRROR is known to run.

Table 2.2: History of WP-MIRROR Support for GNU/Linux Distributions

WP-MIRROR Version	Debian			Ubuntu	
	6.0	7.0	7.4	12.10	Raring
0.7			Y		
0.6		Y		Y	
0.5		Y		Y	
0.4		Y			
0.3	Y				

WP-MIRROR has been reported to install and run successfully on the above GNU/Linux distributions. See [Table 2.2, History of WP-MIRROR Support for GNU/Linux Distributions](#).

2.1.3 How to Get WP-MIRROR

Check the home page at <http://www.nongnu.org/wp-mirror/> for information about the current version of WP-MIRROR. The home page has a link to the downloads page at <http://download.savannah.gnu.org/releases/wp-mirror/> where one may find recent releases in several file formats: tarball `.tar.gz` file, `DEB` package, and `RPM` package.

2.1.4 Choosing Which WP-MIRROR Distribution to Install

You have three decisions to make: which version, which package format, and when to upgrade.

2.1.4.1 Choosing Which Version of WP-MIRROR to Install

Choosing the most recent version is recommended, as it offers more features and bug fixes.

2.1.4.2 Choosing a Distribution Format

After choosing which version to install, you should decide whether to install a binary distribution (e.g. `DEB`, `RPM`) or a source distribution (e.g. `.tar.gz`).

Binary packages are the easiest to install. You may prefer binary distributions if:

- If you need dependency issues taken care of for you.
- If you have multiple platforms and, to reduce maintenance cost, you have decided that all platforms should run the same major distribution, such as Debian GNU/Linux or RedHat.
- If you want the default configuration which ‘just works’, without having to read much documentation.

Source distributions are more challenging to install. You may want the source if:

- You want to configure things yourself (e.g. if you need different install locations).
- You want to port WP-MIRROR to a new platform.

2.1.4.3 Choosing When to Upgrade

If you are using a major distribution, such as Debian GNU/Linux or RedHat, then it is best to upgrade your WP-MIRROR distribution at the same time you upgrade your major distribution (e.g. from Debian GNU/Linux 6.0 (squeeze) to Debian GNU/Linux 7.0 (wheezy)). This is because upgrading a major distribution entails upgrading `clisp`, `MediaWiki`, `MySQL`, and many other dependencies in a consistent fashion. Some of these upgrades may be incompatible. In particular, `MediaWiki` upgrades usually involve changes to its database schema, the historical record of which is shown at http://www.mediawiki.org/wiki/Manual:Database_layout.

2.1.5 Verifying Package Integrity Using Checksums or `GnuPG`

After downloading a WP-MIRROR package and before installing it, you should verify its integrity. This is to protect you against partial downloads and alteration. All WP-MIRROR packages are cryptographically signed using `GnuPG`, the GNU Privacy Guard.

2.1.5.1 How to Get the Author’s Public Build Key

All tarballs and documentation are signed using `GnuPG`. `DEB` packages are signed as well (see §2.1.5.2, [Checksums for a DEB Package](#)). See <http://www.gnupg.org/> and <http://www.opengpg.org/> for documentation.

To verify a signed package, you must first obtain a copy of the author’s public `gpg` build key and store it on a `gpg` keyring. Public keys are available from key servers such as <http://pgpkeys.mit.edu/>. The desired key can be found by searching by KeyID `0x320AFC9D382FBD0C` or by User ID `WP-MIRROR`.

Each shell account has a `gpg` keyring stored under the `~/.gnupg/` directory:

```
root-shell# ls -l ~/.gnupg/pubring.gpg
-rw----- 1 root root 22771 Oct 13 2012 /root/.gnupg/pubring.gpg
```

First, determine if you already have the key stored on your `root` shell account's keyring by executing:

```
root-shell# gpg --list-keys 0x320AFC9D382FBD0C
pub 2048R/0x320AFC9D382FBD0C 2011-12-25 [expires: 2017-01-01]
    Key fingerprint = 9F55 7EEA 08B6 A87E 3070 FAD4 320A FC9D 382F BD0C
uid [ unknown] WP-MIRROR <wpmirrordev@gmail.com>
sub 2048R/0x70C5CDCEE5A8EOCB 2011-12-25 [expires: 2017-01-01]
```

If you get the above, then you have the key, and may proceed to §2.1.5.2, [Checksums for a DEB Package](#). On the other hand, if you get the following:

```
root-shell# gpg --list-keys 0x320AFC9D382FBD0C
gpg: error reading key: public key not found
```

then you do not have the key, and must import it into your `root` shell account's `gpg` keyring.

There are two ways of obtaining the public key:

2.1.5.1.1 Download the Public Key from Public Keyserver First, confirm that `gpg` is configured with a known public keyserver:

```
root-shell# cd /root/.gnupg/
root-shell# cat gpg.conf | grep ^keyserver
keyserver hkp://pgp.mit.edu:11371
```

or, better yet, one that offers encryption and an `IPv6` address:

```
root-shell# cat gpg.conf | grep ^keyserver
keyserver hkps://zimmerman.mayfirst.org
```

Second, download the key directly from a public keyserver using the public KeyID `0x320AFC9D382FBD0C`, and import it into your `root` shell account's `gpg` keyring:

```
root-shell# gpg --recv-keys 0x320AFC9D382FBD0C
gpg: requesting key 0x320AFC9D382FBD0C from hkps server zimmermann.mayfirst.org
gpg: key 0x320AFC9D382FBD0C: "WP-MIRROR <wpmirrordev@gmail.com>" imported
gpg: Total number processed: 1
gpg: imported: 1
gpg: no ultimately trusted keys found
```

Third, confirm that you have successfully imported it by executing:

```
root-shell# gpg --list-keys 0x320AFC9D382FBD0C
pub 2048R/0x320AFC9D382FBD0C 2011-12-25 [expires: 2017-01-01]
    Key fingerprint = 9F55 7EEA 08B6 A87E 3070 FAD4 320A FC9D 382F BD0C
uid [ unknown] WP-MIRROR <wpmirrordev@gmail.com>
sub 2048R/0x70C5CDCEE5A8EOCB 2011-12-25 [expires: 2017-01-01]
```

Fourth, if you also wish to import the public key into your personal shell account's `gpg` keyring, then you should log into your personal shell account and repeat the process (and this is recommended).

2.1.5.1.2 Cut and Paste the Public Key from Public Keyserver Alternatively, you may try the following ‘cut-and-paste’ method.

First, find the desired key by searching a public key server, such as <http://pgpkeys.mit.edu/>, by KeyID `0x320AFC9D382FBD0C` or by User ID `WP-MIRROR`.

Second, cut and paste the resulting PGP PUBLIC KEY BLOCK into a file named `wp-mirror_pubkey.asc`. Visually confirm that it is the following:

```
root-shell# cat wp-mirror_pubkey.asc
-----BEGIN PGP PUBLIC KEY BLOCK-----
Version: SKS 1.1.4
Comment: Hostname: pgp.mit.edu

mQENBE72h9MBCADqNjKAJs1jj9OxqM6m7iTk211V7g2U+PiLujnEmvg/BokAtoFzLHigBYw8
oemQGfp0AqOzYirQKnzBFTL/BaOSNv/TVGHXgK349GzJZ1/MY8rf9hvoSoNSV7RIGEBou5a6
Bv47k4CYCDck++jAifTpk3yAgyW7JOZ3uzwEYrvIdEW/4JZuli4ZMmZIja+o6Q41bXylwzoq
KKBtLWcofdpNKoS+/3Mq1wENN+d3c8SjqH8NL4tMCyF4LXCOCpSxfxUiMY1d8ifl+BjpguDl
jod+UqKEKigXeP7kiwdEO9t01RLFYLwBcRuW+qbfUXi0o6tTnQPiEO6xqr3f6HywnTxrABEB
AAG0IVdQLU1JULJPuiA8d3BtaXJyb3JkZXZAZ21haWwuY29tPokBOAQTaQIAIgUCTvaH0wIb
AwYLCQgHAWiGFqGCGQOLBBYCAwECHgECF4AACgkQMGr8nTgvvQyK5QgAv62RuSJ/VB8V5ALj
1+J3Q4CRQjmwNncUbc7xvSJPbRjl3CeZsd7MflEjevA10japTGwrUboPeOyYPupxin2I4jMY
rWHTIfqtgh03YkxYaoK2MTrNKbYUBmzM5I9jQ49aNYfM3ikhaHMUIUFFzTV6nRmekEo1L2o2
wlVmw2j/naF8KaHXL3X+dnNBZDZ6kuBTo3MI3oIR5mRuVhj9ppbS6qYF3pmVmS2agj2186D
thSrD4JBbUhzqPriPS43JPEs1L696LcNgBQbQ70964ZiNrTyu/FBIkGGk160ly4zALApE8V
XmaYMwnJQwSvt8WLD250S/Trb+CO5WQfbvMyYkBPQQTaQIAJwIbAwIeAQIXgAUJCXHi2gUC
UsTfRgULCQgHAWUVCgkICwUWAwIBAAAKCRAyCvydOC+9DCFRB/9qccd/aQvI9me9m3qzLpds
HBnIuPib4evzssnjNVqGPFMfGiwUCFmVrFSId2Ak3q5diZR0fdULuNF5Rg4GIq9t2wn+wTcP
Dh6FpUtGxoCnbl9JyCig3Tn21NUPPc/fInZWkCs2DTiPvtNip0la/dhHnLQG6NEZPsHVWuii
lhy3jppqBCAlr1Wn8ajVljrPSwbrm0eJsuJ8d20G5P63fufPKckQZ3VBxBqw0abBoVgtA3UTW
hhh5XkXMLLi8GYlkQg8DpeWRTcfD0khMZERCZGdFQl4XvsoHgg6/FMCdT9KQ3LSoquKD6qnD
7SCHhZvEZwTikLCcLKDHSR66+1KVJuPZuQENBE72h9MBCADqfjFZe3nY99YRixc+4Nstrnsz
UqLIU8oetWIVHmJz3EOjLgfk/civKnWmUowGRQIjpN0o1dwxxHVfi26Bi3Kr8vLFiC3zZ/Z4
1lUwrfBsU+394w60yfTmf4r7gnym276qTDKuVWQBo+h9u1AaVnBv3BCasOx10mDqLOHu8++q
MZpkBG2uf0Zyq7zK2384xz89z1jXiK4KmQvhB4EyEC4q4EE4CoYbIKi8g/vCVGa8Y7mh8qa1
jXMB0oZeSdmmjQdJtpVyfcBGSQt2lWTZJkMVQ4LzYQntKje3MIhEm81SHRgT5A/Uhj9dhX+
7ClzEAeZrft0279r6jd4hd+3wBXHABEBAAGJAR8EGAECAAkFAk72h9MCGwwACgkQMGr8nTgv
vQzzVQgAlUfJ5ZC9ToQBnra3COY0F9zCeg6wv9UetOxR7Shj4KNmPqnYSwZCKjzAL3vDCiXt
9z3/xRRyp2BXEGvJc67IexKNtJipDnyjt7Q/qG6UE9z/N/Da0GlfcniROTJfsKA9a90L5Yce
ebN3IE+6/6w+GwlPOJVv+Cv4nO2Le/zlr5i1jCIZdX/ujZHfvdSukUuXny95XiAXk3wgytc/
VT4IpNe/BL2pCNQvLvJF+sqIGInvSQ2QDab5Pv01ciudQHgYfDy1LtPtucDRz8TQC0zolaII
QXfFI9LdDxoSnibENQF17sVZOUklU8WUBXs8aZwWtkuPriPrOttIiQX6TFu0QokBJQQYAQIA
DwIbDAUCUsTTEQUJCXHluQAKCRAyCvydOC+9DAWyB/9QVr679+80iIitoBGkTZb4R2ZXi/3Y
3xN+/cZVhV1wZcrRw4meoYuuJcvz2czUN10jHu61ok3kd0geWKHhUAs0+QCcmYpV25Vp/Vbv
hlCyWE40ZA+jQ/fUm75j8YxI5vS01GZhvOLBK9B8G/x8hKVPP0yQ5iKnme2wYROXLARWvr6N
Ivzpdn9qJnNvzgAIjOP7Xfi2HG7114kXKQ2gWzGatrVzp2RszySEL4J0fx7t8nxDPAq639HU
HV6/1hd7rOb3WC1JTMcle+BfWxXveszU8kmCVGTUQShsXx5n4T5JFBS8w1EyIxbtqsbg8eS
Q9sr3edUIoDuEhilyu15jMu2
=eLnA
-----END PGP PUBLIC KEY BLOCK-----
```

Third, import the public key into your `root` shell account’s `gpg` keyring by executing:

```
root-shell# gpg --import wp-mirror_pubkey.asc
gpg: key 382FBD0C: "WP-MIRROR <wpmirrordev@gmail.com>" imported
gpg: Total number processed: 1
gpg: imported: 1
gpg: no ultimately trusted keys found
```


Fourth, confirm that you have successfully imported it by executing:

```
root-shell# gpg --list-keys 0x320AFC9D382FBD0C
pub  2048R/0x320AFC9D382FBD0C 2011-12-25 [expires: 2017-01-01]
      Key fingerprint = 9F55 7EEA 08B6 A87E 3070  FAD4 320A FC9D 382F BD0C
uid          [ unknown] WP-MIRROR <wpmirrordev@gmail.com>
sub  2048R/0x70C5CDCEE5A8E0CB 2011-12-25 [expires: 2017-01-01]
```

Fifth, if you also wish to import the public key into your personal shell account's `gpg` keyring, then you should log into your personal shell account and repeat the process (and this is recommended).

Design note. For best practices in setting up `gnupg` see:

- <https://we.riseup.net/riseuplabs+paow/openpgp-best-practices>, and
 - <https://support.mayfirst.org/wiki/faq/security/mfpl-certificate-authority>
-

2.1.5.1.3 Import Public Key into `apt` Trusted Keyring The Advanced Package Tool, `apt`, has a `gpg` trusted keyring which is stored under the `/etc/apt/` directory.

```
root-shell# ls -l /etc/apt/trusted.gpg
-rw----- 1 root root 29908 Dec 29 14:46 /etc/apt/trusted.gpg
```

If you wish to install WP-MIRROR from a Debian package repository, then the author's public `gpg` build key will have to be imported into the `apt` trusted keyring.

If you have the public key on your `root` shell account's `gpg` keyring, then import it into the `apt` trusted keyring by executing:

```
root-shell# gpg --armor --export 0x320AFC9D382FBD0C | apt-key add -
OK
```

Confirm that you have successfully imported the key by executing:

```
root-shell# apt-key list
/etc/apt/trusted.gpg
-----
...
pub  2048R/382FBD0C 2011-12-25 [expires: 2017-01-01]
uid          WP-MIRROR <wpmirrordev@gmail.com>
sub  2048R/E5A8E0CB 2011-12-25 [expires: 2017-01-01]
...
```

Alternatively, if you used the 'cut-and-paste' method described above, then execute:

```
root-shell# apt-key add wp-mirror_pubkey.asc
OK
```

Finally, confirm that the public key is on the `apt` trusted keyring by executing one of the following:

```
root-shell# apt-key finger
root-shell# apt-key list
```

If you wish to install WP-MIRROR from a Debian package repository, then you may proceed to [§2.2.1, Installing from a Debian Repository](#).

2.1.5.2 Checksums for a DEB Package

Checksums for a [DEB](#) package are stored in a separate `.changes` file which is cryptographically signed with the author's secret key. Both files may be downloaded as described in [§2.1.3, How to Get WP-MIRROR](#).

First, verify the `.changes` file by executing:

```
shell$ gpg --verify wp-mirror_0.7-1_amd64.changes
gpg: Signature made Tue 24 Dec 2013 03:16:47 AM EST
gpg:      using RSA key 0x320AFC9D382FBDOC
gpg: Good signature from "WP-MIRROR <wpmirrordev@gmail.com>" [unknown]
gpg: WARNING: This key is not certified with a trusted signature!
gpg:      There is no indication that the signature belongs to the owner.
Primary key fingerprint: 9F55 7EEA 08B6 A87E 3070  FAD4 320A FC9D 382F BDOC
```

The `Good signature` message indicates two things: 1) integrity, the `.changes` file was downloaded successfully (i.e. without transmission errors), and 2) authenticity, the file was signed by someone with access to the author's secret key (only the author, one may hope).

Second, the `.changes` file contains three types of checksum: `sha1sum`, `sha256sum`, and `md5sum`. To verify the `.deb` file execute:

```
shell$ sha1sum wp-mirror_0.5-1_all.deb
1c313fe66de0d74e4e6f74b6d0fa6a6efb0d68eb  wp-mirror_0.5-1_all.deb
shell$ cat wp-mirror_0.5-1_amd64.changes | grep all | grep deb | head -n 1
1c313fe66de0d74e4e6f74b6d0fa6a6efb0d68eb 3296430 wp-mirror_0.5-1_all.deb
```

and then visually confirm that the `sha1sum` checksums match. A match indicates two things: 1) integrity, that the `DEB` package was downloaded successfully (i.e. without transmission error), and 2) authenticity, since the checksums were provided by a `.changes` file for which integrity and authenticity have been shown.

2.1.5.3 Checksums for a RPM Package

Checksums for a `RPM` package are conveniently included within the package. The `RPM` package may be downloaded as described in [§2.1.3, How to Get WP-MIRROR](#).

To verify the `RPM` file execute:

```
shell$ rpm --checksig wp-mirror-0.3-2.noarch.rpm
wp-mirror-0.3-2.noarch.rpm: sha1 md5 OK
```

The `OK` message indicates one thing: integrity, that the `RPM` package was downloaded successfully (i.e. without transmission error).

2.1.5.4 Signature Checking for a Tarball

After downloading and importing the public build key, download the latest tarball `.tar.gz` file and its associated signature `.sig` file. Both files may be downloaded as described in [§2.1.3, How to Get WP-MIRROR](#). Be sure to put both files into the same directory, then execute:

```
shell$ gpg --verify wp-mirror-0.7.tar.gz.sig
gpg: Signature made Sat 21 Dec 2013 02:49:38 AM EST
gpg:      using RSA key 0x320AFC9D382FBDOC
gpg: Good signature from "WP-MIRROR <wpmirrordev@gmail.com>" [ultimate]
```

The `Good signature` message indicates two things: 1) integrity, that the tarball was downloaded successfully (i.e. without transmission errors), and 2) authenticity, that the tarball was signed by someone with access to the author's secret key (only the author, one may hope).

2.2 Installing WP-MIRROR on Linux

Table 2.3: History of WP-MIRROR Packages

Version	Package	Distributions
0.7	DEB	Debian GNU/Linux 7.4 (wheezy)
0.6	DEB	Debian GNU/Linux 7.0 (wheezy) Ubuntu 12.10 (quantal)
0.5	DEB	Debian GNU/Linux 7.0 (wheezy) Ubuntu 12.10 (quantal)
0.4	DEB	Debian GNU/Linux 7.0 (wheezy)
0.3	DEB	Debian GNU/Linux 6.0 (squeeze)

2.2.1 Installing from a Debian Repository

A Debian package repository organizes [DEB](#) packages, source packages, and various index files into distributions that greatly ease the task of system administration. In particular, use of a Debian package repository makes [DEB](#) packages easy to download, install, and upgrade.

WP-MIRROR 0.6 and later versions are available in an on-line Debian package repository. Access to the repository is done by appending to `/etc/apt/sources.list` the following two lines:

```
root-shell# cat /etc/apt/sources.list
deb http://ftp.us.debian.org/debian/ wheezy          main
deb http://security.debian.org/      wheezy/updates  main
deb http://ftp.us.debian.org/debian/ wheezy-updates  main
deb http://ftp.us.debian.org/debian/ wheezy-backports main
deb http://download.savannah.gnu.org/releases/wp-mirror/debian-wpmirror/ wheezy main
```

or if your network is IPv6 only:

```
root-shell# cat /etc/apt/sources.list | tail -n 2
deb http://ftp.us.debian.org/debian/ wheezy-backports main
deb http://savannah.c3sl.ufpr.br/wp-mirror/debian-wpmirror/ wheezy main
```

and then executing:

```
root-shell# aptitude update
...
Reading package lists... Done
root-shell# aptitude safe-upgrade
root-shell# aptitude install wp-mirror
```

If you get the above, then WP-MIRROR is installed and ready to use. On the other hand, if you get the following:

```
root-shell# aptitude update
...
Reading package lists... Done
W: GPG error: http://localhost wheezy Release: The following signatures couldn't
be verified because the public key is not available: NO_PUBKEY 320AFC9D382FBD0C
```

then the author's public `gpg` build key is not on the `apt` trusted keyring. See §2.1.5.1.3, [Import Public Key into apt Trusted Keyring](#).

For WP-MIRROR 0.4 and later versions, configuration of WP-MIRROR and its dependencies is entirely automated. Just execute:

```
root-shell# wp-mirror --mirror
```

Then, to monitor the build process, open another terminal and execute:

```
root-shell# wp-mirror --gui &
```

2.2.2 Installing from a DEB Package

A `DEB` package includes a `debian/control` file that lists all of the build and binary dependencies. Naturally, the build and installation processes will be easiest when you have a platform using a Linux distribution containing the dependencies listed. WP-MIRROR 0.5 and later versions were packaged for use with the Debian GNU/Linux 7.0 (wheezy) distribution and Ubuntu 12.10 (quantal) distributions.

First, download the latest `DEB` packages for `mediawiki-mwxml2sql`, `wp-mirror-mediawiki`, `wp-mirror-mediawiki-extensions`, `wp-mirror-mediawiki-extensions-math-texvc`, and `wp-mirror` as described above in §2.1.3, [How to Get WP-MIRROR](#).

Second, install the `DEB` packages. Beginning with version 0.7, this is done by executing:

```
root-shell# dpkg --install mediawiki-mwxml2sql_0.0.2-2_amd64.deb
root-shell# dpkg --install wp-mirror-mediawiki_1.23-1_all.deb
root-shell# dpkg --install wp-mirror-mediawiki-extensions-math-texvc_1.23-1_amd64.deb
root-shell# dpkg --install wp-mirror-mediawiki-extensions_1.23-1_all.deb
root-shell# dpkg --install wp-mirror_0.7-1_all.deb
```

For WP-MIRROR 0.6, this is done by executing:

```
root-shell# dpkg --install mediawiki-mwxml2sql_0.0.2-1_amd64.deb
root-shell# dpkg --install wp-mirror_0.6-1_all.deb
```

For WP-MIRROR 0.4 and 0.5, this is done by executing:

```
root-shell# dpkg --install wp-mirror_0.6-1_all.deb
```

For WP-MIRROR 0.3, install the `DEB` package by executing:

```
root-shell# dpkg --install --force-overwrite wp-mirror_0.3-2_all.deb
root-shell# cp /etc/wp-mirror/local.conf.template /etc/wp-mirror/local.conf
```

where the `--force-overwrite` option is required because the WP-MIRROR 0.3 package overwrites a file that belongs to another package (the `mediawiki_1.15.5-2squeeze4_all.deb` package). Specifically, WP-MIRROR 0.3 provides a patched version of `/usr/share/mediawiki/includes/Import.php`.

For WP-MIRROR 0.4 and later versions, configuration of WP-MIRROR and its dependencies is entirely automated. Just execute:

```
root-shell# wp-mirror --mirror
```

Then, to monitor the build process open another terminal and execute:

```
root-shell# wp-mirror --gui &
```

For WP-MIRROR 0.3, post-installation configuration is required. See §2.4, [Postinstallation Configuration and Testing](#).

2.2.3 Installing from a RPM Package

TBD

For WP-MIRROR 0.4 and later versions, configuration of WP-MIRROR and its dependencies is entirely automated. Just execute:

```
root-shell# wp-mirror --mirror
```

Then, to monitor the build process open another terminal and execute:

```
root-shell# wp-mirror --gui &
```

For WP-MIRROR 0.3, post-installation configuration is required. See §2.4, [Postinstallation Configuration and Testing](#).

2.3 Installing WP-MIRROR from Source

This approach is not for the faint of heart. Please consider installing from a [DEB](#) or [RPM](#) package.

There are two kinds of dependencies that you will have to install and configure:

- **build dependencies** are software utilities required to build WP-MIRROR from source; and
- **binary dependencies** are software utilities required to install and run WP-MIRROR.

2.3.1 Installing Dependencies

Building WP-MIRROR from source code has the advantage of letting you customize everything. The disadvantage, of course, is that you must first install and configure its software dependencies.

2.3.1.1 Installing Build Dependencies

For WP-MIRROR 0.4 and later versions, the following packages must be installed before you can build.

```
Build-Depends: clisp (>= 1:2.48-3), common-lisp-controller (>= 7.9),
cl-getopt (>= 1.2.0), cl-md5 (>= 1:1.8.5), clisp-module-clx (>= 1:2.49-8.1),
debhelper (>= 7.0.50~), help2man (>= 1.38.2)
```

The above dependency information is copied from the `debian/control` file in the [DEB](#) package.

2.3.1.2 Verifying `clisp` Version

Table 2.4: History of `clisp` Version

Version	Configuration
≥ 0.1	<code>clisp</code> 2.48

Check that you have `clisp` 2.48 or higher.

```
shell$ clisp --version | head -n 1
GNU CLISP 2.48 (2009-07-28) (built 3487543663) (memory 3534965158)
```

Earlier distributions, such as Debian GNU/Linux 5.0 (lenny), and its derivatives, such as Ubuntu 10.04 LTS (lucid), provide older versions of `clisp` that lack some of the functions called by WP-MIRROR.

2.3.1.3 Configuring `common-lisp-controller`

Table 2.5: History of `common-lisp-controller` Configuration

Version	Configuration
≥ 0.4	no user configuration is necessary
≤ 0.3	N/A

All modern language systems come with libraries that provide functionality greatly in excess of that needed for standards compliance. Often these libraries are provided by third parties. Common Lisp systems are no exception.

For Debian distributions, third-party libraries for Common Lisp are installed under `/usr/share/common-lisp/source/`, and symbolic links to these source files are collected under `/usr/share/common-lisp/systems/`. The `common-lisp-controller` makes use of `cl-asdf` (see below).

For WP-MIRROR 0.4 and later versions, `common-lisp-controller` is used to manage libraries. No user configuration of `common-lisp-controller` is necessary.

2.3.1.4 Configuring `cl-asdf`

Table 2.6: History of `cl-asdf` Configuration

Version	Configuration
≥ 0.4	no user configuration is necessary
≤ 0.3	user configuration required (see below)

Another System Definition Facility (`cl-asdf`), is the link between a Common Lisp system and any third-party libraries that it calls. `cl-asdf` is not immediately usable upon installation. Your Common Lisp system (`clisp` in this case) must first be made aware of its location. `cl-asdf` comes with documentation that discusses configuration.

```
shell$ less /usr/share/doc/cl-asdf/README.Debian
shell$ lynx /usr/share/doc/cl-asdf/asdf/index.html
```

For WP-MIRROR 0.4 and later versions, `common-lisp-controller` manages `cl-asdf`. No user configuration of `cl-asdf` is necessary.

For WP-MIRROR 0.3 and earlier versions, it is necessary for the user to configure `cl-asdf`.

But, before configuring, first note that WP-MIRROR will be run as `root`, so the configuration file `.clisprc`, must be put in the root directory, rather than the user's home directory. To configure `clisp` to use `cl-asdf`, append the following line to `/root/.clisprc`.

```
(load #P"/usr/share/common-lisp/source/cl-asdf/asdf.lisp")
(push #P"/usr/share/common-lisp/systems/" asdf:*central-registry*)
```

`clisp` should now be ready to use `asdf`. Check this by running

```
shell$ clisp -q
[1]>*features*
(:ASDF2 :ASDF ...)
[2]>(asdf:asdf-version)
"2.011"
[3]>asdf:*central-registry*
(#P"/usr/share/common-lisp/systems/")
```

2.3.1.5 Installing Binary Dependencies

The following packages must be installed before you can run WP-MIRROR 0.6 to build a mirror.

Depends:

```
apache2 (>= 2.2.16), bzip2 (>= 1.0.5), cjk-latex (>= 4.8.3+git20120621-1),
cl-getopt (>= 1.2.0), cl-md5 (>= 1:1.8.5), clisp (>= 1:2.48-3),
clisp-module-clx (>= 1:2.49-8.1), common-lisp-controller (>= 7.9),
coreutils (>= 8.5), curl (>= 7.21.0),
graphicsmagick (>= 1.3.12), gv (>= 1:3.7.1),
hdparm (>= 9.32), inkscape (>= 0.48.3.1),
libsvg2-bin (>= 2.26.3), mediawiki (>= 1:1.19.1),
mediawiki-extensions (>= 2.6+wheezy1),
mediawiki-extensions-math (>= 2:1.0+git20120528-5),
mediawiki-mwxml2sql (>=0.0.2),
mysql-client (>= 5.5.24+dfsg-9), mysql-server (>= 5.5.24+dfsg-9),
openssl (>= 0.9.8o), rsync (>=3.0.9), tar (>= 1.26),
texlive-latex-base (>= 2009-11), tidy (>= 20091223cvs), tzdata (>= 2012),
wget (>= 1.12)
```

The above dependency information is copied from the `debian/control` file in the DEB package.

2.3.2 Installing WP-MIRROR from a Standard Source Distribution

For WP-MIRROR 0.4 and later versions, installation from a standard source distribution is done by executing:

```
shell$ tar --extract --gzip --preserve-permissions --file wp-mirror-0.4.tar.gz
shell$ cd wp-mirror-0.4
shell$ make build
root-shell# make install
```

For WP-MIRROR 0.3 and earlier versions, also execute:

```
root-shell# cp /etc/wp-mirror/local.conf.template /etc/wp-mirror/local.conf
```

For WP-MIRROR 0.3, post-installation configuration is required. See §2.4, [Postinstallation Configuration and Testing](#).

2.3.3 WP-MIRROR Build Options

WP-MIRROR has command line options that may be invoked to generate files during the build and install process. These command line options are listed in [Table 2.7, WP-MIRROR Build Options Reference](#).

Table 2.7: WP-MIRROR Build Options Reference

Build Options	Description	Intr	Rem
<code>--copyright</code>	generate <code>copyright</code>	0.1	
<code>--help</code>	used by <code>help2man</code> to generate <code>wp-mirror.1.gz</code>	0.1	
<code>--version</code>	used by <code>help2man</code> to generate <code>wp-mirror.1.gz</code>	0.1	

Many build options have been removed from recent versions. The files, previously generated by WP-MIRROR using these build options, are now simply included in the package. These

Table 2.8: WP-MIRROR Build Options Reference (Obsolete)

Build Options	Description	Intr	Rem
<code>--changelog</code>	generate <code>changelog</code>	0.1	0.3
<code>--config-default</code>	generate <code>default.conf</code>	0.1	0.4
<code>--config-local</code>	generate <code>local.conf</code>	0.1	0.4
<code>--cron</code>	generate <code>cron.d/wp-mirror</code>	0.1	0.3
<code>--changelog-debian</code>	generate <code>debian/changelog</code>	0.1	0.3
<code>--debian-control</code>	generate <code>debian/control</code>	0.1	0.3
<code>--localsettings-wpmirror</code>	generate <code>LocalSettings-wpmirror.php</code>	0.2	0.3
<code>--logrotate</code>	generate <code>logrotate.d/wp-mirror</code>	0.1	0.3
<code>--mw-farm-importdump</code>	generate <code>importDump_farm.php</code>	0.2	0.3
<code>--mw-farm-rebuildimages</code>	generate <code>rebuildImages_farm.php</code>	0.2	0.3
<code>--mw-farm-update</code>	generate <code>update_farm.php</code>	0.2	0.3
<code>--mw-import</code>	download <code>Import.php</code> from SVN	0.2	0.4
<code>--thanks</code>	generate <code>thanks</code>	0.1	0.3
<code>--virtual-host</code>	generate <code>mediawiki.site.conf</code>	0.2	0.3

obsolete command line options are listed in [Table 2.8, WP-MIRROR Build Options Reference \(Obsolete\)](#).

Additionally, WP-MIRROR has several run-time options for use in mirror mode, which are listed in [Table 4.1, WP-MIRROR Mirror Mode Options Reference](#), and several more options for use in monitor mode, which are listed in [Table 4.3, WP-MIRROR Monitor Mode Options Reference](#).

2.4 Postinstallation Configuration and Testing

After installation, we note that WP-MIRROR relies on a great number of binary dependencies, such as [apache2](#), [MediaWiki](#), [MySQL](#), and others. These dependencies must now be configured.

There are three cases:

- **Default configuration** is completely automated. See [§2.4.1, Default Configuration](#).
- **Farm configuration** requires editing one line in a configuration file. See [§2.4.3, Configuration of a Wiki Farm](#).
- **Top ten wikipedia configuration** requires quite a bit of system planning and configuration. See [Chapter 3, System Planning and Configuration](#).

2.4.1 Default Configuration

For WP-MIRROR 0.4 and later versions, the default configuration is entirely automated. The user should execute:

```
root-shell# wp-mirror --mirror
```

and watch the stream of messages. These messages, which identify each step during the run, are explained in [§5.1, How --mirror Works](#). If any message indicates a warning or a failure, please read that section. Also, any message from the Finite State Machine (FSM) serves also as a checkpoint. FSM messages look like:

```
...
[ ok ] fsm-file-download simplewiki-20131231-image.sql.gz
[ ok ] fsm-file-validate simplewiki-20131231-image.sql.gz
...
```

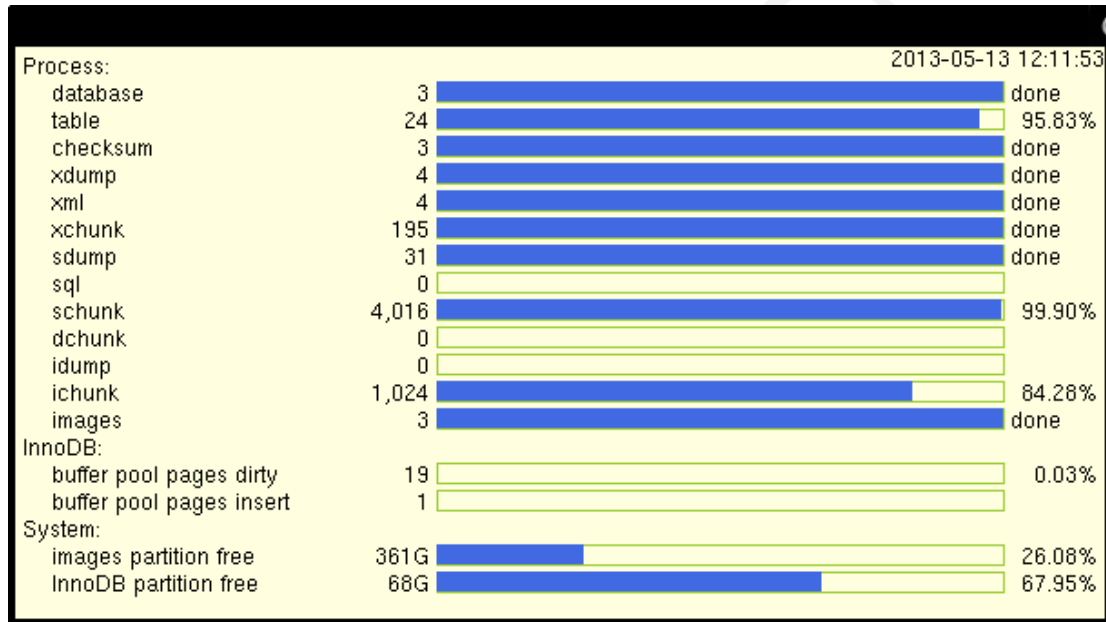

It is convenient to monitor the mirror by opening a second terminal and executing one of the following:

```
root-shell# wp-mirror --gui &
root-shell# wp-mirror --screen
root-shell# wp-mirror --text
```

2.4.2 Working with X

WP-MIRROR is an X client, so an user sitting at an X server should try the `--gui` option. A screen shot of the GUI display is shown in Figure 2.1, WP-MIRROR Monitor Mode in X.

Figure 2.1: WP-MIRROR Monitor Mode in X



Note that `ssh` can be configured to transport the X protocol, so that the X client and X server can be on separate hosts. This is easily done. On each host, edit the `ssh` and `sshd` configuration files to read:

```
root-shell# cat /etc/ssh/ssh_config | grep X
ForwardX11 yes
#ForwardX11Trusted yes
```

and

```
root-shell# cat /etc/ssh/sshd_config | grep X
X11Forwarding yes
X11DisplayOffset 10
```

If the user does not have an X server, then the `--screen` or `--text` options should be adequate.

2.4.3 Configuration of a Wiki Farm

To mirror a set of wikis, it is necessary to edit one line in `/etc/wp-mirror/local.conf`.

First, visit

http://meta.wikimedia.org/wiki/List_of_Wikipedias, and
http://meta.wikimedia.org/wiki/Table_of_Wikimedia_projects

to see which wikis are available.

Second, decide which wikis you would like to mirror, and look up their language codes.

Third, edit the configuration file `/etc/wp-mirror/local.conf` by uncommenting and editing the `*mirror-language-code-list*` parameter. Several examples are provided in the comments:

```
root-shell# cat /etc/wp-mirror/local.conf
...
;;; This is the default. Expect 200ks (two days) build.
;;(defparameter *mirror-language-code-list* '("simple"))
;;;
;;; For a quick test. Expect 5ks (one hour) build.
;;(defparameter *mirror-language-code-list* '("zh" "zu"))
;;;
;;; Major third-world languages.
;;(defparameter *mirror-language-code-list* '("ar" "simple")) ;arabic
;;(defparameter *mirror-language-code-list* '("hi" "simple")) ;hindi
;;(defparameter *mirror-language-code-list* '("vi" "simple")) ;vietnamese
;;(defparameter *mirror-language-code-list* '("zh" "simple")) ;chinese
;;;
;;; Classical languages.
;;(defparameter *mirror-language-code-list* '("el" "la" "simple")) ;greek,latin
;;(defparameter *mirror-language-code-list* '("he" "yi" "simple")) ;hebrew,yiddish
;;(defparameter *mirror-language-code-list* '("zh-classical" "simple")) ;chinese
...
```

Fourth, consider also uncommenting and editing the `*mirror-project-list*` parameter.

```
root-shell# cat /etc/wp-mirror/local.conf
...
;;; Project. Default is 'wikipedia' and 'wiktionary'. If you want all
;;; the projects, uncomment the following:
;;(defparameter *mirror-project-list*
;; '("wikibooks" "wikimedia" "wikinews" "wikipedia" "wikiquote"
;; "wikisource" "wikiversity" "wikivoyage" "wiktionary"
...

```

Fifth, launch the mirror building process, and monitor its progress as above in [§2.4.1, Default Configuration](#).

Chapter 3

System Planning and Configuration

The [Wikimedia Foundation](#) offers wikipedias in nearly [300 languages](#). However, if you intend to mirror any of the ten largest wikipedias, namely, the [en wikipedia](#) (which is the most demanding case), followed by the [de](#), [nl](#), [fr](#), [it](#), [ru](#), [es](#), [sv](#), [pl](#), and [ja](#) wikipedias (as of year 2014), then reading this chapter is required. Why?

- **Size.** As of year 2014, the top ten wikipedias are judged to be too large to fit on a laptop PC equipped with a single 500G hard disk drive (HDD). A desktop PC with extra hard disk drives (HDD) and memory (DRAM) is required, unless you can make do without the media files (and this is configurable).
- **Performance.** An order of magnitude improvement in system performance can be achieved by customizing the configuration of [MediaWiki](#) and [MySQL](#). Indeed this performance gain is necessary, because processing a top ten wikipedia is very demanding in terms of disk access, CPU utilization, memory utilization, and Internet bandwidth. The Wikimedia Foundation publishes dump files on a monthly basis (more or less), and, with merely default performance, the processing of a large dump file would take longer than a month.

3.1 General Information

3.1.1 Storage at the Wikimedia Foundation

The Wikimedia Foundation maintains about a thousand wiki's, including wikipedias for nearly 300 languages.

3.1.1.1 XML dump files

The Foundation provides compressed dump files of each wiki. These files have names like

[enwiki-yyyyymmdd-pages-articles.xml.bz2](#),
[enwiktionary-yyyyymmdd-pages-articles.xml.bz2](#),
[simplewiki-yyyyymmdd-pages-articles.xml.bz2](#), etc.

The leading characters are a language code: [de](#) for German, [en](#) for English, [fr](#) for French, [ja](#) for Japanese, [ru](#) for Russian, [simple](#) for Simple English, etc. The next few characters are the project: [wikibooks](#), [wiktionary](#), [wiki](#) for Wikipedia, etc. The string [yyyyymmdd](#) is replaced by a date.

New dump files appear every month, more or less. These dump files are posted on one of the Foundation's web sites. You can expect URL's like

[http://dumps.wikimedia.org/enwiki/yyyyymmdd/...](#),
[http://dumps.wikimedia.org/enwiktionary/yyyyymmdd/...](#),
[http://dumps.wikimedia.org/simplewiki/yyyyymmdd/...](#), etc.

The dump files of greatest interest are the [pages-articles](#) dumps, which contain the latest revisions of articles, templates, media file descriptions, and the primary meta-pages. They do not contain talk, old revisions, or user pages. You can expect URL's like

[http://dumps.wikimedia.org/enwiki/yyyyymmdd/enwiki-yyyyymmdd-pages-articles.xml.bz2](#),

<http://dumps.wikimedia.org/enwiktionary/yyyymmdd/enwiktionary-yyyyymmdd-pages-articles.xml.bz2>,
<http://dumps.wikimedia.org/simplewiki/yyyymmdd/simplewiki-yyyyymmdd-pages-articles.xml.bz2>,
etc.

3.1.1.2 SQL dump files

Also posted are dump files of individual database tables, and they have URL's like

<http://dumps.wikimedia.org/enwiki/yyyymmdd/enwiki-yyyyymmdd-category.sql.gz>,
<http://dumps.wikimedia.org/enwiki/yyyymmdd/enwiki-yyyyymmdd-categorylinks.sql.gz>,
<http://dumps.wikimedia.org/enwiki/yyyymmdd/enwiki-yyyyymmdd-externallinks.sql.gz>,
etc.

3.1.1.3 Media

Media files are stored separately from everything else. Media files that are used by more than one wiki are stored in the [commons](#) directory tree with URL's like

http://upload.wikimedia.org/wikipedia/commons/0/00/Arc_en_ciel.png.

Media files that are unique to a given wiki have their own directory tree. You can expect URL's with names something like

<http://upload.wikimedia.org/wikipedia/en/...>,
<http://upload.wikimedia.org/wiktionary/en/...>,
<http://upload.wikimedia.org/wikipedia/simple/...>, etc.

The Wikimedia Foundation does not provide a dump of media files. Nor does it provide any kind of bulk download method (e.g. [rsync](#), [torrent](#)). Copyright and bandwidth issues have been cited. However, there are sites that do provide bulk download methods (see next).

3.1.2 Storage at Other Dump Sites

Mirror sites that provide dump files and media dump tarballs are listed on http://meta.wikimedia.org/wiki/Mirroring_Wikimedia_project_XML_dumps.¹

3.1.3 Storage on Mirror

As for your computer: Articles, templates, image metadata, etc. are stored in the form of a database. We use [MySQL](#) as the database management system (and so does WMF). [MySQL](#) offers many storage engines (sub-systems that manage the data in memory and on disk). The [InnoDB](#) storage engine is preferred, because it supports transactions and is 'ACID compliant' (explained in the Design Note in [§3.2.1, Plan Your Disk Space](#) below). As already mentioned, the Wikimedia Foundation makes compressed dump files available. These dump files must be downloaded, validated, decompressed, and then imported into the database. WP-MIRROR automates all these tasks for you.

Media files for wikis, are stored in a file system, rather than a database. This is a design decision on the part of people at the Wikimedia Foundation. It recognizes that web servers are better at caching files than database contents.

¹The mirror site <http://ftpmirror.your.org/pub/wikimedia/imagetdumps/tarballs/fulls/> provides media dumps, but the Wikimedia Foundation issues the following caution:

The Wikimedia Foundation has permission to use certain images, and many of the fair use images are borderline in terms of whether they can be used or not off Wikipedia. If you choose to download the image base, you do so at your own risk and assume all liability for the use of any images on the main Wikipedia site. The Wikipedia Community vigorously police the site and remove infringing images daily, however, it is always possible that some images may escape this extraordinary level of vigilance and end up on the site for a short time. As of February of 2007, the entire collection of images produce a compressed tar.gz file of over 213 GB (gigabytes). As of November 2011 the image and other media files take up about 17T, most of it already compressed media.

http://meta.wikimedia.org/wiki/Importing_a_Wikipedia_database_dump_into_mediawiki, accessed 2012-12-22

The author recommends using a modern journalling file system (such as [ReiserFS](#)).

3.1.4 WP-MIRROR

WP-MIRROR can read the dump file, identify the media files needed, and download them. Again WP-MIRROR automates all these tasks for you.

When you wish to access your mirror, open a browser and enter the URL <http://simple.wikipedia.site/>. This URL is a virtual host set up for your convenience by WP-MIRROR. Your web server (e.g. [apache2](#)) will first resolve the virtual host name to `::1`, which is your [localhost](#). Then it will call the [MediaWiki PHP](#) script `/var/lib/mediawiki/index.php`. This script will in turn interact with [MySQL](#) and your file system to fetch articles and media files, respectively. Then the web server will serve the articles and media files to your browser, which will then render the page.

As of year 2014, the ten largest wikipeias are judged to be too large to fit on a laptop PC equipped with a single 500G hard disk drive (HDD). They are: the [en wikipedia](#) (the largest at about 3T), followed by the [de](#), [nl](#), [fr](#), [it](#), [ru](#), [es](#), [sv](#), [pl](#), and [ja](#) wikipeias. When HDDs of larger capacity reach the market, this list may be shortened. But for now, a desktop PC with ample disk space and memory (DRAM) is required for any of the top ten, unless you can make do without the media files (and this is configurable). Most other languages should fit on a laptop. The [simple](#) wiki at about 100G (as of year 2014) should fit easily.

If you will be building your mirror on a laptop PC, please read [§3.2, Laptop Planning and Configuration](#) below. It contains detailed instructions for building a mirror of the [simple wikipedia](#), the [simple wiktionary](#), and the [wikidata wiki](#) (default).

If you will be building your mirror on a desktop PC, please read both [§3.2, Laptop Planning and Configuration](#) and [§3.3, Desktop Planning and Configuration](#) below. The latter contains instructions for building a mirror of the [en wikipedia](#). This is the most demanding case. You should expect a steeper learning curve and allow yourself more time.

3.2 Laptop Planning and Configuration

Laptops usually have a single HDD, so the configuration is simpler (albeit with reduced performance). In this section, the author assumes that you will be building a mirror of the [simple wikipedia](#), the [simple wiktionary](#), and the [wikidata wiki](#).

To reduce the labor involved in configuring dependencies such as [apache2](#), [MediaWiki](#), and [MySQL](#); many installation and post-installation configuration activities have been automated in WP-MIRROR 0.4 and later versions. This is shown in [Table 3.1, Automation of laptop Configuration](#).

3.2.1 Plan Your Disk Space

3.2.1.1 Configure HDD Write Caching

3.2.1.1.1 Purpose: Permit trade-off between database performance and Durability (the ‘D’ in ACID).

3.2.1.1.2 Motivation: Enabling HDD write cache improves performance (22% less time). Disabling HDD write cache helps assure Durability of individual [COMMIT](#)ted transactions. See [§G.3, fsm-file-import and Durability](#).

3.2.1.1.3 Implementation: Automatic configuration of the HDD write cache was introduced with WP-MIRROR 0.1. No user configuration is necessary.

Beginning with WP-MIRROR 0.6, the HDD write cache is *enabled* (default).

For WP-MIRROR 0.5 and earlier versions, the HDD write cache was *disabled* (default).

The user who wishes to configure the HDD write cache may do so, and two parameters have been introduced in WP-MIRROR 0.6 for this purpose:

Table 3.1: Automation of `laptop` Configuration

Category	Configuration	Auto	Warn	Opt
Disk	Configure HDD Write Caching	Y		
	Assert Adequate Disk Space		Y	
	Setup Thermal Management			Y
	Setup <code>smart</code> Disk Monitoring			Y
DBMS	Secure Database Management System		Y	
	Load Time Zone Tables	Y		
	Configure <code>InnoDB</code> Storage Engine	Y		
DRAM	N/A			
Internet	N/A			
mediawiki	Configure <code>MediaWiki</code>	Y		
	Enable <code>MediaWiki</code> extensions	Y		
Images	N/A			
Host	Enable Virtual Host	Y		
Proxy	Configure <code>bash</code> for Use with Caching Web Proxy			Y
	Configure <code>wget</code> for Use with Caching Web Proxy			Y
	Configure Browser for Use with Caching Web Proxy			Y

Table 3.2: History of Configuring `hdparm`

Version	Configuration
≥ 0.6	automated, enabled (default), no user configuration is necessary
≤ 0.5	automated, disabled (default), no user configuration is necessary

Name	Default	Range
<code>*system-hdd-write-cache*</code>	1	0, 1
<code>*system-hdd-write-cache-flush*</code>	nil	nil, t

The first parameter `*system-hdd-write-cache*` defaults to `1` (HDD write cache enabled). When set to `0`, the HDD write cache is disabled. WP-MIRROR configures HDD write caching by executing something like:

```
root-shell# hdparm -W1 /dev/sda      <-- enable, or
root-shell# hdparm -W0 /dev/sda      <-- disable
```

The second parameter `*system-hdd-write-cache-flush*` defaults to `nil` (no flushing after each checkpoint). When set to `t`, the HDD write cache is flushed immediately after each checkpoint. WP-MIRROR flushes the HDD write cache by executing something like:

```
root-shell# hdparm -F /dev/sda
```

When set to `nil` (default), the flushing is left up to `InnoDB`, which is in turn configured by `/etc/mysql/conf.d/wp-mirror.cnf`:

```
shell$ cat /etc/mysql/conf.d/wp-mirror.cnf
...
# for Durability (the 'D' in 'ACID compliance')          (0=flush log buff 1/sec)
innodb_flush_log_at_trx_commit = 0 # default            1. (2=write log file 1/sec)
...
```

This configuration means that the [InnoDB](#) log buffer is flushed to disk once per second, and that any [mysqld](#) or hardware failure could erase at most the last second of transactions. Such a loss would not be tragic because WP-MIRROR resumes from the last checkpoint and therefore repeats any transactions that were lost.

Write caching is configured only for the disk(s) holding your [InnoDB](#) data. Disabling HDD write caching helps assure Durability (the ‘D’ in ACID) of committed transactions.

You may manually disable write caching for an hard drive (and this is *not* recommended) by configuring `/etc/rc.local` by inserting the following lines:

```
hdparm -W0 /dev/sda
exit 0
```

But one hazard in doing so arises for systems using Linux dynamic device management, [udev](#). There is no guarantee that `/dev/sda` will refer to the same HDD each time the system is rebooted, unless there is only one HDD. Instead you will need the UUID of the disk, and this is found by executing:

```
shell$ ls -l /dev/disk/by-uuid/
```

Design note. A virtual machine presents an important exception. A virtual machine provides a virtual disk. Configuration of a virtual disk’s write cache is impossible (because the virtual disk is actually a file on the host machine’s HDD). In this case, a warning is issued.

The user who requires Durability for database transactions on a virtual machine, must log into the underlying host machine, and manually disable write caching for its physical hard drives.

Design note. WP-MIRROR 0.6 offers a design compromise.

- `*system-hdd-write-cache*`. Enabling HDD write caching can enhance performance, but sacrifices the Durability (the ‘D’ in ACID) of each individual transaction.
- `*system-hdd-write-cache-flush*`. However, this loss of Durability is mitigated somewhat by flushing the HDD write caches immediately after each checkpoint. Flushing assures that all transactions up to the last checkpoint are Durable.

In the event of a system failure that wipes the contents of the HDD write caches (e.g. power fails), the loss is not tragic because WP-MIRROR resumes from the last checkpoint, and therefore repeats any transactions that were lost.

Design note. When we say that a storage engine is ‘ACID compliant’, we mean that database transactions will have the following four features: Atomicity, Consistency, Isolation, and Durability.

- **Atomicity** means that database transactions follow the all-or-nothing rule—they either commit or they leave the database unchanged (there are no half-measures).
 - **Consistency** means that the database is never in an invalid state, not even for a moment.
 - **Isolation** means that one transaction can not access uncommitted changes made by another transaction.
 - **Durability** means that committed transaction will not be lost due to system failure.
-

3.2.1.2 Put [images](#) Directory on Partition with Adequate Free Space

3.2.1.2.1 Purpose: Assure adequate storage for WP-MIRROR installation.

Table 3.3: History of Configuring `images` Directory

Version	Configuration
≥ 0.7	warning issued if <code>/var/</code> has <100G free space; user configuration optional (see below)
0.6	warning issued if <code>/var/</code> has <90G free space; user configuration optional (see below)
0.4 – 0.5	warning issued if <code>/var/</code> has <60G free space; user configuration optional (see below)
≤ 0.3	user configuration optional (see below)

3.2.1.2.2 Motivation: WP-MIRROR is storage intensive. Databases and media files are stored under `/var/`. Stuffing that partition would interfere with other processes.

3.2.1.2.3 Implementation: A mirror of the [simple wikipedia](#), the [simple wiktionary](#), and the [wikidata wiki](#) (default), requires about 100G (as of year 2014).

Beginning with WP-MIRROR 0.7, media files are stored under `/var/lib/wp-mirror-mediawiki/images/`.

For WP-MIRROR 0.6 and earlier versions, media files are stored under `/var/lib/mediawiki/images/`.

WP-MIRROR periodically checks the amount of free disk space. If `/var/` has less than 100G free space, WP-MIRROR issues a warning. If `/var/` has less than 5G, WP-MIRROR gracefully exits.

If you mounted `/var/` on its own partition (which you should do), and if that partition has insufficient free space, then there is still hope. It may not be necessary to repartition your HDD. If you mounted `/home/` on its own partition (which is recommended), and if it has enough free space, then you can, instead, store the media files there and set a symbolic link. This is done by executing:

```
root-shell# mkdir /home/images
root-shell# chown --recursive www-data:www-data /home/images
root-shell# cd /var/lib/wp-mirror-mediawiki/
root-shell# rm --recursive images/
root-shell# ln --symbolic /home/images/ images
```

3.2.1.3 Setup Thermal Management

Table 3.4: History of Configuring `hddtemp`

Version	Configuration
≥ 0.1	user configuration optional (see below)

3.2.1.3.1 Purpose: Avoid harming HDDs.

3.2.1.3.2 Motivation: Running WP-MIRROR puts quite a load on CPU, HDD, and memory. Hot HDDs (e.g. over 50°C) do not last. HDD failure is traumatic for users not in the habit of performing backups.

3.2.1.3.3 Implementation: Check the temperature of the HDD by executing:

```
root-shell# aptitude install hddtemp
root-shell# /usr/sbin/hddtemp /dev/sda
```


or perhaps

```
root-shell# aptitude install smartmontools
root-shell# smartctl -a /dev/sda | grep Celsius
```

Make sure that the airflow is unobstructed. Better yet, go to your kitchen, and look for a cookie rack (a wire frame used for letting freshly baked cookies cool). Put the cookie rack under your laptop PC.

3.2.1.4 Setup `smart` Disk Monitoring

Table 3.5: History of Configuring `smart` Disk Monitoring

Version	Configuration
≥ 0.1	user configuration optional (see below)

3.2.1.4.1 Purpose: Monitor health of HDDs.

3.2.1.4.2 Motivation: Disks age, wear out, and fail. It is important to monitor the health of all your HDDs.

3.2.1.4.3 Implementation: Most HDDs are equipped with on-board diagnostics—the Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) System. The software utilities `smartctl` and `smartd` let you control and monitor such disks. `smartd` can send you an e-mail warning of imminent disk failure.

To enable `smartd` to run as a daemon, edit the configuration file `/etc/default/smartmontools` by uncommenting the line to read

```
start_smartd=yes
```

Then, to monitor all attributes, to schedule a short self-test daily at 2am, a long self-test weekly on Saturdays at 3am, and to receive an email of disk failure, edit the configuration file `/etc/smartd.conf` to read:

```
/dev/sda -d ata -a -o on -S on -s (S/../../02|L/../../06/03)
/dev/sda -d ata -H -m root@localhost
```

From time-to-time you should read the test report by executing:

```
root-shell# smartctl -a /dev/sda
```

You should pay careful attention to attributes of type `Pre-fail`. Look also for evidence that the disk is encountering bad sectors, by finding the attributes `Reallocated_Sector_Ct` and `Current_Pending_Sector`. Check also that the scheduled tests are actually running by comparing the attribute `Power_On_Hours` with the `LifeTime(hours)` column of the `Self-test log`.

3.2.2 Plan Your Database Management System

It is simplest if you start with a clean database.

3.2.2.1 Secure the Database Management System

3.2.2.1.1 Purpose: Enhance database security.

Table 3.6: History of Configuring MySQL Security

Version	Configuration
≥ 0.4	warning issued if no security; user configuration optional (see below)
≤ 0.3	user configuration optional (see below)

3.2.2.1.2 Motivation: MySQL by default has no password for the `root` account. Some people think that this is safe. The author respectfully disagrees.

3.2.2.1.3 Implementation: Security testing of the database management system (DBMS) was introduced with WP-MIRROR 0.4. Warnings are issued as needed. User configuration is optional but highly recommended. You should secure your installation by executing:

```
root-shell# mysql_secure_installation
```

This interactive script prompts you do five things:

- set a password for root accounts,
- remove anonymous-user accounts,
- remove root accounts that are accessible from outside the local host,
- remove the `test` database,
- reload the privilege tables so that changes take effect immediately.

Alternatively, you can do this manually by executing:

```
shell$ mysql --user=root
mysql> UPDATE mysql.user SET password=PASSWORD('new_pwd') WHERE user='root';
mysql> DELETE FROM mysql.user WHERE user='root'
    -> AND host NOT IN ('localhost', '127.0.0.1', ':::1');
mysql> DELETE FROM mysql.user WHERE user='';
mysql> DELETE FROM mysql.db WHERE db='test' OR db='test_%';
mysql> DROP DATABASE test;
mysql> FLUSH PRIVILEGES;
```

where `new_pwd` is replaced by a password of your choice.

3.2.2.2 Load the DBMS `time_zone` Tables

Table 3.7: History of Configuring MySQL `time_zone` Tables

Version	Configuration
≥ 0.4	automated, no user configuration is necessary
≤ 0.3	user configuration required (see below)

3.2.2.2.1 Purpose: Assure correct handling of timestamps.

3.2.2.2.2 Motivation: Mediawiki and MySQL handle timestamps differently.

3.2.2.2.3 Implementation: Automatic loading of the `time_zone` tables was introduced with WP-MIRROR 0.4. No user configuration is necessary.

WP-MIRROR checks that the `time_zone` tables are populated; and, if they are not, loads them from another package (namely, the `tzdata` package which installs its time zone information under `/usr/share/zoneinfo/`).

For WP-MIRROR 0.3 and earlier versions, it is necessary to load the `time_zone` tables manually by executing:

```
shell$ mysql_tzinfo_to_sql /usr/share/zoneinfo | mysql --host=localhost \
--user=root --password mysql
Enter password:
root-shell# /etc/init.d/mysql restart
```

where the password you enter should be your MySQL root password chosen in §3.2.2.1, [Secure the Database Management System](#) above.

Design note. `MediaWiki` has its own kind of timestamp, and does not use the MySQL timestamp. This can be seen when running the `/usr/share/mediawiki/maintenance/update.php` script, which emits the message:

```
Converting tc_time from UNIX epoch to mediawiki timestamp... done.
```

MySQL has tables that store time zone information. These tables enable recognition of named time zones.

While not required by `MediaWiki`, these `time_zone` tables are useful. This is because, several of the `MediaWiki` tables (e.g. `image`, `logging`, `page`, etc.) have a field that contains a `MediaWiki` timestamp. These fields are of type `BINARY(14)` rather than of type `TIMESTAMP`. According to the [MySQL 5.5 Reference Manual](#):

MySQL converts `TIMESTAMP` values from the current time zone to UTC for storage, and back from UTC to the current time zone for retrieval.

[Section 11.3.1, The DATE, DATETIME, and TIMESTAMP Types](#), accessed 2012-12-19

This is not true of type `BINARY(14)`.

This difference in behaviour could result in converting or comparing timestamps incorrectly. When the MySQL data directory is first installed, these tables are empty.

3.2.2.3 Configure the InnoDB Storage Engine

Table 3.8: History of Configuring InnoDB Storage Engine

Version	Configuration
≥ 0.4	automated, no user configuration is necessary
≤ 0.3	user configuration required (see below)

3.2.2.3.1 Purpose: Increase DBMS performance.

3.2.2.3.2 Motivation: With proper DBMS configuration, one can improve performance by an order of magnitude. See [Figure E.1, InnoDB Experiments—Importing imagelinks Table](#) and [Figure G.1, InnoDB Experiments—Importing commonswiki.image Table](#).

3.2.2.3.3 Implementation: Automatic customizing of the [InnoDB](#) storage engine was introduced with WP-MIRROR 0.4. No user configuration is necessary.

For WP-MIRROR 0.3 and earlier versions, configuration is done as follows:

First, copy the configuration file for the laptop case by executing:

```
root-shell# cd /usr/share/doc/wp-mirror/examples/  
root-shell# cp wp-mirror_laptop.cnf /etc/mysql/conf.d/.  
root-shell# cd /etc/mysql/conf.d/  
root-shell# mv wp-mirror_laptop.cnf wp-mirror.cnf
```

Second, delete the existing [InnoDB](#) log files, and restart [MySQL](#) by executing:

```
root-shell# /etc/init.d/mysql stop  
root-shell# rm /var/lib/mysql/ib_logfile*  
root-shell# /etc/init.d/mysql start
```

Alternatively, you can try the cut-and-paste method:

First, edit `/etc/mysql/conf.d/wp-mirror.cnf` to read:

```
[mysqld]
# time zone UTC
default-time-zone            = UTC
# transactional (ACID) storage engine.
default-storage-engine       = innodb
# UTF-8 character set and collation.
character-set-server         = utf8
collation-server             = utf8_general_ci

# InnoDB

# to speed disk I/O bound operations (compress tables using 'zlib')
innodb_file_per_table        = 1 # default OFF. Create .ibd file/table
innodb_file_format           = Barracuda # default Antelope.
innodb_file_format_check     = 1 # default ON.
innodb_strict_mode           = 1 # default 0.
# increase size of buffer pool and log files for speed
innodb_buffer_pool_size      =1024M # default 128M.
innodb_log_buffer_size       = 80M # default 8M.
innodb_log_file_size         = 512M # default 5M.
innodb_additional_mem_pool_size = 8M # default 8M. (data dict, internals)
# for Durability (the 'D' in 'ACID compliance') (0=flush log buff 1/sec)
innodb_flush_log_at_trx_commit = 0 # default 1. (2=write log file 1/sec)
sync_binlog                  = 0 # default 0.
# fast index creation requires large TMP directory
tmpdir                       = /var/tmp # default /tmp
# enable large page support. InnoDB will use it automatically for its
# buffer_pool and its additional_memory_pool
large_pages                  = 1 # default 0.

# Other

lower_case_table_names       = 1 # default 0. (use 1 for InnoDB)
# <meta.wikimedia.org/wiki/Data_dumps> recommends 20M.
max_allowed_packet           = 64M # default 16M.
query_cache_size             = 16M # default 16M.
query_cache_type             = 1 # default ON.

[mysql]
default-character-set        = utf8
# <meta.wikimedia.org/wiki/Data_dumps> recommends 20M.
max_allowed_packet          = 64M # default 16M.
```

Second, delete the existing log files, and restart **MySQL** as above.

Design note. **InnoDB** has four ways of storing the data on disk:

1. **Antelope** (data uncompressed) with all data stored in a single file, called a **data file** or **table space**,
2. **Antelope** with each database in a separate directory and each table in a separate file,
3. **Antelope** with the **table space** written directly onto a raw partition (no file system), and
4. **Barracuda** (data compressed using **zlib**) with each database in a separate directory and each table in a separate file, as in case 2 (default).

Barracuda (case 4) is best for a laptop PC, because data compression saves disk space and improves **SELECT** performance. However, it also requires much more CPU power, for compressing

your data before writing it to disk, and for decompressing it after reading it back from disk. [Barracuda](#) performs poorly at concurrency (handling multiple connections). Experiments show that, when running two or more instances of WP-MIRROR in mirror mode, two out of three [xchunks](#) experience deadlocks and fail to install completely. However, the laptop user normally starts a single instance in mirror mode, lets it run overnight, and no deadlocks occur. For WP-MIRROR 0.5 and earlier versions, the author recommends [Barracuda](#) for mirroring small wikis (but not the top ten). For WP-MIRROR 0.6 and later versions, [Barracuda](#) is recommended for all wikis.

[Antelope](#) (case 3) is a good choice for a desktop PC or a server, because it is fast, it handles concurrency well, and because disk space is cheap. Writing directly onto a raw partition is faster, because it avoids an extra layer of journalling. All modern file systems use journalling to improve crash recovery. However, [InnoDB](#)'s [table space](#) already has its own journaling system. Storing the [table space](#) on top of a journaling file system (case 1) is unnecessary and slow—and it makes the HDDs run harder and hotter. [Antelope](#) also handles concurrency well. It is normal for an user to start two or three instances of WP-MIRROR in mirror mode, and let them run for days or weeks. Very few deadlocks occur, and very few [xchunks](#) fail to install completely. For WP-MIRROR 0.5 and earlier versions, the author recommends it (case 3) for mirroring the top ten wikis. For WP-MIRROR 0.6 and later versions, [Antelope](#) is no longer recommended.

Third, the [buffer pool](#) is the space in memory (DRAM) where [InnoDB](#) stores data that it is currently processing. A large [buffer pool](#) improves performance, because more of your data is available in memory (fast), and less of it has to be read from disk (slow). For large wikipedias, such as the [en wikipedia](#), it may be necessary to install extra DRAM to accommodate a large [buffer pool](#).

Fourth, the [log files](#) are the journals where [InnoDB](#) first logs any transactions that will be written to disk. Whenever the [log files](#) fill up, [InnoDB](#) must stop and flush the data from memory to disk. Large [log files](#) can improve performance. Beginning with [MySQL 5.5](#) it is reasonable to set [innodb_log_file_size](#) to half the value of [innodb_buffer_pool_size](#), and [innodb_log_buffer_size](#) should be set to the size that can be written to disk in one second.

3.2.2.4 MySQL Redux

3.2.2.4.1 Purpose: Reinstall [MySQL](#).

3.2.2.4.2 Motivation: The word ‘redux’ means brought back or restored. If you experiment aggressively with [MySQL](#) you might inadvertently trash your installation. If this happens to you, there is an easy way to make a fresh start.

3.2.2.4.3 Implementation: First, delete the old installation by executing:

```
root-shell# /etc/init.d/mysql stop
root-shell# rm -r /var/lib/mysql/*
root-shell# rm /etc/mysql/conf.d/wp-mirror.cnf
```

Second, make a clean install by executing:

```
root-shell# mysql_install_db --user=mysql
root-shell# /etc/init.d/mysql start
```

Third, restore the [debian-sys-maint](#) account info by executing:

```

root-shell# cat /etc/mysql/debian.cnf
[client]
host      = localhost
user      = debian-sys-maint
password  = abcdefghijklmnop
socket    = /var/run/mysqld/mysqld.sock
[mysql_upgrade]
host      = localhost
user      = debian-sys-maint
password  = abcdefghijklmnop
socket    = /var/run/mysqld/mysqld.sock
basedir   = /usr
shell$ mysql --host=localhost --user=root
mysql> CREATE USER 'debian-sys-maint'@'localhost' IDENTIFIED BY 'abcdefghijklmnop';
mysql> GRANT ALL PRIVILEGES ON *.* TO 'debian-sys-maint'@'localhost' WITH GRANT OPTION;
mysql> FLUSH PRIVILEGES;
mysql> quit;

```

where `abcdefghijklmnop` is to be replaced by a password of sixteen alphanumeric characters (i.e. [A-Za-z0-9]).

Fourth, improve security by executing:

```
root-shell# mysql_secure_installation
```

Fifth, restore the WP-MIRROR configuration by executing:

```
root-shell# wp-mirror --mirror
```

3.2.3 Plan Your DRAM

No configuration is required for laptops.

3.2.4 Plan Your Internet Access

3.2.4.1 Configure `cURL` (Obsolete)

Table 3.9: History of Configuring `cURL`

Version	Configuration
≥ 0.6	obsolete, no user configuration is necessary
$0.4 - 0.5$	automated, no user configuration is necessary
≤ 0.3	user configuration required (see below)

3.2.4.1.1 Obsolete: `cURL` is no longer used for downloading dump files or media files.

3.2.4.1.2 Purpose: Prevent `cURL` from blocking.

3.2.4.1.3 Motivation: By default, `cURL` does not time-out when a file takes a long time to download. This means that `cURL` will block when a file fails to download completely.

3.2.4.1.4 Implementation: For WP-MIRROR 0.6 and later, [cURL](#) is no longer used for downloading dump files and media files. No user configuration is necessary.

For WP-MIRROR 0.5 and earlier versions, the utility [cURL](#) is used for downloading dump files and media files.

Automatic configuration of [cURL](#) was introduced with WP-MIRROR 0.4. No user configuration is necessary. WP-MIRROR does this by appending the command-line option `-m 1000` to all invocations of [cURL](#).

For WP-MIRROR 0.3 or earlier versions, you must manually edit (or create) the configuration file `/root/.curlrc` by appending the lines:

```
# We want 1ks timeout (initially and for each retry)
--max-time 1000
```

3.2.5 Plan Your [MediaWiki](#)

3.2.5.1 Configure [MediaWiki](#)

Table 3.10: History of Configuring [MediaWiki](#)

Version	Configuration
≥ 0.4	automated, no user configuration is necessary
≤ 0.3	user configuration required (see below)

3.2.5.1.1 Purpose: Use [MediaWiki](#) as wiki engine to mirror WMF wikis.

3.2.5.1.2 Motivation: [MediaWiki](#) needs DBMS credentials to access wiki content.

3.2.5.1.3 Implementation: Automatic configuration of [MediaWiki](#) was introduced with WP-MIRROR 0.4. No user configuration is necessary.

For WP-MIRROR 0.3 and earlier version, you must manually configure [MediaWiki](#) as follows:

First, open a browser to <http://localhost/mediawiki/config/index.php> and fill in the blanks with:


```

Site config
Wiki name: Wikipedia
Contact e-mail: webmaster@localhost
Language: simple - Simple English
Copyright/license: (*) No licence metadata
Admin username: WikiSysop
Password: *****
Password confirm: *****
Object caching: (*) No caching
Memcached servers: <blank>
E-mail, e-mail notification and authentication setup
E-mail features (global): (*) Disabled
User-to-user e-mail: (*) Disabled
E-mail notification about changes: (*) Disabled
E-mail address authentication: (*) Disabled
Database config
Database type: (*) MySQL
Database host: localhost
Database name: wikidb
DB username: wikiuser
DB password: *****
DB password confirm: *****
Superuser account: [x] Use superuser account
Superuser name: root
Superuser password: *****
MySQL specific options
Database table prefix: <blank>
Storage Engine: (*) InnoDB
Database character set: (*) MySQL 4.1/5.0 binary

```

If you are installing on a laptop, and are the only user, it is reasonable to use the same password for all the database accounts (namely, `root`, `WikiSysop`, and `wikiuser`) by entering the same password that you created in §3.2.2.1, [Secure the Database Management System](#).

Second, press the [Install mediawiki!](#) button. The browser may take a minute to respond while it: 1) creates and populates the database `wikidb`, and 2) writes the file `/var/lib/mediawiki/config/LocalSettings.php`.

Third, move the `LocalSettings.php` into place and set permissions to protect passwords, by executing:

```

root-shell# mv /var/lib/mediawiki/config/LocalSettings.php /etc/mediawiki/.
root-shell# chown www-data:www-data LocalSettings.php
root-shell# chmod 600 LocalSettings.php

```

Fourth, WP-MIRROR provides a supplementary configuration file `/etc/mediawiki/LocalSettings_wpmirror.php` which contains several important customizations. To include this, edit `/etc/mediawiki/LocalSettings.php` by appending the lines:

```

# wp-mirror specific include:
if (is_file( '/etc/mediawiki/LocalSettings_wpmirror.php' ) ) {
    include( '/etc/mediawiki/LocalSettings_wpmirror.php' );
}

```

Fifth, move the administrator config file into place and set permissions to protect passwords, by executing:

```

root-shell# cd /usr/share/doc/mediawiki/examples/
root-shell# cp -a AdminSettings.sample /etc/mediawiki/AdminSettings.php
root-shell# cd /etc/mediawiki/
root-shell# chmod 600 /etc/mediawiki/AdminSettings.php

```

Sixth, edit the `/etc/mediawiki/AdminSettings.php` by appending:

```

$wgDBAdminuser = 'root';
$wgDBAdminpassword = 'new_pwd';

```

where `new_pwd` should be replaced with the password you set above in §3.2.2.1, [Secure the Database Management System](#). The credentials in the administrator config file are needed by many of the scripts in `/usr/share/mediawiki/maintenance/`.

3.2.5.2 Enable MediaWiki Extensions

Table 3.11: History of Configuring `mediawiki-extensions`

Version	Configuration
≥ 0.4	automated, no user configuration is necessary
≤ 0.3	user configuration required (see below)

3.2.5.2.1 Purpose: Assure proper formatting of wiki pages.

3.2.5.2.2 Motivation: Without `MediaWiki` extensions enabled, most of the Wikipedia articles will look messy; and articles with citations will be almost unreadable.

3.2.5.2.3 Implementation: Automatic configuration of the `mediawiki-extensions` was introduced with WP-MIRROR 0.4. No user configuration is necessary.

For WP-MIRROR 0.3 and earlier versions, extensions are configured by setting a couple dozen links. This is most easily done by executing:

```

root-shell# cd /etc/mediawiki-extensions/extensions-enabled/
root-shell# cp -a ../extensions-available/* .

```

3.2.5.3 MediaWiki Redux (Obsolete)

3.2.5.3.1 Obsolete: Beginning with WP-MIRROR 0.4, `MediaWiki` is configured automatically by WP-MIRROR.

3.2.5.3.2 Purpose: Reinstall `MediaWiki`.

3.2.5.3.3 Motivation: The word ‘redux’ means brought back or restored. If you mess up your installation of `MediaWiki`, there is an easy way to make a fresh start.

3.2.5.3.4 Implementation: For WP-MIRROR 0.4, which uses `MediaWiki` 1.19, restart the installation as follows:

First, delete the old configuration by executing:

```

root-shell# rm /etc/mediawiki/LocalSettings.php

```

Second, open a browser to <http://localhost/mediawiki/index.php>. You will get message what says:

```
LocalSettings.php not found.
Please [set up the wiki] first.
```

Third, click on the link “set up the wiki”, which will take you to <http://localhost/mediawiki/mw-config/index.php>.

Third, on that page click on the link which says “Restart installation”.

For WP-MIRROR 0.3 and earlier versions, which use [MediaWiki 1.15](#), restarting the installation as follows:

First, drop the database by executing:

```
shell$ mysql --host=localhost --user=root --password
Enter password:
...
mysql> DROP DATABASE wikidb;
```

Second, edit `/var/lib/mediawiki/config/index.php` by commenting out the following lines (scroll down about 220 lines):

```
#if( file_exists( "../LocalSetings.php" ) ) {
# $script = defined('MW_INSTALL_PHP5_EXT') ? 'index.php5 : 'index.php';
# dieout( "<p><strong>Setup has completed, <a href='../$script'>your wiki</a>
#         is configured.</strong></p>" );
# <p>Please delete the /config directory for extra security.</p>" );
# }
```

Third, redo the installation described above in [§3.2.5.1, Configure MediaWiki](#).

3.2.6 Plan Your Image Processing

3.2.6.1 Replace [ImageMagick](#) with [GraphicsMagick](#) (Obsolete)

Table 3.12: History of Configuring Image Processing

Version	Configuration
≥ 0.7	obsolete, no user configuration is necessary
0.1 – 0.6	automated, no user configuration is necessary

3.2.6.1.1 Obsolete: [ImageMagick](#) is now used by default. It appears stable.

3.2.6.1.2 Purpose: Prevent [ImageMagick](#) from hanging the system.

3.2.6.1.3 Motivation: By default, [MediaWiki](#) processes media files with [convert](#) from [ImageMagick](#). However, [convert](#) often grabs too much memory, which can cause: poor performance, memory starvation of other processes, and system hang.

3.2.6.1.4 Implementation: It is better to use `gm convert` from `GraphicsMagick`.

Automatic replacement of `ImageMagick` with `GraphicsMagick` in `MediaWiki`'s configuration was introduced with WP-MIRROR 0.1. No user configuration is necessary.

WP-MIRROR provides a supplementary configuration file `/etc/mediawiki/LocalSettings_wpmirror.php` that deals with the image processing issue by providing the following lines:

```
$wgUseImageMagick=false;
$wgCustomConvertCommand="/usr/bin/gm convert %s -resize %wx%h %d";
```

Instructions for installing the supplementary configuration file are found above in §3.2.5.1, [Configure MediaWiki](#).

Design note. Most of the older and larger articles have images. Usually, the authors of such articles provide images that do not fit the page layout. So `MediaWiki` resizes them. The resized images, which are called ‘thumb’s, are stored in a directory tree under

```
/var/lib/mediawiki/images/wikipedia/common/thumb/,
/var/lib/mediawiki/images/wikipedia/simple/thumb/, and
/var/lib/mediawiki/images/wiktionary/simple/thumb/.
```

By default, `MediaWiki` uses `convert` from `ImageMagick`. However, `convert` often grabs too much memory, which can:

- cause poor performance,
- cause other processes to fail for lack of memory to allocate, and
- cause your system to hang.

To reduce your frustration, you should instead have `MediaWiki` resize images using `gm convert` from `GraphicsMagick`.

Beginning with WP-MIRROR 0.7, `ImageMagick` (default) is deemed stable enough.

3.2.6.2 Replace SVG Converter (Obsolete)

Table 3.13: History of Configuring SVG to PNG Conversion

Version	Configuration
≥ 0.7	obsolete, no user configuration is necessary
0.1 – 0.6	automated, no user configuration is necessary

3.2.6.2.1 Obsolete: `ImageMagick` is now used by default. It appears stable.

3.2.6.2.2 Purpose: Prevent `ImageMagick` from hanging the system.

3.2.6.2.3 Motivation: Media files provided in `SVG` format are usually converted into `PNG` format, because some browsers do not render `SVG` files properly.

By default, `MediaWiki` converts `SVG` image files using `convert` from `ImageMagick`. However, `convert` often grabs too much memory, which can cause: poor performance, memory starvation of other processes, and system hang.

3.2.6.2.4 Implementation: It is better to use [inkscape](#) or [rsvg](#).

Automatic replacement of [ImageMagick](#) in [MediaWiki](#)'s configuration was introduced with WP-MIRROR 0.1. No user configuration is necessary.

WP-MIRROR provides a supplementary configuration file `/etc/mediawiki/LocalSettings_wpmirror.php` that deals with the image processing issue by providing the following lines:

For WP-MIRROR 0.4 and later versions, [inkscape](#) is preferred.

```
$wgUseImageMagick=false;
$wgCustomConvertCommand="/usr/bin/gm convert %s -resize %wx%h %d";
$wgSVGConverter="inkscape";
```

For WP-MIRROR 0.3 and earlier versions, [rsvg](#) is preferred.

```
$wgUseImageMagick=false;
$wgCustomConvertCommand="/usr/bin/gm convert %s -resize %wx%h %d";
$wgSVGConverter="rsvg";
```

Instructions for installing the supplementary configuration file are found above in [§3.2.5.1, Configure MediaWiki](#).

3.2.7 Plan Your Virtual Host**3.2.7.1 Enable Virtual Host**Table 3.14: History of Configuring [apache2](#) Virtual Host

Version	Configuration
≥ 0.2	automated, no user configuration is necessary
≤ 0.1	user configuration required (see below)

3.2.7.1.1 Purpose: Direct web server to local mirror.

3.2.7.1.2 Motivation: By default, [apache2](#) will not know that your local mirror exists, and will instead try (unsuccessfully) to look outside your system.

3.2.7.1.3 Implementation: WP-MIRROR sets up virtual hosts named [wikibooks.site](#), [wikipedia.site](#), [wiktionary.site](#), etc. on your own computer. This lets you access your mirror locally by giving your web browser the URL [http://simple.wikipedia.site/](#). If you set up a mirror farm, you will have one URL for each language (replace 'simple' with the language code, e.g. [http://en.wikipedia.site/](#)).

Most laptops will not be running a Domain Name Server (DNS), such as [bind](#). Therefore, WP-MIRROR resolves the virtual host names to the [localhost](#), by editing `/etc/hosts`.

URL rewriting is also implemented so that the user can enter URLs similar to those used by the WMF. That is to say, we prefer to enter URLs like the first two of the following while avoiding the third:

http://simple.wikipedia.org/wiki/John_Adams	WMF
http://simple.wikipedia.site/wiki/John_Adams	WP-MIRROR
http://simple.wikipedia.site/wiki/index.php?title=John_Adams	without URL rewriting

Automatic enabling of URL rewriting was introduced with WP-MIRROR 0.7. No user configuration is necessary.

Automatic enabling of the virtual host was introduced with WP-MIRROR 0.2. No user configuration is necessary.

For WP-MIRROR 0.1, a virtual host is configured as follows:

First, create a virtual host container in `/etc/apache2/sites-available/wpmirror.site.conf` with the following text:

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wpmirror.site
    # for access using: en.wpmirror.site, simple.wpmirror.site, etc.
    ServerAlias *.wpmirror.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wikibooks.site
    # for access using: en.wikibooks.site, simple.wikibooks.site, etc.
    ServerAlias *.wikibooks.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wikimedia.site
    # for access using: en.wikimedia.site, simple.wikimedia.site, etc.
    ServerAlias *.wikimedia.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wikinews.site
    # for access using: en.wikinews.site, simple.wikinews.site, etc.
    ServerAlias *.wikinews.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wikipedia.site
    # for access using: en.wikipedia.site, simple.wikipedia.site, etc.
    ServerAlias *.wikipedia.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wikiquote.site
    # for access using: en.wikiquote.site, simple.wikiquote.site, etc.
    ServerAlias *.wikiquote.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wikisource.site
    # for access using: en.wikisource.site, simple.wikisource.site, etc.
    ServerAlias *.wikisource.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wikiversity.site
    # for access using: en.wikiversity.site, simple.wikiversity.site, etc.
    ServerAlias *.wikiversity.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wikivoyage.site
    # for access using: en.wikivoyage.site, simple.wikivoyage.site, etc.
    ServerAlias *.wikivoyage.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerAdmin webmaster@localhost
    ServerName wiktory.site
    # for access using: en.wiktory.site, simple.wiktory.site, etc.
    ServerAlias *.wiktory.site
    DocumentRoot /var/www
    # for logs using: NCSA Combined Log Format
    CustomLog $APACHE_LOG_DIR/wpmirror.site-access.log combined
    ErrorLog $APACHE_LOG_DIR/wpmirror.site-error.log
</VirtualHost>
```

Second, enable the virtual host, and restart `apache2` by executing:

```
root-shell# a2ensite wpmirror.site.conf
root-shell# /etc/init.d/apache2 reload
```

Third, edit `/etc/hosts` by appending lines like:

```
::1 simple.wikipedia.site
::1 simple.wiktory.site
```

and additional lines corresponding to each language and project specified in `/etc/wp-mirror/local.conf`.

For WP-MIRROR 0.6 and earlier versions, URL rewriting is enabled as follows:

First, enable the `apache2` rewrite module by executing:

```
root-shell# a2enmod rewrite
Enabling module rewrite.
To activate the new configuration, you need to run:
    service apache2 restart
root-shell# service apache2 restart
[ ok ] Restarting web server: apache2 ... waiting .
```

Second, create `/var/www/.htaccess` containing the following rewrite rules:

```
RewriteEngine On
#Look for the word 'wiki' followed by a slash, and then the article title
RewriteCond %{REQUEST_FILENAME} !-f
RewriteRule ^wiki/?(.*)$ /wiki/index.php?title=$1 [L,QSA]
#Look for empty page name
RewriteRule ^$ /wiki/index.php?title=Main_Page [L,QSA]
```

Third, set a symbolic link so that `apache2` can find the `index.php` script in the `/var/lib/mediawiki` directory:

```
root-shell# cd /var/www/
root-shell# ln --symbolic /var/lib/mediawiki/ wiki
```

Design note. If you wish to configure your virtual host differently, then create a new virtual host container in a separate file `/etc/apache2/sites-available/your-virtual-host.conf`. Your new virtual host must then be enabled by executing:

```
root-shell# a2disssite wp-mirror.site.conf
root-shell# a2ensite your-virtual-host.conf
root-shell# /etc/init.d/apache2 reload
```


You will also have to make corresponding edits to `/etc/hosts` in order to resolve the new names.

3.2.8 Plan Your Caching Web Proxy

If your system sits behind a caching web proxy, then it can happen that many web-access programs fail to connect to the Internet.

Most web-access programs look for environment variables to determine if traffic must go through a caching web proxy. These environment variables (`ftp_proxy`, `http_proxy`, and `https_proxy`) provide the host name of the caching web proxy, and the port that the proxy is listening on (usually port 8123). The variables look something like:

```
https_proxy = http://proxy-hostname:8123/
http_proxy  = http://proxy-hostname:8123/
ftp_proxy   = http://proxy-hostname:8123/
```

where `proxy-hostname` is replaced by the host name of your caching web proxy.

3.2.8.1 Configure `bash` for Use with Caching Web Proxy

Table 3.15: History of Configuring `bash` for Caching Web Proxy

Version	Configuration
<code>≥ 0.1</code>	user configuration required (see below)

3.2.8.1.1 Purpose: Assure web-access programs are usable when behind a web caching proxy.

3.2.8.1.2 Motivation: Most web-access programs look for environment variables to determine whether or not traffic must go through a caching web proxy.

3.2.8.1.3 Implementation: These environment variables can be set globally by editing `/etc/bash.bashrc` by appending:

```
export HTTP_PROXY=http://proxy-hostname:8123/
export HTTPS_PROXY=http://proxy-hostname:8123/
export FTP_PROXY=http://proxy-hostname:8123/
```

where `proxy-hostname` is replaced by the host name of your proxy.

Confirm that the environment variables have been declared by executing:

```
shell$ export | grep PROXY
declare -x FTP_PROXY="http://proxy-hostname:8123/"
declare -x HTTPS_PROXY="http://proxy-hostname:8123/"
declare -x HTTP_PROXY="http://proxy-hostname:8123/"
```

If the above environment variables do not appear, then try closing and reopening your shell to load the new environment variables.

3.2.8.2 Configure `cURL` for Use with Caching Web Proxy (Obsolete)

3.2.8.2.1 Obsolete: `cURL` is no longer used by WP-MIRROR.

Table 3.16: History of Configuring `cURL` for Caching Web Proxy

Version	Configuration
≥ 0.7	obsolete, no user configuration is required
<code>0.1 – 0.6</code>	user configuration required (see below)

3.2.8.2.2 Purpose: Assure `cURL` is usable when behind a web caching proxy.

3.2.8.2.3 Motivation: If your system sits behind a web caching proxy, then it can happen that `cURL` fails to connect to the Internet.

3.2.8.2.4 Implementation: `cURL` looks for environment variables. These can be provided by editing the configuration file `/root/.curlrc` by appending:

```
proxy "http://proxy-hostname:8123/"
```

where `proxy-hostname` is replaced by the host name of your caching web proxy.

`cURL` does not have a global configuration file. So you may wish to repeat the process for the shell account of each user.

3.2.8.3 Configure `wget` for Use with Caching Web Proxy

Table 3.17: History of Configuring `wget` for Caching Web Proxy

Version	Configuration
≥ 0.1	user configuration required (see below)

3.2.8.3.1 Purpose: Assure `wget` is usable when behind a web caching proxy.

3.2.8.3.2 Motivation: If your system sits behind a caching web proxy, then it can happen that `wget` fails to connect to the Internet.

3.2.8.3.3 Implementation: `wget` looks for environment variables. These can be provided by editing the configuration file `/etc/wgetrc` with the following lines:

```
# You can set the default proxies for Wget to use for http, https, and ftp.
# They will override the value in the environment.
https_proxy = http://proxy-hostname:8123/
http_proxy  = http://proxy-hostname:8123/
ftp_proxy   = http://proxy-hostname:8123/
```

where `proxy-hostname` is replaced by the host name of your caching web proxy.

3.2.8.4 Configure Browser for Use with Caching Web Proxy

Table 3.18: History of Configuring Browsers for Caching Web Proxy

Version	Configuration
≥ 0.1	user configuration required (see below)

3.2.8.4.1 Purpose: Assure browser can find local mirror.

3.2.8.4.2 Motivation: If your system sits behind a caching web proxy, then attempts to browse <http://simple.wikimedia.site/> might get routed to the web caching proxy, which returns an error message.

3.2.8.4.3 Implementation: Examine your browser settings. For Firefox (and related) look under:

Edit->Preferences->Advanced->Network->Settings...

For Konqueror look under:

Settings->Configure Konqueror->Proxy

3.3 Desktop Planning and Configuration

Building a mirror of one of the large wikipedias is challenging. If this is your first attempt at building a mirror, then you can expect weeks of effort. There is, however, a learning curve effect. If you first build a mirror of a small wikipedia on a laptop PC, and afterwards build a mirror of a large wikipedia on a desktop PC, then the total time will be greatly reduced.

This is because it is far better to make all your mistakes on a project that can be done in a couple of days, than to make them on a project that takes a couple of weeks (months for WP-MIRROR 0.5 and earlier versions).

In what follows, the author assumes that you would like to build a mirror of the [en wikipedia](#) and [en wiktionary](#) on a desktop PC (or a server), and that you have already done some learning by building a mirror of the [simple wikipedia](#), the [simple wiktionary](#), and the [wikidata wiki](#) on a laptop PC.

3.3.1 Procure Hardware

Table 3.19: History of Procure Hardware for Desktop

Version	Configuration
≥ 0.6	procure 2x3T HDD, 3-speed case fan (see below)
≤ 0.5	procure 2x2T HDD, 3-speed case fan, 4G DRAM (see below)

You may need additional hardware. We shall assume that you already have a working GNU/Linux distribution on a desktop PC with one HDD `/dev/sda`.

To this, you will add two HDDs: `/dev/sdb` and `/dev/sdc`, for use by this project, and that you will add more DRAM, also for use by this project. Here is your shopping list:

- hard disk drives - qty 2, size 3T (or more) each,
- case fan - qty 1, 3-speed (if disks run hot).

Before buying anything, be sure of the following:

- PC case has vacant bays to mount the HDDs,
- power supply has connectors to power the HDDs,
- power supply can handle another 10W per disk,
- mother-board, or extension card, has connectors and cables,

For WP-MIRROR 0.5 and earlier versions, add to your shopping list:

- memory - qty 1 set, size 4G,

and also be sure of the following:

- mother-board has a pair of empty slots for the DRAM,
- mother-board manual specifies the type of DRAM.

3.3.2 Plan Your Disk Space

3.3.2.1 Configure HDD Write Caching

No user configuration is necessary (see §3.2.1.1, [Configure HDD Write Caching](#) above).

3.3.2.2 Setup Thermal Management

Table 3.20: History of Configuring `hddtemp` for Desktop

Version	Configuration
≥ 0.1	user configuration optional (see below)

Same as §3.2.1.3, [Setup Thermal Management](#), except that there will be more disks to manage. Check the temperature of your hard disk drives by executing:

```
root-shell# /usr/sbin/hddtemp /dev/sd[a-c]
```

or perhaps

```
root-shell# smartctl -a /dev/sda | grep Celsius
root-shell# smartctl -a /dev/sdb | grep Celsius
root-shell# smartctl -a /dev/sdc | grep Celsius
```

If your disks are running hot (e.g. over 50°C), they will not last. In which case, you will need to increase the air flow. A ‘3-speed case fan’ comes with a three-way switch ‘low-medium-high’. If you already have one, then set it to ‘high’. If the noise is too much for you, then procure a case that features a large diameter fan. These provide higher air flow with less noise. Also, because a large fan rotates at a lower RPM, the noise spectrum will be shifted an octave lower, which for many people is easier to bear.

3.3.2.3 Setup `smart` Disk Monitoring

Table 3.21: History of Configuring `smart` Disk Monitoring for Desktop

Version	Configuration
≥ 0.1	user configuration optional (see below)

Same as §3.2.1.4, [Setup `smart` Disk Monitoring](#), except that there will be extra lines to add in `/etc/smartd.conf`:

```
/dev/sdb -a -d ata -o on -S on -s (S/../../../../02/L/../../../../6/03)
/dev/sdc -a -d ata -o on -S on -s (S/../../../../02/L/../../../../6/03)
```

or, if you built your RAID array using an attached USB enclosure (and this is not recommended), then the above two lines might read something like:

```
/dev/sdb -a -d usbjmicron,0 -o on -S on -s (S/../../../../02/L/../../../../6/03)
/dev/sdc -a -d usbjmicron,1 -o on -S on -s (S/../../../../02/L/../../../../6/03)
```

Misconfiguration can easily happen, so you will need to wait a day and then confirm that the scheduled self-test(s) actually ran. This is done by executing:

```
root-shell# smartctl -a /dev/sdb
root-shell# smartctl -a /dev/sdc
```

or, in the case of an attached USB enclosure, something like

```
root-shell# smartctl -a -d usbjmicron,0 /dev/sdb
root-shell# smartctl -a -d usbjmicron,1 /dev/sdc
```

3.3.2.4 Allocate Disk Space for Articles

Articles for the [en wikipedia](#) require about 200G (as of 2014).

Articles are head in databases stored under the directory `/var/lib/mysql/`. However, given the size requirement, you would do better to store the databases on a separate disk, and set a symbolic link to it (as shown in [§3.2.1, Plan Your Disk Space](#) above).

Implementation instructions are given below in [§3.3.2.7, Build Your Storage Array](#).

3.3.2.5 Allocate Disk Space for Media Files

Media files for the [en wikipedia](#) require about 2.3T (as of 2014) and growing.

Media files are stored under the directory `/var/lib/wp-mirror-mediawiki/images/`. However, given the size requirement, you would do better to store the media files on a separate disk, and set a symbolic link to it (as shown in [§3.2.1, Plan Your Disk Space](#) above).

Implementation instructions are given below in [§3.3.2.7, Build Your Storage Array](#).

3.3.2.6 Design Storage for Security and Robustness

If you value your data, and especially if [InnoDB](#) is storing other databases containing confidential records (e.g. [drupal](#), [sendmail](#), etc.), then security and robustness are paramount.

In [§3.3.2.7, Build Your Storage Array](#) we shall: 1) enhance security by using [LUKS](#) to encrypt all storage; and 2) enhance robustness by using [RAID](#) to mirror all data.

Design note. “There is no security without security policy.” As a good start, you may wish to consider the following:

Table 3.22: Security Policy

Policy	Debian Package
encrypt all storage	cryptsetup
backup all valuable data	mdadm , rsync
encrypt all network traffic	openssh-client , openssh-server
block all unwanted IP addresses	pgld , pglcmd
block all unused ports	iptables
apply latest security patches	aptitude
deinstall all unused services	aptitude
close all unused or guest accounts	

To obtain the latest versions of all packages for your system execute:

```
root-shell# aptitude update
root-shell# aptitude safe-upgrade
```

and this should be done daily.

3.3.2.7 Build Your Storage Array

We shall build a RAID array out of whole disks, and then encrypt that.

To allow for future growth in the [en wikipedia](#) and [en wiktionary](#), the author recommends procuring a pair of HDDs no smaller than 3T. The following instructions assume 3T (0.3T for table space, 2.7T for media files).

One builds the structure from the bottom up.

For WP-MIRROR 0.6 and later versions, the author recommends the structure shown in [Figure 3.1, Recommended Disk Configuration of WP-MIRROR 0.6 and later versions.](#)

- `mysql` on `ReiserFS` over `LVM2` over `LUKS` over `RAID` over whole disks
- `images` on `ReiserFS` over `LVM2` over `LUKS` over `RAID` over whole disks

For WP-MIRROR 0.5 and earlier versions, the author recommends the structure shown in [Figure 3.2, Recommended Disk Configuration of WP-MIRROR 0.5 and earlier versions.](#) Note that the `ibdata0` table space is stored directly on a raw partition:

- `ibdata0` on `LVM2` over `LUKS` over `RAID` over whole disks
- `images` on `ReiserFS` over `LVM2` over `LUKS` over `RAID` over whole disks

Figure 3.1: Recommended Disk Configuration of WP-MIRROR 0.6 and later versions.

Data	<code>/var/lib/mysql/</code>	<code>/var/lib/mediawiki/images/</code>
Filesystem	<code>ReiserFS</code>	<code>ReiserFS</code>
LVM2	<code>/dev/mapper/vg0-ibdata0</code>	<code>/dev/mapper/vg0-images0</code>
LUKS	<code>/dev/mapper/xts_database0</code>	
RAID1	<code>/dev/md0</code>	
Whole disks	<code>/dev/sdb</code>	<code>/dev/sdc</code>

Table 3.23: History of Configuring Whole Disks for Desktop

Version	Configuration
≥ 0.1	user configuration required (see below)

3.3.2.7.1 Whole Disks First, open the case of your desktop PC, and follow the instructions given, in the case manual and the motherboard manual, for installing the pair of 3T HDDs.

Second, boot up and check that the fan is working. Allow 1ks (20 min) for temperatures to settle, then check HDD temperatures by executing:

```
root-shell# aptitude install hddtemp
root-shell# hddtemp /dev/sd[a-c]
```

Figure 3.2: Recommended Disk Configuration of WP-MIRROR 0.5 and earlier versions.

Data	/var/lib/mysql/ibdata0	/var/lib/mediawiki/images/
Filesystem	none	ReiserFS
LVM2	/dev/mapper/vg0-ibdata0	/dev/mapper/vg0-images0
LUKS	/dev/mapper/xts_database0	
RAID1	/dev/md0	
Whole disks	/dev/sdb	/dev/sdc

Third, check each new disk for bad blocks by executing:

```
root-shell# badblocks -c 102400 -o /tmp/badblocks.txt -s -t random -v -w /dev/sdb
root-shell# badblocks -c 102400 -o /tmp/badblocks.txt -s -t random -v -w /dev/sdc
```

Each of the above `badblocks` commands should take about 75ks (21 hours) to run.

Fourth, if you find even one bad block, return the disk(s) and get new ones. Beware, many disks are ‘refurbished’, meaning, a previous user had problems and returned them—and now they are back on the shelf at your computer store.

Note that there will be no need to partition your new disks. So there is no need to run `cfdisk`.

Table 3.24: History of Configuring `mdadm` for Desktop

Version	Configuration
<code>≥ 0.1</code>	user configuration required (see below)

3.3.2.7.2 RAID We use `RAID1` (mirrored) as the next layer.

First, create the mirror by executing:

```
root-shell# aptitude install mdadm
root-shell# mdadm --create /dev/md0 --verbose --level=1 --raid-devices=2 \
--metadata=1.0 --bitmap=internal --name=database0 --auto=md /dev/sdb /dev/sdc
```

where

- `level=1` means `RAID1` (mirrored).
- `raid-devices=2` means the raid set will have two active disks.
- `metadata=1.0` means a version-1 formatted superblock will be placed at the end of each disk. If the array will be larger than 2T, then the `metadata=0.90` (default) will not do.
- `bitmap=internal` means a write-intent log is stored near the superblock. Resync is greatly optimized. A full resync takes about 100ks (1 day) if there is no bitmap.

- `name=database0` means the raid array will have a name. This is possible with the version-1 format superblock.
- `auto=md` means the array will be non-partitionable.
- `/dev/sdb` and `/dev/sdc` are the disks.

Second, check that the RAID array is healthy by executing:

```
root-shell# cat /proc/mdstat
root-shell# mdadm --detail /dev/md0
```

Third, set up the configuration file by executing

```
root-shell# mdadm --detail --scan
root-shell# mdadm --detail --scan >> /etc/mdadm/mdadm.conf
```

Table 3.25: History of Configuring LUKS for Desktop

Version	Configuration
≥ 0.1	user configuration required (see below)

3.3.2.7.3 LUKS Encryption is unnecessary for public information like a set of wikipedias. However, InnoDB stores all tables in a single partition. This means, if you later decide to install any other database-backed service (e.g. `drupal`, `sendmail`, etc.) then its data would be stored together on the same partition. This would be a security hole.

First, create the encrypted block device by executing:

```
root-shell# aptitude install cryptsetup
root-shell# cryptsetup --cipher aes-xts-plain --key-size 512 luksFormat /dev/md0
```

You will be asked for a LUKS passphrase. Choose a phrase that you can remember, but that others will not guess. As a precaution, you may wish to write it down and store it in a safe.

```
root-shell# cryptsetup luksOpen /dev/md0 xts_database0
```

You can (optionally) add up to eight keys to the LUKS partition.

Third, in order to automate the boot process, store a second key in a file in the `/etc/keys/` directory, and set the permissions to deny non-root access, by executing:

```
root-shell# emacs /etc/keys/luks_key_md0
My V3ry S3cr3t P0ssphr@s3
root-shell# chmod 600 /etc/keys/luks_key_md0
root-shell# cryptsetup luksAddKey /dev/md0 /etc/keys/luks_key_md0
```

Take a look at the meta-data by executing:

```
root-shell# cryptsetup luksDump /dev/md0
```

Fourth, to automatically unlock this partition during the `cryptdisks-early` phase of the boot process, edit `/etc/crypttab` to read:

```
#<target dev> <source dev> <key file> <options>
xts_database0 /dev/md0 /etc/keys/luks_key_md0 luks,tries=3
```


Fifth, reboot to test.

Design note.

Keeping the passphrase on `/dev/sda` is not a security hole, if you also encrypt `/dev/sda` (which you should).

Table 3.26: History of Configuring LVM2 for Desktop

Version	Configuration
≥ 0.1	user configuration required (see below)

3.3.2.7.4 LVM2 Next we wish to partition the LUKS partition: 0.3T for `ibdata0`, and the rest (2.7T) for `images`.

```
root-shell# aptitude install lvm2
root-shell# pvcreate /dev/mapper/xts_database0
root-shell# vgcreate vg0 /dev/mapper/xts_database0
root-shell# vgdisplay vg0
root-shell# lvcreate --extents 75000 --name ibdata0 vg0
root-shell# lvcreate --extents 100%FREE --name images0 vg0
root-shell# vgdisplay vg0
root-shell# lvdisplay vg0
```

Extents are 4MB in size, so the logical volume `/dev/mapper/vg0-ibdata0` is about 300G (75,000 x 4MB), while `/dev/mapper/vg0-images0` occupies the rest of the LUKS partition.

Table 3.27: History of Configuring File System for Desktop

Version	Configuration
≥ 0.6	format <code>/dev/vg0/ibdata0</code> and <code>/dev/vg0/images0</code> (see below)
≤ 0.5	format <code>/dev/vg0/images0</code> , leave <code>/dev/vg0/ibdata0</code> raw (see below)

3.3.2.7.5 File System First, set up a modern journalling file system. There are several choices. Some, however, you may wish to avoid:

- `btrfs` is under development (underlying disk format may change),
- `ext2` has no journal, and the file reference counter is only two bytes,
- `ext4` has poor performance,
- `reiser4` is under development, and
- `zfs` is encumbered.

For now, the author recommends ReiserFS.

For WP-MIRROR 0.6 and later versions, also format the second partition by executing:

```
root-shell# aptitude install reiserfsprogs
root-shell# mkfs.reiserfs /dev/vg0/ibdata0
root-shell# mkdir -p /database0/mysql
root-shell# mkfs.reiserfs /dev/vg0/images0
root-shell# mkdir -p /database0/images
```

Second, to automate mounting during the boot process, edit `/etc/fstab` by appending the lines:

```
root-shell# emacs /etc/fstab
/dev/vg0/ibdata0 /database0/mysql reiserfs defaults 0 2
/dev/vg0/images0 /database0/images reiserfs defaults 0 2
```

Third, test the mount procedure by executing:

```
root-shell# mount /database0/mysql
root-shell# chown mysql:mysql /database0/images
root-shell# mount /database0/images
root-shell# chown www-data:www-data /database0/images
```

Fourth, move the database to the new partition and establish a link by executing:

```
root-shell# cd /var/lib/
root-shell# mv /var/lib/mysql/* /database0/mysql/.
root-shell# rmdir mysql
root-shell# ln -s /database0/mysql/ mysql
root-shell# chown -R mysql:mysql /database0/mysql/
```

For WP-MIRROR 0.5 and earlier versions, leave the `/dev/vg0/ibdata0` partition unformatted (raw).

Table 3.28: History of Configuring Raw Partition for Desktop

Version	Configuration
≥ 0.6	obsolete, no user configuration is necessary
≤ 0.5	user configuration required (see below)

3.3.2.7.6 Raw Partition For WP-MIRROR 0.6 and later versions, there is no raw partition.

For WP-MIRROR 0.5 and earlier versions, there is nothing to do just yet. We will discuss this when we [Customize the InnoDB Storage Engine](#) (see below).

3.3.3 Plan Your Database Management System

It is simplest if you start with a clean database.

3.3.3.1 Secure the Database Management System

User configuration is optional (see [§3.2.2.1, Secure the Database Management System](#) above).

3.3.3.2 Load the DBMS `time_zone` Tables

Automated. No user configuration is necessary (see [§3.2.2.2, Load the DBMS `time_zone` Tables](#) above).

3.3.3.3 Customize the InnoDB Storage Engine

Table 3.29: History of Configuring InnoDB Storage Engine for Desktop

Version	Configuration
≥ 0.6	automated, no user configuration is necessary
≤ 0.5	user configuration required (see below)

For WP-MIRROR 0.6 and later versions, no user configuration is necessary (see §3.2.2, [Plan Your Database Management System](#) above).

For WP-MIRROR 0.5 and earlier versions, customization is done as follows:

First, copy `/usr/share/doc/wp-mirror/examples/wp-mirror_desktop.cnf` to `/etc/mysql/conf.d/.`:

```
root-shell# cd /usr/share/doc/wp-mirror/examples/
root-shell# cp wp-mirror_desktop.cnf /etc/mysql/conf.d/.
root-shell# cd /etc/mysql/conf.d/
```

Second, delete the existing log files and `table space`, and restart `MySQL` by executing:

```
root-shell# /etc/init.d/mysql stop
root-shell# rm /var/lib/mysql/ib*
root-shell# /etc/init.d/mysql start
```

Third, edit `/etc/mysql/conf.d/wp-mirror_desktop.cnf` to replace the lines:

```
innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mnewraw
#innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mraw
```

with:

```
#innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mnewraw
innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mraw
```

Fourth, restart `MySQL`.

```
root-shell# /etc/init.d/mysql restart
```

Fifth, confirm that it retains data.

Design note.

WARNING: Creating a new `table space` on the raw partition is a two step process.

1) In `/etc/mysql/conf.d/custom.cnf` the lines

```
innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mnewraw
#innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mraw
```

create the new `table space`—and will do so again and again (with data loss) every time you restart `mysqld`.

2) You must comment the first line, and uncomment the second line, so that they read:

```
#innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mnewraw
innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mraw
```

and restart `mysqld`.

Alternatively, you can try the ‘cut-and-paste’ approach:

First, edit `/etc/mysql/conf.d/wp-mirror_desktop.cnf` to read:

```
[mysqld]
default-time-zone = UTC
default-storage-engine = innodb
character-set-server = utf8
collation-server = utf8_general_ci

# put table space on a disk separate from the log files
innodb_data_home_dir =

# put table space on a raw partition
innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mnewraw
#innodb_data_file_path=/dev/mapper/vg0-ibdata0:300000Mraw
innodb_file_format_check

# increase buffer pool for speed (but fit within 4000M hugepages)
innodb_buffer_pool_size =3998M      # default 128M

# increase size of log files for speed
innodb_log_file_size =250M          # default=5M.

# for Durability (the 'D' in 'ACID compliance')
innodb_flush_log_at_trx_commit = 2 # default 1. (2=write log file once per sec)
sync_binlog = 0                     # default 0.
max_allowed_packet = 64M            # default 16M.

# Enable large page support.  InnoDB will use it automatically
# for its buffer_pool and additional_memory_pool
large-pages

[mysql]
default-character-set = utf8
max_allowed_packet = 64M            # default 16M.
```

Second, delete the existing log files and `table space`, and restart `MySQL` as above.

Third, edit `/etc/mysql/conf.d/wp-mirror_desktop.cnf` as above.

Fourth, restart `MySQL` as above.

Design note. The `large-pages` setting tells `InnoDB` to make use of `hugepages`, which are discussed in §3.3.4, [Plan Your DRAM](#) next.

3.3.4 Plan Your DRAM

All major CPU's organize memory into pages (e.g. for Intel the default page size is 4KB). All major operating systems (OS) have a memory management (MM) algorithm that swaps the least recently used (LRU) pages out to disk.

However, `MySQL`'s `InnoDB` storage engine has its own MM algorithm and uses a page size of 16KB.

There is no need for the OS to swap pages used by `InnoDB`, and actually there is harm in letting the OS do so. Due to the difference in page size (OS 4KB vs. `InnoDB` 16KB), the OS swap algorithm could inadvertently break up `InnoDB` pages whenever other memory intensive processes (e.g. `gm`) run.

Fortunately there is a way to disable OS swapping. Most modern CPU's offer pages of various sizes. Intel offers `hugepages` of 2MB or 4MB (depending on the CPU model), which the OS swap algorithm will leave alone.

To run efficiently, **InnoDB** needs to have a large **innodb-buffer-pool** in DRAM, and it is best to store it on **hugepages**. This is why you should consider buying another 4G of DRAM and configuring that space as **hugepages**. Total installed DRAM should be at least 6G (more is better).

Design note. WP-MIRROR will not let you start mirroring large wikipeidias without first finding adequate physical memory (at least 4G default).

3.3.4.1 Hugepages

Table 3.30: History of Configuring **Hugepages** for Desktop

Version	Configuration
≥ 0.6	allocate 1G, user configuration required (see below)
≤ 0.5	allocate 4G, user configuration required (see below)

For WP-MIRROR 0.6 and later versions, allocate 1G of DRAM as **hugepages** by configuring **/etc/sysctl.conf** by adding the lines:

```
root-shell# emacs /etc/sysctl.conf
vm.nr_hugepages = 512
vm.hugetlb_shm_group = 1001
kernel.shmmax = 1073741824
kernel.shmall = 262144
root-shell# sysctl -p
```

Confirm that **hugepages** have been allocated by executing:

```
shell$ cat /proc/meminfo | grep Huge
```

For WP-MIRROR 0.5 and earlier versions, allocate 4G of DRAM as **hugepages** by configuring **/etc/sysctl.conf** by adding the lines:

```
root-shell# emacs /etc/sysctl.conf
vm.nr_hugepages = 2048
vm.hugetlb_shm_group = 1001
kernel.shmmax = 4294967296
kernel.shmall = 1048576
root-shell# sysctl -p
shell$ cat /proc/meminfo | grep Huge
```

Confirm allocation as above.

If the **hugepages** were *not* allocated, then it may be necessary to **reboot** the system in order to allocate the **hugepages**. Failure to allocate happens when the desktop has been running for some time and the DRAM is fully allocated to other processes.

3.3.4.2 Permissions

Set permissions so that **MySQL** can access the **hugepages** by configuring **/etc/group** by appending the line:

```
hugepage:x:1001:mysql
```

Table 3.31: History of Configuring [Hugepages](#) Permissions for Desktop

Version	Configuration
≥ 0.1	user configuration required (see below)

Table 3.32: History of Configuring [InnoDB](#) Buffer Pool for Desktop

Version	Configuration
≥ 0.6	automated, no user configuration is necessary
≤ 0.5	user configuration required (see below)

3.3.4.3 Buffer Pool

Automatic configuration of the [buffer pool](#) was introduced with WP-MIRROR 0.6. No user configuration is necessary.

For WP-MIRROR 0.5 and earlier versions, you must manually configure [mysql](#) as follows:

Tell [mysqld](#) to use the [hugepages](#) and set [InnoDB](#)'s [buffer pool](#) to fit within the [hugepages](#) by configuring `/etc/mysql/conf.d/custom.cnf` by appending the lines:

```
[mysqld]
innodb_buffer_pool_size=3998M #default=8M.
large-pages
```

This was done above in [§3.3.3.3, Customize the InnoDB Storage Engine](#).

3.3.4.4 Process Limits

Table 3.33: History of Configuring Process Limits for Desktop

Version	Configuration
≥ 0.5	obsolete, no user configuration is necessary
≤ 0.4	user configuration required (see below)

For WP-MIRROR 0.5 and later versions, configuring [mysqld](#) process limits is no longer needed. No user configuration is necessary.

For WP-MIRROR 0.4 and earlier versions, relax [mysqld](#) process limits by configuring `/usr/bin/mysqld_safe` by appending the line:

```
ulimit -l unlimited
```

3.3.5 Plan Your Internet Access

No user configuration is necessary (see [§3.2.4, Plan Your Internet Access](#) above).

3.3.6 Plan Your [MediaWiki](#)

No user configuration is necessary (see [§3.2.5, Plan Your MediaWiki](#) above).

3.3.7 Plan Your Image Processing

No user configuration is necessary (see [§3.2.6, Plan Your Image Processing](#) above).

3.3.8 Plan Your Virtual Host

No user configuration is necessary (see §3.2.7, [Plan Your Virtual Host](#) above).

3.3.9 Plan Your Caching Web Proxy

If your Internet traffic must go through a caching web proxy (e.g. [polipo](#)), you should let your system administrator know what you are up to before you stuff his cache. You may expect problems when you [Download Large Dump Files](#) and when you [Download Millions of Media Files](#) (see below).

3.3.9.1 Download Large Dump Files

The [en wikipedia](#) dump file is about 11G (as of 2014). Some caching web proxies (e.g. [polipo](#)) crash if a file exceeds available memory. A crash blocks web traffic for everyone—not a great way to make friends, even if productivity soars. In this case, the dump file must be manually copied into WP-MIRROR's working directory, `/var/lib/wp-mirror-mediawiki/images/wp-mirror/`. For example, take a laptop off-site, download the dump file, bring the laptop back on-site, and then [scp](#) the dump file to the working directory. Better yet, if you are the system administrator, [ssh](#) to your proxy, run [wget](#) with the `--no-proxy` option, then [scp](#) the downloaded dump file to the WP-MIRROR working directory like so:

```
root-shell# cd /var/lib/wp-mirror-mediawiki/images/wp-mirror/
root-shell# ssh my-proxy
my-proxy# wget --no-proxy http://dumps.wikimedia.org/enwiki/yyyyymmdd/enwiki-
yyyyymmdd-pages-articles.xml.bz2
my-proxy# exit
root-shell# scp -p my-proxy:enwiki-yyyyymmdd-pages-articles.xml.bz2 .
```

Then restart WP-MIRROR. It will find the dump file, and handle matters from there.

3.3.9.2 Download Millions of Media Files

Some caching proxies might not have disk space adequate for caching nearly 3T of media files. Usually `/var/` is mounted on its own partition (and this is highly recommended); and usually a caching web proxy keeps its cache on that partition (e.g. `/var/cache/polipo/`). However, if the `/var/` partition fills up, then no other process will be able to write to that partition. For example,

- **rsyslogd**: [rsyslogd](#) writes its system log files under `/var/log/`. While the loss of log files is not too tragic and would pass unnoticed by most users, it would draw the concern of the system administrator.
- **sendmail**: If, moreover, the system administrator had the poor judgement to install a mail transfer agent (MTA) (e.g. [exim](#), [sendmail](#), etc.) on the same host, then stuffing `/var/` would hold up the mails, and the loss of service would be felt widely. Again, not a great way to make friends.

In this case, the cached media files should be removed each day (perhaps by using a daily [cron](#) job) like this

```
root-shell# killall -USR1 polipo
root-shell# rm -f /var/cache/polipo/dumps.wikimedia.org/*
root-shell# rm -f /var/cache/polipo/upload.wikimedia.org/*
root-shell# killall -USR2 polipo
```

3.3.9.3 Bypass Unreliable Caching Web Proxy

If the caching web proxy is unable to handle your traffic, it may be best to by-pass the caching web proxy altogether. One good method is to use the port-forwarding feature of [SSH](#) to connect to a box that is outside of the network served by the caching web proxy. But try working with your system administrator first.

3.3.9.4 Configure Utilities for Use with Caching Web Proxy

Utility	Configuration
bash	See §3.2.8.1, Configure bash for Use with Caching Web Proxy above.
cURL	See §3.2.8.2, Configure cURL for Use with Caching Web Proxy (Obsolete) above.
wget	See §3.2.8.3, Configure wget for Use with Caching Web Proxy above.
browsers	See §3.2.8.4, Configure Browser for Use with Caching Web Proxy above.

3.4 Virtual Machine Planning and Configuration

With virtual machines we must distinguish between the ‘host machine’ which is physical and the ‘guest machine’ which runs as an application on the host machine. For example:

- **Guest HDD:** The guest machine appears to have an HDD; but this is a single large file, a disk image file, stored on the host’s HDD;
- **Guest processes:** The guest machine appears to run all the processes one expects of a physical machine; but the host machine sees just one process (e.g. [kvm](#)), and this process either emulates the instructions that the guest processes execute, or passes those instructions (perhaps with some rewriting) to the host machine for execution;
- **Guest peripheral devices:** The guest machine appears to have peripheral devices such as a network interface card, a sound card, etc.; but these are also emulated, with the guest machine passing instructions to the host machine, which in turn manages its physical peripheral devices.

3.4.1 Plan Your Disk Space

For the default installation, where you will be building a mirror of the [simple wikipedia](#), the [simple wiktionary](#), and the [wikidata](#), you will need 200G free space on your host HDD. This space on the host HDD will be occupied by a single file which backs the virtual disk of the guest machine.

3.4.2 Plan Your DRAM

Your host machine will need at least 4G DRAM, of which 1.5G DRAM will be occupied by the guest machine (i.e. the [kvm](#) process running on the host machine). The guest machine needs this amount because, it will need 1G for its [mysqld](#) guest process, and 0.5G for all other guest processes.

3.4.3 Trial Run—Round 1

A guest machine that needs no Internet access is quite easy to configure. Let us test this with a Knoppix [ISO](#) image.

First, on the host machine, install [qemu-kvm](#), and create the following [Makefile](#):


```

root@host-5:~# aptitude install qemu-kvm
kmiller@host-5:~$ mkdir knoppix_7.2.0
kmiller@host-5:~$ cd knoppix_7.2.0
kmiller@host-5:~/knoppix-7.2.0$ emacs Makefile
#-----+
# Makefile - virtual machine using KNOPPIX ISO image |
# Copyright (C) 2014 Dr. Kent L. Miller. All rights reserved. |
#-----+

SITE = http://mirrors.kernel.org/knoppix-dvd/
ISO = KNOPPIX_V7.2.0DVD-2013-06-16-EN.iso
KEY = 0x3798E3D757E37087

boot:
    kvm -cdrom $(ISO) -m 256M -boot d -soundhw ac97 \
        -net nic -net tap,ifname=tap0,script=no,downscript=no
wget:
    wget $(SITE)$(ISO)
    wget $(SITE)$(ISO).sha1
    wget $(SITE)$(ISO).sha1.asc
check:
    gpg --recv-keys $(KEY)
    gpg --verify $(ISO).sha1.asc
    sha1sum --check $(ISO).sha1
boot-no-net:
    kvm -cdrom $(ISO) -m 256M -boot d -soundhw ac97
clean:
    rm -f *~

```

Second, on the host machine, download the [ISO](#) image by executing:

```
kmiller@host-5:~/knoppix-7.2.0$ make wget
```

Third, on the host machine, check the authenticity and integrity of the [ISO](#) image by executing:

```

kmiller@host-5:~/knoppix-7.2.0$ make check
gpg --recv-keys 0x3798E3D757E37087
...
gpg: key 0x3798E3D757E37087: public key "Klaus Knopper <knopper@knopper.net>" imported
...
gpg --verify KNOPPIX_V7.2.0DVD-2013-06-16-EN.iso.sha1.asc
...
gpg: Good signature from "Klaus Knopper <knopper@knopper.net>" [unknown]
...
sha1sum --check KNOPPIX_V7.2.0DVD-2013-06-16-EN.iso.sha1
KNOPPIX_V7.2.0DVD-2013-06-16-EN.iso: OK

```

Fourth, on the host machine, create the guest machine by executing:

```

kmiller@host-5:~/knoppix-7.2.0$ make boot-no-net
kvm -cdrom KNOPPIX_V7.2.0DVD-2013-06-16-EN.iso -m 256M -boot d -soundhw ac97

```

A window will open up on your host PC's desktop, and inside of this window, you will see the Knoppix live DVD boot up, display its own desktop, and emit an audio flourish. This guest machine will have no network access.

Attempting to gain Internet access will fail at this point, for lack of a `tap` device on the host machine.

```
kmliller@host-5:~/knoppix-7.2.0$ make boot
kvm -cdrom KNOPPIX_V7.2.0DVD-2013-06-16-EN.iso -m 256M -boot d -soundhw ac97 \
-net nic -net tap,ifname=tap0,script=no,downscript=no
kvm: -net tap,ifname=tap0,script=no,downscript=no: could not configure
/dev/net/tun (tap0): Operation not permitted
kvm: -net tap,ifname=tap0,script=no,downscript=no: Device 'tap' could not be
initialized
```

This we shall remedy. See §3.4.4, [Plan Your Internet Access](#).

3.4.4 Plan Your Internet Access

To establish a connection between your guest machine and host machine (and the Internet), a number of delicate steps must be followed. Here we show how to do it for an home network.

The main idea is this: if we invest some effort in planning and configuring both a router and an host; then, thanks to the technology of [IPv6](#) stateless autoconfiguration, network access for guest machines will be automatically configured ‘out-of-the-box’.

3.4.4.1 Obtain IPv6 Prefix

In the case of an home, an Internet Service Provider (ISP) usually offers [IPv4](#) service only. To obtain [IPv6](#) service in this situation, you need to install the SixXS Automatic [IPv6](#) Connectivity Client Utility, `aiccu`. But, for this to work, “a SixXS account or an account of another supported tunnel broker and at least one tunnel are required. These can be freely requested from the SixXS website at no cost. For more information about SixXS check their homepage.” See <https://www.sixxs.net/>.

3.4.4.2 Configure Router–WAN Side

In the case of an home, an Internet Service Provider (ISP) usually offers [IPv4](#) service only; and the [IPv4](#) address is assigned by a `dhcp` server. Therefore, to configure the router’s WAN side, you will need a `dhcp` client and `aiccu`, both of which run as daemons on your router. See [Figure 3.3, Recommended Configuration of Router](#).

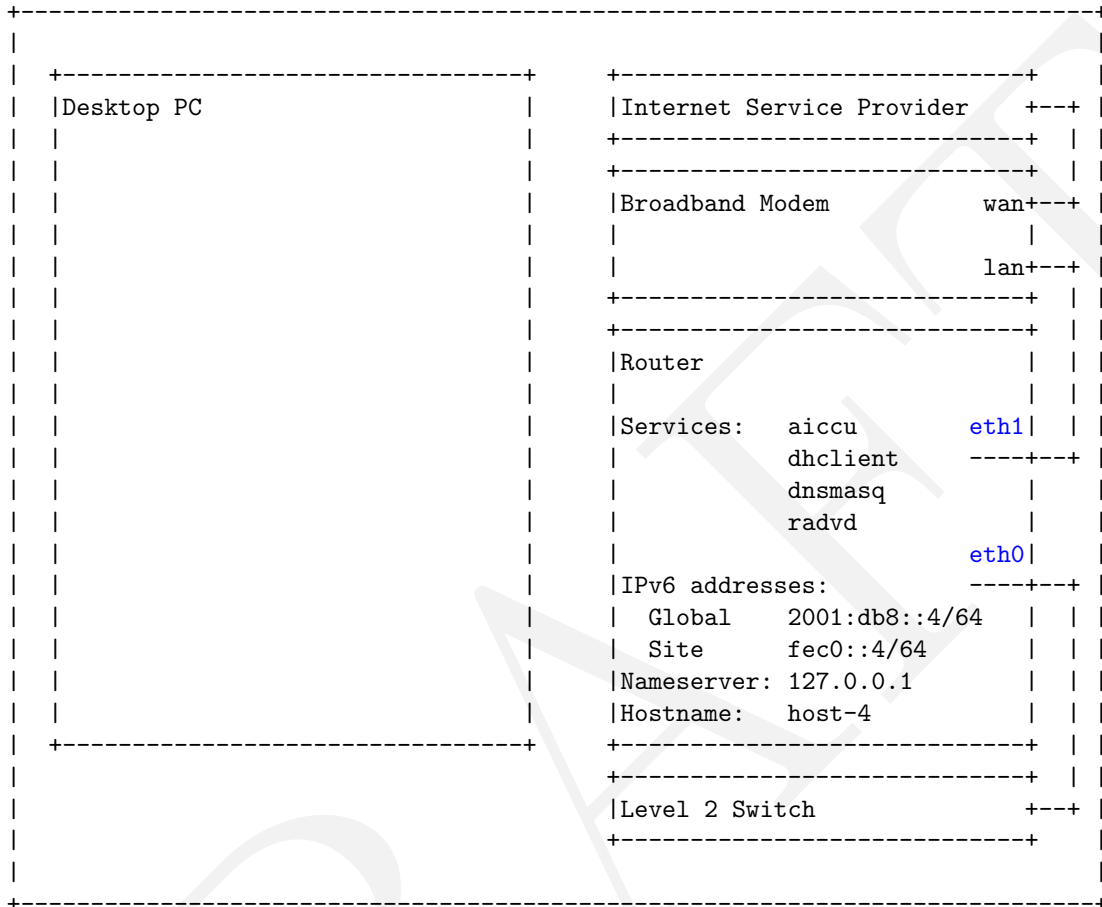
3.4.4.2.1 `dhclient` To set up a `dhcp` client: First install `dhclient` by executing:

```
root@host-4:~# aptitude install isc-dhcp-client
```

This daemon should be correctly configured ‘out-of-the-box’. When the ISP’s `dhcp` server grants a lease to `dhclient`, it should also provide all other the necessary information, such as the addresses of domain name servers.

3.4.4.2.2 `aiccu` Once you have an account with a tunnel broker (e.g. SixXS), and have been provided with at least one tunnel, you will want to establish [IPv6](#) connectivity. To do this: First, edit `/etc/hosts` to resolve tunnel names:

Figure 3.3: Recommended Configuration of Router



```

root@host-4:~# cat /etc/hosts
# The following lines are desirable for IPv6 capable hosts
::1          localhost loopback
fe00::0      localnet

# Multicast addresses
ff00::0      mcastprefix
ff02::1      allnodes
ff02::2      allrouters
ff02::3      allhosts

# Scope: Host (needed for #hostname -f and #dnsdomainname -v)
127.0.0.1    host-4.local      host-4

# Scope: Site local
fec0::4      host-4.local      host-4
fec0::5      host-5.local      host-5

# Tunnel - sixxs.net
66.117.47.228      tunnel-server
2001:4830:1600:2ab::1      tunnel-pop-end      tunnel-far
2001:4830:1600:2ab::2      tunnel-my-end      tunnel-near

```

This is useful because, in the event that IPv6 connectivity fails, you will want to look for the cause by executing:

```
root@host-4:~# ping -c 1 tunnel-server
root@host-4:~# ping6 -c 1 tunnel-my-end
root@host-4:~# ping6 -c 1 tunnel-pop-end
```

Second, install the tunnel client `aiccu` by executing:

```
root@host-4:~# aptitude install aiccu
```

Third, configure `aiccu` by editing `/etc/aiccu.conf` to reflect your tunnel broker account information:

```
root@host-4:~# cat /etc/aiccu.conf
username abcd-SIXXS
password *****
protocol tic
server tic.sixxs.net
tunnel_id T12345
# AICCU Configuration

# Login information (defaults: none)
#username <your nichandle/username>
#password <your password>

# Protocol and server to use for setting up the tunnel (defaults: none)
#protocol <tic|tsp|l2tp>
#server <server to use>

# Interface names to use (default: aiccu)
# ipv6_interface is the name of the interface that will be used as a tunnel interface.
# On *BSD the ipv6_interface should be set to gifX (eg gif0) for proto-41 tunnels
# or tunX (eg tun0) for AYIYA tunnels.
ipv6_interface sixxs

# The tunnel_id to use (default: none)
# (only required when there are multiple tunnels in the list)
#tunnel_id Txxxx

# Be verbose? (default: false)
verbose false

# Daemonize? (default: true)
# Set to false if you want to see any output
# When true output goes to syslog
#
# WARNING: never run AICCU from DaemonTools or a similar automated
# 'restart' tool/script. When AICCU does not start, it has a reason
# not to start which it gives on either the stdout or in the (sys)log
# file. The TIC server *will* automatically disable accounts which
# are detected to run in this mode.
#
daemonize true

# Automatic Login and Tunnel activation?
automatic true
```

```
# Require TLS?
# When set to true, if TLS is not supported on the server
# the TIC transaction will fail.
# When set to false, it will try a starttls, when that is
# not supported it will continue.
# In any case if AICCU is build with TLS support it will
# try to do a 'starttls' to the TIC server to see if that
# is supported.
requiretls false

# PID File
#pidfile /var/run/aiccu.pid

# Add a default route (default: true)
#defaultroute true

# Script to run after setting up the interfaces (default: none)
#setupscript /usr/local/etc/aiccu-subnets.sh

# Make heartbeats (default true)
# In general you don't want to turn this off
# Of course only applies to AYIYA and heartbeat tunnels not to static ones
#makebeats true

# Don't configure anything (default: false)
noconfigure true

# Behind NAT (default: false)
# Notify the user that a NAT-kind network is detected
behindnat true

# Local IPv4 Override (default: none)
# Overrides the IPv4 parameter received from TIC
# This allows one to configure a NAT into "DMZ" mode and then
# forwarding the proto-41 packets to an internal host.
#
# This is only needed for static proto-41 tunnels!
# AYIYA and heartbeat tunnels don't require this.
#local_ipv4_override
```

3.4.4.3 Configure Router-LAN Side

A level 2 switch is usually attached to the LAN side of a router. Hosts attached to this switch will need a way to obtain the [IPv6](#) address of the router, and a way to obtain the [IPv6](#) address of a domain name server.

Therefore, to configure the router's LAN side, you will need an [IPv6](#) router advertisement daemon, and a recursive domain name server, such as [dnsmasq](#), both of which run as daemons on your router. See [Figure 3.3, Recommended Configuration of Router](#).

3.4.4.3.1 [dnsmasq](#) On your router, it is useful to install a recursive domain name server such as [dnsmasq](#). Repeated requests to resolve the same domain name can be answered out of the [dnsmasq](#) cache rather than passed upstream to the ISP's name servers; and [dnsmasq](#) can answer some requests by reading the router's `/etc/hosts` file.

First, on the router, install [dnsmasq](#) by executing:

```
root@host-4:~# aptitude install dnsmasq
```

This should be configured ‘out-of-the-box’. The IP addresses of the ISP’s domain name servers, should be provided automatically by way of `dhcp`, as mentioned above.

3.4.4.3.2 `radvd` We shall make use of “IPv6 stateless autoconfiguration.” This works as follows:

1. When an host is attached to a link, it multicasts a router solicitation (RS);
2. a router running the IPv6 Router ADvertisement Daemon, `radvd`, replies with a router advertisement (RA);
3. the host, seeing the router advertisement, will automatically configure its IPv6 routing table; and
4. if the host is also running the IPv6 Recursive DNS Service Discover Daemon, `rdnssd`, and has the `resolvconf` utility installed, then the host name resolver will be automatically configured as well.

To do this: First, on the router, install `radvd` by executing:

```
root@host-4:~# aptitude install radvd
```

Second, on the router, edit `/etc/radvd.conf` to read:

```
root@host-4:~# cat /etc/radvd.conf
# LAN side of the router.
interface eth0
{
    IgnoreIfMissing on;
    AdvSendAdvert on;
    prefix 2001:db8::/64
    {
        AdvOnLink on;
        AdvAutonomous on;
    };
    #      dnsmasq nscache.us.sixxs.net nscache.us.sixxs.net
    RDNSS fec0::4 2001:4de0:1000:a3::2 2001:4de0:1000:a4::2
    {
    };
};
```

Note that the IPv6 addresses of two additional name servers (from SixXS) have also been configured, and will be provided to LAN side hosts by way of router advertisements.

Third, on the router, reload `radvd` by executing:

```
root@host-4:~# /etc/init.d/radvd reload
Reloading radvd configuration files.
```

3.4.4.4 Configure Router Security

3.4.4.4.1 `/etc/hosts` There are great numbers of sites that you should avoid. Some are hit counters. Some infringe your privacy by tracking your web browsing. Some are known to offer malware. Some sites may offend a cleric. Some display advertising banners that consume bandwidth and detract from your browsing experience.

To these sites, you should never send a packet. Indeed, you should block them. To do this: First, on the router, download and append `HOSTS.zip` as follows:

```
kmiller@host-4:~$ wget http://bluetack.co.uk/bims/blacklists/HOSTS.zip
root@host-4:~# zcat HOSTS.zip >> /etc/hosts
```

Second, on the router, confirm that `/etc/hosts` now resolves these names to the localhost, as follows:

```
root@host-4:~# less /etc/hosts
#BIMS HOSTS FILE      20140123      http://bluetack.co.uk
127.0.0.1      localhost
127.0.0.1      0-29.com
127.0.0.1      0-2u.com
127.0.0.1      0-days.net
127.0.0.1      0-free-porn-0.com
...
kmiller@host-4:~$ ping -c 1 0-29.com
PING 0-29.com (127.0.0.1) 56(84) bytes of data.
64 bytes from localhost (127.0.0.1): icmp_req=1 ttl=64 time=0.059 ms

--- 0-29.com ping statistics ---
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.059/0.059/0.059/0.000 ms
```

3.4.4.4.2 PeerGuardian Linux There are great numbers of IPv4 addresses that you should avoid. Some addresses have no owner. Some sites are known to be compromised. Some are known to offer malware. Some are corporate, government, or other sites for which there is no good reason to communicate.

For these addresses, you should neither receive nor send packets. Indeed, you should block them. To do this: First, on the router, install PeerGuardian Linux by executing:

```
root@host-4:~# aptitude install pglld pglcmd
```

This works ‘out-of-the-box’. If you wish to communicate with an address that is blocked, then append it to `/etc/pgl/allow.p2p` as follows:

```
root@host-4:~# emacs /etc/pgl/allow.p2p
# allow.p2p - allow list for pglcmd
#
# This file contains IP ranges that shall not be checked.
# They must be in the PeerGuardian .p2p text format like this      :
#   Some organization      :1.0.0.0-1.255.255.255
# This is also true if your blocklists are in another format.
# Lines beginning with a hash (#) are comments and will be ignored.
#
# Do a "pglcmd restart" when you have edited this file.
dcwater.com      :4.21.70.9
root@host-4:~# pglcmd restart
```

3.4.4.4.3 iptables It is good security practice to close all unused ports. Most of the security risks are transported by IPv4. Therefore, we do not want any IPv4 traffic on the LAN side, and so we shall block IPv4 packet forwarding. Note that the IPv4 and IPv6 netfilters are configured separately.

To configure the IPv4 netfilter: First, on the router, configure `iptables` as follows:

```
kmliller@host-4:~$ cat /etc/network/if-pre-up.d/iptables-active
#!/bin/sh

# iptables-active - IP Firewall script (Linux 2.6.x, iptables) for router.
# Based on "Iptables Tutorial 1.2.2," Oskar Andreasson.
# Copyright (C) 2010,2014 Dr. Kent L. Miller. All rights reserved.

#-----
# 0. Connection
# eth0 - level 2 switch - internal network
# eth1 - wireless access point - cable modem - internet service provider
# sixxs0 - ipv6 tunnel provider

#-----
# 1. Configuration options

IPTABLES="/sbin/iptables"
IP6TUNNEL="66.117.47.228" # usqas01.sixxs.net (6in4 tunnel server)

#-----
# 2. Module loading (should load automatically)

#-----
# 3. /proc setup (Not needed for router. Used for forwarding and dhcpd)

#-----
# 4. Rules setup
# 4.1. Filter table (this is the only one needed for firewalling a PC)
# 4.1.1. Set Policies

# Reset

$IPTABLES -F # Flush all rules in all chains in the filter table
$IPTABLES -X # Delete all user-defined chains in the filter table
$IPTABLES -Z # Zero all packet/byte counters in the filter table

# Establish policy

$IPTABLES -P INPUT DROP # Block all inbound traffic
$IPTABLES -P FORWARD DROP # Block all forward traffic
$IPTABLES -P OUTPUT DROP # Block all outbound traffic
```


4.1.2. Create user specified chains

```
$IPTABLES -N icmp_packets
$IPTABLES -N other_packets
$IPTABLES -N tcp_packets_bad
$IPTABLES -N packets_conntrack
$IPTABLES -N tcp_packets_allow
$IPTABLES -N tcp_packets_ssh
$IPTABLES -N tcp_packets_in
$IPTABLES -N udp_packets_in
$IPTABLES -N tcp_packets_out
$IPTABLES -N udp_packets_out
```

4.1.3. Create content in user specified chains

```
#-----
# Allow loopback traffic

$IPTABLES -A INPUT -i lo -j ACCEPT
$IPTABLES -A OUTPUT -o lo -j ACCEPT
```

```
#-----other-packets-----
$IPTABLES -A other_packets -p ipv6 -s $IP6TUNNEL -j ACCEPT # proto-41
$IPTABLES -A other_packets -p ipv6 -d $IP6TUNNEL -j ACCEPT # proto-41
$IPTABLES -A other_packets ! -i lo -d 127.0.0.0/8 -j DROP
$IPTABLES -A other_packets -d 0.0.0.0/8 -j DROP
$IPTABLES -A other_packets -d 172.16.0.0/12 -j DROP
$IPTABLES -A other_packets -d 10.0.0.0/8 -j DROP
$IPTABLES -A other_packets -p sctp -j DROP # Stream Ctl
$IPTABLES -A other_packets -p ah -j DROP # IPsec
$IPTABLES -A other_packets -p esp -j DROP # IPsec
$IPTABLES -A other_packets -d 224.0.0.0/8 -j DROP # MS Multicast
```

```
#-----icmp-packets-----
$IPTABLES -A icmp_packets -p icmp -s 0/0 --icmp-type 11 -j ACCEPT # TTL=0
$IPTABLES -A icmp_packets -p icmp -s 0/0 ! --icmp-type 8 -j ACCEPT
# In event of PING flood, drop any in excess of limit.
$IPTABLES -A icmp_packets -p icmp -s 0/0 --icmp-type 8 -m limit --limit 1/sec --limit-burst 2 -j A
#$IPTABLES -A icmp_packets -p icmp -j LOG --log-prefix "IPv4 ping-flood over-limit: "
$IPTABLES -A icmp_packets -p icmp -j DROP
```

```
#-----tcp-packets-bad-----
# Note: The SYN,ACK AND NEW rule must stand before the NEW NOT SYN rule.
# 1) SYN,ACK AND NEW helps victim of spoofing attack that uses my IP address.
$IPTABLES -A tcp_packets_bad -p tcp --tcp-flags SYN,ACK SYN,ACK -m state --state NEW -j REJECT --re
# 2) NEW NOT SYN prevents bad tcp connection attempts.
#$IPTABLES -A tcp_packets_bad -p tcp ! --syn -m state --state NEW -j LOG --log-prefix "IPv4 new not
$IPTABLES -A tcp_packets_bad -p tcp ! --syn -m state --state NEW -j DROP
# 3) Port scan
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags ACK,FIN FIN -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags ACK,PSH PSH -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags ACK,URG URG -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags FIN,RST FIN,RST -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags SYN,FIN SYN,FIN -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags SYN,RST SYN,RST -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags ALL ALL -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags ALL NONE -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags ALL FIN,PSH,URG -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags ALL SYN,FIN,PSH,URG -j DROP
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags ALL SYN,RST,ACK,FIN,URG -j DROP
```

```
# 4) Log if entry in the /proc/net/nf_conntrack times out.
$IPTABLES -A tcp_packets_bad -p tcp --tcp-flags SYN,ACK,PSH,FIN ACK,PSH,FIN -m state --state NEW -j
# 5) Throttle the following (not really bad) packets
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags SYN,RST,ACK SYN -m limit --limit 3/sec -j RE
$IPTABLES -A tcp_packets_bad -p tcp -m tcp --tcp-flags FIN,SYN,RST,ACK RST -m limit --limit 1/sec -
```

```
#-----packets-conntrack-----
$IPTABLES -A packets_conntrack -m state --state ESTABLISHED,RELATED -j ACCEPT
#$IPTABLES -A packets_conntrack -m state --state INVALID -j LOG --log-prefix "IPv4 invalid: "
$IPTABLES -A packets_conntrack -m state --state INVALID -j DROP
```

```
#-----tcp-packets-allow-----
$IPTABLES -A tcp_packets_allow -p tcp -m tcp --syn -m limit --limit 1/s --limit-burst 20 -j ACCEPT
$IPTABLES -A tcp_packets_allow -j LOG --log-prefix "IPv4 syn-flood over-limit: "
$IPTABLES -A tcp_packets_allow -j DROP
```

```
#-----tcp-packets-ssh-----
# Limit rate of connection to SSH to block dictionary attacks
# This allows up to 3 connections per minute. Any more than that are
# blocked and logged. Waiting 20 seconds before retrying the connection
# attempt makes it work again.
$IPTABLES -A tcp_packets_ssh -p tcp -m tcp --dport 22 -m limit --limit 3/min --limit-burst 3 -j ACC
$IPTABLES -A tcp_packets_ssh -j LOG --log-prefix "IPv4 ssh over-limit: "
$IPTABLES -A tcp_packets_ssh -j DROP
```

```
#-----tcp-packets-in-----
# Block the following services to prevent swamping the log files
#      +----tor-relay----+ +--tor-socks--+
DPORTS="9001 9030 9090 9091 9050 9051 9100"
for port in $DPORTS; do
    $IPTABLES -A tcp_packets_in -p tcp -m tcp --dport $port -j DROP
done
# Limit rate of connection to SSH to block dictionary attacks
$IPTABLES -A tcp_packets_in -p tcp -m tcp --dport 22 -m state --state NEW -j tcp_packets_ssh
# Allow connections to the following services
#      whois dns http https rsync mysql  tic mdns   torrent  traceroute
DPORTS=" 43 53 80 443 873 3306 3874 5353 6881:6999 33434:33534"
for port in $DPORTS; do
    $IPTABLES -A tcp_packets_in -p tcp -m tcp --dport $port -m state --state NEW -j RETURN
done
```

```
#-----udp-packets-in-----
# Block the following services to prevent swamping the log files
#      NetBIOS
DPORTS="135:139"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_in -p udp -m udp --dport $port -j DROP
done
# Allow the following services
#      dns  dhcp ntp rsync mysql heartbeat bt-tracker ayiya mdns  traceroute
DPORTS=" 53 67:68 123 873 3306 3740 4444 5072 5353 33434:33534"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_in -p udp -m udp --dport $port -j ACCEPT
done
$IPTABLES -A udp_packets_in -p udp -m udp --sport 5072 -j ACCEPT
```

```
#-----tcp-packets-out-----
# Block the following services
#      smtp mtp nntp NetBIOS NetBIOS kazaa dict +eDonkey+ gnutella +--irc--+ napster
DPORTS=" 25 57 119 135:139 445 1214 2628 4661:4666 6346:6429 6660:6667 6699"
for port in $DPORTS; do
    $IPTABLES -A tcp_packets_out -p tcp -m tcp --dport $port -j DROP
done
# Allow the following services
#      ssh whois dns http https submission rsync imaps mysql  tic mdns +-----torrent-----+ t
DPORTS=" 22 43 53 80 443 587 873 993 3306 3874 5353 2710 3310 6881:6999 8888 90
for port in $DPORTS; do
    $IPTABLES -A tcp_packets_out -p tcp -m tcp --dport $port -j ACCEPT
done
```

```
#-----udp-packets-out-----
# Block the following services
#      nntp NetBIOS NetBIOS +-talk+ kazaa dict   eDonkey  gnutella napster
DPORTS=" 119 135:139      445 517:518 1214 2628 4661:4666 6346:6429   6699"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_out -p udp -m udp --dport $port -j DROP
done
# Allow the following services
#      dns  dhcp http ntp  rsync imaps mysql heartbeat ayiya +-bttrack mdns  tor   hkp  traceroute
DPORTS=" 53 67:68   80 123   873   993 3306      3740 5072 2710 4444 5353 9001 11371 33434:33534"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_out -p udp -m udp --dport $port -j ACCEPT
done
```

4.1.4. INPUT chain

```
#-----INPUT-----
$IPTABLES -A INPUT -i eth0                -j other_packets
$IPTABLES -A INPUT -i eth0 -p icmp          -j icmp_packets
$IPTABLES -A INPUT -i eth0 -p tcp           -j tcp_packets_bad
$IPTABLES -A INPUT -i eth0                -j packets_conntrack
$IPTABLES -A INPUT -i eth0 -p tcp           -j tcp_packets_in
$IPTABLES -A INPUT -i eth0 -p tcp           -j tcp_packets_allow
$IPTABLES -A INPUT -i eth0 -p udp           -j udp_packets_in
$IPTABLES -A INPUT -i eth1                -j other_packets
$IPTABLES -A INPUT -i eth1 -p icmp          -j icmp_packets
$IPTABLES -A INPUT -i eth1 -p tcp           -j tcp_packets_bad
$IPTABLES -A INPUT -i eth1 -p tcp -m tcp --dport 22 -m state --state NEW -j DROP
$IPTABLES -A INPUT -i eth1                -j packets_conntrack
$IPTABLES -A INPUT -i eth1 -p tcp           -j tcp_packets_in
$IPTABLES -A INPUT -i eth1 -p tcp           -j tcp_packets_allow
$IPTABLES -A INPUT -i eth1 -p udp           -j udp_packets_in
$IPTABLES -A INPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv4 input packet di
```

4.1.5. FORWARD chain (no forwarding for IPv4)

4.1.6. OUTPUT chain

```
#-----OUTPUT-----
$IPTABLES -A OUTPUT -o eth0                -j other_packets
$IPTABLES -A OUTPUT -o eth0 -p icmp          -j icmp_packets
$IPTABLES -A OUTPUT -o eth0 -p tcp           -j tcp_packets_bad
$IPTABLES -A OUTPUT -o eth0                -j packets_conntrack
$IPTABLES -A OUTPUT -o eth0 -p tcp           -j tcp_packets_out
$IPTABLES -A OUTPUT -o eth0 -p tcp -m state --state NEW -j ACCEPT
$IPTABLES -A OUTPUT -o eth0 -p udp           -j udp_packets_out
$IPTABLES -A OUTPUT -o eth1                -j other_packets
$IPTABLES -A OUTPUT -o eth1 -p icmp          -j icmp_packets
$IPTABLES -A OUTPUT -o eth1 -p tcp           -j tcp_packets_bad
$IPTABLES -A OUTPUT -o eth1 -p tcp -m tcp --dport 22 -m state --state NEW -j DROP
$IPTABLES -A OUTPUT -o eth1                -j packets_conntrack
$IPTABLES -A OUTPUT -o eth1 -p tcp           -j tcp_packets_out
$IPTABLES -A OUTPUT -o eth1 -p tcp -m state --state NEW -j ACCEPT
$IPTABLES -A OUTPUT -o eth1 -p udp           -j udp_packets_out
$IPTABLES -A OUTPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv4 output packet
```

```
# 4.2. nat table
# 4.2.1. Set policies
# 4.2.2. Create user specified chains
# 4.2.3. Create content in user specified chains
# 4.2.4. PREROUTING chain
# 4.2.5. POSTROUTING chain
# 4.2.6. OUTPUT chain
# 4.3. mangle table
# 4.3.1. Set policies
# 4.3.2. Create user specified chains
# 4.3.3. Create content in user specified chains
# 4.3.4. PREROUTING chain
# 4.3.5. INPUT chain
# 4.3.6. FORWARD chain
# 4.3.7. OUTPUT chain
# 4.3.8. POSTROUTING chain
```

Second, on the router, load `iptables` by executing:

```
root@host-4:~# chmod 755 /etc/network/if-pre-up.d/iptables-active
root@host-4:~# /etc/network/if-pre-up.d/iptables-active
root@host-4:~# iptables-save | less
# Generated by iptables-save v1.4.14 on Fri Jan 24 19:37:35 2014
*filter
:INPUT DROP [0:0]
:FORWARD DROP [0:0]
:OUTPUT DROP [0:0]
...
```

3.4.4.4.4 `ip6tables` It is good security practice to close all unused ports. Note that the `IPv4` and `IPv6` netfilters are configured separately. First, configure `ip6tables` as follows:

```
#!/bin/sh

# ip6tables-active - IP Firewall script (Linux 2.6.x, iptables) for router.
# Based on "Iptables Tutorial 1.2.2," Oskar Andreasson.
# Copyright (C) 2010,2014 Dr. Kent L. Miller. All rights reserved.

#-----
# 0. Connection
# eth0 - level 2 switch - internal network
# eth1 - wireless access point - cable modem - internet service provider
# sixxs0 - tunnel to IPv6 provider

#-----
# 1. Configuration options

IPTABLES="/sbin/ip6tables"
SUBNET="2001:db8::/64" # assigned to me from <http://www.sixxs.net>

#-----
# 2. Module loading (should load automatically)
```

```
#-----
# 3. /proc setup (router should not accept router advertisements)
```

```
#echo 0 > /proc/sys/net/ipv6/conf/eth0/autoconf
#echo 0 > /proc/sys/net/ipv6/conf/eth0/accept_ra
#echo 0 > /proc/sys/net/ipv6/conf/eth0/accept_ra_defrtr
#echo 0 > /proc/sys/net/ipv6/conf/eth0/accept_ra_rtr_pref
#echo 0 > /proc/sys/net/ipv6/conf/eth0/accept_ra_pinfo
echo 0 > /proc/sys/net/ipv6/conf/eth1/autoconf
echo 0 > /proc/sys/net/ipv6/conf/eth1/accept_ra
echo 0 > /proc/sys/net/ipv6/conf/eth1/accept_ra_defrtr
echo 0 > /proc/sys/net/ipv6/conf/eth1/accept_ra_rtr_pref
echo 0 > /proc/sys/net/ipv6/conf/eth1/accept_ra_pinfo
```

```
#-----
# 4. Rules setup
# 4.1. Filter table (this is the only one needed for firewalling a PC)
# 4.1.1. Set Policies
```

```
# Reset
```

```
$IPTABLES -F          # Flush  all rules in all chains in the filter table
$IPTABLES -X          # Delete all user-defined chains in the filter table
$IPTABLES -Z          # Zero   all packet/byte counters in the filter table
```

```
# Establish policy
```

```
$IPTABLES -P INPUT    DROP      # Block all inbound traffic
$IPTABLES -P FORWARD DROP      # Block all forward traffic
$IPTABLES -P OUTPUT   DROP      # Block all outbound traffic
```

```
# 4.1.2. Create user specified chains
```

```
$IPTABLES -N ipv6_icmp_packets
$IPTABLES -N packets_conntrack
$IPTABLES -N tcp_packets_allow
$IPTABLES -N tcp_packets_ssh
$IPTABLES -N tcp_packets_in
$IPTABLES -N udp_packets_in
$IPTABLES -N tcp_packets_out
$IPTABLES -N udp_packets_out
```

```
# 4.1.3. Create content in user specified chains
```

```
#-----
# Allow loopback traffic
```

```
$IPTABLES -A INPUT  -i lo -j ACCEPT
$IPTABLES -A OUTPUT -o lo -j ACCEPT
```

```
#-----ipv6-icmp-packets-----
$IPTABLES -A ipv6_icmp_packets -p ipv6-icmp          -j ACCEPT
```

```
#-----packets-contrack-----
$IPTABLES -A packets_contrack -m state --state ESTABLISHED,RELATED -j ACCEPT
#$IPTABLES -A packets_contrack -m state --state INVALID -j LOG --log-prefix "IPv6 invalid: "
$IPTABLES -A packets_contrack -m state --state INVALID -j DROP
```

```
#-----tcp-packets-allow-----
$IPTABLES -A tcp_packets_allow -p tcp -m tcp --syn -m limit --limit 1/s --limit-burst 20 -j ACCEPT
$IPTABLES -A tcp_packets_allow -j LOG --log-prefix "IPv6 syn-flood over-limit: "
$IPTABLES -A tcp_packets_allow -j DROP
```

```
#-----tcp-packets-ssh-----
# Limit rate of connection to SSH to block dictionary attacks
# This allows up to 3 connections per minute. Any more than that are
# blocked and logged. Waiting 20 seconds before retrying the connection
# attempt makes it work again.
$IPTABLES -A tcp_packets_ssh -p tcp -m tcp --dport 22 -m limit --limit 3/min --limit-burst 3 -j ACC
$IPTABLES -A tcp_packets_ssh -j LOG --log-prefix "IPv6 ssh over-limit: "
$IPTABLES -A tcp_packets_ssh -j DROP
```

```
#-----tcp-packets-in-----
# Block the following services to prevent swamping the log files
# +----tor-relay----+ +--tor-socks--+
DPORTS="9001 9030 9090 9091 9050 9051 9100"
for port in $DPORTS; do
    $IPTABLES -A tcp_packets_in -p tcp -m tcp --dport $port -j DROP
done
# Limit rate of connection to SSH to block dictionary attacks
$IPTABLES -A tcp_packets_in -p tcp -m tcp --dport 22 -m state --state NEW -j tcp_packets_ssh
# Allow connections to the following services
# whois dns http https rsync mysqld tic nuttcp mdns torrent traceroute
DPORTS=" 43 53 80 443 873 3306 3874 5000:5001 5353 6881:6999 33434:33534"
for port in $DPORTS; do
    $IPTABLES -A tcp_packets_in -p tcp -m tcp --dport $port -m state --state NEW -j RETURN
done
```

```
#-----udp-packets-in-----
# Block the following services to prevent swamping the log files
# NetBIOS
DPORTS="135:139"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_in -p udp -m udp --dport $port -j DROP
done
# Allow the following services
# dns dhcp ntp rsync mysqld heartbeat bt-tracker ayiya mdns traceroute
DPORTS=" 53 67:68 123 873 3306 3740 4444 5072 5353 33434:33534"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_in -p udp -m udp --dport $port -j ACCEPT
done
```

```
#-----tcp-packets-out-----
# Allow the following services
#      ssh whois dns http https submission rsync imaps mysqld tic      nuttcp mdns +-----torrent
DPORTS=" 22    43 53  80  443      587  873  993  3306 3874 5000:5001 5353 2710 3310 6881:6
for port in $DPORTS; do
    $IPTABLES -A tcp_packets_out -p tcp -m tcp --dport $port -j ACCEPT
done
$IPTABLES -A tcp_packets_out -p tcp                                -j RETURN
```

```
#-----udp-packets-out-----
# Block the following services
#      nntp NetBIOS NetBIOS +-talk+ kazaa dict   eDonkey gnutella napster
DPORTS=" 119 135:139      445 517:518 1214 2628 4661:4666 6346:6429  6699"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_out -p udp -m udp --dport $port -j DROP
done
# Allow the following services
#      dns  dhcp ntp rsync imaps mysqld heartbeat bttrack ayiya mdns  tor   hkp  traceroute tracep
DPORTS=" 53 67:68 123  873  993  3306      3740  4444  5072 5353 9001 11371 33434:33534  44
for port in $DPORTS; do
    $IPTABLES -A udp_packets_out -p udp -m udp --dport $port -j ACCEPT
done
```

4.1.4. INPUT chain

```
#-----INPUT-----
$IPTABLES -A INPUT -m rt --rt-type 0                                -j REJECT
$IPTABLES -A INPUT -i eth0 -p ipv6-icmp                          -j ipv6_icmp_packets
$IPTABLES -A INPUT -i eth0                                         -j packets_conntrack
$IPTABLES -A INPUT -i eth0 -p tcp                                 -j tcp_packets_in
$IPTABLES -A INPUT -i eth0 -p tcp                                 -j tcp_packets_allow
$IPTABLES -A INPUT -i eth0 -p udp                                 -j udp_packets_in
$IPTABLES -A INPUT -i sixxs+ -p ipv6-icmp                        -j ipv6_icmp_packets
$IPTABLES -A INPUT -i sixxs+                                       -j packets_conntrack
$IPTABLES -A INPUT -i sixxs+ -p tcp                               -j tcp_packets_in
$IPTABLES -A INPUT -i sixxs+ -p tcp                               -j tcp_packets_allow
$IPTABLES -A INPUT -i sixxs+ -p udp                               -j udp_packets_in
$IPTABLES -A INPUT -i eth1                                         -j DROP
$IPTABLES -A INPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv6 input packet di
```

4.1.5. FORWARD chain (forward IPv6 only)

```
#-----FORWARD-----
$IPTABLES -A FORWARD -m rt --rt-type 0                            -j REJECT
$IPTABLES -A FORWARD -i eth0 -o sixxs -s $SUBNET                 -j ACCEPT
$IPTABLES -A FORWARD -i sixxs -o eth0 -d $SUBNET                 -j ACCEPT
$IPTABLES -A FORWARD                                             -j REJECT
```



```
# 4.1.6. OUTPUT chain
#-----OUTPUT-----
$IPTABLES -A OUTPUT -m rt --rt-type 0 -j REJECT
$IPTABLES -A OUTPUT -o eth0 -p ipv6-icmp -j ipv6_icmp_packets
$IPTABLES -A OUTPUT -o eth0 -j packets_conntrack
$IPTABLES -A OUTPUT -o eth0 -p tcp -j tcp_packets_out
$IPTABLES -A OUTPUT -o eth0 -p tcp -m state --state NEW -j ACCEPT
$IPTABLES -A OUTPUT -o eth0 -p udp -j udp_packets_out
$IPTABLES -A OUTPUT -o sixxs+ -p ipv6-icmp -j ipv6_icmp_packets
$IPTABLES -A OUTPUT -o sixxs+ -j packets_conntrack
$IPTABLES -A OUTPUT -o sixxs+ -p tcp -j tcp_packets_out
$IPTABLES -A OUTPUT -o sixxs+ -p udp -j udp_packets_out
$IPTABLES -A OUTPUT -o eth1 -j DROP
$IPTABLES -A OUTPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv6 output packet"
```

Second, on the router, load `ip6tables` by executing:

```
root@host-4:~# chmod 755 /etc/network/if-pre-up.d/ip6tables-active
root@host-4:~# /etc/network/if-pre-up.d/ip6tables-active
root@host-4:~# ip6tables-save | less
# Generated by ip6tables-save v1.4.14 on Fri Jan 24 19:38:50 2014
*filter
:INPUT DROP [147:11466]
:FORWARD DROP [0:0]
:OUTPUT DROP [419:34373]
...
```

3.4.4.5 Configure Host Physical Port

Once the router is configured, the next step is to connect the host machine to the router (via the level 2 switch), and then configure the host machine physical port.

Here we configure a physical port, `eth0`, through which we obtain network access to the router and to the Internet. See [Figure 3.4, Recommended Configuration of Host Machine Port](#).

To do this: First, on the host machine, edit `/etc/hosts` to read:

```
root@host-5:~# cat /etc/hosts
127.0.0.1      host-5.local host-5 localhost.localdomain  localhost

::1          localhost loopback ip6-localhost ip6-loopback
fe00::0 ip6-localnet
fe00::0 ip6-mcastprefix
fe02::1 ip6-allnodes
fe02::2 ip6-allrouters
fe02::3 ip6-allhosts

# Scope: Site local
fec0::4 host-4.local host-4
fec0::5 host-5.local host-5
```

Second, on the host machine, edit `/etc/network/interfaces` to read:

Figure 3.4: Recommended Configuration of Host Machine Port

+-----+-----+		+-----+-----+	
Desktop PC		Internet Service Provider +--+	
		+-----+-----+	
		+-----+-----+	
		Broadband Modem wan+--+	
		lan+--+	
		+-----+-----+	
		+-----+-----+	
		Router	
Services: rdnssd		Services: aiccu eth1	
		dhclient ----+--+	
		dnsmasq	
		radvd	
		eth0	
IPv6 addresses: eth0		IPv6 addresses: ----+--+	
Global 2001:db8::5/64		Global 2001:db8::4/64	
Site fec0::5/64		Site fec0::4/64	
Nameserver: fec0::4		Nameserver: 127.0.0.1	
Hostname: host-5		Hostname: host-4	
+-----+-----+		+-----+-----+	
		+-----+-----+	
		+Level 2 Switch +--+	
		+-----+-----+	
+-----+-----+		+-----+-----+	

```

root@host-5:~# cat /etc/network/interfaces
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

#----IPv6-----
# The primary network interface (00:11:22:33:44:55)
#auto eth0
iface eth0 inet6 static
    # 0) Site-local address
    address fec0::5
    netmask 64
    # Global address
    up ip -6 addr add 2001:db8::5/64 dev eth0
    down ip -6 addr del 2001:db8::5/64 dev eth0
    # 1) IPv6 stateless autoconfiguration (radvd there->rdnssd here).
    # Default is /proc/sys/net/ipv6/conf/all/forwarding = 0, and
    # /proc/sys/net/ipv6/conf/all/accept_ra = 1. Else,
    #gateway fec0::4
    #dns-nameservers fec0::4

```

Note that IPv6 stateless autoconfiguration will not work if forwarding is enabled.

To test the port: First, on the host machine, bring it up the physical port:

```

root@host-5:~# ifup eth0

```

and see what addresses were assigned:

```

kmiller@host-5:~$ ip -6 addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qlen 1000
    inet6 2001:db8::5/64 scope global
        valid_lft forever preferred_lft forever
    inet6 fec0::5/64 scope site
        valid_lft forever preferred_lft forever
    inet6 fe80::211:22ff:fe33:4455/64 scope link
        valid_lft forever preferred_lft forever

```

Note that the IPv6 scope link address is derived from the link address (Ethernet MAC address) as follows:

Ethernet MAC address	00:11:22:33:44:55
Insert ff:fe	0011:22ff:fe33:4455
Toggle bit 6	0211:22ff:fe33:4455
Apply link-local prefix	fe80::0211:22ff:fe33:4455

Second, on the host machine, ping6 the router:

```

kmiller@host-5:~$ ping6 -c 1 fec0::4
...
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 0.314/0.314/0.314/0.000 ms

```

Third, on the host machine, confirm that the router is sending Router Advertisements which are needed for IPv6 stateless autoconfiguration, by executing:

```
root@host-5:~# aptitude install ndisc6
kmiller@host-5:~$ rdisc6 eth0
Soliciting ff02::2 (ff02::2) on eth0...

Hop limit           :           64 (      0x40)
Stateful address conf. :           No
Stateful other conf.  :           No
Router preference    :          medium
Router lifetime       :          1800 (0x00000708) seconds
Reachable time        : unspecified (0x00000000)
Retransmit time       : unspecified (0x00000000)
Prefix               : 2001:db8::/64
  Valid time          :          86400 (0x00015180) seconds
  Pref. time          :          14400 (0x00003840) seconds
Recursive DNS server  : fec0::4
Recursive DNS server  : 2001:4de0:1000:a3::2
Recursive DNS server  : 2001:4de0:1000:a4::2
  DNS servers lifetime :           600 (0x00000258) seconds
Source link-layer address: 00:11:22:33:44:55
from fe80::211:22ff:fe33:4455
```

Fourth, on the host machine, enable IPv6 stateless autoconfiguration of the name resolver by installing the `resolvconf` utility and the `rdnssd` daemon. This is done by executing:

```
root@host-5:~# aptitude install resolvconf rdnssd
```

Both `resolvconf` and `rdnssd` are configured ‘out-of-the-box’.

Fifth, on the host machine, confirmed that IPv6 stateless autoconfiguration is working, by executing:

```
kmiller@host-5:~$ rdisc6 eth0
kmiller@host-5:~$ cat /etc/resolv.conf
# Dynamic resolv.conf(5) file for glibc resolver(3) generated by resolvconf(8)
#     DO NOT EDIT THIS FILE BY HAND -- YOUR CHANGES WILL BE OVERWRITTEN
nameserver fec0::4
nameserver 2001:4de0:1000:a3::2
nameserver 2001:4de0:1000:a4::2
```

Sixth, on the host machine, use `dig` to test domain name resolution:

```
kmiller@host-5:~$ dig en.wikipedia.org AAAA
...
;; ANSWER SECTION:
www.wikipedia.org.      3189    IN      CNAME   wikipedia-lb.wikimedia.org.
wikipedia-lb.wikimedia.org. 483 IN     CNAME   text-lb.eqiad.wikimedia.org.
text-lb.eqiad.wikimedia.org. 3001 IN   AAAA    2620:0:861:ed1a::1
...
```

Seventh, on the host machine, use `ping6` to test Internet access:

```
kmiller@host-5:~$ ping6 -c 1 en.wikipedia.org
...
1 packets transmitted, 1 received, 0% packet loss, time 0ms
rtt min/avg/max/mdev = 12.616/12.616/12.616/0.000 ms
```



```

root@host-5:~# cat /etc/network/interfaces
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

#----IPv6-----
# The primary network interface (00:11:22:33:44:55)
iface eth0 inet6 manual

# The bridge
#auth br0
iface br0 inet6 static
    # 0) Site-local address
    address fec0::5
    netmask 64
    # Global address
    up ip -6 addr add 2001:db8::5/64 dev br0
    down ip -6 addr del 2001:db8::5/64 dev br0
    # 1) IPv6 stateless autoconfiguration (radvd there->rdnssd here).
    # Default is /proc/sys/net/ipv6/conf/all/forwarding = 0, and
    # /proc/sys/net/ipv6/conf/all/accept_ra = 1. Else,
    #gateway fec0::4
    #dns-nameservers fec0::4
    # 2) Device br0 is a bridge
    # enable multicast
    up echo 0 > /proc/sys/net/bridge/bridge-nf-call-arptables
    up echo 0 > /proc/sys/net/bridge/bridge-nf-call-ip6tables
    bridge_ports eth0
    bridge_fd 9
    bridge_hello 2
    bridge_maxage 12
    bridge_maxwait 0
    bridge_stp off

```

Note that the lines that were previously in the stanza for `eth0` has been moved to the stanza for `br0`. This means that the bridge `br0` will be assigned the IP addresses that were previously assigned to the physical port `eth0`. Additional lines have been added to enable multicast. The `bridge_ports` command connects `eth0` to the bridge.

Third, on the host machine, bring up the bridge by executing:

```

root@host-5:~# ifup br0

```

Confirm that the bridge is configured by executing:

```

kmiller@host-5:~$ ip -6 link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436 qdisc noqueue state UNKNOWN mode DEFAULT
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast master br0 state UP mode DEFAULT
    link/ether 00:11:22:33:44:55 brd ff:ff:ff:ff:ff:ff
12: br0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP mode DEFAULT
    link/ether 00:11:22:33:44:55 brd ff:ff:ff:ff:ff:ff

```

Note that `eth0` was brought up and attached to the bridge `br0`. Note also that the MAC address for `eth0` is now also the MAC address for the bridge `br0`.

```
kmiller@host-5:~$ ip -6 addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
12: br0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500
    inet6 2001:db8::5/64 scope global
        valid_lft forever preferred_lft forever
    inet6 fec0::5/64 scope site
        valid_lft forever preferred_lft forever
    inet6 fe80::211:22ff:fe33:4455/64 scope link
        valid_lft forever preferred_lft forever
```

Note that `eth0` is no longer assigned any IP address; and that the bridge `br0` is now assigned the IP addresses formerly assigned to `eth0`.

Test the bridge as follows: First, on the host machine, `ping6` the router:

```
kmiller@host-5:~$ ping6 -c 1 fec0::4
```

Second, on the host machine, use `rdisc6` to test IPv6 stateless autoconfiguration setting the resolver:

```
kmiller@host-5:~$ rdisc6 br0
Soliciting ff02::2 (ff02::2) on br0...

Hop limit           :           64 (      0x40)
Stateful address conf. :           No
Stateful other conf.  :           No
Router preference    :          medium
Router lifetime      :          1800 (0x00000708) seconds
Reachable time       : unspecified (0x00000000)
Retransmit time      : unspecified (0x00000000)
Prefix              : 2001:db8::/64
  Valid time         :          86400 (0x00015180) seconds
  Pref. time         :          14400 (0x00003840) seconds
Recursive DNS server  : fec0::4
Recursive DNS server  : 2001:4de0:1000:a3::2
Recursive DNS server  : 2001:4de0:1000:a4::2
  DNS servers lifetime :           600 (0x00000258) seconds
Source link-layer address: 00:11:22:33:44:55
from fe80::211:22ff:fe33:4455
```

Third, on the host machine, test domain name resolution and Internet access by executing:

```
kmiller@host-5:~$ dig en.wikipedia.org AAAA
kmiller@host-5:~$ ping6 -c 1 en.wikipedia.org
```

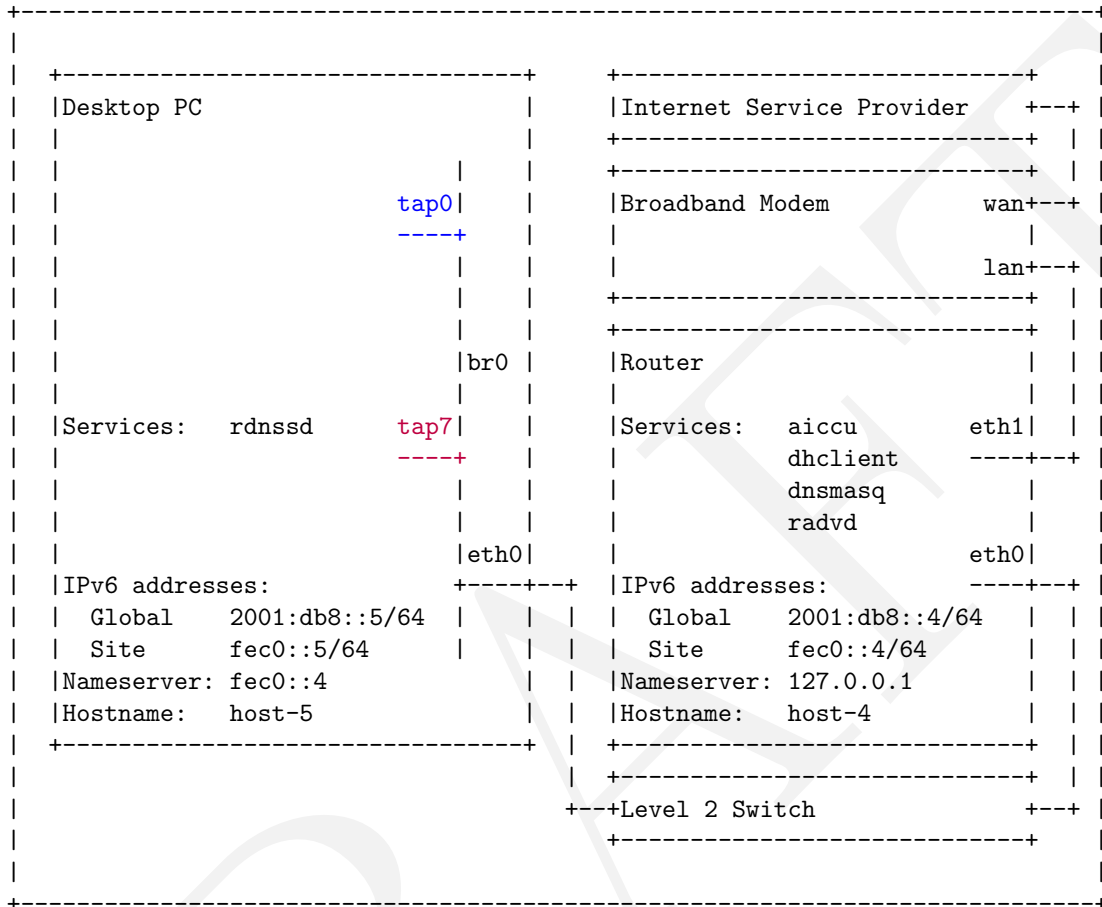
3.4.4.7 Configure Host TAP Device

Once the bridge is working, in the sense that a user logged into the host machine has Internet access, then the next step to create TAP devices to which virtual machines can connect.

Here we create two TAP devices, `tap0` for use by a VM running under the user account `kmiller`, and `tap7` for use by a VM running as `root`. See [Figure 3.6, Recommended Configuration of Host Machine TAP Devices](#).

This is done as follows: First, on the host machine, bring down the bridge:

Figure 3.6: Recommended Configuration of Host Machine TAP Devices



```
root@host-5:~# ifdown br0
```

Second, on the host machine, define one or more TAP devices by editing `/etc/network/interfaces`:


```

root@host-5:~# cat /etc/network/interfaces
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

#-----IPv6-----
# The primary network interface (00:11:22:33:44:55)
iface eth0 inet6 manual

# The bridge
#auth br0
iface br0 inet6 static
    # 0) Site-local address
    address fec0::5
    netmask 64
    # Global address
    up ip -6 addr add 2001:db8::5/64 dev br0
    down ip -6 addr del 2001:db8::5/64 dev br0
    # 1) IPv6 stateless autoconfiguration (radvd there->rdnssd here).
    # Default is /proc/sys/net/ipv6/conf/all/forwarding = 0, and
    # /proc/sys/net/ipv6/conf/all/accept_ra = 1. Else,
    #gateway fec0::4
    #dns-nameservers fec0::4
    # 2) Device br0 is a bridge
    # enable multicast
    up echo 0 > /proc/sys/net/bridge/bridge-nf-call-arptables
    up echo 0 > /proc/sys/net/bridge/bridge-nf-call-ip6tables
    bridge_ports eth0 tap0 tap7
    bridge_fd 9
    bridge_hello 2
    bridge_maxage 12
    bridge_maxwait 0
    bridge_stp off
    # 3) TAP devices (each VM connects to a TAP device)
    # for VM belonging to user
    pre-up ip tuntap add dev tap0 mode tap user kmiller
    pre-up ip link set tap0 up
    post-down ip link set tap0 down
    post-down ip tuntap del dev tap0 mode tap
    # for VM belonging to root
    pre-up ip tuntap add dev tap7 mode tap user root
    pre-up ip link set tap7 up
    post-down ip link set tap7 down
    post-down ip tuntap del dev tap7 mode tap

```

Third, on the host machine, bring up the bridge:

```

root@host-5:~# ifup br0

```

Fourth, confirm that the `tap` devices are configured by executing:

```

kmliller@host-5:~$ ip -6 link
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436 qdisc noqueue state UNKNOWN mode DEFAULT
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast master br0 state UP mode DEFAULT
    link/ether 00:11:22:33:44:55 brd ff:ff:ff:ff:ff:ff
10: tap0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast master br0 state DOWN mode DEFAULT
    link/ether 9a:34:26:73:25:bb brd ff:ff:ff:ff:ff:ff
11: tap7: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc pfifo_fast master br0 state DOWN mode DEFAULT
    link/ether fe:0f:32:17:50:09 brd ff:ff:ff:ff:ff:ff
12: br0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc noqueue state UP mode DEFAULT
    link/ether 00:11:22:33:44:55 brd ff:ff:ff:ff:ff:ff

```

Fifth, on the host machine, test host Internet access by executing:

```

kmliller@host-5:~$ ping6 -c 1 host-4
kmliller@host-5:~$ dig en.wikipedia.org AAAA
kmliller@host-5:~$ ping6 -c 1 en.wikipedia.org

```

3.4.4.8 Configure Host Security

3.4.4.8.1 `/etc/hosts` On the host, `/etc/hosts` should be appended with `HOSTS.zip` same as was done for the router. See §3.4.4.4.1, `/etc/hosts`.

3.4.4.8.2 **PeerGuardian Linux** On the host, installation of PeerGuardian Linux is not necessary. This is because all IPv4 traffic has been blocked by the router.

3.4.4.8.3 `iptables` Here we wish to block all IPv4 traffic. To do this: First, on the host, configure `iptables` as follows:

```

root@host-5:~# cat /etc/network/if-pre-up.d/iptables-active
#!/bin/sh

# iptables-active - IP Firewall script (Linux 2.6.x, iptables) for host.
# Based on "Iptables Tutorial 1.2.2," Oskar Andreasson.
# Copyright (C) 2010,2014 Dr. Kent L. Miller. All rights reserved.

#-----
# 1. Configuration options

IPTABLES="/sbin/iptables"

```

```

#-----
# 2. Module loading (should load automatically)

```

```

#-----
# 3. /proc setup (not needed)

```

```
#-----
# 4. Rules setup
# 4.1. Filter table (this is the only one needed for firewalling a PC)
# 4.1.1. Set Policies

# Reset

$IPTABLES -F          # Flush  all rules in all chains in the filter table
$IPTABLES -X          # Delete all user-defined chains in the filter table
$IPTABLES -Z          # Zero  all packet/byte counters in the filter table

# Establish policy

$IPTABLES -P INPUT DROP      # Block all inbound traffic
$IPTABLES -P FORWARD DROP   # Block all forward traffic
$IPTABLES -P OUTPUT DROP     # Block all outbound traffic
```

```
# 4.1.2. Create user specified chains
```

```
# 4.1.3. Create content in user specified chains
```

```
#-----
# Allow loopback traffic

$IPTABLES -A INPUT  -i lo -j ACCEPT
$IPTABLES -A OUTPUT -o lo -j ACCEPT
```

```
# 4.1.4. INPUT chain
```

```
#-----INPUT-----
$IPTABLES -A INPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv4 input packet di
```

```
# 4.1.5. FORWARD chain (no forwarding for a host)
```

```
# 4.1.6. OUTPUT chain
```

```
#-----OUTPUT-----
$IPTABLES -A OUTPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv4 output packet
```

Second, on the host, load `iptables`

```
root@host-5:~# chmod 755 /etc/network/if-pre-up.d/iptables-active
root@host-5:~# /etc/network/if-pre-up.d/iptables-active
root@host-5:~# iptables-save
# Generated by iptables-save v1.4.14 on Fri Jan 24 19:50:06 2014
*filter
:INPUT DROP [707:23808]
:FORWARD DROP [4:1312]
:OUTPUT DROP [0:0]
-A INPUT -i lo -j ACCEPT
-A INPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv4 input packet died: "
-A OUTPUT -o lo -j ACCEPT
-A OUTPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv4 output packet died: "
COMMIT
# Completed on Fri Jan 24 19:50:06 2014
```

3.4.4.8.4 ip6tables It is good security practice to close all unused ports. To do this: First, on the host, configure `ip6tables` as follows:

```
root@host-5:~# cat /etc/network/if-pre-up.d/ip6tables-active
#!/bin/sh

# ip6tables-active - IP Firewall script (Linux 2.6.x, iptables) for host.
# Based on "Iptables Tutorial 1.2.2," Oskar Andreasson.
# Copyright (C) 2010,2014 Dr. Kent L. Miller. All rights reserved.

#-----
# 1. Configuration options

IPTABLES="/sbin/ip6tables"
SUBNET="2001:db8::/64"      # assigned to me from <http://www.sixxs.net>

#-----
# 2. Module loading (should load automatically)

#-----
# 3. /proc setup (not needed for host)

#-----
# 4. Rules setup
# 4.1. Filter table (this is the only one needed for firewalling a PC)
# 4.1.1. Set Policies

# Reset

$IPTABLES -F          # Flush  all rules in all chains in the filter table
$IPTABLES -X          # Delete all user-defined chains in the filter table
$IPTABLES -Z          # Zero  all packet/byte counters in the filter table

# Establish policy

$IPTABLES -P INPUT    DROP      # Block all inbound traffic
$IPTABLES -P FORWARD DROP      # Block all forward traffic
$IPTABLES -P OUTPUT   DROP      # Block all outbound traffic

# 4.1.2. Create user specified chains

$IPTABLES -N ipv6_icmp_packets
$IPTABLES -N packets_conntrack
$IPTABLES -N tcp_packets_allow
$IPTABLES -N tcp_packets_ssh
$IPTABLES -N tcp_packets_in
$IPTABLES -N udp_packets_in
$IPTABLES -N tcp_packets_out
$IPTABLES -N udp_packets_out
```

```
# 4.1.3. Create content in user specified chains
```

```
#-----
```

```
# Allow loopback traffic
```

```
$IPTABLES -A INPUT -s ::1/128 -p tcp -j ACCEPT
```

```
$IPTABLES -A INPUT -s ::1/128 -p udp -j ACCEPT
```

```
$IPTABLES -A INPUT -i lo -j ACCEPT
```

```
$IPTABLES -A OUTPUT -o lo -j ACCEPT
```

```
#----ipv6-icmp-packets-----
```

```
$IPTABLES -A ipv6_icmp_packets -p ipv6-icmp -j ACCEPT
```

```
#----packets-contrack-----
```

```
$IPTABLES -A packets_contrack -m state --state ESTABLISHED,RELATED -j ACCEPT
```

```
#$IPTABLES -A packets_contrack -m state --state INVALID -j LOG --log-prefix "IPv6 invalid: "
```

```
$IPTABLES -A packets_contrack -m state --state INVALID -j DROP
```

```
#----tcp-packets-allow-----
```

```
$IPTABLES -A tcp_packets_allow -p tcp -m tcp --syn -m limit --limit 1/s --limit-burst 20 -j ACCEPT
```

```
$IPTABLES -A tcp_packets_allow -j LOG --log-prefix "IPv6 syn-flood over-limit: "
```

```
$IPTABLES -A tcp_packets_allow -j DROP
```

```
#----tcp-packets-ssh-----
```

```
# Limit rate of connection to SSH to block dictionary attacks
```

```
# This allows up to 3 connections per minute. Any more than that are
```

```
# blocked and logged. Waiting 20 seconds before retrying the connection
```

```
# attempt makes it work again.
```

```
$IPTABLES -A tcp_packets_ssh -p tcp -m tcp --dport 22 -m limit --limit 3/min --limit-burst 3 -j ACCEPT
```

```
$IPTABLES -A tcp_packets_ssh -j LOG --log-prefix "IPv6 ssh over-limit: "
```

```
$IPTABLES -A tcp_packets_ssh -j DROP
```

```
#----tcp-packets-in-----
```

```
# Limit rate of connection to SSH to block dictionary attacks
```

```
$IPTABLES -A tcp_packets_in -p tcp -m tcp --dport 22 -m state --state NEW -j tcp_packets_ssh
```

```
# Allow connections to the following services
```

```
# dns http https rsync mysqld nuttcp
```

```
DPORTS=" 53 80 443 873 3306 5000:5001"
```

```
for port in $DPORTS; do
```

```
    $IPTABLES -A tcp_packets_in -p tcp -m tcp --dport $port -m state --state NEW -j RETURN
```

```
done
```

```
#-----udp-packets-in-----
# Block the following services to prevent swamping the log files
#       NetBIOS
DPORTS="135:139"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_in -p udp -m udp --dport $port -j DROP
done
# Allow the following services
#       dns  dhcp  ntp  rsync  mysqld  mdns  traceroute
DPORTS=" 53 67:68 123 873 3306 5353 33434:33534"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_in -p udp -m udp --dport $port -j ACCEPT
done
```

```
#-----tcp-packets-out-----
# Allow the following services
#       ssh  http  https  rsync  imap  mysqld  nuttcp  mdns  hkp
DPORTS=" 22 80 443 873 993 3306 5000:5001 5353 11371"
for port in $DPORTS; do
    $IPTABLES -A tcp_packets_out -p tcp -m tcp --dport $port -j ACCEPT
done
$IPTABLES -A tcp_packets_out -p tcp -j RETURN
```

```
#-----udp-packets-out-----
# Block the following services
#       nntp NetBIOS NetBIOS +-talk+ kazaa dict eDonkey gnutella napster
DPORTS=" 119 135:139 445 517:518 1214 2628 4661:4666 6346:6429 6699"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_out -p udp -m udp --dport $port -j DROP
done
# Allow the following services
#       dns  dhcp  ntp  rsync  imap  mysqld  mdns  hkp  traceroute  tracepath
DPORTS=" 53 67:68 123 873 993 3306 5353 11371 33434:33534 44444"
for port in $DPORTS; do
    $IPTABLES -A udp_packets_out -p udp -m udp --dport $port -j ACCEPT
done
```

4.1.4. INPUT chain

```
#-----INPUT-----
$IPTABLES -A INPUT -m rt --rt-type 0 -j DROP
$IPTABLES -A INPUT -i br+ -p ipv6-icmp -j ipv6_icmp_packets
$IPTABLES -A INPUT -i br+ -j packets_contrack
$IPTABLES -A INPUT -i br+ -p tcp -j tcp_packets_in
$IPTABLES -A INPUT -i br+ -p tcp -j tcp_packets_allow
$IPTABLES -A INPUT -i br+ -p udp -j udp_packets_in
$IPTABLES -A INPUT -i eth+ -p ipv6-icmp -j ipv6_icmp_packets
$IPTABLES -A INPUT -i eth+ -j packets_contrack
$IPTABLES -A INPUT -i eth+ -p tcp -j tcp_packets_in
$IPTABLES -A INPUT -i eth+ -p tcp -j tcp_packets_allow
$IPTABLES -A INPUT -i eth+ -p udp -j udp_packets_in
$IPTABLES -A INPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv6 input packet di
```

```
# 4.1.5. FORWARD chain (forwarding on bridge only)
```

```
#-----FORWARD-----
$IPTABLES -A FORWARD -m rt --rt-type 0 -j DROP
$IPTABLES -A FORWARD -i br+ -o br+ -s $SUBNET -j ACCEPT
$IPTABLES -A FORWARD -i br+ -o br+ -d $SUBNET -j ACCEPT
$IPTABLES -A FORWARD -j REJECT
```

```
# 4.1.6. OUTPUT chain
```

```
#-----OUTPUT-----
$IPTABLES -A OUTPUT -m rt --rt-type 0 -j DROP
$IPTABLES -A OUTPUT -o br+ -p ipv6-icmp -j ipv6_icmp_packets
$IPTABLES -A OUTPUT -o br+ -j packets_conntrack
$IPTABLES -A OUTPUT -o br+ -p tcp -j tcp_packets_out
$IPTABLES -A OUTPUT -o br+ -p tcp -m state --state NEW -j ACCEPT
$IPTABLES -A OUTPUT -o br+ -p udp -j udp_packets_out
$IPTABLES -A OUTPUT -o eth+ -p ipv6-icmp -j ipv6_icmp_packets
$IPTABLES -A OUTPUT -o eth+ -j packets_conntrack
$IPTABLES -A OUTPUT -o eth+ -p tcp -j tcp_packets_out
$IPTABLES -A OUTPUT -o eth+ -p tcp -m state --state NEW -j ACCEPT
$IPTABLES -A OUTPUT -o eth+ -p udp -j udp_packets_out
$IPTABLES -A OUTPUT -m limit --limit 3/min --limit-burst 3 -j LOG --log-prefix "IPv6 output packet"
```

Second, on the host, load `ip6tables`

```
root@host-5:~# chmod 755 /etc/network/if-pre-up.d/ip6tables-active
root@host-5:~# /etc/network/if-pre-up.d/ip6tables-active
root@host-5:~# ip6tables-save
# Generated by ip6tables-save v1.4.14 on Fri Jan 24 19:57:47 2014
*filter
:INPUT DROP [0:0]
:FORWARD DROP [0:0]
:OUTPUT DROP [0:0]
```

3.4.5 Trial Run—Round 2

Once the `tap` devices are configured, the next step is to connect a guest machine (virtual machine) to a `tap` device. If that succeeds, the guest machine will have network access to other guest machines, to the host machine, and to the Internet. See [Figure 3.7, Recommended Configuration of Guest Machine—Knoppix](#).

Let us continue with the trial run started in [§3.4.3, Trial Run—Round 1](#).

First, on the host machine, open a terminal and boot the virtual machine by executing:

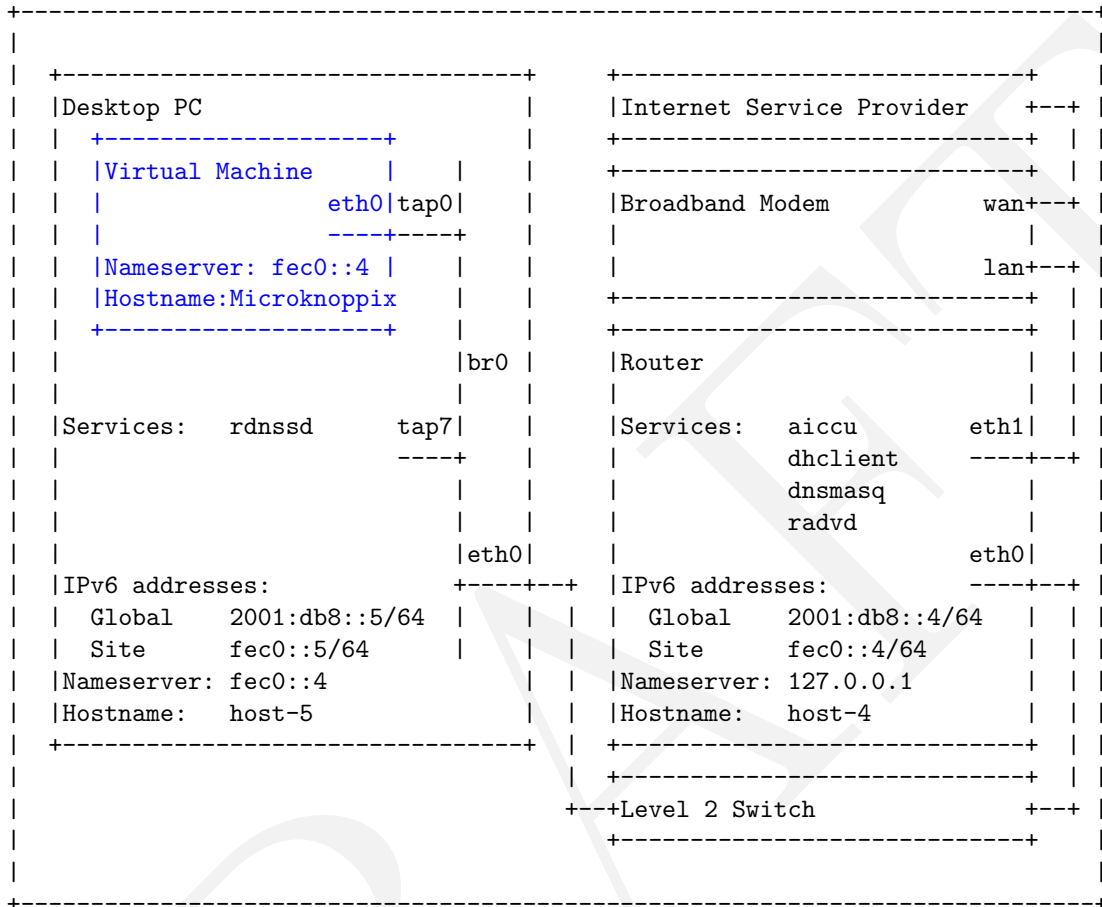
```
kmiller@host-5:~/knoppix-7.2.0$ make boot
kvm -cdrom KNOPPIX_V7.2.0DVD-2013-06-16-EN.iso -m 256M -boot d -soundhw ac97 \
-net nic -net tap,ifname=tap0,script=no,downscript=no &
```

As before, a window will open up on your host PC's desktop, and inside of this window, you will see the Knoppix live DVD boot up, display its own desktop, and emit an audio flourish.

The guest machine's interface port `eth0` is connected to the host machine's `tap0` device. Due to `IPv6` stateless autoconfiguration, the guest machine is configured 'out-of-the-box'; and due to `NetworkManager`, the interface is up and connected to the Internet.

On the guest machine, addresses are assigned:

Figure 3.7: Recommended Configuration of Guest Machine—Knoppix



```
knoppix@Microknoppix:~$ ip -6 addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 65536
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qlen 1000
    inet6 2001:db8::5054:ff:fe12:34546/64 scope global dynamic
        valid_lft 86323sec preferred_lft 14323sec
    inet6 fe80::5054:ff:fe12:34546/64 scope link
        valid_lft forever preferred_lft forever
```

On the guest machine, the route is configured:

```
knoppix@Microknoppix:~$ ip -6 route
2001:db8::/64 dev eth0  proto kernel  metric 256  expires 86315sec
fe80::/64 dev eth0  proto kernel  metric 256
ff00::/8 dev eth0  metric 256
default via fe80::211:22ff:fe33:4455 dev eth0  proto ra  metric 1024  expires 1715sec
```

On the guest machine, domain name resolution is configured:


```
knoppix@Microknoppix:~$ cat /etc/resolv.conf
# Generated by NetworkManager
nameserver fec0::4
nameserver 2001:4de0:1000:a3::2
nameserver 2001:4de0:1000:a4::2
```

On the guest machine, the `/etc/hosts` file is the default:

```
knoppix@Microknoppix:~$ cat /etc/hosts
127.0.0.1      Microknoppix   Knoppix localhost.localdomain  localhost

::1          localhost ip6-localhost ip6-loopback
fe00::0 ip6-localnet
fe00::0 ip6-mcastprefix
fe02::1 ip6-allnodes
fe02::2 ip6-allrouters
fe02::3 ip6-allhosts
```

On the guest machine, the `/etc/network/interfaces` file is the default:

```
knoppix@Microknoppix:~$ cat /etc/network/interfaces
# /etc/network/interfaces -- configuration file for ifup(8), ifdown(8)

# The loopback interface
# automatically added when upgrading
auto lo
iface lo inet loopback
```

On the guest machine, the connection can be tested by executing:

```
knoppix@Microknoppix:~$ ping6 -c 1 host-5
knoppix@Microknoppix:~$ dig en.wikipedia.org AAAA
knoppix@Microknoppix:~$ ping6 -c 1 en.wikipedia.org
```

At this point, from the guest machine, you should be able to `ssh` to the host machine, and be able to browse the Internet.

3.4.6 Plan Your Guest Machines

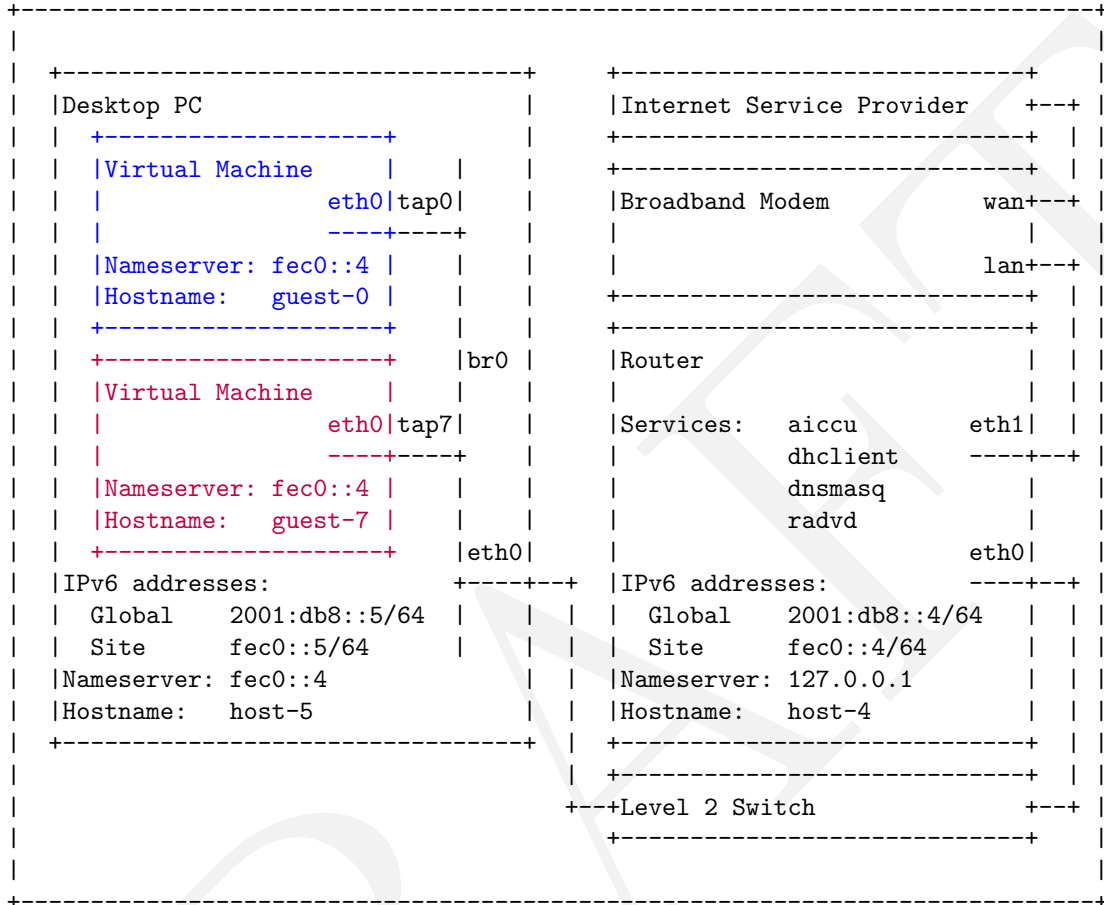
Once we have confirmed that we can connect a guest machine (in the above case, a virtual machine made from a Knoppix ISO image) to a `tap` device; it is time to roll your own guest machine.

Here we will create a guest machine, `guest-0`, upon which we shall install Debian GNU/Linux stable (wheezy) and WP-MIRROR 0.7. See [Figure 3.8, Recommended Configuration of Guest Machines](#).

3.4.6.1 Create Guest Machine

First, on the host machine, create the following `Makefile`:

Figure 3.8: Recommended Configuration of Guest Machines



```

kmill@host-5:~$ mkdir debian-7.4.0-amd64
kmill@host-5:~$ cd debian-7.4.0-amd64
kmill@host-5:~/debian-7.4.0-amd64$ emacs Makefile
#-----+
# Makefile - virtual machine using Debian stable \(wheezy\) |
# Copyright (C) 2014 Dr. Kent L. Miller. All rights reserved. |
# SOI: <https://wiki.debian.org/QEMU> |
#-----+

VERSION = 7.4.0
ARCH     = amd64
SITE     = http://cdimage.debian.org/debian-cd/\${VERSION}/\${ARCH}/iso-cd/
ISO      = debian-${VERSION}-${ARCH}-netinst.iso
IMG      = debian-${VERSION}-${ARCH}-1.qcow
BAK      = ${IMG}.bak
KEY      = 0xDA87E80D6294BE9B
MEMO     = 1024
MEM1     = 1536
SIZE     = 200G
SUMS     = SHA1SUMS
TAP      = tap,ifname=tap0,script=no,downscript=no

boot:
    kvm -hda ${IMG} -m ${MEM1} \
        -net nic -net ${TAP} &

#-----+
# Initial setup - wget, check, create, install, backup |
#-----+

wget:
    wget ${SITE}${ISO}
    wget ${SITE}${SUMS}
    wget \${SITE}\${SUMS}.sign

check:
    gpg --recv-keys \${KEY}
    gpg --verify \${SUMS}.sign
    grep ${ISO} ${SUMS} | sha1sum --check -

create:
    qemu-img create -f qcow2 ${IMG} ${SIZE}

install:
    kvm -hda ${IMG} -cdrom ${ISO} -boot d -m ${MEMO} \
        -net nic -net ${TAP} &

backup:
    cp ${IMG} ${BAK}

#-----+
restore:
    rm -f ${IMG}
    cp ${BAK} ${IMG}

wipe:
    rm -f ${ISO} ${SUMS} \${SUMS}.sign ${IMG} ${BAK}

clean:
    rm -f *~

```

Second, on the host machine, download the [ISO](#) image by executing:

```
kmill@host-5:~/debian-7.4.0-amd64$ make wget
```

Third, on the host machine, check the integrity of the ISO image by executing:

```
kmiller@host-5:~/debian-7.4.0-amd64$ make check
grep debian-testing-amd64-netinst.iso SHA1SUMS | sha1sum --check -
debian-testing-amd64-netinst.iso: OK
```

Fourth, on the host machine, create a file that will serve as the backing store for the virtual disk of our virtual machine. To economize host HDD space, we use the `qemu-img` disk format `qcow2` to create a Copy-on-Write (COW) image.

```
kmiller@host-5:~/debian-7.4.0-amd64$ make create
```

Fifth, on the host machine, we use the Debian net installer to install Debian on the virtual machine:

```
kmiller@host-5:~/debian-7.4.0-amd64$ make install
```

A window will open up on you host PC's desktop, and inside of this window, you will see the Debian net installer boot up.

Sixth, on the guest machine, we make the following install menu choices:

Menu	Choice
Language	English
Country, territory, area	United States
Keymap	American English
Name server addresses	fec0::4 (skipped if IPv6 stateless autoconfiguration)
Hostname	guest-0
Domain name	local
Root password	*****
Full name for the new user	Dr. Kent L. Miller
User name for your account	kmiller
Password for the new user	*****
Select your time zone	Eastern
Partitioning method	Guided - use entire disk
Select disk to partition	SCSI1 (0,0,0) (sda) - 214.7 GB ATA QEMU HARDDISK
Partitioning scheme	All files in one partition (recommended for new users)
Partition disks	Finish partitioning and write changes to disk
Write changes to disk	Yes
Debian archive mirror country	United States
Debian archive mirror	ftp.us.debian.org
HTTP proxy information	(blank)
Package usage survey	No
Choose software to install	Debian desktop, Standard system utilities
Install GRUB to MBR	Yes
Installation complete	Continue

When the installation is complete, shut down the guest machine.

Seventh, on the host machine, make a backup copy of the installed disk image. Such a copy is useful if you wish to run experiments:

```
kmiller@host-5:~/debian-7.4.0-amd64$ make backup
```

Eighth, on the host machine, boot the guest machine without the Debian net installer CD:

```
kmiller@host-5:~/debian-7.4.0-amd64$ make boot
```

Again a window will open up on you host PC's desktop; and, inside of this window, you will see the Debian installation boot up and present its desktop.

The guest machine's interface port `eth0` is connected to the host machine's `tap0` device. Due to IPv6 stateless autoconfiguration, the guest machine is configured 'out-of-the-box'; and due to `NetworkManager`, the interface is up and connected to the Internet.

On the guest machine, addresses are assigned:

```
kmiller@guest-0:~$ ip -6 addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436
    inet6 ::1/128 scope host
        valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qlen 1000
    inet6 2001:db8::5054:ff:fe12:34546/64 scope global dynamic
        valid_lft 86323sec preferred_lft 14323sec
    inet6 fe80::5054:ff:fe12:34546/64 scope link
        valid_lft forever preferred_lft forever
```

On the guest machine, the route is configured:

```
kmiller@guest-0:~$ ip -6 route
2001:db8::/64 dev eth0 proto kernel metric 256 expires 86315sec
fe80::/64 dev eth0 proto kernel metric 256
default via fe80::211:22ff:fe33:4455 dev eth0 proto kernel metric 1024 expires 1715sec
```

On the guest machine, domain name resolution is configured:

```
kmiller@guest-0:~$ cat /etc/resolv.conf
search local
nameserver fec0::4
nameserver 2001:4de0:1000:a3::2
nameserver 2001:4de0:1000:a4::2
```

On the guest machine, the `/etc/hosts` file is the default:

```
kmiller@guest-0:~$ cat /etc/hosts
127.0.0.1    localhost
127.0.0.1    guest-0.local    guest-0

# The following lines are desirable for IPv6 capable hosts
::1        localhost ip6-localhost ip6-loopback
fe02::1    ip6-allnodes
fe02::2    ip6-allrouters
```

On the guest machine, the `/etc/network/interfaces` file is the default:

```
kmiller@guest-0:~$ cat /etc/network/interfaces
# This file describes the network interfaces available on your system
# and how to activate them. For more information, see interfaces(5).

# The loopback network interface
auto lo
iface lo inet loopback

# The primary network interface
# This is an autoconfigured IPv6 interface
allow-hotplug eth0
iface eth0 inet6 auto
```

On the guest machine, the connection can be tested by executing:

```
kmiller@guest-0:~$ ping6 -c 1 host-5
kmiller@guest-0:~$ dig en.wikipedia.org AAAA
kmiller@guest-0:~$ ping6 -c 1 en.wikipedia.org
```

It may be necessary to `ping6` the host machine twice to obtain packets received.

At this point, from the guest machine, you should be able to `ssh` to the host machine, and be able to browse the Internet.

3.4.6.2 Install WP-MIRROR

First, on the guest machine, import the author's public build key into the `gpg` keyring of your `root` account, and from there copy it to your `apt` trusted keyring, by executing:

```
root@guest-0:~# gpg --keyserver zimmermann.mayfirst.org --recv-keys 0x320AFC9D382FBD0C
root@guest-0:~# gpg --armor --export 0x320AFC9D382FBD0C | apt-key add -
root@guest-0:~# apt-key finger
/etc/apt/trusted.gpg
-----
pub  2048R/382FBD0C 2011-12-25 [expires: 2017-01-01]
      Key fingerprint = 9F55 7EEA 08B6 A87E 3070  FAD4 320A FC9D 382F BD0C
uid                          WP-MIRROR <wpmirrordev@gmail.com>
sub  2048R/E5A8E0CB 2011-12-25 [expires: 2017-01-01]
...
```

Second, on the guest machine, append to `/etc/apt/sources` the colored lines:

```
root@guest-0:~# emacs /etc/apt/sources.list
deb http://ftp.us.debian.org/debian/ wheezy          main
deb http://security.debian.org/      wheezy/updates  main
deb http://ftp.us.debian.org/debian/ wheezy-updates  main
deb http://ftp.us.debian.org/debian/ wheezy-backports main
deb http://savannah.c3sl.ufpr.br/wp-mirror/debian-wpmirror/ wheezy main
```

since your network is IPv6 only. Currently (year 2014) <http://download.savannah.gnu.org/> is IPv4 only. However, if someday IPv6 addresses are offered, one could instead use:

```
root@guest-0:~# emacs /etc/apt/sources.list
deb http://ftp.us.debian.org/debian/ wheezy-backports main
deb http://download.savannah.gnu.org/releases/wp-mirror/debian-wpmirror/ wheezy main
```

Third, on the guest machine, upgrade the DEB packages:

```
root@guest-0:~# aptitude update
root@guest-0:~# aptitude safe-upgrade
```

Fourth, on the guest machine, install WP-MIRROR:

```
root@guest-0:~# aptitude install wp-mirror
```

This will install over 100 dependencies, including `mysql-server` which will ask for a `root` password:

Menu	Choice
New password for the MySQL "root" user	*****

Fifth, on the guest machine, build the default mirror:

```
root@guest-0:~# wp-mirror --mirror
```

Sixth, on the guest machine, monitor the build with WP-MIRROR's own monitor:

```
root@guest-0:~# wp-mirror --gui
```

or, if you know [SQL](#), open a `mysql` client and see what tasks are in the queue:

```
kmliller@guest-0:~$ mysql --host=localhost --user=root --password  
Password: *****  
...  
mysql> SELECT name,type,state FROM wpmirror.file WHERE state<>'done';
```

Design note.

If you are building a virtual machine using Debian testing version, then do the following:

First, on the host machine, create the following [Makefile](#):

```

kmliller@host-5:~$ mkdir debian-testing-amd64
kmliller@host-5:~$ cd debian-testing-amd64
kmliller@host-5:~/debian-testing-amd64$ emacs Makefile
#-----+
# Makefile - virtual machine using Debian testing (jessie) |
# Copyright (C) 2014 Dr. Kent L. Miller. All rights reserved. |
# SOI: <https://wiki.debian.org/QEMU> |
#-----+

VERSION = testing
ARCH     = amd64
SITE     = http://cdimage.debian.org/cdimage/weekly-builds/${ARCH}/iso-cd/
ISO      = debian-${VERSION}-${ARCH}-netinst.iso
IMG      = debian-${VERSION}-${ARCH}-1.qcow
BAK      = ${IMG}.bak
MEMO     = 1024
MEM1     = 1536
SIZE     = 200G
SUMS     = SHA1SUMS
TAP      = tap,ifname=tap0,script=no,downscript=no

boot:
    kvm -hda ${IMG} -m ${MEM1} \
        -net nic -net ${TAP} &

#-----+
# Initial setup - wget, check, create, install, backup |
#-----+

wget:
    wget ${SITE}${ISO}
    wget ${SITE}${SUMS}

check:
    grep ${ISO} ${SUMS} | sha1sum --check -

create:
    qemu-img create -f qcow2 ${IMG} ${SIZE}

install:
    kvm -hda ${IMG} -cdrom ${ISO} -boot d -m ${MEMO} \
        -net nic -net ${TAP} &

backup:
    cp ${IMG} ${BAK}

#-----+

restore:
    rm -f ${IMG}
    cp ${BAK} ${IMG}

wipe:
    rm -f ${ISO} ${SUMS} ${IMG} ${BAK}

clean:
    rm -f *~

```

All remaining steps are the same as for installing Debian stable as shown in §3.4.6, [Plan Your Guest Machines](#).

Chapter 4

WP-MIRROR Programs

4.1 WP-MIRROR in Mirror Mode

WP-MIRROR can run either in mirror mode or in monitor mode. Mirror mode can be invoked from your shell as follows:

```
root-shell# wp-mirror --mirror
```

WP-MIRROR in mirror mode, supports the options listed in [Table 4.1, WP-MIRROR Mirror Mode Options Reference](#).

4.2 WP-MIRROR in Monitor Mode

WP-MIRROR can run in either mirror mode or in monitor mode. Monitor mode can be invoked from your shell as follows:

```
root-shell# wp-mirror --monitor
```

WP-MIRROR in monitor mode, supports the options listed in [Table 4.3, WP-MIRROR Monitor Mode Options Reference](#). In monitor mode, WP-MIRROR displays the state of each mirror in a mirror farm. This display can be done in three ways.

4.2.1 WP-MIRROR in Monitor Mode with GUI Display

Monitor mode with GUI display can be invoked by the command:

```
root-shell# wp-mirror --gui
```

A screen shot of the GUI display is shown in [Figure 4.1, WP-MIRROR in Monitor Mode with GUI Display](#).

4.2.2 WP-MIRROR in Monitor Mode with Screen Display

Monitor mode with screen display can be invoked by the command:

```
root-shell# wp-mirror --screen
```

A screen shot of the screen display is shown in [Figure 4.2, WP-MIRROR in Monitor Mode with Screen Display](#).

Table 4.1: WP-MIRROR Mirror Mode Options Reference

Runtime Options	Description	Default	Intr	Rem
<code>--add</code> { <i>wiki</i> <i>language-code</i> <i>project</i> <i>all</i> }	add given language to mirror, and exit.		0.5	
<code>--copyright</code>	display copyright, and exit.		0.1	
<code>--debug</code>	verbose output.		0.1	
<code>--delete</code> { <i>wiki</i> <i>language-code</i> <i>project</i> <i>all</i> <i>template</i> }	delete files and state information (but keep database and media files), for given language, and exit.		0.4	
<code>--drop</code> { <i>wiki</i> <i>language-code</i> <i>project</i> <i>all</i> <i>template</i> }	drop database, delete files and state info (but keep media files), for given language, and exit.		0.4	
<code>--dump</code> { <i>wiki</i> <i>language-code</i> <i>project</i> <i>all</i> <i>template</i> }	dump database, to file <i>xxwiki.sql</i> in working directory (where <i>xx</i> stands for the language code), for given language, and exit. If the language-code is <i>template</i> , then the empty database <i>wikidb</i> is dumped to <i>database_farm.sql</i> .		0.5	
<code>--help</code>	display help, and exit.		0.1	
<code>--info</code>	display configuration parameters, and exit.		0.5	
<code>--mirror</code>	force mirror mode (overrides any monitor mode options or defaults).		0.1	
<code>--profile</code> [<i>run-number</i>]	display real-time profile for mirror-building run(s), and exit.		0.6	
<code>--restore-default</code>	drop all databases and files (except media files), and start over (dangerous).		0.4	
<code>--update</code> { <i>wiki</i> <i>language-code</i> <i>project</i> <i>all</i> <i>template</i> }	update database, to recent MediaWiki schema, for given language, and exit.		0.5	
<code>--version</code>	display version and copyright, and exit.		0.1	

Table 4.2: WP-MIRROR Mirror Mode Options Reference (Obsolete)

Runtime Options	Description	Default	Intr	Rem
<code>--delete-dump</code> <i>language</i>	delete dump file and state information for given language, and exit.		0.1	0.4

4.2.3 WP-MIRROR in Monitor Mode with Text Display

Monitor mode with screen display can be invoked by the command:

```
root-shell# wp-mirror --text
```

A screen shot of the text display is shown in [Figure 4.3, WP-MIRROR in Monitor Mode with Text Display](#).

Table 4.3: WP-MIRROR Monitor Mode Options Reference

Runtime Options	Description	Default	Intr	Rem
<code>--gui</code>	operate monitor in GUI mode.		0.1	
<code>--monitor</code>	force monitor mode (if no other process in mirror mode).	<code>gui</code>	0.1	
<code>--screen</code>	operate monitor in screen mode.		0.1	
<code>--text</code>	operate monitor in text mode.		0.1	

Figure 4.1: WP-MIRROR in Monitor Mode with GUI Display

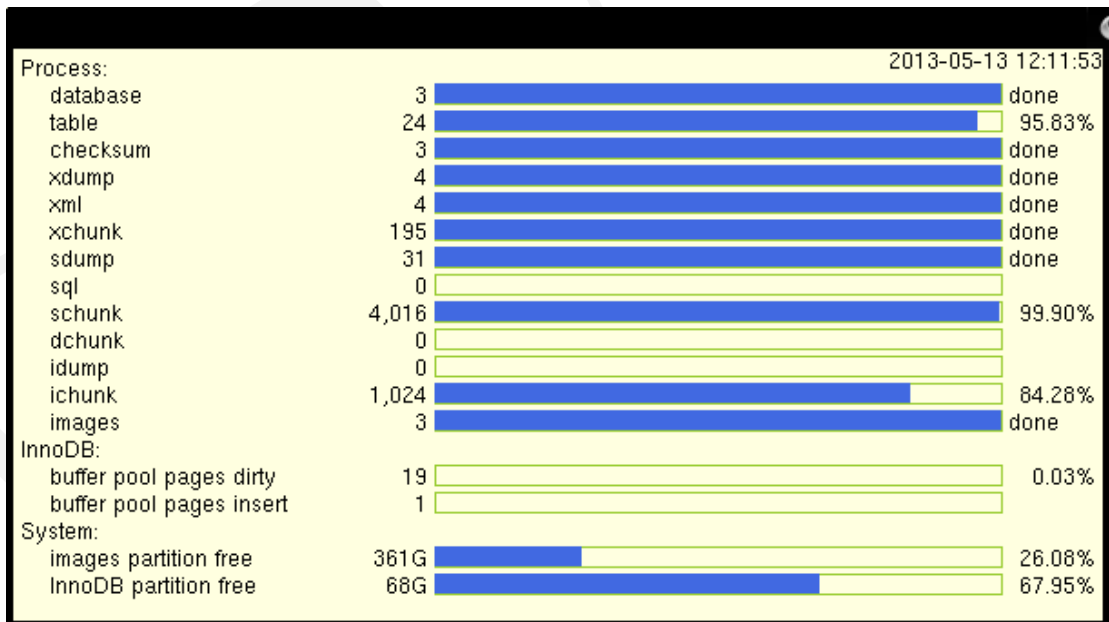


Figure 4.2: WP-MIRROR in Monitor Mode with Screen Display

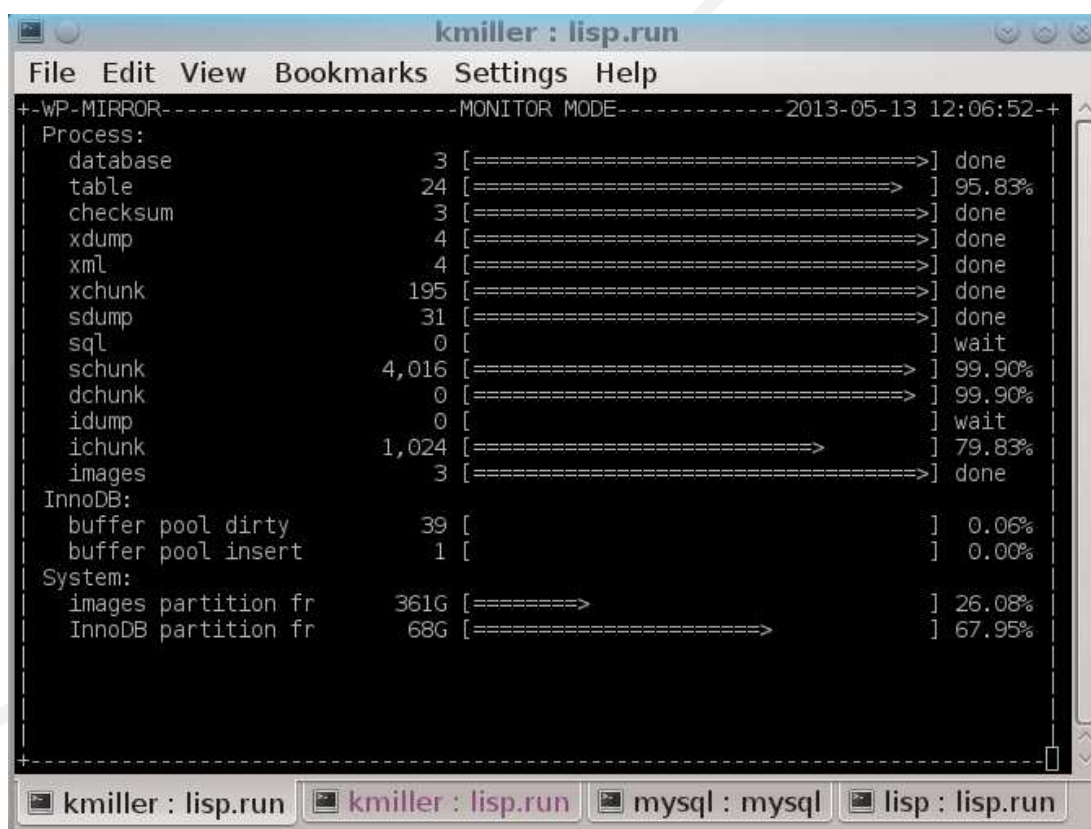
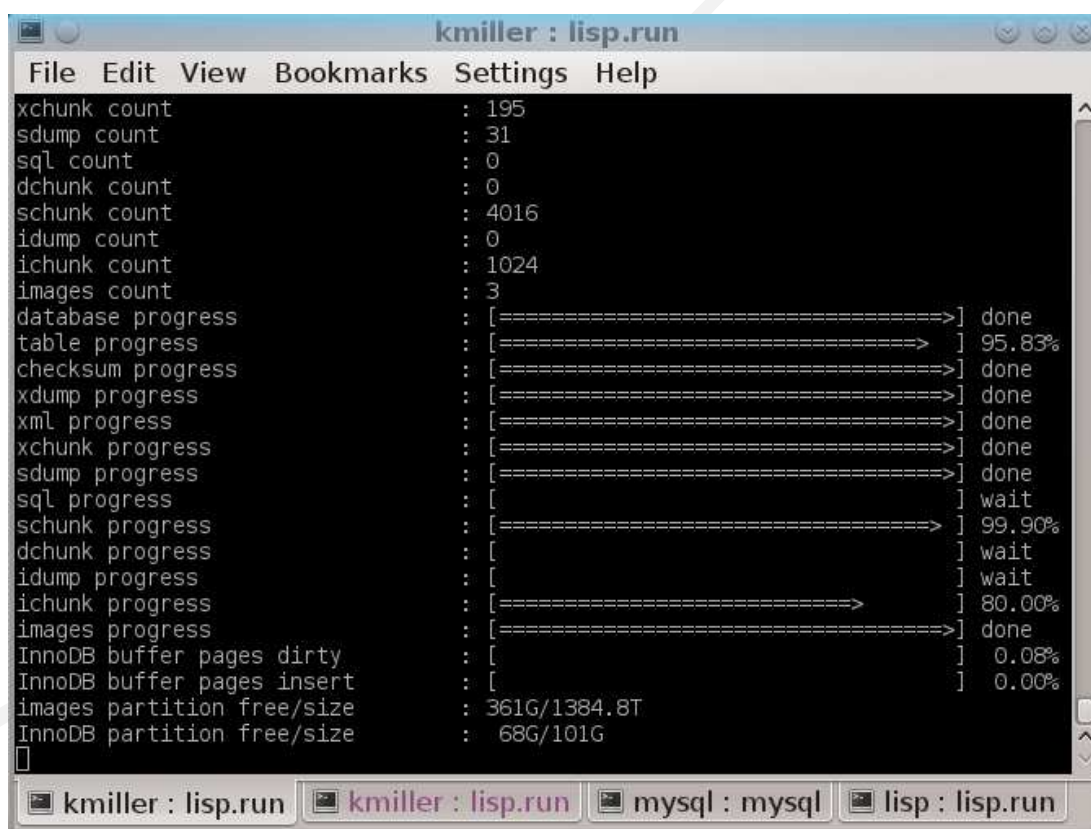


Figure 4.3: WP-MIRROR in Monitor Mode with Text Display



Chapter 5

How WP-MIRROR Works

This chapter describes in great detail, how WP-MIRROR works. This is meant as an aid to developers, but may be also of use to users who are interested in the how and why of each task that WP-MIRROR performs.

5.1 How `--mirror` Works

5.1.1 Start

Processing begins with the command:

```
root-shell# wp-mirror --mirror
```

5.1.1.1 `process-command-line-arguments-or-die`

WP-MIRROR first reads the command-line arguments. If there an error is found, you may expect:

```
root-shell# wp-mirror --foo
Error: command line ...
unexpected option           : (foo)                [fail]
For help, please try:
$ wp-mirror --help
```

5.1.2 Initializing

```
root-shell# wp-mirror --mirror
-----initializing-begin-----
[ ok ] clear-pidfile
[ ok ] set-pidfile
[info] set mode of operation to: FIRST-MIRROR
[ ok ] log-start
[ ok ] assert-clisp-features-p
[ ok ] assert-utilities-p
[ ok ] assert-images-directory-or-create-p
[ ok ] assert-working-directory-or-create-p
[ ok ] assert-dbms-mysql-p
[ ok ] assert-dbms-mysql-install-db-p
[ ok ] assert-dbms-mysql-config-debian-p
[ ok ] assert-dbms-credentials-debian-or-scrape-p
[ ok ] assert-dbms-connect-with-credentials-debian-p
[ ok ] assert-dbms-time-zone-or-load
[ ok ] assert-configuration-files-or-restore-default
[ ok ] process-configuration-files-or-die
[ ok ] put-parameters
```

These messages show the progress of initializing. We now describe each of them:

5.1.2.1 `clear-pidfile`

```
root-shell# wp-mirror --mirror
...
[ ok ] clear-pidfile
```

WP-MIRROR establishes whether or not it is the only instance of WP-MIRROR running. There are a couple of reasons for doing this:

- **cron.** One is to be sure that the weekly `cron` job starts only if there are no other instances of WP-MIRROR running at that time. When mirroring large wikipedias, it can happen that last week's instance is still running.
- **Concurrency.** Another is to distinguish between the instances running as `:first-mirror` and any others running as `:next-mirror`. Tasks that cannot be run concurrently are allowed to run only on the `:first-mirror`.

Determining whether or not there are other instances of WP-MIRROR, is done by looking for the file `/var/run/wp-mirror.pid`. This is called the `PID` file, and it contains the process ID assigned by the operating system. As a precaution, if WP-MIRROR lacks read-write privilege for `/var/run/wp-mirror.pid`, it generates an error message and exits. Now, if a `PID` file is found for which there is no corresponding process, then probably a previous process was terminated prematurely, and so the stale `PID` file is cleared.

5.1.2.2 `set-pidfile`

```
root-shell# wp-mirror --mirror
...
[ ok ] set-pidfile
```

When WP-MIRROR runs in `:first-mirror` mode, it sets a `PID` file at `/var/run/wp-mirror.pid`.

5.1.2.3 set mode of operation to: FIRST-MIRROR

```
root-shell# wp-mirror --mirror
...
[info]set mode of operation to: FIRST-MIRROR
```

Every WP-MIRROR instance must determine its main mode of operation, and this is announced to the user with one of these messages:

```
[info]set mode of operation to: ADD
[info]set mode of operation to: DELETE
[info]set mode of operation to: DROP
[info]set mode of operation to: DUMP
[info]set mode of operation to: FIRST-MIRROR
[info]set mode of operation to: NEXT-MIRROR
[info]set mode of operation to: MONITOR
[info]set mode of operation to: RESTORE-DEFAULT
[info]set mode of operation to: UPDATE
```

Only the instance running as `:first-mirror` may set the `PID` file.

Which mode a particular instance of WP-MIRROR chooses depends upon: 1) whether or not there is a valid `PID` file, and 2) the command-line options, if any. There are several cases to consider, and these are tabulated in [Table 5.1, WP-MIRROR `PID` File Logic](#). For this purpose, the command-line options `--gui`, `--screen`, and `--text`, all count as the `--monitor` option.

Table 5.1: WP-MIRROR `PID` File Logic

Case	Process exists	Cmd-line options	Functions	*main-mode*
1	N	none	clear-pid, set-pidfile	<code>:first-mirror</code>
2	N	<code>--mirror</code>	clear-pid, set-pidfile	<code>:first-mirror</code>
3	N	<code>--monitor</code>	none	<code>:monitor</code>
4	Y	none	none	<code>:monitor</code>
5	Y	<code>--mirror</code>	none	<code>:next-mirror</code>
6	Y	<code>--monitor</code>	none	<code>:monitor</code>
7	N/A	<code>--add</code>	none	<code>:add</code>
8	N/A	<code>--delete</code>	none	<code>:delete</code>
9	N/A	<code>--drop</code>	none	<code>:drop</code>
10	N/A	<code>--dump</code>	none	<code>:dump</code>
11	N/A	<code>--info</code>	none	<code>:info</code>
12	N/A	<code>--profile</code>	none	<code>:time</code>
13	N/A	<code>--restore-default</code>	none	<code>:restore-default</code>
14	N/A	<code>--update</code>	none	<code>:update</code>

When an instance of WP-MIRROR runs in `:next-mirror` mode, that means multiple instances of WP-MIRROR are running concurrently. Most mirror-building tasks can be executed concurrently (and to great advantage when building a large wikipedia on a desktop). However, there is a small number of tasks that can be run safely only by the `:first-mirror` instance.

5.1.2.4 log-start

```
root-shell# wp-mirror --mirror
...
[ ok ]log-start
```

WP-MIRROR turns on logging. Messages are written to `/var/log/wp-mirror.log`.

5.1.2.5 `assert-clisp-features-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-clisp-features-p
```

WP-MIRROR is written in Common Lisp (`clisp` 2.48). WP-MIRROR tests (asserts) that all the required libraries are loaded. For example, the `CLX` library is needed for running WP-MIRROR in `--gui` mode.

5.1.2.6 `assert-utilities-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-utilities-p
```

WP-MIRROR relies on many utilities to do most of the work. WP-MIRROR asserts that the executable files exist.

5.1.2.7 `assert-images-directory-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-images-directory-or-create-p
```

WP-MIRROR creates a directory tree in which `MediaWiki` stores downloaded media files. This directory is `/var/lib/mediawiki/images/` (default).

5.1.2.8 `assert-images-math-directory-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-images-math-directory-or-create-p
```

The `MediaWiki` extension `Math.php` converts math equations from `TeX` format into `PNG` image files.

WP-MIRROR creates a directory tree in which `Math.php` stores the media files it creates. This directory is `/var/lib/mediawiki/images/project/language-code/math/` (default).

5.1.2.9 `assert-images-thumb-directory-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-images-thumb-directory-or-create-p
```

WP-MIRROR creates a directory tree in which `MediaWiki` stores resized images (thumbs). This directory is `/var/lib/mediawiki/images/project/language-code/thumb/` or `/var/lib/mediawiki/images/wikipedia/commons/thumb/` (default).

5.1.2.10 `assert-images-tmp-directory-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-images-tmp-directory-or-create-p
```

WP-MIRROR creates a directory which the `MediaWiki` extension `Math.php` uses as a scratch space, while converting math equations from `TeX` format into `PNG` image files. This directory is `/var/lib/mediawiki/images/project/language-code/tmp/` (default).

5.1.2.11 `assert-working-directory-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-working-directory-or-create-p
```

WP-MIRROR creates a directory in which all its working files will be kept (`checksum`, `ichunk`, `idump`, `schunk`, `sdump`, `sql`, `xchunk`, `xdump`, `xml`, etc.). This directory is `/var/lib/mediawiki/images/wp-mirror/` (default).

5.1.2.12 `assert-dbms-mysql-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-mysql-p
```

MediaWiki is able to use: `MySQL`, `postgres`, `sqlite`, `mssql`, and `ibm_db2`. WP-MIRROR, however, is only able to use the `MySQL` database management system (DBMS). If `MySQL` is not available, then WP-MIRROR exits.

5.1.2.13 `assert-dbms-mysql-install-db-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-mysql-install-db-p
```

WP-MIRROR looks for the `/var/lib/mysql/` directory. If it does not exist, WP-MIRROR attempts to install it by executing:

```
root-shell# mysql_install_db --user=mysql
```

If `/var/lib/mysql/` still does not exist, then WP-MIRROR exits. In this event, please reinstall `MySQL` manually (see §3.2.2.4, `MySQL Redux`).

5.1.2.14 `assert-dbms-mysql-config-debian-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-mysql-config-debian-p
```

WP-MIRROR looks for Debian's database credentials, which are stored in `/etc/mysql/debian.cnf`. Debian's database account has `root` privileges.

5.1.2.15 `assert-dbms-credentials-debian-or-scrape-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-credentials-debian-or-scrape-p
```

WP-MIRROR reads `/etc/mysql/debian.cnf`, and parses the file for Debian's `MySQL user` account and `password`. The file looks something like:

```
# Automatically generated for Debian scripts. DO NOT TOUCH!
[client]
host      = localhost
user      = debian-sys-maint
password  = abcdefghijklmnop
socket    = /var/run/mysqld/mysqld.sock
[mysql_upgrade]
host      = localhost
user      = debian-sys-maint
password  = abcdefghijklmnop
socket    = /var/run/mysqld/mysqld.sock
basedir   = /usr
```

5.1.2.16 `assert-dbms-connect-with-credentials-debian-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-connect-with-credentials-debian-p
```

WP-MIRROR tests (asserts) if it can use the Debian database credentials to access [MySQL](#). If it cannot, WP-MIRROR exits.

5.1.2.17 `assert-dbms-time-zone-or-load`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-time-zone-or-load
```

WP-MIRROR checks if the [MySQL time zone](#) tables are populated. If they are not, the time zone data will be loaded from `/usr/share/zoneinfo/`, and you will see messages like:

```
root-shell# wp-mirror --mirror
...
[....] assert-dbms-time-zone-or-load
looking for time-zone           : UTC                               [fail]
Warning: Unable to load '/usr/share/zoneinfo/Asia/Riyadh87' as time zone. Skipping it.
Warning: Unable to load '/usr/share/zoneinfo/Asia/Riyadh88' as time zone. Skipping it.
Warning: Unable to load '/usr/share/zoneinfo/Asia/Riyadh89' as time zone. Skipping it.
...
[ ok ] assert-dbms-time-zone-or-load
```

5.1.2.18 `assert-configuration-files-or-restore-default`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-configuration-files-or-restore-default
```

If all the configuration files are in place, you will see the above.

If any configuration files are missing, you will see additional messages. If all configuration files are missing, which can happen after you use the `--restore-default` option, you will see:

```

root-shell# wp-mirror --mirror
...
[....]assert-configuration-files-or-restore-default
[info]restoring default      : /etc/cron.d/wp-mirror
[info]restoring default      : /etc/mediawiki/LocalSettings.php
[info]restoring default      : /etc/mediawiki/LocalSettings_wpmirror.php
[info]restoring default      : /etc/mysql/conf.d/wp-mirror.cnf
[info]restoring default      : /etc/wp-mirror/default.conf
[info]restoring default      : /etc/wp-mirror/local.conf
[info]restoring default      : /var/lib/wp-mirror-mediawiki/extensions/LocalisationUpdate/localisatio
[info]restoring default      : /var/lib/wp-mirror-mediawiki/extensions/TitleKey/rebuildTitleKeys_farm
[info]restoring default      : /usr/share/mediawiki/maintenance/database_farm.sql
[info]restoring default      : /usr/share/wp-mirror-mediawiki/maintenance/importDump_farm.php
[info]restoring default      : /usr/share/wp-mirror-mediawiki/maintenance/update_farm.php
[info]restoring default      : /var/lib/mediawiki/favicon.ico
[info]restoring default      : /var/lib/mediawiki/wp-mirror.png
[ ok ] Stopping MySQL database server: mysqld.
[ ok ] Starting MySQL database server: mysqld . . .
[info] Checking for tables which need an upgrade, are corrupt or were
not closed cleanly..
[ ok ]assert-configuration-files-or-restore-default

```

5.1.2.19 `process-configuration-files-or-die`

```

root-shell# wp-mirror --mirror
...
[ ok ]process-configuration-files-or-die

```

WP-MIRROR reads the local configuration file `/etc/wp-mirror/local.conf`. All WP-MIRROR parameters have default values, which may be seen in `/etc/wp-mirror/default.conf`. Parameter values set in `/etc/wp-mirror/local.conf` override the default values.

The parameter that most users will want to edit is,

```
(defparameter *mirror-language-code-list* '("simple"))
```

Users should make their configurations in `/etc/wp-mirror/local.conf` only. The `/etc/wp-mirror/default.conf` is for reference, and should never be edited.

5.1.2.20 `put-parameters`

```

root-shell# wp-mirror --mirror
...
[ ok ]put-parameters

```

WP-MIRROR writes all parameter values to the log file `/var/log/wp-mirror.log`. This information is used for debugging.

5.1.3 Asserting Prerequisite Software

```

...
-----asserting-prerequisite-software-begin-----
[ ok ] assert-dbms-accounts-or-create-p
[ ok ] assert-dbms-credentials-or-scrape-p
[ ok ] assert-dbms-connect-with-credentials-wikiadmin-p
[ ok ] assert-dbms-grant-for-wikiadmin-p
[ ok ] assert-dbms-connect-with-credentials-wikiuser-p
[ ok ] assert-dbms-grant-for-wikiuser-p
[ ok ] warn-if-dbms-root-account-has-no-password
[ ok ] warn-if-dbms-has-anonymous-user-account
[ ok ] warn-if-dbms-has-root-accounts-accessible-from-outside-localhost
[ ok ] warn-if-dbms-has-test-database
[ ok ] assert-database-wpmirror-or-create-p
[ ok ] assert-database-template-and-wikidb-p
[ ok ] assert-mediawiki-localsettings-p
[ ok ] assert-mediawiki-localsettings-account-p
[ ok ] assert-mediawiki-localsettings-wpmirror-p
[ ok ] assert-mediawiki-localsettings-image-p
[ ok ] assert-mediawiki-localsettings-tidy-p
[ ok ] assert-mediawiki-favicon-p
[ ok ] assert-mediawiki-logo-p
[ ok ] assert-mediawiki-dbms-credentials-p
[ ok ] assert-php-xdebug-p
[ ok ] assert-concurrency-limit-xchunk-p
[ ok ] assert-virtual-host-p
[ ok ] assert-virtual-host-name-resolution-p
[ ok ] warn-if-detect-proxy

```

These messages show the progress of asserting software prerequisites. We now describe each of them:

5.1.3.1 `assert-dbms-accounts-or-create-p`

```

root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-accounts-or-create-p

```

WP-MIRROR asserts:

- the DBMS has an account for `wikiadmin`,
- the DBMS has an account for `wikiuser`,
- the file `/etc/mediawiki/LocalSettings_account.php` exists.

If the assertion fails, WP-MIRROR then:

- performs a `DROP USER` on any old `wikiadmin` and `wikiuser` accounts,
- generates random passwords,
- performs a `CREATE USER` to make new `wikiadmin` and `wikiuser` accounts, and
- writes the credentials to `/etc/mediawiki/LocalSettings_account.php`.

5.1.3.2 `assert-dbms-credentials-or-scrape-p`

```

root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-credentials-or-scrape-p

```

WP-MIRROR reads `/etc/mediawiki/LocalSettings_account.php` and parses it to extract database credentials. The file looks something like:

```
root-shell# cat /etc/mediawiki/LocalSettings_account.php
<?php
# Automatically generated by WP-MIRROR for mediawiki scripts. DO NOT TOUCH!
$wgDBAdminuser      = 'wikiadmin';
$wgDBAdminpassword  = 'abcdefghijklm';
$wgDBUser           = 'wikiuser';
$wgDBpassword       = 'abcdefghijklm';
```

5.1.3.3 `assert-dbms-connect-with-credentials-wikiadmin-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-connect-with-credentials-wikiadmin-p
```

WP-MIRROR, using the `wikiadmin` credentials, asserts that it is possible to connect to the `MySQL` server, and execute a simple query.

5.1.3.4 `assert-dbms-connect-with-credentials-wikiuser-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-connect-with-credentials-wikiuser-p
```

WP-MIRROR, using the `wikiuser` credentials, asserts that it is possible to connect to the `MySQL` server, and execute a simple query.

5.1.3.5 `assert-dbms-grant-for-wikiadmin-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-grant-for-wikiadmin-p
```

WP-MIRROR, using the Debian credentials, `GRANTS` elevated database privileges to `wikiadmin`. Namely,

- `GRANT ALL PRIVILEGES ON` each of the databases: `wikidb`, `wpmirror`, `simplewiki` (and any other database in a wikipedia farm), and
- `GRANT PROCESS` globally.

This last privilege is needed for monitoring the status of the `InnoDB` storage engine.

5.1.3.6 `assert-dbms-grant-for-wikiuser-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-grant-for-wikiuser-p
```

WP-MIRROR, using Debian credential, `GRANTS` limited privileges to `wikiuser`. Namely, `SELECT`, `INSERT`, `UPDATE`, and `DELETE` privileges on `wikidb`, `wpmirror`, `simplewiki` (and any other database in a wikipedia farm).

5.1.3.7 `warn-if-dbms-root-account-has-no-password`

```
root-shell# wp-mirror --mirror
...
[ ok ]warn-if-dbms-root-account-has-no-password
```

MySQL, in its ‘out-of-the-box’ configuration, is insecure. WP-MIRROR, using Debian credentials, emits a warning if it detects a `root` account with no password.

5.1.3.8 `warn-if-dbms-has-anonymous-user-account`

```
root-shell# wp-mirror --mirror
...
[ ok ]warn-if-dbms-has-anonymous-user-account
```

MySQL, in its ‘out-of-the-box’ configuration, is insecure. WP-MIRROR, using Debian credentials, emits a warning if it detects an anonymous user account.

5.1.3.9 `warn-if-dbms-has-root-accounts-accessible-from-outside-localhost`

```
root-shell# wp-mirror --mirror
...
[ ok ]warn-if-dbms-has-root-accounts-accessible-from-outside-localhost
```

MySQL, in its ‘out-of-the-box’ configuration, is insecure. WP-MIRROR, using Debian credentials, emits a warning if it detects a `root` account that is accessible from an host outside localhost.

5.1.3.10 `warn-if-dbms-has-test-database`

```
root-shell# wp-mirror --mirror
...
[ ok ]warn-if-dbms-has-test-database
```

MySQL, in its ‘out-of-the-box’ configuration, is insecure. WP-MIRROR, using Debian credentials, emits a warning if it detects a `test` database.

5.1.3.11 `assert-database-wpmirror-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-database-wpmirror-or-create-p
```

WP-MIRROR maintains state information that must be shared with one or more mirror and monitor processes, each of which must be Isolated (the ‘I’ in ACID) from each other. This state information also serves as a checkpoint, and must therefore be Durable (the ‘D’ in ACID) to facilitate resuming after interruption.

WP-MIRROR asserts (and if necessary creates) a database `wpmirror`, managed by the ACID compliant storage engine `InnoDB`, to hold its state information.

Beginning with WP-MIRROR 0.5, this function also carries the responsibility for upgrading the `wpmirror` database schema. If a schema update occurs, it will be noted in the log file, `/var/log/wp-mirror.log`.

WP-MIRROR 0.5 introduced a change: the schema for the `wpmirror.file` database table was altered to support keeping track of databases. This was motivated by desire to be able to `add` and `drop` wikipeidias concurrently with building yet other wikipeidias; which in turn required the introduction of a new file `type` (i.e. `database`); and hence, a new schema for the `wpmirror.file` database table.

The `SQL` command that effects the change for WP-MIRROR 0.5 is:

```
mysql> ALTER TABLE file
-> MODIFY COLUMN type ENUM('database','checksum','dump','xml','xchunk',
->                          'ichunk','images','error')
-> NOT NULL DEFAULT 'error';
```

WP-MIRROR 0.6 introduced further changes:

1. the `wpmirror.file` database table was altered again in order to support: fast index creation (table), the splitting of large SQL files (sdump, sql, schunk, dchunk), and to support downloading media dump tarballs (idump);
2. the `wpmirror.image` database table was removed now that we no longer need to validate media files;
3. the `wpmirror.priority` database table was introduced to support the prioritization of tasks managed by the finite state machine; and
4. the `wpmirror.time` database table was introduced to support profiling;

The SQL command that effects the changes for WP-MIRROR 0.6 are:

```
mysql> ALTER TABLE file
-> ADD COLUMN project VARCHAR(20) NOT NULL DEFAULT 'error' AFTER timestamp,
-> ADD COLUMN wiki VARCHAR(30) NOT NULL DEFAULT 'error' AFTER project,
-> MODIFY COLUMN type ENUM('database','table','checksum','xdump','xml','xchunk',
->                          'sdump','sql','schunk','dchunk',
->                          'idump','ichunk','images','error')
-> NOT NULL DEFAULT 'error';
```

or,

```
mysql> SHOW CREATE TABLE wpmirror.file\G
***** 1. row *****
      Table: file
Create Table: CREATE TABLE 'file' (
  'timestamp'      timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP
                  ON UPDATE CURRENT_TIMESTAMP,
  'project'        varchar(20) NOT NULL DEFAULT 'error',
  'wiki'           varchar(30) NOT NULL DEFAULT 'error',
  'language_code'  varchar(20) NOT NULL DEFAULT 'error',
  'date'           varchar(8)  NOT NULL DEFAULT 'error',
  'name'           varchar(80) NOT NULL DEFAULT 'error',
  'size'           bigint(20) unsigned NOT NULL DEFAULT '0',
  'md5sum'         varchar(32) NOT NULL DEFAULT 'error',
  'type'           ENUM('database','table','checksum','xdump','xml','xchunk',
                        'sdump','sql','schunk','dchunk',
                        'idump','ichunk','images','error')
                  NOT NULL DEFAULT 'error',
  'state'          enum('start','created','valid','pending','done','fail','error')
                  NOT NULL DEFAULT 'error',
  'page'           int(10) unsigned NOT NULL DEFAULT '0',
  'pages'          int(10) unsigned NOT NULL DEFAULT '0',
  'images'         int(10) unsigned NOT NULL DEFAULT '0',
  'updates'        int(10) unsigned NOT NULL DEFAULT '0',
  'semaphore'      int(10) unsigned NOT NULL DEFAULT '1',
  PRIMARY KEY ('name')
) ENGINE=InnoDB DEFAULT CHARSET=utf8
1 row in set (0.00 sec)
```

as well as


```
mysql> SHOW CREATE TABLE wpmirror.priority\G
***** 1. row *****
      Table: priority
Create Table: CREATE TABLE 'priority' (
  'id'          int(10) unsigned NOT NULL AUTO_INCREMENT,
  'type'        enum('database','table','checksum','xdump','xml','xchunk',
                    'sdump','sql','schunk','dchunk',
                    'idump','ichunk','images','error')
                NOT NULL DEFAULT 'error',
  'state'       enum('start','created','valid','pending','done','fail','error')
                NOT NULL DEFAULT 'error',
  'concurrent'  int(10) unsigned NOT NULL DEFAULT '0',
  'image'       int(10) unsigned NOT NULL DEFAULT '0',
  'commons'     int(10) unsigned NOT NULL DEFAULT '0',
  PRIMARY KEY ('id')
) ENGINE=InnoDB AUTO_INCREMENT=52 DEFAULT CHARSET=utf8
1 row in set (0.02 sec)
```

and

```
mysql> SHOW CREATE TABLE wpmirror.time\G
***** 1. row *****
      Table: time
Create Table: CREATE TABLE 'time' (
  'id'          int(10) unsigned NOT NULL AUTO_INCREMENT,
  'timestamp'    timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP
                ON UPDATE CURRENT_TIMESTAMP,
  'run'         int(10) unsigned NOT NULL DEFAULT '0',
  'function_name' varchar(80) NOT NULL DEFAULT 'error',
  'file_name'   varchar(80) NOT NULL DEFAULT 'error',
  'real_time'   bigint(20) unsigned NOT NULL DEFAULT '0',
  PRIMARY KEY ('id')
) ENGINE=InnoDB AUTO_INCREMENT=8631 DEFAULT CHARSET=utf8
1 row in set (0.02 sec)
```

5.1.3.12 `assert-database-template-and-wikidb-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-database-template-and-wikidb-p
```

WP-MIRROR must be able to mirror wikipeidias of more than one language. It must be possible to create or delete one wikipedia without touching others. The author made a design decision to have [MediaWiki](#) store each wikipedia in a separate database. This means that each database must have the identical table structure.

WP-MIRROR, provides a `database template` for wikipedia databases. This template is `/usr/share/mediawiki/maintenance/database.farm.sql`. Almost all of the tables in the template are empty. This template is later used to create one [MediaWiki](#) compatible database for each wikipedia, but first WP-MIRROR uses it into the `wikidb` database.

Actually, for robustness; WP-MIRROR, using Debian credentials, will do one of the following:

- if the `database template` exists, and the `wikidb` database does not; then the `database template` is `LOADED` to create the `wikidb` database; and, conversely,
- if the `wikidb` database exists, and the `database template` does not; then the `wikidb` database is `DUMPED` to create the `database template`.

The first case is the usual one. However, the adventurous user who inadvertently deletes the `database template` will find it back again if `wikidb` had been created during a previous run.

5.1.3.13 `assert-mediawiki-localsettings-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-mediawiki-localsettings-p
```

MediaWiki expects to find user configuration in `/etc/mediawiki/LocalSettings.php`. WP-MIRROR provides this file.

However, it often happens that the user edits this file, and then forgets to set the file ownership and permissions. In particular, it is important that the file not be world readable, because it may contain database credentials.

WP-MIRROR, therefore, asserts that this file exists, and sets its ownership and permissions.

5.1.3.14 `assert-mediawiki-localsettings-account-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-mediawiki-localsettings-account-p
```

The file is `/etc/mediawiki/LocalSettings_account.php` is created by WP-MIRROR to hold the database credentials for `wikiadmin` and `wikiuser`.

However, because the file contains database credentials, it is important that the file not be world readable.

WP-MIRROR, therefore, asserts that this file exists, and sets its ownership and permissions.

5.1.3.15 `assert-mediawiki-localsettings-wpmirror-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-mediawiki-localsettings-wpmirror-p
```

The file is `/etc/mediawiki/LocalSettings_wpmirror.php` is created by WP-MIRROR to hold code for the wikipedia farm as well as additional configuration.

However, because the file may contain database credentials, it is important that the file not be world readable.

WP-MIRROR, therefore, asserts that this file exists, and sets its ownership and permissions.

5.1.3.16 `assert-mediawiki-localsettings-image-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-mediawiki-localsettings-image-p
```

MediaWiki, by default, processes images with `convert` (ImageMagick). ImageMagick overcommits main memory and can cause the system to hang.

The author, therefore, replaces ImageMagick with:

- `gm convert` (GraphicsMagick) for resizing images (making thumbs); and
- `inkscape` for converting files in SVG format into PNG image files.

The configuration for that is written to `/etc/mediawiki/LocalSettings_wpmirror.php`, and looks like:

```
## Images - local
$wgEnableUploads      = true;
...
## Images - thumb
$wgUseImageMagick      = false;
$wgCustomConvertCommand = '/usr/bin/gm convert %s -resize %wx%h %d';
$wgSVGConverter        = 'inkscape';
```

WP-MIRROR reads and parses the file for the last three lines shown above.

5.1.3.17 `assert-mediawiki-localsettings-tidy-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-mediawiki-localsettings-tidy-p
```

Many wikipedia articles contain complicated templates that, without `tidy`, will produce badly formatted pages. In particular, you will find `<p>` and `<pre>` tags in the `HTML` after every citation. The resulting mess will be hard to read. `Tidy` is an `HTML` syntax checker and reformatter, and is needed for generating readable pages.

In `/etc/mediawiki/LocalSettings.wpmirror.php` there should be a line that reads:

```
$wgUseTidy = true;
```

5.1.3.18 `assert-mediawiki-favicon-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-mediawiki-favicon-p
```

A favicon is a small icon, usually 16x16 or 32x32 pixels, that is displayed by a web browser in the Address Bar (the text box where you type the URL). The favicon is displayed just to the left of the URL.

WP-MIRROR provides a favicon, `/var/lib/mediawiki/favicon.ico`, which is a 16x16 pixel version of the WP-MIRROR logo.

5.1.3.19 `assert-mediawiki-logo-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-mediawiki-favicon-p
```

WP-MIRROR provides a 135x135 pixel logo `/var/lib/mediawiki/wp-mirror.png` that is displayed by a web browser in the upper left corner of the page.

`MediaWiki` offers a number of 'skins' (cascading style sheets mostly) which govern the layout of each web page. WP-MIRROR uses the `vector` skin (default). The logo dimension, 135x135 pixel, is chosen for compatibility the legacy skin `Monobook`.

5.1.3.20 `assert-mediawiki-dbms-credentials-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-mediawiki-dbms-credentials-p
```

Before WP-MIRROR can request `MediaWiki` maintenance scripts to import pages and media files, all the database credentials must be in hand. WP-MIRROR asserts that they are. If they are not, WP-MIRROR exits.

5.1.3.21 `assert-php-xdebug-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-php-xdebug-p
```

Some pages, such as <http://simple.wikipedia.site/wiki/France>, cannot be rendered with PHP's maximum nesting level for function calls (default 100). Attempting to render such a page yields "Fatal error: Maximum function nesting level of '100' reached, aborting!" See also <http://www.mediawiki.org/wiki/Manual:Php.ini>.

WP-MIRROR sets an higher limit by appending the following lines:

```
root-shell# tail -n 2 /etc/php5/mods-available/xdebug.ini
; configured by WP-MIRROR
xdebug.max_nesting_level = 200
```

WP-MIRROR then restarts `apache2`.

5.1.3.22 `assert-concurrency-limit-xchunk-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-concurrency-limit-xchunk-p
```

InnoDB has two `table space` formats (as of 2014)

- `Antelope` is uncompressed and handles concurrency well. WP-MIRROR limits concurrency to the lesser of the number of CPUs and three.
- `Barracuda` is compressed using `zlib` and does *not* handle concurrency well (frequent deadlocks). WP-MIRROR limits concurrency to just one. That is, `xchunks` are processed one-by-one.

5.1.3.23 `assert-virtual-host-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-virtual-host-p
```

WP-MIRROR lets you access your mirror locally using a web browser. For this to happen, a web server (such as `apache2`) running on localhost needs to know where to look.

WP-MIRROR sets up virtual hosts like simple.wikipedia.site, simple.wiktionary.site, and www.wikidata.site. The virtual host containers can be found in `/etc/apache2/sites-enabled/wp-mirror.site.conf`, and look like:

```
<VirtualHost *:80>
    ServerName    wikipedia.site
    ServerAdmin    webmaster@localhost
    # for access using: en.wikipedia.site, simple.wikipedia.site, etc.
    ServerAlias    *.wikipedia.site
    DocumentRoot  /var/www/
    # http://www.mediawiki.org/wiki/Manual:Short_URL/Apache
    RewriteEngine on
    RewriteRule    ^/?wiki(/.*)?$ /w/index.php [L,PT]
    RewriteRule    ^/*$ /w/index.php [L,PT]
    # for logs using: NCSA Combined Log Format
    CustomLog      $APACHE_LOG_DIR/wp-mirror.site-access.log combined
    ErrorLog       $APACHE_LOG_DIR/wp-mirror.site-error.log
    # log level value in debug, info, notic, warn, error, cirt, alert, emerg
    LogLevel       warn
</VirtualHost>
```

```
<VirtualHost *:80>
    ServerName    wiktionary.site
    ServerAdmin   webmaster@localhost
    # for access using:  en.wiktionary.site, simple.wiktionary.site, etc.
    ServerAlias   *.wiktionary.site
    DocumentRoot  /var/www
    # http://www.mediawiki.org/wiki/Manual:Short_URL/Apache
    RewriteEngine on
    RewriteRule   ^/?wiki(/.*)?$ /w/index.php [L,PT]
    RewriteRule   ^/*$           /w/index.php [L,PT]
    # for logs using:  NCSA Combined Log Format
    CustomLog      $APACHE_LOG_DIR/wp-mirror.site-access.log combined
    ErrorLog       $APACHE_LOG_DIR/wp-mirror.site-error.log
    # log level value in debug, info, notic, warn, error, cirt, alert, emerg
    LogLevel       warn
</VirtualHost>
```

and

```
<VirtualHost *:80>
    ServerName    wikidata.site
    ServerAdmin   webmaster@localhost
    # for access using:  www.wikidata.site
    ServerAlias   *.wikidata.site
    DocumentRoot  /var/www
    # http://www.mediawiki.org/wiki/Manual:Short_URL/Apache
    RewriteEngine on
    RewriteRule   ^/?wiki(/.*)?$ /w/index.php [L,PT]
    RewriteRule   ^/*$           /w/index.php [L,PT]
    # for logs using:  NCSA Combined Log Format
    CustomLog      $APACHE_LOG_DIR/wp-mirror.site-access.log combined
    ErrorLog       $APACHE_LOG_DIR/wp-mirror.site-error.log
    # log level value in debug, info, notic, warn, error, cirt, alert, emerg
    LogLevel       warn
</VirtualHost>
```

5.1.3.24 `assert-virtual-host-name-resolution-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-virtual-host-name-resolution-p
```

For each language to be mirrored, WP-MIRROR creates a virtual host name. Each such host name must be resolved to an IP address.

WP-MIRROR scans `/etc/hosts` for virtual host names like `simple.wikipedia.site`, where `simple` might be replaced with any other language code. For each missing virtual host name, WP-MIRROR appends to `/etc/hosts` lines like:

```
:::1 simple.wikipedia.site
:::1 simple.wiktionary.site
```

5.1.3.25 `warn-if-detect-proxy`

```
root-shell# wp-mirror --mirror
...
[ ok ] warn-if-detect-proxy
```

Some caching web proxies (such as [polipo](#)) are not able to download files larger than the available system memory (DRAM). And some proxies do not have sufficient cache to handle terabytes of media files.

WP-MIRROR does not attempt to configure your caching web proxy (which is usually on a different host). Rather, WP-MIRROR scans several configuration files (those for [bash](#), [cURL](#), and [wget](#)) looking for evidence of a proxy. If such evidence is found, WP-MIRROR issues a warning:

```
root-shell# wp-mirror --mirror
...
[warn]warn-if-detect-proxy
```

and continues processing.

5.1.4 Asserting Prerequisite Hardware

```
...
-----asserting-prerequisite-hardware-begin-----
[ ok ] count-cpu
[ ok ] assert-disk-space-if-large-wikipedia-p
[ ok ] assert-physical-memory-if-large-wikipedia-p
[ ok ] assert-partition-free-images
[ ok ] warn-if-disk-space-low-p
[ ok ] warn-if-database-on-virtual-disk-p
[ ok ] assert-hdd-write-cache-p
[ ok ] warn-if-no-hugepages-allocated-p
[ ok ] assert-internet-access-to-wikimedia-site-p
```

These messages show the progress of asserting hardware prerequisites. We now describe each of them:

5.1.4.1 `count-cpu`

```
root-shell# wp-mirror --mirror
...
[ ok ] count-cpu
```

WP-MIRROR counts the number of CPUs as part of deciding how much concurrent processing (if any) can be permitted.

5.1.4.2 `assert-disk-space-if-large-wikipedia-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-disk-space-if-large-wikipedia-p
```

WP-MIRROR initially (and periodically) determines the amount of free disk space available for storing databases and media files.

If you are attempting to mirror any of the largest wikipedias, WP-MIRROR will require that you have >100G of free disk space before you can start. While this is not nearly enough to hold a large wikipedia, it is enough to hold the working files ([checksum](#), [xdump](#), etc.).

5.1.4.3 `assert-physical-memory-if-large-wikipedia-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-physical-memory-if-large-wikipedia-p
```

WP-MIRROR initially determines the amount of main memory (DRAM) installed.

If you are attempting to mirror any of the largest wikipedias, WP-MIRROR will require that you have ≥ 4 G of main memory before you can start. While this is not enough to build a mirror, it is enough to create all the working files (`checksum`, `xdump`, etc.).

5.1.4.4 `assert-partition-free-images`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-partition-free-images
```

WP-MIRROR initially (and periodically) determines the amount of free disk space available for storing media files. If the amount falls below 5G, WP-MIRROR gracefully exits.

5.1.4.5 `assert-partition-free-innodb`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-partition-free-innodb
```

WP-MIRROR initially (and periodically) determines the amount of free disk space available for storing databases. If the amount falls below 5G, WP-MIRROR gracefully exits.

5.1.4.6 `warn-if-disk-space-low-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]warn-if-disk-space-low-p
```

WP-MIRROR initially (and periodically) determines the amount of free disk space available for storing media files and the `InnoDB table space`.

WP-MIRROR initially warns when there is < 100 G of free disk space, in which case, the message looks like:

```
root-shell# wp-mirror --mirror
...
[....]warn-if-disk-space-low-p
[info]disk space below threshold ( 17G < 100G)
[warn]warn-if-disk-space-low-p
```

The value 100G was chosen because, WP-MIRROR in its default configuration, mirrors the [simple wikipedia](#), [simple wiktionary](#), and [wikidata wiki](#) which occupy 100G.

5.1.4.7 `warn-if-database-stored-on-virtual-disk-p`

```
root-shell# wp-mirror --mirror
...
[....]warn-if-database-stored-on-virtual-disk-p
[info]/dev/sda: disk identification found
[ ok ]warn-if-database-stored-on-virtual-disk-p
```

WP-MIRROR initially warns if the underlying disk(s) do not provide identification. This happens when WP-MIRROR is installed on a virtual machine, in which case, `hdparm` throws an error message like:

```
root-shell# hdparm -I /dev/vda
/dev/vda:
HDIO_DRIVE_CMD(identify) failed: Inappropriate ioctl for device
```

and WP-MIRROR issues:

```
root-shell# wp-mirror --mirror
...
[....]warn-if-database-stored-on-virtual-disk-p
[info]/dev/vda: disk identification NOT found
[warn]warn-if-database-stored-on-virtual-disk-p
```

and continues processing.

5.1.4.8 `assert-hdd-write-cache-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-hdd-write-cache-p
```

MediaWiki stores its articles in `InnoDB`, which is `MySQL`'s ACID compliant storage engine that is used for transactions. The issue here is Durability (the 'D' in ACID). A committed transaction should be stored in a way that is resistant to many kinds of failure, including power outage. Transactions that `COMMIT` must actually be written to disk, and not retained in the HDDs `write cache`, where it may be lost during system failure. It is therefore important that the disk's `write cache` either be disabled or flushed immediately after each checkpoint (and both are configurable).

WP-MIRROR first identifies the disk(s) that hold the `InnoDB table space`. Next WP-MIRROR attempts to configure the write cache for each such disk. Finally, WP-MIRROR asserts that the `write cache(s)` have been successfully configured.

If `hdparm` cannot obtain identification from the disk(s), as is the case when WP-MIRROR is installed on a virtual machine, then this assertion is allowed to fail; in which case, WP-MIRROR issues:

```
root-shell# wp-mirror --mirror
...
[fail]assert-hdd-write-cache-p
```

and continues processing.

5.1.4.9 `warn-if-no-hugepages-allocated-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]warn-if-no-hugepages-allocated-p
```

WP-MIRROR initially determines if hugepages have been allocated. If no hugepages have been allocated, the message looks like:

```
root-shell# wp-mirror --mirror
...
[....]warn-if-no-hugepages-allocated-p
[info]hugepage size (total/free/resv):  2048[kB] (  0/  0/  0)
[warn]warn-if-no-hugepages-allocated-p
```


5.1.4.10 `assert-internet-access-to-wikimedia-site-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-internet-access-to-wikimedia-site-p
```

WP-MIRROR requires Internet access for some of its tasks. Therefore, WP-MIRROR initially (and periodically) asserts Internet access. If initially there is no access, WP-MIRROR exits. However, in all other circumstances, WP-MIRROR sleeps for 10s (default) and tries again until access is restored.

5.1.5 The Finite State Machine

Most of what WP-MIRROR does is file processing.

Depending on circumstances, files may be: downloaded, validated, parsed, decompressed, counted, split into smaller files, imported into [MediaWiki](#), have their permissions changed, deleted, etc. In most cases, files can be processed concurrently, while in other cases, they must be processed in a specific order.

For WP-MIRROR 0.2 and before, process scheduling was handled by hundreds of lines of ‘spaghetti code’, which soon became a maintenance headache. Whereas the human mind struggles with large blocks of code, and whereas the human mind readily grasps data in tabular format, the experienced engineer looks for ways to replace the former with the later.

For WP-MIRROR 0.3 and later versions: 1) Every file is assigned a:

- **type** (one of `database`, `table`, `checksum`, `xdump`, `xml`, `xchunk`, `sdump`, `sml`, `schunk`, `idump`, `ichunk`, `images`, and `error`), and a
- **state** (one of `start`, `created`, `valid`, `pending`, `done`, `fail`, and `error`).

This information is stored in the `wpmirror.file` database table.

2) A Finite State Machine (FSM) is employed. This requires very few lines of code, because all decision-making is lodged in a set of three tables:

- ***state-transition*** describes how a file changes state according to events (`start`, `done`, or `fail`);
- ***type-state-function*** describes what function (`fsm-file-download`, `fsm-file-decompress`, etc.) is applied to a file of a given **type** and **state**; and
- ***type-state-priority*** describes the order in which files are processed, and if they may be processed concurrently.

These FSM tables are shown below:

- For ***state-transition*** see [Figure 5.1, FSM State Transition Diagram](#) and the top part of [Table 5.2, FSM Tables *state-transition* and *type-state-function*](#);
- For ***type-state-function*** see the bottom part of [Table 5.2, FSM Tables *state-transition* and *type-state-function*](#); and
- For ***type-state-priority*** see [Table 5.3, FSM Priority Table *type-state-priority*](#).

Figure 5.1: FSM State Transition Diagram

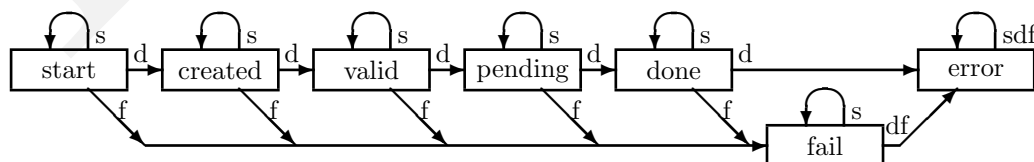


Table 5.2: FSM Tables `*state-transition*` and `*type-state-function*`

Event	State			
	start	created	valid	pending
start	start	created	valid	pending
done	created	valid	pending	done
fail	fail	fail	fail	fail

File type	State			
	start	created	valid	pending
database	fsm-database-grant	fsm-database-create	fsm-database-update	fsm-database-checksum
table	fsm-table-block-size	fsm-table-drop-index	fsm-table-add-index	fsm-no-op
checksum	fsm-file-download	fsm-file-digest	fsm-file-parse	fsm-no-op
xdump	fsm-file-download	fsm-file-validate	fsm-file-decompress	fsm-no-op
xml	fsm-file-count	fsm-file-digest	fsm-file-split-xml	fsm-file-remove
xchunk	fsm-file-count	fsm-file-digest	fsm-file-process-xml	fsm-file-remove
sdump	fsm-file-download	fsm-file-validate	fsm-file-split-sdump	fsm-no-op
sql	fsm-no-op	fsm-file-digest	fsm-file-split-sql	fsm-file-remove
schunk	fsm-no-op	fsm-no-op	fsm-file-load-insert	fsm-file-remove
dchunk	fsm-no-op	fsm-no-op	fsm-file-load-insert	fsm-file-remove
idump	fsm-file-download	fsm-no-op	fsm-file-extract	fsm-file-remove
ichunk	fsm-file-list-missing	fsm-no-op	fsm-file-wget	fsm-file-remove
images	fsm-images-directory	fsm-database-rebuild	fsm-no-op	fsm-no-op

Event	State		
	done	fail	error
start	done	fail	error
done	done	fail	error
fail	error	error	error

File type	State		
	done	fail	error
database	fsm-no-op	fsm-abort	fsm-abort
table	fsm-no-op	fsm-abort	fsm-abort
checksum	fsm-no-op	fsm-abort	fsm-abort
xdump	fsm-no-op	fsm-abort	fsm-abort
xml	fsm-no-op	fsm-abort	fsm-abort
xchunk	fsm-no-op	fsm-abort	fsm-abort
sdump	fsm-no-op	fsm-abort	fsm-abort
sql	fsm-no-op	fsm-abort	fsm-abort
schunk	fsm-no-op	fsm-abort	fsm-abort
dchunk	fsm-no-op	fsm-abort	fsm-abort
idump	fsm-no-op	fsm-abort	fsm-abort
ichunk	fsm-no-op	fsm-abort	fsm-abort
images	fsm-no-op	fsm-abort	fsm-abort

Table 5.3: FSM Priority Table `*type-state-priority*`

Priority	Type	State	Concurrent	Image	Commons	Function
highest	database	pending	t	t	t	fsm-database-checksum
	database	valid	t	t	t	fsm-database-update
	database	created	t	t	t	fsm-database-create
	database	start	t	t	t	fsm-database-grant
	table	pending	t	t	t	fsm-no-op
	table	start	nil	t	t	fsm-table-block-size
	checksum	pending	t	t	t	fsm-no-op
	checksum	valid	t	t	t	fsm-file-parse
	checksum	created	t	t	t	fsm-file-digest
	checksum	start	nil	t	t	fsm-file-download
	xdump	pending	t	t	nil	fsm-file-remove
	xdump	valid	t	t	nil	fsm-file-decompress
	xdump	created	t	t	nil	fsm-file-validate
	xdump	start	nil	t	nil	fsm-file-download
	xml	pending	t	t	nil	fsm-file-remove
	xml	valid	t	t	nil	fsm-file-split-xml
	xml	created	t	t	nil	fsm-file-digest
	xml	start	t	t	nil	fsm-file-count
	xchunk	pending	t	t	nil	fsm-file-remove
	xchunk	valid	t	t	nil	fsm-file-process-xml
	xchunk	created	t	t	nil	fsm-file-digest
	xchunk	start	t	t	nil	fsm-file-count
	sdump	pending	t	t	t	fsm-file-remove
	sdump	valid	t	t	t	fsm-file-split-sdump
	sdump	created	t	t	t	fsm-file-validate
	sdump	start	nil	t	t	fsm-file-download
	sql	pending	t	t	t	fsm-file-remove
	sql	valid	t	t	t	fsm-file-split-sql
	sql	created	t	t	t	fsm-file-digest
	sql	start	t	t	t	fsm-no-op
	table	created	t	t	t	fsm-table-drop-index
	schunk	pending	t	t	t	fsm-file-remove
	schunk	valid	nil	t	t	fsm-file-load-insert
	schunk	created	t	t	t	fsm-no-op
	schunk	start	t	t	t	fsm-no-op
	dchunk	pending	t	t	t	fsm-file-remove
	dchunk	valid	nil	t	t	fsm-file-load-insert
	dchunk	created	t	t	t	fsm-no-op
	dchunk	start	t	t	t	fsm-no-op
	table	valid	nil	t	t	fsm-table-add-index
	idump	pending	t	nil	nil	fsm-file-remove
	idump	valid	nil	nil	nil	fsm-file-extract
	idump	created	t	nil	nil	fsm-no-op
	idump	start	nil	nil	nil	fsm-file-download
	images	created	t	nil	t	fsm-database-rebuild
	images	start	t	nil	t	fsm-images-directory
	ichunk	pending	t	nil	nil	fsm-file-remove
	ichunk	valid	nil	nil	nil	fsm-file-wget
	ichunk	created	t	nil	nil	fsm-no-op
	ichunk	start	nil	nil	nil	fsm-file-list-missing
	images	valid	t	nil	t	fsm-no-op
lowest	images	pending	t	nil	t	fsm-no-op

5.1.6 The Finite State Machine—Step by Step

```
root-shell# wp-mirror --mirror
...
-----mirror-mode-begin-----
[ ok ] fsm-boot
[ ok ] release-all-file-semaphores
[ ok ] fsm-database-grant simplewiki
[ ok ] fsm-database-create simplewiki
[ ok ] fsm-database-update simplewiki
[ ok ] fsm-database-checksum simplewiki
[ ok ] fsm-file-download simplewiki-20121106-md5sums.txt
[ ok ] fsm-file-digest simplewiki-20121106-md5sums.txt
[ ok ] fsm-file-parse simplewiki-20121106-md5sums.txt
[ ok ] fsm-no-op simplewiki-20121106-md5sums.txt
```

The FSM works as follows:

Step 0: Boot FSM. The function `fsm-boot` inserts into the `wp-mirror.file` table, one row for each language you desire. Each row contains the name of a database that holds the pages and articles (the default is `simplewiki`), its `type` (`database`), its `state` (`start`), and a semaphore (set to 1).

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type    | state | semaphore |
+-----+-----+-----+-----+
| simplewiki | database | start |          1 |
+-----+-----+-----+-----+
```

Step 1: Prioritize rows. The FSM orders these rows according to the `*type-state-priority*` table. For any given row, the values of `concurrent`, `image`, and `commons` control whether or not the function in that row will be executed.

Concurrent	Image	Commons	Function
t	t	t	runs unconditionally
nil	t	t	runs if <code>*main-mode*</code> is <code>:first-mirror</code>
t	nil	t	runs if <code>*mirror-image-download-p*</code>
t	t	nil	runs if <code>wiki</code> is not <code>commonswiki</code>

The default is to have media files for the selected wikis, but not the entire `commons` collection which occupies nearly 20T (as of 2013):

```
(defparameter *mirror-image-download-p* t)
```

The default can be changed in two ways:

- **Media:** If an user wants no media files, then edit `/etc/wp-mirror/local.conf` to contain:

```
(defparameter *mirror-image-download-p* nil)
```

- **Commons:** If an user wants the entire `commons` media file collection (and has the storage), then edit `/etc/wp-mirror/local.conf` to contain:

```
(defparameter *mirror-language-code-list* ('('commonswiki' 'simple')))
```

Step 2: Grab semaphore. The FSM grabs the semaphore for the highest priority row.

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

```
+-----+-----+-----+-----+
| name      | type      | state | semaphore |
+-----+-----+-----+-----+
| simplewiki | database  | start |          0 |
+-----+-----+-----+-----+
```

Caveat: This is true only for the `:first-mirror` instance. The `:next-mirror` instance (if any) grabs the semaphore of the highest priority row for which the `concurrent` value in the `*type-state-priority*` table is `t`. See §5.1.8, [Concurrency](#) for details.

Step 3: Look-up function. The FSM looks up the appropriate function from the `*type-state-function*` table. In this case, the function is `fsm-database-create`.

File type	State			
	start	created	valid	...
database	fsm-database-grant	fsm-database-create	fsm-database-update	...
checksum	fsm-file-download	fsm-file-digest	fsm-file-parse	...
...

Step 4: Apply function. The FSM applies the function to the file. In this case, `fsm-database-create` loads a (nearly) empty `database` from the database template file `/usr/share/mediawiki/maintenance/database_farm.sql`.

Step 5: Capture return value. The FSM captures the return value of the function (either `done` or `fail`).

Step 6: Look-up state transition. The FSM looks up the next `state` from the `*state-transition*` table. In this case, if the function returned `done`, then the next `state` will be `created`.

Event	State			
	start	created	valid	...
start	start	created	valid	...
done	created	valid	pending	...
fail	fail	fail	fail	...

File type	State			
	start	created	valid	...
database	fsm-database-grant	fsm-database-create	fsm-database-update	...
...

Step 7: Change state. The FSM updates the row in the `wpmirror.file` database table with the value of the next state.

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

```
+-----+-----+-----+-----+
| name      | type      | state | semaphore |
+-----+-----+-----+-----+
| simplewiki | database  | created |          0 |
+-----+-----+-----+-----+
```

Step 8: Release semaphore. The FSM releases the semaphore.

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

```
+-----+-----+-----+-----+
| name      | type      | state | semaphore |
+-----+-----+-----+-----+
| simplewiki | database  | created |          1 |
+-----+-----+-----+-----+
```

Step 9: Repeat until done. The FSM then returns to **Step 1**, and continues processing until all rows in the table are in an end `state` (`done` or `fail`). The `error state` is never reached unless the FSM itself contains an error.

Some functions insert additional rows into the `wpmirror.file` database (and these are colored in [Table 5.2, FSM Tables *state-transition* and *type-state-function*](#)). They are: `fsm-database-checksum`, `fsm-file-parse`, `fsm-file-decompress`, `fsm-file-split-sql`, and, `fsm-file-split-xml`, `fsm-file-scrape`, and `fsm-file-convert-xml2sql`. See [§5.1.9, The fsm-* Functions](#) for details.

5.1.7 Check-pointing

Process interruptions happen (power failure, laptops closed, cat walks across the keyboard).

Whenever WP-MIRROR resumes after an interruption, the FSM finds the state of every file in the `wpmirror.file` database table just as it was before the interruption. In other words, every time the FSM inserts or updates a row in the `wpmirror.file` database table, the FSM is making a check-point.

Due to check-pointing, no completed task (meaning, for which the semaphore was released) is ever repeated. This is critical for mirroring the large wikipedias, where the initial build could take weeks, and where starting over would be unacceptable.

5.1.8 Concurrency

Experiments show that, for the desktop case, concurrent processing can reduce total run time (wall clock time) by a factor of two or three. For the desktop case, the recommended number of WP-MIRROR instances that may run concurrently is:

- one instance per CPU in `:first-mirror` or `:next-mirror` mode, for importing `xchunks`,
- one or two instances in `:next-mirror` mode, for downloading media files, and
- one instance in `:monitor` mode;

Although, for the laptop case, experiments show that the recommended number is only:

- one instance in `:first-mirror` mode, and
- one instance in `:monitor` mode.

Concurrent processing does however require a mechanism to prevent two WP-MIRROR instances from attempting to process the same file at the same time. Each WP-MIRROR instance must be isolated (the ‘I’ in ACID) from every other instance.

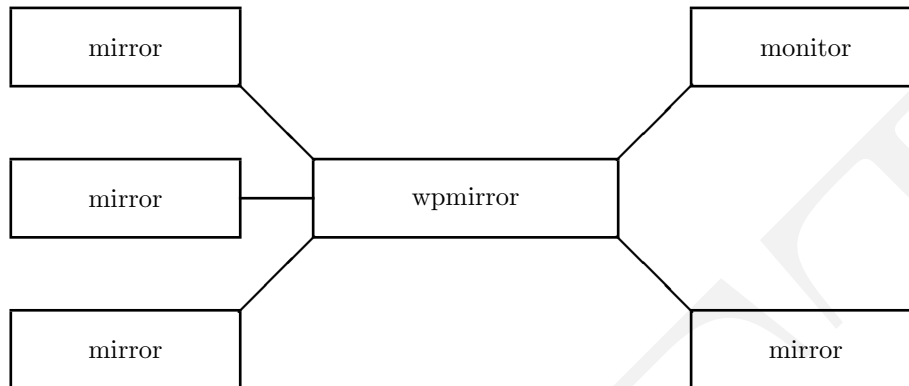
Here is how we enforce isolation:

First, we require each file to have a `type` and a `state` recorded in a row in the `wpmirror.file` table.

Second, in [Table 5.3, FSM Priority Table *type-state-priority*](#) there is a column labeled `concurrent`, which indicates whether or not that file may be processed concurrently with other files. For example, an `xml` file may be processed concurrently with any other file.

Third, we require every WP-MIRROR instance to communicate state *only* via an ACID compliant transactional database storage engine, such as `InnoDB`. See [Figure 5.2, WP-MIRROR Instances Must Communicate State *Only* via the wpmirror Database](#).

Fourth, every row in the `wpmirror.file` database table must have a value in its semaphore field. The schema for `wpmirror.file` is:

Figure 5.2: WP-MIRROR Instances Must Communicate State *Only* via the `wpmirror` Database

```

mysql> SHOW CREATE TABLE 'wpmirror'.'file'\G
***** 1. row *****
      Table: file
Create Table: CREATE TABLE 'file' (
  'timestamp' timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP
              ON UPDATE CURRENT_TIMESTAMP,
  'project'    varchar(20) NOT NULL DEFAULT 'error',      -- e.g. 'wikipedia'
  'wiki'       varchar(30) NOT NULL DEFAULT 'error',      -- e.g. 'simplewiki'
  'language_code' varchar(20) NOT NULL DEFAULT 'error',   -- e.g. 'simple'
  'date'       varchar(8)  NOT NULL DEFAULT 'error',      -- e.g. '20121106'
  'name'       varchar(80) NOT NULL DEFAULT 'error',
  'size'       bigint(20) unsigned NOT NULL DEFAULT '0', -- [0-18e18]
  'md5sum'     varchar(32) NOT NULL DEFAULT 'error',
  'type'       enum('database','checksum','xdump','idump','xml','sql',
                   'xchunk','schunk','ichunk','images','error')
              NOT NULL DEFAULT 'error',
  'state'      enum('start','created','valid','pending','done','fail','error')
              NOT NULL DEFAULT 'error',
  'page'       int(10) unsigned NOT NULL DEFAULT '0',
  'pages'      int(10) unsigned NOT NULL DEFAULT '0',      -- usually 1000
  'images'     int(10) unsigned NOT NULL DEFAULT '0',
  'updates'    int(10) unsigned NOT NULL DEFAULT '0',
  'semaphore'  int(10) unsigned NOT NULL DEFAULT '1',      -- [0-1]
  PRIMARY KEY ('name')
)ENGINE=InnoDB DEFAULT CHARSET=utf8;                -- ACID compliant

```

Fifth, we require every WP-MIRROR instance to obey the following semaphore rules:

- **Rule 1:** Before a WP-MIRROR instance is allowed to process a file, it must first:
 - look up the corresponding row in the `wpmirror.file` table,
 - determine if the semaphore's value is '1', and if so,
 - set the semaphore's value to '0'.
- **Rule 2:** After a WP-MIRROR instance finishes processing a file, it must:
 - capture the fsm-function's return value (`done` or `fail`),
 - look up the next state in the `*state-transition*` table,
 - update the state's value, and
 - set the semaphore's value to '1'.

The (colored) items in **Rule 1** above must be done together as a single transaction (otherwise two processes could simultaneously grab the semaphore and begin processing the corresponding file). This is done using the following atomic (the ‘A’ in ACID) transaction:

```
START TRANSACTION;                                -- atomic transaction

SELECT @name := 'name' AS 'name', @semaphore := 'semaphore' AS 'semaphore', 'id'
FROM 'wpmirror'.'file', 'wpmirror'.'priority'
WHERE 'file'.'type'='priority'.'type'
AND   'file'.'state'='priority'.'state'
AND   ('wiki'<>'commonswiki' OR 'commons'=1)
AND   'semaphore'=1                                -- semaphore is free
ORDER BY 'id', 'name'
LIMIT 1
FOR UPDATE;                                       -- set IX lock on row

UPDATE 'wpmirror'.'file' SET 'semaphore'=0        -- semaphore is grabbed
WHERE name=@name;

COMMIT;                                           -- atomic transaction
```

When InnoDB sees the `SELECT ...FOR UPDATE` command, it sets an `IX` lock on the row. This lock is *intention exclusive*, meaning, the transaction intends to set an `X` lock on the row. An `X` lock is *exclusive*, so when InnoDB grants the `X` lock, all other processes are then prevented from accessing that row until the lock is released.

5.1.9 The `fsm-*` Functions

```
root-shell# wp-mirror --mirror
...
-----mirror-mode-begin-----
[ ok ] fsm-boot
[ ok ] release-all-file-semaphores
[ ok ] fsm-database-grant simplewiki
[ ok ] fsm-database-create simplewiki
[ ok ] fsm-database-update simplewiki
[ ok ] fsm-database-checksum simplewiki
[ ok ] fsm-file-download simplewiki-20121106-md5sums.txt
[ ok ] fsm-file-digest simplewiki-20121106-md5sums.txt
[ ok ] fsm-file-parse simplewiki-20121106-md5sums.txt
[ ok ] fsm-no-op simplewiki-20121106-md5sums.txt
...
```

This section contains detailed descriptions of each of the functions that are applied to files by the FSM.

5.1.9.1 `fsm-abort`

Purpose: Abort the FSM.

Motivation: The `fsm-abort` function would only be invoked if a file ended up in the `error state`. This can only happen if there is an error in the FSM itself (either in its code or in one of its three tables).

5.1.9.2 `fsm-boot`

Purpose: Initialize the Finite State Machine.

FSM before:


```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
Empty set (0.05 sec)
```

FSM function: Insert into the `wp-mirror.file` table, one row for each language you desire. Each row contains the name of the database that will hold the pages and articles (the default is `simplewiki`), its `type` (`database`), its `state` (`start`), and a semaphore (set to 1).

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type      | state | semaphore |
+-----+-----+-----+-----+
| simplewiki | database  | start |          1 |
+-----+-----+-----+-----+
```

5.1.9.3 fsm-database-checksum

Purpose: Insert record for the `checksum` file, the `idump` files, and for each `table` that will be stored with a compressed page size.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type      | state | semaphore |
+-----+-----+-----+-----+
| simplewiki | database  | pending |          1 |
+-----+-----+-----+-----+
```

FSM function: `fsm-database-checksum` inserts a record for the `checksum`, `idump`, and `table` files (the default values are shown below).

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name                                             | type      | state | semaphore |
+-----+-----+-----+-----+
| simplewiki                                     | database  | done  |          1 |
| simplewiki-20121106-md5sums.txt                 | checksum  | start |          1 |
| simplewiki-20121201-local-media-1.tar           | idump     | start |          1 |
| simplewiki-20121201-remote-media-1.tar          | idump     | start |          1 |
| simplewiki.categorylinks                       | table     | start |          1 |
| simplewiki.externallinks                       | table     | start |          1 |
| simplewiki.image                               | table     | start |          1 |
| simplewiki.imagelinks                          | table     | start |          1 |
| simplewiki.langlinks                           | table     | start |          1 |
| simplewiki.pagelinks                           | table     | start |          1 |
| simplewiki.templatelinks                       | table     | start |          1 |
| simplewiki.text                                | table     | start |          1 |
+-----+-----+-----+-----+
```

5.1.9.4 fsm-database-create

Purpose: Create a (nearly) empty database from the database template file `/var/lib/mediawiki/maintenance/database_farm.sql`.

Motivation: WP-MIRROR must be able to mirror wikipeidias of more than one language. Each wikipedia must be Isolated (the 'I' in ACID) from every other, so that one may `CREATE` or `DROP` a wikipedia without touching any other.

For each wikipedia, WP-MIRROR asserts (and if necessary `CREATES`) a separate database with a name like `xxwiki`, where `xx` stands for a language code. Each of these databases have the same table structure and are indeed `CREATED` from the same `database template`.

WP-MIRROR uses Debian credentials to `CREATE` these databases, and to `GRANT` privileges on them to the `wikiadmin` and `wikiuser` database accounts.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type      | state  | semaphore |
+-----+-----+-----+-----+
| simplewiki | database  | created |          1 |
+-----+-----+-----+-----+
```

FSM function: `fsm-database-create` first checks if the database already exists. If it does not, then `fsm-database-create` creates it using the database template file `/var/lib/mediawiki/maintenance/database_farm.sql`.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type      | state  | semaphore |
+-----+-----+-----+-----+
| simplewiki | database  | valid  |          1 |
+-----+-----+-----+-----+
```

5.1.9.5 `fsm-database-grant`

Purpose: `GRANT` database `PRIVILEGES` to the user accounts `wikiadmin` and `wikiuser`.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type      | state  | semaphore |
+-----+-----+-----+-----+
| simplewiki | database  | start  |          1 |
+-----+-----+-----+-----+
```

FSM function: `fsm-database-grant`, using the Debian credentials:

- `GRANTS` elevated database privileges to the user `wikiadmin`. Namely, `GRANT ALL PRIVILEGES ON` the database.
- `GRANTS` limited database privileges to the user `wikiuser`. Namely, `SELECT`, `INSERT`, `UPDATE`, and `DELETE` privileges on the database.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type      | state  | semaphore |
+-----+-----+-----+-----+
| simplewiki | database  | created |          1 |
+-----+-----+-----+-----+
```

5.1.9.6 `fsm-database-rebuild`

Purpose: Rebuild database table `titlekey`.

Motivation: `titlekey` is an index of the page names found in the database table `page`. Therefore `titlekey` should be rebuilt each time after `page` is populated or updated.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type    | state  | semaphore |
+-----+-----+-----+-----+
| simplewiki | images  | created |          1 |
+-----+-----+-----+-----+
```

FSM function: `fsm-database-rebuild` rebuilds the `titlekey` database table by invoking the WP-MIRROR utility `/var/lib/mediawiki/extensions/TitleKey/rebuildTitleKeys_farm.php` which in turn invokes the `TitleKey` extension utility `/var/lib/mediawiki/extensions/TitleKey/rebuildTitleKeys.`

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type    | state  | semaphore |
+-----+-----+-----+-----+
| simplewiki | images  | valid   |          1 |
+-----+-----+-----+-----+
```

5.1.9.7 `fsm-database-update`

Purpose: Update database schema to the latest used by WP-MIRROR.

Motivation: WP-MIRROR, `mwxml2sql`, and `MediaWiki` all must use or expect the same database schema.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type    | state  | semaphore |
+-----+-----+-----+-----+
| simplewiki | database | valid   |          1 |
+-----+-----+-----+-----+
```

FSM function: `fsm-database-update` updates the database schema by invoking the WP-MIRROR utility `/var/lib/mediawiki/maintenance/update_farm.php` which in turn invokes the `MediaWiki` utility `/var/lib/mediawiki/maintenance/update.php`.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name      | type    | state  | semaphore |
+-----+-----+-----+-----+
| simplewiki | database | pending |          1 |
+-----+-----+-----+-----+
```

5.1.9.8 `fsm-file-convert-xml2sql`

Purpose: Convert an `xchunk` file into `schunk` files.

Motivation: An `xchunk` can not be directly loaded into the database. `fsm-file-convert-xml2sql` uses `mwxml2sql` which quickly converts an `xchunk` into three `schunks`.

FSM before: The third row will be processed with the `fsm-file-convert-xml2sql` function:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	valid	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	valid	1
...	xchunk	valid	1
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

FSM function: The `fsm-file-convert-xml2sql` function converts the `xchunk` file, into three `schunk` files.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	pending	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	valid	1
...	xchunk	valid	1
simplewiki-20121106-pages-articles.xml	xml	pending	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1
simplewiki-20121106-page-p000000000-c000001000.sql	schunk	start	1
simplewiki-20121106-revision-p000000000-c000001000.sql	schunk	start	1
simplewiki-20121106-text-p000000000-c000001000.sql	schunk	start	1

5.1.9.9 fsm-file-count

Purpose: Estimate the number of pages and media files.

Motivation: Estimate the work load early in the mirror building process. This information is displayed in `:monitor` mode, so as to give the user early notice as the work required to build the mirror.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles.xml	xml	start	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	pending	1

FSM function: `fsm-file-count` scans the decompressed `xdump` file to:

- count the number of articles (that may be inserted into the database), and
- to estimate the number of media files (that may be downloaded).

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles.xml	xml	created	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	pending	1

5.1.9.10 fsm-file-decompress

Purpose: To decompress a `xdump` file using `bunzip2` and thereby generate an `xml` file.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	valid	1

FSM function: The `fsm-file-decompress` function decompresses the `xdump` file, thereby creating an `xml` file, which is then entered into the `wpmirror.file` database table.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles.xml	xml	start	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	pending	1

5.1.9.11 fsm-file-digest

Purpose: Compute the `md5sum` of a file.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	created	1

FSM function: The `fsm-file-digest` function computes the `md5sum` of the file, which is then entered into the `wpmirror.file` database table (in a field that is not shown in the example here).

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	valid	1

5.1.9.12 fsm-file-download

Purpose: Used to download `checksum`, `xdump`, `sdump`, and `idump` files.

FSM before: Here we are about to download a `checksum` file.

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	start	1

FSM function: `fsm-file-download` invokes `wget` to download the `checksum` file.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	created	1

5.1.9.13 fsm-file-extract

Purpose: Used to extract `idump` (media dump tarball).

FSM before: Here we are about to extract the `idump` file.

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-local-media-1.tar	idump	valid	1
simplewiki-20121106-remote-media-1.tar	idump	valid	1

FSM function: `fsm-file-extract` invokes `tar` to extract the `idump` file.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-local-media-1.tar	idump	pending	1
simplewiki-20121106-remote-media-1.tar	idump	valid	1

5.1.9.14 `fsm-file-import-xml`

Note: For WP-MIRROR 0.7, the obsolete `fsm-file-import` has been brought back and named `fsm-file-import-xml`. This function was brought back to enable testing for functional and performance differences between `fsm-file-import-xml` and `fsm-file-convert-xml2sql`.

Purpose: To have MediaWiki import the articles into the `xxwiki` database (where `xx` stands for the language-code).

Motivation: The `xdumps` for the largest wikipeidias contain millions of articles, which if processed all in one go, would take weeks to complete—if nothing were to go wrong. In fact one always encounters various kinds of failure along the way. In part, this is because, for many years, the Wikimedia Foundation has been unable to generate error free dumps.

Therefore, for robustness and simplicity, both for mirroring and monitoring, WP-MIRROR splits `xdump` files into thousands of smaller `xml` files, called `xchunks`, each containing just 1000 articles (default). WP-MIRROR runs them by forking a separate sub-process for each `xchunk`. The successful processing of all but a few `xchunks` is achievable.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.sh	ichunk	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	pending	1
simplewiki-20121106-pages-articles-p000001000-c000001000.sh	ichunk	done	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	pending	1
...	1
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

FSM function: The `fsm-file-import-xml` invokes

```
root-shell# /usr/bin/php /usr/share/mediawiki/maintenance/importDump_farm.php \
simplewiki-20121106-pages-articles-p000000000-c000001000.xml
```

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.sh	ichunk	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	done	1
simplewiki-20121106-pages-articles-p000001000-c000001000.sh	ichunk	done	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	pending	1
...	1
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

5.1.9.15 `fsm-file-list-missing`

Purpose: Identify any media files that are missing and make a list of URLs from which these files may be downloaded.

Motivation: Minimize the number of missing media files.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-local-media-0-00	ichunk	start	1
simplewiki-20121106-local-media-0-01	ichunk	start	1
...
simplewiki-20121106-local-media-f-ff	ichunk	start	1
simplewiki-20121106-remote-media-0-00	ichunk	start	1
...
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

FSM function: The `fsm-file-list-missing` function has two cases:

- for a `local-media ichunk`, it forms a list by taking the filenames found both in `simplewiki.imagelinks.il_to` and in `simplewiki.image.img_name`, less the filenames found in the directory tree under `./wikipedia/simple/`, or
- for a `remote-media ichunk`, it forms a list by taking the filenames found both in `simplewiki.imagelinks.il_to` and in `commonswiki.image.img_name`, less the filenames of images stored in the directory tree under `./wikipedia/commons/`.

The function outputs a file, the `ichunk`, containing URLs where the missing media files may be found.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-local-media-0-00	ichunk	created	1
simplewiki-20121106-local-media-0-01	ichunk	start	1
...
simplewiki-20121106-local-media-f-ff	ichunk	start	1
simplewiki-20121106-remote-media-0-00	ichunk	start	1
...
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

5.1.9.16 `fsm-file-parse`

Purpose: Scrape a `checksum` file for the names of `xdump` and `sdump` files.

FSM before:


```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	valid	1

FSM function: The `fsm-file-parse` function reads the `checksum` file and looks up the name of the `sdump` and `xdump` files, which are then entered into the `wpmirror.file` database table.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-categorylinks.sql.gz	sdump	start	1
simplewiki-20121106-category.sql.gz	sdump	start	1
simplewiki-20121106-externallinks.sql.gz	sdump	start	1
simplewiki-20121106-imagelinks.sql.gz	sdump	start	1
simplewiki-20121106-image.sql.gz	sdump	start	1
simplewiki-20121106-interwiki.sql.gz	sdump	start	1
simplewiki-20121106-iwlinks.sql.gz	sdump	start	1
simplewiki-20121106-langlinks.sql.gz	sdump	start	1
simplewiki-20121106-md5sums.txt	checksum	pending	1
simplewiki-20121106-oldimage.sql.gz	sdump	start	1
simplewiki-20121106-pagelinks.sql.gz	sdump	start	1
simplewiki-20121106-page_props.sql.gz	sdump	start	1
simplewiki-20121106-page_restrictions.sql.gz	sdump	start	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	start	1
simplewiki-20121106-protected_titles.sql.gz	sdump	start	1
simplewiki-20121106-redirect.sql.gz	sdump	start	1
simplewiki-20121106-stub-articles.xml.gz	xdump	start	1
simplewiki-20121106-templatelinks.sql.gz	sdump	start	1

5.1.9.17 `fsm-file-process-xml`

Purpose: To process `xchunks`, either by converting them into `schunks` or by importing them into the wiki database.

- if the parameter `*mirror-process-xml*` is set to `:xml2sql`, then each `xchunk` is processed by `fsm-file-convert-xml2sql`;
- elseif `*mirror-process-xml*` is set to `:import`, then each `xchunk` is processed by `fsm-file-import-xml`;
- else fail and abort.

5.1.9.18 `fsm-file-remove`

Purpose: Delete a file from the file system.

Motivation: Files are deleted to save disk space.

Type	State	Comment
checksum	pending	Deleted to save disk space
xdump	pending	Deleted to save disk space
xml	pending	Deleted to save disk space
xchunk	pending	Deleted to save disk space
sdump	pending	Deleted to save disk space
sql	pending	Deleted to save disk space
schunk	pending	Deleted to save disk space
dchunk	pending	Deleted to save disk space
idump	pending	Deleted to save disk space
ichunk	pending	Deleted to save disk space

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	start	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	start	1
...	1
simplewiki-20121106-pages-articles.xml	xml	pending	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

FSM function: The `fsm-file-remove` function delete the file from the file system.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	start	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	start	1
...	1
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

5.1.9.19 `fsm-file-split-sdump`

Purpose: Divide a large `sdump` file into smaller `schunk` files (of 10 `INSERT`s each).

Motivation: The `sdumps` for the largest wikis contain millions of records, which if processed all in one go, would take weeks to complete—if nothing were to go wrong. In fact one always encounters various kinds of failure along the way.

Therefore, for robustness and simplicity, both for mirroring and monitoring, WP-MIRROR splits large `sql` files into smaller `schunks`, each containing just 10 `INSERT`s (default), where each `INSERT` statement may contain `VALUES` for 1000 records. The successful processing of all but a few `schunks` is achievable.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-categorylinks.sql.gz	sdump	valid	1

FSM function: The `fsm-file-split-sdump` function divides the `sql.gz` file into smaller `schunk` files, which are then entered into the `wpmirror.file` database table:

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-categorylinks-p000000000-c000000010.sql	schunk	start	1
simplewiki-20121106-categorylinks.sql.gz	sdump	pending	1

5.1.9.20 `fsm-file-split-xml`

Purpose: Divide a large `xdump` file into smaller `xchunk` files (of 10,000 articles each).

Motivation: The `xdumps` for the largest wikipeidias contain millions of articles, which if processed all in one go, would take weeks to complete—if nothing were to go wrong. In fact one usually encounters various kinds of failure along the way. In part, this is because, for many years (as of 2012), the Wikimedia Foundation has been unable to generate error free `xdumps`.

Therefore, for robustness and simplicity, both for mirroring and monitoring, WP-MIRROR splits `xdump` files into thousands of smaller `xml` files, called `xchunks`, each containing just 10,000 articles (default). The successful processing of all but a few `xchunks` is achievable.

This function also turns out to be a convenient place to locate some error correction code. `xdumps` contains thousands of incorrectly named pages. For example:

```
shell$ cat simplewiki-20140220-pages-articles.xml | grep "<title>Template:" | head
<title>Template:Stub</title>
<title>Template:NPOV</title>
<title>Template:Disputed</title>
<title>Template:Disambiguation</title>
<title>Template:TOC</title>
<title>Template:Uw-test1</title>
<title>Template:1911</title>
<title>Template:Please do not change this line</title>
<title>Template:Solar System</title>
<title>Template:Months</title>
```

All of the pages in the above example belong to namespace 10 (Templates), but none should have the word “Template:” prepended to the page title. Pages belonging to other namespaces (e.g. Category, Help, MediaWiki, Module, Wikipedia) are likewise incorrectly named. All such pages must be corrected, by removing the offending word, lest `MediaWiki` fail to find them in the underlying `simplewiki.page` table, and instead render them as red-links.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles.xml	xml	valid	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

FSM function: The `fsm-file-split-xml` function divides the `xml` file into about 160 (as of 2012) smaller `xchunk` files, which are then entered into the `wpmirror.file` database table:

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	start	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	start	1
...	xchunk	start	1
simplewiki-20121106-pages-articles.xml	xml	pending	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

When mirroring the `en wikipedia`, the `fsm-file-split-xml` function will insert over a thousand rows, which the FSM will process *seriatim*.

5.1.9.21 `fsm-file-validate`

Purpose: Compute the `md5sum` of the `xdump` file and compare it to the `md5sum` listed in the `checksum` file.

Motivation: The largest `xdump` files are several gigabytes. It is important to verify the integrity of the download process.

FSM before: The last row will be processed with the `fsm-file-validate` function:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	created	1

FSM function: The `fsm-file-validate` function computes the `md5sum` of the `xdump` file, and compares it to the `md5sum` that was provided in the `checksum` file.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	valid	1

5.1.9.22 fsm-file-wget

Purpose: Download media files from the Wikimedia Foundation.

Motivation: The largest wikipedias reference millions of media files. These are listed in the `xxwiki.imagelinks` table. If processed all in one go, downloading would take weeks to complete—if nothing were to go wrong. In fact one always encounters various kinds of failure along the way. In part, this is because many media file names contain control characters (such as ampersand, apostrophe, asterisk, backquote, brackets, braces, percent, quote, etc.) which make trouble for shell scripts and for database management systems.

Media files are stored under a directory tree like:

```
root-shell# cd /var/lib/mediawiki/images/
root-shell# find -type d
./wikipedia
./wikipedia/commons
./wikipedia/commons/0
./wikipedia/commons/0/00
...
./wikipedia/commons/thumb
./wikipedia/simple
./wikipedia/simple/0
./wikipedia/simple/0/00
...
./wikipedia/simple/tmp
./wikipedia/simple/math
./wikipedia/simple/thumb
./wiktionary
./wiktionary/simple
./wiktionary/simple/0
./wiktionary/simple/0/00
...
./wiktionary/simple/tmp
./wiktionary/simple/math
./wiktionary/simple/thumb
```

For robustness, both for mirroring and monitoring, WP-MIRROR creates one `ichunk` for each image subdirectory, and then runs them one at a time, by forking a separate sub-process for each `ichunk`. The successful processing of all but a few `ichunks` is achievable.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-local-media-0-00	ichunk	valid	1
simplewiki-20121106-local-media-0-01	ichunk	valid	1
...
simplewiki-20121106-local-media-f-ff	ichunk	valid	1
simplewiki-20121106-remote-media-0-00	ichunk	valid	1
...
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

FSM function: The `fsm-file-wget` function is quite simple. It simply invokes `wget` to download media files from the URLs listed in the `ichunk`.

In this example, the `ichunk simplewiki-yyyyymmdd-local-media-0-00` stores media files under `./wikipedia/simple/0/00/`, whereas the `ichunk simplewiki-yyyyymmdd-remote-media-0-00` stores media files under `./wikipedia/commons/0/00/`.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-local-media-0-00	ichunk	pending	1
simplewiki-20121106-local-media-0-01	ichunk	valid	1
...
simplewiki-20121106-local-media-f-ff	ichunk	valid	1
simplewiki-20121106-remote-media-0-00	ichunk	valid	1
...
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

5.1.9.23 `fsm-images-directory`

Purpose: Create directory tree for media files.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-images	ichunk	pending	1

FSM function: The `fsm-images-directory` function creates `/var/lib/mediawiki/images/wikipedia/simple/` and several sub-directories.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-images	images	valid	1

5.1.9.24 fsm-no-op

Purpose: Occupy an otherwise empty space in the `*type-state-function*` table. `fsm-no-op` simply returns with the return code `done`.

5.1.9.25 fsm-table-add-index

Purpose: `ADD` secondary indices (`KEYs`) to a database table.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	pending	1
simplewiki.categorylinks	table	valid	1
...	table	...	1

FSM function: `fsm-table-add-index` `ADDs` secondary indices by executing an `SQL` command like:

```
mysql> ALTER TABLE 'simplewiki'.'categorylinks'
-> ADD KEY 'cl_sortkey' ('cl_to','cl_type','cl_sortkey','cl_from'),
-> ADD KEY 'cl_timestamp' ('cl_to','cl_timestamp'),
-> ADD KEY 'cl_collation' ('cl_collation');
```

Secondary indices (`KEYs`) can greatly improve the `SELECT` performance of a table.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	pending	1
simplewiki.categorylinks	table	pending	1
...	table	...	1

5.1.9.26 fsm-table-block-size

Purpose: Compress on-disk storage for given table. See §G.8, [Experiments with InnoDB data compression](#).

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	pending	1
simplewiki.categorylinks	table	start	1
...	table	...	1

FSM function: `fsm-table-block-size` compresses on-disk storage to fit into smaller InnoDB page sizes. This presupposes that InnoDB storage format is Barracuda. `fsm-table-block-size` executes an SQL command like:

```
mysql> ALTER TABLE 'simplewiki'.'categorylinks'
-> ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4;
```

Compression improve the `SELECT` performance of a table.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	pending	1
simplewiki.categorylinks	table	created	1
...	table	...	1

5.1.9.27 `fsm-table-drop-index`

Purpose: `DROP` secondary indices (`KEYs`) to a database table.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	pending	1
simplewiki.categorylinks	table	created	1
...	table	...	1

FSM function: `fsm-table-drop-index` DROPs secondary indices (`KEYs`) by executing an SQL command like:

```
mysql> ALTER TABLE 'simplewiki'.'categorylinks'
-> DROP KEY 'cl_sortkey',
-> DROP KEY 'cl_timestamp',
-> DROP KEY 'cl_collation';
```

`DROP`ping secondary indices (`KEYs`) can greatly improve the `INSERT` performance of a table.

FSM after:


```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	pending	1
simplewiki.categorylinks	table	valid	1
...	table	...	1

5.1.10 Finalizing

```
-----finalizing-begin-----
[ ok ]update-mediawiki-localization-p
[ ok ]clear-pidfile
[ ok ]log-stop
```

5.1.10.1 update-mediawiki-localization-p

```
root-shell# wp-mirror --mirror
...
[ ok ]update-mediawiki-localization-p
...
```

MediaWiki has an extension, `LocalisationUpdate`, which is able to download updates to the localization of messages in MediaWiki core and extensions. These updates are cached under `/var/lib/wp-mirror-mediawiki/cache/`.

The WP-MIRROR utility `/var/lib/wp-mirror-mediawiki/extensions/LocalisationUpdate/localisationUpdate.php` calls the utility `/var/lib/wp-mirror-mediawiki/extensions/LocalisationUpdate/update.php`.

5.1.10.2 clear-pidfile

```
...
[ ok ]clear-pidfile
...
```

WP-MIRROR deletes the file `/var/run/wp-mirror.pid`.

5.1.10.3 log-stop

```
...
[ ok ]log-stop
...
```

WP-MIRROR stops writing messages to `/var/log/wp-mirror.log`.

5.1.11 Initializing (Obsolete)

5.1.11.1 assert-images-bad-directory-or-create-p (Obsolete)

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-images-bad-directory-or-create-p
```

Thousands of downloaded media files are corrupt. The two leading causes appear to be: incomplete download and proxy errors. These media files must be culled from the `images` directory tree. However, as a matter of safety, it is better to sequester than to delete corrupt files.

WP-MIRROR asserts (and if necessary creates) a directory tree in which the corrupt media files are sequestered for later inspection. This directory is `/var/lib/mediawiki/images/bad-images/` (default).

5.1.12 The `fsm-*` Functions (Obsolete)

Table 5.4: Finite State Machine Functions (Obsolete)

Function	Intr	Rem
<code>fsm-database-interwiki</code>	0.5	0.7
<code>fsm-file-import</code>	0.3	0.6
<code>fsm-file-scrape</code>	0.3	0.6
<code>fsm-file-shell</code>	0.3	0.6
<code>fsm-file-split-sql</code>	0.3	0.6
<code>fsm-file-xml2sql</code>	0.6	0.7
<code>fsm-images-count</code>	0.3	0.6
<code>fsm-images-chown</code>	0.3	0.6
<code>fsm-images-rebuild</code>	0.3	0.6
<code>fsm-images-validate</code>	0.3	0.6

5.1.12.1 `fsm-database-interwiki`

Obsolete: WP-MIRROR 0.7 saw the disappearance of interlanguage links from WMF dump files. This is because, during 2013, WMF centralized all interlanguage links into the [wikidata](#) project. Display of interlanguage links now require a [MediaWiki](#) extension.

Purpose: Enter Interwiki links (interlanguage links actually) into the `interwiki` database table. That is, enter one row for each wikipedia in the mirror. That way, interlanguage links will: 1) be treated as *magical connectors*, 2) appear in the Navigation Sidebar under the ‘Languages’ menu, and 3) when clicked, carry the user to the corresponding article in another language.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	pending	1
simplewiki-20121106-md5sums.txt	checksum	start	1
simplewiki.categorylinks	table	start	1
...	table	start	1

FSM function: Enter one row in the `interwiki` database table for each wikipedia. Each row specifies the language-code and URL of a wikipedia in the mirror.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	start	1
simplewiki.categorylinks	table	start	1
...	table	start	1

5.1.12.2 `fsm-file-import` (Obsolete)

Obsolete: WP-MIRROR 0.6 saw the introduction of `fsm-file-xml2sql` which invokes `mwxml2sql`—a utility announced in 2013-Feb by Ariel T. Glenn at the WMF. The new utility proved to have some performance advantage over `importDump.php` which `fsm-file-import` invokes.

Redux: WP-MIRROR 0.7 saw the return of this function under the new name `fsm-file-import-xml`.

5.1.12.3 `fsm-file-scrape` (Obsolete)

Obsolete: WP-MIRROR 0.6 saw the introduction of `fsm-file-list-missing` which has performance and reliability advantages over `fsm-file-scrape`.

Purpose: Given an `xchunk`, scrape it for the names of media files (if any), then write a shell script (to be used later for downloading the media files) to an `ichunk`.

FSM before: The first row below will be processed with the `fsm-file-scrape` function:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	pending	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	start	1
...	1
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

FSM function: The `fsm-file-scrape` function reads the `xchunk` file and scrapes out the names of any media files. `fsm-file-scrape` then generates a shell script (to be used for downloading these media files) and writes it into an `ichunk` file, which is then entered into the `wpmirror.file` database table:

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.sh	ichunk	start	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	done	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	start	1
...	1
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

5.1.12.4 `fsm-file-shell` (Obsolete)

Obsolete: WP-MIRROR 0.6 saw the introduction of `fsm-file-wget` which has performance and reliability advantages over `fsm-file-shell`.

Purpose: Execute `ichunks` to download media files from the Wikimedia Foundation.

Motivation: The `xdumps` for the largest wikipeidias reference millions of media files, which if processed all in one go, would take weeks to complete—if nothing were to go wrong. In fact one

always encounters various kinds of failure along the way. In part, this is because many media file names contain control characters (such as ampersand, apostrophe, asterisk, backquote, brackets, braces, percent, quote, etc.) which make trouble for shell scripts and for database management systems.

Therefor, for robustness, both for mirroring and monitoring, WP-MIRROR creates one `ichunk` for each `xchunk`, and then runs them one at a time, by forking a separate sub-process for each `ichunk`. The successful processing of all but a few `ichunks` is achievable.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.sh	ichunk	valid	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	pending	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	pending	1
...	1
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

FSM function: The `fsm-file-shell` function is quite simple. It simply runs a shell script which in this case is an `ichunk`.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-pages-articles-p000000000-c000001000.sh	ichunk	pending	1
simplewiki-20121106-pages-articles-p000000000-c000001000.xml	xchunk	pending	1
simplewiki-20121106-pages-articles-p000001000-c000001000.xml	xchunk	pending	1
...	1
simplewiki-20121106-pages-articles.xml	xml	done	1
simplewiki-20121106-pages-articles.xml.bz2	xdump	done	1

Design note. Introduced with version 0.2, WP-MIRROR offers a built-in alternative (default) to `wikix`. Compared to `wikix`, it takes much longer to generate `ichunks`. However the resulting `ichunks` are shorter, run faster, download more media files, and return fewer HTTP ‘400’ and ‘404’ errors. Moreover, whenever the Wikimedia Foundation posts a new `xdump` file and WP-MIRROR processes it, the built-in alternative first checks to see which media files are already downloaded before generating the `ichunks`. Thus the `ichunks` trend smaller and faster over time (containing just the new media files and the old problem cases). Then again `wikix` does download some files that the built-in alternative does not.

Beginning with version 0.4, the built-in alternative generates shell scripts that are POSIX compliant. Previously, the generated shell scripts contained “bashisms” that do not work with the Debian Almquist Shell `dash`. `dash` is a POSIX-compliant implementation of `/bin/sh`, that has become the default `/bin/sh` for Debian distributions.

The use of `wikix` is deprecated, because it generates shell scripts that are not POSIX compliant.

The presence of “bashisms” can be detected by invoking

```
shell$ checkbashisms simplewiki-20121106-pages-articles-p000000000-c000001000.sh
```

WP-MIRROR 0.6 (development) saw the removal of `wikix`. The built-in alternative is now called `fsm-file-scrape`.

WP-MIRROR 0.6 (production) saw the replacement of `fsm-file-scrape` with `fsm-file-list-missing` which has performance and reliability advantages.

5.1.12.5 `fsm-file-split-sql` (Obsolete)

Obsolete: WP-MIRROR 0.6 saw the introduction of `fsm-file-split-sdump` which has the combined functionality of `fsm-file-decompress` and `fsm-file-split-sql`, but with some performance advantage (runs faster and uses less storage).

Purpose: Divide a large decompressed `sdump` file into smaller `schunk` files (of 10 `INSERT`s each).

Motivation: The `sdumps` for the largest wikipeidias contain millions of records, which if processed all in one go, would take weeks to complete—if nothing were to go wrong. In fact one always encounters various kinds of failure along the way.

Therefore, for robustness and simplicity, both for mirroring and monitoring, WP-MIRROR splits large `sql` files into smaller `schunks`, each containing just 10 `INSERT`s (default), where each `INSERT` may contain `VALUES` for 1000 records. The successful processing of all but a few `schunks` is achievable.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-categorylinks.sql	sql	valid	1
simplewiki-20121106-categorylinks.sql.gz	sdump	done	1

FSM function: The `fsm-file-split-sql` function divides the `sql` file into smaller `schunk` files, which are then entered into the `wpmirror.file` database table:

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-20121106-categorylinks-p000000000-c000001000.sql	schunk	start	1
simplewiki-20121106-categorylinks.sql	sql	pending	1
simplewiki-20121106-categorylinks.sql.gz	sdump	done	1

5.1.12.6 `fsm-file-xml2sql` (Obsolete)

Obsolete: WP-MIRROR 0.7 saw the renaming of `fsm-file-xml2sql` to `fsm-file-convert-xml2sql`.

5.1.12.7 fsm-images-count (Obsolete)

Obsolete: WP-MIRROR 0.6 saw a rewrite of the `:monitor` modes, which no longer present media file counts and therefore no longer invoke `fsm-images-count`.

Purpose: Count the media files actually downloaded.

Motivation: This information is displayed by the `:monitor` instance. It give the user information regarding the media file download process.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-images	images	start	1

FSM function: The `fsm-images-count` function counts files under `/var/lib/mediawiki/images/wikipedia/simple/`.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-images	images	created	1

5.1.12.8 fsm-images-chown (Obsolete)

Obsolete: WP-MIRROR 0.6 saw the retirement of `fsm-file-import` which invoked `importDump.php`. `importDump.php` generated thumbs with `root:root` ownership. `fsm-images-chown` was used to change thumb ownership to `www-data:www-data`. Thumbs are now generated during browsing, and hence are created with `www-data:www-data` ownership.

Purpose: Set the ownership of media files, including the resized images (called thumbs) to `www-data:www-data`.

Motivation: WP-MIRROR runs as root, so any files created will initially have `root:root` ownership. However, `root:root` ownership prevents image resizing (making thumbs) during web browsing. If your browser renders a gray box where you expected a thumb, `root:root` ownership is the reason why.

FSM before:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-images	images	pending	1

FSM function: The `fsm-images-chown` function sets ownership of all directories and files under `/var/lib/mediawiki/images/wikipedia/simple/`.

FSM after:

```
mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
```

name	type	state	semaphore
simplewiki	database	done	1
simplewiki-20121106-md5sums.txt	checksum	done	1
simplewiki-images	images	done	1

5.1.12.9 fsm-images-rebuild (Obsolete)

Obsolete: WP-MIRROR 0.6 saw the introduction of `fsm-file-load-insert` which directly loads the `xxwiki.image` table with performance and reliability advantages over `fsm-images-rebuild`.

Purpose: To have MediaWiki rebuild the `xxwiki.image` database table (where `xx` stands for a language code).

Motivation: When media files are downloaded, the `xxwiki.image` database table will not be populated automatically. A maintenance script,

```
root-shell# /usr/bin/php /usr/share/mediawiki/maintenance/rebuildImages_farm.php \
simple.wpmirror.site
```

must be run for that purpose.

Design note. There are two choices about when to apply `fsm-images-rebuild`:

- If the `xxwiki.image` database table is populated *before* articles are imported, then resized images will be created during importation and stored under the `/var/lib/mediawiki/images/thumb/` directory.
- Otherwise, images are resized, and thumbs stored, at the time a browser subsequently accesses the article (which delays the rendering process and tries the patience of the user).

5.1.12.10 fsm-images-validate (Obsolete)

Obsolete: WP-MIRROR 0.6 saw the introduction of `fsm-file-wget` which as such reliability advantages over `fsm-file-shell` as to obviate the need for `fsm-images-validate`. WP-MIRROR 0.6 also saw the removal of `wpmirror.image` which had been used by `fsm-images-validate` to store checksums of media filenames.

Purpose: Validate the integrity of each downloaded media file.

Motivation: The `ichunks` download media files by invoking `cURL`. However, `cURL` sometimes downloads only a partial file. Therefore, all the downloaded media files are validated, and the corrupt ones sequestered to a `bad-images` directory for later inspection.

Design note. Validation is done by invoking

```
root-shell# gm identify -verbose path | grep identify
```

to look for error messages.

This is a CPU intensive process that one is loathe to repeat. WP-MIRROR, therefore, keeps a record of the validated media files. This record is kept in the `wpmirror.image` database table, so that all concurrent instances of WP-MIRROR can have access.

As a precaution `wpmirror.image` does not store the file name (which may have control characters, or be an SQL injection attack), rather it stores the `md5sum` of the file name. This hash is computed by invoking

```
shell$ env printf %s file | openssl dgst -md5
```

Note also that the first two hexadecimal digits of the `md5sum` are used by `MediaWiki` to create the directory tree under which the media files are stored. For example, hashing the media file named `Arc_en_ciel.png` yeilds

```
shell$ env printf %s Arc_en_ciel.png | openssl dgst -md5
(stdin)= 00135a44372c142bd509367a9f166733
```

and therefore, `Arc_en_ciel.png` would be stored under `/var/lib/mediawiki/images/0/00/`.

5.2 How `--monitor` Works

5.2.1 Start

Processing begins when you enter one of the following:

```
root-shell# wp-mirror --monitor
root-shell# wp-mirror --gui
root-shell# wp-mirror --screen
root-shell# wp-mirror --text
```

5.2.1.1 `process-command-line-arguments-or-die`

```
root-shell# wp-mirror --gui
[ ok ]process-command-line-arguments-or-die
...
```

WP-MIRROR first reads the command-line arguments. If there an error is found, you may expect:

```
root-shell# wp-mirror --foo
[... ]process-command-line-arguments-or-die
Error: command line ...
unexpected option           : (foo)                [fail]
For help, please try:
    $ wp-mirror --help
```

5.2.2 Initializing

```
root-shell# wp-mirror --gui
...
-----initializing-begin-----
[info]set mode of operation to: MONITOR
[ ok ]assert-clisp-features-p
[ ok ]assert-utilities-p
[ ok ]assert-images-directory-or-create-p
[ ok ]assert-working-directory-or-create-p
[ ok ]assert-dbms-mysql-p
[ ok ]assert-dbms-mysql-config-debian-p
[ ok ]assert-dbms-credentials-debian-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-debian-p
[ ok ]assert-dbms-time-zone-or-load
[ ok ]assert-configuration-files-or-restore-default
[ ok ]process-configuration-files-or-die
...
```


5.2.2.1 `assert-clisp-features-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-clisp-features-p
```

WP-MIRROR is written in Common Lisp (`clisp` 2.48). WP-MIRROR tests (asserts) that all the required libraries are loaded. For example, the `CLX` library is needed for running WP-MIRROR in `--gui` mode.

5.2.2.2 `assert-utilities-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-utilities-p
```

WP-MIRROR relies on many utilities to do most of the work. WP-MIRROR asserts that they exist.

5.2.2.3 `assert-images-directory-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-images-directory-or-create-p
```

WP-MIRROR creates a directory tree in which `MediaWiki` stores downloaded media files. This directory is `/var/lib/mediawiki/images/` (default).

5.2.2.4 `assert-working-directory-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-working-directory-or-create-p
```

WP-MIRROR creates a directory in which all its working files will be kept. This directory is `/var/lib/mediawiki/images/wp-mirror/` (default).

5.2.2.5 `assert-dbms-mysql-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-dbms-mysql-p
```

`MediaWiki` is able to use: `MySQL`, `postgres`, `sqlite`, `mssql`, and `ibm_db2`. WP-MIRROR, however, is only able to use the `MySQL` database management system (DBMS). If `MySQL` is not available, then WP-MIRROR exits.

5.2.2.6 `assert-dbms-mysql-config-debian-p`

```
root-shell# wp-mirror --mirror
...
[ ok ]assert-dbms-mysql-config-debian-p
```

WP-MIRROR looks for Debian's database credentials, which are stored in `/etc/mysql/debian.cnf`. Debian's database account has `root` privileges.

5.2.2.7 `assert-dbms-credentials-debian-or-scrape-p`

```
root-shell# wp-mirror --mirror
```

```
...
[ ok ] assert-dbms-credentials-debian-or-scrape-p
```

WP-MIRROR reads `/etc/mysql/debian.cnf`, and parses the file for Debian's MySQL user account and `password`. The file looks something like:

```
# Automatically generated for Debian scripts. DO NOT TOUCH!
[client]
host      = localhost
user      = debian-sys-maint
password  = abcdefghijklmnop
socket    = /var/run/mysqld/mysqld.sock
[mysql_upgrade]
host      = localhost
user      = debian-sys-maint
password  = abcdefghijklmnop
socket    = /var/run/mysqld/mysqld.sock
basedir   = /usr
```

5.2.2.8 `assert-dbms-connect-with-credentials-debian-p`

```
root-shell# wp-mirror --mirror
```

```
...
[ ok ] assert-dbms-connect-with-credentials-debian-p
```

WP-MIRROR tests (asserts) if it can use the Debian database credentials to access MySQL. If it cannot, WP-MIRROR exits.

5.2.2.9 `assert-dbms-time-zone-or-load`

```
root-shell# wp-mirror --mirror
```

```
...
[ ok ] assert-dbms-time-zone-or-load
```

WP-MIRROR checks if the MySQL `time zone` tables are populated. If they are not, the time zone data will be loaded from `/usr/share/zoneinfo/`, and you will see messages like:

```
root-shell# wp-mirror --mirror
...
[....] assert-dbms-time-zone-or-load
looking for time-zone           : UTC                               [fail]
Warning: Unable to load '/usr/share/zoneinfo/Asia/Riyadh87' as time zone. Skipping it.
Warning: Unable to load '/usr/share/zoneinfo/Asia/Riyadh88' as time zone. Skipping it.
Warning: Unable to load '/usr/share/zoneinfo/Asia/Riyadh89' as time zone. Skipping it.
...
[ ok ] assert-dbms-time-zone-or-load
```

5.2.2.10 `assert-configuration-files-or-restore-default`

```
root-shell# wp-mirror --mirror
```

```
...
[ ok ] assert-configuration-files-or-restore-default
```

If all the configuration files are in place, you will see the above.

If any configuration files are missing, you will see additional messages. If all configuration files are missing, which can happen after you use the `--restore-default` option, you will see:

```

root-shell# wp-mirror --mirror
...
[....]assert-configuration-files-or-restore-default
[info]restoring default      : /etc/cron.d/wp-mirror
[info]restoring default      : /etc/mediawiki/LocalSettings.php
[info]restoring default      : /etc/mediawiki/LocalSettings_wpmirror.php
[info]restoring default      : /etc/mysql/conf.d/wp-mirror.cnf
[info]restoring default      : /etc/wp-mirror/default.conf
[info]restoring default      : /etc/wp-mirror/local.conf
[info]restoring default      : /var/lib/wp-mirror-mediawiki/extensions/LocalisationUpdate/localisatio
[info]restoring default      : /var/lib/wp-mirror-mediawiki/extensions/TitleKey/rebuildTitleKeys_farm
[info]restoring default      : /usr/share/mediawiki/maintenance/database_farm.sql
[info]restoring default      : /usr/share/wp-mirror-mediawiki/maintenance/importDump_farm.php
[info]restoring default      : /usr/share/wp-mirror-mediawiki/maintenance/update_farm.php
[info]restoring default      : /var/lib/mediawiki/favicon.ico
[info]restoring default      : /var/lib/mediawiki/wp-mirror.png
[ ok ] Stopping MySQL database server: mysqld.
[ ok ] Starting MySQL database server: mysqld . . .
[info] Checking for tables which need an upgrade, are corrupt or were
not closed cleanly..
[ ok ]assert-configuration-files-or-restore-default
...

```

5.2.2.11 process-configuration-files-or-die

```

root-shell# wp-mirror --mirror
...
[ ok ]process-configuration-files-or-die

```

WP-MIRROR reads the local configuration file `/etc/wp-mirror/local.conf`. All WP-MIRROR parameters have default values, which may be seen in `/etc/wp-mirror/default.conf`. Parameter values set in `/etc/wp-mirror/local.conf` override the default values.

The parameter that most users will want to edit is,

```
(defparameter *mirror-language-code-list* '("simple"))
```

Users should make their configurations in `/etc/wp-mirror/local.conf` only. The `/etc/wp-mirror/default.conf` is for reference, and should never be edited.

5.2.3 Asserting Prerequisite Software

```

root-shell# wp-mirror --mirror
...
-----asserting-prerequisite-software-begin-----
[ ok ]assert-dbms-accounts-or-create-p
[ ok ]assert-dbms-credentials-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-wikiadmin-p
[ ok ]assert-dbms-connect-with-credentials-wikiuser-p
[ ok ]assert-dbms-grant-for-wikiadmin-p
[ ok ]assert-dbms-grant-for-wikiuser-p
[ ok ]assert-database-wpmirror-or-create-p
[ ok ]assert-mediawiki-dbms-credentials-p

```

These messages show the progress of asserting software prerequisites. We now describe each of them:

5.2.3.1 `assert-dbms-accounts-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-accounts-or-create-p
```

WP-MIRROR asserts:

- the DBMS has an account for `wikiadmin`,
- the DBMS has an account for `wikiuser`,
- the file `/etc/mediawiki/LocalSettings_account.php` exists.

If the assertion fails, WP-MIRROR then:

- performs a `DROP USER` on any old `wikiadmin` and `wikiuser` accounts,
- generates random passwords,
- performs a `CREATE USER` to make new `wikiadmin` and `wikiuser` accounts, and
- writes the credentials to `/etc/mediawiki/LocalSettings_account.php`.

5.2.3.2 `assert-dbms-credentials-or-scrape-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-credentials-or-scrape-p
```

WP-MIRROR reads `/etc/mediawiki/LocalSettings_account.php` and parses it to extract database credentials. The file looks something like:

```
root-shell# cat /etc/mediawiki/LocalSettings_account.php
<?php
# Automatically generated by WP-MIRROR for mediawiki scripts. DO NOT TOUCH!
$wgDBAdminuser      = 'wikiadmin';
$wgDBAdminpassword  = 'abcdefghijklm';
$wgDBUser           = 'wikiuser';
$wgDBpassword       = 'abcdefghijklm';
```

5.2.3.3 `assert-dbms-connect-with-credentials-wikiadmin-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-connect-with-credentials-wikiadmin-p
```

WP-MIRROR, using the `wikiadmin` credentials, asserts that it is possible to connect to the `MySQL` server, and execute a simple query.

5.2.3.4 `assert-dbms-connect-with-credentials-wikiuser-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-connect-with-credentials-wikiuser-p
```

WP-MIRROR, using the `wikiuser` credentials, asserts that it is possible to connect to the `MySQL` server, and execute a simple query.

5.2.3.5 `assert-dbms-grant-for-wikiadmin-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-grant-for-wikiadmin-p
```

WP-MIRROR, using the Debian credentials, `GRANTs` elevated database privileges to `wikiadmin`. Namely,

- `GRANT ALL PRIVILEGES ON` each of the databases: `wikidb`, `wpmirror`, `simplewiki` (and any other database in a wikipedia farm), and
- `GRANT PROCESS` globally.

This last privilege is needed for monitoring the status of the `InnoDB` storage engine.

5.2.3.6 `assert-dbms-grant-for-wikiuser-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-dbms-grant-for-wikiuser-p
```

WP-MIRROR, using Debian credential, `GRANTs` limited privileges to `wikiuser`. Namely, `SELECT`, `INSERT`, `UPDATE`, and `DELETE` privileges on `wikidb`, `wpmirror`, `simplewiki` (and any other database in a wikipedia farm).

5.2.3.7 `assert-database-wpmirror-or-create-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-database-wpmirror-or-create-p
```

WP-MIRROR maintains state information that must be shared with one or more mirror and monitor processes, each of which must be Isolated (the ‘I’ in ACID) from each other. This state information also serves as a checkpoint, and must therefore be Durable (the ‘D’ in ACID) to facilitate resuming after interruption.

WP-MIRROR asserts (and if necessary creates) a database `wpmirror`, managed by the ACID compliant storage engine `InnoDB`, to hold its state information.

5.2.3.8 `assert-mediawiki-dbms-credentials-p`

```
root-shell# wp-mirror --mirror
...
[ ok ] assert-mediawiki-dbms-credentials-p
```

Before WP-MIRROR can request `MediaWiki` maintenance scripts to import pages and media files, all the database credentials must be in hand. WP-MIRROR asserts that they are. If they are not, WP-MIRROR exits.

5.2.4 Asserting Prerequisite Hardware

```
root-shell# wp-mirror --mirror
...
-----asserting-prerequisite-hardware-begin-----
```

WP-MIRROR in monitor mode, does not assert any hardware prerequisites. This is because it does not write to disk, or occupy much memory.

5.2.5 Compile Status Report

```
root-shell# wp-mirror --mirror
...
-----monitor-mode-begin-----
```

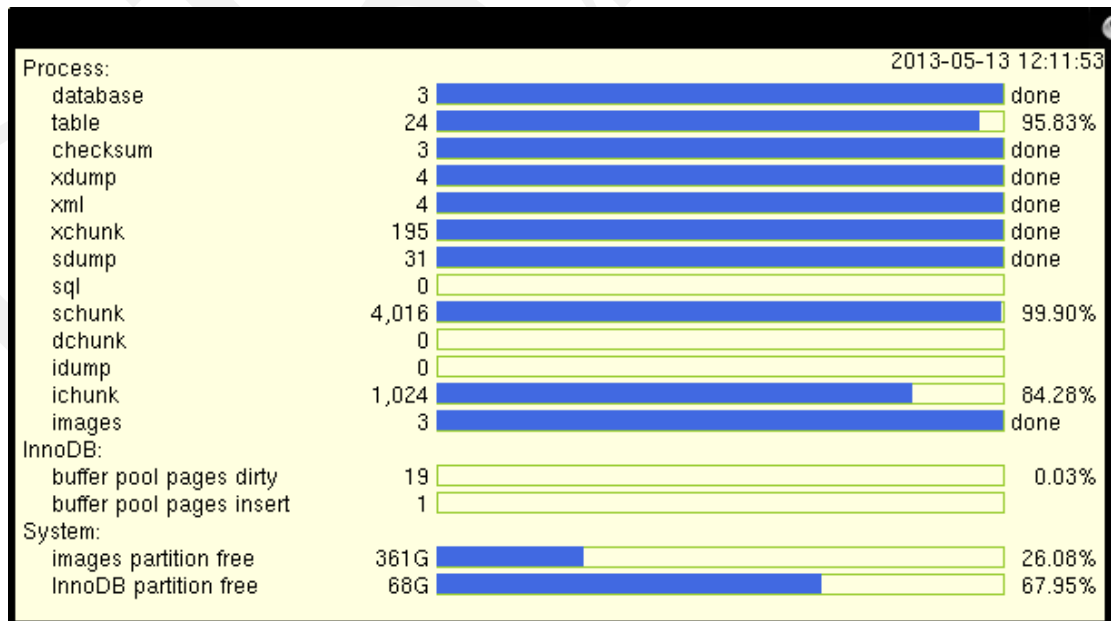
After the method of display is set, WP-MIRROR enters a loop.

Every 10 seconds (default), the monitoring process compiles a status report. This is done by running a set of SQL queries against the `wpmirror` database and against the `InnoDB` storage engine.

5.2.6 Display Progress Bars

After each status report is compiled, WP-MIRROR displays the results. Seven groups of progress bars are rendered as shown in [Figure 5.3, WP-MIRROR Monitor Mode Progress Bars](#).

Figure 5.3: WP-MIRROR Monitor Mode Progress Bars



5.3 How --add Works

```

root-shell# wp-mirror --add xh
-----initializing-begin-----
[info]set mode of operation to: ADD
[ ok ]log-start
[ ok ]assert-clisp-features-p
[ ok ]assert-utilities-p
[ ok ]assert-images-directory-or-create-p
[ ok ]assert-working-directory-or-create-p
[ ok ]assert-dbms-mysql-p
[ ok ]assert-dbms-mysql-install-db-p
[ ok ]assert-dbms-mysql-config-debian-p
[ ok ]assert-dbms-credentials-debian-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-debian-p
[ ok ]assert-dbms-time-zone-or-load
-----asserting-prerequisite-software-begin-----
[ ok ]assert-dbms-accounts-or-create-p
[ ok ]assert-dbms-credentials-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-wikiadmin-p
[ ok ]assert-dbms-grant-for-wikiadmin-p
[ ok ]assert-dbms-connect-with-credentials-wikiuser-p
[ ok ]assert-dbms-grant-for-wikiuser-p
[ ok ]assert-database-wpmirror-or-create-p
-----asserting-prerequisite-hardware-begin-----
[ ok ]assert-internet-access-to-wikimedia-site-p
-----add-mode-begin-----
[ ok ]fsm-boot
-----finalizing-begin-----
[ ok ]log-stop

```

5.3.1 fsm-boot

WP-MIRROR in --add mode, simply adds the following row to the `wpmirror.file` database table:

```

mysql> SELECT name,type,state,semaphore FROM wpmirror.file;
+-----+-----+-----+-----+
| name   | type   | state | semaphore |
+-----+-----+-----+-----+
| xhwiki | database | start | 1         |
+-----+-----+-----+-----+

```

If another WP-MIRROR process happens to be running in `:first-mirror` or `:next-mirror` mode, then it will build the new wikipedia. Adding, building, and dropping wikis can be done concurrently.

5.4 How `--delete` Works

```
root-shell# wp-mirror --delete xh
-----initializing-begin-----
[info]set mode of operation to: DELETE
[ ok ]log-start
[ ok ]assert-dbms-mysql-p
[ ok ]assert-dbms-mysql-install-db-p
[ ok ]assert-dbms-mysql-config-debian-p
[ ok ]assert-dbms-credentials-debian-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-debian-p
-----asserting-prerequisite-software-begin-----
[ ok ]assert-dbms-accounts-or-create-p
[ ok ]assert-dbms-credentials-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-wikiadmin-p
[ ok ]assert-dbms-grant-for-wikiadmin-p
-----asserting-prerequisite-hardware-begin-----
[ ok ]assert-internet-access-to-wikimedia-site-p
-----delete-mode-begin-----
[ ok ]delete-state-for-wiki xhwiki
[ ok ]delete-working-files-for-wiki xhwiki
[ ok ]delete-state-for-wiki xhwiktionary
[ ok ]delete-working-files-for-wiki xhwiktionary
-----finalizing-begin-----
[ ok ]log-stop
```

5.4.1 `delete-state-for-wiki`

Purpose: Reset the Finite State Machine.

Motivation: When the user wishes to delete a wikipedia, or just start over, it is best to reset the Finite State Machine.

Method: `DELETE` all rows from `filenamewpmirror.file` for the given wiki.

5.4.2 `delete-working-files-for-wiki`

Purpose: Remove unneeded files from the working directory, `/var/lib/mediawiki/images/wp-mirror/`

Motivation: Clean up obsolete files, save disk space.

Method: Remove all files that have file names beginning with `wiki`, where `wiki` is the name of the wiki.

5.5 How `--drop` Works

```

root-shell# wp-mirror --drop xh
-----initializing-begin-----
[info]set mode of operation to: DROP
[ ok ]log-start
[ ok ]assert-dbms-mysql-p
[ ok ]assert-dbms-mysql-install-db-p
[ ok ]assert-dbms-mysql-config-debian-p
[ ok ]assert-dbms-credentials-debian-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-debian-p
-----asserting-prerequisite-software-begin-----
[ ok ]assert-dbms-accounts-or-create-p
[ ok ]assert-dbms-credentials-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-wikiadmin-p
[ ok ]assert-dbms-grant-for-wikiadmin-p
-----asserting-prerequisite-hardware-begin-----
[ ok ]assert-internet-access-to-wikimedia-site-p
-----drop-mode-begin-----
[ ok ]delete-state-for-wiki xhwiki
[ ok ]drop-database-for-wiki-p xhwiki <---
[ ok ]delete-working-files-for-wiki xhwiki
[ ok ]delete-state-for-wiki xhwiktionary
[ ok ]drop-database-for-wiki-p xhwiktionary <---
[ ok ]delete-working-files-for-wiki xhwiktionary
-----finalizing-begin-----
[ ok ]log-stop

```

5.5.1 `drop-database-for-wiki`

Purpose: Drop a wikipedia from the mirror.

Method: `DROP DATABASE wiki`; where *wiki* is the name of the given wiki.

5.6 How `--dump` Works

```

root-shell# wp-mirror --dump xh
-----initializing-begin-----
[info]set mode of operation to: DUMP
[ ok ]log-start
[ ok ]assert-dbms-mysql-p
[ ok ]assert-dbms-mysql-install-db-p
[ ok ]assert-dbms-mysql-config-debian-p
[ ok ]assert-dbms-credentials-debian-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-debian-p
-----asserting-prerequisite-software-begin-----
[ ok ]assert-dbms-accounts-or-create-p
[ ok ]assert-dbms-credentials-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-wikiadmin-p
[ ok ]assert-dbms-grant-for-wikiadmin-p
-----asserting-prerequisite-hardware-begin-----
[ ok ]assert-internet-access-to-wikimedia-site-p
-----dump-mode-begin-----
[ ok ]dump-database-for-wiki-p xhwiki
[ ok ]dump-database-for-wiki-p xhwiktionary
-----finalizing-begin-----
[ ok ]log-stop

```

5.6.1 `dump-database-for-wiki-p`

Purpose: Backup a wikipedia.

Motivation: Prior to performing any database maintenance, one should make a backup.

Method: Execute `mysqldump` and write the results to `wiki.sql` in the working directory `/var/lib/mediawiki/images/wp-mirror/`.

5.7 How `--info` Works

```
root-shell# wp-mirror --info
*db-name*                : wikidb
*db-server*              : localhost
*db-type*                : mysql
*db-wikiadmin-user*      : wikiadmin
*db-wikiuser-user*       : wikiuser
*db-wpmirror-name*       : wpmirror
*debug-level*            : 0
*mediawiki-version*      : 1.23
...
```

Purpose: List global parameters together with their values.

Note: A few parameters are not listed by `--info` because they contain sensitive information such as passwords.

5.8 How `--profile` Works

If no run number follows the `--profile` option,

```
root-shell# wp-mirror --profile
-----initializing-begin-----
[info]set mode of operation to: PROFILE
[ ok ]log-start
[ ok ]assert-dbms-mysql-p
[ ok ]assert-dbms-mysql-install-db-p
[ ok ]assert-dbms-mysql-config-debian-p
[ ok ]assert-dbms-credentials-debian-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-debian-p
-----asserting-prerequisite-software-begin----
[ ok ]assert-dbms-accounts-or-create-p
[ ok ]assert-dbms-credentials-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-wikiadmin-p
[ ok ]assert-dbms-grant-for-wikiadmin-p
-----asserting-prerequisite-hardware-begin-----
```

then WP-MIRROR provides a profile (in seconds) of the most recent five runs:

```

-----profile-mode-begin-----
+-----+-----+-----+-----+
| Function          | 73 | 72 | 71 | 70 | 69 |
+-----+-----+-----+-----+
| fsm-boot          | 4  | 4  | 3  | 4  | 3  |
| fsm-database-checksum | 0  | 0  | 0  | 0  | 0  |
| fsm-database-create  | 0  | 0  | 0  | 0  | 0  |
| fsm-database-grant   | 0  | 0  | 0  | 0  | 0  |
| fsm-database-interwiki | 0  | 0  | 0  | 0  | 0  |
| fsm-file-count       | 0  | 0  | 215 | 4  | 68 |
| fsm-file-decompress  | 0  | 0  | 42  | 0  | 43 |
| fsm-file-digest      | 0  | 0  | 20  | 1  | 10 |
| fsm-file-directory    | 0  | 0  | 0  | 0  | 0  |
| fsm-file-download    | 0  | 0  | 59  | 0  | 60 |
| fsm-file-import      | 0  | 0  | 2,553 | 0  | 0  |
| fsm-file-parse       | 0  | 0  | 0  | 0  | 0  |
| fsm-file-remove      | 0  | 0  | 0  | 0  | 0  |
| fsm-file-scrape      | 0  | 0  | 5  | 0  | 5  |
| fsm-file-split       | 0  | 0  | 82  | 0  | 79 |
| fsm-file-validate    | 0  | 0  | 0  | 0  | 0  |
| fsm-no-op           | 0  | 0  | 0  | 0  | 0  |
| FSM-TOTAL           | 7  | 7  | 4,246 | 0  | 0  |
| GRAND-TOTAL         | 12 | 11 | 4,248 | 0  | 0  |
+-----+-----+-----+-----+
-----finalizing-begin-----
[ ok ]log-stop

```

If a run number (a positive integer) is provided,

```

root-shell# wp-mirror --profile 71
-----initializing-begin-----
[info]set mode of operation to: PROFILE
...

```

then WP-MIRROR provides a profile (in various units) of the given run:

```

-----profile-mode-begin-----
+-----+-----+-----+-----+-----+-----+
| Function (run 71) | [ms] | [%] | [sec] | [min] | [hr] | [d] |
+-----+-----+-----+-----+-----+-----+
| fsm-boot | 2,646 | 0 | 3 | 0 | 0 | 0 |
| fsm-database-checksum | 138 | 0 | 0 | 0 | 0 | 0 |
| fsm-database-create | 166 | 0 | 0 | 0 | 0 | 0 |
| fsm-database-grant | 8 | 0 | 0 | 0 | 0 | 0 |
| fsm-database-interwiki | 150 | 0 | 0 | 0 | 0 | 0 |
| fsm-file-count | 214,668 | 5 | 215 | 4 | 0 | 0 |
| fsm-file-decompress | 41,728 | 1 | 42 | 1 | 0 | 0 |
| fsm-file-digest | 19,673 | 0 | 20 | 0 | 0 | 0 |
| fsm-file-directory | 155 | 0 | 0 | 0 | 0 | 0 |
| fsm-file-download | 58,527 | 1 | 59 | 1 | 0 | 0 |
| fsm-file-import | 2,553,115 | 60 | 2,553 | 43 | 1 | 0 |
| fsm-file-parse | 139 | 0 | 0 | 0 | 0 | 0 |
| fsm-file-remove | 397 | 0 | 0 | 0 | 0 | 0 |
| fsm-file-scrape | 4,899 | 0 | 5 | 0 | 0 | 0 |
| fsm-file-split | 81,998 | 2 | 82 | 1 | 0 | 0 |
| fsm-file-validate | 416 | 0 | 0 | 0 | 0 | 0 |
| fsm-no-op | 6 | 0 | 0 | 0 | 0 | 0 |
| FSM-TOTAL | 4,245,874 | 100 | 4,246 | 71 | 1 | 0 |
| GRAND-TOTAL | 4,248,259 | 100 | 4,248 | 71 | 1 | 0 |
+-----+-----+-----+-----+-----+-----+
-----finalizing-begin-----
[ ok ]log-stop

```

If a zero follows the `--profile` option, then all profile information is deleted, and run numbers begin again with one (1).

5.9 How `--restore-default` Works

```

root-shell# wp-mirror --restore-default
-----initializing-begin-----
[info]set mode of operation to: RESTORE-DEFAULT
[ ok ]log-start
[ ok ]assert-dbms-mysql-p
[ ok ]assert-dbms-mysql-install-db-p
[ ok ]assert-dbms-mysql-config-debian-p
[ ok ]assert-dbms-credentials-debian-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-debian-p
-----asserting-prerequisite-software-begin-----
-----asserting-prerequisite-hardware-begin-----

+-----+
| WARNING WARNING WARNING WARNING WARNING WARNING WARNING |
|
| This option may DELETE more than you expect or want:
| 1) Delete config files      : /etc/mediawiki/LocalSettings.php
|                             : /etc/mediawiki/LocalSettings_wpmirror.php
|                             : /etc/mysql/conf.d/wp-mirror.cnf
|                             : /etc/wpmirror/local.conf
|                             : /etc/wpmirror/default.conf
| Delete database template : /usr/share/mediawiki/mai../database_farm.sql
| 2) Delete image files      : /var/lib/mediawiki/images/bad-images/
|                             : /var/lib/mediawiki/images/math/
|                             : /var/lib/mediawiki/images/thumb/
| 3) Delete working files    : /var/lib/mediawiki/images/wp-mirror/
| 4) Drop databases          : wikidb, *wiki, wpmirror
| Drop database users        : wikiadmin, wikiuser
| The original default configuration is restored (mirror of 'simple' wiki).
|
| WARNING WARNING WARNING WARNING WARNING WARNING WARNING |
+-----+

Do you wish to continue (yes/no)

```

If after the warning you enter 'no', then you will see the following:

```

-----finalizing-begin-----
[ ok ]log-stop

```

If after the warning you enter 'yes', then you will see the following:

```
-----restore-default-mode-begin-----
[ ok ] drop-database-p simplewiki
[ ok ] assert-dbms-drop-accounts-p
[ ok ] delete-directory-working
[info] deleting config file : /etc/cron.d/wp-mirror
[info] deleting config file : /etc/mediawiki/LocalSettings.php
[info] deleting config file : /etc/mediawiki/LocalSettings_account.php
[info] deleting config file : /etc/mediawiki/LocalSettings_wpmirror.php
[info] deleting config file : /etc/mysql/conf.d/wp-mirror.cnf
[info] deleting config file : /etc/wp-mirror/default.conf
[info] deleting config file : /etc/wp-mirror/local.conf
[info] deleting config file : /var/lib/wp-mirror-mediawiki/extensions/LocalisationUpdate/localisation
[info] deleting config file : /var/lib/wp-mirror-mediawiki/extensions/TitleKey/rebuildTitleKeys_farm
[info] deleting config file : /usr/share/mediawiki/maintenance/database_farm.sql
[info] deleting config file : /usr/share/wp-mirror-mediawiki/maintenance/importDump_farm.php
[info] deleting config file : /usr/share/wp-mirror-mediawiki/maintenance/update_farm.php
[info] deleting config file : /var/lib/mediawiki/favicon.ico
[info] deleting config file : /var/lib/mediawiki/wp-mirror.png
[ ok ] Stopping MySQL database server: mysqld.
[ ok ] Starting MySQL database server: mysqld . . .
[info] Checking for tables which need an upgrade, are corrupt or were
not closed cleanly..
[info] done
-----finalizing-begin-----
[ ok ] log-stop
```

5.10 How `--update` Works

```

root-shell# wp-mirror --update xh
-----initializing-begin-----
[info]set mode of operation to: UPDATE
[ ok ]log-start
[ ok ]assert-dbms-mysql-p
[ ok ]assert-dbms-mysql-install-db-p
[ ok ]assert-dbms-mysql-config-debian-p
[ ok ]assert-dbms-credentials-debian-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-debian-p
-----asserting-prerequisite-software-begin----
[ ok ]assert-dbms-accounts-or-create-p
[ ok ]assert-dbms-credentials-or-scrape-p
[ ok ]assert-dbms-connect-with-credentials-wikiadmin-p
[ ok ]assert-dbms-grant-for-wikiadmin-p
-----asserting-prerequisite-hardware-begin----
[ ok ]assert-internet-access-to-wikimedia-site-p
-----update-mode-begin-----
[....]update-database-for-wiki-p xhwiki
mediawiki 1.19.2-2 Updater

Going to run database updates for xhwiki
Depending on the size of your database this may take a while!
...
[ ok ]update-database-for-wiki-p xhwiki
[....]update-database-for-wiki-p xhwiktionary
...
[ ok ]update-database-for-wiki-p xhwiktionary
[ ok ]log-start
-----finalizing-begin-----
[ ok ]log-stop

```

5.11 How Scheduled Jobs Work

5.11.1 `cron`

During installation, WP-MIRROR sets up a weekly `cron` job.

The idea is to keep your mirror farm up to date. However, as a precaution, the file `/etc/cron.d/wp-mirror` first looks for the PID file `/var/run/wp-mirror.pid`. If the PID file is found, the cron job exits immediately. This is because presence of the PID file indicates that another instance of WP-MIRROR may be running. When mirroring a large wikipedia, it can happen that last week's instance is still running.

5.11.2 `logrotate`

During installation, WP-MIRROR sets up a daily `logrotate` job.

The idea is to avoid stuffing your `/var/` partition. WP-MIRROR instances running in mirror mode write copious logs to `/var/log/wp-mirror.log`. This log file is rotated daily by `/etc/logrotate.d/wp-mirror`. Rotated log files are compressed using `gzip`, kept for seven days, and then discarded.

If you notice that the log file is not being rotated as expected, you may force matters with the command:

```

root-shell# /usr/sbin/logrotate --force /etc/logrotate.d/wp-mirror

```

The log files are *not* world readable. This is because database user passwords are logged whenever an user invokes `wp-mirror --debug`.

```
root-shell# ls -l /var/log/wp-mirror.log*
-rw-r----- 1 root adm      0 Nov  8 07:43 /var/log/wp-mirror.log
-rw-r----- 1 root adm 1809060 Nov  7 15:32 /var/log/wp-mirror.log.1.gz
...
```

Appendix A

Change History

This appendix lists the changes from version to version in the WP-MIRROR source code.

Dates in section headings refer to the release date for that version.

A.1 Changes in Release 0.x

An overview of features added in WP-MIRROR can be found in §1.5, [What Is New in WP-MIRROR](#). For a complete list of changes, please refer to the changelog sections for individual releases.

A.1.1 Changes in WP-MIRROR 0.7 (2014-04-02)

A.1.1.1 Functionality Added or Changed

- **Dependency removed:** Removed dependency on the DEB package `mediawiki-extensions-math`, which contains the `Math` extension for `MediaWiki`. Its functionality is now bundled into the new DEB package `wp-mirror-mediawiki-extensions` (see below).
- **Dependency updated:** Updated the DEB package `mediawiki-mwxml2sql` to extend the maximum allowed `MediaWiki` version to 1.23.
- **FSM:** The new `fsm-database-update` automatically updates database schema for each wiki. WP-MIRROR 0.7 expects the schema for `MediaWiki` 1.23, whereas WP-MIRROR 0.6 expects the schema for `MediaWiki` 1.19.
- **FSM:** `fsm-file-xml2sql` has been renamed `fsm-file-convert-xml`.
- **FSM:** `fsm-file-process-xml` has been introduced together with the parameter `*mirror-process-xml*` (default `:xml2sql`) to govern how `xdumps` are processed.

<code>*mirror-process-xml*</code>	<i>Use function</i>	<i>Which invokes</i>
<code>:xml2sql</code>	<code>fsm-file-convert-xml</code>	<code>mwxml2sql</code>
<code>:import</code>	<code>fsm-file-import-xml</code>	<code>importDumpFarm.php</code>

- **FSM:** Use of `fsm-file-import`, which was removed from WP-MIRROR 0.6, has been reinstated as `fsm-file-import-xml`. It invokes the utility `importDumpFarm.php`.
- **Hugepages:** Hugepages are now detected. If no hugepages are found, a warning is issued.
- **MediaWiki:** Removed dependency on the DEB package `mediawiki`, which tracks the long-term support version of `MediaWiki` (`MediaWiki` 1.19 LTS at the time of this writing). The LTS version does not render features introduced by WMF during 2013. The WMF actually uses its development version of `MediaWiki` (`MediaWiki` 1.23 at the time of this writing) to render the pages on their web site.

Added dependency on the new DEB package `wp-mirror-mediawiki`. This package tracks the development version that the WMF uses to render its pages. For current information about the versions of `MediaWiki` see http://www.mediawiki.org/wiki/Version_lifecycle. This package was created, by the author of WP-MIRROR.

- **MediaWiki extensions:** Removed dependency on the [DEB](#) packages [mediawiki-extensions*](#), which bundle the long-term support (LTS) version of several [MediaWiki](#) extensions. The LTS version does not render features introduced by WMF during 2013, because it lacks several new extensions such as [Scribunto](#) and extensions related to the [wikidata](#) project.

The WMF actually uses its development version of [MediaWiki](#) (version 1.23, at the time of this writing) together with dozens of extensions, some experimental, to render the pages on their web site.

Added dependency on the new [DEB](#) package [wp-mirror-mediawiki-extensions](#). This package bundles many [MediaWiki](#) extensions and tracks the development version of those that the WMF uses to render its pages. This package was created, by the author of WP-MIRROR.

The author decided to include extensions that WMF uses to *render* pages, and to exclude extensions that WMF uses to help authors *edit* pages. This package contains the following extensions:

- [ApiSandbox](#), [Babel](#), [BetaFeatures](#), [CategoryTree](#), [CharInsert](#)
 - [CirrusSearch](#), [Cite](#), [CLRD](#), [CodeEditor](#), [Collection](#)
 - [Disambiguator](#), [EasyTimeline](#), [Elastica](#), [Gadgets](#), [GeoData](#),
 - [ImageMap](#), [InputBox](#), [Interwiki](#),
 - [LabeledSectionTransclusion](#), [LocalisationUpdate](#),
 - [Math](#), [MobileApp](#), [MobileFrontend](#), [MwEmbedSupport](#),
 - [OpenSearchXml](#), [PagedTiffHandler](#), [ParserFunctions](#), [PdfHandler](#), [Poem](#),
 - [Score](#), [Scribunto](#), [Solarium](#), [SyntaxHighlight_GeSHi](#),
 - [TemplateData](#), [TemplateSandbox](#), [TextExtracts](#), [TimedMediaHandler](#),
 - [TitleKey](#), [Translate](#), [UniversalLanguageSelector](#),
 - [VectorBeta](#), [VipsScaler](#), [VisualEditor](#),
 - [Wikidata](#), [WikiEditor](#), [WikiHiero](#),
 - [ZeroRatedMobileAccess](#)
- **Performance:** Database tables [revision](#) and [text](#) are now loaded using [MySQL](#) command [INSERT IGNORE](#) rather than [REPLACE INTO](#). While this does not change performance during the initial mirror building process, it does improve performance during all subsequent mirror updates.
 - **Performance:** Media dump tarballs are out of date and missing many media files. WP-MIRROR must identify the missing files and download them individually from WMF. The performance of the [SQL](#) query used to identify the names of media files has been greatly enhanced (90% less time). The old [SQL](#) queries were like:

```
mysql> SELECT DISTINCT img_name FROM emacs.image,enwiki.imagelinks
-> WHERE il_to=img_name AND MD5(img_name) LIKE '00%' ORDER BY img_name;
mysql> SELECT DISTINCT img_name FROM commonswiki.image,enwiki.imagelinks
-> WHERE il_to=img_name AND MD5(img_name) LIKE '00%' ORDER BY img_name;
```

The new [SQL](#) queries are like:

```
mysql> SELECT img_name FROM emacs.image,
-> (SELECT DISTINCT il_to FROM enwiki.imagelinks) AS tmp
-> WHERE il_to=img_name AND MD5(il_to) LIKE '00%' ORDER BY img_name;
mysql> SELECT img_name FROM commonswiki.image,
-> (SELECT DISTINCT il_to FROM enwiki.imagelinks) AS tmp
-> WHERE il_to=img_name AND MD5(il_to) LIKE '00%' ORDER BY img_name;
```

- **Reliability:** [curl](#) can hang under certain circumstances. Therefore, all uses of [curl](#) have been replaced with [wget](#), which has a retry feature.
- **URL rewriting:** Wikis are now accessed with URLs like http://simple.wikipedia.site/wiki/John_Adams rather than http://simple.wikipedia.site/index.php?title=John_Adams. This is done by: 1) including URL rewriting rules in the virtual host containers (this executes faster than the alternative, which is to place the rewrite rules in [/var/www/.htaccess](#)):

```
shell$ cat /etc/apache2/sites-available/wp-mirror.site.conf
...
<VirtualHost *:80>
    ServerName    wikipedia.site
    ServerAdmin    webmaster@localhost
    # for access using: en.wikipedia.site, simple.wikipedia.site, etc.
    ServerAlias    *.wikipedia.site
    DocumentRoot   /var/www/
    # http://www.mediawiki.org/wiki/Manual:Short_URL/Apache
    RewriteEngine on
    RewriteRule    ^/?wiki(/.*)?$ /w/index.php [L,PT]
    RewriteRule    ^/*$           /w/index.php [L,PT]
    # for logs using: NCSA Combined Log Format
    CustomLog       $APACHE_LOG_DIR/wp-mirror.site-access.log combined
    ErrorLog        $APACHE_LOG_DIR/wp-mirror.site-error.log
    # log level value in debug, info, notice, warn, error, crit, alert, emerg
    LogLevel        warn
</VirtualHost>
...
```

and 2) enabling the `apache2` URL rewriting module, enabling the `wp-mirror.site.conf` site, reloading `apache2`, and setting a symbolic link `/var/www/w` that points to the `/var/lib/wp-mirror-mediawiki` directory containing the `index.php` script—all by including the following commands in the Debian `postinst` script:

```
shell$ cat ./debian/postinst
#!/bin/sh
# postinst script for wp-mirror
# see: dh_installdeb(1)
set -e
case "$1" in
    configure)
        a2enmod rewrite
        a2ensite wp-mirror.site.conf
        invoke-rc.d apache2 reload
        ln --symbolic /var/lib/wp-mirror-mediawiki/ /var/www/w
        ;;
    abort-upgrade|abort-remove|abort-deconfigure)
        ;;
    *)
        echo "postinst called with unknown argument `$1'" >&2
        exit 1
        ;;
esac
# dh_installdeb will replace this with shell code automatically
# generated by other debhelper scripts.
#DEBHELPER#
exit 0
```

- **Wikidatawiki:** Now added to mirror.

A.1.1.2 Bugs Fixed

- **FSM:** Browsing during mirror updating often resulted in page not found. This occurred between the time the `revision` table started updating and the time the `text` table finished updating, because `MediaWiki` cannot find text for the latest revision before it is loaded. The problem was solved by loading the `text` table before other tables. An additional advantage is that the largest temporary files are processed and removed first.

- **idump:** Malformed `idump` names were matched. Examples include `.enwiki-20121201-remote-media-8.tar.MAtp5` and `enwiki-20121201-remote-media-24.tar.bz2`. Problem was solved by rewriting the `regexp-match` pattern.
- **Media:** Media dump tarballs are out of date and missing many media files. Missing media files are now downloaded from WMF.
- **MediaWiki:** `mediawiki 1.19` was unable to render features introduced by WMF during 2013 (such as `Scribunto` and the `wikidata` project). This problem was fixed by packaging the latest development version, `mediawiki 1.23`, as a `DEB` package. Over 40 `mediawiki` extensions were likewise packaged.
- **Templates:** Many templates were rendered as ‘red-links’, which indicates that `mediawiki` could not find the appropriate record in the `page` database table. This was because the `page.title` field was filled with ‘Template:foo’ instead of ‘foo’. Fault was traced to the process for splitting `x.dumps` into `x.chunks`, which ignored the `<siteinfo>` entity.
- **Virtual machine:** Failed to install ‘out-of-the-box’ on virtual machines.

A.1.1.3 Functionality Removed

- **FSM:** Use of `fsm-database-interwiki` is removed from WP-MIRROR 0.7. In future, interlanguage links will be drawn from the `wikidata` project.

A.1.2 Changes in WP-MIRROR 0.6 (2013-12-10)

A.1.2.1 Functionality Added or Changed

- **Command-line option added:** The `--profile` option displays how much time the Finite State Machine functions are consuming. It may be run concurrently with adding, building, and dropping wikipedias from the mirror. This is used for performance analysis. Profiling data is stored in the `wpmirror.time` database table.
- **Command-line option enhanced:** The `--add`, `--drop`, `--delete`, `--dump`, and `--update` options now have enhanced functionality. As before, these options take just one argument. But now there are more choices for that argument:

```
wp-mirror --add {wiki | language-code | project | all}
wp-mirror --delete {wiki | language-code | project | all | template}
wp-mirror --drop {wiki | language-code | project | all | template}
wp-mirror --dump {wiki | language-code | project | all | template}
wp-mirror --update {wiki | language-code | project | all | template}
```

where `wiki` stands for a specific wiki (e.g. `zuwiktionary`), `language-code` stands for a language-code (e.g. `zu`), and `project` stands for the name of a project (e.g. `wikibooks`, `wiktionary`, etc.). For example:

```
root-shell# wp-mirror --add zuwiktionary <-- add one wiki to the mirror
root-shell# wp-mirror --add zu <-- add all isiZulu wikis
root-shell# wp-mirror --add wiktionary <-- add all wiktionaries (100+ wikis)
root-shell# wp-mirror --add all <-- add all wikis (need 30T storage)
```

- **Database schema added:** The `wpmirror.priority` table now contains the `*type-state-priority*` information. Used for sequencing tasks with greatly reduced FSM overhead.
- **Database schema added:** The `wpmirror.time` table contains FSM profile information.
- **Dependency added:** The `mediawiki-mwxml2sql` utility is used by `fsm-file-xml2sql` to convert `x.chunks` into sets of `s.chunks`. `mediawiki-mwxml2sql` is now available as a `DEB` package. It was packaged by the author of WP-MIRROR.
- **Dependency added:** The `rsync` utility now can be used to download dump files from sites that mirror the Wikimedia Foundation dumps.
- **Dependency added:** The `tar` utility is used to extract media dump tarballs.

- **FSM:** New file types have been added to the Finite State Machine: `sdump`, `sql`, `schunk`, `dchunk`, and `idump`. The first four are used to download and import `SQL` dump files. The last is used to download and extract media dump tarballs.

- **FSM:** The new `fsm-file-split-sdump` and `fsm-file-load-insert` functions improve the loading of records into `MediaWiki` database tables.

WP-MIRROR 0.6 now downloads `sdump` files (one for each database table), which are decompressed and split into `schunks`, which in turn are loaded directly into database tables.

The new functions obviate `fsm-file-import` and `fsm-images-rebuild`. `fsm-file-import` calls `importDump.php` which is comparatively slow, and `fsm-images-rebuild` calls `rebuildImages.php` which seems to have a memory leak.

Impressive performance gains (80% less time) are obtained. See §G.10, [Experiments with mwxml2sql](#).

- **FSM:** The new `fsm-file-xml2sql` facilitates the loading of records into `MediaWiki` database tables. This function obviates the comparatively slow `fsm-file-import` which invokes `importDump.php`.

`fsm-file-xml2sql` uses a new utility, `mwxml2sql`, to convert each `xchunk` into a set of three `schunks` (one each for the `page`, `revision`, and `text` database tables).

The utility `mwxml2sql` was announced on 2013-Feb-21 by Ariel T. Glenn of the WMF, the code for which can be found by chasing a link found at https://meta.wikimedia.org/wiki/Data_dumps/Tools_for_importing.

Impressive performance gains (xx% less time) are obtained. See §G.10, [Experiments with mwxml2sql](#).

- **FSM:** The new functions `fsm-file-extract`, `fsm-file-list-missing` and `fsm-file-wget` completely overhaul the way media files are downloaded.

Impressive performance gains (xx% less time) are obtained.

- **Media dumps:** Media dump tarballs are provided by the mirror site <http://ftpmirror.your.org/pub/wikimedia/imagetdumps/tarballs/fulls/>.

WP-MIRROR 0.6 can now download and extract these `idumps`. This feature greatly reduces the work performed by `fsm-file-scrape`, `fsm-file-shell`, and `fsm-image-validate`.

Impressive performance gains (about 67% less time) are obtained.

- **Interwiki:** Previously, at the bottom of each article there was a mass of ‘red links’ (inter-language links to articles in wikipedias that are not part of the mirror). These links have now been moved to the Navigation Bar, even though most of them are unusable.
- **Performance vs. durability:** The degree of Durability (the ‘D’ in ACID) of `COMMIT`ed transactions is now configurable. To achieve the greatest possible Durability, database transactions must be written to disk immediately after they are `COMMIT`ed. However, modest performance gains (22% less time) can be achieved by flushing transactions to disk once per second (default). This is done by setting the configuration file to read:

```
root-shell# cat /etc/mysql/conf.d/wp-mirror.cnf | grep trx
innodb_flush_log_at_trx_commit = 2 # default 1
```

This means, in the case of a system failure, up to one second of transactions may be lost. This is not too tragic, because WP-MIRROR resumes from the last checkpoint, and repeats any lost transactions.

WP-MIRROR 0.6 also introduces two new configuration parameters:

- `*system-hdd-write-cache*` which disables/enables HDD write caching (default `1`, enabled); and
- `*system-hdd-write-cache-flush*` which enables flushing the HDD write cache immediately after each checkpoint (default `nil`).

To achieve the greatest possible Durability (the ‘D’ in ACID) for its database transactions, set the `InnoDB` variable `innodb_flush_log_at_trx_commit` to `1`, and set `*system-hdd-write-cache*` to `nil`.

Modest performance gains (22% less time) are obtained using the defaults. See §G.3, [fsm-file-import and Durability](#).

- **Performance with persistent connections:** `fsm-file-shell` is now obsolete. Media files are now downloaded with `fsm-file-wget` which invokes `wget`. `wget` as two important advantages:
 - `wget` (like `cURL`) supports “persistent connections” as defined in [RFC2616](#), [HTTP/1.1](#). This permits downloading several files using a single `TCP` connection, thereby reducing latency for all but the first file. Significant performance gains (64% less time) are obtained (see §G.4, `fsm-file-shell` and [HTTP/1.1 Persistent Connections](#)).
 - `wget` (unlike `cURL`) has an automatic retry feature. If a download does not complete, `wget` waits a while, then continues downloading the file from the offset where the interruption occurred.
- **Projects:** The Wikimedia Foundation has several projects besides the [wikipedia](#). Other projects include: [wikibooks](#), [wikimedia](#), [wikinews](#), [wikiquote](#), [wikisource](#), [wikiversity](#), [wikivoyage](#), and [wiktionary](#). Most of these projects have language sub-domains (i.e. one wiki for each language).

WP-MIRROR 0.6 can now mirror any set of wikis, not just ones from the wikipedia project. The default configuration now mirrors both the [simple wikipedia](#) and the [simple wiktionary](#).
- **Reliability:** The downloading of dump files and media files from `http` sites is now far more reliable. This was accomplished by using `wget`, which has an automatic retry feature, instead of `cURL`, which often leaves partial files.
- **Sites:** In 2012, three organizations agreed to mirror the Wikimedia Foundation’s dump files, and make them available using the `http`, `ftp`, and `rsync` protocols. WP-MIRROR can now be configured to download from any of them, using any of the protocols.

A.1.2.2 Bugs Fixed

- **FSM:** `fsm-database-create` sometimes failed to create database tables from `database_farm.sql`.
- **HDD write cache:** Configuration failed if database was installed on a Virtual Machine.
- **Partial download:** Downloaded files sometimes incomplete.
- **Restore-default:** Logotype did not restore.

A.1.2.3 Functionality Removed

- **FSM:** Use of `fsm-file-import` is removed from WP-MIRROR 0.6. `fsm-file-import` calls `importDump.php` which is comparatively slow. `fsm-file-xml2sql`, which calls the new (and much faster) `mwxml2sql`, obviates `fsm-file-import`.
- **FSM:** Use of `fsm-file-scrape` is removed from WP-MIRROR 0.6. Media file names are now taken from the `xxwiki.imagelinks` database table, which is loaded directly from an `sdump`.
- **FSM:** Use of `fsm-file-shell` is removed from WP-MIRROR 0.6. Media files are now downloaded using `fsm-file-wget` which performance and reliability advantages.
- **FSM:** Use of `fsm-images-count` is removed from WP-MIRROR 0.6. The `:monitor` mode was rewritten and no longer displays this information.
- **FSM:** Use of `fsm-images-chown` is removed from WP-MIRROR 0.6. Thumbs are now generated during browsing and are therefore created with the `www-data:www-data` ownership.
- **FSM:** Use of `fsm-images-rebuild` is removed from WP-MIRROR 0.6. `fsm-images-rebuild` calls `rebuildImages.php` which is slow and seems to have a memory leak. The `image` database table is now loaded directly from the corresponding `schunks`, which obviates `fsm-images-rebuild`.
- **FSM:** Use of `fsm-images-validate` is removed from WP-MIRROR 0.6. Improved download reliability obviates `fsm-images-validate`. As a consequence:
 - Use of the `wpmirror.image` database table is also removed from WP-MIRROR 0.6. `fsm-images-validate` stores its results in `wpmirror.image`.

- Use of the `/var/lib/mediawiki/images/bad-images/` directory is removed from WP-MIRROR 0.6. `fsm-images-validate` sequesters corrupt media files under that directory.
- **Wikix:** Use of `wikix` is removed from WP-MIRROR 0.6. The built-in alternative to `wikix` is now called `fsm-file-scrape`.

Beginning with WP-MIRROR 0.4, `wikix` was deprecated, because it is not POSIX compliant. That is, `wikix` contains “bashisms” that do not work with the Debian Almquist SHell `dash`. `dash` is a POSIX-compliant implementation of `/bin/sh`, which has become the default `/bin/sh` for Debian.

A.1.3 Changes in WP-MIRROR 0.5 (2012-12-14)

A.1.3.1 Functionality Added or Changed

- **Command-line option added:** The `--add language-code` option allows the user to add a wikipedia to the mirror (in lieu of editing the `*mirror-language-code-list*` parameter in the configuration file `/etc/wp-mirror/local.conf`).
- **Command-line option added:** The `--dump language-code` option allows the user to dump the database of a wikipedia to the file `/var/lib/mediawiki/images/wp-mirror/xxwiki.sql` (where `xx` stands for the language-code). If the language-code is `template`, then the empty database `wikidb` is dumped to `database_farm.sql`.
- **Command-line option added:** The `--info` option lets the user see the value of every parameter can be configured in `/etc/wp-mirror/local.conf`.
- **Command-line option added:** The `--update language-code` option allows the user to update the database of a wikipedia to the latest MediaWiki database schema.
- **Concurrency:** WP-MIRROR 0.5 now permits concurrent adding, building, and dropping of wikipedias.
- **Concurrency:** The `--gui` option displays one window for each wikipedia in the mirror. WP-MIRROR 0.5 now permits the number of windows to increase or decrease dynamically as the user `-adds` and `--drops` wikipedias.
- **FSM:** A new file `type` has been added to the Finite State Machine: `database`.
- **FSM:** The functions that `GRANT` privileges, `CREATE DATABASE`, and establish `interwiki` (interlanguage) links; have been moved into the Finite State Machine. They are now called: `fsm-database-grant`, `fsm-database-create`, `fsm-database-interwiki`, respectively.
- **Interwiki:** Interlanguage links allow the user to easily switch from an article in one language to the corresponding article in another language. This is useful for the user who mirrors two or more wikipedias (e.g. the `simple` wikipedia and a native language wikipedia).
- **Logotype:** WP-MIRROR now has a logotype (see [Figure A.1, WP-MIRROR Logotype](#)). The logotype was composed using the `GIMP`.

Figure A.1: WP-MIRROR Logotype



Many media files of different resolution and format are now included:

- `/var/lib/mediawiki/favicon.ico` is 16x16 pixel, and appears in the web browser Address Bar (the text box where you type the URL);
 - `/var/lib/mediawiki/wp-mirror.png` is 135x135 pixel to be compatible with the legacy skin `Monobook`, and appears as the logotype on <http://wpmirror.site/>;
 - `/usr/share/icons/hicolor/resolution/apps/wp-mirror.png`, where *resolution* is 16x16, 22x22, 24x24, 32x32, 48x48, 64x64, 128x128, and 256x256, and are available to the window manager;
 - `/usr/share/pixmaps/wp-mirror.xpm` is 32x32 pixel, and used by the Debian menu system.
- **Virtual host:** WP-MIRROR now sets up the virtual host <http://wpmirror.site/> rather than <http://mediawiki.site/>. Consistency of naming was the motive. That is: cron job, documentation, logfile, logotype, packaging, software, and virtual host should all have very similar names.

A.1.3.2 Bugs Fixed

- **Dependency fixed:** The `inkscape` dependency was overspecified causing difficulty with installation on Ubuntu 12.10 Quantal.
- **False negative:** Some functions responsible for lengthy operations (e.g. drop a large database or delete a large directory) returned `fail` even though they succeeded. This was due to the functions sometimes returning before the underlying database or shell completed its task. These functions are now guarded by a `sleep-while` or `sleep-until` loop that periodically checks to see if the operation is complete before continuing.
- **Interwiki:** Interwiki links (interlanguage links actually) appear at the bottom of many pages. These appear as ‘red links’ (meaning ‘page does not exist’).

Yet within a wikipedia farm, an article on say ‘Nelson Mandela’ appears in many languages. Therefore, the interwiki links from the article in one language to the corresponding articles in other languages (within the farm) should all work. Moreover, those links should be located in the Navigation Sidebar (usually on the left side under the ‘Languages’ menu).

This turns out to be three issues:

- **magic connector:** We want each interwiki link to connect to the corresponding article in a sister wikipedia (within the farm). Solution is to make sure that: 1) `$wgInterwikiMagic` is set to true (default), 2) `$wgHideInterlanguageLinks` is set to false (default), and 3) for each wikipedia, the language-code and URL of every other wikipedia, is entered into its `interwiki` database table. See http://www.mediawiki.org/wiki/Interwiki#Interwiki_links_to_other_languages.

```
mysql> SHOW CREATE TABLE xhwiki.interwiki\G
***** 1. row *****
      Table: interwiki
Create Table: CREATE TABLE 'interwiki' (
  'iw_prefix' varbinary(32) NOT NULL,
  'iw_url' blob NOT NULL,
  'iw_api' blob NOT NULL,
  'iw_wikiid' varbinary(64) NOT NULL,
  'iw_local' tinyint(1) NOT NULL,
  'iw_trans' tinyint(4) NOT NULL DEFAULT '0',
  UNIQUE KEY 'iw_prefix' ('iw_prefix')
) ENGINE=InnoDB DEFAULT CHARSET=binary
1 row in set (0.00 sec)
```

For example, if we mirror the `xh` and `zu` wikipedias, then the `interwiki` table of each database would need the URL of the other wikipedia:


```
mysql> INSERT INTO xhwiki.interwiki (iw_prefix, iw_url, iw_local, iw_trans,
-> iw_api, iw_wikiid)
-> VALUES ('zu', 'http://zu.wpmirror.site/index.php/$1', 1, 0,
-> 'http://zu.wpmirror.site/api.php', 'zuwiki');
mysql> INSERT INTO zuwiki.interwiki (iw_prefix, iw_url, iw_local, iw_trans,
-> iw_api, iw_wikiid)
-> VALUES ('xh', 'http://xh.wpmirror.site/index.php/$1', 1, 0,
-> 'http://xh.wpmirror.site/api.php', 'xhwiki');
```

- **sidebar:** We want language links to appear in the sidebar, rather than in-text. Solution: make sure that: 1) `$wgHideInterlanguageLinks` is set to false (default), and 2) do not use the `polyglot` extension. See <http://www.mediawiki.org/wiki/Extension:Polyglot>.
- **red links:** We want to suppress the remaining ‘red links’ (interwiki links to articles in languages that are not in our farm). This has not been solved in version 0.5.

- **Md5sum:** A very rare bug was caught. The fatal error:

```
*** -
      overflow during multiplication of large numbers
```

was traced to the `md5sum` hash:

```
593726e2900813494807083136417364
```

The hash was correctly stored in the `wpmirror.file` database table as a `VARCHAR(32)`, but then read back as a number in exponential notation (notice the lone `e`).

The ultimate cause is this: WP-MIRROR relies upon the `read` function in `common lisp` to distinguish numbers from strings, rather than checking the database schema.

- **Monitor:** The monitor gave a pair of ‘database not found’ error messages every 10 seconds if a wikipedia was dropped while the monitor was running.
- **Monitor:** The ‘Image: importing’ bar was blank.
- **Wikix:** The built-in alternative to `wikix` missed about one third of the media file names. What it did right was to scrape media file names from links:

```
... [[File:foo.png| ... ]] ...
... [[Image:bar.png| ... ]] ...
... [[Media:baz.png| ... ]] ...
```

What it neglected to do was to scrape media file names from other sources, such as, `gallery`, `infobox`, `multiple image`, and `wide image` templates. See http://en.wikipedia.org/wiki/Wikipedia:Picture_tutorial.

A.1.4 Changes in WP-MIRROR 0.4 (2012-11-12)

A.1.4.1 Functionality Added or Changed

- **Command-line option added:** The `--restore-default` option offers users who mess up the configuration files, a way to start over. This option drops all WP-MIRROR related databases, deletes all WP-MIRROR files (except media files), and restores all WP-MIRROR related configuration files to the default (i.e. build a mirror of the `simple` wikipedia). This option is used frequently during coding and debugging.
- **Configuration automated:** For the dependency `MySQL`, previously, the configuration was done manually for each of two cases: laptop and desktop. WP-MIRROR now automatically configures `MySQL` for the laptop case which is appropriate for building the default mirror, the `simple` wikipedia.
- **Configuration automated:** For the dependency `MediaWiki`, previously, the configuration was done manually through a web interface. WP-MIRROR now automatically configures `MediaWiki`.
- **Dependency added:** Lisp libraries are now managed by `common-lisp-controller`.

- **Dependency added:** The `CLX` module which implements `XLIB` is now packaged separately from `clisp`. The new package is called `clisp-module-clx`.
- **Dependency added:** `inkscape` is now preferred for converting media files in `SVG` format into `PNG` format. The `rsVG` package is still listed as a dependency, but is no longer used as the default configuration.
- **Dependency added:** The `mediawiki-extensions-math` package has been added. The code that use `TeX` to format math equations into `PNG` image files, has been removed from `MediaWiki` 1.18 core, and is now packaged separately. The `mediawiki-extensions-math` package implements this functionality, as described in <http://www.mediawiki.org/wiki/Extension:Math> and in http://www.mediawiki.org/wiki/Manual:Enable_TeX.

Note also that the `xxwiki.math` database has also been removed from the core, but can be added by running:

```
root-shell# /usr/bin/php /usr/share/mediawiki/maintenance/update_farm.php \
simple.wpmirror.site
```

- **Dependency added:** The `tzdata` package provides time-zone info that is now loaded into `MySQL` time zone tables.
- **Dependency removed:** The `cl-asdf` package is no longer listed as a dependency, because it is a dependency of the `common-lisp-controller` package.
- **Dependency removed:** The `php5-suhosin` package has been dropped from Debian GNU/Linux 7.0 (wheezy).
- **Document:** The WP-MIRROR Reference Manual (this document) is now available. It contains bookmarks, internal links, and URL links to make browsing easy. It is written in `TeX`, with document class `memoir`, and uses the `hyperref` package. This document is published in `PDF` format. Other formats such as `HTML` are being considered for a future release.
- **Document:** Previously, the `README` document was a long text file that could not easily be browsed. It has been truncated, and is now a stub that refers to the WP-MIRROR Reference Manual (this document).
- **Doc-base:** The WP-MIRROR Reference Manual (this document) is now automatically registered with `doc-base`. Users can now find this document on-line using utilities such as `doc-central`, `dhelP` and `dwww`.
- **Hardware:** WP-MIRROR now warns if disk space is likely to be inadequate for the default, a mirror of the `simple` wikipedia. Currently, this threshold is set at 60G.
- **Menufile:** WP-MIRROR is now automatically registered with `menufile`, so that it will appear in the Debian menu system.
- **Pbuilder:** The WP-MIRROR `DEB` package is built by `pbuilder`, which is now configured for Debian GNU/Linux 7.0 (wheezy).
- **Patch removed:** `Import.php.patched` was needed for `MediaWiki` 1.15. Now WP-MIRROR uses `MediaWiki` 1.19, and the patch is no longer needed.
- **Security:** WP-MIRROR now issues a warning if `MySQL` is insecure (e.g. if the `root` account has no password).
- **User interface:** Previously, the user running WP-MIRROR in mirror mode, saw copious messages scroll up the screen. Now these messages are far less verbose, and use color coding to indicate either an exit condition (fail, ok), or the importance of the message to the user (info, warn). The log files are still verbose and properly so.

A.1.4.2 Bugs Fixed

- **Hardware:** HDD write-cache disabling requires identifying the underlying hard disk. This failed for the simple case, such as when the `table space /var/lib/mysql/ibdata0` was a file in a file system on top of a partition like `/dev/sda6`.
- **Ichunks:** Incorrect URLs were found in `ichunks`. These URLs contained a `nil` instead of a language code. For example,

```
IMAGEPATH=http://upload.wikimedia.org/wikipedia/nil/  
COMMONSPATH=http://upload.wikimedia.org/wikipedia/commons/
```

should read

```
IMAGEPATH=http://upload.wikimedia.org/wikipedia/simple/  
COMMONSPATH=http://upload.wikimedia.org/wikipedia/commons/
```

- **POSIX:** The `C` language program `wikix` generates shell scripts that download media files. These scripts contain ‘bashisms’ that do not work with the Debian Almquist Shell `dash`. `dash` is a POSIX compliant implementation of `/bin/sh`, which has become the default `/bin/sh` for Debian. Use of `wikix` is now deprecated.
- **POSIX:** The built-in alternative to `wikix` generated shell scripts, `ichunks`, that were not POSIX compliant. For example,

```
if [-a $IMAGE./foo]; then
```

should read

```
if [-e $IMAGE./foo]; then
```

- **POSIX:** Several shell commands, forked by WP-MIRROR for a variety of tasks, were not POSIX compliant. For example,

```
echo -n "foo" | openssl md5
```

should read

```
env printf %s "foo" | openssl dgst -md5
```

- **Media:** The initial estimates for the number media files was far too low.
- **Media:** When `*mirror-image-download-p*` was set to `nil` (i.e. when the user wanted a mirror without media files), the `xchunks` were not processed.
- **Logrotate:** Log files `/var/log/wp-mirror.log*` were world readable. This is a problem because the log files contain database user accounts and passwords whenever the user runs WP-MIRROR with the `--debug` option.

A.1.5 Changes in WP-MIRROR 0.3 (2012-03-04)

A.1.5.1 Functionality Added or Changed

- **Document:** The `README` has been updated with dependency information. Additionally, there are now instructions for installing WP-MIRROR: from a `DEB` package consistent with Debian GNU/Linux 6.0 (squeeze); and from a traditional tarball.
- **FSM:** WP-MIRROR undertakes a great number of tasks. While some can be run concurrently, some must be done in a particular order. Previously, the sequencing was handled by hundreds of lines of ‘spaghetti code’. This has been replaced by very few lines of code that perform table look-ups (against the `*type-state-priority*` table). Basically, it is a Finite State Machine (FSM). This greatly eases the task of coding and debugging.

A.1.5.2 Bugs Fixed

- **Copyright:** The `debian/copyright` file has been rewritten to be machine-readable to satisfy Debian’s DEP5 requirement.
- **Lintian:** The configuration file `/root/.clisprc` has been removed to satisfy a `lintian` error message. The necessary configuration has been moved into the WP-MIRROR code.
- **Miscellaneous:** Several minor bugs were fixed.
- **Pbuilder:** The `Makefile` for building, installing, and deinstalling WP-MIRROR has been rewritten for compatibility with `pbuilder` (e.g. commands such as `mv` and `cp` were replaced with `install`).
- **Pbuilder:** The WP-MIRROR `DEB` package is built by `pbuilder`, which is now configured for Debian GNU/Linux 6.0 `pbuilder` is used to build Debian packages from source in a `fakeroot` ‘clean-room’. A successful build with `pbuilder` is a prerequisite for acceptance into a Debian distribution. (squeeze).

A.1.6 Changes in WP-MIRROR 0.2 (2011-12-25)

A.1.6.1 Functionality Added or Changed

- **Mirror:** Previously, WP-MIRROR could only mirror a single wikipedia. Now it can mirror a set of wikipedias (e.g. [meta](#), [simple](#), and [zh](#)).
- **Wikix:** Previously, one of the important tasks of WP-MIRROR was performed by [wikix](#). According to the Wikimedia Foundation:

[Wikix](#) is a [C](#) based program written by Jeffrey Vernon Merkey that will read any [XML](#) dump provided by the foundation, extract all image names from the [XML](#) dump which it may reference, then generate a series of [BASH](#) or Bourne Unix style scripts which can be invoked to download all image from Wikimedia Commons and Wikipedia.

<http://meta.wikimedia.org/wiki/Wikix>, accessed 2012-12-19

The code for [wikix](#) is posted on the above mentioned web page. It can also be downloaded as a tarball from <http://wikix.ngen-cast.de/wikix.tar.gz>.

Now, WP-MIRROR offers a built-in alternative to [wikix](#). This alternative:

- **PRO:** generates smaller shell scripts that capture more media files, and throw fewer [HTTP 400](#) and [404](#) errors than [wikix](#); but
- **CON:** takes longer to run than [wikix](#), and fails to download some media files that [wikix](#) does.

Appendix B

Configuration File Parameter Reference

Table B.1: WP-MIRROR Configuration File Parameter Reference

Name	Default	Range	Intr	Rem
<code>*mediawiki-extension-link-list*</code>	<code>'(((*whereis-texvc*</code> <code>*whereis-directory-mediawiki-extensions-math-math*</code> <code>"texvc")</code> <code>(*whereis-texvccheck*</code> <code>*whereis-directory-mediawiki-extensions-math-texvccheck*</code> <code>"texvccheck"))</code>		0.7	
<code>*mediawiki-php-xdebug-max-nesting-level*</code>	200		0.7	
<code>*mediawiki-version*</code>	1.23		0.6	
<code>*mirror-alter-table-timeout-sec-max*</code>	15000		0.6	
<code>*mirror-commonswiki*</code>	commonswiki		0.6	
<code>*mirror-create-table-timeout-sec-max*</code>	100		0.6	
<code>*mirror-dchunk-load-timeout-sec-max*</code>	3000		0.6	
<code>*mirror-dchunk-page-count*</code>	10		0.6	
<code>*mirror-download-connection-time-max*</code>	10000		0.6	
<code>*mirror-image-download-p*</code>	t	nil, t	0.1	
<code>*mirror-innodb-fast-index-creation*</code>	t	nil, t	0.6	

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Name	Default	Range	Intr	Rem
mirror-innodb-table-key-block-size-list	'(("categorylinks" 4 t ("cl_from")) ("externallinks" 4 t nil) ("image" 4 t nil) ("imagelinks" 4 t ("il_from")) ("langlinks" 4 t ("ll_from")) ("page" 4 t ("name_title")) ("pagelinks" 4 t ("pl_from")) ("revision" 4 t nil) ("templatelinks" 4 t ("tl_from")) ("text" 4 t nil) ("titlekey" 4 t nil) ("wb_entity_per_page" 4 t nil) ("wb_items_per_site" 4 t nil) ("wb_terms" 4 t nil)))		0.6	
mirror-language-code-list	'("simple")		0.6	
mirror-objectcache-delete-limit	1000		0.1	
mirror-objectcache-threshold	10000		0.1	
mirror-process-xml	:xml2sql	:import, :xml2sql	0.7	
mirror-profiles-max	5		0.6	
mirror-project-list	("wikipedia" "wiktionary")		0.6	
mirror-schunk-page-count	10		0.6	
mirror-split-sql	:schunk	:dchunk, :schunk	0.6	
mirror-virtual-host-name	wp-mirror.site		0.6	
mirror-xchunk-page-count	10000		0.6	
monitor-gui-font-preference-list	'(("-*-helvetica-medium-r-*-*12-*-*-*-*0.1" "-*-lucida-medium-r-*-*12-*-*-*-*" "-*-lucida-medium-r-*-*14-*-*-*-*"))		0.1	
monitor-mode	:auto	:auto, :gui, :screen, :text	0.1	
monitor-poll-sec	10		0.1	
monitor-poll-sec-min	10		0.1	
monitor-poll-sec-max	1000		0.1	
system-cpu	1	1-3	0.1	
system-cpu-min	1		0.4	
system-cpu-max	3		0.4	
system-hdd-write-cache	1	0, 1	0.6	
system-hdd-write-cache-flush	nil	nil, t	0.6	
system-partition-free-images-min	(* 5 *gigabyte*))		0.4	

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Name	Default	Range	Intr	Rem
system-partition-free-images-start-min	(* 100 *gigabyte*))		0.4	
system-partition-free-images-warn	(* 50 *gigabyte*))		0.4	
system-partition-free-innodb-min	(* 5 *gigabyte*))		0.4	
system-physical-memory-min	(* 4 *gigabyte*)		0.1	
whereis-apache2	/etc/init.d/apache2		0.7	
whereis-apache2ctl	/usr/sbin/apache2ctl		0.2	
whereis-bashrc	/etc/bash.bashrc		0.1	
whereis-bunzip2	/bin/bunzip2		0.1	
whereis-cat	/bin/cat		0.4	
whereis-cp	/bin/cp		0.1	
whereis-chown	/bin/chown		0.1	
whereis-chmod	/bin/chmod		0.1	
whereis-curl	/usr/bin/curl		0.1	
whereis-curlrc	/root/.curlrc		0.1	
whereis-directory-apache-sites-available	/etc/apache2/sites-available/		0.2	
whereis-directory-apache-sites-enabled	/etc/apache2/sites-enabled/		0.2	
whereis-directory-cron	/etc/cron.d/		0.7	
whereis-directory-mediawiki	/var/lib/wp-mirror-mediawiki/		0.5	
whereis-directory-mediawiki-cache	/var/lib/wp-mirror-mediawiki/cache/		0.7	
whereis-directory-mediawiki-config	/etc/wp-mirror-mediawiki/		0.4	
whereis-directory-mediawiki-localisation-update	/var/lib/wp-mirror-mediawiki/extensions/LocalisationUpdate/		0.7	
whereis-directory-mediawiki-extensions-math-math	/var/lib/wp-mirror-mediawiki/extensions/Math/math/		0.7	
whereis-directory-mediawiki-extensions-math-texvccheck	/var/lib/wp-mirror-mediawiki/extensions/Math/texvccheck/		0.7	
whereis-directory-mediawiki-extensions-titlekey	/var/lib/wp-mirror-mediawiki/extensions/TitleKey/		0.7	
whereis-directory-mediawiki-images	/var/lib/wp-mirror-mediawiki/images/		0.6	
whereis-directory-mediawiki-maintenance	/usr/share/wp-mirror-mediawiki/maintenance/		0.1	
whereis-directory-mysql-config	/etc/mysql/		0.4	
whereis-directory-mysql-config-conf.d	/etc/mysql/conf.d/		0.4	

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Name	Default	Range	Intr	Rem
whereis-directory-mysql-datadir	/var/lib/mysql/		0.4	
whereis-directory-php-mods-available	/etc/php5/mods-available/		0.7	
whereis-directory-tmp	/tmp/		0.2	
whereis-directory-wpmirror-config	/etc/wp-mirror/		0.4	
whereis-directory-wpmirror-restore	/usr/share/doc/wp-mirror/restore/		0.6	
whereis-directory-wpmirror-working	/var/lib/wp-mirror-mediawiki/images/wp-mirror/		0.6	
whereis-echo	/bin/echo		0.6	
whereis-env	/usr/bin/env		0.4	
whereis-file-cron	wp-mirror		0.7	
whereis-file-dev-null	/dev/null		0.2	
whereis-file-etc-hosts	/etc/hosts		0.2	
whereis-file-mediawiki-config-localsettings	LocalSettings.php		0.4	
whereis-file-mediawiki-config-localsettings-account	LocalSettings_account.php		0.4	
whereis-file-mediawiki-config-localsettings-wpmirror	LocalSettings_wpmirror.php		0.4	
whereis-file-mediawiki-extensions-localisation-update	localisationUpdate_farm.php		0.7	
whereis-file-mediawiki-extensions-titlekey-rebuild-title-keys	rebuildTitleKeys_farm.php		0.7	
whereis-file-mediawiki-farm-database	database_farm.sql		0.4	
whereis-file-mediawiki-farm-importdump	importDump_farm.php		0.2	0.6
whereis-file-mediawiki-farm-update	update_farm.php		0.7	
whereis-file-mediawiki-favicon	favicon.ico		0.2	
whereis-file-mediawiki-logo	wp-mirror.png		0.5	
whereis-file-mediawiki-update	update.php		0.5	
whereis-file-mysql-config-debian	debian.cnf		0.2	
whereis-file-mysql-config-wpmirror	wp-mirror.cnf		0.4	
whereis-file-mysql-log-file	ib_logfile*		0.4	
whereis-file-php-xdebug	xdebug.ini		0.7	
whereis-file-tmp-http	/tmp/http		0.4	

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Name	Default	Range	Intr	Rem
whereis-file-virtual-host	wp-mirror.site.conf		0.2	
whereis-file-wpmirror-config-default	default.conf		0.4	
whereis-file-wpmirror-config-local	local.conf		0.4	
whereis-file-wpmirror-log	/var/log/wp-mirror.log		0.6	
whereis-file-wpmirror-pid	/var/run/wp-mirror.pid		0.6	
whereis-gm	/usr/bin/gm		0.1	
whereis-grep	/bin/grep		0.2	
whereis-gunzip	/bin/gunzip		0.4	
whereis-hdparm	/sbin/hdparm		0.1	
whereis-inkscape	/usr/bin/inkscape		0.4	
whereis-invoke-rc.d	/usr/sbin/invoke-rc.d		0.4	
whereis-ls	/bin/lis		0.1	
whereis-lua	/usr/bin/wp-mirror-lua		0.7	
whereis-md5sum	/usr/bin/md5sum		0.1	
whereis-mv	/bin/mv		0.1	
whereis-mwxm12sql	/usr/bin/mwxm12sql		0.6	
whereis-mysql	/usr/bin/mysql		0.1	
whereis-mysqldump	/usr/bin/mysqldump		0.2	
whereis-mysql-tzinfo-to-sql	/usr/bin/mysql-tzinfo-to-sql		0.4	
whereis-openssl	/usr/bin/openssl		0.2	
whereis-php	/usr/bin/php		0.1	
whereis-replace	/usr/bin/replace		0.6	
whereis-rm	/bin/rm		0.1	
whereis-rsvg	/usr/bin/rsvg		0.1	
whereis-split	/usr/bin/split		0.6	
whereis-tar	/usr/bin/tar		0.6	
whereis-texvc	/usr/bin/wp-mirror-texvc		0.4	
whereis-texvccheck	/usr/bin/wp-mirror-texvccheck		0.7	
whereis-wc	/usr/bin/wc		0.1	
whereis-wget	/usr/bin/wget		0.1	
whereis-wgetrc	/etc/wgetrc		0.1	
whereis-x	/usr/bin/X		0.1	
whereis-zgrep	/bin/zgrep		0.6	
whereis-zoneinfo	/usr/share/zoneinfo		0.4	
wikimedia-path-checksums-template	xxwiki/latest/xxwiki-latest-md5sums.txt		0.6	

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Name	Default	Range	Intr	Rem
wikimedia-path-dump-template-list	'("xxwiki/yyyymmdd/xxwiki-yyyyymmdd-categorylinks.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-categorylinks.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-externallinks.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-image.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-imagelinks.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-interwiki.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-iwlinks.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-langlinks.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-oldimage.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-page_props.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-page_restrictions.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-pagelinks.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-protected_titles.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-redirect.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-site_stats.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-sites.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-templatelinks.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-pages-articles.xml.bz2" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-stub-articles.xml.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-wb_entity_per_page.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-wb_items_per_site.sql.gz" "xxwiki/yyyymmdd/xxwiki-yyyyymmdd-wb_terms.sql.gz")) fulls/yyyymmdd/xxwiki-yyyyymmdd-zz-media-0.6.tar"	0.6	0.6	
wikimedia-path-idump-template			0.6	
wikimedia-language-code-list			0.1	
wikimedia-large-wiki-list	'("en" "de" "nl" "fr" "it" "ru" "es" "sv" "pl" "ja")		0.1	
wikimedia-site-idump	http://ftpmirror.your.org/pub/wikimedia/10.6/gedumps/tarballs/		0.6	
wikimedia-site-image	http://ftpmirror.your.org/pub/wikimedia/10.6/pages/		0.6	
wikimedia-site-xdump	http://ftpmirror.your.org/pub/wikimedia/10.6/dumps/		0.6	
wikimedia-site-xdump-dirlist	"rsync-dirlist-last-1-good.txt"		0.6	
wpmirror-config-delete-list			0.4	
wpmirror-config-restore-list			0.4	

Table B.2: WP-MIRROR Configuration File Parameter Reference (Obsolete)

Name	Default	Range	Intr	Rem
ichunk-curl-retry	0	0, 1	0.1	0.6
mirrors	1	1-3	0.1	0.6
mirror-chunk-diff-threshold	20		0.1	0.2
mirror-ichunk-connection-time-max	3000		0.6	0.6
mirror-ichunk-persistent-connection	1000		0.6	0.6

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Name	Default	Range	Intr	Rem
mirror-ichunk-post-connection-sleep	1		0.6	0.6
mirror-image-rebuild-threshold	20000		0.1	0.2
mirror-image-then-page-p	t	nil, t	0.1	0.2
mirror-image-use-wikix-p	nil	nil, t	0.1	0.6
mirror-image-validate-p	t	nil, t	0.1	0.6
mirror-importdump-timeout-sec-max	nil	nil, 500-5000	0.4	0.6
mirror-languages	'("simple")		0.2	0.6
mirror-rebuildimages-threshold	20000		0.2	0.6
mirror-rebuildimages-timeout-sec-inc	200		0.2	0.6
mirror-rebuildimages-timeout-sec-min	2000		0.2	0.6
mirror-rebuildimages-timeout-sec-max	20000		0.2	0.6
monitor-gui-one-window-per-wiki	t	nil, t	0.6	0.6
monitor-gui-one-window-per-language	t	nil, t	0.1	0.6
system-disk-space-min	(* 250 *gigabyte*)		0.1	0.4
virtual-host-name	wpmirror.site		0.4	0.6
whereis-cron	/etc/cron.d/wp-mirror		0.1	0.7
whereis-directory-configuration	/etc/wp-mirror/		0.1	0.4
whereis-directory-images	/var/lib/mediawiki/images/		0.1	0.6
whereis-directory-images-bad	/var/lib/mediawiki/images/bad-images/		0.1	0.6
whereis-directory-images-math	/var/lib/mediawiki/images/math/		0.4	0.6
whereis-directory-images-thumb	/var/lib/mediawiki/images/thumb/		0.4	0.6
whereis-directory-images-tmp	/var/lib/mediawiki/images/tmp/		0.4	0.6
whereis-directory-mediawiki	/etc/mediawiki/		0.2	0.4
whereis-directory-mediawiki-extensions	/etc/mediawiki-extensions/		0.4	0.4
whereis-directory-mediawiki-extensions-available	/etc/mediawiki-extensions/extensions-available/		0.4	0.4
whereis-directory-mediawiki-extensions-enabled	/etc/mediawiki-extensions/extensions-enabled/		0.4	0.4

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Name	Default	Range	Intr	Rem
whereis-directory-mediawiki-extensions-math	/var/lib/wp-mirror-mediawiki/extensions/Math/math/		0.4	0.7
whereis-directory-mediawiki-includes	/usr/share/mediawiki/includes/		0.2	0.4
whereis-directory-mysql	/var/lib/mysql/		0.1	0.4
whereis-directory-mysql	/etc/mysql/		0.4	0.4
whereis-directory-working	/var/lib/mediawiki/images/wp-mirror/		0.1	0.6
whereis-echo	/bin/echo/		0.2	0.4
whereis-file-checksums-template	xxwiki-latest-md5sums.txt		0.2	0.6
whereis-file-config-default	default.conf		0.1	0.4
whereis-file-config-local	local.conf		0.1	0.4
whereis-file-dump-template	xxwiki-yyyyymmdd-pages-articles.xml.bz2		0.2	0.6
whereis-file-log	/var/log/wp-mirror.log		0.1	0.6
whereis-file-mediawiki-farm-rebuildimages	rebuildImages_farm.php		0.2	0.6
whereis-file-mediawiki-importdump	importDump.php		0.2	0.6
whereis-file-mediawiki-rebuildimages	rebuildImages.php		0.2	0.6
whereis-file-mediawiki-import	Import.php		0.2	0.4
whereis-file-pid	/var/run/wp-mirror.pid		0.4	0.6
whereis-file-wikidb-template	template.sql		0.2	0.4
whereis-file-mediawiki-adminsettings	AdminSettings.php		0.2	0.4
whereis-file-mediawiki-localsettings	LocalSettings.php		0.2	0.4
whereis-file-mediawiki-localsettings-wpmirror	LocalSettings_wpmirror.php		0.2	0.4
whereis-file-mysql-custom	/etc/mysql/conf.d/custom.cnf		0.4	0.4
whereis-file-mysql-debian	/etc/mysql/debian.cnf		0.4	0.4
whereis-mediawiki-adminsettings	/etc/mediawiki/AdminSettings.php		0.1	0.2
whereis-mediawiki-importdump	/usr/share/mediawiki/maintenance/importDump.php		0.1	0.2
whereis-mediawiki-localsettings	/etc/mediawiki/LocalSettings.php		0.1	0.2
whereis-mediawiki-rebuildimages	/usr/share/mediawiki/maintenance/rebuildImages.php		0.1	0.2

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Name	Default	Range	Intr	Rem
whereis-mediawiki-update	/usr/share/mediawiki/maintenance/update.php		0.1	0.2
whereis-mysql-custom	/etc/mysql/conf.d/custom.cnf		0.1	0.4
whereis-php5-suhosin	/etc/php5/conf.d/suhosin.ini		0.1	0.4
whereis-pidfile	/var/run/wp-mirror.pid		0.1	0.4
whereis-wikix	/usr/bin/wikix		0.1	0.6
wikimedia-checksums	xxwiki/latest/xxwiki-latest-md5sums.txt		0.1	0.2
wikimedia-checksums-template	xxwiki/latest/xxwiki-latest-md5sums.txt		0.2	0.6
wikimedia-dump-pattern	pages-articles.xml.bz2		0.1	0.2
wikimedia-dump-template	xxwiki/yyyymmdd/xxwiki-yyyyymmdd-pages-articles.xml.bz2		0.2	0.6
wikimedia-import	http://svn.wikimedia.org/viewvc/mediawiki/trunk/phase3/includes/Import.php		0.1	0.4
wikimedia-languages-to-mirror	'("simple")		0.1	0.2
wikimedia-site	http://dumps.wikimedia.org/		0.1	0.6
wikimedia-wikix	http://wikix.ngen-cast.de/wikix.tar.gz		0.1	0.6
wpmirror-directory-restore	/usr/share/doc/wp-mirror/restore/		0.4	0.6
xchunk-page-count	1000		0.1	0.6

Appendix C

Design Notes

C.1 Concurrency

WP-MIRROR imposes limits on concurrency:

- If `InnoDB` uses the `Antelope` storage format, then concurrency is limited to the lesser of the number of CPUs and three; and
- If `InnoDB` uses the `Barracuda` storage format, then concurrency is limited one.

C.1.1 Why not Fork 20 `ichunk` Sub-processes? (Obsolete)

Obsolete: As of WP-MIRROR 0.6, media files are downloaded using `wget`, which has an automatic retry feature. So corrupt media files are now rare. Concurrency is limited on the server side. Limits to the number of connections from the same IP address, and rate limits should be expected.

Original text: Media files are downloaded using `cURL`.

Experiments showed that forking three or more sub-processes results in `cURL` failing to download an unacceptable number of media files. Of course, many of the missing media files can be downloaded later by rerunning each `ichunk`, but this hurts performance. There is, however, a worse problem, namely, `cURL` frequently times-out after partially downloading a file. Hence all media files must later be validated (e.g. with `gm identify -verbose`), and the corrupt ones sequestered to a `bad-images` directory for later inspection. Processing `ichunks` one or two at a time works acceptably well.

C.1.2 Concurrency and `fsm-file-scape` (Obsolete)

Obsolete: As of WP-MIRROR 0.6, `fsm-file-scape` is no longer used. Rather media file names are taken from `xxwiki.imagelinks.il.to` and `commonswiki.image.img_name`.

Original text: Experiments showed that:

1. three processes running `fsm-file-scape` concurrently, can generate enough heat to shut down the laptop, and
2. two processes running `fsm-file-scape` concurrently, seems reasonable.

Scraping `xchunks` for media file names is CPU intensive.

Note: In recent years, most laptops are equipped with a number of temperature sensors. These can be used for self-protection of the laptop. If one of the temperatures exceeds a certain threshold, the laptop will automatically turn off. Some thresholds can be set by the user. The author sets a threshold of 55° for hard disk drives because: 1) they have a design limit of 60°, and 2) hot disks do not last.

C.1.3 Concurrency and `xchunk` Sub-processes (Obsolete)

Obsolete: As of WP-MIRROR 0.6, `importDump.php` is no longer used. Nor are thumbs made during the importation process.

Original text: Experiments showed that:

1. During building the mirror for the first time, forking even two sub-processes results in significantly degraded `InnoDB` performance. The main reason seems to be that `PHP` (running `importDump.php`), and `gm` (making thumbs) burden the CPUs heavily.
2. During mirror updates, forking two sub-processes can improve performance. The main reasons being that there is much less `gm` activity (most thumbs already made), which leaves a ‘locality of reference’ issue, mostly involving the `pagelinks` table, which burdens the disks heavily. Competition between multiple sub-processes for a finite number of `InnoDB` buffer pool pages in DRAM results in more ‘cache misses’ and more disk accesses. If there is ample DRAM, then the number of CPUs becomes the limiting factor. There seems to be no advantage to forking more `xchunks` than one has CPUs. Indeed one or two seems reasonable.
3. If `InnoDB` uses the `Barracuda` file format (data compressed using `zlib`) then `xchunks` should be processed one-by-one. `Barracuda` does not handle concurrency well. Even two concurrent `xchunks` will cause a great number of deadlocks. The author recommends: for laptops, use `Barracuda` to save space; but for desktops, use `Antelope` on a raw partition to maximize speed.

C.1.4 Concurrent Processing of `ichunks` in Parallel with `xchunks` (Obsolete)

Experiments showed that:

- When the `xchunk` corresponds to the `ichunk` (that is, the chunks pertain to the same articles), then this results in `InnoDB` resource deadlocks, failure to create the records involved in the deadlock, and degraded `InnoDB` performance while waiting for deadlocks to time-out.
- When care is exercised to ensure that corresponding chunks are not processed concurrently, then significant performance gains are achieved.

Update 2013: As of WP-MIRROR 0.6, the databases are loaded before the media files are downloaded.

C.1.5 Design Decision

WP-MIRROR was designed so that one could have multiple mirror and monitor processes communicating state via the `wpmirror` database. For each working file (`checksum`, `xdump`, `idump`, `xml`, `xchunk`, `ichunk`) there is a record in the database showing its name, size, type, and state—and a semaphore.

`InnoDB` is an ACID compliant transactional storage engine, and therefore already has the locking mechanism needed to keep transactions Isolated (the ‘I’ in ACID). The locking can be used to maintain semaphores (one for each file) that can keep concurrent mirror processes from handling the same file at the same time.

For desktop, experiments using four processes: three mirror (two downloading media files, one importing articles) and one monitor, have worked well by providing a balanced burden upon CPUs, disks, and Internet.

For laptop, experiments using two processes: one mirror and one monitor, have worked well.

C.2 Durability (the ‘D’ in ACID)

C.2.1 HDD Write Caching

Source: <http://monolight.cc/2011/06/barriers-caches-filesystems/>

WP-MIRROR 0.5 and earlier versions, automatically disabled the HDD write cache for any disks underlying InnoDB. This was to assure the Durability of each database transaction COMMITted.

If HDD write caching is enabled, then any writes to disk actually go first to an electronic cache, and only later are written to disk. Caching has a few consequences:

- **Write Performance:** Writing to the physical disk, which involves the mechanical movement of read-write heads and disk rotation, can be ordered using something like the ‘elevator algorithm’.
- **Read Performance:** Reading from the physical disk has a latency (5ms) that is orders of magnitude greater than that of reading from electronic cache (90 μ s).
- **Durability:** Unfortunately, in the event of a system failure (e.g. power fails) items in electronic cache are lost. This can result in database corruption (lost transactions that were supposedly COMMITted) as well as lost files.

It is possible to strike a compromise between performance and durability. For example, all modern file systems use journalling to guard against file system corruption.

WP-MIRROR 0.6 by default disables the HDD write cache. The user may configure HDD write caching using two parameters: `*system-hdd-write-cache*` and `*system-hdd-write-cache-flush*`. For example, consider:

```
root-shell# cat /etc/wp-mirror/local.conf | grep hdd
(defparameter *system-hdd-write-cache*      1)
(defparameter *system-hdd-write-cache-flush* t)
```

This setting has two effects: The first parameter enables HDD write caching, while the second flushes the HDD write cache immediately after each checkpoint. This assures the Durability of all transactions prior to the last checkpoint. Transactions after the last checkpoint may be lost, but this is not tragic because WP-MIRROR resumes from the last checkpoint and therefore repeats those transactions.

C.2.2 Experiments

Time trials is needed to quantify the performance gains (if any).

C.2.2.1 Experimental Method

We set up a desktop PC with Debian GNU/Linux 7.0 and WP-MIRROR 0.6 installed.

Platform	Storage
Desktop	InnoDB Barracuda format, on ReiserFS over LVM2 over LUKS over RAID1 (mirror) over whole disks Seagate, 1.5T, Model: ST31500341AS, Transport: Serial

Disk information can be obtained by executing:

```
root-shell# hdparm -I /dev/sde
/dev/sde:
ATA device, with non-removable media
    Model Number:      ST31500341AS
    Serial Number:     9VS2HM9Q
    Firmware Revision: CC1H
    Transport:         Serial
...
```

First, build a mirror by executing:


```
root-shell# emacs /etc/wp-mirror/local.conf
(defparameter *mirror-language-code-list* '(xh zu))
root-shell# wp-mirror --mirror
```

Building the mirror involves downloading all the media files, validating them, and producing thumbs. Validation and resizing burden the disks with far more reads than writes. Therefore we shall complete this image processing before the time trials, in order to better isolate the effect of HDD write caching upon database performance.

Second, for each run: 1) drop the database (keeping all media files intact), 2) edit the configuration file, 3) `SET MySQL` variables, and 4) `time` the mirror building.

C.2.2.2 Experiment 1a: Baseline

Process: When a transaction `COMMITs`:

- transaction is written to `log buffer`,
- `log buffer` is written immediately to `log file`,
- `log file` is written immediately to physical disk.

Durability: Greatest possible durability.

Configuration:

```
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# emacs /etc/wp-mirror/local.conf
(defparameter *mirror-language-code-list* '(xh zu))
(defparameter *system-hdd-write-cache* 0) <-- 0 or 1
(defparameter *system-hdd-write-cache-flush* nil) <-- nil or t
root-shell# mysql --host=localhost --user=root --password
mysql> SET GLOBAL innodb_flush_log_at_trx_commit=1; -- 0, 1, or 2
mysql> SHOW VARIABLES LIKE 'innodb_flush_log_at_trx_commit';
+-----+
| Variable_name | Value |
+-----+
| innodb_flush_log_at_trx_commit | 1 |
+-----+
1 row in set (0.00 sec)
mysql> quit;
root-shell# time wp-mirror --mirror
real    51m21.812s
user    20m9.332s
sys     2m23.192s
```

Of the three times (real, user, and sys) only the first is interesting to the user. It is sometimes referred to as ‘wall clock’ time. The other two (user and sys) are not accurate because: they refer only to resources consumed by WP-MIRROR, and not to resources consumed by the many sub-processes that WP-MIRROR forks to perform most of the work.

Experiments 1a and 1b were repeated to estimate how much ‘scatter’ there is in the times. The elapsed ‘real’ times vary by about 1m, probably due to other loads on the system. This means that the performance *loss* incurred by enabling HDD write caching is statistically significant.

C.2.2.3 Experiment 1b: HDD Write Cache Enabled

Process: When a transaction `COMMITs`:

- transaction is written to `log buffer`,
- `log buffer` is written immediately to `log file`,

- `log file` is flushed immediately to HDD write cache,
- HDD write cache is written *later* to physical disk.

Durability: System failure can cause loss of any transaction held in HDD write cache that is not yet written to the physical disk.

Configuration:

```
(defparameter *system-hdd-write-cache* 1)
(defparameter *system-hdd-write-cache-flush* t)
mysql> SET GLOBAL innodb_flush_log_at_trx_commit=1;
```

C.2.2.4 Experiment 1c: Log file Flushed Once Per Second

Process: When a transaction `COMMITs`:

- transaction is written to `log buffer`,
- `log buffer` is written immediately to `log file`,
- `log file` is written *once per second* to HDD write cache,
- HDD write cache is *later* written to physical disk.

Durability: System failure can cause loss of up to one second of transactions.

Configuration:

```
(defparameter *system-hdd-write-cache* 1)
(defparameter *system-hdd-write-cache-flush* t)
mysql> SET GLOBAL innodb_flush_log_at_trx_commit=2;
```

C.2.2.5 Experiment 1d: Log Buffer Flushed Once Per Second

Process: When a transaction `COMMITs`:

- transaction is written to `log buffer`,
- `log buffer` is written *once per second* to `log file`,
- `log file` is flushed immediately to HDD write cache,
- HDD write cache is written *later* to physical disk.

Durability: Any `mysqld` crash, and any system failure, can cause loss of up to one second of transactions.

Configuration:

```
(defparameter *system-hdd-write-cache* 1)
(defparameter *system-hdd-write-cache-flush* t)
mysql> SET GLOBAL innodb_flush_log_at_trx_commit=0;
```

C.2.2.6 Experiment 1e: HDD Write Cache Disabled, Log File Flushed Once Per Second

Process: When a transaction `COMMITs`:

- transaction is written to `log buffer`,
- `log buffer` is written immediately to `log file`,
- `log file` is written *once per second* to physical disk.

Durability: Any `mysqld` crash, and any system failure, can cause loss of up to one second of transactions.

Configuration:

```
(defparameter *system-hdd-write-cache* 0)
(defparameter *system-hdd-write-cache-flush* nil)
mysql> SET GLOBAL innodb_flush_log_at_trx_commit=2;
```

C.2.2.7 Experimental Results

The time trials, rounded to nearest minute, yield the following:

	Experiments				
	1a	1b	1c	1d	1e
Platform	desktop				
<code>*mirror-language-code-list*</code>	(xh zu)				
<code>*system-hdd-write-cache*</code>	0	1	1	1	0
<code>*system-hdd-write-cache-flush*</code>	nil	t	t	t	nil
<code>innodb_flush_log_at_trx_commit</code>	1	1	2	0	2
real:	51m	57m	44m	44m	43m
user:	20m	20m	21m	21m	20m
sys:	2m	3m	2m	3m	2m
real time as percentage of baseline	100%	111%	86%	86%	84%

C.2.2.8 Conclusions

For the storage configuration used in these experiments:

- **HDD Write Caching:** A performance *loss* (11% more time overall) was incurred by *enabling* HDD write caching,
- **Log Flushing:** Modest performance gain (16% less time overall) was achieved by writing `log files` to disk *once per second*.

Update: WP-MIRROR 0.6 can perform profiling. Profiling data is displayed using the command-line option `--profile`. These experiments were repeated with profiling. See [§G.3, fsm-file-import](#) and [Durability](#).

C.3 Extensions to [MediaWiki](#)

Purpose: This set of design notes exists so that the reader can test if the [MediaWiki](#) extensions are enabled and working.

Configuration: The extensions included in the [DEB](#) package `wp-mirror-mediawiki-extensions` are enabled by default. An extension can be disabled by commenting the appropriate line in the configuration file: `/etc/wp-mirror-mediawiki/LocalSettings.php`. For example, to enable the [CategoryTree](#) extension, the corresponding line in the config file should read:

```
shell$ cat /etc/wp-mirror-mediawiki/LocalSettings.php | grep CategoryTree
require_once( "$IP/extensions/CategoryTree/CategoryTree.php" );
```

To disable, comment the line:

```
shell$ cat /etc/wp-mirror-mediawiki/LocalSettings.php | grep CategoryTree
#require_once( "$IP/extensions/CategoryTree/CategoryTree.php" );
```

Special page: On the special page, <http://simple.wikipedia.site/wiki/Special:Version>, there is a list of “Installed extensions.” At the bottom of that page, there is also a list of “Parser extension tags” and a list of “Parser function hooks.”

C.3.1 **ApiSandbox**

Purpose	adds special page Special:ApiSandbox
Config	<code>require_once("\$IP/extensions/ApiSandbox/ApiSandbox.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Special:ApiSandbox
Disable	No such special page
Enable	You have requested an invalid special page. special page rendered

C.3.2 **Babel**

Purpose	adds parser function hook <code>#babel</code>
Config	<code>require_once("\$IP/extensions/Babel/Babel.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/User:Wp_mirror
Disable	create user account, log in, create home page containing <code>{{#babel:en}}</code> user page rendered without box labeled “Babel user information”
Enable	user page rendered with box labeled “Babel user information”

C.3.3 **BetaFeatures**

Purpose	adds special page Special:Preferences
Config	<code>require_once("\$IP/extensions/BetaFeatures/BetaFeatures.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Main_Page
Disable	create user account, log in, no link labeled “Beta” at top
Enable	log in, link labeled “Beta” displayed at top

C.3.4 **CategoryTree**

Purpose	adds <code><categorytree></code> tag for dynamic view of category tree
Config	<code>require_once("\$IP/extensions/CategoryTree/CategoryTree.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Category:Mathematics
Disable	• Geometry
Enable	▷ Geometry (5 C, 64 P)
Click	▽ Geometry (5 C, 64 P) <ul style="list-style-type: none">▷ Category:Angles (empty)▷ Category:Conic sections (empty)▷ Category:Coordinate systems (empty)▷ Category:Fractals (empty)▷ Category:Shapes (2 C, 22 P)

C.3.5 **CharInsert**

Purpose	adds <code><charinsert></code> tag for Mediawiki:Edittools
Config	<code>require_once("\$IP/extensions/CharInsert/CharInsert.php");</code>
Depends	extensions (Gadgets)
Test URL	
Disable	
Enable	

C.3.6 CirrusSearch

Purpose	adds search using Elasticsearch
Config	<code>require_once("\$IP/extensions/CirrusSearch/CirrusSearch.php");</code> not configured
Depends	extensions (Elastica, Solarium)
Test URL	
Disable	
Enable	

C.3.7 Cite

Purpose	adds <ref> and <references> tags for citation
Config	<code>require_once("\$IP/extensions/Cite/Cite.php");</code> <code>require_once("\$IP/extensions/Cite/SpecialCite.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/France
Disable	citation displayed as text (e.g. every year.<ref name="tourism">)
Enable	citation displayed as number (e.g. every year. ^[7])
Test URL	http://simple.wikipedia.site/wiki/Special:Cite/France
Disable	No such special page
Enable	You have requested an invalid special page. special page rendered

C.3.8 CLDR

Purpose	adds localized language names (languages, countries, currencies, and time units)
Config	<code>require_once("\$IP/extensions/cldr/cldr.php");</code>
Depends	
Test URL	
Disable	
Enable	

C.3.9 CodeEditor

Purpose	adds Ace editor widget to WikiEditor extension
Config	<code>require_once("\$IP/extensions/CodeEditor/CodeEditor.php");</code> <code>\$wgCodeEditorEnableCore = true;</code> <code>\$wgScribuntoUseCodeEditor = true;</code>
Depends	extensions (Gadgets, WikiEditor)
Test URL	
Disable	
Enable	

C.3.10 Collection

Purpose	adds management of personal collections of pages
Config	<code>require_once("\$IP/extensions/Collection/Collection.php");</code>
Depends	
Test URL	simple.wikipedia.site/wiki/Main_Page
Disable	navigation bar has no Print/export entry
Enable	navigation bar displays Print/export entry

C.3.11 [Disambiguator](#)

Purpose	adds <code>__DISAMBIG__</code> magic word adds <code>Special:DisambiguationPages</code> and <code>Special:DisambiguationPageLinks</code>
Config	<code>require_once("\$IP/extensions/Disambiguator/Disambiguator.php");</code>
Depends	
Test URL	simple.wikipedia.site/wiki/Sandbox
Disable	displays <code>__DISAMBIG__</code> near bottom of page
Enable	no <code>__DISAMBIG__</code> on page

C.3.12 [EasyTimeline](#)

Purpose	adds <code><timeline></code> tag to make ploticus image
Config	<code>require_once("\$IP/extensions/timeline/Timeline.php");</code> <code>putenv("GDFONTPATH=/usr/share/fonts/truetype/freefont");</code>
Depends	DEB (ploticus)
Test URL	http://simple.wikipedia.site/wiki/New_Kingdom
Disable	timeline displayed as text (e.g. <code><timeline> ImageSize ...</timeline></code>)
Enable	timeline displayed as PNG image file

C.3.13 [Elastica](#)

Purpose	adds base elasticsearch capability for use by <code>CirrusSearch</code>
Config	<code>require_once("\$IP/extensions/Elastica/Elastica.php");</code> not configured
Depends	
Test URL	
Disable	
Enable	

C.3.14 [Gadgets](#)

Purpose	adds way for user to select Javascript/CSS snippets
Config	<code>require_once("\$IP/extensions/Gadgets/Gadgets.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Special:Gadgets
Disable	No such special page You have requested an invalid special page.
Enable	special page rendered

C.3.15 [GeoData](#)

Purpose	adds parser function hook <code>#coordinates</code>
Config	<code>require_once("\$IP/extensions/GeoData/GeoData.php");</code> not configured
Depends	extensions (Solarium)
Test URL	
Disable	
Enable	

C.3.16 ImageMap

Purpose	adds <imagemap> tag to make clickable image map
Config	<code>require_once("\$IP/extensions/ImageMap/ImageMap.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Shakespeare_authorship_question
Disable	image not displayed, polygon coordinates listed as text
Enable	image displayed, web links appear when mouse rolls over image

C.3.17 InputBox

Purpose	adds <inputbox> tag for HTML input form
Config	<code>require_once("\$IP/extensions/InputBox/InputBox.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Help:How_to_change_pages
Disable	displayed as text (e.g. <inputbox> type=create width=45 </inputbox>)
Enable	displayed as HTML form input box with “Create page” button

C.3.18 Interwiki

Purpose	adds special page http://simple.wikipedia.site/wiki/Special:Interwiki
Config	<code>require_once("\$IP/extensions/Interwiki/Interwiki.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Special:Interwiki
Disable	No such special page You have requested an invalid special page.
Enable	special page rendered

C.3.19 LabeledSectionTransclusion

Purpose	adds <section> tag and adds parser function hooks (#lst, #lstx, ...) for selective transclusion
Config	<code>require_once("\$IP/extensions/LabeledSectionTransclusion/lst.php");</code> <code>#require_once("\$IP/extensions/LabeledSectionTransclusion/lsth.php");</code>
Depends	
Test URL	
Disable	
Enable	

C.3.20 LocalisationUpdate

Purpose	adds maintenance script to update localizations for MediaWiki messages
Config	<code>require_once("\$IP/extensions/LocalisationUpdate/LocalisationUpdate.php");</code> <code>\$wgLocalisationUpdateDirectory = "\$IP/cache";</code>
Depends	
Test URL	
Disable	
Enable	files appear under <code>/var/lib/wp-mirror-mediawiki/cache/</code>

WP-MIRROR will execute:

```
root-shell# cd /usr/share/wp-mirror-mediawiki/
root-shell# /usr/bin/php extensions/LocalisationUpdate/localisationUpdate_farm.php
```

C.3.21 **Math**

Purpose	adds <math> tag to make mathematical equation
Config	<code>require_once("\$IP/extensions/Math/Math.php");</code> <code>\$wgMathValidModes[] = MW_MATH_MATHJAX;</code> <code>\$wgUseMathJax = true;</code> <code>\$wgDefaultUserOptions['math'] = MW_MATH_MATHJAX;</code>
Depends	DEB (fonts-mathjax)
Test URL	http://simple.wikipedia.site/wiki/Differential_calculus
Disable	equations displayed as text (e.g. $\frac{1}{n}$)
Enable	equations displayed with MathJax OpenType Font

C.3.22 **MobileApp**

Purpose	adds styles and scripts for use in Wikimedia Mobile Applications
Config	<code>require_once("\$IP/extensions/MobileApp/MobileApp.php");</code>
Depends	
Test URL	
Disable	
Enable	

C.3.23 **MobileFrontend**

Purpose	adds mobile friendly view
Config	<code>require_once("\$IP/extensions/MobileFrontend/MobileFrontend.php");</code> <code>\$wgMFAutodetectMobileView = true;</code> <code>\$wgUseFileCache = false;</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/New_Kingdom
Disable	No “Mobile view” link at bottom of page
Enable	“Mobile view” link at bottom of page

C.3.24 **MwEmbedSupport**

Purpose	adds support for other extensions
Config	<code>require_once("\$IP/extensions/MwEmbedSupport/MwEmbedSupport.php");</code>
Depends	
Test URL	
Disable	
Enable	

C.3.25 **OpenSearchXml**

Purpose	adds OpenSearchXML (for search box suggestion)
Config	<code>require_once("\$IP/extensions/OpenSearchXml/OpenSearchXml.php");</code> <code>\$wgEnableMWSuggest = true;</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Main_Page
Disable	search box does not suggest search terms in the dropdown box below it
Enable	

C.3.26 `PagedTiffHandler`

Purpose	adds TIFF image handler
Config	<code>require_once("\$IP/extensions/PagedTiffHandler/PagedTiffHandler.php");</code> <code>\$wgImageMagickIdentifyCommand = '/usr/bin/identify';</code> <code>\$wgTiffUseExiv = true;</code> <code>\$wgTiffExivCommand = '/usr/bin/exiv2';</code> <code>\$wgTiffUseVips = true;</code> <code>\$wgTiffVipsCommand = '/usr/bin/vips';</code>
Depends	DEB (exiv2, libvips-tools)
Test URL	http://simple.wikipedia.site/wiki/Hardwood
Disable	no image for “Children’s wooden play blocks made from hardwood”
Enable	image for “Children’s wooden play blocks made from hardwood”

C.3.27 `ParserFunctions`

Purpose	adds parser function hooks
Example	DOM functions: <code>#if</code> , <code>#ifeq</code> , etc. String functions: <code>#len</code> , <code>#urlencode</code> , etc.
Config	<code>require_once("\$IP/extensions/ParserFunctions/ParserFunctions.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/France
Disable	<code>{{#if:PresidentFranois Hollande {{#if: }}}}}</code> <code>{{#if:President }}</code>
Enable	<code>President</code> <code>François Hollande</code>

C.3.28 `PdfHandler`

Purpose	adds PDF image handler (converts PDF to JPG)
Config	<code>require_once("\$IP/extensions/PdfHandler/PdfHandler.php");</code> <code>\$wgPdfProcessor = 'gs';</code> <code>\$wgPdfPostProcessor = \$wgImageMagickConvertCommand;</code> <code>\$wgPdfInfo = 'pdftinfo';</code> <code>\$wgFileExtensions[] = 'pdf';</code>
Depends	DEB (ghostscript, poppler-utils)
Test URL	http://simple.wikipedia.site/wiki/BP_oil_spill
Disable	Error creating thumbnail
Enable	display map

C.3.29 `Poem`

Purpose	adds <code><poem></code> tag
Config	<code>require_once("\$IP/extensions/Poem/Poem.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Waltzing_Matilda
Disable	lyrics formatted in paragraphs
Enable	lyrics formatted in stanzas

C.3.30 **Score**

Purpose	adds <score> tag to make musical score image
Config	<code>require_once("\$IP/extensions/Score/Score.php");</code> <code>\$wgScoreLilyPond = '/usr/bin/lilypond';</code> <code>\$wgScoreAbc2Ly = '/usr/bin/abc2ly';</code> <code>\$wgScoreTimidity = '/usr/bin/timidity;</code> <code>\$wgScoreTrim = true;</code>
Depends	DEB (lilypond, timidity)
Test URL	http://en.wikipedia.site/wiki/Help:Score http://en.wikipedia.site/wiki/Special:PagesWithProp/score
Disable	score tags rendered as text
Enable	score tags rendered as musical notation

C.3.31 **Scribunto**

Purpose	adds scripts contained within the Module namespace
Config	<code>require_once("\$IP/extensions/Scribunto/Scribunto.php");</code> <code>\$wgScribuntoDefaultEngine = 'luastandalone';</code> <code>\$wgScribuntoEngineConf['luastandalone']['errorFile'] = "/tmp/lua-error.log";</code> <code>\$wgScribuntoEngineConf['luastandalone']['luaPath'] = '/usr/bin/lua5.1';</code> <code>\$wgScribuntoUseGeSHi = true;</code> <code>\$wgShowExceptionDetails = true;</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Debian
Disable	Infobox displays <code>{{#invoke:InfoboxImage ...</code>
Enable	Infobox displays properly

C.3.32 **Solarium**

Purpose	adds Solr client library for use by other extensions (e.g. Extension:CirrusSearch, Extension:GeoData, Extension:Translate)
Config	<code>require_once("\$IP/extensions/Solarium/Solarium.php");</code>
Depends	
Test URL	
Disable	
Enable	

C.3.33 **SyntaxHighlight_GeSHi**

Purpose	adds <source> and <syntaxhighlight> tags to highlight computer program syntax GeSHi stands for General Syntax Highlighter
Config	<code>require_once("\$IP/extensions/SyntaxHighlight_GeSHi/SyntaxHighlight_GeSHi.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Programming_language
Disable	sample code is not highlighted
Enable	sample code is highlighted

C.3.34 `TemplateData`

Purpose	adds <code><templatedata></code> tag to document templates
Config	<code>require_once("\$IP/extensions/TemplateData/TemplateData.php");</code> <code>\$wgTemplateDataUseGUI = false;</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Template:Infobox_football_biography/doc
Disable	
Enable	table rendered

C.3.35 `TemplateSandbox`

Purpose	adds special page http://simple.wikipedia.site/wiki/Special:TemplateSandbox which renders page by transcluding a template from a sandbox
Config	<code>require_once("\$IP/extensions/TemplateSandbox/TemplateSandbox.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Special:TemplateSandbox
Disable	No such special page You have requested an invalid special page.
Enable	special page rendered

C.3.36 `TextExtracts`

Purpose	adds API to retrieve plain-text extract of page content
Config	<code>require_once("\$IP/extensions/TextExtracts/TextExtracts.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/w/api.php?action=query&prop=extracts&exchars=100&titles=Ea
Disable	Unrecognized value for parameter 'prop': extracts
Enable	renders page extract

C.3.37 `TimedMediaHandler`

Purpose	adds display of audio/video files in wiki pages
Config	<code>require_once("\$IP/extensions/TimedMediaHandler/TimedMediaHandler.php");</code> <code>ini_set('include_path',</code> <code> "::\$IP:\$IP/includes:\$IP/languages:/usr/share/php" .</code> <code> PATH_SEPARATOR .</code> <code> ini_get('include_path'));</code> <code>\$wgVideoPlayerSkin = 'kskin';</code> <code>\$wgEnableTranscode = true;</code> <code>\$wgEnableNiceBackgroundTranscodeJobs = true;</code> <code>\$wgFFmpeg2theoraLocation= '/usr/bin/ffmpeg2theora';</code> <code>#\$wgFFmpegLocation = '/usr/bin/ffmpeg';</code> <code>\$wgFFmpegLocation = '/usr/bin/avconv';</code> <code>\$wgOggThumbLocation = '/usr/bin/oggThumb';</code>
Depends	DEB (cortado, ffmpeg, ffmpeg2theora, libav-tools, libvpx1) DEB (oggvideotools, php5-cli, php-getid3, php-pear) extensions (MwEmbedSupport)
Test URL	http://simple.wikipedia.site/wiki/Burnout http://simple.wikipedia.site/wiki/Sintel
Disable	renders link “File:Sintel movie 720x306.ogv”
Enable	renders embedded frame

C.3.38 TitleKey

Purpose	adds case-insensitive title prefix key for search box suggestion
Config	<code>require_once("\$IP/extensions/TitleKey/TitleKey.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Main_Page
Disable	no suggestions displayed in dropdown box below search box
Enable	suggestions displayed in dropdown box below search box

C.3.39 Translate

Purpose	adds <language> and <translate> tags
Config	<code>require_once("\$IP/extensions/Translate/Translate.php");</code> <code>\$wgGroupPermissions['user']['translate'] = true;</code> <code>\$wgGroupPermissions['user']['translate-messagereview'] = true;</code> <code>\$wgGroupPermissions['user']['translate-groupreview'] = true;</code> <code>\$wgGroupPermissions['user']['translate-import'] = true;</code> <code>\$wgGroupPermissions['sysop']['pagetranslation'] = true;</code> <code>\$wgGroupPermissions['sysop']['translate-manage'] = true;</code> <code>\$wgTranslateDocumentationLanguageCode = 'qqq';</code> <code>\$wgExtraLanguageNames['qqq'] = 'Message documentation';</code>
Depends	extensions (UniversalLanguageSelector)
Test URL	http://www.wikidata.site/wiki/Wikidata:Introduction
Disable	tags rendered as text
Enable	tags do not appear

C.3.40 UniversalLanguageSelector

Purpose	adds tools to select and configure language
Config	<code>require_once("\$IP/extensions/UniversalLanguageSelector/UniversalLanguageSelector.php");</code> <code>\$wgULSEnable = true;</code> <code>\$wgULSGeoService = false;</code> <code>\$wgULSPosition = 'personal';</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Main_Page
Disable	no language selector link
Enable	language selector link at top of page

C.3.41 VectorBeta

Purpose	adds alterations to Vector skin to list of beta features
Config	<code>require_once("\$IP/extensions/VectorBeta/VectorBeta.php");</code>
Depends	extensions (BetaFeatures)
Test URL	http://simple.wikipedia.site/wiki/Main_Page
Disable	titles are sans serif
Enable	create user account, log in, click link labeled “Beta”, select “Typography refresh”, titles should now be serif

C.3.42 `VipsScaler`

Purpose	adds wrapper around VIPS (to resize PNG and JPEG images using VIPS) adds special page http://simple.wikipedia.site/wiki/Special:VipsTest
Config	<code>require_once("\$IP/extensions/VipsScaler/VipsScaler.php");</code> <code>require_once("\$IP/extensions/VipsScaler/VipsTest.php");</code> <code>\$wgVipsCommand</code> = <code>'/usr/bin/vips'</code> ;
Depends	DEB (libvips-tools)
Test URL	http://simple.wikipedia.site/wiki/Special:VipsTest
Disable	No such special page
Enable	You have requested an invalid special page. special page rendered. To use “VIPS scaling test page”: enter “File on this wiki: Header_MediaWiki_Homepage.png”, press “Generate thumbnails”, see difference between default scaler and VIPS scaler

C.3.43 `VisualEditor`

Purpose	adds rich-text editor
Config	<code>require_once("\$IP/extensions/VisualEditor/VisualEditor.php");</code> <code>\$wgDefaultUserOptions['visualeditor-enable'] = 1;</code> <code>\$wgHiddenPrefs[] = 'visualeditor-enable';</code>
Depends	
Test URL	
Disable	
Enable	

C.3.44 Wikidata

Purpose	adds Wikibase repo and client
Config	<pre> # 1) wikidata repo putenv("MW_INSTALL_PATH=\$IP"); #define('WB_EXPERIMENTAL_FEATURES', true); \$wgEnableWikibaseRepo = true; \$wgEnableWikibaseClient = true; \$wmgUseWikibaseRepo = true; \$wmgUseWikibaseClient = true; require_once("\$IP/extensions/Wikidata/Wikidata.php"); #require_once("\$IP/extensions/Wikidata/extensions/Wikibase/repo/ExampleSettings.php"); \$wgContentHandlerUseDB = true; define('WB_NS_PROPERTY', 120); define('WB_NS_PROPERTY_TALK', 121); \$wgNamespaceAliases['Item'] = NS_MAIN; \$wgNamespaceAliases['Item_talk'] = NS_TALK; \$wgNamespaceAliases['Wikidata'] = NS_PROJECT; \$wgNamespaceAliases['Wikidata_talk'] = NS_PROJECT_TALK; \$wgExtraNamespaces[WB_NS_PROPERTY] = 'Property'; \$wgExtraNamespaces[WB_NS_PROPERTY_TALK] = 'Property_talk'; \$wgNamespacesToBeSearchedDefault[WB_NS_PROPERTY] = true; #\$wgNamespaceContentModels[NS_MAIN] = CONTENT_MODEL_WIKIBASE_ITEM; \$wgNamespaceContentModels[WB_NS_PROPERTY] = CONTENT_MODEL_WIKIBASE_PROPERTY; #\$wgWBRepoSettings['entityNamespaces'][CONTENT_MODEL_WIKIBASE_ITEM] = NS_MAIN; \$wgWBRepoSettings['entityNamespaces'][CONTENT_MODEL_WIKIBASE_PROPERTY] = WB_NS_PROPERTY; \$wgGroupPermissions['*']['item-term'] = true; \$wgGroupPermissions['*']['item-merge'] = true; \$wgGroupPermissions['*']['property-term'] = true; \$wgGroupPermissions['*']['property-create'] = true; # 2) wikidata client \$wgWBClientSettings['repoNamespaces'] = array('wikibase-item' => '', 'wikibase-property' => 'Property',); \$wgWBClientSettings['siteLocalID'] = \$wgLanguageCode; \$wgWBClientSettings['repoUrl'] = 'http://www.wikidata.site'; \$wgWBClientSettings['repoArticlePath'] = '/wiki/\$1'; \$wgWBClientSettings['repoScriptPath'] = '/w'; \$wgWBClientSettings['repoDatabase'] = 'wikidatawiki'; \$wgWBClientSettings['siteGlobalID'] = \$wgDBname; \$wgWBClientSettings['repoSiteId'] = 'wikidatawiki'; \$wgWBClientSettings['siteGroup'] = \$project; # 3) wb_changes_dispatch - not really needed for a mirror \$wgWBClientSettings['changesDatabase'] = 'wikidatawiki'; </pre>
Depends	extensions (UniversalLanguageSelector)
Test URL	http://simple.wikipedia.site/wiki/Barneveld
Disable	Infobox contains text like {{#property:p41}}
Enable	Infobox contains flag, coat of arms, and other property values

C.3.45 WikiEditor

Purpose	adds extendable wikitext editing interface
Config	<code>require_once("\$IP/extensions/WikiEditor/WikiEditor.php");</code> <code>\$wgDefaultUserOptions['usebetatoolbar'] = 1;</code> <code>\$wgDefaultUserOptions['usebetatoolbar-cgd'] = 1;</code> <code>\$wgDefaultUserOptions['wikieditor-preview'] = 1;</code> <code>\$wgDefaultUserOptions['wikieditor-publish'] = 1;</code>
Depends	extensions (Gadgets)
Test URL	http://simple.wikipedia.site/w/index.php?title=Barneveld&action=edit
Disable	displays stock toolbar
Enable	displays toolbar icons, tabs (Wikitext, Preview, Changes), buttons (Publish, Cancel)

C.3.46 wikihierio

Purpose	adds <hierio> tag for hieroglyphics
Config	<code>require_once("\$IP/extensions/wikihierio/wikihierio.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Ra
Disable	hieroglyph displayed as text (e.g. <hierio>D10</hierio>)
Enable	hieroglyph displayed as PNG image file

C.3.47 ZeroRatedMobileAccess

Purpose	adds features (banner, hyperlink, image) for mobile providers that offer free access to Wikipedia
Config	<code>require_once("\$IP/extensions/ZeroRatedMobileAccess/ZeroRatedMobileAccess.php");</code>
Depends	
Test URL	http://simple.wikipedia.site/wiki/Main_Page
Disable	
Enable	

C.4 Forking Subprocesses

WP-MIRROR gets most of its work done by forking sub-processes. This is done for robustness. If a sub-process fails, the damage is contained within that sub-process, and WP-MIRROR continues to run.

When we print out the `kernel ring buffer`, we discover that image processing is error prone:

```
root-shell# dmesg | grep segfault
[311284.542732] gm[18286]: segfault at 30000001f ip 00007ffc3a7d63eb sp 00007fffba65c5d0
error 4 in libGraphicsMagick.so.3.9.0[7ffc3a6bd000+29f000]
[312876.143152] gm[21701]: segfault at 30000001f ip 00007f5029d853eb sp 00007fff4678cef0
error 4 in libGraphicsMagick.so.3.9.0[7f5029c6c000+29f000]
[631890.556242] convert[28284]: segfault at 7f5a2834e000 ip 00007f5a26c57f31 sp 00007fff1434b750
error 6 in libGraphicsMagick.so.3.9.0[7f5a26b46000+29f000]
[638061.613181] convert[11446]: segfault at 7f8461790000 ip 00007f8460843f31 sp 00007fff84543de0
error 6 in libGraphicsMagick.so.3.9.0[7f8460732000+29f000]
[678738.583009] convert[24596]: segfault at 7f450210e020 ip 00007f4500175f31 sp 00007fffd0725f90
error 6 in libGraphicsMagick.so.3.9.0[7f4500064000+29f000]
```

These ‘segfaults’ however are contained within their respective sub-processes, and do not disturb WP-MIRROR.

C.5 Icons

C.5.1 Graphic Arts

Icons fall into two categories: raster and vector.

C.5.1.1 Raster Images

What: Raster images, such as the [PNG](#) format, are created with a fixed resolution (e.g. 32x32 pixels).

Pros: Good for working with photographic images.

Cons: When magnified, lines and edges can look ragged.

Tools: Open source tools for raster images include the [gimp](#).

C.5.1.2 Vector Images

What: Vector images, such as the [SVG](#) format, are defined as a set of geometrical objects (lines, polygons) with edges and interiors that may be colored or textured.

Pros: Good for simple geometric patterns, such as national flags, coats of arms, company logos, and the like. When magnified they should preserve their appearance.

Tools: Open source tools for vector images include [inkscape](#).

C.5.2 Logotype for use by MediaWiki

Documentation: [http://www.mediawiki.org/wiki/Manual:\\$wgLogo](http://www.mediawiki.org/wiki/Manual:$wgLogo)

[MediaWiki](#) offers a number of “skins”. A skin provides a consistent look and feel to all of its web pages, and consists of: a cascading style sheet ([css](#) file), some media files, and a few bits of code ([js](#) or [php](#) files).

As of [MediaWiki 1.19](#), the default skin is [vector](#). Several other skins are also available ([chick](#), [cologneblue](#), [modern](#), [monobook](#), [nostalgia](#), and [simple](#)). These are all found under `/var/lib/mediawiki/skins`. The “legacy” skin is [monobook](#).

These skins should display a logo. The default is `/var/lib/mediawiki/skins/common/images/wiki.png` (see margin). This default should be replaced with one of our own. However, according to <http://www.mediawiki.org/wiki/Manual:FAQ>:

The maximum logo size in Vector is 160x160px, while MonoBook’s is 155x155px, and Standard / Classic’s is 135x135px. A good logo size is 135x135px or one of 150x150px or 155x155px if you don’t care about legacy skins. Note that in Vector and MonoBook a logo that is too large will be cut off, while in Standard / Classic a logo that is too large will simply extend a tiny bit into the content area.

[FAQ](#), “How do I change the logo?”, accessed 2012-12-19

To assure backward compatibility with legacy skins, the WP-MIRROR Logotype is 135x135 pixels. It was made using the [gimp](#). The artistic process is not discussed here, nor are the details of how to use the [gimp](#).

We install the logotype as `/var/lib/mediawiki/wp-mirror.png`, set ownership to `www-data:www-data` (so [apache2](#) can use it), and configure [MediaWiki](#) to find it.

```
shell$ ls /var/lib/mediawiki/[fw]*[log]
-rw-r--r-- 1 www-data www-data 971 Dec 14 05:41 favicon.ico
-rw-r--r-- 1 www-data www-data 30677 Dec 14 05:41 wp-mirror.png
shell$ cat /etc/mediawiki/LocalSettings_wpmirror.php
...
$wgFavicon          = "$wgScriptPath/favicon.ico";
$wgLogo             = "$wgScriptPath/wp-mirror.png";
```



C.5.3 Favicon for use by the Web Browser

Documentation: [http://www.mediawiki.org/wiki/Manual:\\$wgFavicon](http://www.mediawiki.org/wiki/Manual:$wgFavicon).

A **favicon** is a 16x16 (or 32x32) pixel icon in **ICO** format. It is displayed in the web browser's Address Bar (the text box where you enter the URL).

We can make a favicon by miniaturizing our logotype. Interestingly, **Graphics Magick** is not able to write an **ICO** file. Therefore, we must manually use the **gimp**. First, execute:

```
shell$ gimp 16px-wp-mirror.png
File -> Export ...
```

Second, a new window should open with title “Export Image”. Click on

```
Select File Type (By Extension)
```

scroll down to

File Type	Extensions
Microsoft Windows Icon	ico

click on “Microsoft Window Icon”, and click “Export”.

Third, a new window should open with title “Export Image as Windows Icon”. Click “Export”, and exit the **gimp**.

Fourth, repeat for **32px-wp-mirror.png**.

Fifth, execute:

```
shell$ cp 16px-wp-mirror.ico favicon.ico
shell$ ls -l *ico
-rw-r--r-- 1 kmiller kmiller 1150 Dec 15 02:22 16px-wp-mirror.ico
-rw-r--r-- 1 kmiller kmiller 4286 Nov 29 06:43 32px-wp-mirror.ico
-rw-r--r-- 1 kmiller kmiller 1150 Dec 15 02:22 favicon.ico
```

We install the favicon as **/var/lib/mediawiki/favicon.ico**, set ownership to **www-data:www-data** (so **apache2** can use it), and configure **MediaWiki** to find it.

```
shell$ ls /var/lib/mediawiki/[fw]*[og]
-rw-r--r-- 1 www-data www-data 971 Dec 14 05:41 favicon.ico
-rw-r--r-- 1 www-data www-data 30677 Dec 14 05:41 wp-mirror.png
shell$ cat /etc/mediawiki/LocalSettings-wpmirror.php
...
$wgFavicon          = "$wgScriptPath/favicon.ico";
$wgLogo              = "$wgScriptPath/wp-mirror.png";
```

C.5.4 Makefile

All the icons, except for the favicon, can be converted by **Graphics Magick** from the original **PNG** image file.

```

shell$ cat Makefile
#-----+
# Makefile - for wp-mirror icon and favicon |
# Copyright (C) 2012 Dr. Kent L. Miller. All rights reserved. |
#-----+

PROGRAM = wp-mirror
XCF      = $(PROGRAM).xcf
PNG      = $(PROGRAM).png
ICON16   = 16px-$(PROGRAM).png
ICON22   = 22px-$(PROGRAM).png
ICON24   = 24px-$(PROGRAM).png
ICON32   = 32px-$(PROGRAM).png
ICON48   = 48px-$(PROGRAM).png
ICON64   = 64px-$(PROGRAM).png
ICON128  = 128px-$(PROGRAM).png
ICON256  = 256px-$(PROGRAM).png
ICON135  = 135px-$(PROGRAM).png
PIXMAP   = $(PROGRAM).xpm
ICO      = favicon.ico

thumb:
    gm convert -size 16x16 $(PNG) -resize 16x16 +profile "*" $(ICON16)
    gm convert -size 22x22 $(PNG) -resize 22x22 +profile "*" $(ICON22)
    gm convert -size 24x24 $(PNG) -resize 24x24 +profile "*" $(ICON24)
    gm convert -size 32x32 $(PNG) -resize 32x32 +profile "*" $(ICON32)
    gm convert -size 48x48 $(PNG) -resize 48x48 +profile "*" $(ICON48)
    gm convert -size 64x64 $(PNG) -resize 64x64 +profile "*" $(ICON64)
    gm convert -size 128x128 $(PNG) -resize 128x128 +profile "*" $(ICON128)
    gm convert -size 256x256 $(PNG) -resize 256x256 +profile "*" $(ICON256)
    gm convert -size 135x135 $(PNG) -resize 135x135 +profile "*" $(ICON135)
    gm convert -size 32x32 $(PNG) -resize 32x32 +profile "*" $(PIXMAP)
    # the ICO file must be made with GIMP (File->Export...)

clean:
    rm -f *~

```

C.5.5 Pixmap for use by the [Debian Menu System](#)

We would like to add WP-MIRROR to the Debian Menu System. Tools and documentation are available.

```

root-shell# aptitude install dh-make maint-guide menu
shell$ man menufile
shell$ lynx http://localhost/doc/maint-guide/html/index.en.html

```

According to the [Debian New Maintainer's Guide](#)

X Window System users usually have a window manager with a menu that can be customized to launch programs. If they have installed the Debian [menu](#) package, a set of menus for every program on the system will be created for them.

Here's the default `menu.ex` file that `dh.make` created.

```

?package(gentoo):needs=X11|text|vc|wm \
    section=Applications/see-menu-manual \
    title=gentoo command=/usr/bin/gentoo

```

The first field after the colon character is `needs`, and it specifies what kind of interface the program needs. Change this to one of the listed alternatives, e.g. `text` or `X11`.

The next is the `section` that the menu and submenu entry should appear in. [58]

The `title` field is the name of the program. You can start this one in uppercase if you like. Just keep it short.

Finally, the `command` field is the command that runs the program.

Let's change the file name to `menu` and change the menu entry to this:

```
?package(gentoo): needs=X11 \  
    section=Applications/Tools \  
    title=Gentoo command=gentoo
```

You can also add other fields like `longtitle`, `icon`, `hints` etc. See `dh_installmenu(1)`, `menufile(5)`, `update-menus(1)`, and The Debian Menu sub-policy for more information. [Debian New Maintainer's Guide](#), Chapter 5.16

In our case, we filled out the `menu` file like so:

```
shell$ cat debian/menu  
?package(wp-mirror):\br/>    needs="X11" \  
    section="Applications/Network/Web Browsing" \  
    command="/usr/bin/wp-mirror --gui" \  
    title="wp-mirror" \  
    icon="/usr/share/pixmaps/wp-mirror.xpm" \  
    longtitle="Wp-mirror: Utility for mirroring a set of wikipedias"
```

When we execute:

```
root-shell# dpkg --install wp-mirror_0.6-1_all.deb
```

This file is then automatically installed as `/usr/share/menu/wp-mirror`.

The icon, which is optional, should be 32x32 pixels, in `XPM` format, and installed as `/usr/share/pixmaps/wp-mirror.xpm`. This pixmap is easily converted from the original `PNG` image file using `Graphics Magick`. See the `Makefile` shown in §C.5.4, `Makefile`, the relevant lines of which are:

```
PROGRAM    = wp-mirror  
PNG         = $(PROGRAM).png  
PIXMAP      = $(PROGRAM).xpm  
  
thumb:  
    gm convert -size 32x32  $(PNG) -resize 32x32  +profile "*" $(PIXMAP)
```

Experience: This works in the sense that WP-MIRROR and the icon are added to the menu system. However, when clicked, we see a small icon bounce up and down for while, and then vanish. This seems to be a permissions issue. Presently, WP-MIRROR must be run with `root` permissions.

C.5.6 Icons for use by the Window Manager

C.5.6.1 Icon Theme Specification

Documentation:

<http://standards.freedesktop.org/icon-theme-spec/icon-theme-spec-latest.html>

Window Manager: An `X` server (almost) always comes with a couple of specialized `X` clients: a window manager and a clip board. A window manager determines

where and how the windows of other `X` clients are displayed on the screen. There are dozens of window managers available (e.g. `kwin` is the window manager for `KDE`). See http://en.wikipedia.org/wiki/Comparison_of_X_window_managers.

Window Icons: A window manager uses many icons of different resolution. For example:

- a window can be minimized and represented by an icon with some accompanying text;
- a window is usually surrounded by a frame at the top of which is a “Title Bar”, which usually has a “Title Bar Icon” in the upper left corner;
- when the user presses `alt-tab` to cycle among the windows, an icon for each window will appear in turn;
- most window managers offer some kind of application launcher, which also make use of icons.

Themes: Window managers have “themes” (which are much like “skins” discussed above). Most of the theme information (icons, indexes, and caches) is stored under `/usr/share/icons/`:

```
shell$ ls /usr/share/icons/
default      oxy-chrome      oxy-norway      oxy-sea_blue
default.kde4 oxy-desert      oxy-obsidian    oxy-steel
gnome        oxy-emerald     oxy-obsidian-hc oxy-terra
hicolor      oxygen          oxy-olympus     oxy-terra_green
locolor      oxy-green       oxy-olympus-inv oxy-violet
mono         oxy-grey        oxy-orchid      oxy-viorange
oxy-black   oxy-honeycomb   oxy-oxygen      oxy-white
oxy-blue     oxy-hot_orange  oxy-peach       oxy-whitewater
oxy-bluecurve oxy-lilac       oxy-purple      oxy-wonton
oxy-brown    oxy-midnight_meadow oxy-red         oxy-yellow
oxy-cherry   oxy-navy        oxy-red-argentina oxy-zion
```

One theme can “inherit” icons from another theme (the default, or perhaps fallback, theme is `hicolor`):

```
shell$ cat /usr/share/icons/oxygen/index.theme | grep Inherit
Inherits=hicolor
```

For efficiency, this information is cached (one cache per theme):

```
shell$ ls -l /usr/share/icons/oxygen/
drwxr-xr-x 11 root root      280 Sep  2 22:32 128x128
drwxr-xr-x 13 root root      336 Sep  2 22:32 16x16
drwxr-xr-x 13 root root      336 Sep  2 22:32 22x22
drwxr-xr-x  9 root root      232 Sep  2 22:32 256x256
drwxr-xr-x 12 root root      312 Sep  2 22:32 32x32
drwxr-xr-x 12 root root      312 Sep  2 22:32 48x48
drwxr-xr-x 11 root root      280 Sep  2 22:32 64x64
drwxr-xr-x  3 root root       72 Sep  2 22:32 8x8
-rw-r--r--  1 root root 146850472 Dec 14 09:06 icon-theme.cache
-rw-r--r--  1 root root    8827 Jul 27  2011 index.theme
drwxr-xr-x  6 root root      152 Sep  2 22:40 scalable
```

The [Freedesktop.org](http://freedesktop.org) publishes a number of standards for the `X` Window System. According to their [Icon Theme Specification](#):

Installing Application Icons

So, you're an application author, and want to install application icons so that they work in the [KDE](#) and [Gnome](#) menus. Minimally you should install a 48x48 icon in the [hicolor](#) theme. This means installing a [PNG](#) image file in `$prefix/share/icons/hicolor/48x48/apps`. Optionally you can install icons in different sizes. For example, installing a [svg](#) icon in `$prefix/share/icons/hicolor/scalable/apps` means most desktops will have one icon that works for all sizes. You might even want to install icons with a look that matches other well known themes so your application will fit in with some specific desktop environment.

It is recommended that the icons installed in the [hicolor](#) theme look neutral, since it is a fallback theme that will be used in combination with some very different looking themes. But if you don't have any neutral icon, please install whatever icon you have in the [hicolor](#) theme so that all applications get at least some icon in all themes. [Icon Theme Specification, v0.11](#), accessed 2012-12-19

C.5.6.2 WP-MIRROR Themes

WP-MIRROR provides a file to help the window manager locate an icon for a minimized window.

```
shell$ cat /usr/share/applications/wp-mirror.desktop
[Desktop Entry]
Categories=Network;
Comment=Mirror a set of wikipedias
Exec=/usr/bin/wp-mirror --gui
Icon=wp-mirror
Name=wp-mirror
Terminal=true
TryExec=/usr/bin/wp-mirror
Type=Application
```

C.5.6.3 WP-MIRROR Icons

WP-MIRROR provides icons for use by the window manager. They are stored as `/usr/share/icons/hicolor/resolution/apps/wp-mirror.png`, where *resolution* is 16x16, 22x22, 24x24, 32x32, 48x48, 64x64, 128x128, and 256x256.

C.5.6.4 Experience

None of the WP-MIRROR icons are displayed by the window manager (in our case [kwin](#)). Instead the default "X" icon is displayed. Rebuilding the KDE System Configuration Cache did not help:

```
shell$ man kbuildsycoca4
shell$ kbuildsycoca4 --noincremental
root-shell# kbuildsycoca4 --noincremental
root-shell# ls -l /var/tmp/kdecache-[UserName]/
...
root-shell# ls -l /var/tmp/kdecache-root/
...
```

Nor did clearing the icon caches:

```
shell$ cd ~/.kde/cache-[ComputerName]/
shell$ rm icon-cache.kcache
shell$ rm plasma_theme_*.kcache
```

Nor did restarting the [X](#) server. Still no WP-MIRROR icons displayed.

C.5.6.5 The Extended Window Manager Hints Standard

Documentation:

<http://standards.freedesktop.org/wm-spec/1.3/index.html>

Freedesktop.org published a standard for [Extended Window Manager Hints](#). Each X client sends messages to the X server, which passes in turn passes them to the window manager. The window manager takes these message under advisement. The standard describes over 30 of these messages (most of which are called properties).

Some of these properties are in regards to icons. In particular, we are interested in [NET_WM_ICON](#), which tells the window manager which icons to use for the Title Bar Icon and the [alt-tab](#) icon.

C.5.6.6 The [_NET_WM_ICON](#) Hint

According to the [Extended Window Manager Hints](#) standard:

[_NET_WM_ICON](#)

[_NET_WM_ICON](#) CARDINAL[][2+n]/32

This is an array of possible icons for the client. This specification does not stipulate what size these icons should be, but individual desktop environments or toolkits may do so. The Window Manager MAY scale any of these icons to an appropriate size.

This is an array of 32bit packed CARDINAL ARGB with high byte being A, low byte being B. The first two cardinals are width, height. Data is in rows, left to right and top to bottom.

[Extended Window Manager Hints, v1.3](#), Application Window Properties, accessed 2012-12-19

So let us test this.

C.5.6.7 C++ Program to Test the [_NET_WM_ICON](#) Hint

The following example was found at <http://lists.kde.org/?l=kwin&m=115435217715650&w=2>.

The array `buffer` contains two icons: the first is 16x16 pixels, the second is 32x32 pixels. Each pixel is in ARGB format. Here the A stands for Alpha (as in alpha-blending, where 0 is transparent, and 255 is opaque), R for Red, G for Green, and B for Blue.

This array, `buffer`, is assigned to the property [_NET_WM_ICON](#), and the message sent to the X server. The window manager should take the hint, and use the icons for the Title Bar Icon and the [alt-tab](#) icon.

If the reader wishes to download the example posted above, then please be aware that it contains an half dozen typos. Some of the larger numbers in the `buffer` array contain an unwanted blank space. These blank spaces are caught by the compiler, and must then be manually removed. The code provided below is the corrected version.

```

shell$ cat native.cpp
// gcc -lX11 -lstdc++ -L/usr/X11/lib -o native native.cpp

#include <stdlib.h>
#include <X11/Xlib.h>

int main( int argc, char **argv )
{
    unsigned int buffer[] = {16, 16, 4294901760, 4294901760, 4294901760, 4294901760, \
4294901760, 4294901760, 4294901760, 4294901760, 338034905, 3657433343, 0, 184483840, \
234881279, 3053453567, 3221225727, 1879048447, 0, 0, 0, 0, 0, 0, 0, 0, 1224737023, \
3305111807, 3875537151, 0, 0, 2063597823, 1291845887, 0, 67109119, 4294901760, \
4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, \
50266112, 3422552319, 0, 0, 3070230783, 2063597823, 2986344703, 771752191, 0, 0, 0, \
0, 0, 0, 0, 0, 0, 3422552319, 0, 0, 3372220671, 1509949695, 704643327, 3355443455, \
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4278255360, 4026597120, 3758161664, 3489726208, 3204513536, 2952855296, 2684419840, \
2399207168, 2130771712, 1845559040, 1593900800, 1308688128, 1040252672, 755040000, \
486604544, 234946304, 4278255360, 4043374336, 3774938880, 3506503424, 3221290752, \
2952855296, 2667642624, 2399207168, 2130771712, 1862336256, 1627453957, 1359017481, \
1073805064, 788591627, 503379721, 218169088, 4278255360, 4043374336, 3758161664, \
3506503424, 3221290752, 2952855296, 2684419840, 2415984384, 2130771712, 1862336256, \
1577123584, 1308688128, 1040252672, 755040000, 486604544, 218169088, 4278190335, \
4026532095, 3758096639, 3489661183, 3221225727, 2952790271, 2667577599, 2415919359, \
2130706687, 1862271231, 1593835775, 1325400319, 1056964863, 771752191, 520093951, \
234881279, 4278190335, 4026532095, 3758096639, 3489661183, 3221225727, 2952790271, \
2667577599, 2415919359, 2130706687, 1862271231, 1593835775, 1325400319, 1056964863, \
771752191, 503316735, 234881279, 4278190335, 4026532095, 3758096639, 3489661183, \
3221225727, 2952790271, 2684354815, 2399142143, 2130706687, 1862271231, 1593835775, \
1325400319, 1040187647, 771752191, 520093951, 234881279, 4294901760, 4043243520, \
3774808064, 3506372608, 3221159936, 2952724480, 2684289024, 2399076352, 2147418112, \
1862205440, 1593769984, 1308557312, 1040121856, 771686400, 503250944, 234815488, \
4294901760, 4060020736, 3758030848, 3506372608, 3221159936, 2952724480, 2684289024, \
2415853568, 2130640896, 1862205440, 1593769984, 1308557312, 1040121856, 771686400, \
503250944, 234815488, 4294901760, 4043243520, 3774808064, 3489595392, 3237937152, \
2952724480, 2684289024, 2415853568, 2147418112, 1862205440, 1593769984, 1325334528, \
1056899072, 788463616, 503250944, 234815488, 32, 32, 4294901760, 4294901760, \
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0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 4294901760, \
4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, \
4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, \
4294901760, 1509949695, 3120562431, 4009754879, 4194304255, 3690987775, 2130706687, \

```

83886335, 0, 50331903, 1694499071, 3170894079, 3992977663, 4211081471, 3657433343, \

1879048447, 16777471, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 3087007999, \

2281701631, 1191182591, 1040187647, 2030043391, 4127195391, 2566914303, 0, 16777471, \

3254780159, 2181038335, 1191182591, 973078783, 2030043391, 4177527039, 2130706687, \

4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, \

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4294901760, 4294901760, 0, 0, 0, 0, 0, 2214592767, 4093640959, 0, 0, 0, 0, 0, 0, 0, \

2298478847, 3909091583, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, \

0, 2214592767, 3607101695, 0, 0, 0, 0, 0, 0, 0, 1946157311, 4093640959, 4294901760, \

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100597760, 251592704, 33488896, 0, 3321889023, 2919235839, 0, 0, 0, 0, 0, 0, 0, 0, 0, \

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 2550137087, 4278190335, 4278190335, 3405775103, 570425599, \

0, 0, 0, 0, 0, 0, 2046820607, 4043309311, 620757247, 4294901760, 4294901760, \

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1996488959, 4093640959, 1073742079, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, \

0, 0, 0, 0, 0, 0, 1761607935, 4278190335, 150995199, 0, 0, 67109119, 2550137087, \

3909091583, 889192703, 0, 0, 4294901760, 4294901760, 4294901760, 4294901760, \

4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 4294901760, \

4294901760, 4294901760, 4294901760, 4294901760, 4294901760, 0, 0, 0, 0, 0, \

2181038335, 3925868799, 0, 0, 218104063, 3070230783, 3623878911, 570425599, 0, 0, 0, \

0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 805306623, 3288334591, 1795162367, \

1040187647, 1023410431, 2231369983, 4211081471, 1694499071, 0, 369099007, 3456106751, \

3825205503, 1174405375, 872415487, 872415487, 872415487, 872415487, 4294901760, \

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4293984270, 2046951677, 3422552319, 4110418175, 4177527039, 3405775103, 1409286399, \

0, 0, 1409286399, 4278190335, 4278190335, 4278190335, 4278190335, 4278190335, \

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0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, 0, \

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100728576, 4278255360, 4144037632, 4009819904, 3875602176, 3724607232, 3607166720, \

3472948992, 3338731264, 3204513536, 3070295808, 2936078080, 2801860352, 2667642624, \

2516647680, 2399207168, 2264989440, 2130771712, 1996553984, 1845559040, 1728118528, \

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4009819904, 3875602176, 3741384448, 3607166720, 3472948992, 3338731264, 3204513536, \

3053518592, 2919300864, 2801860352, 2650865408, 2533424896, 2399207168, 2264989440, \

2113994496, 1996553984, 1862336256, 1728118528, 1593900800, 1459683072, 1325465344, \

1191247616, 1040252672, 906034944, 771817216, 654376704, 503381760, 369164032, \

234946304, 117505792, 4278255360, 4144037632, 4009819904, 3858824960, 3741384448, \

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771817216, 637599488, 503381760, 369164032, 234946304, 100728576, 4278255360, \

4144037632, 4009819904, 3875602176, 3741384448, 3607166720, 3472948992, 3338731264, \

3204513536, 3070295808, 2919300864, 2801860352, 2667642624, 2533424896, 2399207168, \

2264989440, 2113994496, 1996553984, 1862336256, 1728118528, 1593900800, 1442905856, \

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922747135, 788529407, 654311679, 520093951, 385876223, 251658495, 117440767, \

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2130706687, 1996488959, 1862271231, 1728053503, 1593835775, 1459618047, 1325400319, \

1191182591, 1056964863, 922747135, 788529407, 654311679, 503316735, 369099007, \

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3623878911, 3489661183, 3355443455, 3204448511, 3087007999, 2936013055, 2818572543, \

2667577599, 2533359871, 2399142143, 2264924415, 2130706687, 1996488959, 1879048447, \

1728053503, 1593835775, 1459618047, 1325400319, 1191182591, 1056964863, 922747135, \

788529407, 654311679, 520093951, 385876223, 251658495, 117440767, 4278190335, \

4160749823, 4026532095, 3892314367, 3758096639, 3623878911, 3489661183, 3355443455, \

```
3221225727, 3087007999, 2952790271, 2818572543, 2667577599, 2533359871, 2399142143, \
2264924415, 2147483903, 2013266175, 1862271231, 1744830719, 1610612991, 1476395263, \
1342177535, 1191182591, 1056964863, 922747135, 788529407, 654311679, 520093951, \
385876223, 251658495, 100663551, 4294901760, 4160684032, 4026466304, 3909025792, \
3774808064, 3623813120, 3489595392, 3355377664, 3237937152, 3103719424, 2952724480, \
2818506752, 2684289024, 2550071296, 2415853568, 2281635840, 2147418112, 2013200384, \
1878982656, 1744764928, 1593769984, 1476329472, 1325334528, 1207894016, 1056899072, \
939458560, 788463616, 654245888, 520028160, 385810432, 251592704, 117374976, \
4294901760, 4177461248, 4043243520, 3909025792, 3774808064, 3640590336, 3506372608, \
3355377664, 3221159936, 3086942208, 2952724480, 2818506752, 2701066240, 2550071296, \
2415853568, 2281635840, 2147418112, 2013200384, 1878982656, 1727987712, 1610547200, \
1476329472, 1325334528, 1191116800, 1073676288, 922681344, 788463616, 654245888, \
520028160, 385810432, 251592704, 100597760, 4294901760, 4177461248, 4043243520, \
3909025792, 3774808064, 3640590336, 3489595392, 3372154880, 3237937152, 3103719424, \
2952724480, 2818506752, 2700935170, 2550071296, 2415853568, 2281635840, 2147418112, \
2013200384, 1878982656, 1744764928, 1610547200, 1459552256, 1342111744, 1191116800, \
1056899072, 922681344, 788463616, 671023104, 520028160, 385810432, 251592704, \
100597760, 4294901760, 4177461248, 4043243520, 3909025792, 3774808064, 3640590336, \
3489595392, 3372154880, 3237937152, 3086942208, 2969501696, 2818506752, 2684289024, \
2550071296, 2432630784, 2281635840, 2147418112, 2013200384, 1862205440, 1744764928, \
1610547200, 1476329472, 1342111744, 1191116800, 1056899072, 922681344, 788463616, \
654245888, 520028160, 385810432, 251592704, 117374976, 4294901760, 4177461248, \
4043243520, 3909025792, 3774808064, 3623813120, 3506372608, 3372154880, 3237937152, \
3103719424, 2952724480, 2835283968, 2684289024, 2550071296, 2432630784, 2281635840, \
2147418112, 2046492676, 1862205440, 1744764928, 1610547200, 1476329472, \
1342111744, 1207894016, 1056899072, 939458560, 788463616, 654245888, 536281096, \
385810432, 251592704, 134152192};
```

```
Display *d = XOpenDisplay(0);
int s = DefaultScreen(d);
Atom net_wm_icon = XInternAtom(d, "_NET_WM_ICON", False);
Atom cardinal = XInternAtom(d, "CARDINAL", False);
Window w;
XEvent e;
w = XCreateWindow(d, RootWindow(d, s), 0, 0, 200, 200, 0,
                  CopyFromParent, InputOutput, CopyFromParent, 0, 0);

int length = 2 + 16 * 16 + 2 + 32 * 32;
XChangeProperty(d, w, net_wm_icon, cardinal, 32,
                PropModeReplace, (const unsigned char*) buffer, length);

XMapWindow(d, w);
while(1) XNextEvent(d, &e);
}
```

C.5.6.8 Experience with `_NET_WM_ICON` Hint

First, we need the libraries:

```
root-shell# aptitude install libstdc++6 libX11-6
```

Second, a `Makefile` can save much typing:

```
shell$ Makefile
compile:
    gcc -lX11 -lstdc++ -L/usr/X11/lib -o native native.cpp
clean:
    rm -f *~
```

Third, we run:

```
shell$ make
gcc -lX11 -lstdc++ -L/usr/X11/lib -o native native.cpp
shell$ ./native
```

The `X` server does render this window.

- The drawable area is transparent, of course, as the `X` client draws nothing.
- The window frame has the usual border, title bar, and buttons (the window manager requests the `X` server to draw these).
- However the Title Bar Icon is still the default “X” icon.
- This is also true of the `alt-tab` icon.

It is unclear why the window manager, `kwin`, is not using the `_NET_WM_ICON` hint.

C.6 Mathematical Equations

Many wikipedia articles present mathematical equations. This is especially true of articles about math, science, and engineering. Often these equations are delimited by the tags:

```
<math>y = mx + b</math>
```

where the equation between the tags is formatted using `TeX`.

C.6.1 Example: the Article on Algebra

The article on Algebra contains a few simple equations formatted this way. This can be seen as follows:

First, find the `page.page_id`:

```
mysql> USE simplewiki;
mysql> SHOW CREATE TABLE page\G
***** 1. row *****
      Table: page
Create Table: CREATE TABLE 'page' (
  'page_id' int(10) unsigned NOT NULL AUTO_INCREMENT,          <--- 25
  'page_namespace' int(11) NOT NULL,
  'page_title' varbinary(255) NOT NULL,                        <--- Algebra
  'page_restrictions' tinyblob NOT NULL,
  'page_counter' bigint(20) unsigned NOT NULL DEFAULT '0',
  'page_is_redirect' tinyint(3) unsigned NOT NULL DEFAULT '0',
  'page_is_new' tinyint(3) unsigned NOT NULL DEFAULT '0',
  'page_random' double unsigned NOT NULL,
  'page_touched' binary(14) NOT NULL DEFAULT '\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0',
  'page_latest' int(10) unsigned NOT NULL,
  'page_len' int(10) unsigned NOT NULL,
  PRIMARY KEY ('page_id'),
  UNIQUE KEY 'name_title' ('page_namespace','page_title'),
  KEY 'page_random' ('page_random'),
  KEY 'page_len' ('page_len'),
  KEY 'page_redirect_namespace_len' ('page_is_redirect','page_namespace','page_len')
) ENGINE=InnoDB AUTO_INCREMENT=945 DEFAULT CHARSET=binary
1 row in set (0.00 sec)
```

```
mysql> SELECT page_id,page_title FROM page WHERE page_title LIKE 'Algebra';
+-----+-----+
| page_id | page_title |
+-----+-----+
|      25 | Algebra    |
+-----+-----+
1 row in set (0.00 sec)
```

Second, find the `revision.rev_id`:

```
mysql> SHOW CREATE TABLE revision\G
***** 1. row *****
      Table: revision
Create Table: CREATE TABLE 'revision' (
  'rev_id' int(10) unsigned NOT NULL AUTO_INCREMENT,          <--- 25
  'rev_page' int(10) unsigned NOT NULL,                       <--- 25
  'rev_text_id' int(10) unsigned NOT NULL,                     <--- 25
  'rev_comment' tinyblob NOT NULL,
  'rev_user' int(10) unsigned NOT NULL DEFAULT '0',
  'rev_user_text' varbinary(255) NOT NULL DEFAULT '',
  'rev_timestamp' binary(14) NOT NULL DEFAULT '\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0',
  'rev_minor_edit' tinyint(3) unsigned NOT NULL DEFAULT '0',
  'rev_deleted' tinyint(3) unsigned NOT NULL DEFAULT '0',
  'rev_len' int(10) unsigned DEFAULT NULL,
  'rev_parent_id' int(10) unsigned DEFAULT NULL,
  'rev_sha1' varbinary(32) NOT NULL DEFAULT '',
  PRIMARY KEY ('rev_id'),
  UNIQUE KEY 'rev_page_id' ('rev_page','rev_id'),
  KEY 'rev_timestamp' ('rev_timestamp'),
  KEY 'page_timestamp' ('rev_page','rev_timestamp'),
  KEY 'user_timestamp' ('rev_user','rev_timestamp'),
  KEY 'usertext_timestamp' ('rev_user_text','rev_timestamp')
) ENGINE=InnoDB AUTO_INCREMENT=945 DEFAULT CHARSET=binary MAX_ROWS=10000000 AVG_ROW_LENGTH=1024
1 row in set (0.00 sec)
```

```
mysql> SELECT rev_id,rev_page,rev_text_id FROM revision WHERE rev_page=25;
+-----+-----+-----+
| rev_id | rev_page | rev_text_id |
+-----+-----+-----+
|      25 |        25 |           25 |
+-----+-----+-----+
1 row in set (0.01 sec)
```

Third, find the `text.old_id`:

```
mysql> SHOW CREATE TABLE text\G
***** 1. row *****
      Table: text
Create Table: CREATE TABLE 'text' (
  'old_id' int(10) unsigned NOT NULL AUTO_INCREMENT,          <--- 25
  'old_text' mediumblob NOT NULL,                             <--- <math>...</math>
  'old_flags' tinyblob NOT NULL,
  PRIMARY KEY ('old_id')
) ENGINE=InnoDB AUTO_INCREMENT=945 DEFAULT CHARSET=binary MAX_ROWS=10000000 AVG_ROW_LENGTH=10240
1 row in set (0.00 sec)
```

```
mysql> SELECT * FROM text WHERE old_id=25\G
***** 1. row *****
  old_id: 25
 old_text: complex|date=February 2010
...
== Graphing algebra ==
Algebra also introduces graphing, or drawing a picture that shows all the
values of the variables that make the equation true. Usually this is easy to do
when there are only one or two variables. The graph is often a line, and if the
line does not bend or go straight up-and-down it can be described by the basic
formula  $y = mx + b$  where 'b' is the [[y-intercept]] of the graph
and 'm' is the [[slope]]. This formula applies to the coordinates of the
graph or  $(x, y)$ .
```

Fourth, `Math.php` invokes `texvc` to generate the:

- `md5sum` (with a leading 'C' character),
- HTML string,
- MathML string, and
- PNG image file.

```
root-shell# texvc '/var/lib/mediawiki/images/tmp/' '/var/lib/mediawiki/images/tmp/' \
'y = mx + b' 'UTF-8'
Cee668a8b96a7fc367f89135101df6c90
<i>y</i> = <i>m</i><i>x</i> + <i>b</i>
<mi>y</mi><mo>=</mo><mi>m</mi><mi>x</mi><mo>+</mo><mi>b</mi>
root-shell# ls -l /var/lib/mediawiki/images/tmp/
ee668a8b96a7fc367f89135101df6c90.png
root-shell# mv /var/lib/mediawiki/images/tmp/ee668a8b96a7fc367f89135101df6c90.png \
/var/lib/mediawiki/images/math/e/e/6/.
```

It seems that the `md5sum` is computed after removing white space:

```
env printf %s "y = mx + b" | openssl dgst -md5          <--- wrong
(stdin)= 6d74d8f1c6d1196d2e75893f266ae552
env printf %s "y=mx+b" | openssl dgst -md5            <--- right
(stdin)= ee668a8b96a7fc367f89135101df6c90
```

Fifth, the first three characters in the `md5sum` are used to create a directory path where the PNG image file will be stored. In this case, the PNG image file is stored under `/var/lib/mediawiki/images/math/e/e/6/`.

Sixth, the metadata is stored in the `simplewiki.math` database table:

```
mysql> SHOW CREATE TABLE math\G
***** 1. row *****
Table: math
Create Table: CREATE TABLE 'math' (
  'math_inputhash' varbinary(16) NOT NULL,
  'math_outputhash' varbinary(16) NOT NULL,
  'math_html_conservativeness' tinyint(4) NOT NULL,
  'math_html' blob,
  'math_mathml' blob,
  UNIQUE KEY 'math_inputhash' ('math_inputhash')
) ENGINE=InnoDB DEFAULT CHARSET=binary
1 row in set (0.00 sec)
```

```
mysql> SELECT HEX(math_inputhash),hex(math_outputhash),math_html_conservativeness,
  math_html,math_mathml FROM simplewiki.math WHERE HEX(math_inputhash) LIKE 'ee66%'\G
***** 1. row *****
      hex(math_inputhash): EE668A8B96A7FC367F89135101DF6C90
      hex(math_outputhash): EE668A8B96A7FC367F89135101DF6C90
math_html_conservativeness: 2
      math_html: <i>y</i> = <i>m</i><i>x</i> + <i>b</i>
      math_mathml: <mi>y</mi><mo>=</mo><mi>m</mi><mi>x</mi><mo>+</mo><mi>b</mi>
1 row in set (0.00 sec)
```

Seventh, when the page is rendered by a browser, math tags:

```
<math>y = mx + b</math>
```

are replaced with image tags:

```

```

C.6.2 LaTeX

LaTeX is a macro package built on top of **TeX**, which is a typesetting system. **LaTeX** does a professional job of typesetting mathematical equations, chemical formulae, etc. The American Mathematical Society uses **LaTeX** for its publications.

C.6.3 Math.php and texvc

The **MediaWiki** extension **Math.php**, is located in `/var/lib/mediawiki/extensions/`. It invokes the utility **texvc**, to take a mathematical equation in **TeX** format and generate the:

- **md5sum** (with a leading ‘C’ character),
- **HTML** string,
- **MathML** string, and
- **PNG** image file.

The **Math.php** extension directs **texvc** to use `/var/lib/mediawiki/images/tmp/` as a scratch space.

The media files produced by **texvc** are stored in a directory tree under `/var/lib/mediawiki/images/math/`.

C.6.3.1 Update (2012)

The code that converts math equations from **TeX** format into **PNG** image files, has been removed from the **MediaWiki** 1.18 core, and is now packaged separately. This is described in <http://www.mediawiki.org/wiki/Extension:Math> and in http://www.mediawiki.org/wiki/Manual:Enable_TeX.

Caveat 1: The Debian package **mediawiki-math-texvc** installs **texvc** in `/usr/bin/texvc`. **Math.php**, however, expects to find **texvc** in `/var/lib/mediawiki/extensions/Math/math/texvc`.

The `Math/math/` directory must be created.

```
root-shell# cd /var/lib/mediawiki/extensions/Math/
root-shell# mkdir math
root-shell# cd math/
root-shell# ln --symbolic /usr/bin/texvc texvc
root-shell# ls -l
lrwxrwxrwx 1 root root 14 Nov 12 12:57 texvc -> /usr/bin/texvc
```

If this is not done, the page be will rendered with error messages like:

Failed to parse (Missing texvc executable; please see math/README to configure.): $y = mx + b$

Caveat 2: The `xxwiki.math` database table has been removed from the MediaWiki 1.18 core. However, if `Math.php` is installed, then the missing `math` database table can be created by running:

```
root-shell# /usr/bin/php /usr/share/mediawiki/maintenance/update_farm.php \
simple.wpmirror.site
```

WP-MIRROR 0.4 automates the configuration required by the above two caveats.

C.6.4 Messages

When the `simplewiki` database does not exist, we get:

```
Sorry! This site is experiencing technical difficulties.

Try waiting a few minutes and reloading.

(Can't contact the database server: Access denied for user
'wikiuser'@'localhost' to database 'simplewiki' (localhost))
...
```

When the `simplewiki` database exists, but the `page` table does not contain the article, we get:

```
shell$ lynx http://simple.wpmirror.site/index.php/Algebra
...
Algebra

From simplewiki
Jump to: navigation, search

There is currently no text in this page. You can search for this page
title in other pages, search the related logs, or edit this page.
Retrieved from "http://simple.wpmirror.site/index.php/Algebra"
...
```

When the article is in the database, but `Math.php` does not regard `texvc` as executable, we get:

```
shell$ lynx http://simple.wpmirror.site/index.php/Algebra
...
to do when there are only one or two variables. The graph is often a
line, and if the line does not bend or go straight up-and-down it can be
described by the basic formula Failed to parse (Missing texvc executable;
please see math/README to configure.):  $y = mx + b$ 
where b is the y-intercept of the graph and m is the slope. This formula
applies to the coordinates of the graph or Failed to parse (Missing texvc
executable; please see math/README to configure.): (x, y)
...
```


C.7 Prioritizing Tasks (Obsolete)

Which is better? 1) First download media files and then import articles, or 2) the reverse? The author prefers the first, and here is the reasoning.

When a browser accesses a wikipedia article featuring an image, that image must first be resized. These resized images, called ‘thumb’s, come in different sizes, and once created they are stored (cached) in a directory tree under `/var/lib/mediawiki/images/thumb/`.

The image processing required to produce these thumbs is quite demanding in terms of time and memory. Moreover, if one uses `convert` from `ImageMagick` (instead of `gm convert` from `GraphicsMagick` and `inkscape`), the image processing can also hang the system.

So here are the design choices:

- **First Import Articles and Then Download Media Files.** In this case, the thumbs displayed with a given article will be created when that article is first accessed with a browser. More precisely, to serve an article, the `apache2` web-server calls the `MediaWiki PHP` script `/var/lib/mediawiki/index.php` which, for each missing thumb, forks a `convert` process, then blocks until the thumbs are all available, and finally renders the whole article. This means the browsing experience will be marred by delays, time-outs, and even system crashes when accessing certain articles.
- **First Download Media Files and Then Import Articles.** Alternatively, the thumbs are all created during importation. While all this image processing may be a pain up front, thereafter the thumbs will be readily available to the web-server. This means the browsing experience will be more enjoyable.

The author of WP-MIRROR choose the later design option.

Update 2013: As of WP-MIRROR 0.6, `importDump.php` is no longer used. Best performance is now achieved by first importing articles, then importing media files.

C.8 Scraping Media File Names from `xchunks` (Obsolete)

`fsm-file-scrape` scrapes media file names from `xchunks`. How this is done is a little complicated because there is, as far as I know, no grammar (such as Bachus-Naur Form) that describes a wikipedia page. Basically, we have a lot of special cases.

Update 2013: As of WP-MIRROR 0.6, `fsm-file-scrape` is no longer used. Rather, media file names are scraped from `xxwiki.imagelinks.il.to` and `commonswiki.image.img.name`.

C.8.1 Links, Gallery, Infobox, and other Templates

C.8.1.1 Link

About 65% of the media file names are found in links:

```
... [[File:foo.png| ... ]] ...  
... [[Image:bar.png| ... ]] ...  
... [[Media:baz.png| ... ]] ...
```

C.8.1.2 Gallery

About 10% are found in galleries, of which there are two kinds:

```
<gallery>  
File:foo.png| ...  
Image:bar.png| ...  
Media:baz.png| ...  
<\gallery>
```

and

```
{{gallery
|File:foo.png| ...
|Image:bar.png| ...
|Media:baz.png| ...
}}
```

Caveat: The `File`, `Image`, `Media` tags are not always capitalized.

See <http://simple.wpmirror.site/index.php/Berlin> for galleries (one of landmarks, one of flags).

C.8.1.3 Infobox Template

The remaining 25% of media file names are found mostly in the `infobox` template.

```
{{Infobox
...
| image_flag = foo.png
| image_coat = bar.png
| image_map  = baz.png
...
}}
```

or even

```
{{Infobox
...
| image_flag
= foo.png
| image_coat
= bar.png
| image_map
= baz.png
...
}}
```

with arbitrary amounts of white space. And beware the mixing of links with templates.

```
{{Infobox
...
| image = [[File:foo.png]]
|      map=[[Image:bar.png]]
|coat
= [[Media:baz.png]]
...
}}
```

See <http://simple.wpmirror.site/index.php/Berlin> for an `infobox` in the upper right corner of the page.

C.8.1.4 Other Templates

Very few (less than 1 per mil) are found in the `multiple image` and `wide image` templates.

```
{{multiple image
...
| image1 = foo.png
...
| image2 = bar.png
...
}}
```

See <http://simple.wpmirror.site/index.php/Neptune> for groups of three images using the `multiple image` template.

```
{{wide image|File:foo.png| ... }}
{{wide image|Image:foo.png| ... }}
```

See <http://simple.wpmirror.site/index.php/London> for a panoramic view of London using the `wide image` template.

Source: See http://en.wikipedia.org/wiki/Wikipedia:Picture_tutorial.

C.8.2 Media File Name Extensions

A candidate file name must be checked for a known file extension: `bmp`, `bz2`, `dia`, `djvu`, `fig`, `gif`, `jpg`, `jpeg`, `ogg`, `png`, `tif`, `tiff`, `mid`, `mov`, `mp3`, `pdf`, `psp`, `svg`, `wav`, and `xcf`. If such a file extension is not found, the candidate is discarded.

C.8.3 Normalizing Media File Names

C.8.3.1 Standards

[RFC3986, Uniform Resource Identifier: Generic Syntax](#) defines “percent-encoding” and lists the reserved characters.

C.8.3.2 White Space

Many media file names contain spaces. These spaces must be replaced with underscores. For example,

```
Arc en ciel.png
```

becomes

```
Arc_en_ciel.png
```

Any leading or trailing white space is also trimmed.

C.8.3.3 Special Characters

[HTTP](#). According to [RFC2616, HTTP/1.1](#), page 17, the following characters are defined as ‘separators’:

```
separators    = "(" | ")" | "<" | ">" | "@"
               | "," | ";" | ":" | "\" | "<"
               | "/" | "[" | "]" | "?" | "="
               | "{" | "}" | SP | HT
```

but offers three ways of quoting:

Comments can be included in some HTTP header fields by surrounding the comment text with parentheses. Comments are only allowed in fields containing "comment" as part of their field value definition. In all other fields, parentheses are considered part of the field value.

```
comment      = "(" *( ctext | quoted-pair | comment ) ")"
ctext        = <any TEXT excluding "(" and ">
```

A string of text is parsed as a single word if it is quoted using double-quote marks.

```
quoted-string = ( "> *(qdtex | quoted-pair ) "> )
qdtex        = <any TEXT except ">>
```

The backslash character ("`\`") MAY be used as a single-character quoting mechanism only within quoted-string and comment constructs.

```
quoted-pair   = "\" CHAR
```

`dash`. According to the `man` page for `dash` (the default POSIX compliant `/bin/sh` for Debian scripts) the following characters have special meanings:

```
Control operators:
    & && ( ) ; ;; | || <newline>
Redirection operators:
    < > >| << >> <& >& <<- <>
Reserved words:
    ! { }
Special parameters:
    * @ # ? -(Hyphen.) $ ! 0 (Zero.)
Command Substitution
    $(command) `command`
Shell patterns:
    ! * ? [ ]
Builtins
    : . [ ]
Character escape sequences (as defined in ANSI X3.159-1989):
    \a \b \f \n \r \t \v \\ \num (1-, 2-, or 3-digit octal)
```

but offers three ways of quoting:

Quoting

Quoting is used to remove the special meaning of certain characters or words to the shell, such as operators, whitespace, or keywords. There are three types of quoting: matched single quotes, matched double quotes, and backslash.

Backslash

A backslash preserves the literal meaning of the following character, with the exception of newline. A backslash preceding a newline is treated as a line continuation.

Single Quotes

Enclosing characters in single quotes preserves the literal meaning of all the characters (except single quotes, making it impossible to put single-quotes in a single-quoted string).

Double Quotes

Enclosing characters within double quotes preserves the literal meaning of all characters except dollarsign (\$), backquote (`), and backslash (\). The backslash inside double quotes is historically weird, and serves to quote only the following characters:

```
$ ' " \ <newline>.
```

Otherwise it remains literal.

MySQL. According to the [MySQL 5.5 Reference Manual](#), Table 9.1, the following are ‘special character escape sequences’.

Special Character Escape Sequences

```
\0 \' \" \b \n \r \t \Z \\ \% \_
```

and also offers ways of quoting: matched backquotes (identifier quotes), matched single quotes (string quotes), matched double quotes (ANSI identifier quotes, non-ANSI string quotes), and backslash (escape a single character).

C.8.3.4 Media File Names

Nearly all of the special characters mentioned above can be found in media file names. This is especially true of media files found in the [en wikipedia](#).

Media file names containing such characters (and a few additional ones) should be escaped to avoid confusing the [shell](#), [MySQL](#), web browser, web proxy, and web server. By *escaped* we mean, that their special meaning is somehow removed. Usually this involves: prefixing the special character with a backslash (\), or enclosing it with matched single quotes or matched double quotes.

The special characters that we have studied are listed in [Table C.1, Special Characters](#). The media file names containing special characters in the lower part of the table are successfully downloaded. The media file names containing special characters in the upper part of the table are not attempted.

Even a character that has been escaped for the [shell](#) may be problematic for other reasons:

- **ampersand (&):** could be an [HTML Special Entity Code](#), aka “AMP code” (like © > < ");
- **angle brackets (<,>):** troublesome to parse because it might be an [XML](#) tag in the [xchunk](#); and it must be replaced with an AMP code for use with [cURL](#);
- **asterisk (*):** [shell](#) wild card, can be escaped and downloaded with [cURL](#), but then becomes troublesome to have on a [UNIX](#) file system where it is a wild card;
- **backquote (`):** [shell](#) command substitution; this can be escaped and downloaded, but it is always an hazard to have and to handle (think hard before trying the following slightly risky example, and remember that THE AUTHOR ASSUMES NO LIABILITY):

```
shell$ curl http://foo'ls'bar.jpg
```

and there seems to be a problem computing the [md5sum](#) if the other characters are unicode;

- **backslash (\):** used as escape character for [shell](#), [HTTP](#), and [MySQL](#); denotes line continuation for [shell](#);
- **braces ({,}):** troublesome to parse because it might be a [MediaWiki](#) template in the [xchunk](#); braces are also used by [cURL](#)’s “URL globbing parser” and therefore would have to be “URL encoded”;
- **colon (:):** can be escaped and downloaded, but then becomes troublesome for [common lisp](#) where it indicates a package name;

Table C.1: Special Characters

Name	Char	Esc	Keep	shell	path	HTTP	lisp	MediaWiki	SQL	Other
ampersand	&	Y	N	control		GET				HTML AMP
angle brackets	<,>		N	redirect				xml tag		
asterisk	*	Y	N	wild	wild					
backquote	`	Y	N	cmd subst					quote	
baskslash	\	Y	N	esc	dir	esc			esc	
braces	{,}	Y	N	reserved				template		
colon	:		N	builtin	sep	URI	package	sep		
percent	%		N						wild	
pipe			N	redirect			quote	sep		
question mark	?		N			GET	wild			
slash	/		N		dir	URI				
square brackets	[,]	Y	N	builtin				link		
tilde	~		N	expand						
apostrophe	'	Y	Y	quote					quote	polipo
at	@	Y	Y	parameter						
caret	^	N	Y	regex						
comma	,	N	Y							
dash	-	Y	Y	option						
dollar	\$	Y	Y	regex						
equal	=	N	Y			GET				
exclamation	!	Y	Y	reserved						
parentheses	(,)	Y	Y	control						
quote	"	Y	Y	quote						
semicolon	;	Y	Y	control					control	
underscore	_	Y	Y						wild	

- **percent (%)**: [MySQL](#) wild card; can appear in file names and URLs that have been “percent-encoded”, and are easy to download; however, they are troublesome to have in the database, and the Wikimedia Foundation has tried to stamp them out (there seem to be a few remaining in the [en wikipedia](#));
- **pipe (|)**: [shell](#) redirection operator, and used by [common lisp](#) for quoting;
- **question mark (?)**: [common lisp](#) wild card; can be escaped and downloaded with [cURL](#), but then becomes troublesome for [common lisp](#) where it is a wild card;
- **slash (/)**: confuses [shell](#) where it could indicate a directory or URL; and
- **square brackets ([,])**: troublesome to parse because it might be a [MediaWiki](#) link; square brackets are used by [cURL](#)’s “URL globbing parser” and therefore would have to be “URL encoded”
- **tilde (~)**: used by [shell](#) for ‘Tilde Expansion’ (substituting user’s home directory).

Media file names containing the above characters are dropped from further consideration. It is possible that, in a future release, some of the above characters could be handled.

C.8.3.5 Apostrophe

The **apostrophe (')** is an interesting case. It appears in about 1% of media file names, which makes getting it right a priority:

- Glottal stop [Nisga’a Memorial Lava Bed Provincial Park.jpg](#),
- Irish surname [Peter O’Toole.jpg](#),
- Possessive case [Saint Peter’s Square from the dome.jpg](#).

Whereas backslash escapes only one character, a matched pair of apostrophes escapes the enclosed string. This escaping can itself be escaped by placing a backslash before each apostrophe (and this we do).

This appears to work well—unless your traffic passes through a caching web proxy. It turns out that an URL with an escaped apostrophe confuses the caching web proxy `polipo`, which then returns a file containing the following error message:

```
root-shell# cd /var/lib/mediawiki/images/bad-images/f/fa/
root-shell# ls -l Flag_of_the_People's_Republic_of_China.svg
-rw-r--r-- 1 root root 449 Nov 28 18:44 Flag_of_the_People's_Republic_of_China.svg
root-shell# cat Flag_of_the_People's_Republic_of_China.svg
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
"http://www.w3.org/TR/html4/loose.dtd">
<html><head>
<title>Proxy result: 302 Redirected by external redirector.</title>
</head><body>
<h1>302 Redirected by external redirector</h1>
<p>The following status was returned:<br><br>
<strong>302 Redirected by external redirector</strong></p>
<hr>Generated Wed, 28 Nov 2012 18:44:08 EST by Polipo on <em>darkstar-7:8123</em>.
</body></html>
```

`fsm-images-validate` detects such files by scanning any file smaller than 1k for the string `302 Redirected`. Any file meeting that criterion is then sequestered under the `bad-images` directory tree.

C.8.4 Manual Testing

It is possible to test manually whether or not special characters have been properly escaped:

1. Compute the `md5sum`,

```
shell$ printf %s US_\$10_Series_2004_reverse.jpg | openssl dgst -md5
(stdin)= 30294ae0d622e6e1e068660c639e3c85
```

2. See if `cURL` can download the file:

```
shell$ curl --output test.jpg \
http://upload.wikimedia.org/wikipedia/commons/3/30/US_\$10_Series_2004_reverse.jpg
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100 28553  100 28553    0     0  233k      0  --:--:-- --:--:-- --:--:--  449k
```

3. Look in the output file (`test.jpg` in this case) to see if there is an error message. In this next example, we give the wrong directory path (`/3/31/` instead of `/3/30/`) to provoke an error message:

```

shell$ curl --output test.jpg \
http://upload.wikimedia.org/wikipedia/commons/3/31/US_\$10_Series_2004_reverse.jpg
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left   Speed
100  285    100    285     0     0   2402      0  --:--:--  --:--:--  --:--:--  4672
shell$ cat test.jpg
<html>
<head>
  <title>404 Not Found</title>
</head>
<body>
  <h1>404 Not Found</h1>
  The resource could not be found.<br /><br />
File not found: /v1/AUTH_43651b15-ed7a-40b6-b745-47666abf8dfe/
wikipedia-commons-local-public.31/3/31/US_\$10_Series_2004_reverse.jpg
</body>
</html>

```

Note also the difference in file size. Error messages are less than 1k.

See [Table C.2, Media File Names with Special Characters](#) for examples that may be tested.

C.8.5 Downloading Media Files Efficiently

C.8.5.1 Checking if File is Already Downloaded

Apart from its first run, WP-MIRROR usually updates an existing mirror. Therefore most media files are already available, and their existence need only be confirmed to avoid repeating a lot of work.

The `md5sum` of each media file name is computed and used for deciding where the media files should be stored and retrieved:

```

shell$ env printf %s file-name | openssl dgst -md5

```

The first two hexadecimal digits of the `md5sum` are used to create the directory tree under which the media files are stored. For example, hashing the normalized media file name `Arc_en_ciel.png` yields

```

shell$ env printf %s Arc_en_ciel.png | openssl dgst -md5
(stdin)= 00135a44372c142bd509367a9f166733

```

and therefore, `Arc_en_ciel.png` would be stored under `/var/lib/mediawiki/images/0/00/`. This is where WP-MIRROR would look to determine if the file already exists.

C.8.5.2 Eliminating Duplicates

When a normalized media file name is determined to be new (i.e. the file has not already been downloaded), it is added to an hash table: where the `key` is the normalized file name (e.g. `Arc_en_ciel.png`) and the `value` is the directory path (e.g. `/0/00/`). One advantage of using a hash table, is that it never holds two entries with the same key.

Design note. Of course, we must define what we mean when we say that two keys are the same. `Common Lisp` has four different tests for equality: `eq`, `eql`, `equal`, and `equalp`. In our hash table, the keys are file names which are strings. Therefore, we use the `equal` test, rather than the default `eql`. When comparing two strings:

- the value of `equal` is true if the two strings match character-by-character; whereas

Table C.2: Media File Names with Special Characters

Char	Version	File Name
Apostrophe (')	URL	http://simple.wpmirror.site/index.php/European_Union
	xchunk	Quai_d'Orsay.jpg
	normalized	Quai_d\'Orsay.jpg
	md5sum	6090d234ab9c1e7d842f648136c69ab5
At (@)	URL	http://simple.wpmirror.site/index.php/Hatshepsut
	xchunk	KarnakTemple@LuxorEgypt_obelisk2_2007feb9-96_byDanielCsorfolly.JPG
	normalized	KarnakTemple\@LuxorEgypt_obelisk2_2007feb9-96_byDanielCsorfolly.JPG
	md5sum	6fe4389ef3edc536c64d6754eafe7603
Caret (^)	URL	http://simple.wpmirror.site/index.php/House_of_Wettin
	xchunk	Banner_of_Saxony_(1^1).svg
	normalized	Banner_of_Saxony_(1^1\).svg
	md5sum	46e5c452f2d5c345430073bea9a70f4d
Comma (,)	URL	http://simple.wpmirror.site/index.php/Renewable_resource
	xchunk	Braine_le_Chateau,Belgium,moulin_banal.JPG
	normalized	Braine_le_Chateau,Belgium,moulin_banal.JPG
	md5sum	00154570ef59b3074ea0b42ad0043f8
Dash (-)	URL	http://simple.wpmirror.site/index.php/Pre-Columbian
	xchunk	Uxmal-mexico.jpg
	normalized	Uxmal\-mexico.jpg
	md5sum	001d7a95430654f08049dc61987597a4
Dollar sign (\$)	URL	http://simple.wpmirror.site/index.php/United_States_dollar
	xchunk	US_\$10_Series_2004_reverse.jpg
	normalized	US_10_Series_2004_reverse.jpg
	md5sum	30294ae0d622e6e1e068660c639e3c85
Equal (=)	URL	http://simple.wpmirror.site/index.php/Planet
	xchunk	Gas_giants_and_the_Sun_(1_px=_1000_km).jpg
	normalized	Gas_giants_and_the_Sun_(1_px=_1000_km\).jpg
	md5sum	bee860e6fab92ee90a67c66b10377cb4
Exclamation (!)	URL	http://simple.wpmirror.site/index.php/Religion
	xchunk	Sikhs_on_the_move!.jpg
	normalized	Sikhs_on_the_move\!.jpg
	md5sum	9805c1725a16fc06ef33b32686a284fa
Parentheses	URL	http://simple.wpmirror.site/index.php/Soprano
	xchunk	Maria_Callas_(La_Traviata).JPG
	normalized	Maria_Callas_(La_Traviata\).JPG
	md5sum	00d64fd7148552b18e24760e8d4fd99a
Quote (")	untested	
Semicolon (;)	URL	http://simple.wpmirror.site/index.php/St_Peter's_College,_Auckland
	xchunk	St_Peter's_College,_Auckland;_Bro_0'Driscoll_Building.JPG
	normalized	St_Peter\'s_College,_Auckland\;;_Bro_0\'Driscoll_Building.JPG
	md5sum	1acdc6e79eb46e5f35a7591a5b7c3021
Underscore (_)	URL	http://simple.wpmirror.site/index.php/Neptune
	xchunk	Neptune_darkspot.jpg
	normalized	Neptune_darkspot.jpg
	md5sum	51dafcb702c1d37434859c4181dd2cae

- the value of [eq1](#) is true only if the two strings are the same object (that is, occupy the same location in memory).

C.8.5.3 Generating the [shell](#) Script

Thanks to the hash table, there are no duplicates within any given [ichunk](#). However, when one compares two or more [ichunks](#), there may be duplicates. Since, [ichunks](#) may be run concurrently, we need a way to avoid downloading the same file multiple times. For this reason, the script for downloading an media file, first checks to see if the file is already available.

Also, media files may be stored either in a [commons](#) directory tree, or in a directory tree specific to that wikipedia. Every wikipedia, with the possible exception of the [en wikipedia](#), stores most if its media files in the [commons](#). Therefore, it saves time to try downloading the media file from the [commons](#) first; and, failing that, go on to try downloading from the directory tree specific to that wikipedia.

For example, variables such as these:

```
language-code <-- simple
path          <-- /0/00/Arc_en_ciel.png
key           <-- Arc_en_ciel.png
value         <-- /0/00/
```

are filled into a template to generate a working [shell](#) script.

WP-MIRROR 0.6 introduced a new template to make use of [HTTP/1.1](#) “persistent connections” (see §C.8.5.4, [Downloading with Persistent Connections](#)):

```
#!/bin/sh
COMMONSPATH=http://upload.wikimedia.org/wikipedia/commons/
IMAGEPATH=http://upload.wikimedia.org/wikipedia/language-code/

sleep 1

curl -f -m 3000 \
$COMMONSPATH./path -o ./path \
...
if [ -e ./path ]; then
    echo ./path downloaded >> download.log
else
    curl -f -m 3000 $IMAGEPATH./path -o ./path
    if [ -e ./path ]; then
        echo ./path downloaded >> download.log
    else
        echo ./path failed >> failed.log
    fi
fi
...
```

WP-MIRROR 0.2 through 0.5, used a template that closely resembles that of the original [wikix](#) (which is described in §A.1.6, [Changes in WP-MIRROR 0.2 \(2011-12-25\)](#)):

```
#!/bin/sh
COMMONSPATH=http://upload.wikimedia.org/wikipedia/commons/
IMAGEPATH=http://upload.wikimedia.org/wikipedia/language-code/
...
if [ -e path ]; then
    echo ./path already exists >> exists.log
else
    curl -f -m 1000 -O --retry 0 $COMMONSPATH./path
    if [ -e key ]; then
        /bin/mkdir -p value
        /bin/mv ./key value
        echo ./path downloaded >> download.log
    else
        curl -f -m 1000 -O --retry 0 $IMAGEPATH./path
        if [ -e key ]; then
            /bin/mkdir -p value
            /bin/mv ./key value
            echo ./path downloaded >> download.log
        else
            echo ./path failed >> failed.log
        fi
    fi
fi
```

C.8.5.4 Downloading with Persistent Connections

The first call to `cURL`, the one that downloads media files from the Wikimedia Commons, has multiple filenames on one command line. This is in order to download them using a single TCP connection, as described in [RFC2616](#), [HTTP/1.1](#). Persistent connections are supported by `cURL`, and according to the documentation:

PERSISTENT CONNECTIONS

Specifying multiple files on a single command line will make `cURL` transfer all of them, one after the other in the specified order.

`libcurl` will attempt to use persistent connections for the transfers so that the second transfer to the same host can use the same connection that was already initiated and was left open in the previous transfer. This greatly decreases connection time for all but the first transfer and it makes a far better use of the network.

Note that `cURL` cannot use persistent connections for transfers that are used in subsequence[sic] `cURL` invokes. Try to stuff as many URLs as possible on the same command line if they are using the same host, as that'll make the transfers faster. If you use an [HTTP](#) proxy for file transfers, practically all transfers will be persistent.

<http://curl.haxx.se/docs/manual.html>, accessed 2012-12-18

Note that there is a limit to how many URLs can be put on one command line. See [§C.8.5.5, Limiting Shell Command-line Length](#).

C.8.5.5 Limiting Shell Command-line Length

The operating system (e.g. [Linux](#)) imposes limits to how long a command-line may be. This can be determined by executing:

```
shell$ getconf ARG_MAX
2097152
```

Actually one must deduct for the length of the environment variables. This is done by executing:

```
shell$ echo $(( $(getconf ARG_MAX) - $(env | wc -c) ))
2097152
```

See <http://www.cyberciti.biz/faq/argument-list-too-long-error-solution/>.

On average, media file names are 27 characters. This can be estimated by executing:

```
root-shell# cd /var/lib/mediawiki/images/0/
root-shell# ls -R | wc -l
4245
root-shell# ls -R | wc -c
116146
root-shell# dc
116146 4245/pq
27
```

Thus:

```
$COMMONSPATH./path -o ./path \
```

on average will be $(2 \times 27) + 23 = 77$ characters long (including the newline), which means we can pack a maximum of $(2097152 - 18)/77 = 27235$ URLs into a single invocation of `cURL`. It appears that the [en wikipedia](#) can easily exceed this limit.

Therefore, we impose our own limit of URLs per `cURL` invocation.

C.8.5.6 Parameters for Persistent Connections

WP-MIRROR 0.6 introduces two new parameters: `*mirror-ichunk-persistent-connection*` which determines how many media files may be downloaded for each persistent connection (default 10); and `*mirror-ichunk-post-connection-sleep*`, which determines how many seconds the `ichunk` process will sleep before establishing the next persistent connection (default 1 second).

If maximizing performance were our only concern, then we would set `*mirror-ichunk-persistent-connection*` to 1000, and `*mirror-ichunk-post-connection-sleep*` to zero. However, the Wikimedia Foundation can block the IP address of someone who is downloading too aggressively. Their advice has been to avoid downloading more than one page per second:

Please do not use a web crawler

Please do not use a web crawler to download large numbers of articles. Aggressive crawling of the server can cause a dramatic slow-down of Wikipedia.

Sample blocked crawler email

IP address nnn.nnn.nnn.nnn was retrieving up to 50 pages per second from wikipedia.org addresses. `Robots.txt` has a rate limit of one per second set using the `Crawl-delay` setting. Please respect that setting. If you must exceed it a little, do so only during the least busy times shown in our site load graphs at <http://stats.wikimedia.org/EN/ChartsWikipediaZZ.htm>. It's worth noting that to crawl the whole site at one hit per second will take several weeks. The originating IP is now blocked or will be shortly. Please contact us if you want it unblocked. Please don't try to circumvent it - we'll just block your whole IP range.

If you want information on how to get our content more efficiently, we offer a variety of methods, including weekly database dumps which you can load into `MySQL` and crawl locally at any rate you find convenient. Tools are also available which will do that for you as often as you like once you have the infrastructure in place. More details are available at http://en.wikipedia.org/wiki/Wikipedia:Database_download.

Instead of an email reply you may prefer to visit `#mediawiki` at irc.freenode.net to discuss your options with our team.

Note that the `robots.txt` currently has a commented out `Crawl-delay`:

```
## *at least* 1 second please. preferably more :D  
## we're disabling this experimentally 11-09-2006  
#Crawl-delay: 1
```

Please be sure to use an intelligent non-zero delay regardless.

http://en.wikipedia.org/wiki/Wikipedia:Database_download

Appendix D

Error Messages

This appendix is mostly of historical interest.

A main design objective for WP-MIRROR 0.4, that configuration of WP-MIRROR and its many dependencies should be entirely automated, led to a number of design decisions, including:

- the user interface should be far less verbose, ideally one line per checkpoint, and
- the log file should not need the highly verbose error messages seen in §D.4, [Full Error Messages \(Obsolete\)](#), because the Reference Manual (this document) is now available.

D.1 Error Codes

Table D.1: WP-MIRROR Error Codes

Code	Intr	Rem
None		

D.2 Error Codes (Obsolete)

- 1000 ([assert-asdf](#))
- 1001 ([assert-clisp-features-p](#))
- 1002 ([assert-concurrency-limit-xchunk-p](#))
- 1003 ([assert-curl-max-time-p](#))

WP-MIRROR uses `cURL` to download files. Sometimes however only a partial file is served. In this case `cURL` blocks. However, `cURL` does offer a time-out to break the block, namely, the `-m/--max-time <seconds>` option.

Originally, the user was requested to append `--max-time 1000` to the configuration file `/root/.curlrc`. This was troublesome to entry level users, and would not pass `lintian`. Beginning with WP-MIRROR 0.4, you no longer need to configure `cURL` if you are using the built-in alternative to `wikix` (which is recommended). This is because the option `-m 1000` is now appended to every `cURL` command found in any shell script generated by WP-MIRROR. This renders configuration of `cURL` unnecessary.

- 1004 ([assert-database-administrator-credentials-p](#))
- 1005 ([assert-database-administrator-account-p](#))
- 1006 ([assert-database-administrator-template-or-create](#))
- 1007 ([assert-database-wikidb-p](#))
- 1008 ([assert-database-wpmirrordb-p](#))

Beginning with WP-MIRROR 0.2, this function was renamed `assert-database-wpmirror-p`. Beginning with WP-MIRROR 0.3, this option was eliminated in favour of `assert-database-wpmirror-or-create`.

Table D.2: WP-MIRROR Error Codes (Obsolete)

Code	Intr	Rem
1000 (assert-asdf)	0.3	0.5
1001 (assert-clisp-features-p)	0.1	0.5
1002 (assert-concurrency-limit-xchunk-p)	0.1	0.5
1003 (assert-curl-max-time-p)	0.1	0.4
1004 (assert-database-administrator-credentials-p)	0.1	0.5
1005 (assert-database-administrator-account-p)	0.1	0.5
1006 (assert-database-administrator-template-or-create)	0.2	0.5
1007 (assert-database-wikidb-p)	0.1	0.5
1008 (assert-database-wpmirrordb-p)	0.1	0.2
1008 (assert-database-wpmirror-p)	0.2	0.3
1009 (assert-database-wpmirrordb-or-create)	0.1	0.2
1009 (assert-database-wpmirror-or-create)	0.2	0.5
1010 (assert-database-wpmirrordb-table-p)	0.1	0.2
1010 (assert-database-wpmirror-table-p)	0.2	0.5
1011 (assert-database-xxwiki-or-create)	0.2	0.5
1012 (assert-dbms-mysql-p)	0.1	0.5
1013 (assert-disk-space-p)	0.1	0.5
1013 (assert-disk-space-if-large-wikipedia-p)	0.5	0.5
1014 (assert-hdd-write-cache-disabled-p)	0.1	0.5
1015 (assert-images-directory-p)	0.1	0.5
1016 (assert-images-bad-directory-or-create)	0.1	0.5
1017 (assert-internet-access-to-wikimedia-site-p)	0.1	0.5
1018 (assert-mediawiki-adminsettings-p)	0.1	0.4
1019 (assert-mediawiki-extensions)	0.1	0.4
1020 (assert-mediawiki-import)	0.2	0.4
1021 (assert-mediawiki-localsettings-p)	0.1	0.5
1022 (assert-mediawiki-localsettings-image)	0.1	0.5
1023 (assert-mediawiki-localsettings-tex)	0.1	0.4
1024 (assert-mediawiki-localsettings-tidy)	0.1	0.5
1025 (assert-php5-suhosin-p)	0.1	0.4
1026 (assert-physical-memory-p)	0.1	0.5
1026 (assert-physical-memory-if-large-wikipedia-p)	0.5	0.5
1027 (assert-utilities-p)	0.1	0.5
1028 (assert-virtual-host-p)	0.2	0.5
1029 (assert-virtual-host-name-resolution-p)	0.2	0.5
1030 (assert-working-directory-or-create)	0.1	0.5
1031 (warn-if-detect-proxy)	0.1	0.5

- 1009 ([assert-database-wpmirrordb-or-create](#))

Beginning with WP-MIRROR 0.2, this function was renamed [assert-database-wpmirror-or-create](#).

- 1009 ([assert-database-wpmirror-or-create](#))
- 1010 ([assert-database-wpmirrordb-table-p](#))

Beginning with WP-MIRROR 0.2, this function was renamed [assert-database-wpmirror-table-p](#).

- 1010 ([assert-database-wpmirror-table-p](#))
- 1011 ([assert-database-xxwiki-or-create](#))
- 1012 ([assert-dbms-mysql-p](#))
- 1013 ([assert-disk-space-p](#))

Beginning with WP-MIRROR 0.5, this function was renamed [assert-disk-space-if-large-wikipedia-p](#).

- 1013 ([assert-disk-space-if-large-wikipedia-p](#))
- 1014 ([assert-hdd-write-cache-disabled-p](#))

- 1015 ([assert-images-directory-p](#))

- 1016 ([assert-images-bad-directory-or-create](#))

- 1017 ([assert-internet-access-to-wikimedia-site-p](#))

- 1018 ([assert-mediawiki-adminsettings-p](#))

Beginning with [MediaWiki 1.19](#) no longer uses [AdminSettings.php](#). Therefore, WP-MIRROR 0.4 and later, do not assert it.

- 1019 ([assert-mediawiki-extensions](#))

Beginning with WP-MIRROR 0.4, this function is no longer used, because [MediaWiki](#) extensions are directly loaded from the configuration file [LocalSettings.php](#).

- 1020 ([assert-mediawiki-import](#))

- 1021 ([assert-mediawiki-localsettings-p](#))

- 1022 ([assert-mediawiki-localsettings-image](#))

- 1023 ([assert-mediawiki-localsettings-tex](#))

Beginning with [MediaWiki 1.18](#), the `$wgUseTex` option is no longer used. Therefore, WP-MIRROR 0.4 and later, do not assert it.

- 1024 ([assert-mediawiki-localsettings-tidy](#))

- 1025 ([assert-php5-suhosin-p](#))

Beginning with WP-MIRROR 0.4, this function is no longer used, because [php5-suhosin](#) was dropped from Debian GNU/Linux 7.0 (wheezy).

- 1026 ([assert-physical-memory-p](#))

Beginning with WP-MIRROR 0.5, this function was renamed [assert-physical-memory-if-large-wikipedia-p](#)

- 1026 ([assert-physical-memory-if-large-wikipedia-p](#))

For the largest wikipedias (the top ten as of 2012), WP-MIRROR will not let you start without at least 4G main memory. This is because database performance will slow to a crawl without adequate memory.

- 1027 ([assert-utilities-p](#))

WP-MIRROR makes use of a couple dozen existing software utilities. This was due to a design decision akin to ‘Do not reinvent the wheel’. WP-MIRROR will not let you start in mirror mode if any are missing (see the full error message for the list of utilities).

- 1028 ([assert-virtual-host-p](#))

- 1029 ([assert-virtual-host-name-resolution-p](#))

- 1030 ([assert-working-directory-or-create](#))

- 1031 ([warn-if-detect-proxy](#))

D.3 Full Error Messages

None.

D.4 Full Error Messages (Obsolete)

```

+-----+
| ERROR:      1000 (assert-asdf)
| ABSTRACT:   The installed version of clisp is missing key features.
| DESCRIPTION: Like all languages, clisp comes with extensions and
|              packages that offer features well beyond the minimum for
|              compliance with standards. WP-MIRROR relies on:
|              (:asdf2 :asdf :clisp :clx :common-lisp-controller :gettext
|              :i18n :loop :regexp :screen :syscalls)
|              This error message occurred because the cl-asdf package
|              has not been installed, or has not been configured.
|              Please run
|
|              root-shell# aptitude install cl-asdf
|
|              Then read the documentation, which can usually be found
|              under /usr/share/doc/cl-asdf/. Information on
|              configuration is usually found in the file README.Debian
|              or in a directory containing HTML pages. Configuration
|              may entail adding the following lines to /root/.clisprc:
|
|              (load #P"/usr/share/common-lisp/source/cl-asdf/asdf.lisp")
|              (push #P"/usr/share/common-lisp/systems/" asdf:*central-registry*)
|
| GNU/LINUX:   To see the features your clisp installation offers, try:
|              shell$ clisp -q
|              [1]> *features*
| REFERENCE:   See the WP-MIRROR README for more on installation.
+-----+

```

```

+-----+
| ERROR:      1001 (assert-clisp-features-p)
| ABSTRACT:   The installed version of clisp is missing key features.
| DESCRIPTION: Like all languages, clisp comes with extensions and packages
|              that offer features well beyond the minimum for compliance with
|              standards. WP-MIRROR relies on these:
|              (:asdf2 :asdf :clisp :clx :common-lisp-controller :gettext
|              :i18n :loop :regexp :screen :syscalls)
| GNU/LINUX:   To see what features your clisp installation offers, try:
|              shell$ clisp -q -q
|              [1]> *features*
| REFERENCE:   See the WP-MIRROR README for more on planning your software.
+-----+

```

```
+-----+
| ERROR:      1002 (assert-concurrency-limit-xchunk-p) |
| ABSTRACT:   Unknown innodb-file-format |
| DESCRIPTION: InnoDB has two file formats (as of 2012): |
|               o Antelope is uncompressed and handles concurrency well. |
|                 We limit concurrency to lesser of number of CPUs and three. |
|               o Barracuda is compressed using zlib and does NOT handle |
|                 concurrency well (frequent deadlocks). |
|                 We limit concurrency to one (that is, we process xchunks |
|                 one-by-one). |
| REFERENCE:  See the WP-MIRROR README for more on InnoDB. |
+-----+
```

```
+-----+
| ERROR:      1003 (assert-curl-max-time-p) |
| ABSTRACT:   Unable to find timeout option in configuration file for curl. |
| DESCRIPTION: WP-MIRROR uses curl to download files. Sometimes however |
|               only a partial file is served. In this case curl blocks. |
|               However, curl does offer a time-out to break the block. |
| GNU/LINUX:  The configuration file for curl is |
|               /root/.curlrc |
|               In this file you should append |
|               --max-time 1000 |
| REFERENCE:  See WP-MIRROR README for more on planning your system. |
+-----+
```

```

+-----+
| ERROR:      1004 (assert-database-administrator-credentials-p) |
| ABSTRACT:   Unable to find database administrator credentials. |
| DESCRIPTION: WP-MIRROR reads through the MediaWiki configuration file |
|              looking for both wikiuser and administrator credentials. |
|              WP-MIRROR will not let you start without finding these |
|              credentials there. WP-MIRROR needs database administrator |
|              credentials for just two purpose: 1) to grant permissions to |
|              the wikiuser account---permissions to submit create, read, |
|              update, delete (CRUD) queries to the wpmirror database, and |
|              2) to submit the query |
|              mysql> SHOW ENGINE INNODB STATUS G |
|              Wikiuser credentials for all other database access. |
|              Indirectly, one of the MediaWiki maintenance scripts invoked |
|              by WP-MIRROR, namely, rebuildImages.php, needs database |
|              administrator credentials. |
| NOTE:       MySQL's out-of-the-box configuration has no password set for |
|              the database administrator account. Some people think this is |
|              safe, others deem it unwise. Please set a password, and enter |
|              it into the MediaWiki configuration file. |
| GNU/LINUX:  1) Set the database administrator password: |
|              shell$ mysql -u root |
|              mysql> UPDATE mysql.user SET password=PASSWORD\('new\_pwd'\) |
|                      WHERE user='root'; |
|              mysql> FLUSH PRIVILEGES; |
|              2) The MediaWiki configuration file is |
|                  /etc/mediawiki/AdminSettings.php |
|              Edit the administrator credentials in this file |
|                  \$wgDBAdminuser="root"; |
|                  \$wgDBAdminpassword="new\_pwd"; |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
|              See MySQL 5.1 Reference Manual, available on-line. |
+-----+

```

```

+-----+
| ERROR:      1005 (assert-database-administrator-account-p) |
| ABSTRACT:   Unable to access database administrator account. |
| DESCRIPTION: WP-MIRROR directly accesses the database administrator |
|              for just one purpose: to grant permissions to the wikiuser |
|              account---permissions to submit create, read, update, delete |
|              (CRUD) queries to the wpmirror database. |
|              WP-MIRROR uses wikiuser credentials for all other database |
|              access. Indirectly, one of the MediaWiki maintenance |
|              scripts used by WP-MIRROR, namely, rebuildImages.php, |
|              needs database administrator credentials. |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```

```

+-----+
| ERROR:      1006 (assert-database-template-or-create) |
| ABSTRACT:   Unable to find the wikidb database.      |
| DESCRIPTION: WP-MIRROR uses the newly created wikidb database (and its |
|               mostly empty tables) as a template for creating a separate |
|               database for each member of *mirror-languages*.           |
|               The template is a mysqldump of wikidb, and it is stored as |
|               /usr/share/mediawiki/maintenance/template.sql.            |
| REFERENCE:  See the WP-MIRROR README for more on planning your system.  |
+-----+

```

```

+-----+
| ERROR:      1007 (assert-database-wikidb-p)          |
| ABSTRACT:   Unable to find the wikidb database.      |
| DESCRIPTION: WP-MIRROR uses the newly created wikidb database (and its |
|               mostly empty tables) as a template for creating a separate |
|               database for each member of *mirror-languages*.           |
| REFERENCE:  See the WP-MIRROR README for more on planning your system.  |
+-----+

```

```

+-----+
| ERROR:      1008 (assert-database-wpmirror-p)        |
| ABSTRACT:   Unable to find the wpmirror database.    |
| DESCRIPTION: WP-MIRROR creates state information about the progress of the |
|               mirroring, and uses InnoDB to store, retrieve and share it. |
|               This information is stored as records (one per file) in the |
|               database table wpmirror.file.          |
| REFERENCE:  See the WP-MIRROR README for more on planning your system.  |
+-----+

```

```

+-----+
| ERROR:      1009 (assert-database-wpmirror-or-create)|
| ABSTRACT:   Unable to create the wpmirror database. |
| DESCRIPTION: WP-MIRROR creates state information about the progress of the |
|               mirroring, and uses InnoDB to store, retrieve and share it. |
|               This information is stored as records (one per file) in the |
|               database table wpmirror.file.          |
| REFERENCE:  See the WP-MIRROR README for more on planning your system.  |
+-----+

```

```

+-----+
| ERROR:      1010 (assert-database-wpmirror-table-p) |
| ABSTRACT:   Unable to find tables in wpmirror database. |
| DESCRIPTION: WP-MIRROR creates state information about the progress of the |
|               mirroring, and uses InnoDB to store, retrieve and share it. |
|               This information is stored as records (one per file) in the |
|               database table wpmirror.file.          |
| REFERENCE:  See the WP-MIRROR README for more on planning your system.  |
+-----+

```

```
+-----+
| ERROR:      1011 (assert-database-xxwiki-or-create) |
| ABSTRACT:   Unable to find or create one of the xxwiki databases. |
| DESCRIPTION: WP-MIRROR mirrors needs to be sure that a separate database |
|               exists for each member of \*mirror-languages\*. These databases |
|               must exist before running MediaWiki maintenance scripts, such |
|               as importDump.php which inserts articles from a dump file into |
|               the database. |
|               WP-MIRROR monitors also access these databases to determine |
|               how many articles, images, etc. have been imported. |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+
```

```

| ERROR:      1012 (assert-dbms-mysql-p)
| ABSTRACT:   MediaWiki is not using MySQL which WP-MIRROR requires.
| DESCRIPTION: WP-MIRROR creates state information about the progress of the
|              mirroring, and uses InnoDB to store, retrieve and share it.
|              The database is called wpmirror and it is accessed using
|              the same credentials (host, user, and password info) that
|              MediaWiki uses for its own database wikidb. Indeed,
|              WP-MIRROR reads through the MediaWiki configuration file to
|              obtain these credentials. So, at least for time being,
|              WP-MIRROR expects MediaWiki to use MySQL.
| DESIGN:    MediaWiki is the software that will maintain and serve the
|              articles that you mirror. MediaWiki is usually configured to
|              store its articles in one of five database management
|              systems (DBMS): MySQL, postgres, sqlite, mssql, and
|              ibm_db2. WP-MIRROR however uses MySQL only, for reasons
|              of performance.
|              WP-MIRROR has two main modes: mirror and monitor.
|              The mirror maintains state, mostly about the files in its
|              working directory, while the monitor(s) read state to present a
|              set of progress bars.
|              The design issue is that of concurrency---how to let mirrors
|              write and monitors read without data loss or resource
|              contention. Semaphores or locks are used, and one may lock at
|              different levels: row, page, extent, table, or database (in
|              order from fine to course granularity). Course granularity
|              locks can cause deadlocks and writer starvation. Not all
|              storage engines offer locks of fine granularity.
|              o bdb      - page-level
|              o ibm_db2  - page-level and extent-level
|              o innodb   - row-level (MVCC)
|              o mssql    - row-level with escalation to page-level and
|                          table-level
|              o myisam   - table-level
|              o oracle   - row-level (MVCC)
|              o postgres - row-level (MVCC)
|              o sqlite   - table-level (actually file-level)
|              WP-MIRROR uses InnoDB because it offers multi-version
|              concurrency control (MVCC), that is, row-level locking without
|              escalation to coarser granularity locks, together with Oracle
|              style consistent non-locking reads.
|              Another design issue is that of scalability---how well the
|              storage engine performs as the number of records increases
|              greatly. If the WP-MIRROR option *xchunk-page-count* is
|              left at its default value of 1000, then wpmirror will have
|              only tens of thousands of records. If the option is set to 1,
|              then wpmirror will have tens of millions of records. So it
|              is important that the storage engine scale well over several
|              orders of magnitude.
| GNU/LINUX: The configuration files for WP-MIRROR are
|              /etc/wp-mirror/default.conf and /etc/wp-mirror/local.conf
| NOTE:      Support for postgres could be added later given evidence of
|              significant demand.
| REFERENCE: See the WP-MIRROR README for more on planning your system.

```

```

+-----+
| ERROR:      1013 (assert-disk-space-p) |
| ABSTRACT:   Insufficient disk space for building mirror of biggest wiki's. |
| DESCRIPTION: For the largest wiki's (the top ten as of 2012), WP-MIRROR |
|              will not let you start without at least 100 G free disk space. |
| PLANNING:   Disk space requirements for mirroring the latest revisions of |
|              en wiki are approximately (as of 2012): |
|              o working directory - 100G |
|              o InnoDB database - 200G |
|              o images directory - 2T |
|              Given the size requirements, it would be best to put this all |
|              on a separate disk. |
| GNU/LINUX:  The images directory is usually |
|              /var/lib/mediawiki/images/ |
|              This can (and should) be a symbolic link to a separate disk. |
|              The working directory for WP-MIRROR should be placed under |
|              the images directory. |
| REFERENCE:  See the WP-MIRROR README for more on planning your disk space |
+-----+

```

```

+-----+
| ERROR:      1013 (assert-disk-space-if-large-wikipedia-p) |
| ABSTRACT:   Insufficient disk space for building mirror of biggest wiki's. |
| DESCRIPTION: For the largest wiki's (the top ten as of 2012), WP-MIRROR |
|              will not let you start without at least 100 G free disk space. |
| PLANNING:   Disk space requirements for mirroring the latest revisions of |
|              en wiki are approximately (as of 2012): |
|              o working directory - 100G |
|              o InnoDB database - 200G |
|              o images directory - 2T |
|              Given the size requirements, it would be best to put this all |
|              on a separate disk. |
| GNU/LINUX:  The images directory is usually |
|              /var/lib/mediawiki/images/ |
|              This can (and should) be a symbolic link to a separate disk. |
|              The working directory for WP-MIRROR should be placed under |
|              the images directory. |
| REFERENCE:  See the WP-MIRROR README for more on planning your disk space |
+-----+

```

```

+-----+
| ERROR:      1014 (assert-hdd-write-cache-disabled-p) |
| ABSTRACT:   Data could lost during a power failure. |
| DESCRIPTION: MediaWiki stores its articles in InnoDB, which is |
|              MySQL's ACID compliant storage engine that is used for |
|              transactions. The issue here regards Durability (the 'D' in |
|              'ACID'). A committed transaction should be stored in a way |
|              that is resistant to many kinds of failure, including power |
|              outage. Transactions that 'commit' must actually be written to |
|              disk, and not remain in the hard-disk-drive's write cache, |
|              where is may be lost during system failure. It is therefore |
|              important that the disk's write cache be disabled. |
| GNU/LINUX:  An hard-drive's write cache can be disabled with a command like |
|              root-shell# hdparm -W0 /dev/sda |
|              To avoid forgetting, this command should be made part of the |
|              system boot process. This can be done by appended it to |
|              /etc/rc.local |
| REFERENCE:  See the WP-MIRROR README for more on planning your disk space |
+-----+

```

```

+-----+
| ERROR:      1015 (assert-images-directory-p) |
| ABSTRACT:   Unable to find mediawiki images directory. |
| DESCRIPTION: WP-MIRROR needs access to the images directory so that the |
|              image files that it downloads can found by MediaWiki. |
|              Usually this directory is '/var/lib/mediawiki/images/'. |
|              MediaWiki is the software that will maintain and help serve |
|              the articles that you mirror. MediaWiki maintains a directory |
|              tree where images, thumbs (resized images), and math (formulae |
|              rendered by TeX as PNG images) are stored. |
| PLANNING:   Storage requirements for the images directory for mirroring |
|              the latest revisions of en wiki are approximately (as of |
|              2012): |
|              o image files      - 2T (two million image files) |
|              o thumbs           - 50G (several million files) |
|              o math              - 1G (half a million files) |
|              The images directory should probably be put on a separate |
|              disk. |
| GNU/LINUX:  The images directory is usually /var/lib/mediawiki/images/. |
|              This can (and should) be a symbolic link to a separate disk. |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```

```

+-----+
| ERROR:      1016 (assert-images-bad-directory-or-create) |
| ABSTRACT:   Unable to create bad-images directory for WP-MIRROR. |
| DESCRIPTION: Many of the downloaded images are incomplete or corrupt. A |
|              directory is needed to sequester these image files. |
| GNU/LINUX:  The bad-images directory is usually |
|              /var/lib/mediawiki/images/bad-images/ |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```



```

+-----+
| ERROR:      1017 (assert-internet-access-to-wikimedia-site-p) |
| ABSTRACT:   Unable to download wikipedia articles and images. |
| DESCRIPTION: Wikipedia articles are made available in the form of |
|              a large compressed 'dump' file. A million image files may also |
|              be downloaded (individually and not as a single dump). |
| PLANNING:   Bandwidth requirements for mirroring the latest revisions of |
|              en wiki are approximately (as of 2012): |
|              o dump file - 8G (one file containing millions of articles) |
|              o images    - 2T (two million files each containing an image) |
| NOTE:       If this traffic must go through a caching proxy, there may be |
|              problems. Some caching proxies crash if a file exceeds its |
|              available memory. In this case, the dump file must be manually |
|              copied into WP-MIRRORS working directory. Some caching |
|              proxies might not have disk space adequate for caching 2TB of |
|              images. In this case, the cached images should be removed each |
|              day (perhaps by using a daily cron job). Best of all, is to |
|              by-pass the proxy altogether. One good method is to use the |
|              port-forwarding feature of ssh to connect to a box outside |
|              the network served by the proxy. |
| REFERENCE:  See the WP-MIRROR README for more on planning your internet |
|              access. |
+-----+

```

```

+-----+
| ERROR:      1018 (assert-mediawiki-adminsettings-p) |
| ABSTRACT:   Unable to find the admin config file for MediaWiki. |
| DESCRIPTION: WP-MIRROR creates state information about the progress of the |
|              mirroring, and uses InnoDB to store, retrieve and share it. |
|              The database is called wpmirror and it is accessed using |
|              the same credentials (host, user, and password info) that |
|              MediaWiki uses for its own database wikidb. Indeed, |
|              WP-MIRROR reads through the MediaWiki configuration file to |
|              obtain these credentials. |
| GNU/LINUX:  The configuration file for MediaWiki is |
|              /etc/mediawiki/AdminSettings.php |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```

```

+-----+
| ERROR:      1019 (assert-mediawiki-extensions) |
| ABSTRACT:   MediaWiki extensions not installed or enabled. |
| DESCRIPTION: Many wikipedia articles use templates to format special content |
|              such as citations, footnotes, and poems. These are available |
|              in the mediawiki-extensions package. Without these |
|              extensions, the templates will fail to render, and you will get |
|              quite a mess consisting of scores of nested braces. |
| GNU/LINUX:  Please install the mediawiki-extensions package, then go to |
|              /etc/mediawiki-extensions/extensions-available/. |
|              This directory contains a set of symbolic links. |
|              Copy all these links to |
|              /etc/mediawiki-extensions/extensions-enabled/. |
|              root-shell# cd /etc/mediawiki-extensions/extensions-enabled/ |
|              root-shell# cp -a ../extensions-available/\* . |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```



```

+-----+
| ERROR:      1022 (assert-mediawiki-localsettings-image) |
| ABSTRACT:   MediaWiki not configured to use gm and rsvg. |
| DESCRIPTION: By default MediaWiki converts images (e.g. makes thumbs) by |
|              using ImageMagick. Unfortunately, ImageMagick grabs far |
|              too much scratch space in main memory, and this results in poor |
|              performance and system failures. Much better is to use |
|              GraphicsMagick (aka gm). Also, scalable vector graphics |
|              SVG files are converted into PNG files. It is beter to use |
|              rsvg than the default. |
| GNU/LINUX:  The configuration file for MediaWiki is |
|              /etc/mediawiki/LocalSettings.php |
|              Please install gm, and if |
|              /etc/mediawiki/LocalSettings_wpmirror.php is not installed, |
|              edit LocalSettings.php by appending the lines |
|              $wgUseImageMagick = false; |
|              $wgCustomConvertCommand = '/usr/bin/gm convert %s -resize %wx%h %d'; |
|              $wgSVGConverter = 'rsvg'; |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```

```

+-----+
| ERROR:      1023 (assert-mediawiki-localsettings-tex) |
| ABSTRACT:   MediaWiki not configured to use TeX. |
| DESCRIPTION: Many Wikipedia articles contain mathematical formulae. These |
|              are best rendered using TeX. TeX turns the math into small |
|              PNG image files. If TeX is not used, then the math will be |
|              rendered rather poorly using character strings. |
| GNU/LINUX:  The configuration file for MediaWiki is |
|              /etc/mediawiki/LocalSettings.php |
|              If /etc/mediawiki/LocalSettings_wpmirror.php is not installed |
|              then please install the mediawiki-math package (Debian), and |
|              edit the MediaWiki configuration file by appending the line |
|              $wgUseTeX = true; |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```

```

+-----+
| ERROR:      1024 (assert-mediawiki-localsettings-tidy) |
| ABSTRACT:   MediaWiki not configured to use tidy. |
| DESCRIPTION: Many wikipedia articles contain complicated templates that, |
|              without tidy, will produce badly formatted pages. In |
|              particular, you will find '<p>' and '<pre>' tags in the HTML |
|              after every citation. The resulting mess will be hard to read. |
|              Tidy is an HTML syntax checker and reformatter, and is needed |
|              for generating readable pages. |
| GNU/LINUX:  The configuration file for MediaWiki is |
|              /etc/mediawiki/LocalSettings.php |
|              Please install tidy, and if |
|              /etc/mediawiki/LocalSettings_wpmirror.php is not installed, |
|              edit LocalSettings.php by appending the line |
|              $wgUseTidy = true; |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```

```
| ERROR:      1025 (assert-php5-suhosin-p) |
| ABSTRACT:   PHP5 not configured to use suhosin. |
| DESCRIPTION: MediaWiki is written in PHP, and is not entirely safe. |
|              Suhosin, to paraphrase its documentation, is an advanced |
|              protection module for PHP5. It was designed to protect |
|              servers and users from known and unknown flaws in PHP |
|              applications and the PHP core. |
|              When you run importDump.php, you can expect to find many |
|              alert messages in the syslog, such as this: |
|              |
|              suhosin[21288]: ALERT - script tried to disable memory_limit by |
|              setting it to a negative value -1 bytes which is not allowed |
|              (attacker 'REMOTE_ADDR not set', file 'unknown') |
|              |
| GNU/LINUX:  The configuration file for php5-suhosin is |
|              /etc/php5/conf.d/suhosin.ini. |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
|-----|
```

ERROR:	1026 (assert-physical-memory-p)
ABSTRACT:	Insufficient physical memory found building biggest wiki's.
DESCRIPTION:	For the largest wiki's (the top ten as of 2012), WP-MIRROR will not let you start without at least 4G main memory. Database performance will slow to a crawl without adequate memory.
	MediaWiki stores its articles in InnoDB , which is MySQL 's ACID compliant storage engine. InnoDB organizes both its disk space and its memory into 16K pages. InnoDB also keeps its records sorted. Since most records are small, several can fit in a page. Accessing a record entails accessing the right page. In worst case, each time a record is created, updated, or deleted, a page would have to be read from disk, modified, and written back to disk. Moreover, as records are inserted, over-full pages are split up, and as records are deleted, under-full pages are merged. So accessing a record could entail accessing several pages. This could cause a tremendous amount of disk I/O, which would hurt performance. The answer is to keep a large number of pages in memory, so that a page can be read in once, then quickly accessed multiple times before writing it back to disk. So InnoDB maintains a large buffer pool in main memory. When a page is read from disk, it will be put into the buffer pool , where it will stay a while. InnoDB also keeps its own administrative data in the buffer pool . So the larger the buffer pool , the better.
PLANNING:	Install at least 4G DRAM onto your mother board. Install much more if you can afford it. If your mother board does not accept that much, then replace it (for it is antiquated).
NOTE:	Modern CPUs and operating systems can organize main memory into pages of different sizes. For example, while Intel usually organizes memory into 4K pages, it also offers huge pages that are 2M or 4M. Modern operating systems will swap the smaller pages to a swap space on disk, according to some aging algorithm, but will leave the huge pages alone. Given that InnoDB has its own memory management algorithm, there is no advantage to having the OS swap anything held in the buffer pool ---and actually swapping would hurt performance. So it is highly recommended (though not currently required) to allocate at least 3G of memory for huge pages , and to configure InnoDB to use them for its buffer pool . Leave at least 1G memory for other processes. Importing the dump into wikidb entails creating thumbs (resized images). As some image files are over 100M, the resizing can easily occupy memory several times that amount.
REFERENCE:	See the WP-MIRROR README for more on planning your memory.

ERROR:	1026 (assert-physical-memory-if-large-wikipedia-p)
ABSTRACT:	Insufficient physical memory found building biggest wiki's.
DESCRIPTION:	For the largest wiki's (the top ten as of 2012), WP-MIRROR will not let you start without at least 4G main memory. Database performance will slow to a crawl without adequate memory.
	MediaWiki stores its articles in InnoDB , which is MySQL 's ACID compliant storage engine. InnoDB organizes both its disk space and its memory into 16K pages. InnoDB also keeps its records sorted. Since most records are small, several can fit in a page. Accessing a record entails accessing the right page. In worst case, each time a record is created, updated, or deleted, a page would have to be read from disk, modified, and written back to disk. Moreover, as records are inserted, over-full pages are split up, and as records are deleted, under-full pages are merged. So accessing a record could entail accessing several pages. This could cause a tremendous amount of disk I/O, which would hurt performance. The answer is to keep a large number of pages in memory, so that a page can be read in once, then quickly accessed multiple times before writing it back to disk. So InnoDB maintains a large buffer pool in main memory. When a page is read from disk, it will be put into the buffer pool , where it will stay a while. InnoDB also keeps its own administrative data in the buffer pool . So the larger the buffer pool , the better.
PLANNING:	Install at least 4G DRAM onto your mother board. Install much more if you can afford it. If your mother board does not accept that much, then replace it (for it is antiquated).
NOTE:	Modern CPUs and operating systems can organize main memory into pages of different sizes. For example, while Intel usually organizes memory into 4K pages, it also offers huge pages that are 2M or 4M. Modern operating systems will swap the smaller pages to a swap space on disk, according to some aging algorithm, but will leave the huge pages alone. Given that InnoDB has its own memory management algorithm, there is no advantage to having the OS swap anything held in the buffer pool ---and actually swapping would hurt performance. So it is highly recommended (though not currently required) to allocate at least 3G of memory for huge pages , and to configure InnoDB to use them for its buffer pool . Leave at least 1G memory for other processes. Importing the dump into wikidb entails creating thumbs (resized images). As some image files are over 100M, the resizing can easily occupy memory several times that amount.
REFERENCE:	See the WP-MIRROR README for more on planning your memory.

```

| ERROR:      1027 (assert-utilities-p)
| ABSTRACT:   Unable to find all of the software utilities required.
| DESCRIPTION: WP-MIRROR makes use of a couple dozen existing software
|               utilities. This was due to a design decision akin to 'Do not
|               reinvent the wheel'. WP-MIRROR will not let you start in
|               mirror mode if any of the following utilities are missing:
|               o bunzip2, chown, chmod, cat, cp, cron, curl, env,
|                 gm, hdparm, md5sum, mv, mysql, mysqldump,
|                 openssl, php, printf, rm, rsvg, wget,
|               o wikix (if you do not use the built-in default),
|               o /etc/mediawiki/adminsettings.php,
|                 /etc/mediawiki/localsettings.php,
|                 /etc/mediawiki/localsettings_wpmirror.php,
|               o /usr/share/mediawiki/includes/Import.php,
|               o /usr/share/mediawiki/maintenance/importDump_farm.php,
|                 /usr/share/mediawiki/maintenance/rebuildImages_farm.php,
|                 /usr/share/mediawiki/maintenance/update_farm.php,
|                 /usr/share/mediawiki/maintenance/importDump.php,
|                 /usr/share/mediawiki/maintenance/rebuildImages.php,
|                 /usr/share/mediawiki/maintenance/update.php.
| GNU/LINUX:  A package management system (e.g. Debian) can provide easy
|               installation and maintenance of a consistent set of utilities.
| REFERENCE:  See the WP-MIRROR README for more on planning your system.

```

```

| ERROR:      1028 (assert-virtual-host-p)
| ABSTRACT:   Virtual host wpmirror.site not found.
| DESCRIPTION: WP-MIRROR sets up a virtual host to let you access your new
|               mirrors. For example, you access your mirror of the simple
|               wiki by giving your browser http://simple.wpmirror.site/.
|               The virtual host container should be found in
|                 /etc/apache2/sites-available/wpmirror.site.conf.
|               There should also be a symbol link to it found in
|                 /etc/apache2/sites-enabled/wpmirror.site.conf.
|               And the virtual host configuration should be loaded into
|               Apache2.
|
|               root-shell# apache2ctl -S 2>&1 | grep mediawiki
|                           port 80 namevhost wpmirror.site (/etc/apache2/sites-en
|                           abled/wpmirror.site.conf:1)
| REFERENCE:  See the WP-MIRROR README for more on planning your system.

```

```

+-----+
| ERROR:      1029 (assert-virtual-host-name-resolution-p) |
| ABSTRACT:   Virtual host wpmirror.site not found in /etc/hosts. |
| DESCRIPTION: Apache2 needs to resolve the name wpmirror.site into the IP |
|               address ::1 (or 127.0.0.1 if you prefer IPv4). This can be |
|               done with a DNS server, such as bind, but that is atypical for |
|               a PC. Name resolution is most easily done by appending lines |
|               to /etc/hosts like these: |
|               |
|               ::1 localhost wpmirror.site www.wpmirror.site |
|               ::1 meta.wpmirror.site simple.wpmirror.site |
|               ::1 en.wpmirror.site zh.wpmirror.site |
|               |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```

```

+-----+
| ERROR:      1030 (assert-working-directory-or-create) |
| ABSTRACT:   Unable to create working directory for WP-MIRROR. |
| DESCRIPTION: WP-MIRROR uses a directory to generate and maintain tens of |
|               thousands of files used by the mirroring process. |
| PLANNING:   Storage requirements for the working directory for mirroring |
|               the latest revisions of en wiki are approximately (as of |
|               2012): |
|               |
|               o dump file - 8G |
|               o decompressed dump file - 37G |
|               o xchunks - 37G |
|               o ichunks - 5G |
| GNU/LINUX:  The working directory is usually |
|               /var/lib/mediawiki/images/wp-mirror/ |
| REFERENCE:  See the WP-MIRROR README for more on planning your system. |
+-----+

```

```

+-----+
| ERROR:      1031 (warn-if-detect-proxy) |
| ABSTRACT:   Web proxy detected. Manually check if it can handle traffic. |
| DESCRIPTION: Caching web proxies offer many benefits: economize band-width, |
|               reduce latency, improve security, log web traffic, block |
|               inappropriate sites, and bridge between IPv6 and IPv4 networks. |
|               They also have weaknesses: unable to handle downloading very |
|               large files, and need large disk space for cache. |
| PLANNING:   1) Dump file. Dump files containing the latest revisions of |
|               en wiki are 8G (as of 2012). Some caching web proxies crash |
|               when downloading a file larger than their available memory. |
|               You may need to obtain the dump file some other way, then |
|               manually copy it to WP-MIRRORs working directory. |
|               2) Images. en wiki references about two million image files, |
|               which collectively occupy about 2T (as of 2012). Downloading |
|               the image files may stuff your proxy's cache. This can be |
|               managed by deleting image files from the cache on a daily basis |
|               (using a cron job say). |
| GNU/LINUX:  The WP-MIRROR working directory is usually |
|               /var/lib/mediawiki/images/wp-mirror/ |
| REFERENCE:  See the WP-MIRROR README for more on caching web proxies. |
+-----+

```

Appendix E

Experiments (Autumn 2010—Spring 2011)

This is a transcript of my original notes, edited, and formatted for [L^AT_EX](#). In the notes below, the terms [darkstar-4](#), [darkstar-5](#), and [darkstar-7](#), are host names.

Source: [/root/sysadmin/2010_09_sysadmin.log](#).

Date: 2010-Sept-12 through 2011-Apr

Re: How to build a mirror of the <http://en.wikipedia.org/>.

E.1 Introduction

Purpose. Mirror the latest revision of <http://en.wikipedia.org/>. The web pages, when loaded into [MySQL](#) might occupy about 0.2T. The media files might also occupy an additional 1.0T. We do not want to mirror all its revisions, user talk, etc. as the entire en.wikipedia.org site might require over 10T. Likewise we do not want to mirror all languages as this might exceed 100T.

HDD. By default [MySQL](#) stores its tables under [/var/lib/mysql/](#). Since [darkstar-5](#)'s [/var/](#) partition is currently 100GB (and already holds about 50GB due to mirroring of part of the Debian archive), we need to store the database tables elsewhere. We shall settle upon a new HDD dedicated to storing the [MySQL](#) tables. Currently we need a bit over 1T. So to allow for future growth we should purchase a 1.5T or 2T HDD.

Cooling. The existing two HDDs are running a little hot (50-55C, design limit is 60C). Addition of a third HDD will make it worse. We will need a fan with higher air flow.

Structure. The HDD shall have two [LVM2](#) partitions: one for the database, one for the media files:

[ibdata0](#): [InnoDB](#) on [LVM2](#) on [LUKS](#) on [RAID](#) on whole disks

[images0](#): [ReiserFS](#) on [LVM2](#) on [LUKS](#) on [RAID](#) on whole disks

We shall use the [InnoDB](#) storage engine. [InnoDB](#) supports transactions and is the ACID compliant storage engine for [MySQL](#). The [table space](#) for [InnoDB](#) can be stored either as a file on a file system, or directly on a raw disk or partition. There is some speed advantage to the later. This is because [InnoDB](#) is, in effect, a journaling file system; and, therefore, there is no advantage to storing the [InnoDB](#) table space on a journaling file system such as [ReiserFS](#).

The media files for the wikipedia are, however, stored in a file system, rather than in a database. This is a design decision by the Wikimedia Foundation that recognizes that web servers are better at caching files than database contents.

Here are the storage requirements:

enwiki-yyyyymmdd-		2010 09-16	2011 01-15	03-21	10-07
pages-articles.xml.bz2	a	6.2G	6.5	6.7	7.8
pages-articles.xml	a	28	29	30	34
wikidb in InnoDB	b	50*	54**	1xx	
images/	c	690	745	780	
pages-articles (rows)	d	10.3m	10.8	11.1	11.7
<title> is "File:..."	e			0.87	0.85
image count (*)	f	1.24	1.46	1.49	
images - download.log +	g			34.5k	
from exists.log	g			1.65m	
wikix failed.log	g			287k	

Notes:

- a) `ls -lh <file>`
- b) see [InnoDB](#) diskspace computation (next Note below)
- c) `df -h | grep database0` (includes [0-9a-f], math, thumb)
- d) `cat <file> | grep "<page>" | wc -l`
- e) `cat <file> | grep "<title>" | grep "File:" | wc -l`
- f) `mysql> SELECT COUNT(*) FROM image;`
- g) `wc -l *log` (duplicates seen in [exists.log](#) and [failed.log](#))
- *) imported 6.5m/10.3m pages before fiasco with [pagelinks](#) indices.
- **) `xml` parse errors prevented importation of 3 million pages.
- +) 2011-03-21 images downloaded: 18k new, 16k previously failed.

Note: the diskpace occupied by [InnoDB](#) data is computed as follows:

1. `vg5` has two logical volumes

```
root-shell# lvsdisplay -v vg5 | grep LE
Current LE      75000      <--- ibdata0 (75000*4MB=300000MB)
Current LE      401931     <--- images0
```

each logical extent (LE) is 4MB in size

2. the total space available to [InnoDB](#) is 300000Mraw = 314572800000 bytes

```
root-shell# cat /etc/mysql/conf.d/custom.cnf | grep Mraw
#innodb_data_file_path      = /dev/mapper/vg5-ibdata0:300000Mnewraw
innodb_data_file_path      = /dev/mapper/vg5-ibdata0:300000Mraw
```

3. after inserting records we can see how much space [InnoDB](#) has left for example, after importation of 2011-01-15 dump, we get

```
mysql> SHOW TABLE STATUS LIKE 'page'\G
Data_free: 256567672832
```

4. finally, we take the difference and reduce to GB $(314572800000 - 256567672832) / (1024 * 1024 * 1024) = 54\text{G}$

Note: [failed.log](#) contains a very great number of duplicates: any file name containing blanks, will be attempted with underscores as

```
./1/10/River South New Caledonia.JPG failed
./2/20/River_South_New_Caledonia.JPG failed
```

DRAM. We eventually learned the hard way that 2GB DRAM is not enough. The system freezes for a minute or two to perform a lot of swapping when `/usr/bin/convert` runs to resize images (make thumbs). We add 4GB for a total of 6GB, choosing DDR2 800 to match existing DIMMs. Later on we learned that `convert` (ImageMagick) uses an unreasonable amount of scratch space, and that it is much better to use `/usr/bin/gm convert` (GraphicsMagick).

E.2 Hardware

E.2.1 PARTS

Qty	Description
1	Seagate ST320005N4A1AS-RK (2.0T SATA HDD) S/N 5XW0SCXV
1	Antec TriCool 120mm (3-speed case fan, set on high)
1	OCZ OCZ2G8004GK (2x2GB DDR2 DIMM 800 5-5-5 1.8V)

Install packages:

```
root-shell# aptitude install hddtemp mdadm cryptsetup lvm2 reiserfsprogs
root-shell# aptitude install mysql-server mysql-client mysqltuner
root-shell# aptitude install atsar
root-shell# aptitude install mediawiki mediawiki-extensions mediawiki-math tidy
root-shell# aptitude install php5-suhosin      <-- if not already installed with php5
root-shell# aptitude install libssl-dev build-essential curl
root-shell# aptitude install graphicsmagick librsvg2-bin librsvg-common
```

E.2.2 H/W Test

Check that the new fan is cooling the HDDs (allow 20 min to settle):

```
root-shell# aptitude install hddtemp
root-shell# hddtemp /dev/sd[a-z]
/dev/sda: ST31500341AS: 42<B0>C
/dev/sdb: ST31500341AS: 37<B0>C
/dev/sdc: ST32000542AS: 36<B0>C
```

Yes!

Check new disk for bad blocks using:

```
root-shell# badblocks -c 102400 -o /tmp/badblocks.txt -s -t random -v -w /dev/sdc
Checking for bad blocks in read-write mode
From block 0 to 1953514583
Testing with random pattern: done
Reading and comparing: done
Pass completed, 0 bad blocks found.
```

This took about fourteen hours (seven to write, seven to verify).

E.2.3 Partitions

We shall use whole disks, no `cfdisk` partitions.

E.2.4 RAID

We use `raid1` as the next layer just in case we later wish to mirror it with a second disk.

```
root-shell# aptitude install mdadm
root-shell# mdadm --create /dev/md4 --verbose \
--level=1 --raid-devices=2 --metadata=1.0 --bitmap=internal \
--name=database0 --auto=md /dev/sdc missing
```

where

- `level=1` means `raid1` (mirrored),

- **raid-devices=2** means raid set will have two active disks,
- **metadata=1.0** means version-1 format superblock located at the end of each disk (if array will be larger than 2T, then default=0.90 will not do),
- **bitmap=internal** means a write-intent log is stored near the superblock (resync greatly optimized; full resync takes over 25 hours if no bitmap),
- **name=database0** means the RAID array will have a name (possible with version-1 format superblock)
- **auto=md** means a non-partitionable array, and
- **/dev/sdc** and **missing** are the disks.

`mdadm` responded with the following message:

```
mdadm: size set to 1953514448K
mdadm: array /dev/md4 started.
```

Let us collect some data:

```
shell$ cat /proc/mdstat
md4 : active (auto-read-only) raid1 sdc[0]
      1953514448 blocks super 1.0 [2/1] [U_]
      bitmap: 0/466 pages [0KB], 2048KB chunk
```

```
root-shell# mdadm --detail /dev/md4
/dev/md4:
    Version : 01.00
  Creation Time : Sun Sep 12 23:10:05 2010
    Raid Level : raid1
    Array Size : 1953514448 (1863.02 GiB 2000.40 GB)
  Used Dev Size : 3907028896 (3726.03 GiB 4000.80 GB)
    Raid Devices : 2
    Total Devices : 1
Preferred Minor : 4
    Persistence : Superblock is persistent

    Intent Bitmap : Internal

    Update Time : Sun Sep 12 23:10:05 2010
      State : active, degraded
    Active Devices : 1
    Working Devices : 1
    Failed Devices : 0
    Spare Devices : 0


    Name : darkstar-5:database0 (local to host darkstar-5)
    UUID : 7a801ff2:bd55f4c9:83164cba:aa29323b
    Events : 0

   Number   Major   Minor   RaidDevice State
    -----
     0        8       32         0    active sync  /dev/sdc
     1        0        0         1    removed
```

```
root-shell# mdadm --detail --scan
ARRAY /dev/md2 level=raid1 num-devices=2 metadata=01.00 name=darkstar-5:cryptroot
  UUID=a7cc74e7:0a5b34fe:0e2ce5f0:05237600
ARRAY /dev/md3 level=raid1 num-devices=2 metadata=01.00 name=darkstar-5:archive1
  UUID=09c2f411:76ed3beb:8e526ddc:e370eb70
ARRAY /dev/md4 level=raid1 num-devices=2 metadata=01.00 name=darkstar-5:database0
  UUID=7a801ff2:bd55f4c9:83164cba:aa29323b
```

```
root-shell# mdadm --detail --scan >> /etc/mdadm/mdadm.conf
```

WARNING: There is a bug in `mdadm`. You must edit `mdadm.conf` and replace “meta-data=01.00” with “metadata=1.0”, like so:

```
root-shell# mdadm --detail --scan
ARRAY /dev/md2 level=raid1 num-devices=2 metadata=1.0 name=darkstar-5:cryptroot
  UUID=a7cc74e7:0a5b34fe:0e2ce5f0:05237600
ARRAY /dev/md3 level=raid1 num-devices=2 metadata=1.0 name=darkstar-5:archive1
  UUID=09c2f411:76ed3beb:8e526ddc:e370eb70
ARRAY /dev/md4 level=raid1 num-devices=2 metadata=1.0 name=darkstar-5:database0
  UUID=7a801ff2:bd55f4c9:83164cba:aa29323b
```

Test `/etc/mdadm/mdadm.conf`:

```
root-shell# mdadm --stop /dev/md4
mdadm: stopped /dev/md4
root-shell# mdadm --assemble --scan
mdadm: no devices found for /dev/md0
mdadm: no devices found for /dev/md1
mdadm: /dev/md4 has been started with 1 drive (out of 2).
```

E.2.5 (Optionally) Add Second Disk To Raid Array

We created `/dev/md4` with only one disk. One can later add a second.

```
root-shell# mdadm /dev/md4 --add /dev/sdd
root-shell# cat /proc/mdstat
md4 : active raid1 sdd[2] sdc[0]
      1953514448 blocks super 1.0 [2/1] [U_]
      [>.....] recovery = 3.2% (48038208/1465039472)
      finish=245.5min speed=96166K/sec
      bitmap: 3/466 pages [1864KB], 2048KB chunk
```

Resync should take about 40 hours for a 2T array.

E.2.6 LUKS

Encryption is unnecessary for wikipedia. However, the MySQL storage engine InnoDB stores all tables in a single “table space”. This means that other database backed services (e.g. [drupal](#), [sendmail](#), etc.) will be stored on the same disk. This would be a security hole.

Install packages:

```
root-shell# aptitude install cryptsetup
```

Policy. Encrypt all storage.

Create LUKS partition:

```
root-shell# cryptsetup --cipher aes-xts-plain --key-size 512 luksFormat /dev/md4
WARNING!
=====
This will overwrite data on /dev/md4 irrevocably.

Are you sure? (Type uppercase yes): YES
Enter LUKS passphrase: pass-phrase
Verify passphrase: pass-phrase
Command successful.
```

Where *pass-phrase* should be replaced with a secret pass-phrase of your own.
Open the LUKS partition with the pass phrase entered above:

```
root-shell# cryptsetup luksOpen /dev/md4 xts_database0
Enter LUKS passphrase:
key slot 0 unlocked.
Command successful.
```

```
root-shell# ls /dev/mapper
control    vg0-home  vg0-swap  vg0-usr   vg4-archive1  xts_database0
cryptroot  vg0-root  vg0-tmp   vg0-var   xts_archive1
```

Add a second key to the LUKS partition (optionally):

```
root-shell# cryptsetup luksAddKey /dev/md4 /etc/cryptpass
Enter any LUKS passphrase:
key slot 0 unlocked.
Command successful.
```

Examine the LUKS partition header:

```
root-shell# cryptsetup luksDump /dev/md4
LUKS header information for /dev/md4

Version:          1
Cipher name:      aes
Cipher mode:      xts-plain
Hash spec:        sha1
Payload offset:   4040
MK bits:          512
MK digest:        e5 29 4e 23 e3 93 d8 7f 07 0d a6 85 cb 07 a9 2f 81 1b 60 eb
MK salt:          b0 85 90 3f f7 25 75 ce 03 f5 9e c6 ad c0 f5 ae
                  f2 66 9f 98 68 97 fc 11 fc f5 b7 cd 92 a6 d6 a2
MK iterations:    10
UUID:             3348fa04-4abf-42e8-906b-1bc9dba9b580

Key Slot 0: ENABLED
  Iterations:      359864
  Salt:            b9 84 59 4c ed 89 14 fb 38 63 fc 9d b5 a9 96 a0
                  a0 06 73 ce 59 22 cb dc bf 12 05 9c 83 37 03 cd
  Key material offset: 8
  AF stripes:      4000
Key Slot 1: ENABLED
  Iterations:      364323
  Salt:            93 6c e0 9b 99 52 48 0f e9 bf 3f ca a9 e5 11 40
                  93 7c b1 bc 2f 01 40 cb 71 2a 68 b1 af 75 19 dc
  Key material offset: 512
  AF stripes:      4000
Key Slot 2: DISABLED
Key Slot 3: DISABLED
Key Slot 4: DISABLED
Key Slot 5: DISABLED
Key Slot 6: DISABLED
Key Slot 7: DISABLED
```

To unlock this partition during boot, there are two options: interactive and automatic:

a) For interactive, give “none” as the key-file:

Edit `/etc/crypttab` (for `/etc/init.d/cryptdisks-early`):

```
root-shell# cat /etc/crypttab
#<target dev> <source dev> <key file> <options>
xts_database0 /dev/md4      none      luks,tries=3
```

b) For automatic, supply a key file:

```
root-shell# emacs /etc/keys/luks_key_md4
My S3cr3t P@ssphr@s3
```

Deny non-root access by setting file permissions:

```
root-shell# chmod 600 /etc/keys/luks_key_md4
```

Edit `/etc/crypttab` (for `cryptdisks-early`):

```
#<target dev> <source dev> <key file>      <options>
xts_database0 /dev/md4      /etc/keys/luks_key_md4 luks,tries=3
```

Reboot to test. Yes!

E.2.7 LVM2

Install packages:

```
root-shell# aptitude install lvm2
```

Create physical volume:

```
root-shell# pvcreate /dev/mapper/xts_database0
Physical volume "/dev/mapper/xts_database0" successfully created
```

Create volume group:

```
root-shell# vgcreate vg5 /dev/mapper/xts_database0
Volume group "vg5" successfully created
```

```

root-shell# vgdisplay vg5
--- Volume group ---
VG Name                vg5
System ID
Format                 lvm2
Metadata Areas         1
Metadata Sequence No   1
VG Access               read/write
VG Status               resizable
MAX LV                 0
Cur LV                 0
Open LV                 0
Max PV                  0
Cur PV                 1
Act PV                  1
VG Size                 1.82 TB
PE Size                 4.00 MB
Total PE                476931
Alloc PE / Size         0 / 0
Free PE / Size           476931 / 1.82 TB
VG UUID                 XiXr0n-BsIq-SugA-ohBy-k0o1-tXU1-t5wCqd

```

Create logical volumes:

```

root-shell# lvcreate --extents 75000 --name ibdata0 vg5
Logical volume "ibdata0" created
root-shell# lvcreate --extents 401931 --name images0 vg5
Logical volume "images0" created

```

```

root-shell# ls /dev/mapper/
control    vg3-home  vg3-swap  vg3-usr   vg5-ibdata0  xts_database0
cryptroot  vg3-root  vg3-tmp   vg3-var   vg5-images0

```

```

root-shell# vgdisplay vg5
--- Volume group ---
VG Name                vg5
System ID
Format                 lvm2
Metadata Areas         1
Metadata Sequence No   9
VG Access               read/write
VG Status               resizable
MAX LV                 0
Cur LV                 2
Open LV                 0
Max PV                  0
Cur PV                 1
Act PV                  1
VG Size                 1.82 TB
PE Size                 4.00 MB
Total PE                476931
Alloc PE / Size         476931 / 1.82 TB
Free PE / Size           0 / 0
VG UUID                 XiXr0n-BsIq-SugA-ohBy-k0o1-tXU1-t5wCqd

```



```
root-shell# lvm display vg5
```

```
--- Logical volume ---
```

```
LV Name           /dev/vg5/ibdata0
VG Name           vg5
LV UUID           jQSCdj-xImA-wZIG-bY0P-M4Ck-v0Ep-SXppHW
LV Write Access    read/write
LV Status          available
# open            0
LV Size           292.97 GB
Current LE         75000
Segments          1
Allocation         inherit
Read ahead sectors auto
- currently set to 256
Block device       253:10
```

```
--- Logical volume ---
```

```
LV Name           /dev/vg5/images0
VG Name           vg5
LV UUID           f38Moc-NSEd-oBkN-AIxe-qd0X-l9VY-h88sMT
LV Write Access    read/write
LV Status          available
# open            0
LV Size           1.53 TB
Current LE         401931
Segments          1
Allocation         inherit
Read ahead sectors auto
- currently set to 256
Block device       253:11
```

E.2.8 ReiserFS

Install packages:

```
root-shell# aptitude install reiserfsprogs
```

Create the file system:

```

root-shell# mkfs.reiserfs /dev/vg5/images0
mkfs.reiserfs 3.6.19 (2003 www.namesys.com)
...
Guessing about desired format.. Kernel 2.6.26-2-amd64 is running.
Format 3.6 with standard journal
Count of blocks on the device: 411577344
Number of blocks consumed by mkreiserfs formatting process: 20772
Blocksize: 4096
Hash function used to sort names: "r5"
Journal Size 8193 blocks (first block 18)
Journal Max transaction length 1024
inode generation number: 0
UUID: 3c9eb1d3-4b82-4580-86f2-a4516b240f54
ATTENTION: YOU SHOULD REBOOT AFTER FDISK!
        ALL DATA WILL BE LOST ON '/dev/vg5/images0'!
Continue (y/n):
Initializing journal - 0%....20%....40%....60%....80%....100%
Syncing..ok
...
ReiserFS is successfully created on /dev/vg5/images0.

```

```

root-shell# mkdir /database0
root-shell# mkdir /database0/images0

```

Add one line to `/etc/fstab`:

```
/dev/vg5/images0 /database0/images reiserfs defaults 0 2
```

and mount the file system:

```

root-shell# mount /database0/images
root-shell# chown www-data:www-data /database0/images
root-shell# ls -l /database0/ | grep images0
drwxr-xr-x 4 www-data www-data 80 2010-09-13 05:21 images0

```

E.3 Configuring MySQL

Install packages:

```
root-shell# aptitude install hdparm mysql-server mysql-client mysqltuner
```

HDD. Turn off write-caching for the disk that holds the InnoDB table space (or raw partitions). This is to make transactions durable (the 'D' in ACID). To make this happen during system boot, edit `/etc/hdparm.conf` to read:

```

root-shell# cat /etc/hdparm.conf
/dev/sdc {
    write_cache = off
}

```

and reboot. Actually, although `hdparm.conf` ran during boot but I still found the HDD with write caching on. So I edited `/etc/rc.local` to read:

```

root-shell# cat /etc/rc.local
hdparm -W0 /dev/sdc

```

then rebooted. This got the job done.

Password. Set passwords (initially users `root` and `test` have no password):

```
shell$ mysql -u root mysql
mysql> SET PASSWORD = PASSWORD('root_password');
mysql> SET PASSWORD FOR 'test'@'localhost' = PASSWORD('test_password');
mysql> FLUSH PRIVILEGES;
mysql> QUIT;
```

Time Zone. Load time zone information (so we can set default to UTC).

```
shell$ mysql_tzinfo_to_sql /usr/share/zoneinfo | mysql -u root -p mysql
```

Edit `/etc/mysql/conf.d/custom.cnf` (to override default values found in `/etc/mysql/my.cnf`). This we shall refer to this as our baseline configuration.

```
shell$ cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone      = UTC
character-set-server   = utf8
collation-server       = utf8_general_ci
default-storage-engine = innodb
# Enable InnoDB Plugin instead of the Built-in InnoDB (features)
ignore-builtin-innodb
plugin-load=innodb=ha_innodb_plugin.so;innodb_trx=ha_innodb_plugin.so;
innodb_locks=ha_innodb_plugin.so;innodb_lock_waits=ha_innodb_plugin.so;
innodb_cmp=ha_innodb_plugin.so;innodb_cmp_reset=ha_innodb_plugin.so;
innodb_cmpmem=ha_innodb_plugin.so;innodb_cmpmem_reset=ha_innodb_plugin.so
plugin_dir=/usr/lib/mysql/plugin
[mysql]
default-character-set   = utf8
default-collation      = utf8_general_ci
```

Note: The value of `plugin-load` must be typed all on one line with no spaces.

Run benchmarks:

```
root-shell# cd /usr/share/mysql/sql-bench
root-shell# perl run-all-tests --user=test --password=test_password --log
root-shell# cd output
```

Drop test user and database for security:

```
shell$ mysql -u root -p mysql
mysql> DROP USER 'test'@'localhost';
mysql> DROP DATABASE test;
mysql> QUIT;
```

E.4 Configuring hugepages

Distribution: Debian lenny

We allocated 2GB hugepages to MySQL.

Reason: We have 6GB DRAM

- need 2GB for `convert` (which makes thumbs from images),
- need 2GB for `Xorg`, `KDE 3.5`, and all else,

- leaving 2GB to be dedicated to `MySQL`.

Note: `PHP` seems to have a memory leak, gradually eating up memory. It is best to allow 1GB for this, and to kill jobs (e.g. `rebuildImages.php`, `importDump.php`) with `Ctrl-C` every 50,000 records.

MAJOR UPGRADE.

Distribution: Debian squeeze

We allocate 3GB hugepages to `MySQL`.

Reason: We have 6GB DRAM

- we now use `gm convert` which uses much less scratch space,
- need 3GB for `Xorg`, KDE 4.4.5 (`plasma-desktop`), and all else,
- leaving 3GB to be dedicated to `MySQL`.

Note: `convert` (ImageMagick) (default) uses too much scratch space (>2 GB).

References:

<http://www.python.com/news/1326/performance-tuning-hugepages-in-linux/>

<http://wiki.debian.org/Hugepages>

<http://www.ibm.com/developerworks/linux/library/l-mem26/>

<http://dev.mysql.com/doc/refman/5.1/en/large-page-support.html>

<http://developer.postgresql.org/pgdocs/postgres/kernel-resources.html>

`InnoDB` has its own memory manager. `InnoDB` pages are 16KB (rather than Intel's 4KB), and `InnoDB` has its own algorithm for moving pages to and from disk. The Linux swap algorithm would interfere (e.g by moving a 4KB page to the swap partition, when `InnoDB` needs its 16KB page to stay together in DRAM).

Intel (like most CPU manufacturers) offers `hugepages` (aka `superpages`, `largepages`) of size 2MB or 4MB. `Hugepages` stay in DRAM and are not touched by the Linux swap algorithm. There is a system control parameter for reserving `hugepages`, and `InnoDB` will use `hugepages` if they have been so reserved.

If you notice your system periodically slowing to a crawl, you should run diagnostics with the System Activity Report:

```
root-shell# aptitude install atsar
```

`Atsar` runs every 10 minutes as a `cron` job as `/etc/cron.d/atsar`, and each day's reports are stored in `/var/log/atsar/atsaXX` (where XX is the day of the month).

```
shell$ atsar -p      <-- paging
shell$ atsar -r      <-- memory
shell$ atsar -P      <-- process load
shell$ atsar -u      <-- CPU utilization
shell$ atsar -D      <-- Disk activity
```

In my case there were sudden fits of page swapping, and the page tables occupied a lot of RAM.

```
shell$ cat /proc/meminfo | grep PageTables
PageTables:      28496 kB
```

`Hugepages` reduce number of Translation Lookaside Buffer (TLB) misses. `Hugepages` are 2MB instead of 4KB, and they are locked in RAM and cannot be swapped out. Best yet, `MySQL` `InnoDB` can and will use them if available.

Check if Linux (> 2.6.23) supports it:

```
shell$ cat /proc/meminfo | grep Huge
HugePages_Total:      0
HugePages_Free:       0
HugePages_Rsvd:       0
HugePages_Surp:       0
Hugepagesize:        2048 kB
```

Create a group for users of `hugepages`:

```
root-shell# groupadd hugepage
root-shell# getent group hugepage
hugepage:x:1001:
root-shell# adduser mysql hugepage
Adding user 'mysql' to group 'hugepage' ...
Adding user mysql to group hugepage
Done.
root-shell# getent group hugepage
hugepage:x:1001:mysql
```

To specify number of `hugepages` to be reserved, edit `/etc/sysctl.conf`, append lines:

```
# Hugepages can reduce Translation Lookaside Buffer (TLB) misses.
#
# Let us allocate 3GB of hugepages to mysql.
#
# Allocate 2MiB hugepages. (default: 0)
# 512 2MB hugepages = 1024MB = 1GB
# 1024 2MB hugepages = 2048MB = 2GB
# 1536 2MB hugepages = 3072MB = 3GB
# 2048 2MB hugepages = 4096MB = 4GB
vm.nr_hugepages = 1536
# Add the gid of the group hugepage(1001) to give access to its users
vm.hugetlb_shm_group = 1001
# Maximum shared memory segment size (default: 33554432 bytes = 32MB)
# 1073741824 bytes = 1024MB = 1GB
# 2147483648 bytes = 2048MB = 2GB
# 3221225472 bytes = 3072MB = 3GB
# 4294967296 bytes = 4096MB = 4GB
kernel.shmmax = 3221225472
# Total amount of shared memory (default: 2097152 4KB pages = 8GB)
# 262144 4KB pages = 1024MB = 1GB
# 524288 4KB pages = 2048MB = 2GB
# 786432 4KB pages = 3072MB = 3GB
# 1048576 4KB pages = 4096MB = 4GB
kernel.shmall = 786432
```

Create a mount point for file system:

```
root-shell# mkdir /hugepages
```

Edit `/etc/fstab` (mode 1770 allows every user in group to create files but not unlink or rename each other's files):

```
hugetlbfs /hugepages hugetlbfs mode=1770,gid=1001 0 0
```

Reboot. a) It is an easy way to allocate `hugepages` before memory gets fragmented. b) Instead of rebooting, I tried:

```
root-shell# sysctl -p
```

and got no hugepages allocated. c) So I exited several large processes, tried again, and got only 8 hugepages. d) So I exit the KDM session, did console login as root, ran:

```
root-shell# sysctl -p
```

and got all of them.

```
root-shell# cat /proc/meminfo | grep Huge
HugePages_Total: 1536
HugePages_Free: 1536
HugePages_Rsvd: 0
HugePages_Surp: 0
Hugepagesize: 2048 kB
```

Allow users in the `hugepage` group to lock up to 3GB. Edit `/etc/security/limits.conf`, append the line:

```
#<domain>    <type>  <item>      <value>
@hugepage    hard    memlock     1024000
@hugepage    soft    memlock     1024000
mysql        -       memlock     1024000
```

To enable `hugepage` support in MySQL, edit `/etc/mysql/conf.d/custom.cnf` by appending:

```
[mysqld]
# Enable large page support. InnoDB will use it automatically for its
# buffer_pool and its additional_memory_pool.
large-pages
```

```
root-shell# /etc/init.d/mysql restart
Stopping MySQL database server: mysqld.
Starting MySQL database server: mysqld.
Checking for corrupt, not cleanly closed and upgrade needing tables..
```

```
shell$ mysql -u root -p
mysql> SHOW VARIABLES LIKE 'large_page%';
+-----+-----+
| Variable_name | Value |
+-----+-----+
| large_page_size | 2097152 |
| large_pages    | ON    |
+-----+-----+
2 rows in set (0.00 sec)
```

Debug: If you get the following message in `/var/log/syslog`:

```
# cat /var/log/syslog | grep InnoDB
Sep 14 23:30:45 darkstar-5 mysqld[4427]: InnoDB: HugeTLB: Warning: Failed to
allocate 33570816 bytes. errno 12
Sep 14 23:30:45 darkstar-5 mysqld[4427]: InnoDB HugeTLB: Warning: Using
conventional memory pool
```

this means that either a) the `hugepage` space is too small for the `MySQL` RAM footprint, in which case, reduce the `innodb_buffer_pool_size` a bit (from 3000M down to 2998M):

```
shell$ cat /etc/mysql/conf.d/custom.cnf | grep pool
innodb_buffer_pool_size          =2998M # default 8M.
innodb_additional_mem_pool_size = 8M # default 8M (plugin), 1M (built-in).
```

```
shell$ mysql -u root -p
mysql> SHOW VARIABLES LIKE '%pool%';
+-----+-----+
| Variable_name | Value |
+-----+-----+
| innodb_additional_mem_pool_size | 8388608 |
| innodb_buffer_pool_size | 3143630848 |
+-----+-----+
2 rows in set (0.00 sec)
```

or b) your settings in `/etc/security/limits.conf` are being ignored. To be sure that the `memlock` limits are being read, go to `/etc/pam.d/` and make sure that:

```
session required pam_limits.so
```

for `PAM` is being used. That is, ensure that the above line is included in the following files and is not commented out:

```
/etc/pam.d/su
/etc/pam.d/login
/etc/pam.d/other
/etc/pam.d/sshd
```

This did NOT work for me. So I added the following code to `/usr/bin/mysqld_safe` right below the other calls to `ulimit`.

```
# <edit>
# Here I am trying to use "large-pages" (linux "hugepage")
ulimit -l unlimited
# </edit>
```

This did the trick.

E.5 Configuring `MediaWiki`

Install packages:

```
root-shell# aptitude install mediawiki mediawiki-extensions mediawiki-math tidy
root-shell# aptitude install php5-suhosin <-- if not already installed with php5
root-shell# aptitude install graphicsmagick librsvg2-bin librsvg-common
root-shell# aptitude install graphicsmagick-imagemagick-compat <-- maybe not wise
```

Note: `php5-suhosin` (PHP-hardening project) is recommended because `MediaWiki` uses `PHP` code, and some of it has security risks. Every time I run `importDump.php`, I see the following alert in my logs.

```
Feb 15 12:04:24 darkstar-5 suhosin[20029]: ALERT - script tried to disable
memory_limit by setting it to a negative value -1 bytes which is not allowed
(attacker 'REMOTE_ADDR not set', file 'unknown')
```

`MediaWiki` tries to disable memory limits requested by the user.

Now let us setup up `MediaWiki`.

Edit `/etc/mediawiki/apache.conf` to set an useful alias by uncommenting the following line, then restart the web server.

```
root-shell# cat /etc/mediawiki/apache.conf | grep Alias
Alias /mediawiki /var/lib/mediawiki
```

```
root-shell# /etc/init.d/apache2 restart
```

Open browser to <http://localhost/mediawiki/config/index.php>, and fill out the form.

Site config

```
Wiki name:           Wikipedia
Contact e-mail:      webmaster@localhost
Language:            en-English
Copyright/license:   * No license metadata
Admin username:      WikiSysop
Password:            *****
Password confirm:    *****
Object caching:      (*) No caching
Memcached servers:   <blank>
```

E-mail, e-mail notification and authentication setup

```
E-mail features:          (*) Disabled
User-to-user e-mail:      (*) Disabled
E-mail notification about changes: (*) Disabled
E-mail address authentication: (*) Disabled
```

Database config

```
Database type:           (*) MySQL
Database host:            localhost
Database name:            wikidb
DB username:              wikiuser
DB password:              *****
DB password confirm:      *****
Superuser account:        [x] Use superuser account
Superuser name:           root
Superuser password:       *****
```

MySQL specific options

```
Database table prefix:   <blank>
Storage Engine:          InnoDB
Database character set:   MySQL 4.1/5.0 binary
```

Press "Install `MediaWiki`!"

Move the settings, edit as follows, and apply file protections:


```

root-shell# cd /etc/mediawiki
root-shell# mv /var/lib/mediawiki/config/LocalSettings.php .
root-shell# emacs LocalSettings.php
$wgShowExceptionDetails = true;

$wgDBAdminuser      = "root";          <-- set this to run maintenance scripts
$wgDBAdminpassword  = "root_password"; such as rebuildImages

$wgDBTableOptions   = "ENGINE=InnoDB, DEFAULT CHARSET=binary";
$wgDBmysql5         = true;           <-- charset for MySQL 4.1/5.0

$wgEnableUploads    = true;           <-- set these to make image thumbs
$wgUseImageMagick    = false;         <-- over-commits VIRT and RES memory
$wgCustomConvertCommand = "/usr/bin/gm convert %s -resize %wx%h %d";
$wgSVGConverter      = 'rsvg';        <-- converts SVG to PNG

$wgUseTeX           = true;           <-- set this to use mediawiki-math
$wgUseTidy           = true;         <-- set this to clean up citations

root-shell# chown www-data:www-data LocalSettings.php
root-shell# chmod 600 LocalSettings.php
root-shell# rm LocalSettings.php~

```

Next, enable the `MediaWiki` extensions. If you forget this, then all the templates “...” will fail to render, and you will get quite a mess.

```

root-shell# cd /etc/mediawiki-extensions/extensions-enabled
root-shell# cp -a ../extensions-available/* .

```

Note, if you forget to use `tidy`, then the `HTML` will contain a paragraph tag “<p>” and a “<pre>” tag after every citation, and the resulting layout will detract from the reading experience.

Note, `graphicsmagick-imagemagick-compat` purges `imagemagick` and replaces `/usr/bin/convert` with a link to `gm`. Supposedly, this requires no changes to other code (e.g. the `MediaWiki` maintenance scripts). If it worked, it would be useful because some of the `MediaWiki` maintenance scripts call `convert` (to rasterize `SVG` into `PNG`). However, when I tried it, I found that `convert` either hung or caused a segmentation fault. So I reinstalled `imagemagick` and purged `graphicsmagick-imagemagick-compat`.

It is best to entirely avoid using `convert` (ImageMagick), because it often overcommits virtual and physical memory (run `top` and watch the VIRT and RES columns), which prevents other processes from running, which in turn causes the kernel to kill unresponsive processes at random and thereby hang the machine.

With our settings, `importDump.php` calls `gm convert` (GraphicsMagick) to make thumbnail images; and calls `rsvg` to convert Scaled Vector Graphics (`SVG`) image files into `PNG` image files (since `SVG` is not yet standardized, most browsers will not render it).

Finally, store the media files on a separate drive

```

root-shell# cd /var/lib/mediawiki
root-shell# mv images /database0/.          <-- this is my RAID array
root-shell# ln -s /database0/images images  <-- don't forget this
root-shell# cd /database0/images
root-shell# mkdir archive temp thumb tmp
root-shell# cd ..
root-shell# chown -R www-data:www-data images

```

Go to http://localhost/mediawiki/index.php/Main_Page. Done.

If you mess up the importation of Wikipedia dumps (next section), and want to start over. The easiest method is to drop the `wikidb` database, and reinstall mediawiki.

```
shell$ mysql -u root -p
mysql> SHOW DATABASES;
+-----+
| Database |
+-----+
| information_schema |
| mysql |
| wikidb |
+-----+
3 rows in set (0.09 sec)
mysql> DROP DATABASE wikidb;
Query OK, 35 rows affected (1.88 sec)
mysql> USE mysql;
mysql> SELECT user,host FROM user;
+-----+-----+
| user | host |
+-----+-----+
| wikiuser | % |
| root | 127.0.0.1 |
| root | darkstar-5 |
| debian-sys-maint | localhost |
| root | localhost |
| wikiuser | localhost |
| wikiuser | localhost.localdomain |
+-----+-----+
7 rows in set (0.00 sec)
mysql> DROP USER 'wikiuser'@'%';
mysql> DROP USER 'wikiuser'@'localhost';
mysql> DROP USER 'wikiuser'@'localhost.localdomain';
mysql> exit;
```

Update (2012-Nov): For `MediaWiki` 1.17 and later versions, maintenance scripts now respects a `--memory-limit` option

```
shell$ cat /usr/share/mediawiki/maintenance/Maintenance.php
...
/**
 * Normally we disable the memory_limit when running admin scripts.
 * Some scripts may wish to actually set a limit, however, to avoid
 * blowing up unexpectedly. We also support a --memory-limit option,
 * to allow sysadmins to explicitly set one if they'd prefer to override
 * defaults (or for people using Suhosin which yells at you for trying
 * to disable the limits)
 * @return string
 */
...
```

Source: http://www.mediawiki.org/wiki/Manual:Maintenance_scripts.

E.6 Experiments with `MWdumper.jar`—Round 1

Install packages:

```
root-shell# aptitude purge mediawiki mediawiki-extensions mediawiki-math
```

Go to <http://download.wikimedia.org/enwiki/latest/> and look-up the names of the `dump` files, and download them:

```
shell$ mkdir wikipedia
shell$ cd wikipedia
shell$ wget http://download.wikimedia.org/enwiki/latest/enwiki-latest-md5sums.txt
shell$ wget http://download.wikimedia.org/enwiki/latest/enwiki-latest-pages-articles.xml.bz2
shell$ wget http://download.wikimedia.org/enwiki/latest/enwiki-latest-pagelinks.sql.gz
shell$ gunzip enwiki-latest-pagelinks.sql.gz
```

Estimate the number of `page`, `revision`, `text`, and `pagelink` records:

```
shell$ cat enwiki-latest-pages-articles.xml | grep "<page>" | wc -l
10355225
shell$ cat enwiki-latest-pagelinks.sql | tr -cd "(" | wc -c
522713440
```

Importation of 10M pages and 500M links will be the main challenge. There are two distinct methods:

- `MWdumper.jar` - only used for importing initial set of pages, and
- `importDump.php` - best used for importing latest revisions.

`MWdumper.jar` must start with a clean database. If you first tried `importDump.php` but aborted after seeing that it is too slow, then some tables in `wikidb` contain records that must first be removed. Go back and drop `wikidb` and reinstall `MediaWiki`.

Import with `MWdumper.jar`. This requires a clean `wikidb`. Note that it only imports pages, and that links must be imported separately.

```
shell$ wget http://download.wikimedia.org/tools/mwdumper.jar
shell$ wget http://download.wikimedia.org/tools/README.txt
```

For a dry run:

```
shell$ java -jar mwdumper.jar --format=sql:1.5 enwiki-latest-pages-articles.xml.bz2
```

This failed (circa page 309,000 in a lengthy article about Croatia) due to page data that results in a malformed SQL query.

For import, load pages with:

```
shell$ java -jar mwdumper.jar --format=sql:1.5 enwiki-latest-pages-articles.xml.bz2 \
| mysql -u wikiuser -p wikidb
```

After running `MWdumper.jar`, expect to see records only in the following database tables: `interwiki`, `objectcache`, `page`, `revision`, `site_stats`, `text`, `user`, and `user_groups`.

If `MWdumper.jar` supplies a bad SQL query, MySQL gives an error message:

```
ERROR 1064 (42000) at line 6115: You have an error in your SQL syntax;
check the manual that corresponds to your MySQL server version for the
right syntax to use near ''==Earliest history==\nThe details of the
arrival of the [[Croats]] are scarcely' at line 1
make: *** [mwdumper] Error 1
```

In this case, truncate the relevant tables:

```
shell$ mysql -u wikiuser -p wikidb
mysql> TRUNCATE TABLE page;
mysql> TRUNCATE TABLE revision;
mysql> TRUNCATE TABLE text;
mysql> exit;
```

Then try again using the force flag `-f`:

```
shell$ java -jar mwdumper.jar --format=sql:1.5 enwiki-latest-pages-articles.xml.bz2 \
| mysql -f -u wikiuser -p wikidb
```

This also failed (circa page 309,000).

Summary of results:

- Failed every time (due to unparsable page).
- Must find and remove bad page from `dump` file.
- Must start over with empty database tables.
- Fast, but does not populate the `pagelinks` table.
- Must run `rebuildall.php` which takes days or weeks.
- Failed every time (due to memory leak that hangs PC)

Recommendation: Do not use.

References:

- 1) http://www.mediawiki.org/wiki/Manual:Importing_XML_dumps
- 2) <http://www.mediawiki.org/wiki/Mwdumper>

E.7 Experiments with `InnoDB`

Purpose: Determine the optimal configuration of hardware, `MySQL`, and `InnoDB`.

E.7.1 Experimental Method

Overall method: Measure the time required to load 500m `pagelinks` v. a variety of configurations.

Load `pagelinks` with:

```
shell$ gunzip enwiki-latest-pagelinks.sql.gz
shell$ mysql -u wikiuser -p wikidb < enwiki-latest-pagelinks.sql
```

Take measurements with:

```
mysql> SELECT CURRENT_TIMESTAMP(),COUNT(*),MAX(pl_from),
-> COUNT(*)/MAX(pl_from) AS links_per_page FROM wikidb.pagelinks;
+-----+-----+-----+-----+
| current_timestamp() | count(*) | max(pl_from) | links_per_page |
+-----+-----+-----+-----+
| 2010-09-17 19:56:03 | 51373348 | 1228877 | 41.8051 |
+-----+-----+-----+-----+
1 row in set (8 min 31.87 sec)
```

and

```
shell$ atsar -D
08:40:01 partition busy read/s Kbyt/r write/s Kbyt/w avque avserv _part_
23:50:01 sdc (8-32) 90% 65.10 24.6 225.72 22.6 3.42 3.09 ms
03:30:02 sdc (8-32) 80% 45.58 24.5 154.86 21.5 4.10 3.97 ms
21:00:02 sdc (8-32) 91% 65.08 23.0 227.03 20.1 3.34 3.12 ms
```

Experimental method:

1. Setup:

- Edit `/etc/mysql/conf.d/custom.cnf` (if using `hugepages`)

```
root-shell# sysctl -p          <-- to reserve hugepages
root-shell# reboot            <-- if memory already fragmented
```
- Edit `/etc/sysctl.conf` (as described below)

```
root-shell# /etc/init.d/mysql restart
root-shell# aptitude install mediawiki mediawiki-extensions
```
- Setup `mediawiki` (as described above)

2. Run:

- In one terminal run the test:

```
shell$ mysql -u root -p wikidb < enwiki-latest-pagelinks.sql
```
- In another terminal collect data:

```
shell$ mysql -u wikiuser -p wikidb
mysql> SELECT CURRENT_TIMESTAMP(),COUNT(*),MAX(pl_from),
-> COUNT(*)/MAX(pl_from) AS links_per_page FROM wikidb.pagelinks;
```

3. Tear-down:

- Purge database:

```
mysql> TRUNCATE TABLE wikidb.pagelinks;
mysql> DROP DATABASE wikidb;          <-- if ibdata1 is to be relocated

root-shell# /etc/init.d/mysql stop
root-shell# rm /var/lib/mysql/ibdata1  <-- ibdata1 may be on another disk
root-shell# rm /var/lib/mysql/ib_logfile*
```
- Purge packages:

```
root-shell# aptitude purge mediawiki mediawiki-extensions
```

E.7.2 EXPERIMENT.0 Baseline configuration

Code: D1F+L5P8H- (D=disks, F=filesystems, L=log[MB], P=pool[MB], H=hugepages)

- **D1** `/var/lib/mysql/ibdata1` and `/var/lib/mysql/ib_logfile*` are on the same disk,
- **F+** `/var/lib/mysql/ibdata1` is a file on a file system,
- **L5** `/var/lib/mysql/ib_logfile*` are 5M each,
- **P8** InnoDB buffer pool is 8M, and
- **H-** `hugepages` are not used.

Configuration files:

```
root-shell# cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone      = UTC
default-storage-engine = innodb
default-character-set   = utf8
default-collation       = utf8_general_ci
[mysql]
default-character-set   = utf8
```

Measurements:

```
Time  1  1  hours, insert  5.0M  5.0M links, 1390 1390 links/sec
Time  2  1  hours, insert  7.4M  2.4M links, 1030  670 links/sec
Time 12 10  hours, insert 22.4M 14.0M links,  510  390 links/sec
kill.
```

E.7.3 EXPERIMENT.1 Put `ibdata1` on separate disk (but still on a file system)

Code: D2F+L5P8H-

- **D2** `/var/lib/mysql/ibdata1` and `/var/lib/mysql/ib_logfile*` are on separate disks

Configuration files:

```
shell$ cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone      = UTC
default-storage-engine = innodb
default-character-set   = utf8
default-collation       = utf8_general_ci
innodb_data_home_dir    =
innodb_data_file_path   = /database0/images0/ibdata1:10M:autoextend
[mysql]
default-character-set   = utf8
```

Measurements:

```
Time  1  1  hours, insert  6.9M  6.9M links, 1920 1920 links/sec
Time  2  1  hours, insert 11.0M  4.1M links, 1530 1140 links/sec
Time 12 10  hours, insert 24.0M 13.0M links,  560  360 links/sec
kill.
```

E.7.4 EXPERIMENT.2 Store `ibdata1` on raw `LVM2` partition (not a file system)

```
root-shell# chown mysql /dev/mapper/vg5-ibdata0
```

Code: D2F-L5P8H-

- **F-** `/var/lib/mysql/ibdata1` does not use a file system (it is written directly on a raw partition)

Configuration files:

```
shell$ cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone      = UTC
default-storage-engine = innodb
default-character-set   = utf8
default-collation       = utf8_general_ci
innodb_data_home_dir    =
innodb_data_file_path   = /dev/mapper/vg5-ibdata0:100000Mnewraw # <-- note
#innodb_data_file_path  = /dev/mapper/vg5-ibdata0:100000Mrw
[mysql]
default-character-set   = utf8
```

Create the `table space` on the raw partition. Here we set file size to 100GB, which takes about 20 minutes to physically write.

```
root-shell# /etc/init.d/mysql start
```

Progress is logged to `/var/log/syslog`.

```
root-shell# cat /var/log/syslog | grep InnoDB | tail
Sep 28 11:56:54 darkstar-5 mysqld[649]: 100928 11:56:54 InnoDB: Setting file
/dev/mapper/vg5-ibdata0 size to 102400 MB
Sep 28 11:56:54 darkstar-5 mysqld[649]: InnoDB: Database physically writes the
file full: wait...
Sep 28 12:00:24 darkstar-5 mysqld[649]: InnoDB: Progress in MB: 100 200 300
```

Stop `mysqld`, edit `custom.cnf`, and start again

```
root-shell# /etc/init.d/mysql stop
root-shell# cat /etc/mysql/conf.d/custom.cnf | grep raw
#innodb_data_file_path = /dev/mapper/vg5-ibdata0:100000Mnewraw
innodb_data_file_path = /dev/mapper/vg5-ibdata0:100000Mraw      # <-- note
root-shell# /etc/init.d/mysql start
```

Measurements:

```
Time  1  1  hours, insert 7.4M  7.4M links,  2060  2060 links/sec
Time  2  1  hours, insert 12.2M  4.8M links,  1690  1330 links/sec
Time 12 10  hours, insert 24.1M 11.9M links,   560   330 links/sec
kill.
```

E.7.5 EXPERIMENT.3 Increase size of `buffer pool`

Code: D2F-L5P100H-

Configuration files:

```
shell$ cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone           = UTC
default-storage-engine      = innodb
default-character-set       = utf8
default-collation           = utf8_general_ci
innodb_data_home_dir        =
#innodb_data_file_path      = /dev/mapper/vg5-ibdata0:100000Mnewraw
innodb_data_file_path       = /dev/mapper/vg5-ibdata0:100000Mraw
innodb_buffer_pool_size     = 100M # default  8M.
innodb_additional_mem_pool_size = 2M # default  1M.
[mysql]
default-character-set       = utf8
```

Measurements:

```
Time  1  1  hours, insert 10.1M 10.1M links,  2800  2800 links/sec
Time  2  1  hours, insert 16.6M  6.5M links,  2300  1800 links/sec
Time 12 10  hours, insert 49.6M 33.0M links,  1150   920 links/sec
kill.
```

E.7.6 EXPERIMENT.4 Increase size of log file and log buffer

Code: D2F-L250P100H-

Configuration files:

```

shell$ cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone           = UTC
default-storage-engine      = innodb
default-character-set       = utf8
default-collation           = utf8_general_ci
innodb_data_home_dir        =
innodb_data_file_path       = /dev/mapper/vg5-ibdata0:100000Mraw
innodb_buffer_pool_size     = 100M # default  8M.
innodb_additional_mem_pool_size = 2M # default  1M.
innodb_log_file_size        = 250M # default  5M.
innodb_log_buffer_size      = 8M # default  1M.
[mysql]
default-character-set       = utf8

```

Measurements:

```

Time  1  1  hours, insert 13.2M 13.2M links, 3670 3670 links/sec
Time  2  1  hours, insert 19.4M 6.2M links, 2690 1720 links/sec
Time 12 10  hours, insert 53.4M 34.0M links, 1240 940 links/sec
kill.

```

E.7.7 EXPERIMENT.5 Increase size of `buffer pool`

Code: D2F-L250P1000H-

Configuration files:

```

shell$ cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone           = UTC
default-storage-engine      = innodb
default-character-set       = utf8
default-collation           = utf8_general_ci
innodb_data_home_dir        =
#innodb_data_file_path      = /dev/mapper/vg5-ibdata0:100000Mnewraw
innodb_data_file_path       = /dev/mapper/vg5-ibdata0:100000Mraw
innodb_buffer_pool_size     =1000M # default  8M.
innodb_additional_mem_pool_size = 2M # default  1M.
innodb_log_file_size        = 250M # default  5M.
innodb_log_buffer_size      = 8M # default  1M.
[mysql]
default-character-set       = utf8

```

Measurements:

```

Time  1  1  hours, insert 36.0M 36.0M links, 10000 10000 links/sec
Time  2  1  hours, insert 46.4M 10.4M links, 6440 2890 links/sec
Time 12 10  hours, insert 131.8M 85.4M links, 3050 2370 links/sec
kill.

```


E.7.8 EXPERIMENT.6 Enable `hugepages`

Code: D2F-L250P1000H+

Configuration files:

```

shell$ getent group hugepage
hugepage:x:1001:mysql
root-shell# mkdir /hugepages
root-shell# chown root:hugepage hugepages

root-shell# tail /etc/security/limits.conf
@hugepage      -      memlock 1024000
mysql          -      memlock 1024000
root-shell# tail /usr/bin/mysqld_safe
ulimit -l unlimited
shell$ cat /etc/fstab | grep hugepage
hugetlbfs      /hugepages      hugetlbfs      mode=1770,gid=1001 0 0
shell$ tail /etc/sysctl.conf
vm.nr_hugepages      =      512 # default:      0 2MiB      = 0MB.
vm.hugetlb_shm_group =      1001
kernel.shmmax        = 1073741824 # default: 33554432 bytes      = 32MB.
kernel.shmall        =      262144 # default: 2097152 4KB pages = 8GB.

```

```

shell$ cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone      = UTC
default-storage-engine = innodb
default-character-set   = utf8
default-collation       = utf8_general_ci
innodb_data_home_dir    =
#innodb_data_file_path  = /dev/mapper/vg5-ibdata0:100000Mnewraw
innodb_data_file_path   = /dev/mapper/vg5-ibdata0:100000Mraw
innodb_buffer_pool_size = 1000M # default 8M.
innodb_additional_mem_pool_size = 2M # default 1M.
innodb_log_file_size    = 250M # default 5M.
innodb_log_buffer_size  = 8M # default 1M.
large-pages
[mysql]
default-character-set   = utf8

```

Measurements:

```

shell$ cat /proc/memstat
...
PageTables:      24904 kB
...
HugePages_Total: 512
HugePages_Free:  11
HugePages_Rsvd:  2
HugePages_Surp:  0
Hugepagesize:    2048 kB

```

```

Time  1  1  hours, insert 36.3M 36.3M links, 10080 10080 links/sec
Time  2  1  hours, insert 48.0M 11.7M links, 6670 3250 links/sec
Time 12 10  hours, insert 124.3M 76.3M links, 2880 2120 links/sec
kill.

```

E.7.9 EXPERIMENT.6b Repeat. Run to completion.

Measurements:

```
Time 1.1 1.1 hours, insert 36.6M 36.6M links, 9240 9240 links/sec
Time 2 0.9 hours, insert 46.4M 9.8M links, 6440 3020 links/sec
Time 12 10 hours, insert 128.7M 82.3M links, 2980 2290 links/sec
Time 48 36 hours, insert 353.0M 224.3M links, 2040 1730 links/sec
Time 72 24 hours, insert 466.8M 113.8M links, 1800 1320 links/sec
Time 83 11 hours, insert 499.7M 32.9M links, 1670 830 links/sec
done.
```

Note: During hours 9 to 44, a cron job ran:

```
shell$ ps -ewf
... /usr/share/mdadm/checkarray --cron --all --quiet
```

E.7.10 EXPERIMENT.6c Repeat. Do not disable keys.

In `enwiki-latest-pagelinks.sql`, near the beginning and the end, respectively, one will find the two following commands. I suspect that the second takes 2-3 hours:

```
...
/*!40000 ALTER TABLE 'pagelinks' DISABLE KEYS */;
...
/*!40000 ALTER TABLE 'pagelinks' ENABLE KEYS */;
...
```

Code: D2F-L250P1000H+K+

Configuration files: (same as Experiment 6)

Data: `enwiki-latest-pagelinks.sql`, but remove line 38, which reads

```
/*!40000 ALTER TABLE 'pagelinks' DISABLE KEYS */;
```

Measurements:

```
Time 1 1 hours, insert 34.7M 34.7M links, 9640 9640 links/sec
Time 2 1 hours, insert 46.1M 11.4M links, 6400 3170 links/sec
Time 12 10 hours, insert 129.4M 83.3M links, 3000 2310 links/sec
Time 24 12 hours, insert 212.2M 82.8M links, 2460 1920 links/sec
Time 42 18 hours, insert 320.4M 108.2M links, 2120 1670 links/sec
Time 66 24 hours, insert 419.1M 98.7M links, 1760 1140 links/sec
Time 90 24 hours, insert 499.7M 80.6M links, 1540 930 links/sec
done.
```

Conclusion:

Apparently disabling keys has little or no effect on `InnoDB`. Presumably this matters more for `MyISAM`.

E.7.11 EXPERIMENT.7 Increase `innodb.buffer_pool_size` with filesystem, `hugepage`

Code: D2F+L250P49H+

Configuration files:

```

shell$ cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone           = UTC
default-storage-engine      = innodb
default-character-set       = utf8
default-collation           = utf8_general_ci
innodb_data_home_dir        =
innodb_data_file_path       = /database0/mysql/ibdata1:1024M:autoextend
innodb_buffer_pool_size    = 49M # default 8M.
innodb_additional_mem_pool_size = 2M # default 1M.
innodb_log_file_size       = 250M # default 5M.
innodb_log_buffer_size     = 8M # default 1M.
large-pages
[mysql]
default-character-set       = utf8

```

Measurements:

```

Time 4.5 4.5 hours, insert 30M 30M links, 1850 1850 links/sec
Time 15.5 11 hours, insert 62M 32M links, 1110 810 links/sec
Time 23.5 8 hours, insert 76M 14M links, 900 490 links/sec
Time 39.5 16 hours, insert 100M 24M links, 700 420 links/sec
Time 51.5 12 hours, insert 121M 21M links, 650 490 links/sec
Time 60.5 9 hours, insert 134M 13M links, 620 400 links/sec
kill.

```

E.7.12 EXPERIMENT.8 Increase `innodb.buffer.pool.size` again with filesystem, `hugepage`

Code: D2F+L250P999H+

Configuration files:

```

shell$ cat /etc/mysql/conf.d/custom.cnf
[mysqld]
default-time-zone           = UTC
default-storage-engine      = innodb
default-character-set       = utf8
default-collation           = utf8_general_ci
innodb_data_home_dir        =
innodb_data_file_path       = /database0/mysql/ibdata1:1024M:autoextend
innodb_buffer_pool_size    = 999M # default 8M.
innodb_additional_mem_pool_size = 2M # default 1M.
innodb_log_file_size       = 250M # default 5M.
innodb_log_buffer_size     = 8M # default 1M.
large-pages
[mysql]
default-character-set       = utf8

```

Measurements:

```

Time 4 4 hours, insert 68M 68M links, 4720 4720 links/sec
Time 8 4 hours, insert 100M 32M links, 3470 2220 links/sec
Time 20 12 hours, insert 187M 87M links, 2600 2010 links/sec
Time 38 18 hours, insert 286M 99M links, 2100 1530 links/sec
Time 62 24 hours, insert 389M 103M links, 1740 1190 links/sec
Time 86 24 hours, insert 466M 77M links, 1510 890 links/sec
Time 100 14 hours, insert 500M 34M links, 1390 670 links/sec
done.

```

Table E.1: InnoDB Experiments—Codes

Code	Description	Default
D1	ib_data0, ib_logfile* all on same disk	Y
D2	ib_data0 is on a disk separate from ib_logfile*	
F+	ib_data0 is on a file system (ReiserFS)	Y
F-	ib_data0 is on a raw partition	
L5	ib_logfile* are 5M each	Y
L250	ib_logfile* are 250M each	
P8	ib_data0 is 8M	Y
P50	ib_data0 is 50M	
P100	ib_data0 is 100M	
P1000	ib_data0 is 1000M	
H-	hugepages not enabled	Y
H+	hugepages enabled	

Storage of `pagelinks`:

- `ibdata1` 49GB,
- `ibdata1` 53588525056 bytes/499678288 links = 107 bytes/link,
- `pagelinks.sql` 16845703455 bytes/499678288 links = 33 bytes/link,

E.7.13 Conclusions

Configuration of `MySQL` can yield order-of-magnitude improvements in database performance.

By far, the largest performance gain (2-5x) came from increasing the size of the `InnoDB buffer pool`. The purchase of more DRAM is probably money well spent.

Lesser gains were obtained by: 1) using separate disks for the `InnoDB table space` and log files (1.07), 2) using larger `InnoDB` log files (1.08), and 3) putting the `table space` on a raw partition (1.07).

No gains were seen from enabling `hugepages`.

The results are tabulated in [Table E.2, InnoDB Experimental Results—Performance Ratios](#) and [Table E.3, InnoDB Experimental Results—Summary](#); and charted in [Figure E.1, InnoDB Experiments—Importing `imagelinks` Table](#).

Update (2012): The configuration currently running on `darkstar-5` is (D2F-L250P3000H+). This is like Experiment 6, except the `buffer pool` is 3G instead on 1G.

E.8 Experiments with `importDump.php`—Round 1

These experiments were among the earliest (Summer 2010). This is mostly a transcript of the authors log from that time (see References at the end of this section).

Install packages: Same as [§E.6, Experiments with `MWdumper.jar`—Round 1](#).

Download `dump` files: Same as [§E.6, Experiments with `MWdumper.jar`—Round 1](#).

Decompress: 6.3G expands to 27G.

```
shell$ bunzip2 -c enwiki-latest-pages-articles.xml.bz2 > enwiki-latest-pages-articles.xml
```

For a dry run, edit `/usr/share/mediawiki/maintenance/importDump.php`, and set

```
var $dryRun = true;
```

and run:

Table E.2: InnoDB Experimental Results—Performance Ratios

Exp.	Configuration	Time [h]	Pagelinks Pagelinks	Base Ratio	Pair Ratio	Comment
Base	D1F+L5P8H-	12	22.4	1.00	1.00	
1	D2F+L5P8H-	12	24.0	1.07	1.07	separate disks
2	D2F-L5P8H-	12	24.1	1.08	1.00	
3	D2F-L5P100H-	12	49.6	2.21	2.06	larger <code>buffer pool</code>
4	D2F-L250P100H-	12	53.4	2.38	1.00	
5	D2F-L250P1000H-	12	131.8	5.88	2.47	larger <code>buffer pool</code>
7	D2F+L250P50H+	60.5	134		1.00	
8	D2F+L250P1000H+	63	389		2.90	larger <code>buffer pool</code>
5	D2F-L250P1000H-	12	131.8	5.88	1.00	
6b	D2F-L250P1000H+	12	128.7	5.75	0.98	<code>hugepages</code>
3	D2F-L5P100H-	12	49.6	2.21	1.00	
4	D2F-L250P100H-	12	53.4	2.38	1.08	larger log file
8	D2F+L250P1000H+	86	466		1.00	
6b	D2F-L250P1000H+	83	499.7		1.07	raw partition

Table E.3: InnoDB Experimental Results—Summary

Code	Configuration	Presumed Benefit	Measured Ratio
P1000	Larger <code>InnoDB buffer pool</code>	Reduce disk activity	2-5x
D2	Separate disks for <code>InnoDB table space</code> and log files	Parallelize disk activity	1.07
L250	Larger <code>InnoDB log files</code>	Reduce disk activity	1.08
F-	Use raw partition for <code>InnoDB table space</code>	Eliminate double journaling	1.07
H+	Enable <code>hugepages</code>	Eliminate swapping and reduce TLB activity	0.98

```
shell$ php /usr/share/mediawiki/maintenance/importDump.php \
< enwiki-latest-pages-articles.xml > importDump.log
```

For import, set

```
var $dryRun = false;
```

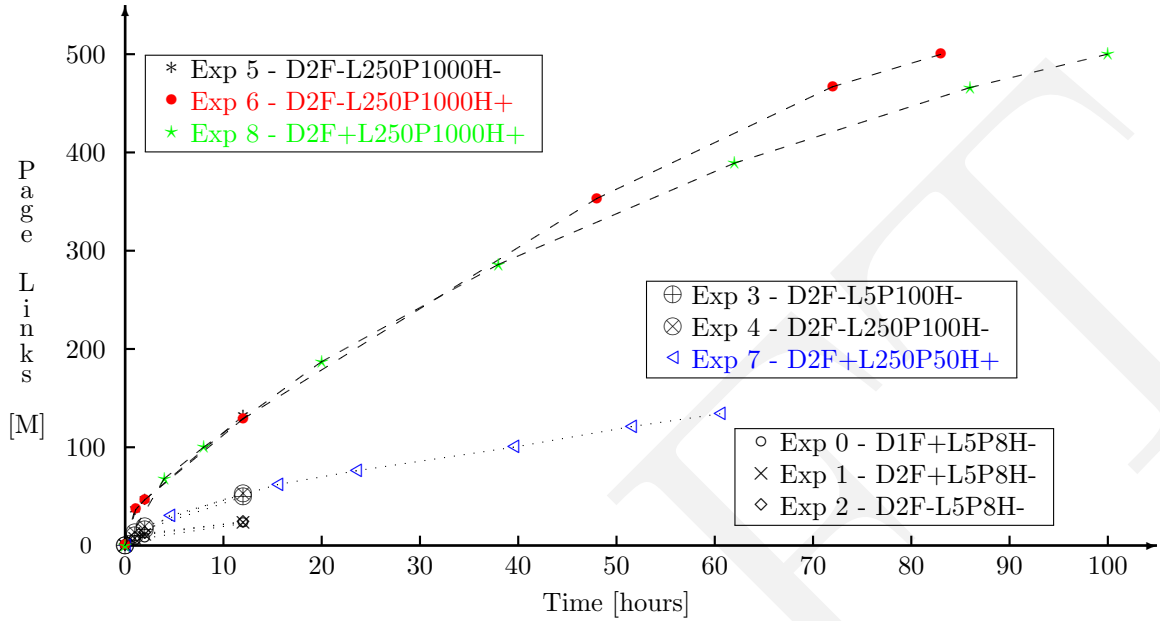
and run:

```
shell$ php /usr/share/mediawiki/maintenance/importDump.php \
< enwiki-latest-pages-articles.xml > importDump.log
```

The code that does the work is `class WikiImporter` which can be found in `/usr/share/mediawiki/includes/SpecialImport.php`.

MySQL configuration (see §E.7, [Experiments with InnoDB](#)) improved importation speed (see [Table E.4, Speed of MWdumper.jar v. importDump.php](#)). Importation is bound by the effort spent searching index B-trees for `pagelinks` to enforce `UNIQUE INDEX` and `UNIQUE KEY` constraints, and this is unnecessary for the initial bulk importation. Hence, the alternative `MWdumper.jar`.

Error messages:

Figure E.1: InnoDB Experiments—Importing `imagelinks` TableTable E.4: Speed of `MWdumper.jar` v. `importDump.php`

Method	Dry Run	MySQL	Rate [page/s]	Est. Time [s]	Est. Time [d]	Outcome
<code>mwumper.jar</code>	true	N/A	400	25,000	0.3	Fail
	false	Exper.6	200	50,000	0.6	Fail 309,000
<code>importDump.php</code>	true	N/A	400	25,000	0.3	
	false	Baseline	2.5	4,000,000	47	
		Exper.6	29	345,000	4.0	1-309,000
		Exper.6	395			Fail 509,200

1) There were problems with translating math from `TeX` format to `PNG` images. Many warning messages appeared, like this:

```
Warning: shell_exec(): Unable to execute '/usr/bin/texvc' '/var/lib/mediawiki/images/tmp'
'/var/lib/mediawiki/images/tmp' 'w(x)' 'UTF-8'' in /usr/share/mediawiki/includes/Math.php
on line 70
```

This was probably due to insufficient DRAM (these messages would come in a burst when memory got low). Also seen was:

```
Failed to parse (Can't write to or create math output directory): w(x)
```

Try again:

After 509,200 pages, `importDump.php` aborted with the message:

```
<p>Set <tt>$wgShowExceptionDetails = true;</tt> in LocalSettings.php to
show detailed debugging information.</p>
```

and from the log file:

```
root-shell# cat /var/log/syslog | grep mysql
```

it looks like `mysqld` died after running out of memory. Restarting the daemon:

```
root-shell# /etc/init.d/mysql start
```

caused `InnoDB` to replay transactions in the double-write buffer, identify 1 transaction with 5 rows for rollback, replay 100 transactions in the logfile, and then rollback the 5 rows.

Try again:

It starts over, and continues well past the point it crashed. After 670,978 pages, `importDump.php` aborted, and again it seems that `mysqld` ran out of memory. Same replay and rollback, except rollback 1 transaction with 7 rows.

Summary of results:

- Failed every time (due to unparsable page).
- Must find and remove bad page from dump file.
- Can resume (rapidly skips over imported pages).
- Slow, but does pagelinks.
- Do not need `rebuildall.php`.
- Failed every time anyway (due to memory leak).

Lesson learned: Import no more than 100k pages at a time.

Recommendation: Split large `dump` file into `xchunks`, import each `xchunk` *seriatim*, and tolerate failure of a few `xchunks`.

Historical note: The notion of splitting large `dump` files, was the idea that motivated the development of WP-MIRROR.

E.9 Experiments with `MWdumper.jar`—Round 2

Whereas the slow speed of `importDump.php` (about 1 page/sec, if 500m `pagelinks` must be searched) in comparison to the speed of `mwDumper.jar` (about 200 pages/sec when piped into `MySQL`; 2,500 pages/sec when writing an `SQL` file; 4,800 pages/sec when writing to `/dev/null`); and

Whereas they both crash: `importDump.php` (when out of memory) and `mwDumper.jar` (when it encounters pages that constitute invalid `XML`; or, if valid `XML`, yield invalid `SQL INSERT` statements);

Resolved that it makes more sense to write some software to remove the offending pages from `enwiki-latest-pages-articles.xml` and then try using `mwDumper.jar` for importation. It seems best to avoid `MySQL` until `mwDumper.jar` has successfully produced an `SQL` file.

To that end, I wrote `remove_page.lisp` that can be given the start and end of a range of pages to be removed. It is reasonably fast (about 2,100 pages/sec).

Process:

```
shell$ java -jar mwDumper.jar --format=sql:1.5 enwiki-latest-pages-articles.xml
> enwiki-latest-pages-articles.sql
```

This crashed after 309,000 pages; so remove pages 309,000 through 310,000, and try again.

```
shell$ remove_page.lisp --start 309000 --end 310000 < enwiki-latest-pages-articles.xml \
> enwiki-309k-310k-pages-articles.xml
shell$ java -jar mwDumper.jar --format=sql:1.5 enwiki-309k-310k-pages-articles.xml > /dev/null
```

This crashed after 1,172,000 pages, so remove pages 1172k-1173k, try again.

This crashed after 1,398,000 pages, etc.

This crashed after 2,218,000 pages

This crashed after 2,296,000 pages

This crashed after 2,755,000 pages

This crashed after 5,704,000 pages

This crashed after 5,749,000 pages

This crashed after 6,261,000 pages

This crashed after 6,397,000 pages

This crashed after 6,397,000 pages again (obviously not the same page)

This crashed after 8,124,000 pages

Done. (12 crashes. It took two days to get a valid `SQL` file)

Now direct output into an `SQL` file (instead of `/dev/null`). This will take a bit longer (about 2,000 pages/sec instead of 4,800 pages/sec).

```
shell$ java -jar mwdumper.jar --format=sql:1.5 enwiki-8124k-8125k-pages-articles.xml \
> enwiki-8124k-8125k-pages-articles.sql
shell$ mysql -u root -p wikidb
mysql> DROP DATABASE wikidb;
mysql> quit;
```

Dropping the `wikidb` database took several minutes.

```
# aptitude purge mediawiki mediawiki-extensions mediawiki-math
```

Repeat `MediaWiki` installation. Load `SQL` file into `wikidb`.

```
shell$ mysql -u root -p wikidb < enwiki-8124k-8125k-pages-articles.sql
Enter password: *****
ERROR 1062 (23000) at line 26237: Duplicate entry '0-' for key 2
```

In a different term box:

```
shell$ mysql -u wikiuser -p wikidb
Enter password: *****
mysql> SELECT COUNT(*) FROM wikidb.page;
+-----+
| count(*) |
+-----+
| 2389001 |
+-----+
1 row in set (11.13 sec)
```

This crashed after 2,389,000 pages. “line 26237: Duplicate”.

So remove pages 2,389k through 2,390k, and try again.

```
shell$ remove_page.lisp --start 2389000 --end 2390000 < enwiki-8124k-8125k-pages-articles.xml \
> enwiki-2389k-2390k-pages-articles.xml
shell$ java -jar mwdumper.jar --format=sql:1.5 enwiki-2389k-2390k-pages-articles.xml \
> enwiki-2389k-2390k-pages-articles.sql
shell$ mysql -u root -p wikidb
mysql> DROP DATABASE wikidb;
mysql> quit;
```

Repeat `MediaWiki` installation.


```
shell$ mysql -u root -p wikidb < enwiki-2389k-2390k-pages-articles.sql
Enter password: *****
ERROR 1062 (23000) at line 26851: Duplicate entry '0-' for key 2
```

This crashed after 2,462,000 pages. “line 26851: Duplicate”. Repeat
 This crashed after 3,258,000 pages. “line 33565: Duplicate”. Repeat
 This crashed after 3,266,000 pages. “line 33632: Duplicate”. Repeat
 This crashed after 3,273,000 pages. “line 33690: Duplicate”. Repeat
 This crashed after 3,332,000 pages. “line 34182: Duplicate”. Repeat
 This crashed after 3,402,000 pages. “line 34756: Duplicate”. Repeat
 Quit. (the last 144,000 took 5 days; `importDump.php` does 100k/day)

Give up on `mwddumper.jar`. We inserted pages with `page_id` up to 7,950,000. We shall insert the `pagelinks` for those pages; that is, just 160m `pagelinks` (1.5 days), enough so that `max(pl_from)` exceeds 8,000,000.

```
shell$ mysql -u root -p wikidb < latest/enwiki-latest-pagelinks.sql
```

The remaining 6.9m pages shall be inserted by `importDump.php` (two months).

```
root-shell# php /usr/share/mediawiki/maintenance/importDump.php \
< latest/enwiki-latest-pages-articles.xml > importDump.log
```

Monitor progress with:

```
mysql> SELECT MAX(page_id),7950022 AS mstart,MAX(page_id)-7950022 AS mdiff,
-> COUNT(*) AS pages,3402001 AS pstart,COUNT(*)-3402001 AS pdiff FROM page;
+-----+-----+-----+-----+-----+-----+
| max(page_id) | mstart | mdiff | pages | pstart | pdiff |
+-----+-----+-----+-----+-----+-----+
|      7951792 | 7950022 | 1770 | 3403814 | 3402001 | 1813 |
+-----+-----+-----+-----+-----+-----+
mysql> SELECT MAX(pl_from),8124748 AS start,MAX(pl_from)-8124748 AS diff FROM pagelinks;
+-----+-----+-----+
| max(pl_from) | start | diff |
+-----+-----+-----+
|      8124748 | 8124748 | 0 |
+-----+-----+-----+
```

Note: the measurement above was taken just after 100k pages.

After a 2 1/2 days (25 pages/sec), the system hung and had to be rebooted. `InnoDB` took about 10 minutes to complete replay/rollback.

```
mysql> SELECT MAX(page_id),7950022 AS mstart,MAX(page_id)-7950022 AS mdiff,
-> COUNT(*) AS pages,3402001 AS pstart,COUNT(*)-3402001 AS pdiff FROM page;
-> SELECT MAX(pl_from),8124748 AS start,MAX(pl_from)-8124748 AS diff FROM pagelinks;
+-----+-----+-----+-----+-----+-----+
| max(page_id) | mstart | mdiff | pages | pstart | pdiff |
+-----+-----+-----+-----+-----+-----+
|      8239053 | 7950022 | 289031 | 3691075 | 3402001 | 289074 |
+-----+-----+-----+-----+-----+-----+
+-----+-----+-----+
| max(pl_from) | start | diff |
+-----+-----+-----+
|      8239053 | 8124748 | 114305 |
+-----+-----+-----+
mysql> EXPLAIN SELECT COUNT(*) FROM pagelinks\G
rows: 176926947
```

So it appears that about 1/3 of the pages have been loaded. In other words:
 This hung after 8,239,053 / 3,691,075 (`MAX(page_id)/COUNT(*)`). Try again.
 The first 2.88m are quickly replayed (480 pages/sec).
 This crashed after 8,634,486 / 4,086,508 loaded. Try again.

```
+-----+
| max(page_id) | mstart | mdiff | pages | pstart | pdiff |
+-----+
|      8634486 | 7950022 | 684464 | 4086508 | 3402001 | 684507 |
+-----+
| max(pl_from) | start  | diff   |
+-----+
|      8634486 | 8124748 | 509738 |
+-----+
```

This crashed after 8,840,722 / 4,292,744 loaded. Try again.

```
+-----+
| max(page_id) | mstart | mdiff | pages | pstart | pdiff |
+-----+
|      8840722 | 7950022 | 890700 | 4292744 | 3402001 | 890743 |
+-----+
| max(pl_from) | start  | diff   |
+-----+
|      8840722 | 8124748 | 715974 |
+-----+
```

Abort. Too many pages had messed up equations (due to `texvc` failing to execute for lack of memory), and too many pages had messed up references (for unknown reasons). Also it seemed that running `mwddumper.jar` followed by `importDump.php` more than doubled the `MAX(page_id)` for the same number of pages.

So I give up on using the (probably) unsupported `mwddumper.jar`, and return to using the supported `importDump.php` only.

E.10 Experiments with `importDump.php`—Round 2

This time I also run `top` in a terminal box because `importDump.php` requests more and more memory until first `texvc` cannot run and then later the system hangs.

The plan is this: after each 100k pages (or if the swap partition gets down to around 100MB), kill `importDump.php`, wait for `InnoDB` to flush its `buffer pool` pages, then restart `importDump.php`. That way `texvc` should not fail for lack of memory. It will probably be necessary to kill and restart `importDump.php` daily.

So let us test the kill and restart behavior:

```
root-shell# php /usr/share/mediawiki/maintenance/importDump.php \
< latest/enwiki-latest-pages-articles.xml
^C
```

and in another terminal:

```
mysql> SELECT MAX(page_id),COUNT(*) AS pages FROM page; SELECT MAX(pl_from),
-> COUNT(*) AS links FROM pagelinks;
+-----+-----+
| max(page_id) | pages |
+-----+-----+
|          45593 | 45593 |
+-----+-----+
+-----+-----+
| max(pl_from) | links  |
+-----+-----+
|          45593 | 4830549 |
+-----+-----+
```

Restart. Test if the number of `pages` and `pagelinks` is preserved, that is, if rerunning `importDump.php` causes any mess. Result: rerunning did not cause `max(page_id)` to differ from `pages`, as least for the pages already imported. Good!

Assuming 2.5 pages/sec, importing `en wikipedia` should take 7 weeks to complete. However I expect it to be less because the number of `pagelinks` per page will decline (and therefore offset the usual $1/\log N$ trend) from a bit over 100 links/page to bit less than 50.

I am still troubled by failure to `exec texvc` when I try to import too many pages (say 100k) at a time. Is there a memory leak? Is garbage collection not happening? I do not know. So, I wrote `split-page.lisp` to break the large file, `enwiki-latest-pages-articles.xml`, into smaller files containing 50k pages each, named:

```
enwiki-latest-pages-articles.page000m000k.xml,
enwiki-latest-pages-articles.page000m050k.xml, and so on.
```

```
shell$ ./split-page.lisp -v --count 50000 enwiki-latest-pages-articles.xml
root-shell# php /usr/share/mediawiki/maintenance/importDump.php \
< lisp/enwiki-latest-pages-articles.page000m000k.xml
shell$ rm enwiki-latest-pages-articles.page000m000k.xml
root-shell# php /usr/share/mediawiki/maintenance/importDump.php
< lisp/enwiki-latest-pages-articles.part000m050k.xml
shell$ rm enwiki-latest-pages-articles.page000m050k.xml
```

and so on. Assuming 100k pages per day, importing should take 14 weeks. Actually, it is going faster than that (about 10 pages/sec), but only I wait between runs for `InnoDB` to flush its `buffer pool` pages (which takes several minutes).

The 7-12 pages/sec rate held for the first 3 million pages, and thereafter fell. After 5 million pages, the rate was 1-2 pages/sec.

E.11 Experiments with wikix

Install packages:

```
root-shell# aptitude install libssl-dev build-essential curl
```

Download `wikix.tar.gz`:

```
shell$ tar -xzipdf wikix.tar.gz
shell$ cd wikix
shell$ make
```

Generate scripts (to download media files) with `wikix`:

```
shell$ wikix < enwiki-latest-pages-articles.xml > image
/bin/sh: line 1: 1066 Segmentation fault   wikix < ../latest/enwiki-latest-pages-articles.xml
make: *** [wikix] Error 139
```

The `wikix` process creates a `bash` script (about 2GB) for downloading media files using `cURL`. Media files are stored in a 16x16 directory tree according to some kind of hash, if `/etc/mediawiki/LocalSettings.php` contains the default

```
#$wgHashedUploadDirectory = false;'
```

The `wikix` script failed after about 6.3 million pages were processed. It will be necessary to split the `xml` file and try to process the last 4 million pages separately. This was done by first splitting `enwiki-latest-pages-articles.xml` into files with 1m pages each, and then extracting the media file names from them.

```
shell$ ./split_page.lisp -c 1000000 enwiki-latest-pages-articles.xml
shell$ wikix < enwiki-latest-pages-articles.page006m.xml > image.page006m
Segmentation fault
shell$ wikix < enwiki-latest-pages-articles.page007m.xml > image.page007m
shell$ wikix < enwiki-latest-pages-articles.page008m.xml > image.page008m
shell$ wikix < enwiki-latest-pages-articles.page009m.xml > image.page009m
shell$ wikix < enwiki-latest-pages-articles.page010m.xml > image.page010m
```

Then splitting `enwiki-latest-pages-articles.page006m.xml` into ten parts:

```
shell$ ./split_page.lisp -c 100000 enwiki-latest-pages-articles.page006m.xml
shell$ wikix < enwiki-latest-pages-articles.page006m000k.xml > image.page006m000k
shell$ wikix < enwiki-latest-pages-articles.page006m100k.xml > image.page006m100k
shell$ wikix < enwiki-latest-pages-articles.page006m200k.xml > image.page006m200k
shell$ wikix < enwiki-latest-pages-articles.page006m300k.xml > image.page006m300k
Segmentation fault
shell$ wikix < enwiki-latest-pages-articles.page006m400k.xml > image.page006m400k
etc.
```

Note: the first million pages are the largest ones:

```
shell$ ls -lh en*m.xml
... kmiller 5.2G ... enwiki-latest-pages-articles.page000m.xml
... kmiller 2.9G ... enwiki-latest-pages-articles.page001m.xml
... kmiller 2.6G ... enwiki-latest-pages-articles.page002m.xml
... kmiller 2.4G ... enwiki-latest-pages-articles.page003m.xml
... kmiller 2.4G ... enwiki-latest-pages-articles.page004m.xml
... kmiller 2.4G ... enwiki-latest-pages-articles.page005m.xml
... kmiller 2.2G ... enwiki-latest-pages-articles.page006m.xml
... kmiller 2.4G ... enwiki-latest-pages-articles.page007m.xml
... kmiller 2.4G ... enwiki-latest-pages-articles.page008m.xml
... kmiller 2.3G ... enwiki-latest-pages-articles.page009m.xml
... kmiller 1.7G ... enwiki-latest-pages-articles.page010m.xml
```

and the first million pages contain the most media files names:

```
shell$ ls -lh i*m
... kmiller 653M ... image.page000m
... kmiller 300M ... image.page001m
... kmiller 248M ... image.page002m
... kmiller 219M ... image.page003m
... kmiller 199M ... image.page004m
... kmiller 170M ... image.page005m
... kmiller  49M ... image.page006m  <-- up to seg fault
... kmiller 148M ... image.page007m
... kmiller  97M ... image.page008m
... kmiller  81M ... image.page009m
... kmiller  45M ... image.page010m
```

This data inspired a more careful survey that lead to: [Figure F.3, Size Distribution by Age of Article on en Wikipedia](#), and [Figure F.4, Size Distribution by ichunk on en Wikipedia](#).

E.12 Experiments with Downloading Media Files

Download Media Files. This is done by running the scripts generated by [wikix](#).

```
shell$ ./image.page000m
```

This does not run smoothly, because `cURL` often stalls whenever the server does not serve the entire file. Hence, I must kill the job (Ctrl-C), remove the partially downloaded media file, edit `image00` to remove the successfully processed `bash` scripts (i.e. those prior to the file that was partially downloaded), and then run the script again.

It took over a week to download `image.page000m`. Also, about 5-10% of the media files ended up in `failed.log`.

To gain speed, run two in parallel (in separate terminals). For example:

```
shell$ ./image.page001m  <-- in first terminal
shell$ ./image.page002m  <-- in second terminal
```

When I replaced my i386 processor with an amd64, and installed the corresponding Debian distribution, I discovered that `cURL` now runs rather differently. Under the i386 version, `cURL` seems to ignore the `--retry 7` option; while under the amd64 version, `cURL` respects it. Thus for each media file, we now see one or two of the following messages:

```

% Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
           0         0         0              0             0      0      0
Warning: Transient problem: FTP error Will retry in 1 seconds. 7 retries left.
0         0         0         0              0             0      0      0
Warning: Transient problem: FTP error Will retry in 2 seconds. 6 retries left.
0         0         0         0              0             0      0      0
Warning: Transient problem: FTP error Will retry in 4 seconds. 5 retries left.
0         0         0         0              0             0      0      0
Warning: Transient problem: FTP error Will retry in 8 seconds. 4 retries left.
0         0         0         0              0             0      0      0
Warning: Transient problem: FTP error Will retry in 16 seconds. 3 retries
Warning: left.
0         0         0         0              0             0      0      0
Warning: Transient problem: FTP error Will retry in 32 seconds. 2 retries
Warning: left.
0         0         0         0              0             0      0      0
Warning: Transient problem: FTP error Will retry in 64 seconds. 1 retries
Warning: left.
0         0         0         0              0             0      0      0
curl: (22) The requested URL returned error: 404

```

This means that `cURL` now takes 2-4 minutes per media file, which means that importing 1.5 million media files would take, say, 10 years (200 sec/file * 1.5 million files = 300 million sec = 10 years). Therefore, I edited the `bash` scripts to replace `--retry 7` with `--retry 1` to get a factor 64 speedup (i.e. 2 months). If one uses `emacs` or `xemacs` the command would be `M-x replace-string`.

The idea is not to download every media file on the first pass, but to maximize the number of files downloaded per day. Two months later, when the next wikipedia dump becomes available, one makes another pass anyway. One should think of the media file download process as akin to raking leaves—one does not get every leave on the first pass, nor does one waste time trying to do so.

E.13 Experiments with `rebuildImages.php`—Round 1

Media File Importation. If the media files are downloaded after the importation of pages, then the `image` table in `wikidb` will not be populated. Therefore, it is necessary to run the maintenance script:

```
root-shell# php /usr/share/mediawiki/maintenance/rebuildImages.php --missing
```

This needs `MySQL` admin access and will therefore fail for lack of permissions unless the following two lines are added to `/etc/mediawiki/LocalSettings.php` (or to `/etc/mediawiki/AdminSettings.php`).

```
$wgDBAdminuser      = "root";
$wgDBAdminpassword  = "*****"; (replace the asterisks, obviously)
```

The `rebuildImages.php` script processes 10 media files/sec, so it will take about 24 hours to process each 1 million media files. There are about 1.5 million media files.

The script `rebuildImages.php` crashed a few times, with this message:

```
PHP Fatal error: Call to a member function recordUpload() on a non-object
in /usr/share/mediawiki/maintenance/rebuildImages.php on line 196
```

This always involves an media file which name includes the percent “%” character. In each case, there is a similarly named media file without the “%”, so deleting the offending media file and restarting the script is appropriate.

As mentioned above, `PHP` seems to have a memory leak, and occupies ever more DRAM. After about 50,000 records, `rebuildImages.php` gives the following error message for each `image` record inserted:

```
PHP Warning:  proc_open(): fork failed - Cannot allocate memory
in /usr/share/mediawiki/includes/parser/Tidy.php on line 101
```

It is best to kill the `rebuildImage.php` process with CTRL-C, which will free up over 1GB DRAM, and then restart it.

E.14 Experiments with Corrupt Media Files

Sometimes `cURL` will download only part of the media file. This can occur when the download is broken off by web server; and `cURL` emits the message

```
curl: (18) transfer closed with 746274 bytes remaining to read
```

When this happens, the script generated by `wikix` will store the corrupt file anyway. This later becomes a nuisance when the pages are imported, and `gm convert` generates error messages like

```
/usr/bin/gm convert: Corrupt JPEG data: premature end of data segment
(/var/lib/mediawiki/images/0/0c/Hurricane_Dennis_10_july_2005_1615Z.jpg).
```

One way to deal with the situation is to preemptively search and destroy the corrupt media files. This is done with `gm identify` like so

```
root-shell# cd /var/lib/mediawiki/images/0/0c/
root-shell# gm identify -verbose Hurricane_Dennis_10_july_2005_1615.jpg | grep identify
/usr/bin/gm identify: Corrupt JPEG data: premature end of data segment
(/var/lib/mediawiki/images/0/0c/Hurricane_Dennis_10_july_2005_1615Z.jpg).
```

One must write a maintenance script to iterate over all 1.5 million media files. Do not try `gm identify -verbose *` as that will just heavily load your CPUs for a minute, then crash `glibc` and produce a backtrace.

The ones identified as corrupt, can be downloaded again using `cURL` with perhaps greater success.

`MediaWiki` offers two utilities: one for dealing with bad media file names, `cleanupImages.php`; and one for corrupt media files, `checkImages.php`:

1) `cleanupImages.php`. Improperly named media files (e.g. file names containing the character “%”) can be caught by running:

```
root-shell# php /usr/share/mediawiki/maintenance/cleanupImages.php
root-shell# php /usr/share/mediawiki/maintenance/cleanupImages.php --fix
```

This reads the `image` database table at about 2400 rows/sec. It found no bad filenames. This cannot be right (unless I had already deleted all such files manually—which is possible).

2) `checkImages.php`. Corrupt media files (e.g. truncated due to faulty download) can be caught by running:

```
root-shell# php /usr/share/mediawiki/maintenance/checkImages.php
```

This reads the `image` database table at about 25 rows/sec. I let it run for two hours, yet it found nothing. This cannot be right, because `importDump.php` calls `gm convert` which reports many corrupt media files.

Neither `cleanupImages.php` nor `checkImages.php` seem to get the job done.

I will have to write my own script.

E.15 Experiments with the `objectcache`

Sometimes `importDump.php` appears to stop, with `top` showing no activity for `PHP`, and significant activity for `MySQL`. This is usually because `InnoDB` sometimes stops taking queries to concentrate upon flushing tens of thousands of dirty pages from the `InnoDB buffer pool` to disk.

Occasionally, the delay is hours long. Investigation revealed that `MediaWiki` sometimes submits a query to delete a million or so rows from the `objectcache` database table. For example,

```
mysql> SHOW ENGINE INNODB STATUS\G
...
DELETE /* mediawikiBagOStuff::_doquery 127.0.0.1 */ FROM
'objectcache' WHERE exptime < '20110517051938'
...
```

In this case, `InnoDB` shows high levels of read and delete

```
mysql> SHOW ENGINE INNODB STATUS\G
...
Number of rows inserted 9536, updated 5830, deleted 1190986, read 1242549
0.00 inserts/s, 0.00 updates/s, 774.23 deletes/s, 774.23 reads/s
...
```

and the `objectcache` table shows millions of rows

```
mysql> SHOW TABLE STATUS LIKE 'objectcache'\G
...
Rows: 2390302
...
```

Even after the deleting stops, `InnoDB` will still need an hour to merge all the underfilled `InnoDB` pages. `update.php` also deletes the cache.

```
root-shell# php /usr/share/mediawiki/maintenance/update.php
```

Recommendation: The best way to deal with this situation is to preemptively deplete the cache by deleting a thousand rows after processing each file. `WP-MIRROR` does this whenever the `objectcache` exceeds a threshold of 10,000 rows.

E.16 Experiments with `rebuildImages.php`—Round 2

`InnoDB` can automatically recognize when records are being inserted in `LINEAR` or in `RANDOM` order; and `InnoDB` has algorithms for each case. So, it is worth looking at the `image` table in `wikidb`, and the insertion process.


```
mysql> SHOW CREATE TABLE image\G
...
Create Table: CREATE TABLE 'image' (
  'img_name' varbinary(255) NOT NULL DEFAULT '',
  ...
  PRIMARY KEY ('img_name'),
  ...
) ENGINE=InnoDB DEFAULT CHARSET=binary
```

So the `image` table records are stored in alphabetical order of `img_name`. Now the `rebuildImages.php` inserts image records in the order that it finds them on disk, which is unlikely to be alphabetical since `image.page000m`, etc. downloads them and writes them to disk in the order that `wikix` finds them in `enwiki-yyyymmdd-pages-articles.xml`.

Therefore, the `image` records are inserted in RANDOM order. Since the average `image` record length is 840B,

```
mysql> SHOW TABLE STATUS LIKE 'image'\G
...
Avg_row_length: 840
...
```

and since randomly filled `InnoDB` database pages are on average a bit over half full, each 16KB page will hold about 10 records. (Note: when a database page is over 15/16 full, `InnoDB` splits it into two half-full database pages.) Thus to insert one `image` record, `InnoDB` must first read a page containing say 10 records and cache it in the `buffer pool` (in DRAM). And, to insert 2 million `image` records, will require `InnoDB` to read (or to create by splitting) over 200k database pages into the `buffer pool`, and later flush the modified database pages (first to the log file, then the double-write buffer, and finally to the `image` table stored in `InnoDB table space`). This causes much more disk I/O than if the records had been inserted sequentially (LINEAR).

If the `buffer pool` is too small, then the same database page will have to be repeatedly read, modified, flushed when it becomes the least recently used (LRU algorithm), and read again (thrashing). A large `buffer pool` that can hold the entire `image` table greatly speeds the process. 4GB will do nicely. 3GB ($2998\text{M}/16\text{K} = 187\text{k}$ pages = 1.8 million rows in the `image` table).

Experiment: Insert an additional 200k media files.

After inserting 100k media files, the `buffer pool` is about half occupied. The `buffer pool` hit rate is perfect (1000/1000) which means that the entire `image` table is sitting in the `buffer pool` (which in our case is 3GB). In the buffer pool, less than half of the pages are marked modified, which is because modified pages are being flushed to disk and marked clean:

```
mysql> SHOW ENGINE innodb STATUS\G
...
-----
BUFFER POOL AND MEMORY
-----
Total memory allocated 348629496; in additional pool allocated 1082624
Dictionary memory allocated 333200
Buffer pool size      192000
Free buffers          109397
Database pages        81887      <-- database pages
Modified db pages     35426
Pending reads 0
Pending writes: LRU 0, flush list 0, single page 0
Pages read 37501, created 44386, written 622566      <-- read + created
0.00 reads/s, 0.81 creates/s, 6.26 writes/s
Buffer pool hit rate 1000 / 1000      <-- hit rate
...
```

Table E.5: Processes that Cause Resource Contention

Task	Process	Consumes	Competes with	Daemon	Cron
Image download	<code>cURL</code>	network I/O	<code>apt-mirror</code> , <code>bittorrent</code> .		daily
Page importation	<code>InnoDB</code>	disk I/O	<code>mdadm/checkarray</code> , <code>nepomuk</code> , <code>strigi</code> , <code>updatedb.mlocate</code> .	Yes	weekly
	<code>php</code> , <code>gm</code>	cpu	<code>plasma-desktop</code> with compositing.	Yes	daily

Since the `image` table fits entirely into the `buffer pool`, ‘pages read’ plus ‘pages created’ (37501+44386=81887) equals the total pages in the buffer pool.

Note, however, that pages written (622566) is much greater, apparently, one flush per `COMMIT`. In other words, the `Built-in InnoDB GROUP COMMIT` feature is not working. Disk I/O is therefore far higher than anticipated.

Recommendation: Use at least 3G DRAM. Use `InnoDB Plug-in` rather than `Built-in InnoDB`.

E.17 Experiments with Resource Contention

Some processes cause resource contention that slows down the media file download and page importation process. Such process should be suspended, killed, or deinstalled. See [Table E.5, Processes that Cause Resource Contention](#).

The daily `apt-mirror` job usually goes quickly, although one should expect to download hundreds of megabytes per day during the months leading up to the announcement of the next `stable` release. In which case, the media file download process will suffer for an hour or two each night.

Running `bittorrent` while downloading media files, results in many partial downloads (corrupt media files). Recommendation: do not use.

If you store your database and media files on a `RAID` array (and you should), then `mdadm/checkarray` will run weekly for about one day. During that day, disk performance will be reduced. Just let it happen.

`nepomuk` collects metadata from all the files on the system. It impairs disk performance. (And do you really need it?)

The `plasma-desktop` is surprisingly demanding of the CPU. This is especially true if compositing is enabled (default). Compositing means that windows are rendered as translucent, with any underlying window images, and with the underlying desktop wallpaper showing through. Only the window with the focus is opaque. To produce this effect, window images are alpha-blended with the desktop wallpaper using, `OpenGL` or `Xrender`. This is attractive, and it lets the user see all his overlapping and hidden windows at a glance, without moving or restacking them. However, `importDump.php` is especially impaired, not only because it is written in `php`, but because it invokes `gm` to perform the image resizing (to make thumbs). Recommendation: consider suspending desktop effects.

`strigi` is a daemon for indexing and searching your personal data. It hammers the system (both disk and CPU). Among other things, it calculates the `sha1sum` for every file on your system—including the 1.5 million media files you just downloaded. (And do you really need it?) Recommendation: deinstall.

`mlocate` is another file indexing and searching utility. The daily `updatedb.mlocate` job reduces the page importation rate by half for several hours (but would complete in less than an hour on an unloaded system). It also slows down desktop response while you are working. If it wakes up while you are working, execute:

```
root-shell# ps -efw | grep mloc
root      1572   799   0 07:49 ?        00:00:00 /bin/bash /etc/cron.daily/mlocate
root      1579   1572   2 07:49 ?        00:00:29 /usr/bin/updatedb.mlocate
root      1660   7742   0 08:09 pts/45   00:00:00 grep mloc
root-shell# kill -15 1579
```

or schedule the cron job for a time when you will not be working. Also be sure that at most one of the two packages, `mlocate` and `locate`, are installed.

E.18 Upgrade from Debian Lenny to Squeeze

The upgrade from Debian lenny to squeeze entailed an update of `MediaWiki`. That the updated `MediaWiki` has a different database schema, was learned when the web browser gave errors like the following:

```
A database query syntax error has occurred. This may indicate a bug in
the software. The last attempted database query was:
(SQL query hidden)
from within function "OutputPage::addCategoryLinks". Database returned
error "1146: Table 'wikidb.page_props' doesn't exist (localhost)".
```

and

```
A database query syntax error has occurred. This may indicate a bug in
the software. The last attempted database query was:
(SQL query hidden)
from within function "Article::updateCategoryCounts". Database returned
error "1146: Table 'wikidb.category' doesn't exist (localhost)".
```

The database was updated by running

```
root-shell# php /usr/share/mediawiki/maintenance/update.php
```

However, `update.php` took a long time to complete. While the missing tables were created quickly (which dealt with the web errors); populating the `wikidb.category` table took an hour; populating the `rev_parent_id` field took several more.

E.18.1 Fiasco with `pagelinks`

After six hours, I canceled `update.php`, and then inadvertently dropped the `pl_from` index for the `pagelinks` table by giving the command:

```
ALTER TABLE 'pagelinks'
DROP INDEX pl_from
ADD INDEX pl_namespace(pl_namespace, pl_title, pl_from);
```

This foolish command took over 10 hours.

The intended `pagelinks` table, had I let `update.php` run to completion, would have been:

```
mysql> SHOW CREATE TABLE PAGELINKS\G
...
Create Table: CREATE TABLE 'pagelinks' (
  'pl_from' int(10) unsigned NOT NULL DEFAULT '0',
  'pl_namespace' int(11) NOT NULL DEFAULT '0',
  'pl_title' varchar(255) CHARACTER SET utf8 COLLATE utf8_bin NOT NULL DEFAULT '',
  UNIQUE KEY 'pl_from' ('pl_from','pl_namespace','pl_title')
  UNIQUE KEY 'pl_namespace' ('pl_namespace','pl_title','pl_from')
) ENGINE=InnoDB DEFAULT CHARSET=utf8
```

What remained to do, aside from fixing the mistake, was to make `pl_namespace`, `tl_namespace`, and `il_to` indices `UNIQUE` (see `/usr/share/mediawiki/maintenance/archives/patch-pl-tl-il-unique` for the following code):

```
DROP INDEX /*i*/pl_namespace ON /*_*/pagelinks;
CREATE UNIQUE INDEX /*i*/pl_namespace ON /*_*/pagelinks (pl_namespace, pl_title, pl_from);
DROP INDEX /*i*/tl_namespace ON /*_*/templatelinks;
CREATE UNIQUE INDEX /*i*/tl_namespace ON /*_*/templatelinks (tl_namespace, tl_title, tl_from);
DROP INDEX /*i*/il_to ON /*_*/imagelinks;
CREATE UNIQUE INDEX /*i*/il_to ON /*_*/imagelinks (il_to, il_from);
```

To obtain count and timing information, I decided to run these commands by hand: first the three `DROP` commands, and then the `CREATE` commands in the order of increasing count:

TABLE	COUNT(*)	TIME DROP INDEX	Time CREATE UNIQUE INDEX
imagelinks	1817324	1 min 38.21 sec	3 min 10.50 sec
templatelinks	29108059	29 min 19.64 sec	32 min 20.52 sec
pagelinks	148496964	< 10 hours	> 1 week

Originally I should have let `update.php` run to completion, because killing it left `pagelinks` without the `pl_namespace` index.

Making `pl_namespace UNIQUE` proved to be a BAD IDEA(tm). Each time I inserted a new `pagelinks` record (with `importDump.php`), `InnoDB` took over two hours to establish row locks on every existing row (all 150 million). This can be seen by running:

```
mysql> SHOW ENGINE INNODB STATUS\G
...
-----
TRANSACTIONS
-----
Trx id counter 0 35221413
Purge done for trx's n:o < 0 35221411 undo n:o < 0 0
History list length 0
LIST OF TRANSACTIONS FOR EACH SESSION:
---TRANSACTION 0 0, not started, process no 6518, OS thread id 139948387165952
MySQL thread id 75, query id 73206 localhost root
---TRANSACTION 0 0, not started, process no 6518, OS thread id 139948386764544
MySQL thread id 74, query id 73209 localhost root
show engine innodb status
---TRANSACTION 0 35221411, ACTIVE 1983 sec, process no 6518, OS thread id 139948390319872 fetching
mysql tables in use 1, locked 1
222735 lock struct(s), heap size 25081840, 42555962 row lock(s), undo log entries 5
MySQL thread id 70, query id 73203 localhost root Sending data
SELECT /* LinksUpdate::getExistingLinks 127.0.0.1 */ pl_namespace,pl_title FROM 'pagelinks' WHERE
Trx read view will not see trx with id >= 0 35221412, sees < 0 35221412
-----
```

Note that the last transaction has established over 42 million row locks and will continue until it has established all 150 million. This is a query submitted by `importDump.php` presumably to enforce uniqueness. When I loaded more pages with `importDump.php`, `mysqld` slowed to a crawl (about 10,000x slower!).

Next we restored the `pl_from` index with:

```
mysql> CREATE UNIQUE INDEX pl_from ON pagelinks (pl_from, pl_namespace, pl_title);
```

The next night, there were two power outages. `MySQL` failed to restart due to a bad sector on the HDD, which was in the `InnoDB` double-write buffer. So I repaired the sector (write zeros on it), and rolled back the transaction in the double-write buffer, like so:

```
root-shell# hdparm -W0 /dev/sdc          <-- should do every boot for InnoDB
root-shell# smartctl -a /dev/sdc | less   <-- LBA 134696376 failed to read
root-shell# hdparm --read-sector 134696376 /dev/sdc <-- failed to read
root-shell# hdparm --repair-sector 134696376 --yes-i-know-what-i-am-doing /dev/sdc
root-shell# /etc/init.d/mysql restart
root-shell# smartctl -a /dev/sdc | less   <-- cleared error, but no remap
```

`InnoDB` recommends disabling write caching:

```
root-shell# emacs /etc/hdparm.conf
/dev/sdc {
    write_cache = off
}
```

If that fails then try:

```
root-shell# emacs /etc/rc.local
hdparm -W0 /dev/sdc
```

E.18.2 Post-Mortem Analysis and Lessons Learned

Post-mortem analysis:

1. Trying to create `UNIQUE` indices for `pagelinks` caused weeks of heavy disk I/O, mostly with the double-write buffer (which occupies about 100 `InnoDB` pages of 16K each). This probably caused the sectors to wear down to the point that they became unreadable.
2. According to `syslog` files, the `ib_logfile[01]` filled up, and the whole transaction had to be rolled back.
3. During index creation, all write access to the `pagelinks` table was blocked and timed out, which consequently blocked insertion of additional pages.
4. During index creation, files are written to `tmpdir` (`/tmp`) which in my case is only 1000M, which is too small to hold the largest column `pl_title` of the `pagelinks` table (table is 10G).
5. Since `pl_title` used UTF8 encoding, `InnoDB` tried to rebuild the entire table in a temporary table (`MySQL Bug #39833`). Consider `BINARY` encoding.
6. The `Built-in InnoDB` rebuilds the table in a temporary table, and when complete, drops the original table and renames the temporary table. The copy process, which had to establish uniqueness as each row was added to the temporary table, turned out to be an enormous task for such a large table.
7. Crash recovery turns out to be non-trivial for index creation. Secondary indices are simply dropped. Cluster indices leave behind a temporary table, but there is no guidance on how to continue the index creation. In either case, it is simplest to start over.

We learn the following lessons:

1. The `pagelinks` table of 10G is far too large to attempt index creation when the `/tmp` partition is 1G and buffer-pool is 3G.
2. Better to `TRUNCATE` the `imagelinks` table, run `update.php`, finish inserting `pages`, `TRUNCATE` the `imagelinks` table again, then download the latest `imagelinks` dump file, and insert the dump.
3. I should have enabled `InnoDB Plugin` instead of `Built-in InnoDB`, which would have allowed much faster index creation, as well as, change buffering for inserts.

E.18.3 Starting Over

Date: 2011-Mar-01

Due to the `pagelinks` index fiasco, I made the decision to:

1. `DROP` the `wikidb` database (but keep all the media files),
2. upgrade `mysql-server` (squeeze uses MySQL 5.1, lenny uses MySQL 5.0),
3. enable `InnoDB Plugin` instead of the `Built-in InnoDB`,
 - faster locking for multi-core processor,
 - fast index creation,
 - change buffer for insertions,
 - group commit works,
 - adaptive flushing of database pages,
4. upgrade `MediaWiki` (squeeze has many updates over lenny),
 - run `update.php` (no apparent memory leak) on empty `wikidb`,
5. download the latest `enwiki-latest-pages-articles.xml.bz2`, and
6. reinsert all the `wikidb` records.

Reinsertion worked as follows:

E.18.3.1 DUMP

Download latest wikipedia dump (time: a few hours):

```
shell$ wget http://dumps.wikimedia.org/enwiki/latest/enwiki-latest-pages-articles.xml.bz2
shell$ bunzip2 enwiki-latest-pages-articles.xml.bz2
shell$ cat enwiki-latest-pages-articles.xml | grep "<page>" | wc -l
```

Note: The latest dump, as of 2011-03-08, is dated 2011-01-17 and has 10.861 million pages.

Dump date	Pages [million]
2010-09-16	10.355
2011-01-17	10.861
2011-09-01	11.577
2011-10-07	11.687

E.18.3.2 SPLIT

Split dump into conveniently sized files (1 million pages per file for image processing; 50 thousand pages per file for page insertion), and generate the media file download scripts (time: a few hours):

```
shell$ ./split_page_v0.3.lisp --count=1000000 enwiki-latest-pages-articles.xml
shell$ ./split_page_v0.3.lisp --count=50000 enwiki-latest-pages-articles.xml
shell$ wikix < enwiki-latest-pages-articles.page000m.xml > image.page000m
shell$ wikix < enwiki-latest-pages-articles.page001m.xml > image.page001m
...
shell$ chmod 755 image.page*
```

There is still one page in `enwiki...page006m` that causes `wikix` to crash. A work-around is to use the 50k split files (`enwiki...page006m300k` crashes, so `image.page006m300k` ends with bad syntax):

```
shell$ wikix < enwiki-latest-pages-articles.page006m000k.xml > image.page006m000k
shell$ wikix < enwiki-latest-pages-articles.page006m050k.xml > image.page006m050k
...
shell$ wikix < enwiki-latest-pages-articles.page006m950k.xml > image.page006m950k
```

The first million pages produce a script (`image.page000m` is 653M) that is unwieldy. So, it too is split using 50k files:

```
shell$ wikix < enwiki-latest-pages-articles.page000m000k.xml > image.page000m000k
shell$ wikix < enwiki-latest-pages-articles.page000m050k.xml > image.page000m050k
...
shell$ wikix < enwiki-latest-pages-articles.page000m950k.xml > image.page000m950k
```

E.18.3.3 IMAGE (existing)

Since we have over 1 million media files, let us insert the `image` table records first, so that we can see images right away during `page` table insertion below (time: one week):

```
root-shell# php /usr/share/mediawiki/maintenance/rebuildImages.php --missing
```

Due to apparent memory leak, this job had to be killed every 50,000 media files and restarted (e.g. process 0/00 to 0/07, kill, then process 0/08 to 0/0f).

E.18.3.4 IMAGE (new)

Download any new media files, then insert into `image` table (time: 3-4 weeks):

```
root-shell# cp image.page* /database0/images/
```

Since `darkstar-5` has no Internet connection, I use `darkstar-4`:

```
root-shell# ssh darkstar-4
darkstar-4:# sshfs darkstar-5:/database0 /database0
darkstar-4:# cd /database0/images/
darkstar-4:# ./image.page000m
darkstar-4:# ./image.page001m
darkstar-4:# ...
darkstar-4:# fusermount -u /database0
darkstar-4:# exit
root-shell#
```

Then I return to `darkstar-5` and insert any new media files into `wikidb`:

```
root-shell# php /usr/share/mediawiki/maintenance/rebuildImages.php --missing
```

E.18.3.5 PAGE

Insert `page` table records 50,000 at a time, due to apparent memory leak (time: two months):

```
root-shell# php /usr/share/mediawiki/maintenance/importDump.php <
enwiki-latest-pages-articles.page000m000k.xml
root-shell# php /usr/share/mediawiki/maintenance/importDump.php <
enwiki-latest-pages-articles.page000m050k.xml
...
```

Actually, I prefer commands that can run for 20-24 hours (or even 2-3 days if I am away for the weekend), for example:


```
root-shell# php /usr/share/mediawiki/maintenance/importDump.php < \
latest/enwiki-latest-pages-articles.page000m000k.xml ; sleep 30m ; php \
/usr/share/mediawiki/maintenance/importDump.php < \
latest/enwiki-latest-pages-articles.page000m050k.xml ; sleep 30m ; php \
/usr/share/mediawiki/maintenance/importDump.php < \
latest/enwiki-latest-pages-articles.page000m100k.xml ; sleep 30m ; php \
/usr/share/mediawiki/maintenance/importDump.php < \
latest/enwiki-latest-pages-articles.page000m150k.xml
root-shell# rm latest/enwiki-latest-pages-articles.page000m[01]*xml
```

E.18.3.6 InnoDB Flushing

The `sleep 30m` commands gives **InnoDB** time to flush its **buffer pool** between each batch of inserts. This actually yeilds an overall speed increase (about 2x). Flushing the **buffer pool** usually takes about 20m:

```
shell$ dc
192000 0.75/p
144000
133/p
1082
60/pq
18
shell$
```

The estimation of time required to flush the **buffer pool** goes as follows: The **InnoDB Plugin** default `innodb_max_dirty_pages_pct` is 75. So

192,000 **buffer pool** size * 75% = 144,000 max modified pages

144,000 modified pages / 133 pages flushed per s = 1082s = 18m.

Actually, this may be an underestimate, because **InnoDB** reads in tens of thousands of pages during the page flushing process; perhaps in order to merge underfilled pages and split overfilled pages. When, during the flushing, we look at the engine status, we can see a great increase in the number of 'merged recs' and 'merges'.

```
mysql> SHOW ENGINE INNODB STATUS\G
...
-----
INSERT BUFFER AND ADAPTIVE HASH INDEX
-----
Ibuf: size 937, free list len 1475, seg size 2413,
952695 inserts, 824292 merged recs, 440497 merges    <-- increase during flush
Hash table size 6222817, node heap has 3850 buffer(s)
0.00 hash searches/s, 174.10 non-hash searches/s
...
```

E.18.3.7 Pipelining

To save time, I pipelined the **IMAGE(new)** and **PAGE** steps:

Timeslot	Image Download	rebuildImages.php	importDump.php
000	image.page000m		
001		image.page000m	
002	image.page001m		enwiki...page000m000k.xml enwiki...page000m050k.xml ...
003		image.page001m	
004	image.page002m		enwiki...page001m000k.xml enwiki...page001m050k.xml enwiki... ...
005		image.page002m	
006	image.page003m		enwiki...page002m000k.xml enwiki...page002m050k.xml ...

Note: Simultaneously running [rebuildImages.php](#) and [importDump.php](#) can cause [InnoDB](#) to deadlock, which in turn causes one or both scripts to abort, leaving an error message identifying the offending [SQL](#) statement.

```
mysql> SHOW ENGINE INNODB STATUS\G
```

also describes the deadlock in detail, identifying the [SQL](#) statements involved, and which one was rolled back to break the deadlock.

Note: There appears to be no conflict between running the media file download scripts and the other two processes.

E.18.3.8 [InnoDB](#) Deleting

Sometimes [importDump.php](#) appears to just stop, with [top](#) showing no activity for [php](#), and significant activity for [mysql](#). This is usually because [InnoDB](#) sometimes stops taking queries to concentrate upon flushing tens of thousands of dirty pages to disk. The above mentioned [sleep 30m](#) is meant for that case.

Occasionally, however, the delay is hours long! Investigation revealed [MediaWiki](#) occasionally submits a query that must delete a million or so rows, such as this one:

```
DELETE /* mediawikiBagOStuff::_doquery 127.0.0.1 */ FROM 'objectcache'
WHERE exptime < '20110517051938'
```

In this particular case, [InnoDB](#) showed high levels of read and delete:

```
mysql> SHOW ENGINE INNODB STATUS\G
...
Number of rows inserted 9536, updated 5830, deleted 1190986, read 1242549
0.00 inserts/s, 0.00 updates/s, 774.23 deletes/s, 774.23 reads/s
...
```

and the [objectcache](#) table showed millions of rows:

```
mysql> SHOW TABLE STATUS LIKE 'objectcache'\G
...
Rows: 2390302
...
```

Even after the deleting stops, `InnoDB` will still need an hour to merge all the underfilled ‘database pages’.

The one way to deal with this situation is to preemptively delete the cache by running `update.php`:

```
root-shell# php /usr/share/mediawiki/maintenance/update.php
```

E.19 Messages

E.19.1 `/bin/bash`

Some media filenames confuse `sh`, even though they are in quotes. Control characters (ampersand, asterisk, backquote, brackets, braces, etc.) must be escaped. In some cases (file name contains a ampersand, percent) WP-MIRROR will not download the file at all.

Many file-names use Unicode. Most utilities are now able to handle Unicode.

E.19.2 Filename Issues

If you use `polipo` (a caching web proxy), then thousands of media file requests will be redirected. File names containing an apostrophe or a quote, seem to be the only ones effected.

```
root-shell# cat /var/lib/mediawiki/images/0/00/Dalida'.jpg
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN"
  "http://www.w3.org/TR/html4/loose.dtd">
<html><head>
<title>Proxy result: 302 Redirected by external redirector.</title>
</head><body>
<h1>302 Redirected by external redirector</h1>
<p>The following status was returned:<br><br>
<strong>302 Redirected by external redirector</strong></p>
<hr>Generated Sat, 05 Nov 2011 18:32:23 EDT by Polipo on
  <em>darkstar-7:8123</em>.
</body></html>
```

We can identify and remove these files after downloading.

```
root-shell# cd /var/lib/mediawiki/images/0/00/
root-shell# gm identify -verbose Chief_Scout's_Bronze_Award_(The_Scout_Association).png
gm identify: Improper image header (Chief_Scout's_Bronze_Award_(The_Scout_Association).png).
root-shell# gm identify -verbose Dalida'.jpg
gm identify: Not a JPEG file: starts with 0x3c 0x21 (Dalida'.jpg).
root-shell# gm identify -verbose Rock_'N_Roll_Loony_Party_-The-_1.gif
gm identify: Improper image header (Rock_'N_Roll_Loony_Party_-The-_1.gif).
root-shell# gm identify -verbose Transistor_Count_and_Moore's_Law_-_2011.svg
gm identify: Opening and ending tag mismatch: br line 0 and p.
```

Note that error messages are different for each media file format.

E.19.3 `gm convert` (GraphicsMagick)

`gm convert` warns of media file corruption

/usr/bin/gm convert: Corrupt image (/var/lib/mediawiki/images/5/5e/Swainsley_Bridge.gif).

/usr/bin/gm convert: Corrupt JPEG data: 190 extraneous bytes before marker 0xd9 (/var/lib/mediawiki/images/4/45/Silveira.jpg).

/usr/bin/gm convert: Corrupt JPEG data: bad Huffman code (/var/lib/mediawiki/images/a/ad/CarolynSGriner3.jpg)

/usr/bin/gm convert: Corrupt JPEG data: found marker 0xd9 instead of RST4 (/var/lib/mediawiki/images/1/11/Union_Station_Louisville.JPG).

/usr/bin/gm convert: Corrupt JPEG data: found marker 0xd9 instead of RST6 (/var/lib/mediawiki/images/c/c5/BrownUniversity-JohnDRockefellerJrLibrary.jpg).

/usr/bin/gm convert: Corrupt JPEG data: premature end of data segment (/var/lib/mediawiki/images/0/0c/Hurricane_Dennis_10_july_2005_1615Z.jpg).

/usr/bin/gm convert: Ignoring attempt to set cHRM RGB triangle with zero area (/var/lib/mediawiki/images/8/8a/DYK_star.png).

/usr/bin/gm convert: Ignoring gAMA chunk with gamma=0 (/var/lib/mediawiki/images/6/62/TF3D_Portrait.png).

/usr/bin/gm convert: Incorrect sRGB chunk length (/var/lib/mediawiki/images/f/f7/Bunny_Breckinridge_(cropped).png).

/usr/bin/gm convert: Invalid JPEG file structure: missing SOS marker (/var/lib/mediawiki/images/9/9b/Vw-baunatal-brand.jpg).

/usr/bin/gm convert: Invalid SOS parameters for sequential JPEG (/var/lib/mediawiki/images/e/e2/Vf142ghost.jpg).

/usr/bin/gm convert: Missing PLTE before bKGD (/var/lib/mediawiki/images/d/d4/SpartaDOS_X_menu.png).

/usr/bin/gm convert: Premature end of JPEG file (/var/lib/mediawiki/images/f/fe/Bush-Howard_2001_review.jpg).

/usr/bin/gm convert: Profile size field missing from iCCP chunk (/var/lib/mediawiki/images/1/13/Couturier.png).

/usr/bin/gm convert: Read Exception (/var/lib/mediawiki/images/2/2b/J.F._de_la_Cerda_por_Claudio_Coello_01.png).

/usr/bin/gm convert: tRNS chunk has out-of-range samples for bit_depth (/var/lib/mediawiki/images/7/76/Communes_of_Luxembourg.png).

/usr/bin/gm convert: Warning: unknown JFIF revision number 2.01 (/var/lib/mediawiki/images/c/c0/MASINT-AF-Helo-AN-TPQ-36.jpg).

E.19.4 `convert` (ImageMagick)

This program overcommits DRAM, causing the kernel to randomly kill other processes, eventually hanging the system.

Recommendation: Do not use.

E.19.5 `graphicsmagick-imagemagick-compat`

This package is supposed to replace `/usr/bin/convert` with a symbolic link to `gm`. However, experiments show that this approach results in a surprising number of segmentation faults. Worse, `convert` frequently hung without crashing, thereby stopping the importation process.

```
sh: line 1: 15126 Segmentation fault      convert -background white -thumbnail
250x198 '/var/lib/mediawiki/images/f/f6/Aphaenogaster.lepida.-.wheeler.svg'
PNG: '/var/lib/mediawiki/images/thumb/f/f6/Aphaenogaster.lepida.-.wheeler.svg/
250px-Aphaenogaster.lepida.-.wheeler.svg.png' 2>&1
```

A few hundred pages thereafter, `convert` crashed with the following error message.

```
*** glibc detected *** convert: double free or corruption (out): 0x00007f313150e010 ***
===== Backtrace: =====
/lib/libc.so.6(+0x71ad6) [0x7f3132ac1ad6]
/lib/libc.so.6(cfree+0x6c) [0x7f3132ac684c]
/usr/lib/libGraphicsMagick.so.3(DestroyCacheInfo+0xd1) [0x7f3135a31901]
/usr/lib/libGraphicsMagick.so.3(DestroyImagePixels+0x28) [0x7f3135a31a88]
/usr/lib/libGraphicsMagick.so.3(DestroyImage+0x76) [0x7f3135a1f5d6]
/usr/lib/libGraphicsMagick.so.3(MogrifyImage+0x14b5) [0x7f31359b38c5]
/usr/lib/libGraphicsMagick.so.3(MogrifyImages+0x147) [0x7f31359b6947]
/usr/lib/libGraphicsMagick.so.3(ConvertImageCommand+0xaba) [0x7f31359cc07a]
/usr/lib/libGraphicsMagick.so.3(MagickCommand+0x161) [0x7f31359c4e91]
/usr/lib/libGraphicsMagick.so.3(GMCommand+0xbc) [0x7f31359c4fbc]
/lib/libc.so.6(__libc_start_main+0xfd) [0x7f3132a6ec4d]
convert(+0x7f9) [0x7f31360777f9]
===== Memory map: =====
7f312c000000-7f312c024000 rw-p 00000000 00:00 0
7f312c024000-7f3130000000 ---p 00000000 00:00 0
...
```

`convert` frequently hung without crashing, thereby stopping the importation process. This could be seen by listing any image conversion processes

```
shell$ ps -wef | grep onv
```

Perhaps this is because `/usr/bin/convert` is a soft link to `gm`, so `convert <params>` becomes `gm <params>` instead of `gm convert <params>`.

Recommendation: Do not use.

E.19.6 `dvips`

On rare occasion, `dvips` can emit an error message:

```
dvips: Can't make it EPSF, sorry
Warning: no %%Page comments generated.
```

E.19.7 PHP Notice: Undefined index:

I got bursts of ‘PHP Notice: Undefined index’ messages. These arise when [PHP](#) reads an array and expects to find a certain index that turns out not to exist. In [GlobalFunctions.php](#) the offending code is trying to create an URL for email.

```
function wfParseUrl( $url )

PHP Notice: Undefined index: scheme in /usr/share/mediawiki/includes/GlobalFunctions.php on line 2423

PHP Notice: Undefined index: scheme in /usr/share/mediawiki/includes/GlobalFunctions.php on line 2425

function wfMakeUrlIndex( $url )

PHP Notice: Undefined index: host in /usr/share/mediawiki/includes/GlobalFunctions.php on line 2449
```

[Fckeditor](#) is a ‘rich text format javascript web editor’. Debian has two packages [fckeditor](#) and [mediawiki-extensions-fckeditor](#).

```
PHP Notice: Undefined index: HTTP_USER_AGENT in /usr/share/fckeditor/fckeditor_php5.php on line 37
```

You probably do not want to edit any pages of your mirror of wikipedia. These errors appear in [/var/log/apache2/](#). They can be reduced by making sure your browsers (including [cURL](#) and [wget](#)) provide the user-agent field.

Update: For WP-MIRROR 0.4, the problem had gone away. As of [MediaWiki 1.18](#), the [Fckeditor](#) extension is obsolete. According to the Wikimedia Foundation:

This extension is no longer supported by the upstream developers.

[http://www.mediawiki.org/wiki/Extension:FCKeditor_\(Official\)](http://www.mediawiki.org/wiki/Extension:FCKeditor_(Official)), accessed 2012-12-19

Recommendation: Do not use.

E.19.8 PHP Notice: xml_parse()

Some 50,000 files gave tens of thousands of warnings like these:

```
PHP Warning: xml_parse(): Unable to call handler in_() in /usr/share/mediawiki/includes/Import.php on line 437

PHP Warning: xml_parse(): Unable to call handler out_() in /usr/share/mediawiki/includes/Import.php on line 437
```

Importation of some 3 million pages was impeded by the above error. This is a bug in [Import.php](#) (1.15). To fix, download a patched version from

<http://svn.wikimedia.org/viewvc/mediawiki/trunk/phase3/includes/Import.php?view=co> and replace the original file in the [/includes/](#) directory.

Update: For WP-MIRROR 0.4, the problem has gone away. [MediaWiki 1.19](#) does not need the patch.

E.19.9 PHP Warning

I have seen this warning a couple dozen times, once as a blast of 40 or so messages.

```
PHP Warning: preg_replace_callback(): Unknown modifier 'c' in /usr/share/php-geshi/geshi.php on line 3300
```

GeSHi stands for Generic Syntax Highlighter. Debian packages are [php-geshi](#) and [mediawiki-extensions-geshi](#).

Appendix F

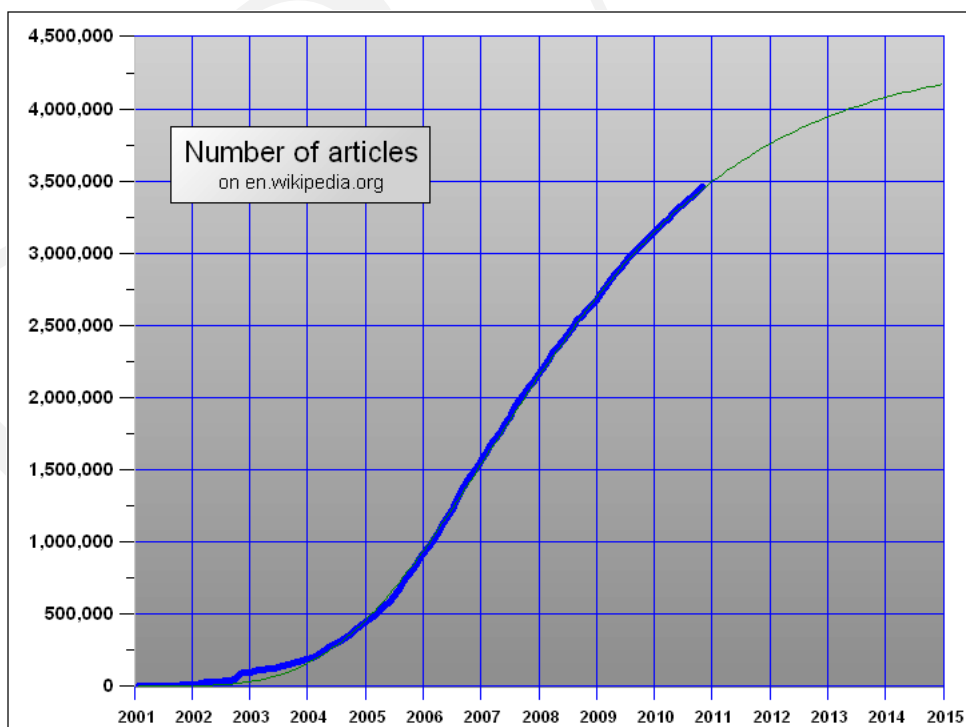
Trends (2011-Dec-21)

On 2011-Dec-21, the author made a presentation at the [DC Linux Users Group](#) days before the release of WP-MIRROR 0.2 on 2011-Dec-25. The slides, in [PDF](#) format, are posted at <http://dclug.tux.org/>. The tables and figures in this chapter are drawn from that presentation. This is also true of [Chapter E, Experiments \(Autumn 2010—Spring 2011\)](#).

F.1 History

We can get an estimate of the future growth and ultimate size of the [en wikipedia](#). See [Figure F.1, Number of Articles on en Wikipedia](#).

Figure F.1: Number of Articles on [en Wikipedia](#)



Source: http://en.wikipedia.org/wiki/History_of_Wikipedia.

Table F.1: Size Distribution by Language

No	Language	Wiki	Articles	Images	Comment
1	English	en	3,806,175	825,559	3T
2	German	de	1,318,393	175,658	
3	French	fr	1,176,662	44,516	
4	Dutch	nl	868,843	18	
5	Italian	it	863,119	96,656	
6	Polish	pl	845,685	2	
7	Spanish	es	845,675	0	
8	Russian	ru	793,753	124,541	
9	Japanese	ja	779,274	77,097	
10	Portugese	pt	705,058	12,920	
44	Simple English	simple	75,489	38	60G
50	Latin	la	61,065	1	
110	Yiddish	yi	9,094	1,434	
249	Zulu	zu	256	0	
275	Choctaw	cho	15	2	

Source: http://meta.wikimedia.org/wiki/List_of_Wikipedias on 2011-11-24.

F.2 Main Components

MediaWiki needs a LAMP stack (Linux, Apache, MySQL, PHP). MediaWiki is written in PHP. MediaWiki and all components of the LAMP stack are available in GNU/Linux distributions (e.g. Debian). The database management system (DBMS) used by the Wikimedia Foundation is MySQL; but, postgres, SQLite, MSsql, and IBM_DB2 are also supported.

Each month (more or less) the Wikimedia Foundation posts a dump file of the en wikipedia. We are interested in the latest revisions only. For example, the dump file `enwiki-20111007-pages-articles.xml.bz2` contains 11.7 million pages and articles, and occupies:

- 7.8G - as a compressed dump file (compressed with bzip2),
- 34G - as an xml file (after decompressed with bunzip2),
- 150G - when stored in a InnoDB table space (using the antelope storage format).

The dump file contains no media files. However, pages and articles do refer to a great number of media files. For example, the dump file `enwiki-20111007-pages-articles.xml.bz2` refers to 1.6 million media files, which after downloading occupy 1T when stored in a file system.

If one wanted to mirror everything, then I would guess (to the nearest power of 10) a disk storage requirement of:

- 10T - for the en wikipedia, with all revisions, user talk, etc.
- 100T - for all languages with everything.

Update (late 2012): Storage estimate for en wikipedia media files is now 3T.

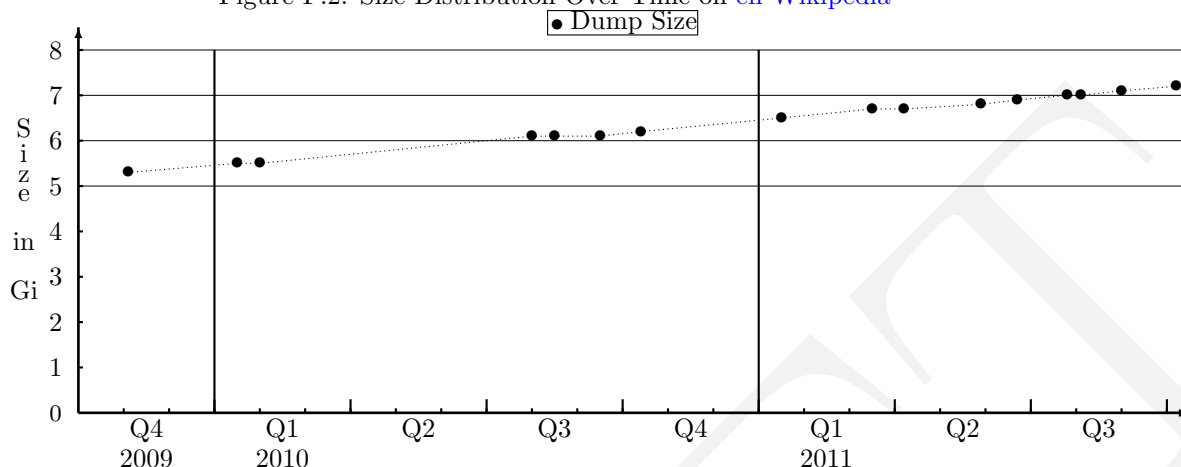
F.3 Size Distribution

F.3.1 Size Distribution—by Language

The en wikipedia is the most challenging case. The simple wikipedia looks manageable for laptops. See Table F.1, Size Distribution by Language.

F.3.2 Size Distribution—over Time

The size of the en wikipedia dump file `enwiki-yyyyymmdd-pages-articles.xml.bz2` file has been growing. See Figure F.2, Size Distribution Over Time on en Wikipedia.

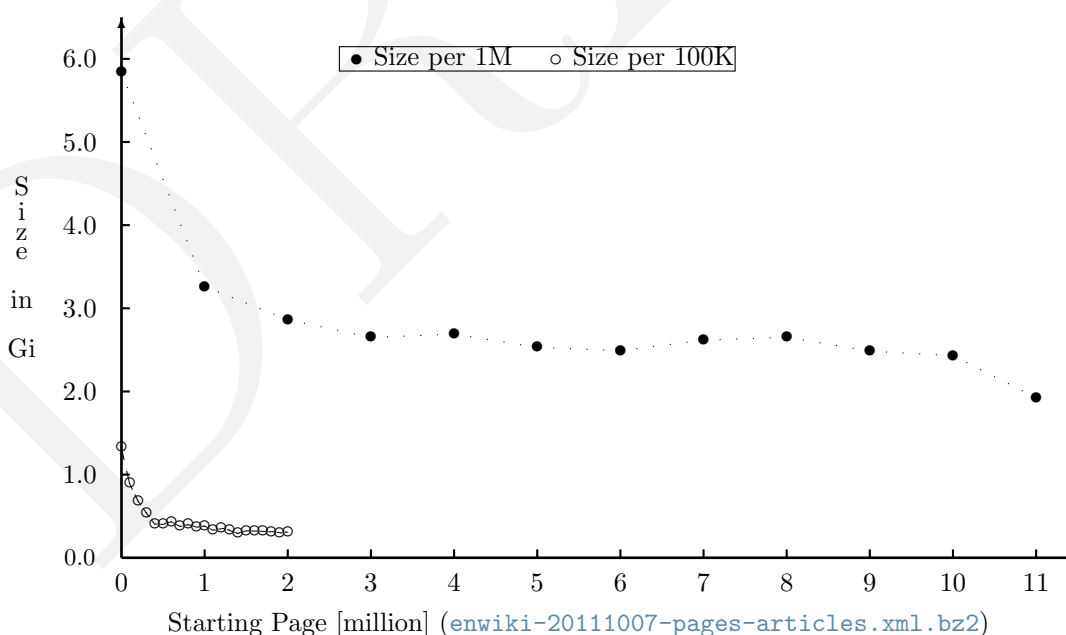
Figure F.2: Size Distribution Over Time on [en Wikipedia](#)

F.3.3 Size Distribution—by Age of Article

The oldest pages are the largest (especially the first 400k). See [Figure F.3, Size Distribution by Age of Article on en Wikipedia](#). The oldest pages also have the most media files (especially the first million). See [Figure F.4, Size Distribution by ichunk on en Wikipedia](#).

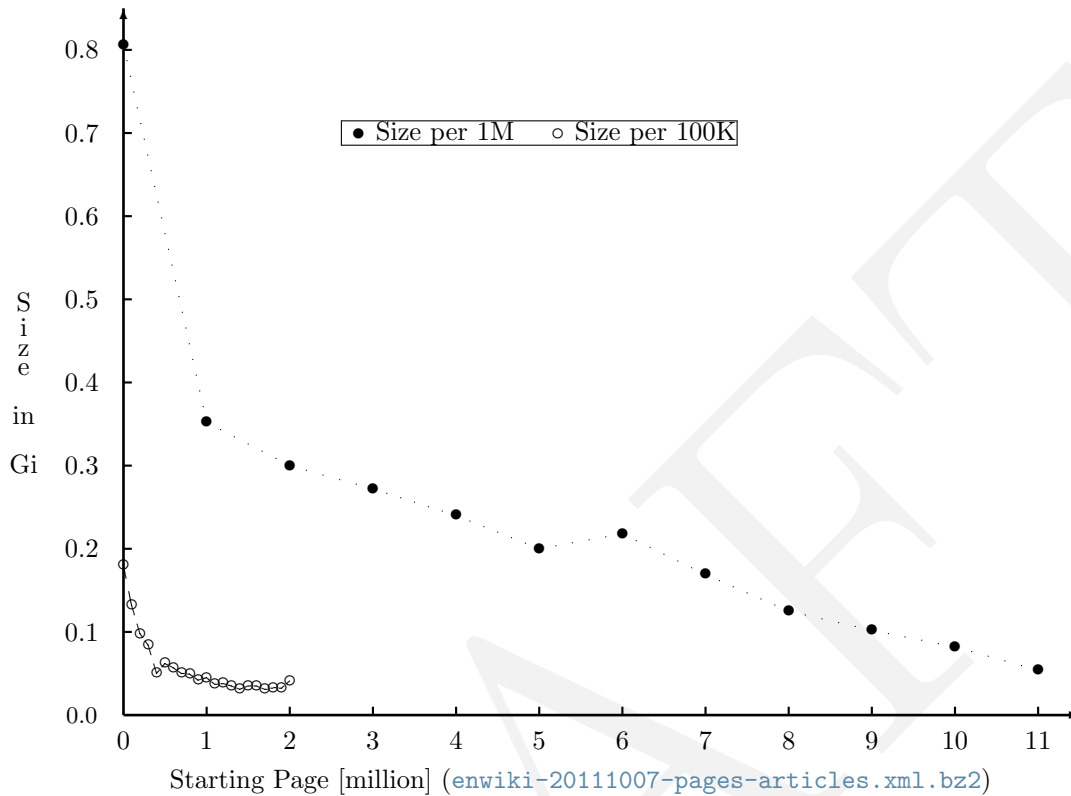
Processing of the oldest pages consumes more resources (disk, cpu, bandwidth, and time) than newer pages. The media file download rate (measured in [ichunks](#) per day) accelerates, because the newer pages have fewer media files. However, the page importation rate (measured in [xchunks](#) per day):

- decelerates, for initial mirror building, because the [pagelinks](#) database table grows too large to fit in the [InnoDB buffer pool](#), and hence disk I/O increases; but
- accelerates, for mirror *updating*, because newer pages are smaller.

Figure F.3: Size Distribution by Age of Article on [en Wikipedia](#)

The data for the size distribution figures:

- [Figure F.3, Size Distribution by Age of Article on en Wikipedia](#), and

Figure F.4: Size Distribution by `ichunk` on [en Wikipedia](#)

- [Figure F.4, Size Distribution by `ichunk` on `en Wikipedia`](#)

were produced by the following SQL commands.

```
mysql> SELECT FLOOR(page/1000000)*1000000 AS page_set,
->          SUM(size)/1000000000 AS 'size [Gi]'
-> FROM file WHERE type='xchunk' GROUP BY page_set;

mysql> SELECT FLOOR(page/100000)*100000 AS page_set,
->          SUM(size)/1000000000 AS 'size [Gi]'
-> FROM file WHERE type='xchunk' GROUP BY page_set LIMIT 20;

mysql> SELECT FLOOR(page/1000000)*1000000 AS page_set,
->          SUM(size)/1000000000 AS 'size [Gi]'
-> FROM file WHERE type='ichunk' GROUP BY page_set;

mysql> SELECT FLOOR(page/100000)*100000 AS page_set,
->          SUM(size)/1000000000 AS 'size [Gi]'
-> FROM file WHERE type='ichunk' GROUP BY page_set LIMIT 20;
```

F.4 Namespace Distribution

Each page belongs to a namespace. However, not all pages are found in the dump files. See [Table F.2, Wikipedia Namespaces](#).

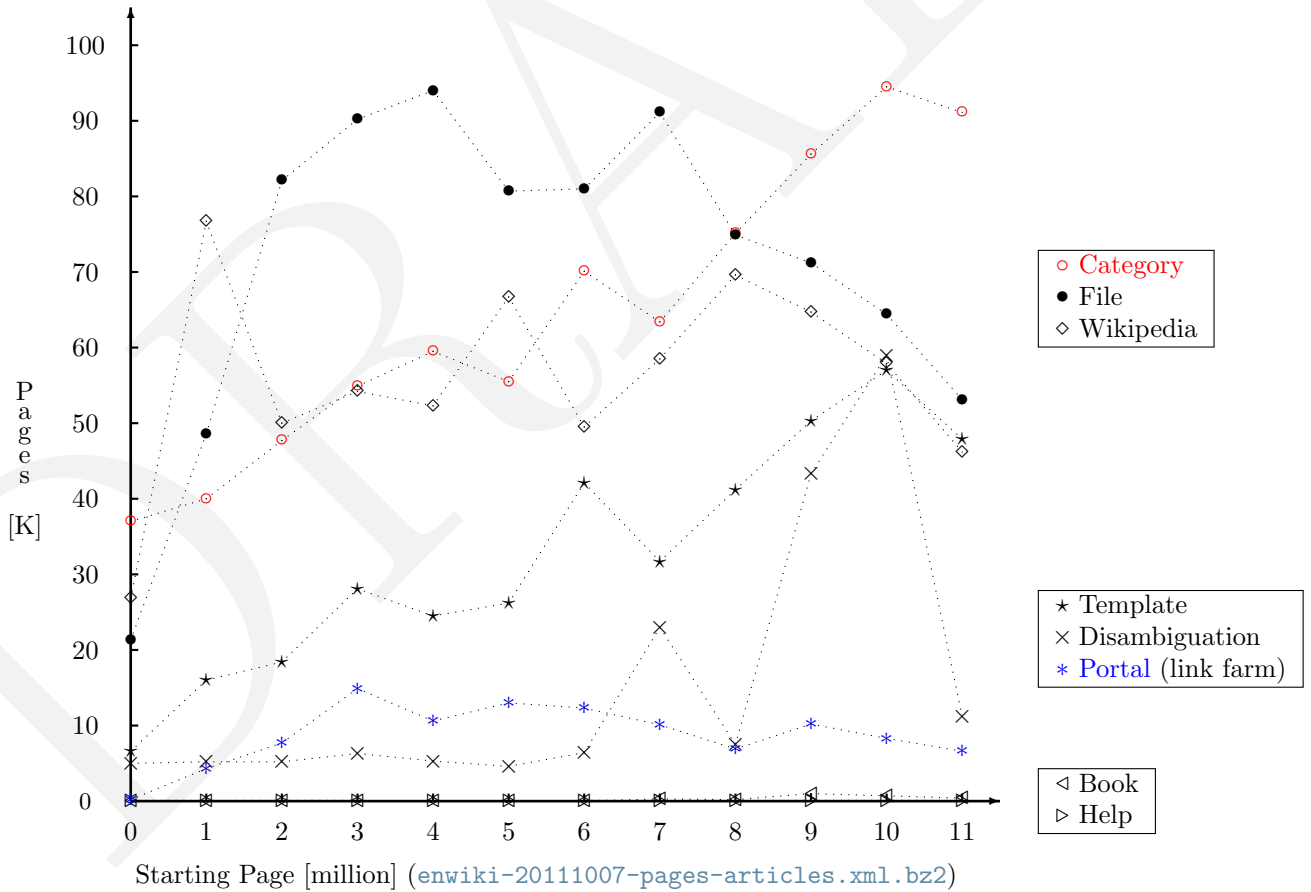
Some trends are apparent. The Category and Template namespaces have become more popular with time. Recently there was a burst of activity writing Disambiguation pages (between pages 9,000,000 and 11,000,000). The File namespace is gradually declining, perhaps due to the

Table F.2: Wikipedia Namespaces

Namespace	Purpose	In Dump
Main	encyclopedia article	Yes
Book	wikipedia books	Yes
Category	topical link farm	Yes
File	audio, image, video	Yes
Help	user and software manual	Yes
Portal	subject area main page	Yes
Template	page inside a page	Yes
Wikipedia	wikipedia project	Yes
Mediawiki	text for auto generated page	No
Summary	liquid thread summary	No
Thread	liquid thread (forum)	No
User	personal use	No

growing use of the Commons for storing media files. See [Figure F.5, Namespace Distribution by Age of Page on en Wikipedia](#) for trends.

Figure F.5: Namespace Distribution by Age of Page on en Wikipedia



Screen shots of pages from different namespaces are shown below.

Figure F.6: Page in Category Namespace

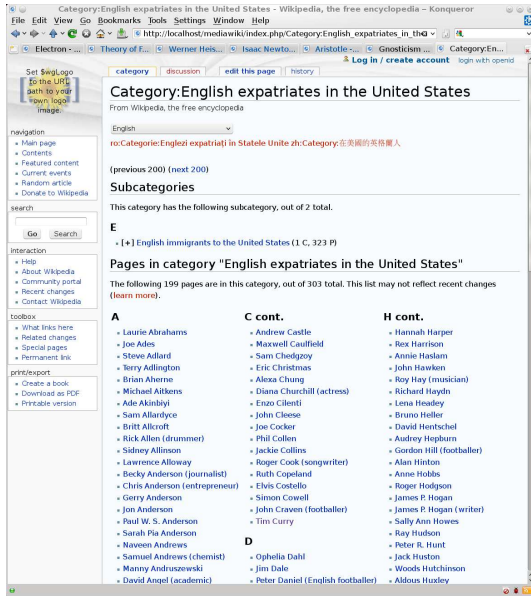


Figure F.7: Page in Help Namespace

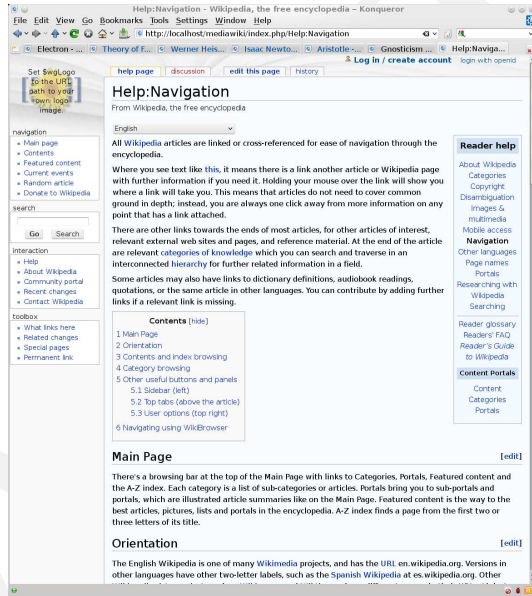


Figure F.8: Page in Main Namespace

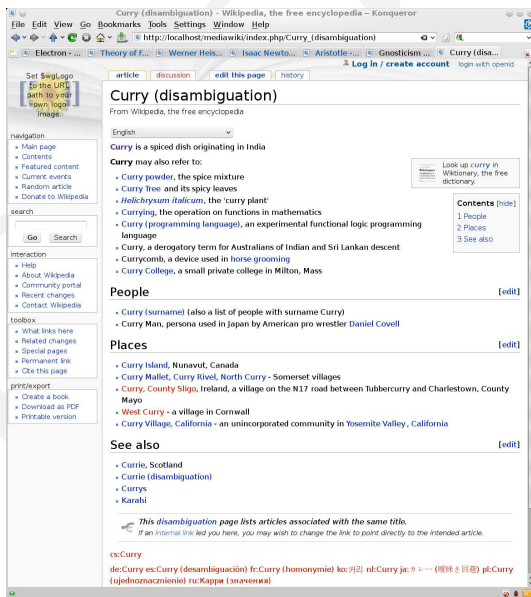


Figure F.9: Page in Portal Namespace

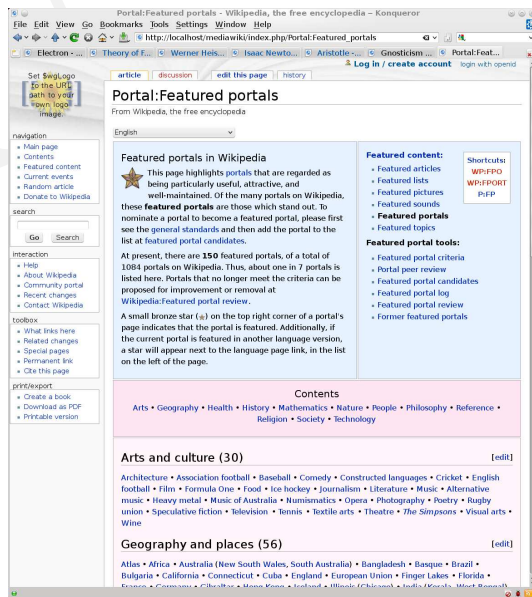


Figure F.10: Page with Small Template

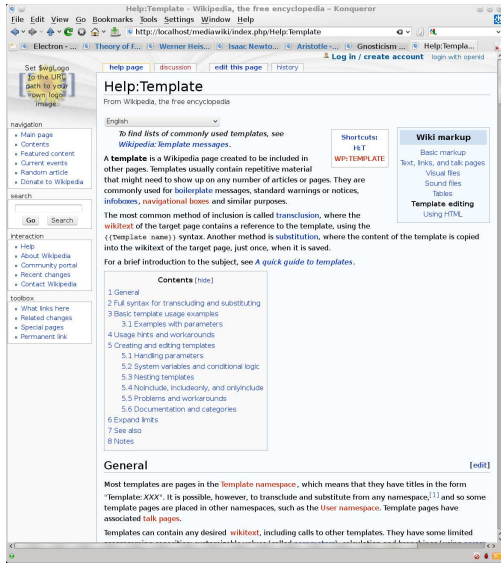


Figure F.11: Page with Large Template

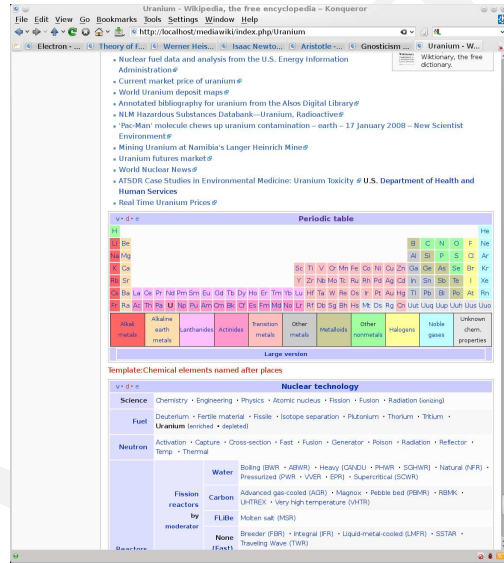
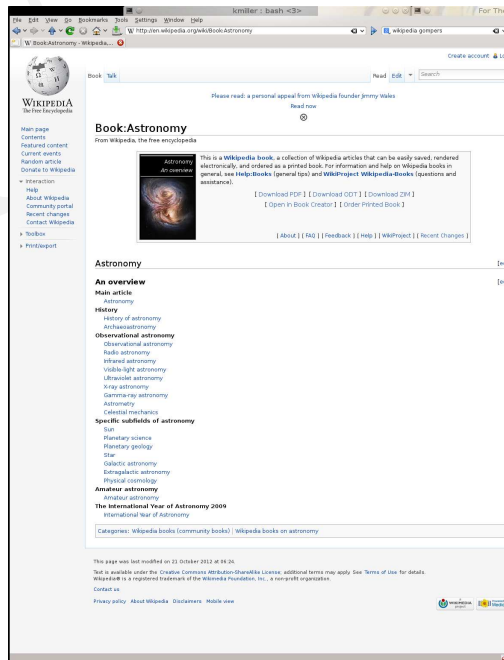


Figure F.12: Page in Wikipedia Namespace



Figure F.13: Page in Book Namespace



Appendix G

Experiments (Winter 2012–2013)

G.1 Introduction

Development for WP-MIRROR 0.6 focused on performance issues. This required profiling the performance of the Finite State Machine. The command-line option `--profile` was introduced to display data collected during a run.

The purpose of profiling is to identify the functions that are consuming most of the resources, and then to look for ways to improve the performance of those functions.

This set of experiments included:

- **Baseline**: profiling WP-MIRROR before any optimization in order to determine which functions needed optimization;
- **Performance vs. durability**: measuring the trade-off between Durability (the ‘D’ in ACID) and database performance;
- **Performance and persistent connections**: measuring the effect of HTTP/1.1 persistent connections for downloading media files;
- **Performance and compilation**: measuring the effect of compiling for maximum speed, a function containing a computationally expensive loop;
- **Performance vs. image processing**: separately measuring the time spent on downloading and validating media files;
- **Experiments with InnoDB data compression**: measuring the effect of compressing InnoDB tables;
- **Experiments with commonswiki.image**: measuring the effect of InnoDB configuration on speed of importing commonswiki.image table; and
- **Experiments with mwxml2sql**: documenting the process of submitting patches upstream to WMF.

Source: <http://www.mysqlperformanceblog.com/2010/02/28/maximal-write-througput-in-mysql/>, accessed 2012-12-28.

G.2 Baseline

Let us profile building a new mirror containing both the `xh` and `zu` wikipedias. These wikipedias are much smaller than the `simple` wikipedia, and are chosen in hopes of collecting profiling data adequate to the task of optimizing WP-MIRROR 0.6, without unduly burdening the servers at the Wikimedia Foundation.

First, since the author’s system stands behind a caching web proxy, let us first `ssh` into the proxy and delete its cache of wikimedia media files by executing:

```
shell$ ssh proxy
proxy$ su
Password:
proxy# /etc/init.d/polipo stop
proxy# rm -rf /var/cache/polipo/upload.wikimedia.org/
proxy# /etc/init.d/polipo start
proxy# exit
proxy$ exit
shell$
```

Second, let us choose our languages:

```
root-shell# emacs /etc/wp-mirror/local.conf
(defparameter *mirror-language-code-list* '("zh" "zu"))
```

Third, we make a series of time trials:

Run 1: Build the mirror and call this the ‘baseline’:

```
root-shell# wp-mirror --mirror
...
```

Run 2: Drop mirror, deleting local media files, but keeping media files cached by proxy, then rebuild mirror and call this the ‘proxy baseline’:

```
root-shell# wp-mirror --drop zh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
shell$ mysql --host=localhost --user=root --password --execute="DROP TABLE wpmirror.image"
Enter password:
root-shell# wp-mirror --mirror
```

Run 3: Drop mirror, keeping media files, then rebuild mirror and call this the ‘non-image baseline’:

```
root-shell# wp-mirror --drop zh
root-shell# wp-mirror --drop zu
root-shell# wp-mirror --mirror
```

Run 4: Rebuild mirror (this is the usual result of the weekly `cron` job when the Wikimedia Foundation has not posted a new dump).

Finally, let us display the profiles by executing:


```
root-shell# wp-mirror --profile
```

```
...
```

Function	4	3	2	1
fsm-boot	0	0	0	0
fsm-database-checksum	0	0	0	0
fsm-database-create	0	48	43	45
fsm-database-grant	0	0	0	0
fsm-database-interwiki	0	0	0	0
fsm-file-count	0	1	1	1
fsm-file-decompress	0	1	0	0
fsm-file-digest	0	0	1	0
fsm-file-download	0	0	0	0
fsm-file-import	0	1,414	1,350	1,387
fsm-file-parse	0	0	0	0
fsm-file-remove	0	0	0	0
fsm-file-scrape	0	133	134	136
fsm-file-shell	0	169	1,308	1,525
fsm-file-split	0	1	1	1
fsm-file-validate	0	0	0	0
fsm-images-chown	0	9	10	10
fsm-images-count	0	16	17	16
fsm-images-rebuild	0	412	443	484
fsm-images-validate	0	45	6,003	7,179
fsm-no-op	0	0	0	0
FSM-TOTAL	7	3,345	10,411	11,889
GRAND-TOTAL	10	3,348	10,456	11,933

Most of the ‘wall clock’ time was consumed by three FSM functions:

- `fsm-file-import` which loads wikipedia pages into the database,
- `fsm-file-shell` which downloads media files, and
- `fsm-images-validate` which sequesters corrupt files.

and `fsm-images-validate` spent most of its time on one large (90M) media file, `Hans_Holbein_the_Younger_-_The_Ambassadors_-_Google_Art_Project.jpg`. Apparently, `gm` placed a 1.9G scratch file under `/tmp/`, and then spent the better part of 2 hours thrashing.

Let us examine the performance of the three functions:

- `fsm-file-import` consumes the same amount of time (runs 1, 2, and 3) independent of what we do with media files;
- `fsm-file-shell` now takes time for the initial download from the Wikimedia Foundation (run 1), shows some savings when downloading from a proxy (run 2), and consumes little time once the media files have been downloaded (run 3);
- and `fsm-images-validate` is expensive (runs 1 and 2), unless the results from a previous run are stored in the `wpmirror.image` database table (run 3).

Let us now see what can be done to improve the performance of these three functions.

G.3 `fsm-file-import` and Durability

Motivation: `fsm-file-import` performance may be improved by tinkering with the database management system (DBMS) and the underlying hardware.

Concept: Full ACID compliance is achieved at a cost; and yet, full ACID compliance may not be necessary, in our case.

For full ACID compliance, each transaction must be flushed to disk right after it `COMMITs`. There is, however, a case to be made for backing away from full ACID compliance. WP-MIRROR was designed for robustness in the face of problematic dump and media files. To achieve robustness, the work was split up into small chunks, separated by checkpoints. If the processing of a chunk fails, the chunk is passed over. In the event of system failure, processing is resumed from the last checkpoint.

The use of checkpoints means that transactions lost due to system failure, are repeated when WP-MIRROR resumes. In other words, full ACID compliance is not a requirement, in our case.

Let us see if any performance gains can be had:

Run 1: The ‘no-image baseline’.

Process: When a transaction `COMMITs`:

- transaction is written to `log buffer`,
- `log buffer` is written immediately to `log file`,
- `log file` is written immediately to physical disk.

Durability: Greatest possible durability.

```
root-shell# wp-mirror --profile 0          <-- drop old profiles
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# wp-mirror --mirror
```

Run 2: Enable HDD Write Cache

Process: When a transaction `COMMITs`:

- transaction is written to `log buffer`,
- `log buffer` is written immediately to `log file`,
- `log file` is flushed immediately to HDD write cache,
- HDD write cache is written *later* to physical disk.

Durability: System failure can cause loss of any transaction held in HDD write cache that is not yet written to the physical disk.

Configuration:

```
root-shell# emacs /etc/wp-mirror/local.conf
(defparameter *system-hdd-write-cache*      1) ; 0=disabled, 1=enabled
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# wp-mirror --mirror
```

Run 3: Flush InnoDB log file once per second

Process: When a transaction `COMMITs`:

- transaction is written to `log buffer`,
- `log buffer` is written immediately to `log file`,
- `log file` is written *once per second* to HDD write cache,
- HDD write cache is *later* written to physical disk.

Durability: System failure can cause loss of up to one second of transactions.

Configuration:

```
root-shell# emacs /etc/mysql/conf.d/wp-mirror.cnf
innodb_flush_log_at_trx_commit = 2 # default 1. (2=write log file once/sec)
sync_binlog                     = 0 # default 0.
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# wp-mirror --mirror
```

Run 4: Flush `InnoDB` log buffer once per second

Process: When a transaction `COMMITs`:

- transaction is written to `log buffer`,
- `log buffer` is written *once per second* to `log file`,
- `log file` is flushed immediately to HDD write cache,
- HDD write cache is written *later* to physical disk.

Durability: Any `mysqld` crash, and any system failure, can cause loss of up to one second of transactions.

Configuration:

```
root-shell# emacs /etc/mysql/conf.d/wp-mirror.cnf
innodb_flush_log_at_trx_commit = 0 # default 1. (0=write log buffer once/sec)
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# wp-mirror --mirror
```

Finally, let us display the profiles by executing:

```
root-shell# wp-mirror --profile
...
+-----+-----+-----+-----+
| Function          | 4 | 3 | 2 | 1 |
+-----+-----+-----+-----+
| fsm-boot          | 0 | 0 | 0 | 0 |
| fsm-database-checksum | 0 | 0 | 0 | 0 |
| fsm-database-create | 30 | 29 | 28 | 47 |
| fsm-database-grant | 0 | 0 | 0 | 0 |
| fsm-database-interwiki | 0 | 0 | 0 | 0 |
| fsm-file-count     | 2 | 1 | 1 | 1 |
| fsm-file-decompress | 0 | 1 | 0 | 0 |
| fsm-file-digest    | 1 | 1 | 1 | 0 |
| fsm-file-download  | 5 | 1 | 3 | 1 |
| fsm-file-import    | 1,145 | 1,151 | 1,328 | 1,459 |
| fsm-file-parse     | 0 | 0 | 0 | 0 |
| fsm-file-remove    | 0 | 0 | 0 | 0 |
| fsm-file-scrape    | 133 | 133 | 136 | 132 |
| fsm-file-shell     | 170 | 170 | 169 | 168 |
| fsm-file-split     | 1 | 1 | 1 | 1 |
| fsm-file-validate  | 0 | 0 | 0 | 0 |
| fsm-images-chown   | 10 | 10 | 10 | 9 |
| fsm-images-count   | 19 | 19 | 18 | 16 |
| fsm-images-rebuild | 216 | 202 | 639 | 428 |
| fsm-images-validate | 50 | 49 | 50 | 45 |
| fsm-no-op          | 0 | 0 | 0 | 0 |
| FSM-TOTAL          | 2,749 | 2,742 | 3,470 | 3,405 |
| GRAND-TOTAL        | 2,751 | 2,745 | 3,473 | 3,407 |
+-----+-----+-----+-----+
```

Analysis: Significant performance improvements are seen for `fsm-file-import` (22% less time) and `fsm-images-rebuild` (50% less time) when HDD write caching is enabled and transactions are flushed to disk once per second (runs 3 and 4). However there is negligible performance difference between: run 3 (`innodb_flush_log_at_trx_commit = 2`) which may lose transactions during system failure; and run 4 (`innodb_flush_log_at_trx_commit = 0`) which may lose transaction during system failure and during `mysqld` failure. Therefore, we should choose the former because it has fewer failure modes.

Recommendation: Default values for WP-MIRROR 0.6 should include:

```
shell$ cat /usr/bin/wp-mirror | grep defparameter | grep write-cache
(defparameter *system-hdd-write-cache*      1) ; 0=disabled, 1=enabled
(defparameter *system-hdd-write-cache-flush* nil) ; t=flush at checkpoint
root-shell# cat /etc/mysql/conf.d/wp-mirror.cnf
[mysqld]
...
# for Durability (the 'D' in 'ACID compliance')
innodb_flush_log_at_trx_commit = 2 # default 1. (2=write logfile once/sec)
sync_binlog                    = 0 # default 0.
...
```

G.4 `fsm-file-shell` and HTTP/1.1 Persistent Connections

Motivation: `fsm-file-shell` performance may be improved by using “persistent connections” as defined in [RFC2616](#), [HTTP/1.1](#).

Concept: Downloading several media files using a single TCP connection, reduces server workload and reduces latency between each download.

Implementation: Write `shell` scripts that invokes `cURL` with several media files specified on the command line. This permits downloading several files using a single TCP connection, thereby reducing latency for all but the first file.

Let us see if any performance gains can be had:

Run 1: The ‘proxy baseline’ with two changes:

- with HDD write caching enabled and InnoDB transactions flushed once per second (as recommended by [§G.3](#), `fsm-file-import` and [Durability](#)) ; and
- keep the `wpmirror.image` database table to avoid repeating media file validation (because validation takes time and is not relevant to measuring the use of persistent connections).

Set WP-MIRROR parameters to:

```
shell$ cat /usr/bin/wp-mirror | grep defparameter | grep connection
(defparameter *mirror-ichunk-connection-time-max*      3000)
(defparameter *mirror-ichunk-persistent-connection*    1)
(defparameter *mirror-ichunk-post-connection-sleep*    0)
```

which produces `shell` scripts that look like:

```
#!/bin/sh
COMMONSPATH=http://upload.wikimedia.org/wikipedia/commons/
IMAGEPATH=http://upload.wikimedia.org/wikipedia/xh/

sleep 0

curl -f -m 3000 \
$COMMONSPATH./6/60/ZICHYJFALU_-_Kastlypark.jpg -o ./6/60/ZICHYJFALU_-_Kastlypark.jpg

sleep 0

curl -f -m 3000 \
$COMMONSPATH./f/fd/IDSKI_BANOVCI.jpg -o ./f/fd/IDSKI_BANOVCI.jpg
...
```

Now execute:

```
root-shell# wp-mirror --profile 0      <-- drop old profiles
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Run 2: Two (2) media files per connection.

Configuration:

```
shell$ cat /usr/bin/wp-mirror | grep defparameter | grep persistent
(defparameter *mirror-ichunk-persistent-connection*      2)
```

which produces `shell` scripts that look like:

```
...
sleep 0

curl -f -m 3000 \
$COMMONSPATH./6/60/ZICHYJFALU_-_Kastlypark.jpg -o ./6/60/ZICHYJFALU_-_Kastlypark.jpg \
$COMMONSPATH./f/fd/IDSKI_BANOVCI.jpg -o ./f/fd/IDSKI_BANOVCI.jpg
...
```

Now execute:

```
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Run 3: Five (5) media files per connection.

Configuration:

```
shell$ emacs /usr/bin/wp-mirror
(defparameter *mirror-ichunk-persistent-connection*      5)
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Run 4: Ten (10) media files per connection.

Configuration:

```
shell$ emacs /usr/bin/wp-mirror
(defparameter *mirror-ichunk-persistent-connection*      10)
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Run 5: Twenty (20) media files per connection.

Configuration:

```
shell$ emacs /usr/bin/wp-mirror
(defparameter *mirror-ichunk-persistent-connection*      20)
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Finally, let us display the profiles by executing:

```
root-shell# wp-mirror --profile
...
+-----+-----+-----+-----+-----+
| Function          | 5 | 4 | 3 | 2 | 1 |
+-----+-----+-----+-----+-----+
| fsm-boot          | 0 | 0 | 0 | 0 | 0 |
| fsm-database-checksum | 0 | 0 | 0 | 0 | 0 |
| fsm-database-create | 32 | 30 | 28 | 31 | 37 |
| fsm-database-grant | 0 | 0 | 0 | 0 | 0 |
| fsm-database-interwiki | 0 | 0 | 0 | 0 | 0 |
| fsm-file-count     | 1 | 1 | 1 | 1 | 1 |
| fsm-file-decompress | 1 | 0 | 1 | 1 | 0 |
| fsm-file-digest    | 1 | 1 | 1 | 1 | 1 |
| fsm-file-download  | 1 | 1 | 1 | 1 | 2 |
| fsm-file-import    | 1,153 | 1,152 | 1,193 | 1,153 | 1,143 |
| fsm-file-parse     | 0 | 0 | 0 | 0 | 0 |
| fsm-file-remove    | 0 | 0 | 0 | 0 | 0 |
| fsm-file-scraper   | 135 | 135 | 134 | 133 | 134 |
| fsm-file-shell     | 487 | 521 | 479 | 747 | 1,308 |
| fsm-file-split     | 1 | 1 | 1 | 1 | 1 |
| fsm-file-validate  | 0 | 0 | 0 | 0 | 0 |
| fsm-images-chown   | 9 | 10 | 10 | 11 | 11 |
| fsm-images-count   | 19 | 19 | 19 | 19 | 19 |
| fsm-images-rebuild | 216 | 212 | 225 | 221 | 222 |
| fsm-images-validate | 50 | 49 | 50 | 49 | 49 |
| fsm-no-op          | 0 | 0 | 0 | 0 | 0 |
| FSM-TOTAL          | 3,074 | 3,111 | 3,121 | 3,331 | 3,883 |
| GRAND-TOTAL        | 3,098 | 3,134 | 3,145 | 3,356 | 3,906 |
+-----+-----+-----+-----+-----+
```

Analysis: Significant performance improvement for `fsm-file-shell` (64% less time) is seen by downloading five media files per TCP connection (run 3). No further improvement is seen by downloading 10 or 20 media files per TCP connection (runs 4 and 5). However, for this experiment, media files were downloaded from a nearby caching web proxy. Therefore, greater latency should be expected when downloading from the Wikimedia Foundation; and, the optimum number of media files per TCP connection should be greater, say 10.

Recommendation: Default values for WP-MIRROR 0.6 should include:

```
shell$ cat /usr/bin/wp-mirror | grep defparameter | grep connection
(defparameter *mirror-ichunk-connection-time-max* 3000)
(defparameter *mirror-ichunk-persistent-connection* 10)
(defparameter *mirror-ichunk-post-connection-sleep* 0)
```

G.5 fsm-file-scraper and compile

Motivation: `fsm-file-scraper` performance may be improved by using compiling the function for maximum speed.

Concept: `common lisp` offers the programmer great control over what *forms* are interpreted vs. compiled; and, if compiled, the degree to which they are optimized for an ‘optimize quality’. The standard ‘optimize qualities’ are: `compilation-speed`, `debug`, `safety`, `space`, and `speed`.

Implementation: The function `fsm-file-scraper` calls `parse-image-file-names` which contains a rather expensive `loop`, which should be compiled for maximum `speed`.

It would be enough to compile just the `loop`, but the author chose to compile the whole function. This is done by placing an `optimize` declaration:

```
(defun parse-image-file-names ...  
...  
  (declare (optimize (speed 3)))  
  (loop  
...  
...)
```

above the `loop` within the body of the function. Then at the bottom of the code, we call the `compile` function:

```
(compile 'parse-image-file-names)
```

There are, in addition, a number of other (frequently called or expensive) functions that will be tested below.

Let us see if any performance gains can be had:

Run 1: The ‘proxy baseline’ with three changes:

- with HDD write caching enabled and InnoDB transactions flushed once per second (as recommended by §G.3, `fsm-file-import` and `Durability`) ;
- keep the `wp-mirror.image` database table to avoid repeating media file validation (because validation takes time and is not relevant to measuring parsing); and
- with HTTP/1.1 persistent connections for downloading media files (as recommended by §G.4, `fsm-file-shell` and `HTTP/1.1 Persistent Connections`).

Configuration:

```
root-shell# wp-mirror --profile 0          <-- drop old profiles  
root-shell# wp-mirror --drop xh  
root-shell# wp-mirror --drop zu  
root-shell# rm -r /var/lib/mediawiki/images/  
root-shell# wp-mirror --mirror
```

Run 2: Optimize `parse-image-file-names` for speed, and compile.

Configuration: Edit code as described above, then

```
root-shell# wp-mirror --drop xh  
root-shell# wp-mirror --drop zu  
root-shell# rm -r /var/lib/mediawiki/images/  
root-shell# wp-mirror --mirror
```

Run 3: Optimize the following ‘overhead’ functions for speed, and compile:

- `fsm-function`, `fsm-process-file`, and `fsm-transition`;
- `parse-image-file-names`; and
- `sql-select-next-file`, and `sql-select-next-file-type-state`.

Configuration: Edit code as described above, then

```
root-shell# wp-mirror --drop xh  
root-shell# wp-mirror --drop zu  
root-shell# rm -r /var/lib/mediawiki/images/  
root-shell# wp-mirror --mirror
```

Run 4: Optimize the following functions for speed, and compile:

- `fsm-function`, `fsm-images-validate`, `fsm-process-file`, and `fsm-transition`; and
- `parse-image-file-names`, `put-and-log-string`;
- `query-database-and-return-stream`, `query-database-and-return-list-of-strings`,
 `query-database-and-return-list-of-lists`;

- `shell-command`;
- `sql-select-next-file`, `sql-select-next-file-type-state`, `sql-select-numeric`, and `sql-update-file`.

Configuration: Edit code as described above, then

```
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Run 5: Optimize the following functions for speed, and compile:

- `_, filter-exist`;
- `fsm-file-shell`, `fsm-function`, `fsm-images-rebuild`, `fsm-images-validate`, `fsm-process-file`, and `fsm-transition`;
- `parse-image-file-names`, `put-and-log-string`, and `put-log-string`;
- `query-database-and-return-stream`, `query-database-and-return-list-of-strings`, `query-database-and-return-list-of-lists`;
- `shell-command`;
- `sql-select-next-file`, `sql-select-next-file-type-state`, `sql-select-numeric`, and `sql-update-file`.

Configuration: Edit code as described above, then

```
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Finally, let us display the profiles by executing:

```
root-shell# wp-mirror --profile
```

```
...
```

Function	5	4	3	2	1
fsm-boot	0	0	0	0	0
fsm-database-checksum	0	0	0	0	0
fsm-database-create	34	34	41	29	30
fsm-database-grant	0	0	0	0	0
fsm-database-interwiki	0	0	0	0	0
fsm-file-count	2	1	1	1	1
fsm-file-decompress	0	0	0	1	0
fsm-file-digest	1	1	1	1	0
fsm-file-download	1	1	1	1	1
fsm-file-import	1,185	1,203	1,208	1,189	1,172
fsm-file-parse	0	0	0	0	0
fsm-file-remove	0	0	0	0	0
fsm-file-scrape	24	25	25	25	137
fsm-file-shell	444	423	440	457	544
fsm-file-split	1	1	1	1	1
fsm-file-validate	0	0	0	0	0
fsm-images-chown	13	11	10	11	8
fsm-images-count	18	19	19	18	19
fsm-images-rebuild	207	209	218	209	211
fsm-images-validate	44	43	50	49	50
fsm-no-op	0	0	0	0	0
FSM-TOTAL	2,921	2,932	2,983	2,968	3,150
GRAND-TOTAL	2,944	2,954	3,007	2,991	3,172
FSM-OVERHEAD	947	961	968	976	976

Analysis: Impressive performance gains for `fsm-file-scrape` (82% less time) are seen from compiling `parse-image-file-names` for speed (run 2). A collateral increase for `fsm-file-shell` (16% less time) is observed (run 2). An increase for `fsm-images-validate` (12% less time) is also seen (run 4). This last observation does not say much, because `gm` was not invoked for any of these runs.

Let us define ‘FSM-OVERHEAD’ as the difference between the sum of `fsm-*` times and the FSM-TOTAL time. Little performance increase for FSM Overhead (3% less time) is seen by compiling the other functions listed above (runs 3, 4, and 5).

Recommendation: The functions `parse-image-file-names` and `fsm-images-validate` should be compiled for speed in WP-MIRROR 0.6.

G.6 Performance and Media Files

Motivation: Mirror building might be quickened by either not downloading media files or by not validating after downloading.

Implementation: WP-MIRROR has two variables `*mirror-image-download-p*` and `*mirror-image-validate-p*` that can be set to `nil` or `t`. This makes four combinations.

Run 1: The ‘proxy baseline’ with four changes:

- with HDD write caching enabled and InnoDB transactions flushed once per second (as recommended by §G.3, `fsm-file-import` and *Durability*) ;
- keep the `wpmirror.image` database table to avoid repeating media file validation (because validation takes time and is not relevant to measuring parsing);
- with HTTP/1.1 persistent connections for downloading media files (as recommended by §G.4, `fsm-file-shell` and *HTTP/1.1 Persistent Connections*); and

- with `parse-image-file-names` compiled for maximum speed (as recommended by §G.6, [Performance and Media Files](#)).

Configuration:

```
root-shell# emacs /etc/wp-mirror/local.conf
(defparameter *mirror-image-download-p* nil)
(defparameter *mirror-image-validate-p* nil)
root-shell# wp-mirror --profile 0          <-- drop old profiles
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Run 2: Enable media file validation (with no media files to validate).

Configuration:

```
root-shell# emacs /etc/wp-mirror/local.conf
(defparameter *mirror-image-download-p* nil)
(defparameter *mirror-image-validate-p* t)
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Run 3: Enable media file downloading.

Configuration:

```
root-shell# emacs /etc/wp-mirror/local.conf
(defparameter *mirror-image-download-p* t)
(defparameter *mirror-image-validate-p* nil)
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Run 4: Enable media file downloading and validation.

Configuration:

```
root-shell# emacs /etc/wp-mirror/local.conf
(defparameter *mirror-image-download-p* t)
(defparameter *mirror-image-validate-p* t)
root-shell# wp-mirror --drop xh
root-shell# wp-mirror --drop zu
root-shell# rm -r /var/lib/mediawiki/images/
root-shell# wp-mirror --mirror
```

Finally, let us display the profiles by executing:

```
root-shell# wp-mirror --profile
```

```
...
```

Function	4	3	2	1
fsm-boot	0	0	0	0
fsm-database-checksum	0	0	0	0
fsm-database-create	35	33	32	35
fsm-database-grant	0	0	0	0
fsm-database-interwiki	12	12	12	12
fsm-file-count	1	1	1	1
fsm-file-decompress	1	0	0	0
fsm-file-digest	0	1	0	0
fsm-file-download	1	6	0	0
fsm-file-import	1,215	1,385	596	589
fsm-file-parse	0	0	0	0
fsm-file-remove	0	0	0	0
fsm-file-scrape	25	25	0	0
fsm-file-shell	461	466	0	0
fsm-file-split	1	1	1	1
fsm-file-validate	0	0	0	0
fsm-images-chown	11	14	0	0
fsm-images-count	19	19	0	0
fsm-images-rebuild	337	353	0	0
fsm-images-validate	6,345	7	0	0
fsm-no-op	0	0	0	0
FSM-TOTAL	9,435	3,292	662	657
GRAND-TOTAL	9,458	3,315	684	679

Analysis: Downloading media files (run 3) triggers many image processing tasks. Interestingly, it also more than doubles the time spent by `fsm-file-import`. This is because the resizing of images to make thumbs is part of this process. Resizing is performed by `gm convert` and `inkscape`.

Validating media files (run 4) adds an expensive task. The intention is to identify bad media files and sequester them before attempting to resize them. Previous experiments with the `en wikipedia` revealed great numbers of corrupt media files, many of which hung the system when resized. See §E.14, [Experiments with Corrupt Media Files](#) and a collection of error messages in §E.19, [Messages](#). That said, I have not seen this problem with the smaller wikipeidias.

Recommendation: The default value for `*mirror-image-validate-p*` should be set to `nil` for WP-MIRROR 0.6. If the user encounters corrupt media files, then the user can enable validation.

G.7 Miscellaneous

G.7.1 Query Cache

```

shell$ mysql --host=localhost --user=root --password
Password:
...
mysql> SHOW GLOBAL VARIABLES LIKE '%query_cache%';
+-----+
| Variable_name          | Value          |
+-----+
| have_query_cache       | YES            |
| query_cache_limit      | 1048576        |
| query_cache_min_res_unit | 4096           |
| query_cache_size       | 16777216       |
| query_cache_type       | ON             |
| query_cache_wlock_invalidate | OFF           |
+-----+
6 rows in set (0.00 sec)
mysql> SHOW GLOBAL STATUS LIKE 'Qcache%';
+-----+
| Variable_name          | Value          |
+-----+
| Qcache_free_blocks     | 980            |
| Qcache_free_memory     | 10983744       |
| Qcache_hits            | 2191250        |
| Qcache_inserts         | 1371568        |
| Qcache_lowmem_prunes   | 0              |
| Qcache_not_cached      | 5259042        |
| Qcache_queries_in_cache | 4827           |
| Qcache_total_blocks    | 10656          |
+-----+
8 rows in set (0.00 sec)

```

Analysis: We see that the `query_cache_size` is 16M, of which 9%, $0.09 = 980/10656$, is free. The default value for `query_cache_size` appears to be adequate.

Recommendation: Keep the default value.

G.7.2 Database Tuning

According to the [MySQL 5.5 Reference Manual](#),

When tuning a [MySQL](#) server, the two most important variables to configure are `key_buffer_size` and `table_open_cache`. You should first feel confident that you have these set appropriately before trying to change any other variables.

[MySQL 5.5 Reference Manual](#), Chap. 8 Optimization, p. 860

G.7.2.1 `key_buffer_size` Tuning

```
shell$ mysql --host=localhost --user=root --password
Password:
```

```
...
mysql> SHOW GLOBAL VARIABLES LIKE 'key%';
```

Variable_name	Value
<code>key_buffer_size</code>	16777216
<code>key_cache_age_threshold</code>	300
<code>key_cache_block_size</code>	1024
<code>key_cache_division_limit</code>	100

```
4 rows in set (0.00 sec)
```

```
mysql> SHOW GLOBAL STATUS LIKE 'key%';
```

Variable_name	Value
<code>Key_blocks_not_flushed</code>	0
<code>Key_blocks_unused</code>	4452
<code>Key_blocks_used</code>	9239
<code>Key_read_requests</code>	22646478
<code>Key_reads</code>	113
<code>Key_write_requests</code>	6238886
<code>Key_writes</code>	4277027

```
7 rows in set (0.00 sec)
```

Analysis: We see that the `key_buffer_size` is 16M, of which 32%, $0.32 = 4452 / (4452 + 9239)$, is free. The default value for `key_buffer_size` appears to be adequate.

Recommendation: Keep the default value.

G.7.2.2 `table_open_cache` Tuning

```
shell$ mysql --host=localhost --user=root --password
Password:
```

```
...
mysql> SHOW GLOBAL VARIABLES LIKE 'table_open%';
```

Variable_name	Value
<code>table_open_cache</code>	400

```
1 row in set (0.00 sec)
```

```
mysql> SHOW GLOBAL STATUS LIKE 'open_table%';
```

Variable_name	Value
<code>Com_show_open_tables</code>	0
<code>Open_table_definitions</code>	46
<code>Open_tables</code>	73

```
3 rows in set (0.00 sec)
```

Analysis: The default value for `table_open_cache` appears to be more than adequate.

Recommendation: Keep the default value.

G.7.3 Optimizing Disk I/O

According to the [MySQL 5.5 Reference Manual](#),

On Linux, you can get much better performance by using [hdparm](#) to configure your disk's interface. (Up to 100% under load is not uncommon.) The following [hdparm](#) options should be quite good for [MySQL](#), and probably for many other applications:

```
hdparm -m 16 -d 1
```

[MySQL 5.5 Reference Manual](#), Chap. 8 Optimization, p. 862

G.7.3.1 Multiple Sector I/O

Multiple sector mode (aka IDE Block Mode), is a feature of most modern IDE hard drives, permitting the transfer of multiple sectors per I/O interrupt. When this feature is enabled, it typically reduces operating system overhead for disk I/O by 30-50%.

[manpage for hdparm](#)

```
root-shell# hdparm -m /dev/sda
/dev/sda:
multcount      = 16 (on)
root-shell# hdparm -I /dev/sda | grep mult
R/W multiple sector transfer: Max = 16  Current = 16
```

Recommendation: Keep default settings.

G.7.3.2 Direct Memory Access

```
root-shell# hdparm -d /dev/sda
/dev/sda:
HDIO_GET_DMA failed: Inappropriate ioctl for device
root-shell# hdparm -I /dev/sda | grep DMA
DMA: mdma0 mdma1 mdma2 udma0 udma1 udma2 udma3 udma4 udma5 *udma6
*   WRITE_DMA|MULTIPLE_FUA_EXT
*   READ,WRITE_DMA_EXT_GPL commands
*   DMA Setup Auto-Activate optimization
```

Recommendation: Keep default settings.

G.8 Experiments with [InnoDB](#) data compression

Purpose: Determine which tables to compress with [InnoDB](#) Data Compression; and to determine the optimal page size for those table that compress well. By page size we mean setting [KEY_BLOCK_SIZE=1,2,4,8, or 16](#) when [ROW_FORMAT=COMPRESSED](#).

Intended benefit: Compressed tables should 1) reduce the time spent on disk I/O bound operations; and 2) ease the disk storage and memory constraints for users with laptops.

G.8.1 Theory

Some [MediaWiki](#) tables should compress well, other not.

Character strings often compress well, whether defined in [CHAR](#), [VARCHAR](#), [TEXT](#), or [BLOB](#) columns. On the other hand, tables containing mostly binary data (integers or floating point numbers) or data that is previously compressed (for example JPEG or PNG images) may not generally compress well, significantly or at all.

[MySQL 5.5 Reference Manual](#), Section 14.4.3 [InnoDB](#) Data Compression, p. 1628

The main benefit is improved performance of I/O bound operations. Economizing on storage and memory is a plus.

Unfortunately, improved performance does not happen for `INSERT` and `UPDATE` workloads.

Compression and the InnoDB Log Files

Before a compressed page is written to a database file, InnoDB writes a copy of the page to the redo log (if it has been recompressed since the last time it was written to the database). This is done to ensure that redo logs will always be usable, even if a future version of InnoDB uses a slightly different compression algorithm. Therefore, some increase in the size of log files, or a need for more frequent checkpoints, can be expected when using compression. The amount of increase in the log file size or checkpoint frequency depends on the number of times compressed pages are modified in a way that requires reorganization and recompression.

MySQL 5.5 Reference Manual, Section 14.4.3 InnoDB Data Compression, p. 1633

G.8.2 Experimental method

Overall method: Measure the size of `*.ibd` files v. a variety of configurations.

Run: We use WP-MIRROR to build a mirror of `simplewiki-20130112-pages-articles.xml.bz2`. Then we identify the tables larger than 100M:

```
root-shell# cd /var/lib/mysql/
root-shell# ls -lh simplewiki/*.ibd | grep [1-9][0-9][0-9]M
-rw-rw---- 1 mysql mysql 124M Jan 14 09:01 simplewiki/categorylinks.ibd
-rw-rw---- 1 mysql mysql 392M Jan 14 09:01 simplewiki/langlinks.ibd
-rw-rw---- 1 mysql mysql 420M Jan 14 09:01 simplewiki/pagelinks.ibd
-rw-rw---- 1 mysql mysql 108M Jan 14 09:00 simplewiki/templatelinks.ibd
-rw-rw---- 1 mysql mysql 476M Jan 14 09:01 simplewiki/text.ibd
```

Experimental method: For each of the above mentioned tables

1. Setup:

- Reset the compression statistics:

```
mysql> SELECT * FROM information_Schema.innodb_cmp_reset;
mysql> SELECT * FROM information_Schema.innodb_cmpmem_reset;
```

- Make empty copy in the `test` database:

```
mysql> CREATE TABLE test.categorylinks LIKE simplewiki.categorylinks;
```

- Set table options where `KEY_BLOCK_SIZE = 1, 2, 4, 8, or 16`:

```
mysql> ALTER TABLE test.categorylinks ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=8;
```

2. Run:

- Populate the copies with data:

```
mysql> INSERT INTO test.categorylinks SELECT * FROM simplewiki.categorylinks;
```

- Measure size of data file:

```
mysql> SELECT * FROM information_schema.innodb_cmp;
mysql> SELECT * FROM information_schema.innodb_cmpmem;
root-shell# cd /var/lib/mysql/
root-shell# ls -lh test/*.ibd
```

3. Tear-down: Drop tables.

```
mysql> DROP TABLE test.categorylinks;
```

G.8.3 EXPERIMENT.0 Baseline configuration

Code: Z-P16

Create copies of the tables:

```
mysql> INSERT INTO test.categorylinks SELECT * FROM simplewiki.categorylinks;
Query OK, 307658 rows affected (45.40 sec)
Records: 307658 Duplicates: 0 Warnings: 0
mysql> INSERT INTO test.langlinks SELECT * FROM simplewiki.langlinks;
Query OK, 2890424 rows affected (8 min 47.26 sec)
Records: 2890424 Duplicates: 0 Warnings: 0
mysql> INSERT INTO test.pagelinks SELECT * FROM simplewiki.pagelinks;
Query OK, 3006777 rows affected (5 min 16.12 sec)
Records: 3006777 Duplicates: 0 Warnings: 0
mysql> INSERT INTO test.templatelinks SELECT * FROM simplewiki.templatelinks;
Query OK, 791802 rows affected (38.08 sec)
Records: 791802 Duplicates: 0 Warnings: 0
mysql> INSERT INTO test.text SELECT * FROM simplewiki.text;
Query OK, 161211 rows affected (1 min 36.74 sec)
Records: 161211 Duplicates: 0 Warnings: 0
```

Measurement:

```
root-shell# ls -lh test/*.ibd
-rw-rw---- 1 mysql mysql 96M Jan 26 06:32 test/categorylinks.ibd
-rw-rw---- 1 mysql mysql 352M Jan 26 06:48 test/langlinks.ibd
-rw-rw---- 1 mysql mysql 296M Jan 26 06:53 test/pagelinks.ibd
-rw-rw---- 1 mysql mysql 76M Jan 26 06:54 test/templatelinks.ibd
-rw-rw---- 1 mysql mysql 476M Jan 26 06:56 test/text.ibd
```

Note the shrinkage for the first four tables. Both `data_length` and `index_length` shrink:

```
mysql> SHOW TABLE STATUS FROM simplewiki WHERE name='categorylinks'\G
***** 1. row *****
      Name: categorylinks
      Engine: InnoDB
      Version: 10
      Row_format: Compact
      Rows: 263136
      Avg_row_length: 185
      Data_length: 48889856
      Max_data_length: 0
      Index_length: 72171520
      Data_free: 4194304
      Auto_increment: NULL
      Create_time: 2013-01-13 18:01:01
      Update_time: NULL
      Check_time: NULL
      Collation: binary
      Checksum: NULL
      Create_options:
      Comment:
1 row in set (0.38 sec)
```

```
mysql> SHOW TABLE STATUS FROM test WHERE name='categorylinks'\G
***** 1. row *****
      Name: categorylinks
      Engine: InnoDB
      Version: 10
      Row_format: Compact
      Rows: 292517
      Avg_row_length: 102
      Data_length: 29982720
      Max_data_length: 0
      Index_length: 62701568
      Data_free: 4194304
      Auto_increment: NULL
      Create_time: 2013-01-26 11:23:02
      Update_time: NULL
      Check_time: NULL
      Collation: binary
      Checksum: NULL
      Create_options:
      Comment:
```

I would guess that the `InnoDB` pages for `test.categorylinks` are filled, whereas the pages for `simplewiki.categorylinks` have more spaces caused by repeated `UPDATES` over many months.

The `test` table did not shrink when copied. This is because the `test` table only sees `INSERTs` at the high end of its primary key `old_id`, so it never fragments.

G.8.4 `categorylinks`

This looks like a good candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.categorylinks\G
***** 1. row *****
      Table: categorylinks
Create Table: CREATE TABLE 'categorylinks' (
  'cl_from' int(10) unsigned NOT NULL DEFAULT '0',
  'cl_to' varbinary(255) NOT NULL DEFAULT '',
  'cl_sortkey' varbinary(230) NOT NULL DEFAULT '',
  'cl_sortkey_prefix' varbinary(255) NOT NULL DEFAULT '',
  'cl_timestamp' timestamp NOT NULL DEFAULT CURRENT_TIMESTAMP ON UPDATE CURRENT_TIMESTAMP,
  'cl_collation' varbinary(32) NOT NULL DEFAULT '',
  'cl_type' enum('page','subcat','file') NOT NULL DEFAULT 'page',
  UNIQUE KEY 'cl_from' ('cl_from','cl_to'),
  KEY 'cl_sortkey' ('cl_to','cl_type','cl_sortkey','cl_from'),
  KEY 'cl_timestamp' ('cl_to','cl_timestamp'),
  KEY 'cl_collation' ('cl_collation')
) ENGINE=InnoDB DEFAULT CHARSET=binary
```

Runs with `KEY_BLOCK_SIZE=16`, `8`, `4`, and `2` were successful. However, the run with `KEY_BLOCK_SIZE=1` failed.

```
mysql> ALTER TABLE test.categorylinks ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=1;
ERROR 1118 (42000): Row size too large. The maximum row size for the used table
type, not counting BLOBs, is 8126. You have to change some columns to TEXT or
BLOBs
```

Measurement:


```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	0	0	0	0	0
2048	334752	211889	140	100902	10
4096	158670	106536	96	40157	7
8192	21432	21378	11	8070	1
16384	12617	12617	5	19053	2

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024		0	0	0	0
2048		14122	0	0	0
4096		6597	0	0	0
8192		5178	1	0	0
16384		2313	0	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-	96	45	n/a	
Z+B16	96	52	100	
Z+B8	48	55	99	
Z+B4	31	208	67	
Z+B2	32	309	63	
Z+B1				Failed

Discussion: `categorylinks` is indeed a good candidate for compression. The **Z+B8** configuration achieves 50% compression, at a cost of only 22% greater `INSERT` time and only 1% failure rate for compression operations. While **Z+B4** achieves even greater compression, it comes at a cost of over four-fold greater `INSERT` time and a 33% failure rate for compression operations. This may be acceptable if `INSERTion` is done once a month.

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.5 `externallinks` (Update Spring 2014)

This looks like a good candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.externallinks\G
```

```
***** 1. row *****
Table: externallinks
Create Table: CREATE TABLE 'externallinks' (
  'el_id' int(10) unsigned NOT NULL AUTO_INCREMENT,
  'el_from' int(10) unsigned NOT NULL DEFAULT '0',
  'el_to' blob NOT NULL,
  'el_index' blob NOT NULL,
  PRIMARY KEY ('el_id'),
  KEY 'el_from' ('el_from','el_to'(40)),
  KEY 'el_to' ('el_to'(60),'el_from'),
  KEY 'el_index' ('el_index'(60))
) ENGINE=InnoDB DEFAULT CHARSET=binary
```

Measurement:

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	1140291	661107	154	289093	13
2048	542909	338332	121	111339	9
4096	247128	163952	98	42497	6
8192	38579	38530	11	1489	0
16384	23844	23844	4	973	0

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024	0	70021	1	0	0
2048	0	29925	0	0	0
4096	0	20418	1	0	0
8192	0	12516	0	21	0
16384	0	10972	0	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-			n/a	
Z+B16	176	34	100	
Z+B8	88	37	99	
Z+B4	56	138	66	
Z+B2	56	167	62	
Z+B1	72	210	57	

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.6 `imagelinks` (Update Spring 2014)

This looks like a medium candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.imagelinks\G
```

```
***** 1. row *****
Table: imagelinks
Create Table: CREATE TABLE 'imagelinks' (
  'il_from' int(10) unsigned NOT NULL DEFAULT '0',
  'il_to' varbinary(255) NOT NULL DEFAULT '',
  PRIMARY KEY ('il_from','il_to'),
  UNIQUE KEY 'il_to' ('il_to','il_from')
) ENGINE=InnoDB DEFAULT CHARSET=binary
```

Measurement:

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	378657	216151	47	77243	3
2048	186561	113470	37	34194	2
4096	76351	46507	22	14010	1
8192	25178	17510	10	3818	0
16384	5650	5650	0	0	0

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024		0	89815	1	0
2048		0	38636	1	0
4096		0	27886	0	0
8192		0	15021	0	0
16384		0	13426	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-			n/a	
Z+B16	52	16	100	
Z+B8	26	27	69	
Z+B4	20	40	60	
Z+B2	20	58	60	
Z+B1	23	69	57	

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.7 `langlinks`

This looks like a medium candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.langlinks\G
```

```
***** 1. row *****
Table: langlinks
Create Table: CREATE TABLE 'langlinks' (
  'll_from' int(10) unsigned NOT NULL DEFAULT '0',
  'll_lang' varbinary(20) NOT NULL DEFAULT '',
  'll_title' varbinary(255) NOT NULL DEFAULT '',
  UNIQUE KEY 'll_from' ('ll_from','ll_lang'),
  KEY 'll_lang' ('ll_lang','ll_title')
) ENGINE=InnoDB DEFAULT CHARSET=binary
```

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	3534262	1790669	941	3365249	175
2048	1696760	922050	692	2159232	174
4096	839084	483681	475	1618030	213
8192	348713	218493	277	1271866	287
16384	51301	51301	26	1165381	264

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024		0	31287	4	91655
2048		0	63637	3	35806
4096		0	33517	1	14789
8192		0	17027	1	5759
16384		0	13936	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-	352	527	n/a	
Z+B16	352	1061	100	
Z+B8	184	2023	62	
Z+B4	180	2637	57	
Z+B2	204	3817	54	
Z+B1	244	6554	50	

Discussion: `langlinks` is indeed a medium candidate for compression. The `Z-B8` configuration uses 48% less disk space, but this comes at a cost of nearly four-fold greater `INSERT` time, with a 38% failure rate for the compression operations. This may be acceptable if `INSERT`ion is done monthly.

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.8 `page` (Update Spring 2014)

This looks like a medium candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.page\G
***** 1. row *****
      Table: page
Create Table: CREATE TABLE 'page' (
  'page_id' int(10) unsigned NOT NULL AUTO_INCREMENT,
  'page_namespace' int(11) NOT NULL,
  'page_title' varbinary(255) NOT NULL,
  'page_restrictions' tinyblob NOT NULL,
  'page_counter' bigint(20) unsigned NOT NULL DEFAULT '0',
  'page_is_redirect' tinyint(3) unsigned NOT NULL DEFAULT '0',
  'page_is_new' tinyint(3) unsigned NOT NULL DEFAULT '0',
  'page_random' double unsigned NOT NULL,
  'page_touched' binary(14) NOT NULL DEFAULT '\0\0\0\0\0\0\0\0\0\0\0\0\0\0',
  'page_latest' int(10) unsigned NOT NULL,
  'page_len' int(10) unsigned NOT NULL,
  'page_content_model' varbinary(32) DEFAULT NULL,
  'page_links_updated' varbinary(14) DEFAULT NULL,
  PRIMARY KEY ('page_id'),
  UNIQUE KEY 'name_title' ('page_namespace','page_title'),
  KEY 'page_random' ('page_random'),
  KEY 'page_len' ('page_len'),
  KEY 'page_redirect_namespace_len' ('page_is_redirect','page_namespace','page_len')
) ENGINE=InnoDB AUTO_INCREMENT=444247 DEFAULT CHARSET=binary
```

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	470112	257268	70	95024	4
2048	229483	132770	57	41755	3
4096	118496	71902	53	19518	2
8192	38719	25247	27	6070	1
16384	5816	5816	1	5	0

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024		0	24230	0	0
2048		0	10586	0	0
4096		0	4945	1	0
8192		0	4164	0	0
16384		0	2448	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-			n/a	
Z+B16	52	19	100	
Z+B8	28	48	65	
Z+B4	24	78	60	
Z+B2	24	83	57	
Z+B1	28	98	54	

Discussion: This is a good candidate for compression.

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.9 `pagelinks`

This looks like a medium candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.pagelinks\G
***** 1. row *****
      Table: pagelinks
Create Table: CREATE TABLE 'pagelinks' (
  'pl_from' int(10) unsigned NOT NULL DEFAULT '0',
  'pl_namespace' int(11) NOT NULL DEFAULT '0',
  'pl_title' varbinary(255) NOT NULL DEFAULT '',
  UNIQUE KEY 'pl_from' ('pl_from','pl_namespace','pl_title'),
  UNIQUE KEY 'pl_namespace' ('pl_namespace','pl_title','pl_from')
) ENGINE=InnoDB DEFAULT CHARSET=binary
```

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	2602824	1502690	478	1468174	90
2048	1288533	794597	363	878152	90
4096	600328	388146	276	532090	92
8192	176814	120716	96	514791	93
16384	41137	41137	10	582956	95

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024	0	27220	16	29314	0
2048	0	20760	16	13715	0
4096	0	7934	16	7101	0
8192	0	10059	15	4654	0
16384	0	49	0	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-	296	316	n/a	
Z+B16	296	480	100	
Z+B8	156	742	68	
Z+B4	120	1178	64	
Z+B2	124	1617	61	
Z+B1	144	2533	57	

Discussion: This is a good candidate for compression.

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.10 `revision` (Update Spring 2014)

This looks like a medium candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.revision\G
***** 1. row *****
      Table: revision
Create Table: CREATE TABLE 'revision' (
  'rev_id' int(10) unsigned NOT NULL AUTO_INCREMENT,
  'rev_page' int(10) unsigned NOT NULL,
  'rev_text_id' int(10) unsigned NOT NULL,
  'rev_comment' tinyblob NOT NULL,
  'rev_user' int(10) unsigned NOT NULL DEFAULT '0',
  'rev_user_text' varbinary(255) NOT NULL DEFAULT '',
  'rev_timestamp' binary(14) NOT NULL DEFAULT '\0\0\0\0\0\0\0\0\0\0\0\0\0\0',
  'rev_minor_edit' tinyint(3) unsigned NOT NULL DEFAULT '0',
  'rev_deleted' tinyint(3) unsigned NOT NULL DEFAULT '0',
  'rev_len' int(10) unsigned DEFAULT NULL,
  'rev_parent_id' int(10) unsigned DEFAULT NULL,
  'rev_sha1' varbinary(32) NOT NULL DEFAULT '',
  'rev_content_format' varbinary(64) DEFAULT NULL,
  'rev_content_model' varbinary(32) DEFAULT NULL,
  PRIMARY KEY ('rev_id'),
  UNIQUE KEY 'rev_page_id' ('rev_page','rev_id'),
  KEY 'rev_timestamp' ('rev_timestamp'),
  KEY 'page_timestamp' ('rev_page','rev_timestamp'),
  KEY 'user_timestamp' ('rev_user','rev_timestamp'),
  KEY 'usertext_timestamp' ('rev_user_text','rev_timestamp'),
  KEY 'page_user_timestamp' ('rev_page','rev_user','rev_timestamp')
) ENGINE=InnoDB AUTO_INCREMENT=4765354 DEFAULT CHARSET=binary MAX_ROWS=10000000 AVG_ROW_LENGTH=1024
```

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	667338	388855	146	125526	6
2048	322407	202548	103	52740	4
4096	158788	104329	80	23526	3
8192	28116	24731	17	1387	0
16384	9578	9578	2	7	0

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024	0	35408	0	0	0
2048	0	15296	0	0	0
4096	0	10660	0	0	0
8192	0	9486	0	0	0
16384	0	4438	0	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-			n/a	
Z+B16	88	25	100	
Z+B8	44	43	87	
Z+B4	36	109	65	
Z+B2	36	133	62	
Z+B1	44	181	58	

Discussion: This is a good candidate for compression.

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.11 `templatelinks`

This looks like a medium candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.templatelinks\G
***** 1. row *****
      Table: templatelinks
Create Table: CREATE TABLE 'templatelinks' (
  'tl_from' int(10) unsigned NOT NULL DEFAULT '0',
  'tl_namespace' int(11) NOT NULL DEFAULT '0',
  'tl_title' varbinary(255) NOT NULL DEFAULT '',
  UNIQUE KEY 'tl_from' ('tl_from','tl_namespace','tl_title'),
  UNIQUE KEY 'tl_namespace' ('tl_namespace','tl_title','tl_from')
) ENGINE=InnoDB DEFAULT CHARSET=binary
```

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	636964	394930	114	120886	7
2048	312377	204010	91	64492	6
4096	107818	70436	40	25451	4
8192	29050	24158	14	7182	1
16384	9128	9128	1	4807	0

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024	0	24925	15	7562	0
2048	0	13068	2	0	0
4096	0	6447	1	0	0
8192	0	4202	0	0	0
16384	0	4166	0	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-	76	38	n/a	
Z+B16	80	68	100	
Z+B8	40	91	83	
Z+B4	29	125	65	
Z+B2	29	212	65	
Z+B1	36	279	62	

Discussion: This is a good candidate for compression.

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.12 `text`

This looks like a good candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.text\G
```

```
***** 1. row *****
```

```
Table: text
```

```
Create Table: CREATE TABLE 'text' (
```

```
  'old_id' int(10) unsigned NOT NULL AUTO_INCREMENT,
```

```
  'old_text' mediumblob NOT NULL,
```

```
  'old_flags' tinyblob NOT NULL,
```

```
  PRIMARY KEY ('old_id')
```

```
) ENGINE=InnoDB AUTO_INCREMENT=2 DEFAULT CHARSET=binary MAX_ROWS=10000000 AVG_ROW_LENGTH=10240;
```

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	228554	99778	44	64659	3
2048	285813	124585	109	83294	8
4096	275680	127268	141	77459	10
8192	63064	62992	24	1851	0
16384	35393	35393	5	2833	0

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024	0	26434	16	18333	0
2048	0	15346	16	7051	0
4096	0	8596	15	3082	0
8192	0	3121	15	2254	0
16384	0	4333	0	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-	476	97	n/a	
Z+B16	456	262	100	
Z+B8	240	236	99	
Z+B4	220	397	46	
Z+B2	244	359	43	
Z+B1	252	406	43	

Discussion: `text` is indeed a good candidate for compression. The `Z+B8` configuration achieves 50% compression, at a cost of 2.4 times the `INSERT` time and only 1% failure rate for compression operations. While `Z+B4` achieves marginally better compression, it comes at a cost of 54% failure rate for compression operations. This may be acceptable if `INSERTion` is done monthly.

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.13 `titlekey` (Update Spring 2014)

This looks like a medium candidate for compression.

```
mysql> SHOW CREATE TABLE simplewiki.titlekey\G
***** 1. row *****
      Table: titlekey
Create Table: CREATE TABLE 'titlekey' (
  'tk_page' int(10) unsigned NOT NULL,
  'tk_namespace' int(11) NOT NULL,
  'tk_key' varbinary(255) NOT NULL,
  PRIMARY KEY ('tk_page'),
  KEY 'name_key' ('tk_namespace','tk_key')
) ENGINE=InnoDB DEFAULT CHARSET=binary
```

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	211535	105897	24	47707	2
2048	97010	51275	18	19733	1
4096	45745	25496	16	7876	1
8192	17216	10384	10	2096	0
16384	3490	3490	0	0	0

Measurement:

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024	0	12522	0	0	0
2048	0	5548	0	0	0
4096	0	25336	6	170	0
8192	0	3032	0	30	0
16384	0	1363	0	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-	36	8	n/a	
Z+B16	36	11	100	
Z+B8	16	19	60	
Z+B4	14	27	55	
Z+B2	14	30	52	
Z+B1	16	37	50	

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.14 `enwiki.image`

Most wikis reference media files from the `commonswiki`. This means that most wikis have a very small `image` database table which is not worth compressing. The `commonswiki.image` table, on the other hand, is too large for quick experiments (but see §G.9, [Experiments with commonswiki.image](#)). The `enwiki` is however a good size for our purposes.

The `image` table looks like a good candidate for compression.

```
mysql> SHOW CREATE TABLE enwiki.image\G
***** 1. row *****
      Table: image
Create Table: CREATE TABLE 'image' (
  'img_name' varbinary(255) NOT NULL DEFAULT '',
  'img_size' int(10) unsigned NOT NULL DEFAULT '0',
  'img_width' int(11) NOT NULL DEFAULT '0',
  'img_height' int(11) NOT NULL DEFAULT '0',
  'img_metadata' mediumblob NOT NULL,
  'img_bits' int(11) NOT NULL DEFAULT '0',
  'img_media_type' enum('UNKNOWN','BITMAP','DRAWING','AUDIO','VIDEO','MULTIMEDIA','OFFICE','TEXT','',
  'img_major_mime' enum('unknown','application','audio','image','text','video','message','model','',
  'img_minor_mime' varbinary(100) NOT NULL DEFAULT 'unknown',
  'img_description' tinyblob NOT NULL,
  'img_user' int(10) unsigned NOT NULL DEFAULT '0',
  'img_user_text' varbinary(255) NOT NULL,
  'img_timestamp' varbinary(14) NOT NULL DEFAULT '',
  'img_sha1' varbinary(32) NOT NULL DEFAULT '',
  PRIMARY KEY ('img_name'),
  KEY 'img_usertext_timestamp' ('img_user_text','img_timestamp'),
  KEY 'img_size' ('img_size'),
  KEY 'img_timestamp' ('img_timestamp'),
  KEY 'img_sha1' ('img_sha1')
) ENGINE=InnoDB DEFAULT CHARSET=binary;
```

Experimental method:

```
shell$ rsync rsync://ftpmirror.your.org/wikimedia-dumps/enwiki/20130102/enwiki-20130102-image.sql.gz
shell$ gunzip enwiki-20130102-image.sql.gz
shell$ mysql --host=localhost --user=root --password --database=test < enwiki-20130102-image.sql
mysql> select * from information_schema.innodb_cmp_reset;
mysql> select * from information_schema.innodb_cmpmem_reset;

mysql> CREATE TABLE test.image0 LIKE test.image;
mysql> INSERT INTO test.image0 SELECT * FROM test.image;
Query OK, 807542 rows affected (15 min 20.25 sec)
Records: 807542 Duplicates: 0 Warnings: 0
root-shell# ls -lh /var/lib/mysql/test/*.ibd
mysql> DROP TABLE test.image0;

mysql> CREATE TABLE test.image0 LIKE test.image;
mysql> ALTER TABLE test.image0 ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=16;
mysql> INSERT INTO test.image0 SELECT * FROM test.image;
root-shell# ls -lh /var/lib/mysql/test/*.ibd
mysql> select * from information_schema.innodb_cmp;
mysql> select * from information_schema.innodb_cmpmem;
mysql> DROP TABLE test.image0;
```

and so on with `KEY_BLOCK_SIZE=8, 4, 2, and 1`.

Measurement:

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	0	0	0	0	0
2048	2862744	1411589	828	2948193	257
4096	1358140	736381	608	2228324	319
8192	319821	244692	203	1783801	410
16384	94043	94043	23	1916914	404

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024	0	0	16	0	0
2048	0	62908	16	22401	0
4096	0	35002	0	6722	0
8192	0	19276	16	2558	0
16384	0	13984	0	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-	748	920	n/a	
Z+B16	744	1337	100	
Z+B8	392	2284	76	
Z+B4	348	3907	54	
Z+B2	412	4916	49	
Z+B1				Failed

Discussion: `image` is indeed a medium candidate for compression. With the `Z+B8` configuration, `image.ibd` is 52% the uncompressed size, at a cost of 2.5 times the `INSERT` time and only 24% failure rate for compression operations. While `Z+B4` achieves marginally better compression, it comes at a cost of 54% failure rate for compression operations. This may be acceptable if `INSERTion` is done once a month.

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.15 `wb_entity_per_page` (Update Spring 2014)

This looks like a poor candidate for compression.

```
mysql> show create table wikidatawiki.wb_entity_per_page\G
```

```
***** 1. row *****
```

```
Table: wb_entity_per_page
```

```
Create Table: CREATE TABLE 'wb_entity_per_page' (
```

```
  'epp_entity_id' int(10) unsigned NOT NULL,
```

```
  'epp_entity_type' varbinary(32) NOT NULL,
```

```
  'epp_page_id' int(10) unsigned NOT NULL,
```

```
  UNIQUE KEY 'wb_epp_entity' ('epp_entity_id','epp_entity_type'),
```

```
  UNIQUE KEY 'wb_epp_page' ('epp_page_id')
```

```
) ENGINE=InnoDB DEFAULT CHARSET=binary
```

Measurement:

```
mysql> SELECT * FROM information_schema.innodb_cmp;
```

page_size	compress_ops	compress_ops_ok	compress_time	uncompress_ops	uncompress_time
1024	7222650	3919304	926	1654106	67
2048	3534664	1989169	797	775291	56
4096	1780874	1026424	760	378522	49
8192	696760	409740	433	144847	31
16384	94826	94826	7	964	0

```
mysql> SELECT * FROM information_schema.innodb_cmpmem;
```

page_size	buffer_pool_instance	pages_used	pages_free	relocation_ops	relocation_time
1024	0	241951	1	10623	0
2048	0	147111	5	3650	0
4096	0	82615	15	936	0
8192	0	46963	1	352	0
16384	0	32869	0	0	0

Table Config	Size [M]	INSERT [sec]	Ops OK [%]	Comment
Z-	828	211	n/a	
Z+B16	828	283	100	
Z+B8	464	714	58	
Z+B4	424	1093	57	
Z+B2	440	1166	56	
Z+B1	488	1572	54	

Discussion: `wb_entity_per_page` is a medium candidate for compression. With the `Z+B4` configuration, `wb_entity_per_page` is 51% the uncompressed size, at a cost of 5.2 times the `INSERT` time and a 43% failure rate for compression operations. This may be acceptable if `INSERTion` is done monthly.

Recommendation: Use `ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4`.

G.8.16 Conclusions

In each case shown above, best compression was achieved with page size 4K. See §G.1, [Database table size \[M\] v. ROW_FORMAT and KEY_BLOCK_SIZE](#).

G.9 Experiments with `commonswiki.image`

Purpose: Determine how to speed up the `INSERTion` of the `commonswiki.image` database table.

Motivation: `commonswiki.image` contains media file metadata needed by every wiki that references media files from the `commonswiki`. The following is known:

- it is large
 - `commonswiki-20130113-image.sql.gz` is 7.4G;
 - `commonswiki-20130113-image.sql` is 31G;
 - `commonswiki/image.ibd` is 39G.
- `INSERT INTO 'image' VALUES ...` is disk I/O bound;

Table G.1: Database table size [M] v. ROW_FORMAT and KEY_BLOCK_SIZE

Wiki	Table	Z-	Z+B16	Z+B8	Z+B4	Z+B2	Z+B1
enwiki	image	748	744	392	348	412	fail
simplewiki	categorylinks	96	96	48	31	32	fail
	externallinks		176	88	56	56	72
	imagelinks		52	26	20	20	23
	langlinks	352	352	184	180	204	244
	pagelinks	296	296	156	120	124	144
	page		52	28	24	24	28
	revision		88	44	36	36	44
	templatelinks	76	80	40	29	29	36
	text	476	456	240	220	244	252
	titlekey	36	36	16	14	14	16
wikidatawiki	wb_entity_per_page	828	828	464	424	440	488
	wb_items_per_site			2992	2432		
	wb_terms			11264	6992		

- it should be a medium candidate for compression.

Intended benefit: Reduce the time required to build a mirror farm that makes use of shared media files.

G.9.1 Theory

G.9.1.1 Disk Write Speed

Most disks in laptops use some version of SATA interface:

```
root-shell# hdparm -I /dev/sda | grep Transport
Transport:          Serial, SATA 1.0a, SATA II Extensions, SATA Rev 2.5, SATA Rev 2.6
```

For such disks, we expect the electronic interface to transport data at 300M/s. However, the hardware (platters and read/write heads) are far less capable. Performance can vary widely. For cylinders near the edge of the platter, we may achieve 90M/s R/W. For cylinders near the spindle we may expect 30M/s R/W. Actually, this is the best case, because it assumes that the read/write heads stay on one cylinder as the platters rotate. If the filesystem is fragmented, we can expect 1-2M/s.

InnoDB tries to flush the log buffer and log files once per second. This is set with `innodb_flush_log_at_trx_commit=0`. Let us increase the size of the log buffer and log files to match the best case, and see if performance improves.

```
root-shell# cat /etc/mysql/conf.d/wp-mirror.cnf | grep log
innodb_log_buffer_size      = 80M # default 8M.
innodb_log_file_size        = 50M # default 5M.
# for Durability (the 'D' in 'ACID compliance') (0=flush log buff 1/sec)
innodb_flush_log_at_trx_commit = 0 # default 1. (2=write log file 1/sec)
sync_binlog                  = 0 # default 0.
```

G.9.1.2 Fast index creation

Overview of Fast Index Creation

With `MySQL` 5.5 and higher, or `MySQL` 5.1 with the `InnoDB` Plugin, creating and dropping secondary indexes for `InnoDB` tables is much faster than before. Historically, adding or dropping an index on a table with existing data could be very slow. The `CREATE INDEX` and `DROP INDEX` statements worked by creating a new, empty table defined with the requested set of indexes, then copying the existing rows to the new table one-by-one, updating the indexes as the rows are inserted. After all rows from the original table were copied, the old table was dropped and the copy was renamed with the name of the original table.

The performance speedup for fast index creation applies to secondary indexes, not to the primary key index. The rows of an `InnoDB` table are stored in a clustered index organized based on the primary key, forming what some database systems call an "index-organized table". Because the table structure is so closely tied to the primary key, redefining the primary key still requires copying the data.

This new mechanism also means that you can generally speed the overall process of creating and loading an indexed table by creating the table with only the clustered index, and adding the secondary indexes after the data is loaded.

[MySQL 5.5 Reference](#)

Manual, Section 14.4.2, Fast Index Creation in the `InnoDB` Storage Engine, p.1621

This presents an opportunity to experiment. Instead of `INSERT`ing the data, the idea is this: first `DROP` the secondary indices, then `INSERT` the data, and finally `ADD` the secondary indices:

```
mysql> ALTER TABLE commonswiki.image
-> DROP INDEX img_usertext_timestamp, DROP INDEX img_size,
-> DROP INDEX img_timestamp, DROP INDEX img_sha1;
root-shell# wp-mirror --delete all
root-shell# wp-mirror --mirror
mysql> ALTER TABLE commonswiki.image
-> ADD INDEX 'img_usertext_timestamp' ('img_user_text','img_timestamp'),
-> ADD INDEX 'img_size' ('img_size'),
-> ADD INDEX 'img_timestamp' ('img_timestamp'),
-> ADD INDEX 'img_sha1' ('img_sha1');
```

G.9.1.3 LOAD DATA INFILE

Speed of `INSERT` Statements

When loading a table from a text file, use `LOAD DATA INFILE`. This is usually 20 times faster than using `INSERT` statements.

[MySQL 5.5 Reference Manual, Section 8.2.2 Optimizing DML Statements](#)

The possibility of such a speed increase must be tested.

G.9.2 Experimental Method

Overall method: Measure the time required to load 15m `commonswiki.image` records v. a variety of configurations.

Run: The file `commonswiki-20130113-image.sql.gz` was downloaded from WMF (or a mirror site). This file contains 27,570 `INSERT` statements, each with about 500 sets of values. This file, when decompressed, expands from 7G to 31G (4.5x). This was split these into 2,757 `schunks` of 10 `INSERT` statements each. These `schunks` were then loaded into the database table.

Measurement: A timestamp was recorded upon completion of each `chunk`. `WP-MIRROR` 0.6 automates both the run and measurement.

Experimental method:

1. Setup:

- Delete working files and state information:

```
root-shell# wp-mirror --delete all
```

- Set table options where KEY_BLOCK_SIZE = 1, 2, 4, 8, or 16:

```
mysql> TRUNCATE TABLE commonswiki.image;
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=8;
```

- Reset compression statistics tables:

```
mysql> SELECT * FROM information_schema.innodb_cmp_reset;
mysql> SELECT * FROM information_schema.innodb_cmpmem_reset;
```

2. Run:

- In one terminal run the test:

```
root-shell# wp-mirror --mirror
```

- In another terminal collect data:

```
mysql> SELECT timestamp, name FROM wpmirror.file
-> WHERE type='schunk' AND state IN ('done','fail') AND name LIKE '%000-c%';
mysql> SELECT * FROM information_schema.innodb_cmp;
mysql> SELECT * FROM information_schema.innodb_cmpmem;
root-shell# ls /var/lib/mysql/commonswiki/image.ibd
```

3. Tear-down: None.

Measurement: The raw data looks like this:

```
mysql> SELECT timestamp, name FROM wpmirror.file WHERE type='schunk'
-> AND state IN ('done','fail') AND name LIKE '%000-c%';
```

timestamp	name
2013-01-21 21:55:25	commonswiki-20130113-image-p000000000-c000000010.sql
2013-01-21 22:43:41	commonswiki-20130113-image-p000001000-c000000010.sql
2013-01-21 23:40:32	commonswiki-20130113-image-p000002000-c000000010.sql
2013-01-22 00:55:51	commonswiki-20130113-image-p000003000-c000000010.sql
2013-01-22 02:18:43	commonswiki-20130113-image-p000004000-c000000010.sql
...	

However the following information, which is derived from the raw data, is more useful for comparing one run with another:

```
mysql> SET @t0=(SELECT TO_SECONDS(MIN(timestamp)) FROM wpmirror.file
-> WHERE type='schunk' AND state IN ('done','fail'));
mysql> SELECT ROUND((TO_SECONDS(timestamp)-@t0)/1000,1) AS 'time [ks]',
-> ROUND(CAST(TRIM(LEADING 'p' FROM SUBSTRING_INDEX(SUBSTRING_INDEX(name,'-',-2),'-',1))
-> AS UNSIGNED)/1000,1) AS 'inserts [k]'
-> FROM wpmirror.file WHERE type='schunk' AND state IN ('done','fail') AND name LIKE '%000-c%';
```

time [ks]	inserts [k]
0.0	0.0
2.9	1.0
6.3	2.0
10.8	3.0
15.8	4.0
...	

Coding: We extend the coding used in §E.7, Experiments with InnoDB:

- **D1** `/var/lib/mysql/[database]/[table].ibd` and `/var/lib/mysql/ib_logfile*` are on the same disk,
- **F+** `/var/lib/mysql/[database]/[table].ibd` are files on a file system,
- **L10** `/var/lib/mysql/ib_logfile*` are 10M each,
- **P1024** `InnoDB.buffer_pool` is 1024M,
- **H-** `hugepages` are not used,
- **Z-** data is uncompressed (`ROW_FORMAT=COMPACT`),
- **Z+** data is compressed with `zlib` (`ROW_FORMAT=COMPRESSED`), and
- **B16** `KEY_BLOCK_SIZE` is 16K.

G.9.3 EXPERIMENT.0 Baseline configuration

Code: D1F+L10P1024H-Z-

Configuration files:

```
root-shell# /etc/mysql/conf.d/wp-mirror.cnf
[mysqld]
# time zone UTC
default-time-zone            = UTC
# transactional (ACID) storage engine.
default-storage-engine       = innodb
# UTF-8 character set and collation.
character-set-server         = utf8
collation-server             = utf8_general_ci

# InnoDB

# to save disk space (compress tables using 'zlib')
innodb_file_per_table        = 1 # default OFF. Create .ibd file/table
innodb_file_format           = Barracuda # default Antelope.
innodb_file_format_check     = 1 # default ON.
innodb_strict_mode           = 1 # default 0.
# increase size of buffer pool and log files for speed
innodb_buffer_pool_size      =1024M # default 128M.
innodb_log_buffer_size       = 8M # default 8M.
innodb_log_file_size         = 10M # default 5M.
innodb_additional_mem_pool_size = 8M # default 8M. (data dict, internals)
# for Durability (the 'D' in 'ACID compliance')
innodb_flush_log_at_trx_commit = 2 # default 1. (2=write log file 1/sec)
sync_binlog                  = 0 # default 0.

# Other

lower_case_table_names       = 1 # default 0. (use 1 for InnoDB)
# <meta.wikimedia.org/wiki/Data_dumps> recommends 20M.
max_allowed_packet           = 64M # default 16M.
query_cache_size             = 16M # default 16M.
query_cache_type              = 1 # default ON.

[mysql]
default-character-set        = utf8
# <meta.wikimedia.org/wiki/Data_dumps> recommends 20M.
max_allowed_packet           = 64M # default 16M.
```

The baseline `image` table has the `Antelope` format:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPACT;
```

Measurement: `/var/lib/mysql/commonswiki.image.ibd` is 39G.

time [ks]	inserts [k]
0.0	0.0
2.9	1.0
6.3	2.0
10.8	3.0
15.8	4.0
22.5	5.0
29.7	6.0
34.7	7.0
41.9	8.0
48.6	9.0
59.3	10.0
67.9	11.0
77.0	12.0
85.2	13.0
91.5	14.0
100.1	15.0
108.1	16.0
117.4	17.0
126.4	18.0
136.8	19.0
144.1	20.0
153.8	21.0
163.4	22.0
173.3	23.0
180.5	24.0
189.5	25.0
198.5	26.0
213.0	27.0

G.9.4 EXPERIMENT.1 ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=16

Code: D1F+L10P1024H-Z+B16

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` is the same as the baseline. The `image` table is now compressed and has 16K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=16;
```

Measurement: This run was terminated after 10,020 `INSERTs`, when it became clear that this configuration had lower performance than the baseline. `/var/lib/mysql/commonswiki/image.ibd` is 12G.

time [ks]	inserts [k]
0.0	0.0
4.6	1.0
8.9	2.0
14.0	3.0
19.2	4.0
26.1	5.0
33.3	6.0
40.7	7.0
50.7	8.0
59.3	9.0
68.9	10.0

```
mysql> SELECT * FROM information_schema.innodb_cmp WHERE page_size=16384\G
***** 1. row *****
      page_size: 16384
      compress_ops: 1231447
compress_ops_ok: 1231447
      compress_time: 237
      uncompress_ops: 10648260
      uncompress_time: 1974
mysql> SELECT * FROM information_schema.innodb_cmpmem WHERE page_size=16384\G
***** 1. row *****
      page_size: 16384
buffer_pool_instance: 0
      pages_used: 56280
      pages_free: 0
      relocation_ops: 0
      relocation_time: 0
```

G.9.5 EXPERIMENT.2 ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=8

Code: D1F+L10P1024H-Z+B8

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` is the same as the baseline. The `image` table is compressed and has 8K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=8;
```

Measurement: This run was terminated after 10,000 `INSERT`s. `/var/lib/mysql/commonswiki/image.ibd` 6.7G.

time [ks]	inserts [k]
0.0	0.0
5.1	1.0
9.9	2.0
15.2	3.0
20.9	4.0
28.0	5.0
36.2	6.0
43.8	7.0
54.1	8.0
64.4	9.0
79.7	10.0

```
mysql> SELECT * FROM information_schema.innodb_cmp WHERE page_size=8192\G
***** 1. row *****
      page_size: 8192
      compress_ops: 3226025
      compress_ops_ok: 2576819
      compress_time: 1503
      uncompress_ops: 10822547
      uncompress_time: 2096
mysql> SELECT * FROM information_schema.innodb_cmpmem WHERE page_size=8192\G
***** 1. row *****
      page_size: 8192
      buffer_pool_instance: 0
      pages_used: 107942
      pages_free: 2
      relocation_ops: 3482
      relocation_time: 8
```

G.9.6 EXPERIMENT.3 ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=4

Code: D1F+L10P1024H-Z+B4

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` is the same as the baseline. The `image` table is compressed and has 4K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4;
```

Measurement: This run was terminated after 10,000 `INSERT`s. `/var/lib/mysql/commonswiki/image.ibd` is 5.3G.

time [ks]	inserts [k]
0.0	0.0
6.9	1.0
12.4	2.0
18.5	3.0
25.6	4.0
34.8	5.0
46.9	6.0
59.7	7.0
79.8	8.0
96.1	9.0
109.8	10.0

```
mysql> SELECT * FROM information_schema.innodb_cmp WHERE page_size=4096\G
mysql> SELECT * FROM information_schema.innodb_cmpmem WHERE page_size=4096\G
```

G.9.7 EXPERIMENT.4 innodb_log_buffer_size=80M, innodb_log_file_size=50M

Code: D1F+L50P1024H-Z-

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` differs from the baseline as follows:

```
innodb_log_buffer_size      = 80M # default    8M.
innodb_log_file_size        = 50M # default    5M.
innodb_flush_log_at_trx_commit = 0 # default    1. (0=flush log buff 1/sec)
```

Measurement: This run was terminated after 10,000 INSERTs.

time [ks]	inserts [k]
0.0	0.0
1.3	1.0
3.1	2.0
5.3	3.0
10.0	4.0
13.7	5.0
18.8	6.0
23.1	7.0
29.0	8.0
34.2	9.0
39.7	10.0

G.9.8 EXPERIMENT.5 innodb_log_buffer_size=80M, innodb_log_file_size=512M

Code: D1F+L512P1024H-Z-

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` differs from the baseline as follows:

```
innodb_log_buffer_size      = 80M # default    8M. (max disk write speed)
innodb_log_file_size        = 512M # default    5M. (1/2 buffer pool size)
innodb_flush_log_at_trx_commit = 0 # default    1. (0=flush log buff 1/sec)
```

Measurement: This run was terminated after 10,000 INSERTs.

time [ks]	inserts [k]
0.0	0.0
1.0	1.0
1.8	2.0
2.7	3.0
3.9	4.0
5.4	5.0
7.2	6.0
9.1	7.0
12.2	8.0
15.4	9.0
18.1	10.0

G.9.9 EXPERIMENT.6 innodb_log_buffer_size=80M, innodb_log_file_size=512M, ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=4

Code: D1F+L512P1024H-Z+B4

Configuration files: /etc/mysql/conf.d/wp-mirror.cnf differs from the baseline as follows:

```
innodb_log_buffer_size      = 80M # default    8M. (max disk write speed)
innodb_log_file_size        = 512M # default    5M. (1/2 buffer pool size)
innodb_flush_log_at_trx_commit = 0 # default    1. (0=flush log buff 1/sec)
```

The image table is compressed and has 4K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4;
```

Some new parameters are introduced for this and the remaining experiments. The values for the baseline, and all runs prior to this one, are:

```
(defparameter *mirror-alter-table-timeout-sec-max* 15000)
(defparameter *mirror-dchunk-load-timeout-sec-max* 3000)
(defparameter *mirror-dchunk-page-count* 10)
(defparameter *mirror-innodb-fast-index-creation* nil)
(defparameter *mirror-innodb-table-key-block-size-list* nil)
(defparameter *mirror-schunk-page-count* 10)
(defparameter *mirror-split-sql* "schunk")
```

The difference for this run is that several tables will use compression with 4K page size:

```
(defparameter *mirror-innodb-table-key-block-size-list*
'(("categorylinks" . 4) ("externallinks" . 4) ("image" . 4)
  ("imagelinks" . 4) ("langlinks" . 4) ("pagelinks" . 4)
  ("templatelinks" . 4) ("text" . 4)))
```

Measurement: commonswiki-20130205-image.sql.gz of 7.7G resulted in
/var/lib/mysql/commonswiki/image.ibd of 15G.

```
mysql> SELECT data_length,index_length FROM information_schema.tables
-> WHERE table_schema='commonswiki' AND table_name='image';
```

data_length	index_length
11219763200	3454533632

time [ks]	inserts [k]
0.0	0.0
3.4	1.0
5.1	2.0
6.5	3.0
8.1	4.0
10.1	5.0
12.1	6.0
14.3	7.0
17.4	8.0
20.4	9.0
23.8	10.0
27.5	11.0
32.0	12.0
42.3	13.0
46.4	14.0
52.2	15.0
56.5	16.0
60.9	17.0
67.8	18.0
75.1	19.0
81.4	20.0
87.7	21.0
95.6	22.0
101.8	23.0
108.0	24.0
112.7	25.0
118.5	26.0
128.2	27.0
140.1	28.0

At the end of the run, the [InnoDB Change Buffer](#) (formerly called the [InnoDB Insert Buffer](#)) occupied about 15% of the buffer pool, and took an additional 3ks to process.

```
mysql> TRUNCATE TABLE commonswiki.image;
Query OK, 0 rows affected (12 min 21.22 sec)
```

The time vs. inserts data, when plotted in [Figure G.1, InnoDB Experiments—Importing commonswiki.image Table](#), exhibits kinks which are due to swapping when other processes contend for limited memory, and thereby disturb the smooth functioning of [InnoDB](#). For this reason, the remaining runs will employ [hugepages](#) so that memory occupied by the [InnoDB](#) buffer pool will not be swapped.

G.9.10 EXPERIMENT.7 `innodb_log_buffer_size=80M,`
`innodb_log_file_size=512M, ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=4`

Code: D1F+L512P1024H+Z+B4

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` differs from the baseline as follows:

```
innodb_log_buffer_size      = 80M # default    8M. (max disk write speed)
innodb_log_file_size        = 512M # default    5M. (1/2 buffer pool size)
innodb_flush_log_at_trx_commit = 0 # default    1. (0=flush log buff 1/sec)
large_pages                  = 1 # default    OFF.
```

The `image` table is compressed and has 4K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4;
```

The new WP-MIRROR parameters are same as the previous run:

```
(defparameter *mirror-innodb-fast-index-creation* nil)
(defparameter *mirror-split-sql* "schunk")
```

The only difference with the previous run is that we now use `hugepages`.Measurement: `commonswiki-20130205-image.sql.gz` of 7.7G resulted in
`/var/lib/mysql/commonswiki/image.ibd` of 15G.

```
mysql> SELECT data_length,index_length FROM information_schema.tables
-> WHERE table_schema='commonswiki' AND table_name='image';
+-----+-----+
| data_length | index_length |
+-----+-----+
| 11219763200 | 3454533632 |
+-----+-----+
```


time [ks]	inserts [k]
0.0	0.0
1.1	1.0
2.3	2.0
3.5	3.0
4.9	4.0
6.8	5.0
8.8	6.0
11.2	7.0
14.4	8.0
17.7	9.0
21.5	10.0
25.7	11.0
30.9	12.0
36.5	13.0
40.2	14.0
46.4	15.0
50.5	16.0
55.9	17.0
63.9	18.0
71.2	19.0
78.2	20.0
81.4	21.0
87.2	22.0
94.6	23.0
101.7	24.0
107.2	25.0
114.2	26.0
121.1	27.0
130.6	28.0

```
mysql> TRUNCATE TABLE commonswiki.image;
Query OK, 0 rows affected (1 min 28.10 sec)
```

We see that the use of `hugepages` did not result in a significant performance gain. This we already knew from [Table E.2, InnoDB Experimental Results—Performance Ratios](#). However, the system did run more smoothly. Without `hugepages`, users frequently perceived poor system response (pauses on the order of 10-100s) which made the system all but unusable for them.

G.9.11 EXPERIMENT.8 `innodb_log_buffer_size=80M,` `innodb_log_file_size=512M, ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=4,` `LOAD DATA INFILE`

Code: D1F+L512P1024H+Z+B4, `LOAD DATA INFILE`

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` differs from the baseline as follows:

```
innodb_log_buffer_size      = 80M # default 8M. (max disk write speed)
innodb_log_file_size        = 512M # default 5M. (1/2 buffer pool size)
innodb_flush_log_at_trx_commit = 0 # default 1. (0=flush log buff 1/sec)
large_pages                  = 1 # default OFF.
```

The `image` table is compressed and has 4K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4;
```

For this run, the values of the new parameters are:

```
(defparameter *mirror-innodb-fast-index-creation* nil)
(defparameter *mirror-split-sql* "dchunk")
```

`LOAD DATA INFILE` is done by preparing files, called `dchunks`, that contain data fields only; then loading each `dchunk` by specifying its absolute path:

```
mysql> LOAD DATA INFILE
-> /var/lib/mediawiki/images/wp-mirror/commonswiki-20130124-image-p000000000-c000000010.dat'
-> IGNORE INTO TABLE 'commonswiki'.'image'
-> FIELDS TERMINATED BY ',' OPTIONALLY ENCLOSED BY '"'
-> LINES TERMINATED BY '),(;'
```

Unfortunately, this failed for the following reason: The transactions piled up waiting for a table lock:

```
...
---TRANSACTION 277CA2, ACTIVE 451 sec inserting
mysql tables in use 1, locked 1
242 lock struct(s), heap size 31160, 457 row lock(s), undo log entries 4327
MySQL thread id 169064, OS thread handle 0x7f02aafeb700, query id 589273 localhost debian-sys-maint
LOAD DATA INFILE '/var/lib/mediawiki/images/wp-mirror/commonswiki-20130124-image-p000000000-c000000010.dat'
---TRANSACTION 277BDC, ACTIVE 454 sec inserting
mysql tables in use 1, locked 1
228 lock struct(s), heap size 31160, 455 row lock(s), undo log entries 4776
MySQL thread id 168756, OS thread handle 0x7f02ab0e0700, query id 588081 localhost debian-sys-maint
LOAD DATA INFILE '/var/lib/mediawiki/images/wp-mirror/commonswiki-20130124-image-p000000000-c000000010.dat'
```

after which some of these transactions failed due to timeout:

```
[ ok ] fsm-no-op commonswiki-20130124-image-p0000001120-c000000010.dat
ERROR 1205 (HY000) at line 1: Lock wait timeout exceeded; try restarting transaction
```

then the number of failed transactions increased, and finally came a flood of error messages:

```
ERROR 1040 (08004): Too many connections
ERROR 1040 (HY000): Too many connections
ERROR 1040 (08004): Too many connections
...
```

Even after WP-MIRROR exited, `InnoDB` continued processing the backlog of transactions, occasionally emitting additional timeout errors, for an hour. Finally, we see that just under 1M of the 15.8M records were successfully loaded.

```
mysql> SELECT COUNT(*) FROM commonswiki.image;
+-----+
| count(*) |
+-----+
| 943800 |
+-----+
```

One solution is to make `LOAD DATA INFILE` a single transaction, and this is done by setting:

```
(defparameter *mirror-dchunk-page-count* 100000)
```

This was tried once successfully. However, on a second attempt there was a mishap that caused a `ROLLBACK`; and, as we soon discovered, rolling back such a large transaction takes days.

A better solution is to poll `information_schema.innodb_trx` and only start a `LOAD DATA INFILE` transaction if no other is running. In this manner the `dchunks` are processed *ad seriatim*; and while the performance is a little worse compared to the single large transaction, the `ROLLBACK` time, in the event of a mishap, is tolerable.

Measurement: `commonswiki-20130205-image.sql.gz` of 7.7G resulted in `/var/lib/mysql/commonswiki/image.ibd` of 7.2G.

```
mysql> SELECT data_length,index_length FROM information_schema.tables
-> WHERE table_schema='commonswiki' AND table_name='image';
+-----+-----+
| data_length | index_length |
+-----+-----+
| 4642832384 | 2792095744 |
+-----+-----+
mysql> SELECT COUNT(*) FROM commonswiki.image;
+-----+
| count(*) |
+-----+
| 14869582 |
+-----+
1 row in set (17 min 48.23 sec)          <-- full table scan!
```

```
mysql> SET @t0=(SELECT TO_SECONDS(MIN(timestamp)) FROM wpmirror.file
-> WHERE type='dchunk' AND state IN ('done','fail'));
mysql> SELECT ROUND((TO_SECONDS(timestamp)-@t0)/1000,1) AS 'time [ks]',
-> ROUND(CAST(TRIM(LEADING 'p' FROM SUBSTRING_INDEX(SUBSTRING_INDEX(name,'-',-2),'-',1)
-> AS UNSIGNED)/1000,1) AS 'inserts [k]'
-> FROM wpmirror.file WHERE type='dchunk' AND state IN ('done','fail') AND name LIKE '%000-c%'

+-----+-----+
| time [ks] | inserts [k] |
+-----+-----+
| 0.0 | 0.0 |
| 1.3 | 1.0 |
| 2.3 | 2.0 |
| 3.5 | 3.0 |
| 4.8 | 4.0 |
| 6.4 | 5.0 |
| 7.9 | 6.0 |
| 9.5 | 7.0 |
| 11.4 | 8.0 |
| 13.3 | 9.0 |
| 15.8 | 10.0 |
| 18.4 | 11.0 |
| 21.3 | 12.0 |
| 25.0 | 13.0 |
| 26.8 | 14.0 |
| 30.6 | 15.0 |
| 33.2 | 16.0 |
| 36.1 | 17.0 |
| 39.8 | 18.0 |
| 44.1 | 19.0 |
| 48.1 | 20.0 |
| 49.7 | 21.0 |
| 53.3 | 22.0 |
| 57.6 | 23.0 |
| 62.0 | 24.0 |
| 65.1 | 25.0 |
| 71.2 | 26.0 |
| 74.9 | 27.0 |
| 80.5 | 28.0 |
+-----+-----+
```

At the end of the run, the [InnoDB Change Buffer](#) (formerly called the [InnoDB Insert Buffer](#)) occupied about 10% of the buffer pool, and took an additional 2ks to process.

G.9.12 EXPERIMENT.9 `innodb_log_buffer_size=80M`, `innodb_log_file_size=512M`, `ROW_FORMAT=COMPRESSED`, `KEY_BLOCK_SIZE=4`, fast index creation

Code: D1F+L512P1024H+Z+B4, fast index creation

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` differs from the baseline as follows:

<code>innodb_log_buffer_size</code>	<code>= 80M # default</code>	8M. (max disk write speed)
<code>innodb_log_file_size</code>	<code>= 512M # default</code>	5M. (1/2 buffer pool size)
<code>innodb_flush_log_at_trx_commit</code>	<code>= 0 # default</code>	1. (0=flush log buff 1/sec)
<code>large_pages</code>	<code>= 1 # default</code>	OFF.

The `image` table is compressed and has 4K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4;
```

The new parameters are set to:

```
(defparameter *mirror-innodb-fast-index-creation* t)
(defparameter *mirror-split-sql* "schunk")
```

Fast index creation is done by **DROPP**ing the secondary indices, **INSERT**ing the data, then **ADD**ing the secondary indices.

```
mysql> ALTER TABLE commonswiki.image
-> DROP INDEX img_usertext_timestamp, DROP INDEX img_size,
-> DROP INDEX img_timestamp, DROP INDEX img_sha1;
root-shell# wp-mirror --delete all
root-shell# wp-mirror --mirror
mysql> ALTER TABLE commonswiki.image
-> ADD INDEX 'img_usertext_timestamp' ('img_user_text','img_timestamp'),
-> ADD INDEX 'img_size' ('img_size'),
-> ADD INDEX 'img_timestamp' ('img_timestamp'),
-> ADD INDEX 'img_sha1' ('img_sha1');
ERROR 1114 (HY000): The table 'image' is full
```

Unfortunately, this failed for the following reason:

Limitations of Fast Index Creation

During index creation, files are written to the temporary directory (\$TMPDIR on Unix, %TEMP% on Windows, or the value of the `tmpdir` [566] configuration variable). Each temporary file is large enough to hold one column that makes up the new index, and each one is removed as soon as it is merged into the final index.

MySQL 5.5 Reference Manual, 14.4.2 Fast Index Creation in the InnoDB Storage Engine

My `/tmp` resides on its own partition which is only 1G. During fast index creation, the `/tmp` directory fills up, and then MySQL throws the “The table ‘image’ is full” error.

Work-around: Use larger partition for TMP.

```
root-shell# emacs /etc/mysql/conf.d/wp-mirror.cnf
# fast index creation requires large TMP directory
tmpdir = /var/tmp # default /tmp
root-shell# service mysql stop
root-shell# service mysql start
mysql> SHOW VARIABLES LIKE 'tmpdir';
+-----+-----+
| Variable_name | Value |
+-----+-----+
| tmpdir        | /var/tmp |
+-----+-----+
mysql> ALTER TABLE commonswiki.image
-> ADD INDEX 'img_usertext_timestamp' ('img_user_text','img_timestamp'),
-> ADD INDEX 'img_size' ('img_size'),
-> ADD INDEX 'img_timestamp' ('img_timestamp'),
-> ADD INDEX 'img_sha1' ('img_sha1');
Query OK, 0 rows affected (2 hours 32 min 24.15 sec)
Records: 0 Duplicates: 0 Warnings: 0
```

Measurement: `commonswiki-20130216-image.sql.gz` is 8.3G, `commonswiki-20130216-image.sql` is 34G, `/var/lib/mysql/commonswiki/image.ibd` is 12G after **INSERT** and 14G after **ADD INDEX**.

```
mysql> SELECT data_length, index_length FROM information_schema.tables
-> WHERE table_schema='commonswiki' AND table_name='image';
```

```
+-----+-----+
| data_length | index_length |
+-----+-----+
| 11947212800 | 2045509632 |
+-----+-----+
```

```
+-----+-----+
| time [ks] | inserts [k] |
+-----+-----+
| 0.0 | 0.0 |
| 0.9 | 1.0 |
| 1.7 | 2.0 |
| 2.4 | 3.0 |
| 3.0 | 4.0 |
| 3.8 | 5.0 |
| 4.6 | 6.0 |
| 5.4 | 7.0 |
| 6.2 | 8.0 |
| 7.0 | 9.0 |
| 7.8 | 10.0 |
| 8.6 | 11.0 |
| 9.4 | 12.0 |
| 10.1 | 13.0 |
| 10.9 | 14.0 |
| 11.6 | 15.0 |
| 12.4 | 16.0 |
| 12.9 | 17.0 |
| 13.6 | 18.0 |
| 14.4 | 19.0 |
| 15.2 | 20.0 |
| 16.0 | 21.0 |
| 16.7 | 22.0 |
| 17.6 | 23.0 |
| 18.4 | 24.0 |
| 19.2 | 25.0 |
| 19.9 | 26.0 |
| 20.6 | 27.0 |
| 21.3 | 28.0 |
| 22.1 | 29.0 |
| 22.9 | 30.0 |
| 33.5 | 30.0 | <-- +10.6 [ks] fsm-table-add-index
+-----+-----+
```

G.9.13 EXPERIMENT.10 innodb_log_buffer_size=80M, innodb_log_file_size=512M, ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=4, fast index, LOAD DATA INFILE

Code: D1F+L512P1024H+Z+B4, fast index, LOAD DATA INFILE

Configuration files: /etc/mysql/conf.d/wp-mirror.cnf differs from the baseline as follows:

```
innodb_log_buffer_size      = 80M # default    8M. (max disk write speed)
innodb_log_file_size        = 512M # default    5M. (1/2 buffer pool size)
innodb_flush_log_at_trx_commit = 0 # default    1. (0=flush log buff 1/sec)
large_pages                  = 1 # default    OFF.
```

The `image` table is compressed and has 4K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4;
```

The new parameters are set to:

```
(defparameter *mirror-innodb-fast-index-creation* t)
(defparameter *mirror-split-sql* "dchunk")
```

The fast index creation and `LOAD DATA INFILE` method involves: 1) `DROP`ping all secondary indices for `commonswiki.image`, 2) preparing a file containing data fields only, 3) `LOAD`ing that file (specifying the absolute path), and finally 4) `ADD`ing the secondary indices:

```
mysql> TRUNCATE TABLE commonswiki.image;
mysql> ALTER TABLE commonswiki.image
-> DROP INDEX img_usertext_timestamp, DROP INDEX img_size,
-> DROP INDEX img_timestamp, DROP INDEX img_sha1;
mysql> LOAD DATA INFILE
-> /var/lib/mediawiki/images/wp-mirror/commonswiki-20130124-image-p000000000-c000100000.dat'
-> IGNORE INTO TABLE 'commonswiki'.'image'
-> FIELDS TERMINATED BY ',' OPTIONALLY ENCLOSED BY '"'
-> LINES TERMINATED BY '),( ';
mysql> ALTER TABLE commonswiki.image
-> ADD INDEX 'img_usertext_timestamp' ('img_user_text','img_timestamp'),
-> ADD INDEX 'img_size' ('img_size'),
-> ADD INDEX 'img_timestamp' ('img_timestamp'),
-> ADD INDEX 'img_sha1' ('img_sha1');
Query OK, 0 rows affected (2 hours 12 min 12.54 sec)
```

Once the data is `LOAD`ed, it is useful to measure the time it takes to reload the data using either the `IGNORE` or the `REPLACE` options:

```
mysql> LOAD DATA INFILE
-> '/var/lib/mediawiki/images/wp-mirror/commonswiki-20130124-image-p000000000-c000100000.dat'
-> IGNORE INTO TABLE 'commonswiki'.'image'
-> FIELDS TERMINATED BY ',' OPTIONALLY ENCLOSED BY '"'
-> LINES TERMINATED BY '),( ';

mysql> LOAD DATA INFILE
-> '/var/lib/mediawiki/images/wp-mirror/commonswiki-20130124-image-p000000000-c000100000.dat'
-> REPLACE INTO TABLE 'commonswiki'.'image'
-> FIELDS TERMINATED BY ',' OPTIONALLY ENCLOSED BY '"'
-> LINES TERMINATED BY '),( ';
```

Measurement: `commonswiki-20130216-image.sql.gz` is 8.3G, `commonswiki-20130216-image.sql` is 34G, `/var/lib/mysql/commonswiki/image.ibd` is 4.6G after `LOAD DATA INFILE` and 6.1G after `ADD INDEX`.

```
mysql> SELECT data_length, index_length FROM information_schema.tables
-> WHERE table_schema='commonswiki' AND table_name='image';

+-----+-----+
| data_length | index_length |
+-----+-----+
| 4714135552 | 1664352256 |
+-----+-----+
```

time [ks]	inserts [k]	
0.0	0.0	
0.9	1.0	
1.8	2.0	
2.6	3.0	
3.4	4.0	
4.2	5.0	
5.0	6.0	
5.8	7.0	
6.6	8.0	
7.4	9.0	
8.2	10.0	
9.1	11.0	
9.9	12.0	
10.8	13.0	
11.5	14.0	
12.3	15.0	
13.2	16.0	
13.8	17.0	
14.4	18.0	
15.1	19.0	
16.0	20.0	
16.7	21.0	
17.5	22.0	
18.2	23.0	
19.0	24.0	
19.9	25.0	
20.7	26.0	
21.4	27.0	
22.3	28.0	
23.0	29.0	
23.9	30.0	
32.0	30.0	<-- +8.1 [ks] fsm-table-add-index

G.9.14 EXPERIMENT.11a innodb_log_buffer_size=80M, innodb_log_file_size=512M, ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=4, fast index creation, schunk-page-count=100

Code: D1F+L512P1024H+Z+B4, fast index creation, p100

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` differs from the baseline as follows:

```
innodb_log_buffer_size      = 80M # default 8M. (max disk write speed)
innodb_log_file_size        = 512M # default 5M. (1/2 buffer pool size)
innodb_flush_log_at_trx_commit = 0 # default 1. (0=flush log buff 1/sec)
large_pages                  = 1 # default OFF.
```

The `image` table is compressed and has 4K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4;
```

The new parameters are set to:


```
(defparameter *mirror-innodb-fast-index-creation* t)
(defparameter *mirror-schunk-page-count* 100)
(defparameter *mirror-split-sql* "schunk")
```

Measurement: `commonswiki-20130216-image.sql.gz` is 8.3G, `commonswiki-20130216-image.sql` is 34G, `/var/lib/mysql/commonswiki/image.ibd` is 12G after INSERT and 14G after ADD INDEX.

```
mysql> SELECT data_length, index_length FROM information_schema.tables
-> WHERE table_schema='commonswiki' AND table_name='image';
```

data_length	index_length
11925192704	2037907456

time [ks]	inserts [k]
0.0	0.0
0.5	1.0
1.0	2.0
1.5	3.0
1.9	4.0
2.4	5.0
2.8	6.0
3.4	7.0
3.9	8.0
4.5	9.0
4.9	10.0
5.4	11.0
5.8	12.0
6.3	13.0
6.8	14.0
7.3	15.0
7.7	16.0
8.0	17.0
8.4	18.0
8.9	19.0
9.4	20.0
9.8	21.0
10.2	22.0
10.8	23.0
11.3	24.0
11.8	25.0
12.2	26.0
12.6	27.0
13.1	28.0
13.6	29.0
14.1	30.0
24.1	30.0

<-- +10.0 [ks] fsm-table-add-index

G.9.15 EXPERIMENT.11b `innodb_log_buffer_size=80M,`
`innodb_log_file_size=512M, ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=4,`
fast index creation, schunk-page-count=100, reload into populated
`commonswiki.image`

This experiment is a repeat of 11a, with one difference: `commonswiki.image` is still populated with the results from 11a, and we use neither `DROP INDEX` at the start of the run nor `ADD INDEX` at the end.

Measurement: `/var/lib/mysql/commonswiki/image.ibd` is 15G.

```
mysql> SELECT data_length, index_length FROM information_schema.tables
-> WHERE table_schema='commonswiki' AND table_name='image';
```

data_length	index_length
11943542784	2712387584

time [ks]	inserts [k]
0.0	0.0
0.7	1.0
1.2	2.0
1.7	3.0
2.1	4.0
2.7	5.0
3.1	6.0
3.6	7.0
4.1	8.0
4.5	9.0
5.0	10.0
5.5	11.0
6.0	12.0
6.6	13.0
7.0	14.0
7.4	15.0
7.9	16.0
8.0	17.0
8.3	18.0
8.7	19.0
9.2	20.0
9.6	21.0
10.0	22.0
10.4	23.0
10.8	24.0
11.3	25.0
11.8	26.0
12.1	27.0
12.6	28.0
13.1	29.0
13.7	30.0
15.9	30.0

<-- +2.2 [ks] fragmentation of secondary indices

G.9.16 EXPERIMENT.12a `innodb_log_buffer_size=80M,`
`innodb_log_file_size=512M, ROW_FORMAT=COMPRESSED, KEY_BLOCK_SIZE=4,`
fast index, LOAD DATA INFILE, dchunk-page-count=100

Code: D1F+L512P1024H+Z+B4, fast index, LOAD DATA INFILE, p100

Configuration files: `/etc/mysql/conf.d/wp-mirror.cnf` differs from the baseline as follows:

```
innodb_log_buffer_size      = 80M # default    8M. (max disk write speed)
innodb_log_file_size        = 512M # default    5M. (1/2 buffer pool size)
innodb_flush_log_at_trx_commit = 0 # default    1. (0=flush log buff 1/sec)
large_pages                  = 1 # default    OFF.
```

The `image` table is compressed and has 4K page size:

```
mysql> ALTER TABLE commonswiki.image ROW_FORMAT=COMPRESSED KEY_BLOCK_SIZE=4;
```

The new parameters are set to:

```
(defparameter *mirror-dchunk-page-count* 100)
(defparameter *mirror-innodb-fast-index-creation* t)
(defparameter *mirror-split-sql* "dchunk")
```

Measurement: `commonswiki-20130216-image.sql.gz` is 8.3G, `commonswiki-20130216-image.sql` is 34G, `/var/lib/mysql/commonswiki/image.ibd` is 4.6G after LOAD DATA INFILE and 6.1G after ADD INDEX.

```
mysql> SELECT data_length, index_length FROM information_schema.tables
-> WHERE table_schema='commonswiki' AND table_name='image';
```

```
+-----+-----+
| data_length | index_length |
+-----+-----+
| 4667994112 | 1644429312 |
+-----+-----+
```

time [ks]	inserts [k]
0.0	0.0
0.4	1.0
0.8	2.0
1.2	3.0
1.6	4.0
2.0	5.0
2.3	6.0
2.7	7.0
3.0	8.0
3.4	9.0
3.7	10.0
4.1	11.0
4.5	12.0
5.0	13.0
5.2	14.0
5.6	15.0
5.9	16.0
6.0	17.0
6.2	18.0
6.5	19.0
6.9	20.0
7.2	21.0
7.6	22.0
7.8	23.0
8.1	24.0
8.5	25.0
8.8	26.0
9.1	27.0
ERROR 2002 (HY000): Can't connect to local MySQL server through socket '/var/run/mysqld/mysqld.sock' (2)	
<-- this loss of connectivity is reproducible	
10.6	30.0
<-- +1.5 [ks] rerun wp-mirror --mirror	
19.3	30.0
<-- +8.7 [ks] fsm-table-add-index	

G.9.17 EXPERIMENT.12b `innodb_log_buffer_size=80M`, `innodb_log_file_size=512M`, `ROW_FORMAT=COMPRESSED`, `KEY_BLOCK_SIZE=4`, **fast index creation**, `dchunk-page-count=100`, **reload into populated** `commonswiki.image`

This experiment is a repeat of 12a, with a difference: `commonswiki.image` is still populated with the results from 12a, and we use neither `DROP INDEX` at the start of the run nor `ADD INDEX` at the end.

Measurement: `/var/lib/mysql/commonswiki/image.ibd` is 6.4G.

```
mysql> SELECT data_length, index_length FROM information_schema.tables
-> WHERE table_schema='commonswiki' AND table_name='image';
```

data_length	index_length
4668776448	1953759232

time [ks]	inserts [k]
0.0	0.0
0.7	1.0
1.5	2.0
2.2	3.0
2.9	4.0
4.1	5.0
5.0	6.0
5.8	7.0
6.6	8.0
7.4	9.0
8.2	10.0
9.1	11.0
10.1	12.0
11.1	13.0
11.6	14.0
12.4	15.0
13.2	16.0
13.4	17.0
13.8	18.0
14.5	19.0
15.4	20.0
16.1	21.0
16.9	22.0
17.3	23.0
18.0	24.0
18.9	25.0
19.7	26.0
20.3	27.0
21.0	28.0
21.6	29.0
22.6	30.0

We note that: 1) experiment 12b took longer than 12a, 2) `/var/lib/mysql/commonswiki/image.ibd` grew from 6.1G to 6.4G; all of the size increase was due to fragmentation of the pages that store the secondary indices.

G.9.18 Conclusions

We achieved a nine-fold increase in speed for loading the `commonswiki.image` database table. This was done by:

- increasing `log buffer` size from 8M to 80M to match best case disk performance;
- increasing `log file` size from 10M to 512M to match `innodb_buffer_pool_size`;
- using `InnoDB` Data Compression with page size 4K (which reduces `INSERT` speed a bit, but saves disk space);
- using fast index creation so that `INSERT` scales linearly rather than as a logarithm;
- using the `LOAD DATA INFILE` command to `INSERT` data at a lower level in the `InnoDB` storage engine; and
- using larger `dchunks` and `schunks` to reduce `FSM` overhead.

The results are charted in [Figure G.1, InnoDB Experiments—Importing commonswiki.image Table](#).

The choice of using `LOAD DATA INFILE` versus using `REPLACE INTO` is interesting. When we populate a table for the first time, `LOAD DATA INFILE` is faster (compare experiment 12 with 11). However, if we update an already populated table, `REPLACE INTO` is faster (compare experiment 11a with 12a). The reason appears to be that `LOAD DATA INFILE` produces a `*ibd` file consisting of tightly packed data pages and index pages; and therefore any later update must entail page splitting, which in turn means writing two pages to disk for each page read. Since WP-MIRROR installs once and then updates monthly, using `REPLACE INTO` is the better choice.

Recommendation: Use `REPLACE INTO` rather than `LOAD DATA INFILE`.

G.10 Experiments with `mwxml2sql`

On 2013-Feb-21, Ariel T. Glenn of the WMF announced the development of new import tools:

Date: Thu, 21 Feb 2013 19:05:17 +0200
From: Ariel T. Glenn <ariel@wikimedia.org>
To: xmldatadumps-l@lists.wikimedia.org
Subject: [Xmldatadumps-l] toos for import (setting up a local mirror)

So partly due to recent work by folks like Kent on creating local WP mirrors using the import process, and partly from helping walk someone through the process for the zillionth time, I have come to the realization that This Process Sucks (TM). I am not taking on the whole stack, but I am trying to make a dent in at least part of it. To that end:

1) `mwddumper` available from download.wikimedia.org is now the current version and should run without a bunch of fancy tricks. Thanks to Chad for fixing up the jenkins build. I tried it on a recent en wikipedia current pages dump and it seemed to work. though I did not test importing the output.

2) I have a couple of tools for *nix users importing into a MySQL database.

* Somewhat equivalent to `mwddumper` is '`mwxml2sql`', name chosen before I saw that there was a long abandoned `xml2sql` tool available in the wild. Input: stubs and page content xml files, output: sql files for each of page, revision, text table, reading 0.4 xsd through 0.7 and writing Mw 1.5 through 1.20 output, as specified by the user. Many specific combinations are untested (e.g. I spent most work on 0.7 xds to MW 1.20).

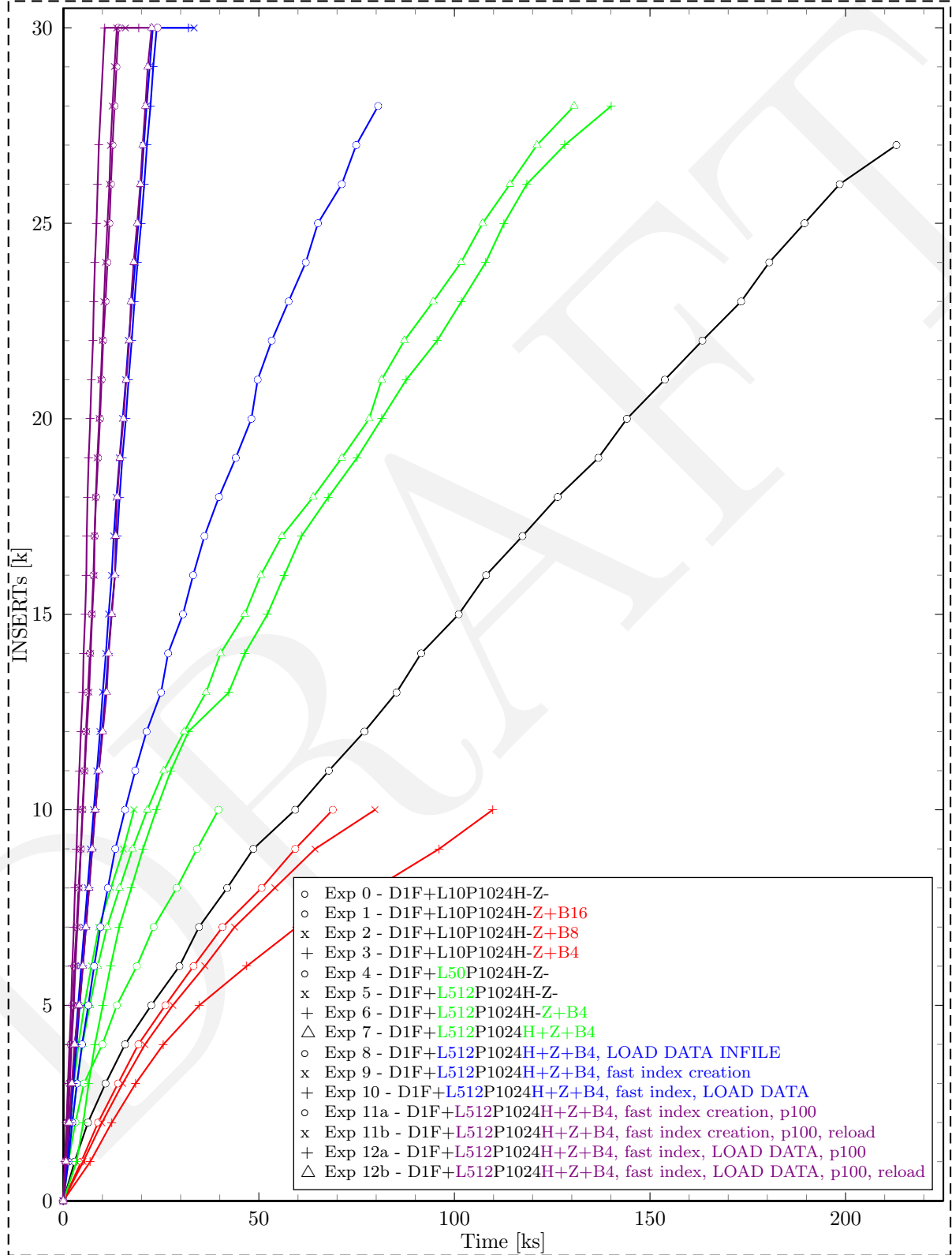
* Converting an sql dump file to a tab delimited format suitable for 'LOAD DATA INFILE' is now possible via '`sql2txt`' (also *nix platforms).

I would like to test `mwxml2sql-0.0.2`, the code for which can be found by chasing a link found at https://meta.wikimedia.org/wiki/Data_dumps/Tools_for_importing. An usage example can be found at https://meta.wikimedia.org/wiki/Data_dumps/Import_examples.

G.10.1 Testing `mwxml2sql`

A design choice had to be made:

1. split the XML dump file into `xchunks`, and then use `mwxml2sql` to convert `xchunks` into `schunks`; or

Figure G.1: InnoDB Experiments—Importing `commonswiki.image` Table

2. use `mwxml2sql` to convert the `XML` dump file into large `SQL` files, and then split the `SQL` files into `schunks`.

I decided that the first choice was more robust, and indeed trial runs with `xchunks` worked well, as failure was confined to very few `xchunks`.

`mwxml2sql` runs fast. It converts an `xchunk` into three `schunks`, one each for the `page`, `revision`, and `text` tables. Some `schunks` fail to import, throwing `SQL` syntax errors like:

```
[....]fsm-file-load-insert simplewiki-20130525-revision-p000035000-c000001000.sql
ERROR 1064 (42000) at line 10: You have an error in your SQL syntax;
check the manual that corresponds to your MySQL server version for the
right syntax to use near ' 'Fix typos, formatting, brackets and links,
typos fixed: etc\n
...
[....]fsm-file-load-insert simplewiki-20130525-revision-p000151000-c000001000.sql
ERROR 1064 (42000) at line 10: You have an error in your SQL syntax;
check the manual that corresponds to your MySQL server version for the
right syntax to use near ' 'Fix typos, formatting, brackets and links,
typos fixed: etc\n
...
[....]fsm-file-load-insert simplewiki-20130525-text-p000035000-c000001000.sql
ERROR 1064 (42000) at line 10: You have an error in your SQL syntax;
check the manual that corresponds to your MySQL server version for the
right syntax to use near ' 'This category is for Kings and Queens in the
various states within Germa
...
[....]fsm-file-load-insert simplewiki-20130525-text-p000151000-c000001000.sql
ERROR 1064 (42000) at line 10: You have an error in your SQL syntax;
check the manual that corresponds to your MySQL server version for the
right syntax to use near ' '>{{documentation subpage}}\nThis template
takes 2 arguments:\n* <nowiki>{
```

In terms of performance, the real issue is importation of the `schunks` into the database, and this was studied in §G.9, [Experiments with commonswiki.image](#). Coding and testing for the Finite State Machine took a couple of months.

The build for `enwiki` and `enwiktionary` without media files completed in 800ks (nine days). This is 80% less time than WP-MIRROR 0.5. While most of the performance gain occurred in other areas of the code, it is clear that using `mwxml2sql` is a win.

G.10.2 Packaging `mwxml2sql` for Debian

For the WP-MIRROR `DEB` package to make use of `mwxml2sql` it was necessary to package `mwxml2sql`, and then edit WP-MIRROR's `debian/control` file to include it as a dependency.

However, to make a `DEB` package for `mwxml2sql`, the code and its `Makefile` had to be patched. For one thing, Debian requires `man` pages, and `mwxml2sql` had none. So I decided to modify the code so that `man` pages could be generated using `help2man`. For another thing, the `Makefile` had no `build` target, no `deinstall` target, and other targets needed work as well.

I produced a `DEB` package called `mediawiki-mwxml2sql`. The name was chosen to be consistent with other `mediawiki` packages that are part of the Debian distribution. `mediawiki-mwxml2sql` builds with `debuild` and `pbuilder`.

The next question was to determine if the patches would be welcome by the upstream author, Ariel T. Glenn <ariel@wikimedia.org>.

G.10.3 Submitting Patches Upstream to WMF

The people at the WMF do welcome patches. However, submitting code requires some initial setup.

- First, on your local platform, you must:
 - install `git` and `git-review`, and
 - generate an `SSH` key pair.
- Second, on the WMF side, you must
 - request a developer account from <http://wikitech.wikimedia.org/> (Log in),
 - upload your `SSH` public key to <http://wikitech.wikimedia.org/> (Log in), and
 - upload your `SSH` public key to <http://gerrit.wikimedia.org/> (Sign in).
- Third, you must familiarize yourself with:
 - the version control system `git`, and
 - the software review system `gerrit`.

All the above is described by reading <https://www.mediawiki.org/wiki/Gerrit>, <https://www.mediawiki.org/wiki/Gerrit/Tutorial>, and related pages.

Using `git` may require some learning. Some useful links are:

- tutorials <http://sixrevisions.com/resources/git-tutorials-beginners/>,
- concepts <http://www.sbf5.com/~cduran/technical/git/>, and
- storage <http://eagain.net/articles/git-for-computer-scientists/index.html>.

Still, it took a day of trial and error to get my patches submitted (see <https://gerrit.wikimedia.org/r/64343/>). The `git` commands I used are given in the following `Makefile`.

```
wikimedia@darkstar-7:~$ cat Makefile
#-----+
# Makefile for submitting patches to the Wikimedia Foundation |
# Copyright (C) 2013 Dr. Kent L. Miller. All rights reserved. |
# |
# This program is free software: you can redistribute it and/or modify |
# it under the terms of the GNU General Public License as published by |
# the Free Software Foundation, either version 3 of the License, or (at |
# your option) any later version. |
# |
# This program is distributed in the hope that it will be useful, but |
# WITHOUT ANY WARRANTY; without even the implied warranty of |
# MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU |
# General Public License for more details. |
# |
# You should have received a copy of the GNU General Public License |
# along with this program. If not, see <http://www.gnu.org/licenses/>") |
#-----+
GERRIT = wpmirrordev@gerrit.wikimedia.org
PORT = 29418
WMFLABS = wpmirrordev@bastion.wmflabs.org

all: clone hooks pull checkout branch edit diff add commit rebase review

clone:
    # create directory 'dumps' and initialize a repository in it
    # copy all commit objects and head references (from remote to local)
```

```
# add 'remote repository reference' named 'origin' (saves typing)
# add 'remote heads' named 'origin/[head-name]'
# add 'HEAD' to track 'origin/master'
git clone ssh://$(GERRIT):$(PORT)/operations/dumps

hooks:
# get 'pre-commit-hook' to add 'change id' to commit summary
scp -p -P $(PORT) $(GERRIT):hooks/commit-msg ~/dumps/.git/hooks/.
cd dumps; git review -s

pull:
# list 'remote heads'
cd dumps; git branch -r
# setup tracking branch 'ariel'
cd dumps; git branch --track ariel origin/ariel
# add new commit objects (if any)
# update 'remote heads'
cd dumps; git fetch origin
# update 'local heads' ('master' and 'ariel') to 'remote-heads'
# merge 'origin/HEAD' into 'HEAD'
cd dumps; git pull origin

checkout:
# point 'HEAD' to 'ariel's commit object
cd dumps; git checkout ariel
cd dumps; git status

branch:
# create head 'wpmirrordev'
# point 'wpmirrordev' to 'ariel's commit object
cd dumps; git branch wpmirrordev ariel
# point 'HEAD' to 'wpmirrordev's commit object
cd dumps; git checkout wpmirrordev
cd dumps; git status

edit:
# apply patched files
cp temp/* dumps/xmlfileutils/.

diff:
# diff files (but not added files) against 'HEAD'
cd dumps; git diff
# list changed files against 'HEAD'
cd dumps; git status

add:
# stage the files to be committed
cd dumps/xmlfileutils; git add mwxml2sql.c sql2txt.c sqlfilter.c
cd dumps/xmlfileutils; git add Makefile
# diff added files against 'HEAD'
cd dumps; git diff --cached
# list changed files against 'HEAD'
cd dumps; git status

commit:
```

```
# create 'commit object'
# point 'HEAD' to the new 'commit object'
cd dumps; git commit -m "Fix for compatibility with help2man and Debian Policy"
# list all commits from 'HEAD' back to initial commit
cd dumps; git log

rebase:
# add new commit objects (if any)
# update 'remote head' 'origin/ariel'
# merge 'origin/ariel' into 'ariel'
# point 'ariel' to 'origin/ariel's commit object
cd dumps; git pull origin ariel
# rebase 'wpmirrordev' branch on updated 'ariel' head
cd dumps; git rebase ariel

review:
# push changes to Gerrit
cd dumps; git review -R ariel

#-----+

shell:
ssh -A $(WMFLABS)

purge:
rm -r dumps

clean:
rm -f *~
```

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