

Yocto Project Reference Manual



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Note

Due to production processes, there could be differences between the Yocto Project documentation bundled in the release tarball and the Yocto Project Reference Manual [<http://www.yoctoproject.org/docs/1.5/ref-manual/ref-manual.html>] on the Yocto Project [<http://www.yoctoproject.org>] website. For the latest version of this manual, see the manual on the website.

Table of Contents

| | |
|--|----|
| 1. Introduction | 1 |
| 1.1. Introduction | 1 |
| 1.2. Documentation Overview | 1 |
| 1.3. System Requirements | 1 |
| 1.3.1. Supported Linux Distributions | 1 |
| 1.3.2. Required Packages for the Host Development System | 2 |
| 1.3.3. Required Git, tar, and Python Versions | 4 |
| 1.4. Obtaining the Yocto Project | 5 |
| 1.5. Development Checkouts | 5 |
| 2. Using the Yocto Project | 7 |
| 2.1. Running a Build | 7 |
| 2.1.1. Build Overview | 7 |
| 2.1.2. Building an Image Using GPL Components | 7 |
| 2.2. Installing and Using the Result | 7 |
| 2.3. Debugging Build Failures | 8 |
| 2.3.1. Task Failures | 8 |
| 2.3.2. Running Specific Tasks | 8 |
| 2.3.3. Dependency Graphs | 9 |
| 2.3.4. General BitBake Problems | 9 |
| 2.3.5. Development Host System Issues | 9 |
| 2.3.6. Building with No Dependencies | 9 |
| 2.3.7. Variables | 9 |
| 2.3.8. Recipe Logging Mechanisms | 9 |
| 2.3.9. Other Tips | 10 |
| 2.4. Maintaining Build Output Quality | 11 |
| 2.4.1. Enabling and Disabling Build History | 11 |
| 2.4.2. Understanding What the Build History Contains | 12 |
| 3. A Closer Look at the Yocto Project Development Environment | 17 |
| 3.1. User Configuration | 18 |
| 3.2. Metadata, Machine Configuration, and Policy Configuration | 19 |
| 3.2.1. Distro Layer | 21 |
| 3.2.2. BSP Layer | 21 |
| 3.2.3. Software Layer | 21 |
| 3.3. Sources | 22 |
| 3.3.1. Upstream Project Releases | 23 |
| 3.3.2. Local Projects | 23 |
| 3.3.3. Source Control Managers (Optional) | 24 |
| 3.3.4. Source Mirror(s) | 24 |
| 3.4. Package Feeds | 24 |
| 3.5. BitBake | 25 |
| 3.5.1. Source Fetching | 26 |
| 3.5.2. Patching | 27 |
| 3.5.3. Configuration and Compilation | 28 |
| 3.5.4. Package Splitting | 29 |
| 3.5.5. Image Generation | 31 |
| 3.5.6. SDK Generation | 33 |
| 3.6. Images | 34 |
| 3.7. Application Development SDK | 35 |
| 4. Technical Details | 37 |
| 4.1. Yocto Project Components | 37 |
| 4.1.1. BitBake | 37 |
| 4.1.2. Metadata (Recipes) | 38 |
| 4.1.3. Classes | 38 |
| 4.1.4. Configuration | 38 |
| 4.2. Cross-Development Toolchain Generation | 38 |
| 4.3. Shared State Cache | 40 |
| 4.3.1. Overall Architecture | 41 |
| 4.3.2. Checksums (Signatures) | 41 |
| 4.3.3. Shared State | 43 |
| 4.3.4. Tips and Tricks | 44 |
| 4.4. x32 | 45 |

| | |
|--|----|
| 4.4.1. Support | 45 |
| 4.4.2. Stabilizing and Completing x32 | 45 |
| 4.4.3. Using x32 Right Now | 45 |
| 4.5. Wayland | 46 |
| 4.5.1. Support | 46 |
| 4.5.2. Enabling Wayland in an Image | 46 |
| 4.5.3. Running Weston | 47 |
| 4.6. Licenses | 47 |
| 4.6.1. Tracking License Changes | 47 |
| 4.6.2. Enabling Commercially Licensed Recipes | 48 |
| 5. Migrating to a Newer Yocto Project Release | 51 |
| 5.1. Moving to the Yocto Project 1.3 Release | 51 |
| 5.1.1. Local Configuration | 51 |
| 5.1.2. Recipes | 51 |
| 5.1.3. Linux Kernel Naming | 53 |
| 5.2. Moving to the Yocto Project 1.4 Release | 53 |
| 5.2.1. BitBake | 53 |
| 5.2.2. Build Behavior | 53 |
| 5.2.3. Proxies and Fetching Source | 53 |
| 5.2.4. Custom Interfaces File (netbase change) | 54 |
| 5.2.5. Remote Debugging | 54 |
| 5.2.6. Variables | 54 |
| 5.2.7. Target Package Management with RPM | 54 |
| 5.2.8. Recipes Moved | 54 |
| 5.2.9. Removals and Renames | 55 |
| 5.3. Moving to the Yocto Project 1.5 Release | 55 |
| 5.3.1. Host Dependency Changes | 55 |
| 5.3.2. atom-pc Board Support Package (BSP) | 56 |
| 5.3.3. BitBake | 56 |
| 5.3.4. QA Warnings | 56 |
| 5.3.5. Directory Layout Changes | 56 |
| 5.3.6. Shortened Git SRCREV Values | 57 |
| 5.3.7. IMAGE_FEATURES | 57 |
| 5.3.8. /run | 57 |
| 5.3.9. Removal of Package Manager Database Within Image Recipes | 57 |
| 5.3.10. Images Now Rebuild Only on Changes Instead of Every Time | 57 |
| 5.3.11. Task Recipes | 58 |
| 5.3.12. BusyBox | 58 |
| 5.3.13. Automated Image Testing | 58 |
| 5.3.14. Build History | 58 |
| 5.3.15. udev | 58 |
| 5.3.16. Removed and Renamed Recipes | 58 |
| 5.3.17. Other Changes | 59 |
| 6. Source Directory Structure | 60 |
| 6.1. Top-Level Core Components | 60 |
| 6.1.1. bitbake/ | 60 |
| 6.1.2. build/ | 60 |
| 6.1.3. documentation | 60 |
| 6.1.4. meta/ | 61 |
| 6.1.5. meta-yocto/ | 61 |
| 6.1.6. meta-yocto-bsp/ | 61 |
| 6.1.7. meta-hob/ | 61 |
| 6.1.8. meta-skeleton/ | 61 |
| 6.1.9. scripts/ | 61 |
| 6.1.10. oe-init-build-env | 61 |
| 6.1.11. oe-init-build-env-memres | 62 |
| 6.1.12. LICENSE, README, and README.hardware | 62 |
| 6.2. The Build Directory - build/ | 62 |
| 6.2.1. build/pseudodone | 62 |
| 6.2.2. build/conf/local.conf | 62 |
| 6.2.3. build/conf/bblayers.conf | 63 |
| 6.2.4. build/conf/sanity_info | 63 |
| 6.2.5. build/downloads/ | 64 |
| 6.2.6. build/sstate-cache/ | 64 |

| | |
|--|----|
| 6.2.7. build/tmp/ | 64 |
| 6.2.8. build/tmp/buildstats/ | 64 |
| 6.2.9. build/tmp/cache/ | 64 |
| 6.2.10. build/tmp/deploy/ | 64 |
| 6.2.11. build/tmp/deploy/deb/ | 64 |
| 6.2.12. build/tmp/deploy/rpm/ | 64 |
| 6.2.13. build/tmp/deploy/licenses/ | 64 |
| 6.2.14. build/tmp/deploy/images/ | 64 |
| 6.2.15. build/tmp/deploy/ipk/ | 65 |
| 6.2.16. build/tmp/sysroots/ | 65 |
| 6.2.17. build/tmp/stamps/ | 65 |
| 6.2.18. build/tmp/log/ | 65 |
| 6.2.19. build/tmp/pkgdata/ | 65 |
| 6.2.20. build/tmp/work/ | 65 |
| 6.3. The Metadata - meta/ | 66 |
| 6.3.1. meta/classes/ | 66 |
| 6.3.2. meta/conf/ | 66 |
| 6.3.3. meta/conf/machine/ | 66 |
| 6.3.4. meta/conf/distro/ | 66 |
| 6.3.5. meta/files/ | 66 |
| 6.3.6. meta/lib/ | 66 |
| 6.3.7. meta/recipes-bsp/ | 66 |
| 6.3.8. meta/recipes-connectivity/ | 66 |
| 6.3.9. meta/recipes-core/ | 67 |
| 6.3.10. meta/recipes-devtools/ | 67 |
| 6.3.11. meta/recipes-extended/ | 67 |
| 6.3.12. meta/recipes-gnome/ | 67 |
| 6.3.13. meta/recipes-graphics/ | 67 |
| 6.3.14. meta/recipes-kernel/ | 67 |
| 6.3.15. meta/recipes-lsb4/ | 67 |
| 6.3.16. meta/recipes-multimedia/ | 67 |
| 6.3.17. meta/recipes-qt/ | 67 |
| 6.3.18. meta/recipes-rt/ | 67 |
| 6.3.19. meta/recipes-sato/ | 67 |
| 6.3.20. meta/recipes-support/ | 67 |
| 6.3.21. meta/site/ | 67 |
| 6.3.22. meta/recipes.txt | 68 |
| 7. BitBake | 69 |
| 7.1. Parsing | 69 |
| 7.2. Preferences and Providers | 69 |
| 7.3. Dependencies | 70 |
| 7.4. The Task List | 70 |
| 7.5. Running a Task | 71 |
| 7.6. BitBake Command Line | 71 |
| 7.7. Fetchers | 72 |
| 8. Classes | 74 |
| 8.1. The base Class - base.bbclass | 74 |
| 8.2. Autotooled Packages - autotools.bbclass | 74 |
| 8.3. Alternatives - update-alternatives.bbclass | 74 |
| 8.4. Initcripts - update-rc.d.bbclass | 75 |
| 8.5. binconfig.bbclass | 75 |
| 8.6. Debian Renaming - debian.bbclass | 75 |
| 8.7. Pkg-config - pkgconfig.bbclass | 75 |
| 8.8. Archiving Sources - archive*.bbclass | 75 |
| 8.9. Perl Modules - cpan.bbclass | 76 |
| 8.10. Python Extensions - distutils.bbclass | 76 |
| 8.11. Developer Shell - devshell.bbclass | 76 |
| 8.12. Package Groups - packagegroup.bbclass | 76 |
| 8.13. Packaging - package*.bbclass | 76 |
| 8.14. Building Kernels - kernel.bbclass | 77 |
| 8.15. Creating Images - image.bbclass and rootfs*.bbclass | 77 |
| 8.16. Host System Sanity Checks - sanity.bbclass | 77 |
| 8.17. insane.bbclass | 78 |
| 8.18. Removing Work Files During the Build - rm_work.bbclass | 80 |

| | |
|---|-----|
| 8.19. Autotools Configuration Data Cache - siteinfo.bbclass | 81 |
| 8.20. Adding Users - useradd.bbclass | 81 |
| 8.21. externalsrc.bbclass | 81 |
| 8.22. testimage.bbclass | 81 |
| 8.23. Other Classes | 82 |
| 9. Images | 83 |
| 10. Reference: Features | 85 |
| 10.1. Distro | 85 |
| 10.2. Machine | 86 |
| 10.3. Images | 86 |
| 10.4. Feature Backfilling | 87 |
| 11. Variables Glossary | 89 |
| 12. Variable Context | 143 |
| 12.1. Configuration | 143 |
| 12.1.1. Distribution (Distro) | 143 |
| 12.1.2. Machine | 143 |
| 12.1.3. Local | 143 |
| 12.2. Recipes | 144 |
| 12.2.1. Required | 144 |
| 12.2.2. Dependencies | 144 |
| 12.2.3. Paths | 144 |
| 12.2.4. Extra Build Information | 144 |
| 13. FAQ | 145 |
| 14. Contributing to the Yocto Project | 151 |
| 14.1. Introduction | 151 |
| 14.2. Tracking Bugs | 151 |
| 14.3. Mailing lists | 151 |
| 14.4. Internet Relay Chat (IRC) | 151 |
| 14.5. Links | 151 |
| 14.6. Contributions | 152 |

Chapter 1. Introduction

1.1. Introduction

This manual provides reference information for the current release of the Yocto Project. The Yocto Project is an open-source collaboration project focused on embedded Linux developers. Amongst other things, the Yocto Project uses the OpenEmbedded build system, which is based on the Poky project, to construct complete Linux images. You can find complete introductory and getting started information on the Yocto Project by reading the Yocto Project Quick Start [<http://www.yoctoproject.org/docs/1.5/yocto-project-qs/yocto-project-qs.html>]. For task-based information using the Yocto Project, see the Yocto Project Development Manual [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html>] and the Yocto Project Linux Kernel Development Manual [<http://www.yoctoproject.org/docs/1.5/kernel-dev/kernel-dev.html>]. For Board Support Package (BSP) structure information, see the Yocto Project Board Support Package (BSP) Developer's Guide [<http://www.yoctoproject.org/docs/1.5/bsp-guide/bsp-guide.html>]. You can also find lots of Yocto Project information on the Yocto Project website [<http://www.yoctoproject.org>].

1.2. Documentation Overview

This reference manual consists of the following:

- Using the Yocto Project: Provides an overview of the components that make up the Yocto Project followed by information about debugging images created in the Yocto Project.
- Technical Details: Describes fundamental Yocto Project components as well as an explanation behind how the Yocto Project uses shared state (sstate) cache to speed build time.
- Directory Structure: Describes the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] created either by unpacking a released Yocto Project tarball on your host development system, or by cloning the upstream Poky [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#poky>] Git repository.
- BitBake: Provides an overview of the BitBake tool and its role within the Yocto Project.
- Classes: Describes the classes used in the Yocto Project.
- Images: Describes the standard images that the Yocto Project supports.
- Features: Describes mechanisms for creating distribution, machine, and image features during the build process using the OpenEmbedded build system.
- Variables Glossary: Presents most variables used by the OpenEmbedded build system, which uses BitBake. Entries describe the function of the variable and how to apply them.
- Variable Context: Provides variable locality or context.
- FAQ: Provides answers for commonly asked questions in the Yocto Project development environment.
- Contributing to the Yocto Project: Provides guidance on how you can contribute back to the Yocto Project.

1.3. System Requirements

For general Yocto Project system requirements, see the "What You Need and How You Get It [<http://www.yoctoproject.org/docs/1.5/yocto-project-qs/yocto-project-qs.html#yp-resources>]" section in the Yocto Project Quick Start. The remainder of this section provides details on system requirements not covered in the Yocto Project Quick Start.

1.3.1. Supported Linux Distributions

Currently, the Yocto Project is supported on the following distributions:

Note

Yocto Project releases are tested against the stable Linux distributions in the following list. The Yocto Project should work on other distributions but validation is not performed against them.

In particular, the Yocto Project does not support and currently has no plans to support rolling-releases or development distributions due to their constantly changing nature. We welcome patches and bug reports, but keep in mind that our priority is on the supported platforms listed below.

Refer to OE and Your Distro [<http://www.openembedded.org/index.php?title=OEandYourDistro>] and Required Software [http://www.openembedded.org/index.php?title=Required_software] for information for information about dependencies and requirements. If you encounter problems, please go to Yocto Project Bugzilla [<http://bugzilla.yoctoproject.org>] and submit a bug. We are interested in hearing about your experience.

- Ubuntu 12.04 (LTS)
- Ubuntu 12.10
- Ubuntu 13.04
- Fedora release 18 (Spherical Cow)
- Fedora release 19 (Schrödinger's Cat)
- CentOS release 6.4
- Debian GNU/Linux 6.0.7 (Squeeze)
- Debian GNU/Linux 7.0 (Wheezy)
- Debian GNU/Linux 7.1 (Wheezy)
- openSUSE 12.2
- openSUSE 12.3

Note

While the Yocto Project Team attempts to ensure all Yocto Project releases are one hundred percent compatible with each officially supported Linux distribution, instances might exist where you encounter a problem while using the Yocto Project on a specific distribution. For example, the CentOS 6.4 distribution does not include the Gtk+ 2.20.0 and PyGtk 2.21.0 (or higher) packages, which are required to run Hob [<http://www.yoctoproject.org/tools-resources/projects/hob>].

1.3.2. Required Packages for the Host Development System

The list of packages you need on the host development system can be large when covering all build scenarios using the Yocto Project. This section provides required packages according to Linux distribution and function.

1.3.2.1. Ubuntu and Debian

The following list shows the required packages by function given a supported Ubuntu or Debian Linux distribution:

- Essentials: Packages needed to build an image on a headless system:

```
$ sudo apt-get install gawk wget git-core diffstat unzip texinfo \
build-essential chrpath
```


- Graphical Extras: Packages recommended if the host system has graphics support:

```
$ sudo apt-get install libsdl1.2-dev xterm
```

- Documentation: Packages needed if you are going to build out the Yocto Project documentation manuals:

```
$ sudo apt-get install make xsltproc docbook-utils fop dblatex xmlto
```

- ADT Installer Extras: Packages needed if you are going to be using the Application Development Toolkit (ADT) Installer [<http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html#using-the-adt-installer>]:

```
$ sudo apt-get install autoconf automake libtool libglib2.0-dev
```

1.3.2.2. Fedora Packages

The following list shows the required packages by function given a supported Fedora Linux distribution:

- Essentials: Packages needed to build an image for a headless system:

```
$ sudo yum install gawk make wget tar bzip2 gzip python unzip perl patch \
diffutils diffstat git cpp gcc gcc-c++ glibc-devel texinfo chrpath \
ccache perl-Data-Dumper perl-Text-ParseWords
```

- Graphical Extras: Packages recommended if the host system has graphics support:

```
$ sudo yum install SDL-devel xterm
```

- Documentation: Packages needed if you are going to build out the Yocto Project documentation manuals:

```
$ sudo yum install make docbook-style-dsssl docbook-style-xsl \
docbook-dtds docbook-utils fop libxslt dblatex xmlto
```

- ADT Installer Extras: Packages needed if you are going to be using the Application Development Toolkit (ADT) Installer [<http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html#using-the-adt-installer>]:

```
$ sudo yum install autoconf automake libtool glib2-devel
```

1.3.2.3. OpenSUSE Packages

The following list shows the required packages by function given a supported OpenSUSE Linux distribution:

- Essentials: Packages needed to build an image for a headless system:

```
$ sudo zypper install python gcc gcc-c++ git chrpath make wget python-xml \
diffstat texinfo python-curses patch
```

- Graphical Extras: Packages recommended if the host system has graphics support:

```
$ sudo zypper install libSDL-devel xterm
```

- Documentation: Packages needed if you are going to build out the Yocto Project documentation manuals:

```
$ sudo zypper install make fop xsltproc dblatex xmlto
```

- ADT Installer Extras: Packages needed if you are going to be using the Application Development Toolkit (ADT) Installer [<http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html#using-the-adt-installer>]:

```
$ sudo zypper install autoconf automake libtool glib2-devel
```

1.3.2.4. CentOS Packages

The following list shows the required packages by function given a supported CentOS Linux distribution:

Note

Depending on the CentOS version you are using, other requirements and dependencies might exist. For details, you should look at the CentOS sections on the Poky/GettingStarted/Dependencies [<https://wiki.yoctoproject.org/wiki/Poky/GettingStarted/Dependencies>] wiki page.

- Essentials: Packages needed to build an image for a headless system:

```
$ sudo yum install gawk make wget tar bzip2 gzip python unzip perl patch \
diffutils diffstat git cpp gcc gcc-c++ glibc-devel texinfo chrpath
```

- Graphical Extras: Packages recommended if the host system has graphics support:

```
$ sudo yum install SDL-devel xterm
```

- Documentation: Packages needed if you are going to build out the Yocto Project documentation manuals:

```
$ sudo yum install make docbook-style-dsssl docbook-style-xsl \
docbook-dtds docbook-utils fop libxslt dblatex xmlto
```

- ADT Installer Extras: Packages needed if you are going to be using the Application Development Toolkit (ADT) Installer [<http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html#using-the-adt-installer>]:

```
$ sudo yum install autoconf automake libtool glib2-devel
```

1.3.3. Required Git, tar, and Python Versions

In order to use the build system, your host development system must meet the following version requirements for Git, tar, and Python:

- Git 1.7.5 or greater

- tar 1.24 or greater
- Python 2.7.3 or greater not including Python 3.x, which is not supported.

If your host development system does not meet all these requirements, you can resolve this by either downloading a pre-built tarball containing these tools, or building such a tarball on another system. Regardless of the method, once you have the tarball you simply install it somewhere on your system, such as a directory in your home directory, and then source the environment script provided, which adds the tools into PATH and sets any other environment variables required to run the tools. Doing so gives you working versions of Git, tar, Python and chrpath.

If downloading a pre-built tarball, locate the *.sh at <http://downloads.yoctoproject.org/releases/yocto/yocto-1.5/buildtools/>.

If building your own tarball, do so using this command:

```
$ bitbake buildtools-tarball
```

Note

The SDKMACHINE variable determines whether you build tools for a 32-bit or 64-bit system. Once the build completes, you can find the file that installs the tools in the tmp/ deploy/ sdk subdirectory of the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]. The file used to install the tarball has the string "buildtools" in the name.

After you have either built the tarball or downloaded it, you need to install it. Install the tools by executing the *.sh file. During execution, a prompt appears that allows you to choose the installation directory. For example, you could choose the following:

```
/home/your-username/sdk
```

The final step before you can actually use the tools is to source the tools environment with a command like the following:

```
$ source /home/your-username/sdk/environment-setup-i586-poky-linux
```

Of course, you need to supply your installation directory and be sure to use the right file (i.e. i585 or x86-64).

1.4. Obtaining the Yocto Project

The Yocto Project development team makes the Yocto Project available through a number of methods:

- Releases: Stable, tested releases are available through <http://downloads.yoctoproject.org/releases/yocto/>.
- Nightly Builds: These releases are available at <http://autobuilder.yoctoproject.org/nightly>. These builds include Yocto Project releases, meta-toolchain tarball installation scripts, and experimental builds.
- Yocto Project Website: You can find releases of the Yocto Project and supported BSPs at the Yocto Project website [<http://www.yoctoproject.org>]. Along with these downloads, you can find lots of other information at this site.

1.5. Development Checkouts

Development using the Yocto Project requires a local Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. You can set up the Source Directory by downloading a Yocto Project release tarball and unpacking it, or by cloning a copy of the upstream

Poky [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#poky>] Git repository. For information on both these methods, see the "Getting Set Up [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#getting-setup>]" section in the Yocto Project Development Manual.

Chapter 2. Using the Yocto Project

This chapter describes common usage for the Yocto Project. The information is introductory in nature as other manuals in the Yocto Project documentation set provide more details on how to use the Yocto Project.

2.1. Running a Build

This section provides a summary of the build process and provides information for less obvious aspects of the build process. For general information on how to build an image using the OpenEmbedded build system, see the "Building an Image [<http://www.yoctoproject.org/docs/1.5/yocto-project-qs/yocto-project-qs.html#building-image>]" section of the Yocto Project Quick Start.

2.1.1. Build Overview

The first thing you need to do is set up the OpenEmbedded build environment by sourcing an environment setup script (i.e. `oe-init-build-env` or `oe-init-build-env-memres`). Here is an example:

```
$ source oe-init-build-env [<build_dir>]
```

The `build_dir` is optional and specifies the directory the OpenEmbedded build system uses for the build - the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]. If you do not specify a Build Directory, it defaults to a directory named `build` in your current working directory. A common practice is to use a different Build Directory for different targets. For example, `~/build/x86` for a `qemux86` target, and `~/build/arm` for a `qemuarm` target. See the "`oe-init-build-env`" section for more information on this script.

Once the build environment is set up, you can build a target using:

```
$ bitbake <target>
```

The target is the name of the recipe you want to build. Common targets are the images in `meta/recipes-core/images`, `/meta/recipes-sato/images`, etc. all found in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. Or, the target can be the name of a recipe for a specific piece of software such as `BusyBox`. For more details about the images the OpenEmbedded build system supports, see the "Images" chapter.

Note

Building an image without GNU General Public License Version 3 (GPLv3) components is only supported for minimal and base images. See the "Images" chapter for more information.

2.1.2. Building an Image Using GPL Components

When building an image using GPL components, you need to maintain your original settings and not switch back and forth applying different versions of the GNU General Public License. If you rebuild using different versions of GPL, dependency errors might occur due to some components not being rebuilt.

2.2. Installing and Using the Result

Once an image has been built, it often needs to be installed. The images and kernels built by the OpenEmbedded build system are placed in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] in `tmp/deploy/images`. For information on how to run pre-built images such as `qemux86` and `qemuarm`, see the "Using Pre-Built Binaries

and QEMU [<http://www.yoctoproject.org/docs/1.5/yocto-project-qs/yocto-project-qs.html#using-pre-built>] section in the Yocto Project Quick Start. For information about how to install these images, see the documentation for your particular board or machine.

2.3. Debugging Build Failures

The exact method for debugging build failures depends on the nature of the problem and on the system's area from which the bug originates. Standard debugging practices such as comparison against the last known working version with examination of the changes and the re-application of steps to identify the one causing the problem are valid for the Yocto Project just as they are for any other system. Even though it is impossible to detail every possible potential failure, this section provides some general tips to aid in debugging.

For discussions on debugging, see the "Debugging With the GNU Project Debugger (GDB) Remotely [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#platdev-gdb-remotedebug>]" and "Working within Eclipse [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#adt-eclipse>]" sections in the Yocto Project Development Manual.

2.3.1. Task Failures

The log file for shell tasks is available in `${WORKDIR}/temp/log.do_taskname.pid`. For example, the compile task for the QEMU minimal image for the x86 machine (qemux86) might be `tmp/work/qemux86-poky-linux/core-image-minimal/1.0-r0/temp/log.do_compile.20830`. To see what BitBake runs to generate that log, look at the corresponding `run.do_taskname.pid` file located in the same directory.

Presently, the output from Python tasks is sent directly to the console.

2.3.2. Running Specific Tasks

Any given package consists of a set of tasks. The standard BitBake behavior in most cases is: fetch, unpack, patch, configure, compile, install, package, package_write, and build. The default task is build and any tasks on which it depends build first. Some tasks exist, such as devshell, that are not part of the default build chain. If you wish to run a task that is not part of the default build chain, you can use the `-c` option in BitBake. Here is an example:

```
$ bitbake matchbox-desktop -c devshell
```

If you wish to rerun a task, use the `-f` force option. For example, the following sequence forces recompilation after changing files in the working directory.

```
$ bitbake matchbox-desktop
.
.
[make some changes to the source code in the working directory]
.
.
$ bitbake matchbox-desktop -c compile -f
$ bitbake matchbox-desktop
```

This sequence first builds and then recompiles matchbox-desktop. The last command reruns all tasks (basically the packaging tasks) after the compile. BitBake recognizes that the compile task was rerun and therefore understands that the other tasks also need to be run again.

You can view a list of tasks in a given package by running the listtasks task as follows:

```
$ bitbake matchbox-desktop -c listtasks
```

The results are in the file `${WORKDIR}/temp/log.do_listtasks`.

2.3.3. Dependency Graphs

Sometimes it can be hard to see why BitBake wants to build some other packages before a given package you have specified. The `bitbake -g targetname` command creates the `depends.dot`, `package-depends.dot`, and `task-depends.dot` files in the current directory. These files show the package and task dependencies and are useful for debugging problems. You can use the `bitbake -g -u depexp targetname` command to display the results in a more human-readable form.

2.3.4. General BitBake Problems

You can see debug output from BitBake by using the `-D` option. The debug output gives more information about what BitBake is doing and the reason behind it. Each `-D` option you use increases the logging level. The most common usage is `-DDD`.

The output from `bitbake -DDD -v targetname` can reveal why BitBake chose a certain version of a package or why BitBake picked a certain provider. This command could also help you in a situation where you think BitBake did something unexpected.

2.3.5. Development Host System Issues

Sometimes issues on the host development system can cause your build to fail. Following are known, host-specific problems. Be sure to always consult the Release Notes [<http://www.yoctoproject.org/download/yocto-project-15-poky-1000>] for a look at all release-related issues.

- `eglibc-initial` fails to build: If your development host system has the unpatched GNU Make 3.82, the `do_install` task fails for `eglibc-initial` during the build.

Typically, every distribution that ships GNU Make 3.82 as the default already has the patched version. However, some distributions, such as Debian, have GNU Make 3.82 as an option, which is unpatched. You will see this error on these types of distributions. Switch to GNU Make 3.81 or patch your make to solve the problem.

2.3.6. Building with No Dependencies

If you really want to build a specific `.bb` file, you can use the command form `bitbake -b <somepath/somefile.bb>`. This command form does not check for dependencies so you should use it only when you know its dependencies already exist. You can also specify fragments of the filename. In this case, BitBake checks for a unique match.

2.3.7. Variables

You can use the `-e` BitBake option to display the resulting environment for a configuration when you do not specify a package or for a specific package when you do specify the package. If you want to show the environment resulting from parsing a single recipe, use the `-b recipename` form.

2.3.8. Recipe Logging Mechanisms

Best practices exist while writing recipes that both log build progress and act on build conditions such as warnings and errors. Both Python and Bash language bindings exist for the logging mechanism:

- Python: For Python functions, BitBake supports several loglevels: `bb.fatal`, `bb.error`, `bb.warn`, `bb.note`, `bb.plain`, and `bb.debug`.
- Bash: For Bash functions, the same set of loglevels exist and are accessed with a similar syntax: `bbfatal`, `bberror`, `bbwarn`, `bbnote`, `bbplain`, and `bbdebug`.

For guidance on how logging is handled in both Python and Bash recipes, see the `logging.bbclass` file in the `meta/classes` folder of the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

2.3.8.1. Logging With Python

When creating recipes using Python and inserting code that handles build logs, keep in mind the goal is to have informative logs while keeping the console as "silent" as possible. Also, if you want status messages in the log, use the "debug" loglevel.

Following is an example written in Python. The code handles logging for a function that determines the number of tasks needed to be run:

```
python do_listtasks() {
    bb.debug(2, "Starting to figure out the task list")
    if noteworthy_condition:
        bb.note("There are 47 tasks to run")
    bb.debug(2, "Got to point xyz")
    if warning_trigger:
        bb.warn("Detected warning_trigger, this might be a problem later.")
    if recoverable_error:
        bb.error("Hit recoverable_error, you really need to fix this!")
    if fatal_error:
        bb.fatal("fatal_error detected, unable to print the task list")
    bb.plain("The tasks present are abc")
    bb.debug(2, "Finished figuring out the tasklist")
}
```

2.3.8.2. Logging With Bash

When creating recipes using Bash and inserting code that handles build logs, you have the same goals - informative with minimal console output. The syntax you use for recipes written in Bash is similar to that of recipes written in Python described in the previous section.

Following is an example written in Bash. The code logs the progress of the do_my_function function.

```
do_my_function() {
    bbdebug 2 "Running do_my_function"
    if [ exceptional_condition ]; then
        bbnote "Hit exceptional_condition"
    fi
    bbdebug 2 "Got to point xyz"
    if [ warning_trigger ]; then
        bbwarn "Detected warning_trigger, this might cause a problem later."
    fi
    if [ recoverable_error ]; then
        bberror "Hit recoverable_error, correcting"
    fi
    if [ fatal_error ]; then
        bbfatal "fatal_error detected"
    fi
    bbdebug 2 "Completed do_my_function"
}
```

2.3.9. Other Tips

Here are some other tips that you might find useful:

- When adding new packages, it is worth watching for undesirable items making their way into compiler command lines. For example, you do not want references to local system files like /usr/lib/ or /usr/include/.
- If you want to remove the psplash boot splashscreen, add psplash=false to the kernel command line. Doing so prevents psplash from loading and thus allows you to see the console. It is also

possible to switch out of the splashscreen by switching the virtual console (e.g. Fn+Left or Fn+Right on a Zaurus).

2.4. Maintaining Build Output Quality

Many factors can influence the quality of a build. For example, if you upgrade a recipe to use a new version of an upstream software package or you experiment with some new configuration options, subtle changes can occur that you might not detect until later. Consider the case where your recipe is using a newer version of an upstream package. In this case, a new version of a piece of software might introduce an optional dependency on another library, which is auto-detected. If that library has already been built when the software is building, the software will link to the built library and that library will be pulled into your image along with the new software even if you did not want the library.

The `buildhistory` class exists to help you maintain the quality of your build output. You can use the class to highlight unexpected and possibly unwanted changes in the build output. When you enable build history, it records information about the contents of each package and image and then commits that information to a local Git repository where you can examine the information.

The remainder of this section describes the following:

- How you can enable and disable build history
- How to understand what the build history contains
- How to limit the information used for build history
- How to examine the build history from both a command-line and web interface

2.4.1. Enabling and Disabling Build History

Build history is disabled by default. To enable it, add the following statements to the end of your `conf/local.conf` file found in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]:

```
INHERIT += "buildhistory"
BUILDHISTORY_COMMIT = "1"
```

Enabling build history as previously described causes the build process to collect build output information and commit it to a local Git [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#git>] repository.

Note

Enabling build history increases your build times slightly, particularly for images, and increases the amount of disk space used during the build.

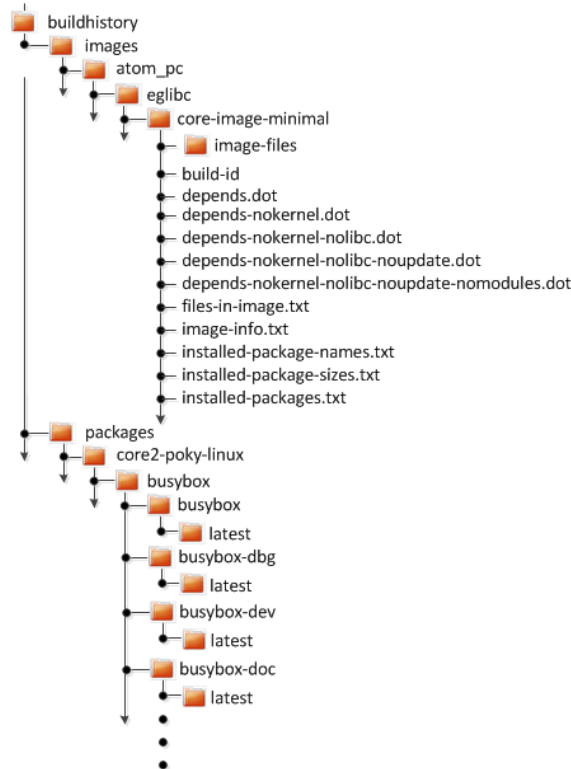
You can disable build history by removing the previous statements from your `conf/local.conf` file. However, you should realize that enabling and disabling build history in this manner can change the `do_package` task checksums, which if you are using the `OEBasicHash` signature generator (the default for many current distro configurations including `DISTRO = "poky"` and `DISTRO = ""`) and will result in the packaging tasks being re-run during the subsequent build.

To disable the build history functionality without causing the packaging tasks to be re-run, add this statement to your `conf/local.conf` file:

```
BUILDHISTORY_FEATURES = ""
```

2.4.2. Understanding What the Build History Contains

Build history information is kept in `$TMPDIR/buildhistory` in the Build Directory. The following is an example abbreviated listing:



At the top level, there is a `metadata-revs` file that lists the revisions of the repositories for the layers enabled when the build was produced. The rest of the data splits into separate packages, images and sdk directories, the contents of which are described below.

2.4.2.1. Build History Package Information

The history for each package contains a text file that has name-value pairs with information about the package. For example, `buildhistory/packages/core2-poky-linux/busybox/busybox/latest` contains the following:

```

PV = 1.19.3
PR = r3
RDEPENDS = update-rc.d eglibc (>= 2.13)
RRECOMMENDS = busybox-syslog busybox-udhcp
PKGSIZE = 564701
FILES = /usr/bin/* /usr/sbin/* /usr/libexec/* /usr/lib/lib*.so.* \
        /etc /com /var /bin/* /sbin/* /lib/*.so.* /usr/share/busybox \
        /usr/lib/busybox/* /usr/share/pixmaps /usr/share/applications \
        /usr/share/idl /usr/share/omf /usr/share/sounds /usr/lib/bonobo/servers
FILELIST = /etc/busybox.links /etc/init.d/hwclock.sh /bin/busybox /bin/sh

```

Most of these name-value pairs correspond to variables used to produce the package. The exceptions are `FILELIST`, which is the actual list of files in the package, and `PKGSIZE`, which is the total size of files in the package in bytes.

There is also a file corresponding to the recipe from which the package came (e.g. `buildhistory/packages/core2-poky-linux/busybox/latest`):

```

PV = 1.19.3
PR = r3

```

```
DEPENDS = virtual/i586-poky-linux-gcc virtual/i586-poky-linux-compilerlibs \
          virtual/libc update-rc.d-native
PACKAGES = busybox-httpd busybox-udhcpd busybox-udhcpd busybox-syslog \
          busybox-mdev busybox-dbg busybox busybox-doc busybox-dev \
          busybox-staticdev busybox-locale
```

Finally, for those recipes fetched from a version control system (e.g., Git), a file exists that lists source revisions that are specified in the recipe and lists the actual revisions used during the build. Listed and actual revisions might differ when SRCREV is set to `${AUTOREV}`. Here is an example assuming `buildhistory/packages/emenlow-poky-linux/linux-yocto/latest_srcrev`:

```
# SRCREV_machine = "b5c37fe6e24eec194bb29d22fdd55d73bcc709bf"
SRCREV_machine = "b5c37fe6e24eec194bb29d22fdd55d73bcc709bf"
# SRCREV_emgd = "caea08c988e0f41103bbe18eafca20348f95da02"
SRCREV_emgd = "caea08c988e0f41103bbe18eafca20348f95da02"
# SRCREV_meta = "c2ed0f16fdec628242a682897d5d86df4547cf24"
SRCREV_meta = "c2ed0f16fdec628242a682897d5d86df4547cf24"
```

You can use the `buildhistory-collect-srcrevs` command to collect the stored SRCREV values from build history and report them in a format suitable for use in global configuration (e.g., `local.conf` or a distro include file) to override floating AUTOREV values to a fixed set of revisions. Here is some example output from this command:

```
# emenlow-poky-linux
SRCREV_machine_pn-linux-yocto = "b5c37fe6e24eec194bb29d22fdd55d73bcc709bf"
SRCREV_emgd_pn-linux-yocto = "caea08c988e0f41103bbe18eafca20348f95da02"
SRCREV_meta_pn-linux-yocto = "c2ed0f16fdec628242a682897d5d86df4547cf24"
# core2-poky-linux
SRCREV_pn-kmod = "62081c0f68905b22f375156d4532fd37fa5c8d33"
SRCREV_pn-blktrace = "d6918c8832793b4205ed3bfede78c2f915c23385"
SRCREV_pn-opkg = "649"
```

Note

Here are some notes on using the `buildhistory-collect-srcrevs` command:

- By default, only values where the SRCREV was not hardcoded (usually when AUTOREV was used) are reported. Use the `-a` option to see all SRCREV values.
- The output statements might not have any effect if overrides are applied elsewhere in the build system configuration. Use the `-f` option to add the forcevariable override to each output line if you need to work around this restriction.
- The script does apply special handling when building for multiple machines. However, the script does place a comment before each set of values that specifies which triplet to which they belong as shown above (e.g., `emenlow-poky-linux`).

2.4.2.2. Build History Image Information

The files produced for each image are as follows:

- `image-files`: A directory containing selected files from the root filesystem. The files are defined by `BUILDHISTORY_IMAGE_FILES`.
- `build-id`: Human-readable information about the build configuration and metadata source revisions.
- `*.dot`: Dependency graphs for the image that are compatible with `graphviz`.
- `files-in-image.txt`: A list of files in the image with permissions, owner, group, size, and symlink information.

- `image-info.txt`: A text file containing name-value pairs with information about the image. See the following listing example for more information.
- `installed-package-names.txt`: A list of installed packages by name only.
- `installed-package-sizes.txt`: A list of installed packages ordered by size.
- `installed-packages.txt`: A list of installed packages with full package filenames.

Note

Installed package information is able to be gathered and produced even if package management is disabled for the final image.

Here is an example of `image-info.txt`:

```
DISTRO = poky
DISTRO_VERSION = 1.1+snapshot-20120207
USER_CLASSES = image-mklibs image-prelink
IMAGE_CLASSES = image_types
IMAGE_FEATURES = debug-tweaks x11-base apps-x11-core \
    package-management ssh-server-dropbear package-management
IMAGE_LINGUAS = en-us en-gb
IMAGE_INSTALL = task-core-boot task-base-extended
BAD_RECOMMENDATIONS =
ROOTFS_POSTPROCESS_COMMAND = buildhistory_get_image_installed ;    rootfs_update_timestamp ;
IMAGE_POSTPROCESS_COMMAND = buildhistory_get_imageinfo ;
IMAGESIZE = 171816
```

Other than `IMAGESIZE`, which is the total size of the files in the image in Kbytes, the name-value pairs are variables that may have influenced the content of the image. This information is often useful when you are trying to determine why a change in the package or file listings has occurred.

2.4.2.3. Using Build History to Gather Image Information Only

As you can see, build history produces image information, including dependency graphs, so you can see why something was pulled into the image. If you are just interested in this information and not interested in collecting history or any package information, you can enable writing only image information without any history by adding the following to your `conf/local.conf` file found in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]:

```
INHERIT += "buildhistory"
BUILDHISTORY_COMMIT = "0"
BUILDHISTORY_FEATURES = "image"
```

2.4.2.4. Build History SDK Information

Build history collects similar information on the contents of SDKs (e.g., `meta-toolchain` or `bitbake -c populate_sdk imagename`) as compared to information it collects for images. The following list shows the files produced for each SDK:

- `files-in-sdk.txt`: A list of files in the SDK with permissions, owner, group, size, and symlink information. This list includes both the host and target parts of the SDK.
- `sdk-info.txt`: A text file containing name-value pairs with information about the SDK. See the following listing example for more information.
- The following information appears under each of the host and target directories for the portions of the SDK that run on the host and on the target, respectively:
 - `depends.dot`: Dependency graph for the SDK that is compatible with `graphviz`.

- `installed-package-names.txt`: A list of installed packages by name only.
- `installed-package-sizes.txt`: A list of installed packages ordered by size.
- `installed-packages.txt`: A list of installed packages with full package filenames.

Here is an example of `sdk-info.txt`:

```
DISTRO = poky
DISTRO_VERSION = 1.3+snapshot-20130327
SDK_NAME = poky-eglibc-i686-arm
SDK_VERSION = 1.3+snapshot
SDKMACHINE =
SDKIMAGE_FEATURES = dev-pkgs dbg-pkgs
BAD_RECOMMENDATIONS =
SDKSIZE = 352712
```

Other than `SDKSIZE`, which is the total size of the files in the SDK in Kbytes, the name-value pairs are variables that might have influenced the content of the SDK. This information is often useful when you are trying to determine why a change in the package or file listings has occurred.

2.4.2.5. Examining Build History Information

You can examine build history output from the command line or from a web interface.

To see any changes that have occurred (assuming you have `BUILDHISTORY_COMMIT = "1"`), you can simply use any Git command that allows you to view the history of a repository. Here is one method:

```
$ git log -p
```

You need to realize, however, that this method does show changes that are not significant (e.g. a package's size changing by a few bytes).

A command-line tool called `buildhistory-diff` does exist, though, that queries the Git repository and prints just the differences that might be significant in human-readable form. Here is an example:

```
$ ~/poky/poky/scripts/buildhistory-diff . HEAD^
Changes to images/qemux86_64/eglibc/core-image-minimal (files-in-image.txt):
  /etc/anotherpkg.conf was added
  /sbin/anotherpkg was added
  * (installed-package-names.txt):
  *   anotherpkg was added
Changes to images/qemux86_64/eglibc/core-image-minimal (installed-package-names.txt):
  anotherpkg was added
packages/qemux86_64-poky-linux/v86d: PACKAGES: added "v86d-extras"
  * PR changed from "r0" to "r1"
  * PV changed from "0.1.10" to "0.1.12"
packages/qemux86_64-poky-linux/v86d/v86d: PKGSIZE changed from 110579 to 144381 (+30%)
  * PR changed from "r0" to "r1"
  * PV changed from "0.1.10" to "0.1.12"
```

To see changes to the build history using a web interface, follow the instruction in the README file here. <http://git.yoctoproject.org/cgit/cgit.cgi/buildhistory-web/>.

Here is a sample screenshot of the interface:

Buildhistory - Mozilla Firefox

Buildhistory queue reviewed

Warning item

| | | | |
|-------------|---|-------------|---|
| Summary | packages/armv5te-poky-linux-gnueabi/cairo/cairo-dev: RDEPENDS: removed "libx11-trim-dev" added "libx11-dev" | | |
| Status | Action Required | Reviewed by | paule on Oct. 9, 2012, 11:51 p.m. (0 minutes ago) |
| Description | packages/armv5te-poky-linux-gnueabi/cairo/cairo-dev: RDEPENDS: removed "libx11-trim-dev" added "libx11-dev" | | |

Un-review Resolve Ignore

Comments

paule - Oct. 9, 2012, 11:51 p.m. (0 minutes ago)

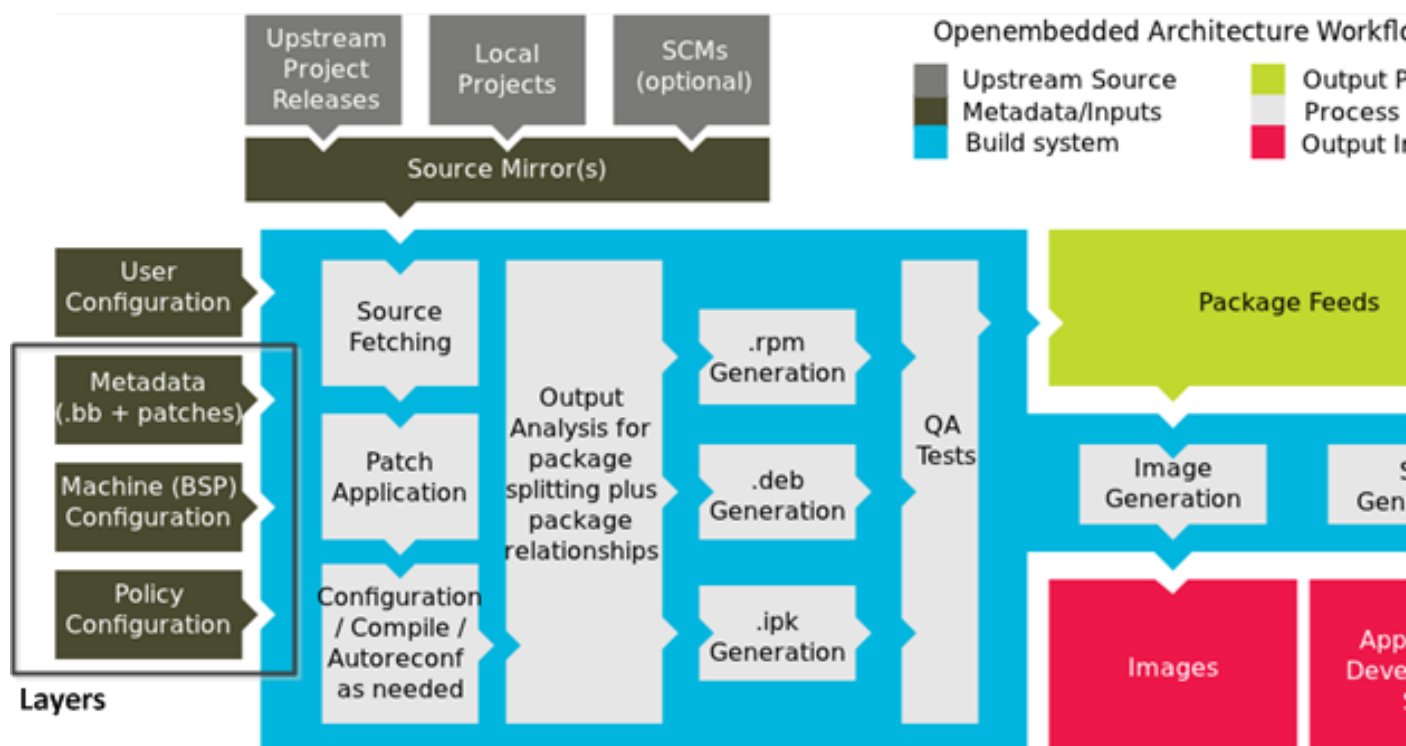
we need to determine if this is legit.

Post a comment

Post

Chapter 3. A Closer Look at the Yocto Project Development Environment

This chapter takes a more detailed look at the Yocto Project development environment. The following diagram represents the development environment at a high level. The remainder of this chapter expands on the fundamental input, output, process, and Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] blocks in the Yocto Project development environment.



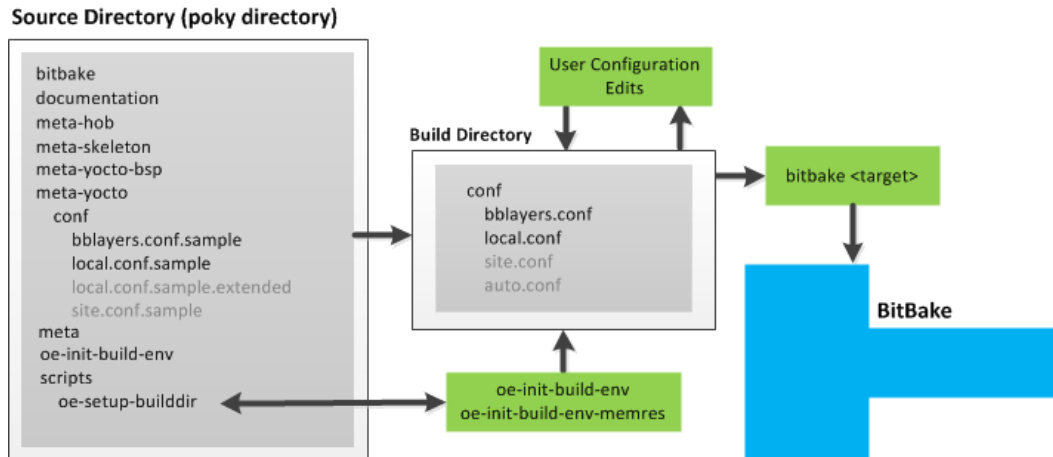
The generalized Yocto Project Development Environment consists of several functional areas:

- User Configuration: Metadata you can use to control the build process.
- Metadata Layers: Various layers that provide software, machine, and distro Metadata.
- Source Files: Upstream releases, local projects, and SCMs.
- Build System: Processes under the control of BitBake. This block expands on how BitBake fetches source, applies patches, completes compilation, analyzes output for package generation, creates and tests packages, generates images, and generates cross-development tools.
- Package Feeds: Directories containing output packages (rpm, deb or ipk), which are subsequently used in the construction of an image or SDK, produced by the build system. These feeds can also be copied and shared using a web server or other means to facilitate extending or updating existing images on devices at runtime if runtime package management is enabled.
- Images: Images produced by the development process. Where do they go? Can you mess with them (i.e. freely delete them or move them?).
- Application Development SDK: Cross-development tools that are produced along with an image or separately with BitBake.

3.1. User Configuration

User configuration helps define the build. Through user configuration, you can tell BitBake the target architecture for which you are building the image, where to store downloaded source, and other build properties.

The following figure shows an expanded representation of the "User Configuration" box of the general Yocto Project Development Environment figure [17]:



BitBake needs some basic configuration files in order to complete a build. These files are `*.conf` files. The minimally necessary ones reside as example files in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. For simplicity, this section refers to the Source Directory as the "Poky Directory."

When you clone the poky Git repository or you download and unpack a Yocto Project release, you can set up the Source Directory to be named anything you want. For this discussion, the cloned repository uses the default name poky.

Note

The Poky repository is primarily an aggregation of existing repositories. It is not a canonical upstream source.

The meta-yocto layer inside Poky contains a `conf` directory that has example configuration files. These example files are used as a basis for creating actual configuration files when you source the build environment script (i.e. `oe-init-build-env` or `oe-init-build-env-memres`).

Sourcing the build environment script creates a Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] if one does not already exist. BitBake uses the Build Directory for all its work during builds. The Build Directory has a `conf` directory that contains default versions of your `local.conf` and `bblayers.conf` configuration files. These default configuration files are created only if versions do not already exist in the Build Directory at the time you source the build environment setup script.

Because the Poky repository is fundamentally an aggregation of existing repositories, some users might be familiar with running the `oe-init-build-env` or `oe-init-build-env-memres` script in the context of separate OpenEmbedded-Core and BitBake repositories rather than a single Poky repository. This discussion assumes the script is executed from within a cloned or unpacked version of Poky.

Depending on where the script is sourced, different sub-scripts are called to set up the Build Directory (Yocto or OpenEmbedded). Specifically, the script `scripts/oe-setup-builddir` inside the poky

directory sets up the Build Directory and seeds the directory (if necessary) with configuration files appropriate for the Yocto Project development environment.

Note

The `scripts/oe-setup-builddir` script uses the `$TEMPLATECONF` variable to determine which sample configuration files to locate.

The `local.conf` file provides many basic variables that define a build environment. Here is a list of a few. To see the default configurations in a `local.conf` file created by the build environment script, see the `local.conf.sample` in the `meta-yocto` layer:

- Parallelism Options: Controlled by the `BB_NUMBER_THREADS` and `PARALLEL_MAKE` variables.
- Target Machine Selection: Controlled by the `MACHINE` variable.
- Download Directory: Controlled by the `DL_DIR` variable.
- Shared State Directory: Controlled by the `SSTATE_DIR` variable.
- Build Output: Controlled by the `TMPDIR` variable.

Note

Configurations set in the `conf/local.conf` file can also be set in the `conf/site.conf` and `conf/auto.conf` configuration files.

The `bblayers.conf` file tells BitBake what layers you want considered during the build. By default, the layers listed in this file include layers minimally needed by the build system. However, you must manually add any custom layers you have created. You can find more information on working with the `bblayers.conf` file in the "Enabling Your Layer [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#enabling-your-layer>]" section in the Yocto Project Development Manual.

The files `site.conf` and `auto.conf` are not created by the environment initialization script. If you want these configuration files, you must create them yourself:

- `site.conf`: You can use the `conf/site.conf` configuration file to configure multiple build directories. For example, suppose you had several build environments and they shared some common features. You can set these default build properties here. A good example is perhaps the level of parallelism you want to use through the `BB_NUMBER_THREADS` and `PARALLEL_MAKE` variables.

One useful scenario for using the `conf/site.conf` file is to extend your `BBPATH` variable to include the path to a `conf/site.conf`. Then, when BitBake looks for Metadata using `BBPATH`, it finds the `conf/site.conf` file and applies your common configurations found in the file. To override configurations in a particular build directory, alter the similar configurations within that build directory's `conf/local.conf` file.

- `auto.conf`: This file is not hand-created. Rather, the file is usually created and written to by an autobuilder. The settings put into the file are typically the same as you would find in the `conf/local.conf` or the `conf/site.conf` files.

You can edit all configuration files to further define any particular build environment. This process is represented by the "User Configuration Edits" box in the figure.

When you launch your build with the `bitbake <target>` command, BitBake sorts out the configurations to ultimately define your build environment.

3.2. Metadata, Machine Configuration, and Policy Configuration

The previous section described the user configurations that define the BitBake's global behavior. This section takes a closer look at the layers the build system uses to further control the build. These layers provide Metadata for the software, machine, and policy.

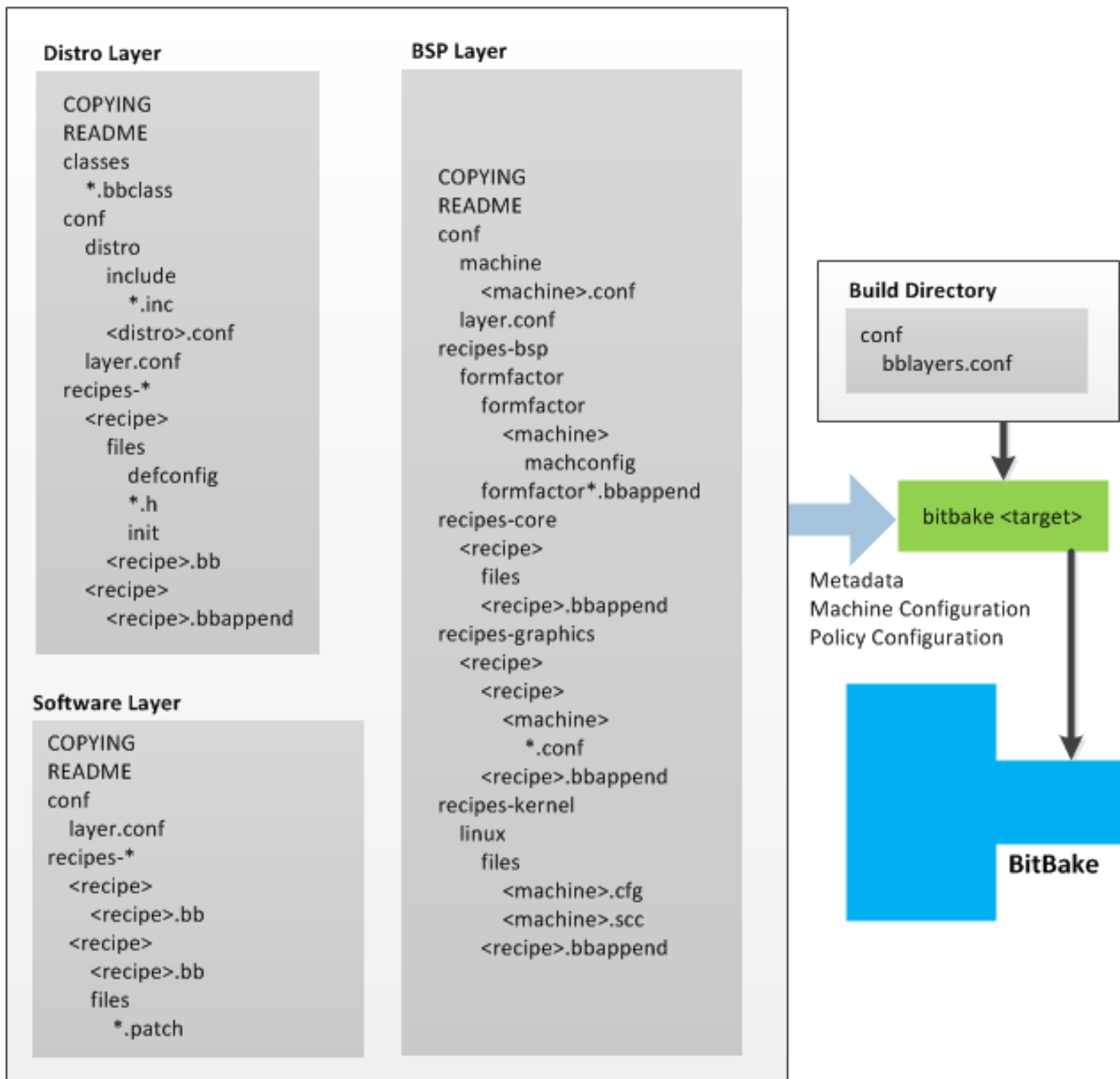
In general, three types of layer input exist:

- Policy Configuration: Distribution Layers provide top-level or general policies for the image or SDK being built. For example, this layer would dictate whether BitBake produces RPM or IPK packages.

- Machine Configuration: Board Support Package (BSP) layers provide machine configurations. This type of information is specific to a particular target architecture.
- Metadata: Software layers contain user-supplied recipe files, patches, and append files.

The following figure shows an expanded representation of the Metadata, Machine Configuration, and Policy Configuration input (layers) boxes of the general Yocto Project Development Environment figure [17]:

Layers



In general, all layers have a similar structure. They all contain a licensing file (e.g. COPYING) if the layer is to be distributed, a README file as good practice and especially if the layer is to be distributed, a configuration directory, and recipe directories.

The Yocto Project has many layers that can be used. You can see a web-interface listing of them on the Source Repositories [<http://git.yoctoproject.org/>] page. The layers are shown at the bottom categorized under "Yocto Metadata Layers." These layers are fundamentally a subset of the OpenEmbedded Metadata Index [<http://layers.openembedded.org/layerindex/layers/>], which lists all layers provided by the OpenEmbedded community.

Note

Layers exist in the Yocto Project Source Repositories that cannot be found in the OpenEmbedded Metadata Index. These layers are either deprecated or experimental in nature.

BitBake uses the `conf/bblayers.conf` file, which is part of the user configuration, to find what layers it should be using as part of the build.

For more information on layers, see the "Understanding and Creating Layers [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#understanding-and-creating-layers>]" section in the Yocto Project Development Manual.

3.2.1. Distro Layer

The distribution layer provides policy configurations for your distribution. Best practices dictate that you isolate these types of configurations into their own layer. Settings you provide in `conf/<distro>.conf` override similar settings that BitBake finds in your `conf/local.conf` file in the Build Directory.

The following list provides some explanation and references for what you typically find in the distribution layer:

- `classes`: Class files (`.bbclass`) holds common functionality that can be shared among recipes in the distribution. When your recipes inherit a class, they take on the settings and functions for that class. You can read more about class files in the "Classes" section.
- `conf`: This area holds configuration files for the layer (`conf/layer.conf`), the distribution (`conf/distro/<distro>.conf`), and any distribution-wide include files.
- `recipes-*`: Recipes and append files that affect common functionality across the distribution. This area could include recipes and append files to add distribution-specific configuration, initialization scripts, custom image recipes, and so forth.

3.2.2. BSP Layer

The BSP Layer provides machine configurations. Everything in this layer is specific to the machine for which you are building the image or the SDK. A common structure or form is defined for BSP layers. You can learn more about this structure in the Yocto Project Board Support Package (BSP) Developer's Guide [<http://www.yoctoproject.org/docs/1.5/bsp-guide/bsp-guide.html>].

Note

In order for a BSP layer to be considered compliant with the Yocto Project, it must meet some structural requirements.

The BSP Layer's configuration directory contains configuration files for the machine (`conf/machine/<machine>.conf`) and, of course, the layer (`conf/layer.conf`).

The remainder of the layer is dedicated to specific recipes by function: `recipes-bsp`, `recipes-core`, `recipes-graphics`, and `recipes-kernel`. Metadata can exist for multiple formfactors, graphics support systems, and so forth.

Note

While the figure shows several `recipe-*` directories, not all these directories appear in all BSP layers.

3.2.3. Software Layer

The software layer provides the Metadata for additional software packages used during the build. This layer does not include Metadata that is specific to the distribution or the machine, which are found in their respective layers.

This layer contains any new recipes that your project needs in the form of recipe files.

3.3. Sources

In order for the OpenEmbedded build system to create an image or any target, it must be able to access source files. The general Yocto Project Development Environment figure[17] represents source files using the "Upstream Project Releases", "Local Projects", and "SCMs (optional)" boxes. The figure represents mirrors, which also play a role in locating source files, with the "Source Mirror(s)" box.

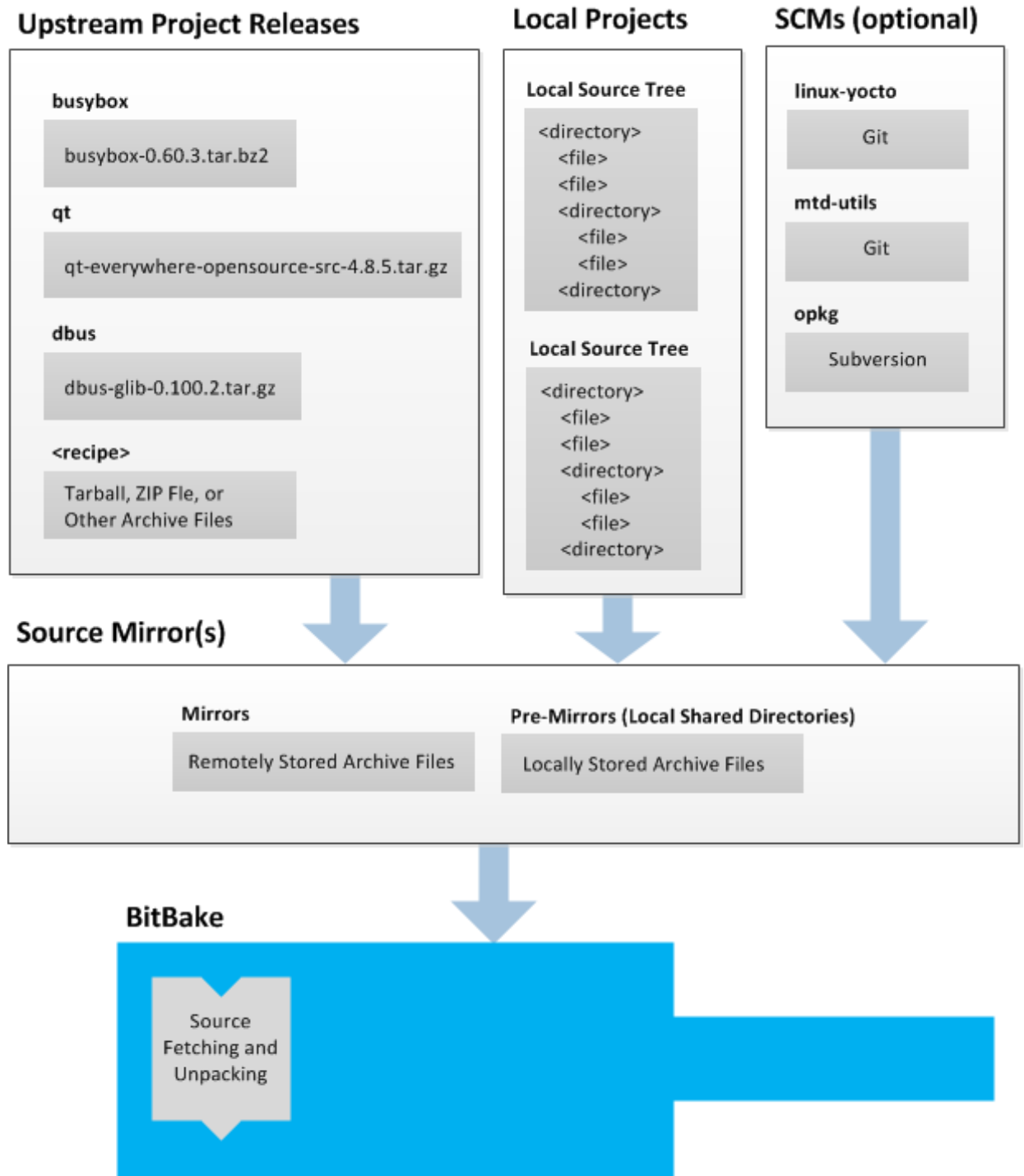
The method by which source files are ultimately organized is a function of the project. For example, for released software, projects tend to use tarballs or other archived files that can capture the state of a release guaranteeing that it is statically represented. On the other hand, for a project that is more dynamic or experimental in nature, a project might keep source files in a repository controlled by a Source Control Manager (SCM) such as Git. Pulling source from a repository allows you to control the point in the repository (the revision) from which you want to build software. Finally, a combination of the two might exist, which would give the consumer a choice when deciding where to get source files.

BitBake uses the `SRC_URI` variable to point to source files regardless of their location. Each recipe must have a `SRC_URI` variable that points to the source.

Another area that plays a significant role in where source files comes from is pointed to by the `DL_DIR` variable. This area is a cache that can hold previously downloaded source. You can also instruct the OpenEmbedded build system to create tarballs from Git repositories, which is not the default behavior, and store them in the `DL_DIR` by using the `BB_GENERATE_MIRROR_TARBALLS` variable.

Judicious use of a `DL_DIR` directory can save the build system a trip across the Internet when looking for files. A good method for using a download directory is to have `DL_DIR` point to an area outside of your Build Directory. Doing so allows you to safely delete the Build Directory if needed without fear of removing any downloaded source file.

The remainder of this section provides a deeper look into the source files and the mirrors. Here is a more detailed look at the source file area of the base figure:



3.3.1. Upstream Project Releases

Upstream project releases exist anywhere in the form of an archived file (e.g. tarball or zip file). These files correspond to individual recipes. For example, the figure uses specific releases each for BusyBox, Qt, and Dbus. An archive file can be for any released product that can be built using a recipe.

3.3.2. Local Projects

Local projects are custom bits of software the user provides. These bits reside somewhere local to a project - perhaps a directory into which the user checks in items (e.g. a local directory containing a development source tree used by the group).

The canonical method through which to include a local project is to use the `externalsrc.bbclass` class to include local project. You use either the `local.conf` or a recipe's append file to override or set the recipe to point to the local directory on your disk to pull in the whole source tree.

For information on how to use the `externalsrc.bbclass`, see the "externalsrc.bbclass" section.

3.3.3. Source Control Managers (Optional)

Another place the build system can get source files from is through an SCM such as Git or Subversion. In this case, a repository is cloned or checked out. The `do_fetch` task inside BitBake uses the `SRC_URI` variable and the argument's prefix to determine the correct fetcher module.

Note

For information on how to have the OpenEmbedded build system generate tarballs for Git repositories and place them in the `DL_DIR` directory, see the `BB_GENERATE_MIRROR_TARBALLS` variable.

When fetching a repository, BitBake uses the `SRCREV` variable to determine the specific revision from which to build.

3.3.4. Source Mirror(s)

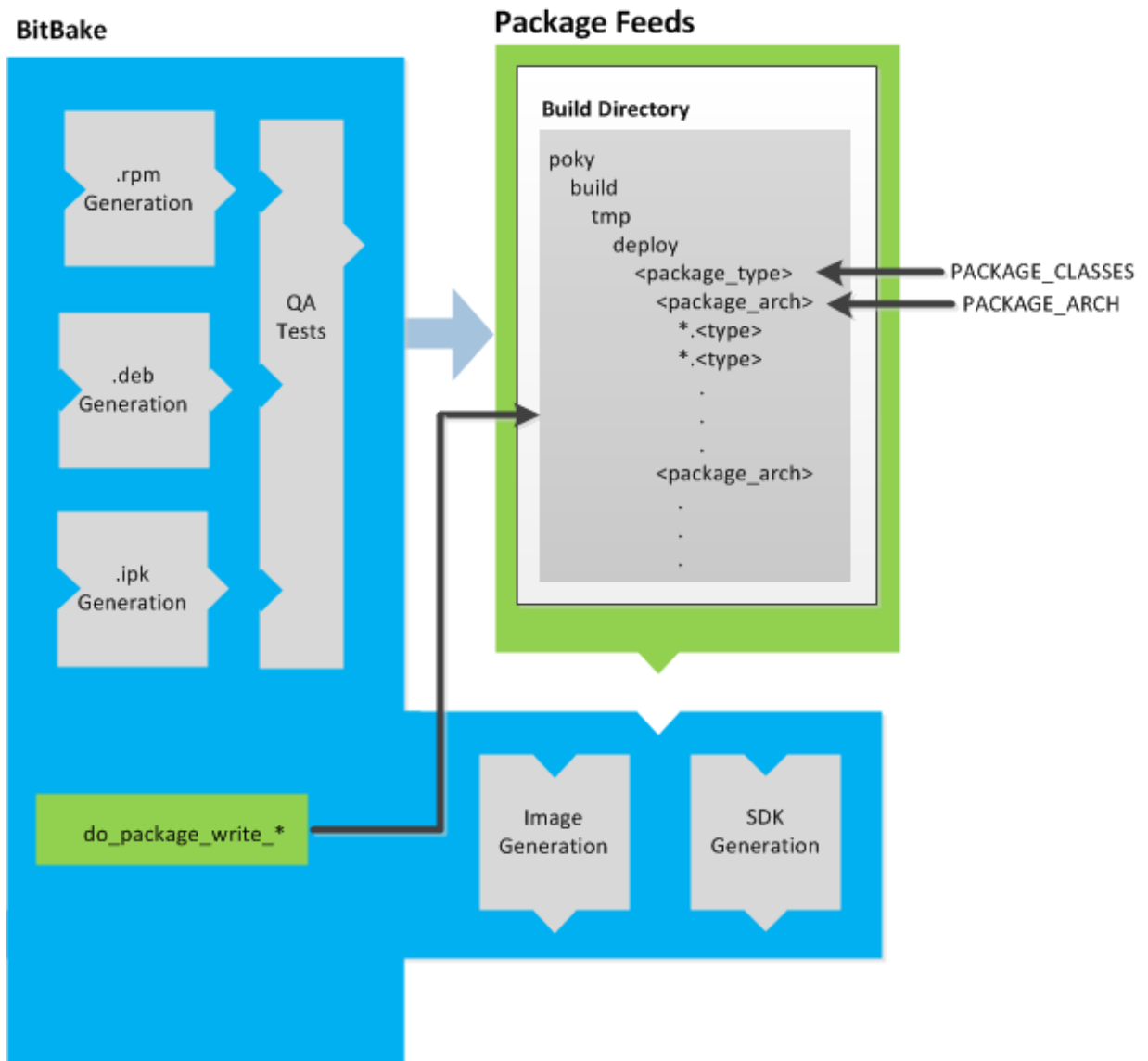
Two kinds of mirrors exist: pre-mirrors and regular mirrors. The `PREMIRRORS` and `MIRRORS` variables point to these, respectively. BitBake checks pre-mirrors before looking upstream for any source files. Pre-mirrors are appropriate when you have a shared directory that is not a directory defined by the `DL_DIR` variable. A Pre-mirror typically points to a shared directory that is local to your organization.

Regular mirrors can be any site across the Internet that is used as an alternative location for source code should the primary site not be functioning for some reason or another.

3.4. Package Feeds

When the OpenEmbedded build system generates an image or an SDK, it gets the packages from a package feed area located in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]. The general Yocto Project Development Environment figure 17 shows this package feeds area in the upper-right corner.

This section looks a little closer into the package feeds area used by the build system. Here is a more detailed look at the area:



Package feeds are an intermediary step in the build process. BitBake generates packages whose type is defined by the `PACKAGE_CLASSES` variable. Before placing the packages into package feeds, the build process validates them with generated output quality assurance checks through the `insane.bbclass` class.

The package feed area resides in `tmp/deploy` of the Build Directory. Folders are created that correspond to the package type (IPK, DEB, or RPM) created. Further organization is derived through the value of the `PACKAGE_ARCH` variable for each package. For example, packages can exist for the `i586` or `qemux86` architectures. The package files themselves reside within the appropriate architecture folder.

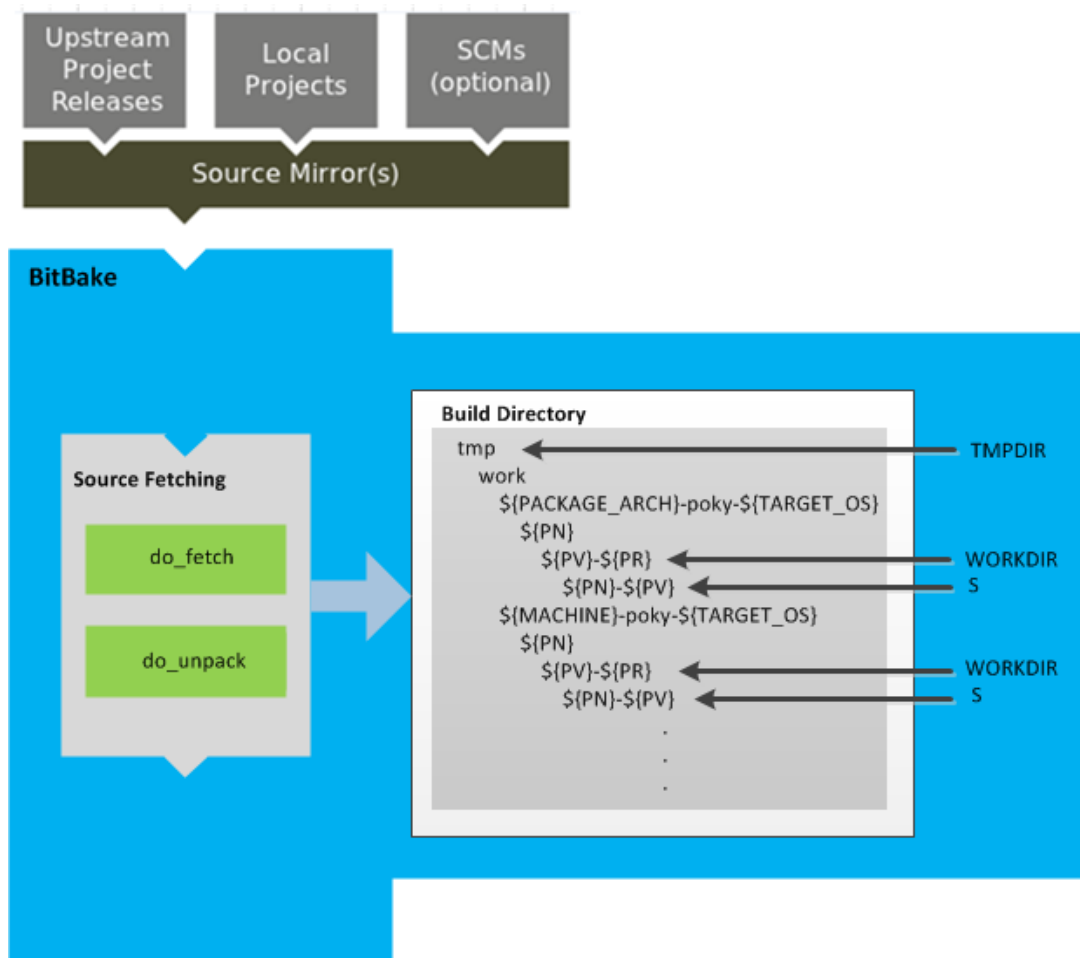
BitBake uses the `do_package_write_*` task to place generated packages into the package holding area (e.g. `do_package_write_ipk` for IPK packages).

3.5. BitBake

The OpenEmbedded build system uses BitBake to produce images. You can see from the general Yocto Project Development Environment figure[17], the BitBake area consists of several functional areas. This section takes a closer look at each of those areas.

3.5.1. Source Fetching

The first stages of building a recipe are to fetch and unpack the source code:



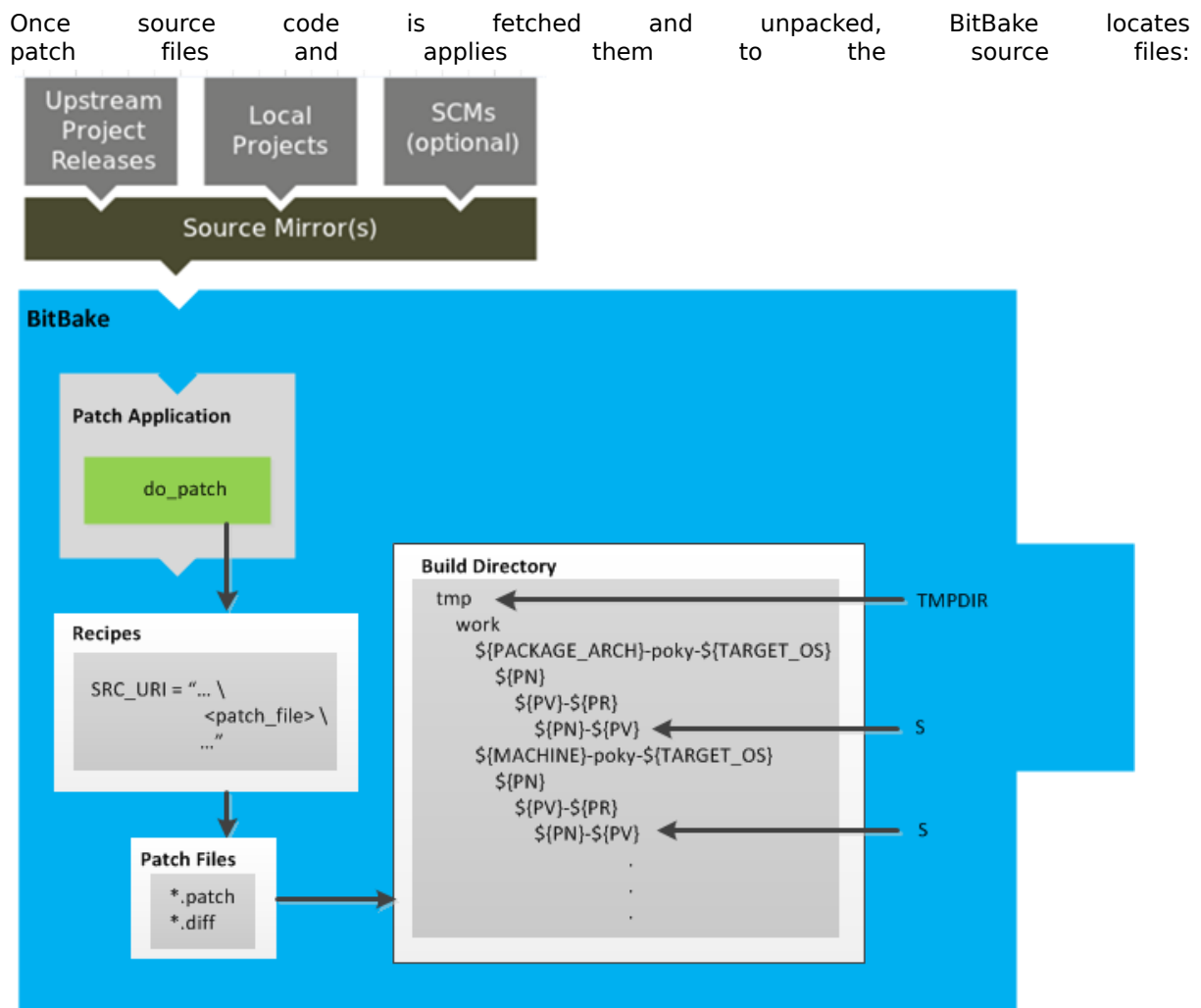
The `do_fetch` and `do_unpack` tasks fetch the source files and unpack them into a working directory. By default, everything is accomplished in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>], which has a defined structure. For additional general information on the Build Directory, see the "build/" section.

Unpacked source files are pointed to by the `S` variable. Each recipe has an area in the Build Directory where the unpacked source code resides. The name of directory for any given recipe is defined from several different variables. You can see the variables that define these directories by looking at the figure:

- `TMPDIR`
- `PACKAGE_ARCH`
- `TARGET_OS`
- `PN`
- `PV`
- `PR`
- `WORKDIR`
- `S`

Briefly, the `S` directory contains the unpacked source files for a recipe. The `WORKDIR` directory is where all the building goes on for a given recipe.

3.5.2. Patching



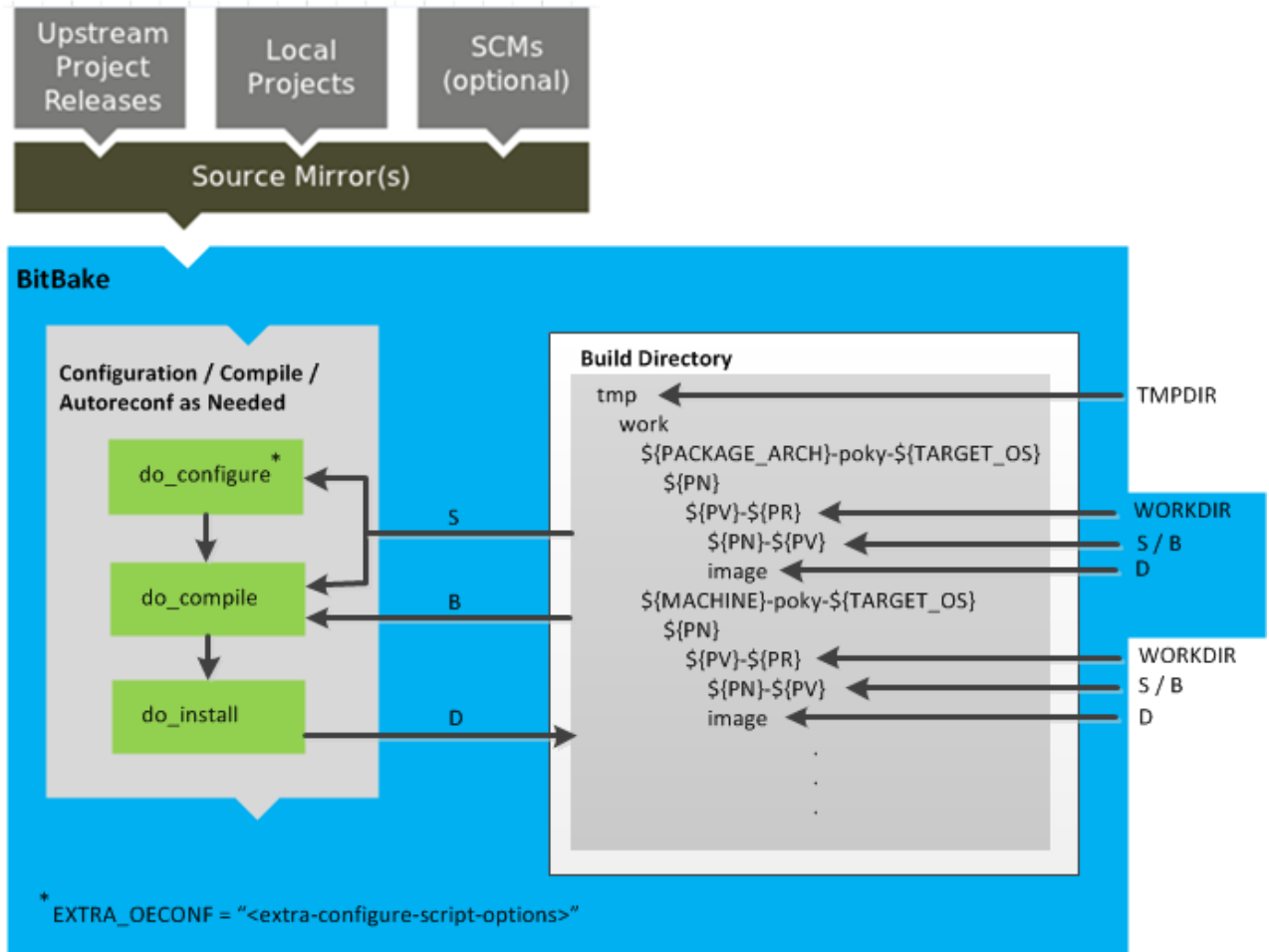
The `do_patch` task processes recipes by using the `SRC_URI` variable to locate applicable patch files, which by default are `*.patch` or `*.diff` files, or any file if "apply=yes" is specified for the file in `SRC_URI`.

BitBake finds and applies multiple patches for a single recipe in the order in which it finds the patches. Patches are applied to the recipe's source files located in the `S` directory.

For more information on how the source directories are created, see the "Source Fetching" section.

3.5.3. Configuration and Compilation

After source code is patched, BitBake executes tasks that configure and compile the source code:



This step in the build process consists of three tasks:

- **do_configure:** This task configures the source by enabling and disabling any build-time and configuration options for the software being built. Configurations can come from the recipe itself as well as from an inherited class. Additionally, the software itself might configure itself depending on the target for which it is being built.

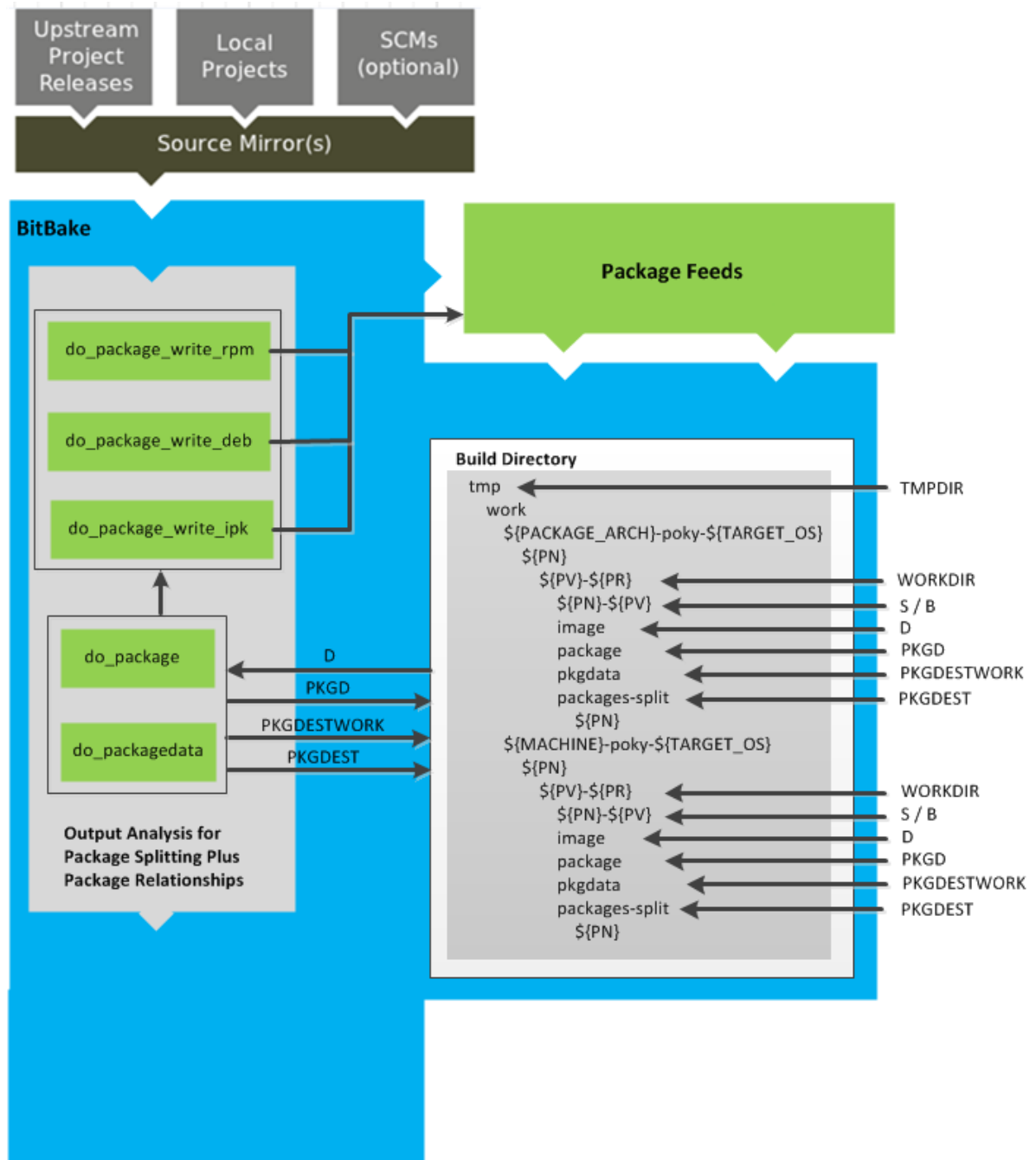
The configurations handled by the `do_configure` task are specific to source code configuration for the source code being built by the recipe.

If you are using `autotools.bbclass`, you can add additional configuration options by using the `EXTRA_OECONF` variable. For information on how this variable works within that class, see the `meta/classes/autotools.bbclass`.

- **do_compile:** Once a configuration task has been satisfied, BitBake compiles the source using the `do_compile` task. Compilation occurs in the directory pointed to by the `B` variable. Realize that the `B` directory, by default, is the same as the `S` directory.
- **do_install:** Once compilation is done, BitBake executes the `do_install` task. This task copies files from the `B` directory and places them in a holding area pointed to by the `D` variable.

3.5.4. Package Splitting

After source code is configured and compiled, the OpenEmbedded build system analyzes the results and splits the output into packages:



The `do_package` and `do_packagedata` tasks combine to analyze the files found in the `D` directory and split them into subsets based on available packages and files. The analyzing process involves the following as well as other items: splitting out debugging symbols, looking at shared library dependencies between packages, and looking at package relationships. The `do_packagedata` task creates package metadata based on the analysis such that the OpenEmbedded build system can generate the final packages. Working, staged, and intermediate results of the analysis and package splitting process use these areas:

- PKGD
- PKGDATA_DIR
- PKGDESTWORK

- PKGDEST

The `FILES` variable defines the files that go into each package in `PACKAGES`. If you want details on how this is accomplished, you can look at `package.bbclass`.

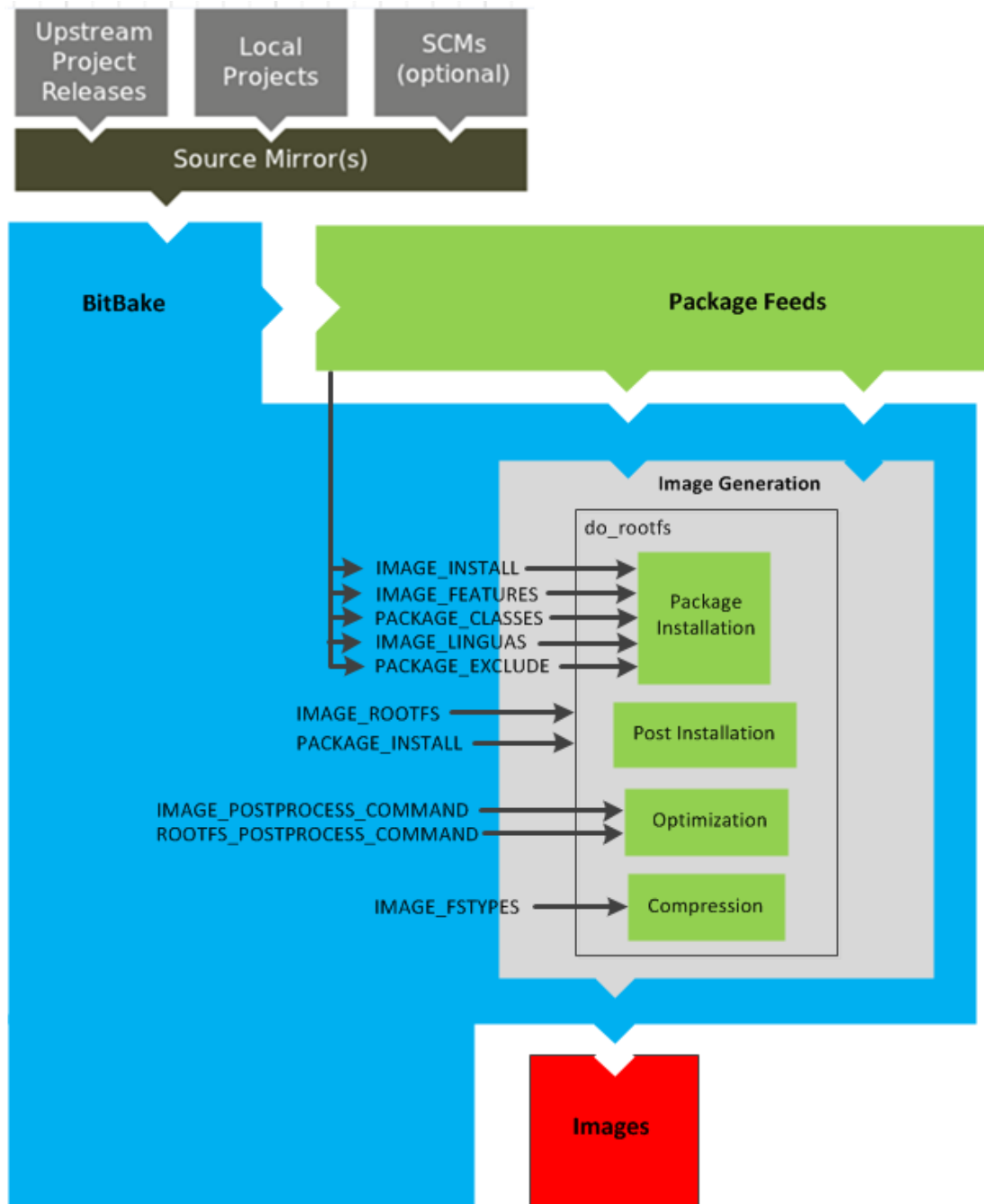
Depending on the type of packages being created (RPM, DEB, or IPK), the `do_package_write_*` task creates the actual packages and places them in the Package Feed area, which is `${TMPDIR}/deploy`. You can see the "Package Feeds" section for more detail on that part of the build process.

Note

Support for creating feeds directly from the `deploy/*` directories does not exist. Creating such feeds usually requires some kind of feed maintenance mechanism that would upload the new packages into an official package feed (e.g. the Ångström distribution). This functionality is highly distribution-specific and thus is not provided out of the box.

3.5.5. Image Generation

Once packages are split and stored in the Package Feeds area, the OpenEmbedded build system uses BitBake to generate the root filesystem image:



The image generation process consists of several stages and depends on many variables. The `do_rootfs` task uses these key variables to help create the list of packages to actually install:

- **IMAGE_INSTALL**: Lists out the base set of packages to install from the Package Feeds area.
- **PACKAGE_EXCLUDE**: Specifies packages that should not be installed.
- **IMAGE_FEATURES**: Specifies features to include in the image. Most of these features map to additional packages for installation.
- **PACKAGE_CLASSES**: Specifies the package backend to use and consequently helps determine where to locate packages within the Package Feeds area.

- `IMAGE_LINGUAS`: Determines the language(s) for which additional language support packages are installed.

Package installation is under control of the package manager (e.g. `smart/rpm`, `opkg`, or `apt/dpkg`) regardless of whether or not package management is enabled for the target. At the end of the process, if package management is not enabled for the target, the package manager's data files are deleted from the root filesystem.

During image generation, the build system attempts to run all post installation scripts. Any that fail to run on the build host are run on the target when the target system is first booted. If you are using a read-only root filesystem [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#creating-a-read-only-root-filesystem>], all the post installation scripts must succeed during the package installation phase since the root filesystem cannot be written into.

During Optimization, optimizing processes are run across the image. These processes include `mklibs` and `prelink`. The `mklibs` process optimizes the size of the libraries. A `prelink` process optimizes the dynamic linking of shared libraries to reduce start up time of executables.

Part of the image generation process includes compressing the root filesystem image. Compression is accomplished through several optimization routines designed to reduce the overall size of the image.

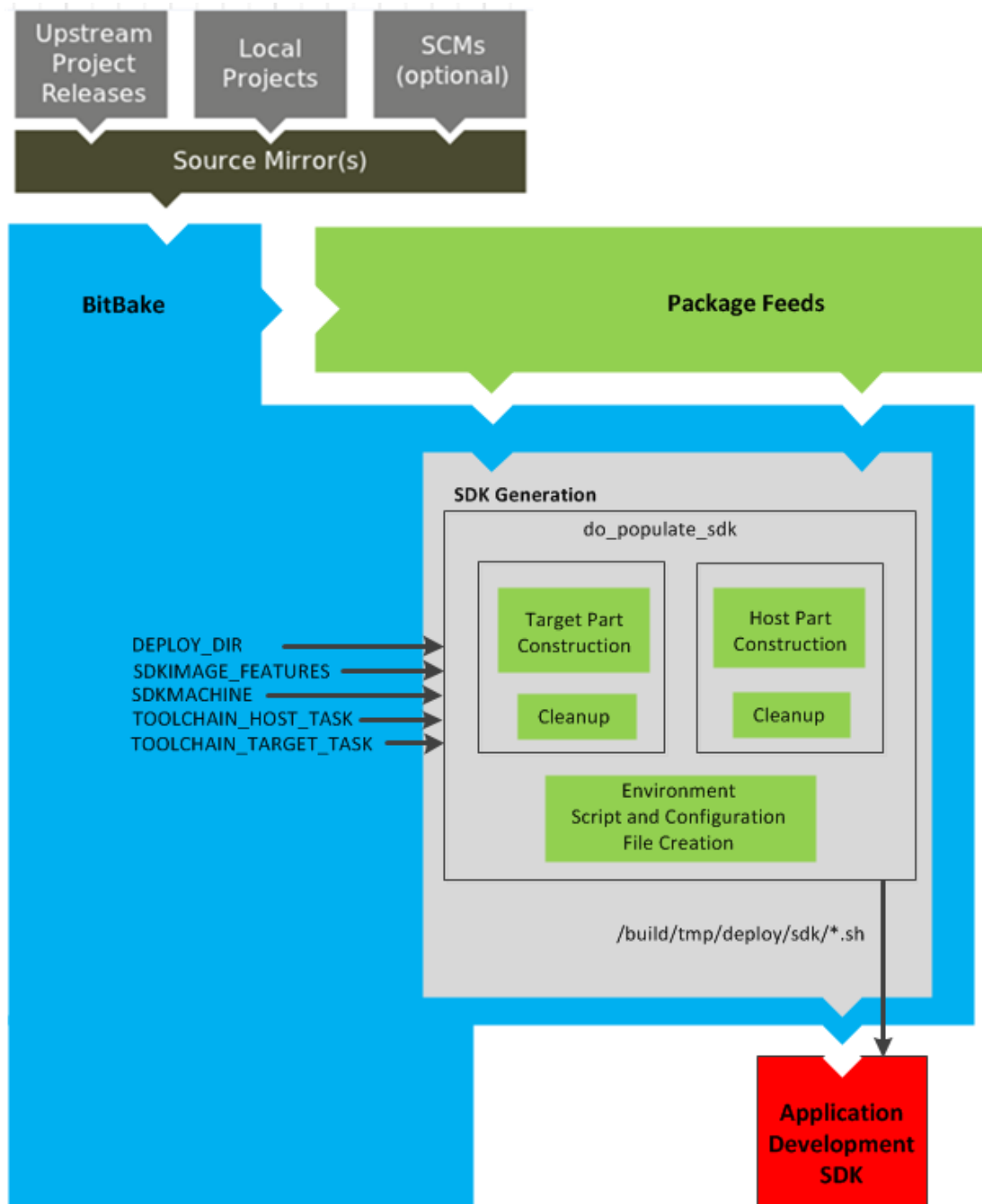
After the root filesystem has been constructed, the image generation process turns everything into an image file or a set of image files. The formats used for the root filesystem depend on the `IMAGE_FSTYPES` variable.

Note

The entire image generation process is run under `Pseudo`. Running under `Pseudo` ensures that the files in the root filesystem have correct ownership.

3.5.6. SDK Generation

The OpenEmbedded build system uses BitBake to generate the Software Development Kit (SDK) installer script:



Note

For more information on the cross-development toolchain generation, see the "Cross-Development Toolchain Generation" section.

Like image generation, the SDK script process consists of several stages and depends on many variables. The `do_populate_sdk` task uses these key variables to help create the list of packages to actually install. For information on the variables listed in the figure, see the "Application Development SDK" section.

The `do_populate_sdk` task handles two parts: a target part and a host part. The target part is the part built for the target hardware and includes libraries and headers. The host part is the part of the SDK that runs on the `SDKMACHINE`.

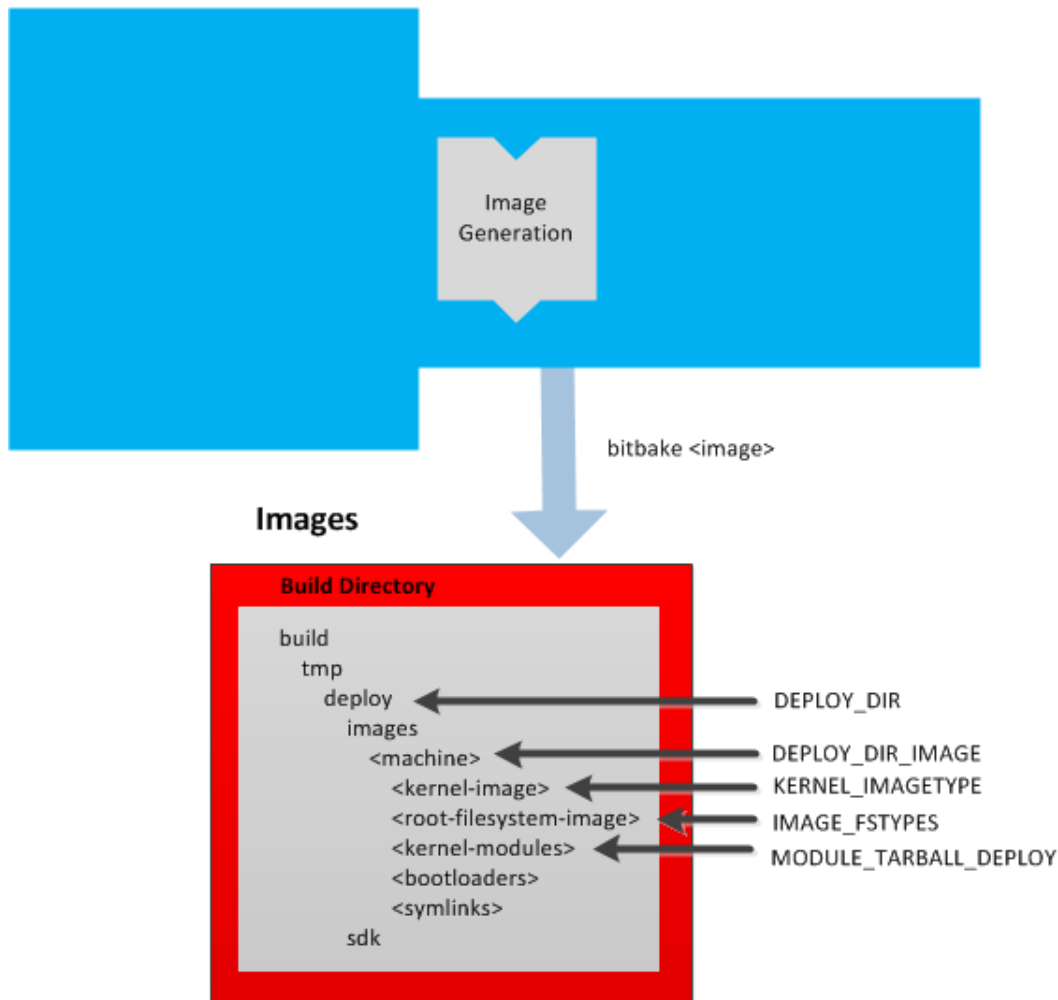
Once both parts are constructed, the `do_populate_sdk` task performs some cleanup on both parts. After the cleanup, the task creates a cross-development environment setup script and any configuration files that might be needed.

The final output of the task is the Cross-development toolchain installation script (`.sh` file), which includes the environment setup script.

3.6. Images

The images produced by the OpenEmbedded build system are compressed forms of the root filesystems that are ready to boot on a target device. You can see from the general Yocto Project Development Environment figure [17] that BitBake output in part consists of images. This section is going to look more closely at this output:

BitBake



For a list of example images that the Yocto Project provides, the "Images" chapter.

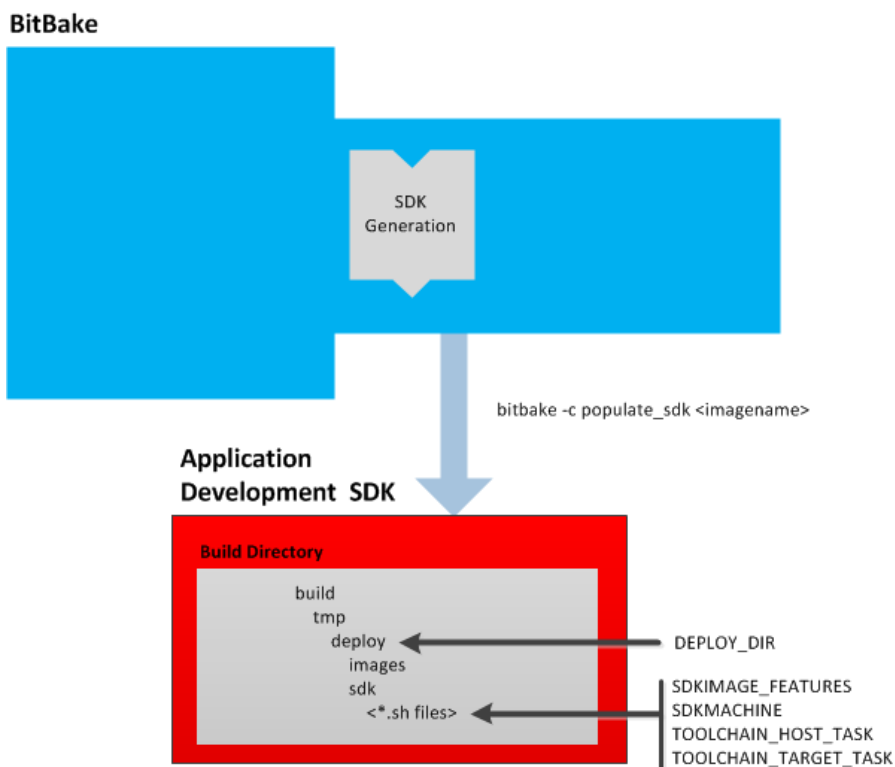
Images are written out to the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] inside the `deploy/images/<machine>/` folder as shown in the figure. This folder contains any files expected to be loaded on the target device. The `DEPLOY_DIR` variable points to the `deploy` directory, while the `DEPLOY_DIR_IMAGE` variable points to the appropriate directory containing images for the current configuration.

- `<kernel-image>`: A kernel binary file. The `KERNEL_IMAGETYPE` variable setting determines the naming scheme for the kernel image file. Depending on that variable, the file could begin with a variety of naming strings. The `deploy/images/<machine>` directory can contain multiple image files for the machine.

- **<root-filesystem-image>**: Root filesystems for the target device (e.g. *.ext3 or *.bz2 files). The IMAGE_FSTYPES variable setting determines the root filesystem image type. The deploy/images/<machine> directory can contain multiple root filesystems for the machine.
- **<kernel-modules>**: Tarballs that contain all the modules built for the kernel. Kernel module tarballs exist for legacy purposes and can be suppressed by setting the MODULE_TARBALL_DEPLOY variable to "0". The deploy/images/<machine> directory can contain multiple kernel module tarballs for the machine.
- **<bootloaders>**: Bootloaders supporting the image, if applicable to the target machine. The deploy/images/<machine> directory can contain multiple bootloaders for the machine.
- **<symlinks>**: The deploy/images/<machine> folder contains a symbolic link that points to the most recently built file for each machine. These links might be useful for external scripts that need to obtain the latest version of each file.

3.7. Application Development SDK

In the general Yocto Project Development Environment figure[17], the output labeled "Application Development SDK" represents an SDK. This section is going to take a closer look at this output:



The specific form of this output is a self-extracting SDK installer (*.sh) that, when run, installs the SDK, which consists of a cross-development toolchain, a set of libraries and headers, and an SDK environment setup script. Running this installer essentially sets up your cross-development environment. You can think of the cross-toolchain as the "host" part because it runs on the SDK machine. You can think of the libraries and headers as the "target" part because they are built for the target hardware. The setup script is added so that you can initialize the environment before using the tools.

Note

The Yocto Project supports several methods by which you can set up this cross-development environment. These methods include downloading pre-built SDK installers, building and installing your own SDK installer, or running an Application Development Toolkit (ADT) installer to install not just cross-development toolchains but also additional tools to help in this type of development.

For background information on cross-development toolchains in the Yocto Project development environment, see the "Cross-Development Toolchain Generation" section. For information on setting up a cross-development environment, see the "Installing the ADT and Toolchains [<http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html#installing-the-adt>]" section in the Yocto Project Application Developer's Guide.

Once built, the SDK installers are written out to the `deploy/sdk` folder inside the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] as shown in the figure at the beginning of this section. Several variables exist that help configure these files:

- `DEPLOY_DIR`: Points to the `deploy` directory.
- `SDKMACHINE`: Specifies the architecture of the machine on which the cross-development tools are run to create packages for the target hardware.
- `SDKIMAGE_FEATURES`: Lists the features to include in the "target" part of the SDK.
- `TOOLCHAIN_HOST_TASK`: Lists packages that make up the host part of the SDK (i.e. the part that runs on the `SDKMACHINE`). When you use `bitbake -c populate_sdk <imagenam>` to create the SDK, a set of default packages apply. This variable allows you to add more packages.
- `TOOLCHAIN_TARGET_TASK`: Lists packages that make up the target part of the SDK (i.e. the part built for the target hardware).

Chapter 4. Technical Details

This chapter provides technical details for various parts of the Yocto Project. Currently, topics include Yocto Project components, shared state (sstate) cache, x32, and Licenses.

4.1. Yocto Project Components

The BitBake task executor together with various types of configuration files form the OpenEmbedded Core. This section overviews these by describing what they are used for and how they interact.

BitBake handles the parsing and execution of the data files. The data itself is of various types:

- Recipes: Provides details about particular pieces of software.
- Class Data: Abstracts common build information (e.g. how to build a Linux kernel).
- Configuration Data: Defines machine-specific settings, policy decisions, and so forth. Configuration data acts as the glue to bind everything together.

For more information on data, see the "Yocto Project Terms [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#yocto-project-terms>]" section in the Yocto Project Development Manual.

BitBake knows how to combine multiple data sources together and refers to each data source as a layer. For information on layers, see the "Understanding and Creating Layers [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#understanding-and-creating-layers>]" section of the Yocto Project Development Manual.

Following are some brief details on these core components. For more detailed information on these components, see the "Source Directory Structure" chapter.

4.1.1. BitBake

BitBake is the tool at the heart of the OpenEmbedded build system and is responsible for parsing the Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>], generating a list of tasks from it, and then executing those tasks. To see a list of the options BitBake supports, use the following help command:

```
$ bitbake --help
```

The most common usage for BitBake is `bitbake <packagename>`, where `packagename` is the name of the package you want to build (referred to as the "target" in this manual). The target often equates to the first part of a `.bb` filename. So, to run the `matchbox-desktop_1.2.3.bb` file, you might type the following:

```
$ bitbake matchbox-desktop
```

Several different versions of `matchbox-desktop` might exist. BitBake chooses the one selected by the distribution configuration. You can get more details about how BitBake chooses between different target versions and providers in the "Preferences and Providers" section.

BitBake also tries to execute any dependent tasks first. So for example, before building `matchbox-desktop`, BitBake would build a cross compiler and `eglibc` if they had not already been built.

Note

This release of the Yocto Project does not support the `glibc` GNU version of the Unix standard C library. By default, the OpenEmbedded build system builds with `eglibc`.

A useful BitBake option to consider is the `-k` or `--continue` option. This option instructs BitBake to try and continue processing the job as much as possible even after encountering an error. When an

error occurs, the target that failed and those that depend on it cannot be remade. However, when you use this option other dependencies can still be processed.

4.1.2. Metadata (Recipes)

The `.bb` files are usually referred to as "recipes." In general, a recipe contains information about a single piece of software. The information includes the location from which to download the source patches (if any are needed), which special configuration options to apply, how to compile the source files, and how to package the compiled output.

The term "package" can also be used to describe recipes. However, since the same word is used for the packaged output from the OpenEmbedded build system (i.e. `.ipk` or `.deb` files), this document avoids using the term "package" when referring to recipes.

4.1.3. Classes

Class files (`.bbclass`) contain information that is useful to share between Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] files. An example is the Autotools class, which contains common settings for any application that Autotools uses. The "Classes" chapter provides details about common classes and how to use them.

4.1.4. Configuration

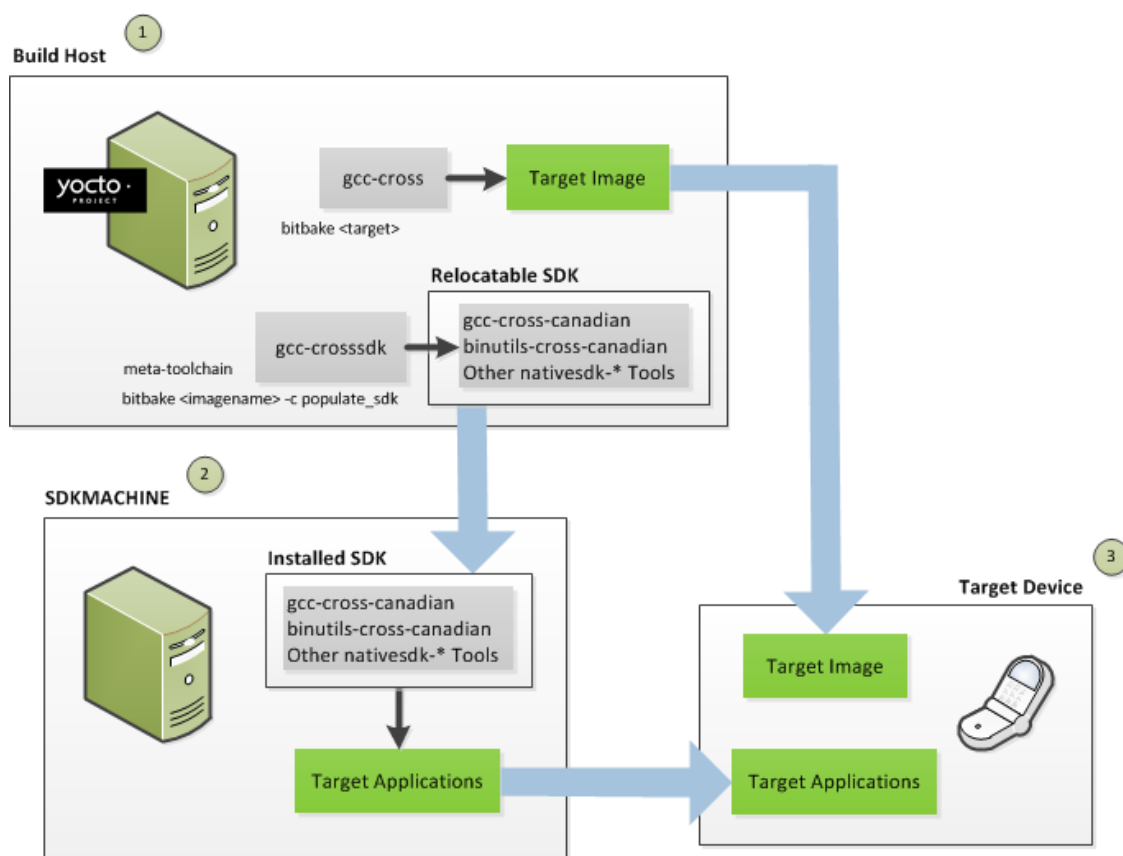
The configuration files (`.conf`) define various configuration variables that govern the OpenEmbedded build process. These files fall into several areas that define machine configuration options, distribution configuration options, compiler tuning options, general common configuration options, and user configuration options in `local.conf`, which is found in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>].

4.2. Cross-Development Toolchain Generation

The Yocto Project does most of the work for you when it comes to creating cross-development toolchains [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#cross-development-toolchain>]. This section provides some technical background information on how cross-development toolchains are created and used. For more information on these toolchain, you can also see the the Yocto Project Application Developer's Guide [<http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html>].

In the Yocto Project development environment, cross-development toolchains are used to build the image and applications that run on the target hardware. With just a few commands, the OpenEmbedded build system creates these necessary toolchains for you.

The following figure shows a high-level build environment regarding toolchain construction and use.



- 1 The Build Host produces three toolchains: 1) `gcc-cross`, which builds the target image. 2) `gcc-crosssdk`, which is a transitory toolchain and produces relocatable code that executes on the SDKMACHINE. 3) `gcc-cross-canadian`, which executes on the SDKMACHINE and produces target applications.
- 2 The SDKMACHINE, which may or may not be the same as the Build Host, runs `gcc-cross-canadian` to create target applications.
- 3 The Target Device runs the Target Image and Target Applications.

Most of the work occurs on the Build Host. This is the machine used to build images and generally work within the the Yocto Project environment. When you run BitBake to create an image, the OpenEmbedded build system uses the host gcc compiler to bootstrap a cross-compiler named `gcc-cross`. The `gcc-cross` compiler is what BitBake uses to compile source files when creating the target image. You can think of `gcc-cross` simply as an automatically generated cross-compiler that is used internally within BitBake only.

The chain of events that occurs when `gcc-cross` is bootstrapped is as follows:

```
gcc -> binutils-cross -> gcc-cross-initial -> linux-libc-headers -> eglibc-initial -> eglibc
```

- `gcc`: The build host's GNU Compiler Collection (GCC).
- `binutils-cross`: The bare minimum binary utilities needed in order to run the `gcc-cross-initial` phase of the bootstrap operation.
- `gcc-cross-initial`: An early stage of the bootstrap process for creating the cross-compiler. This stage builds enough of the `gcc-cross`, the C library, and other pieces needed to finish building the final cross-compiler in later stages. This tool is a "native" package (i.e. it is designed to run on the build host).
- `linux-libc-headers`: Headers needed for the cross-compiler.

- `eglibc-initial`: An initial version of the Embedded GLIBC needed to bootstrap `eglibc`.
- `gcc-cross`: The final stage of the bootstrap process for the cross-compiler. This stage results in the actual cross-compiler that BitBake uses when it builds an image for a targeted device.

Note

If you are replacing this cross compiler toolchain with a custom version, you must replace `gcc-cross`.

This tool is also a "native" package (i.e. it is designed to run on the build host).

- `gcc-runtime`: Runtime libraries resulting from the toolchain bootstrapping process. This tool produces a binary that consists of the runtime libraries need for the targeted device.

You can use the OpenEmbedded build system to build an installer for the relocatable SDK used to develop applications. When you run the installer, it installs the toolchain, which contains the development tools (e.g., the `gcc-cross-canadian`), `binutils-cross-canadian`, and other `nativesdk-*` tools you need to cross-compile and test your software. The figure shows the commands you use to easily build out this toolchain. This cross-development toolchain is built to execute on the `SDKMACHINE`, which might or might not be the same machine as the Build Host.

Note

If your target architecture is supported by the Yocto Project, you can take advantage of pre-built images that ship with the Yocto Project and already contain cross-development toolchain installers.

Here is the bootstrap process for the relocatable toolchain:

```
gcc -> binutils-crosssdk -> gcc-crosssdk-initial -> linux-libc-headers -> eglibc-initial ->
```

- `gcc`: The build host's GNU Compiler Collection (GCC).
- `binutils-crosssdk`: The bare minimum binary utilities needed in order to run the `gcc-crosssdk-initial` phase of the bootstrap operation.
- `gcc-crosssdk-initial`: An early stage of the bootstrap process for creating the cross-compiler. This stage builds enough of the `gcc-crosssdk` and supporting pieces so that the final stage of the bootstrap process can produce the finished cross-compiler. This tool is a "native" binary that runs on the build host.
- `linux-libc-headers`: Headers needed for the cross-compiler.
- `eglibc-initial`: An initial version of the Embedded GLIBC needed to bootstrap `nativesdk-eglibc`.
- `nativesdk-eglibc`: The Embedded GLIBC needed to bootstrap the `gcc-crosssdk`.
- `gcc-crosssdk`: The final stage of the bootstrap process for the relocatable cross-compiler. The `gcc-crosssdk` is a transitory compiler and never leaves the build host. Its purpose is to help in the bootstrap process to create the eventual relocatable `gcc-cross-canadian` compiler, which is relocatable. This tool is also a "native" package (i.e. it is designed to run on the build host).
- `gcc-cross-canadian`: The final relocatable cross-compiler. When run on the `SDKMACHINE`, this tool produces executable code that runs on the target device.

4.3. Shared State Cache

By design, the OpenEmbedded build system builds everything from scratch unless BitBake can determine that parts do not need to be rebuilt. Fundamentally, building from scratch is attractive as it means all parts are built fresh and there is no possibility of stale data causing problems. When developers hit problems, they typically default back to building from scratch so they know the state of things from the start.

Building an image from scratch is both an advantage and a disadvantage to the process. As mentioned in the previous paragraph, building from scratch ensures that everything is current and starts from a

known state. However, building from scratch also takes much longer as it generally means rebuilding things that do not necessarily need rebuilt.

The Yocto Project implements shared state code that supports incremental builds. The implementation of the shared state code answers the following questions that were fundamental roadblocks within the OpenEmbedded incremental build support system:

- What pieces of the system have changed and what pieces have not changed?
- How are changed pieces of software removed and replaced?
- How are pre-built components that do not need to be rebuilt from scratch used when they are available?

For the first question, the build system detects changes in the "inputs" to a given task by creating a checksum (or signature) of the task's inputs. If the checksum changes, the system assumes the inputs have changed and the task needs to be rerun. For the second question, the shared state (sstate) code tracks which tasks add which output to the build process. This means the output from a given task can be removed, upgraded or otherwise manipulated. The third question is partly addressed by the solution for the second question assuming the build system can fetch the sstate objects from remote locations and install them if they are deemed to be valid.

Note

The OpenEmbedded build system does not maintain PR information as part of the shared state packages. Consequently, considerations exist that affect maintaining shared state feeds. For information on how the OpenEmbedded works with packages and can track incrementing PR information, see the "Incrementing a Package Revision Number [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#incrementing-a-package-revision-number>]" section.

The rest of this section goes into detail about the overall incremental build architecture, the checksums (signatures), shared state, and some tips and tricks.

4.3.1. Overall Architecture

When determining what parts of the system need to be built, BitBake uses a per-task basis and does not use a per-recipe basis. You might wonder why using a per-task basis is preferred over a per-recipe basis. To help explain, consider having the IPK packaging backend enabled and then switching to DEB. In this case, `do_install` and `do_package` output are still valid. However, with a per-recipe approach, the build would not include the `.deb` files. Consequently, you would have to invalidate the whole build and rerun it. Rerunning everything is not the best situation. Also in this case, the core must be "taught" much about specific tasks. This methodology does not scale well and does not allow users to easily add new tasks in layers or as external recipes without touching the packaged-staging core.

4.3.2. Checksums (Signatures)

The shared state code uses a checksum, which is a unique signature of a task's inputs, to determine if a task needs to be run again. Because it is a change in a task's inputs that triggers a rerun, the process needs to detect all the inputs to a given task. For shell tasks, this turns out to be fairly easy because the build process generates a "run" shell script for each task and it is possible to create a checksum that gives you a good idea of when the task's data changes.

To complicate the problem, there are things that should not be included in the checksum. First, there is the actual specific build path of a given task - the `WORKDIR`. It does not matter if the working directory changes because it should not affect the output for target packages. Also, the build process has the objective of making native or cross packages relocatable. The checksum therefore needs to exclude `WORKDIR`. The simplistic approach for excluding the working directory is to set `WORKDIR` to some fixed value and create the checksum for the "run" script.

Another problem results from the "run" scripts containing functions that might or might not get called. The incremental build solution contains code that figures out dependencies between shell functions. This code is used to prune the "run" scripts down to the minimum set, thereby alleviating this problem and making the "run" scripts much more readable as a bonus.

So far we have solutions for shell scripts. What about Python tasks? The same approach applies even though these tasks are more difficult. The process needs to figure out what variables a Python

function accesses and what functions it calls. Again, the incremental build solution contains code that first figures out the variable and function dependencies, and then creates a checksum for the data used as the input to the task.

Like the `WORKDIR` case, situations exist where dependencies should be ignored. For these cases, you can instruct the build process to ignore a dependency by using a line like the following:

```
PACKAGE_ARCHS[vardepsexclude] = "MACHINE"
```

This example ensures that the `PACKAGE_ARCHS` variable does not depend on the value of `MACHINE`, even if it does reference it.

Equally, there are cases where we need to add dependencies BitBake is not able to find. You can accomplish this by using a line like the following:

```
PACKAGE_ARCHS[vardeps] = "MACHINE"
```

This example explicitly adds the `MACHINE` variable as a dependency for `PACKAGE_ARCHS`.

Consider a case with in-line Python, for example, where BitBake is not able to figure out dependencies. When running in debug mode (i.e. using `-DDD`), BitBake produces output when it discovers something for which it cannot figure out dependencies. The Yocto Project team has currently not managed to cover those dependencies in detail and is aware of the need to fix this situation.

Thus far, this section has limited discussion to the direct inputs into a task. Information based on direct inputs is referred to as the "basehash" in the code. However, there is still the question of a task's indirect inputs - the things that were already built and present in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]. The checksum (or signature) for a particular task needs to add the hashes of all the tasks on which the particular task depends. Choosing which dependencies to add is a policy decision. However, the effect is to generate a master checksum that combines the basehash and the hashes of the task's dependencies.

At the code level, there are a variety of ways both the basehash and the dependent task hashes can be influenced. Within the BitBake configuration file, we can give BitBake some extra information to help it construct the basehash. The following statements effectively result in a list of global variable dependency excludes - variables never included in any checksum:

```
BB_HASHBASE_WHITELIST ?= "TMPDIR FILE PATH PWD BB_TASKHASH BBPATH"
BB_HASHBASE_WHITELIST += "DL_DIR SSTATE_DIR THISDIR FILESEXTRAPATHS"
BB_HASHBASE_WHITELIST += "FILE_DIRNAME HOME LOGNAME SHELL TERM USER"
BB_HASHBASE_WHITELIST += "FILESPATH USERNAME STAGING_DIR_HOST STAGING_DIR_TARGET"
```

The previous example actually excludes `WORKDIR` since it is actually constructed as a path within `TMPDIR`, which is on the whitelist.

The rules for deciding which hashes of dependent tasks to include through dependency chains are more complex and are generally accomplished with a Python function. The code in `meta/lib/oe/sstatesig.py` shows two examples of this and also illustrates how you can insert your own policy into the system if so desired. This file defines the two basic signature generators OE-Core uses: "OEBasic" and "OEBasicHash". By default, there is a dummy "noop" signature handler enabled in BitBake. This means that behavior is unchanged from previous versions. OE-Core uses the "OEBasicHash" signature handler by default through this setting in the `bitbake.conf` file:

```
BB_SIGNATURE_HANDLER ?= "OEBasicHash"
```

The "OEBasicHash" `BB_SIGNATURE_HANDLER` is the same as the "OEBasic" version but adds the task hash to the stamp files. This results in any Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] change that changes the task hash, automatically causing

the task to be run again. This removes the need to bump PR values and changes to Metadata automatically ripple across the build.

It is also worth noting that the end result of these signature generators is to make some dependency and hash information available to the build. This information includes:

```
BB_BASEHASH_task-<taskname> - the base hashes for each task in the recipe
BB_BASEHASH_<filename:taskname> - the base hashes for each dependent task
BBHASHDEPS_<filename:taskname> - The task dependencies for each task
BB_TASKHASH - the hash of the currently running task
```

4.3.3. Shared State

Checksums and dependencies, as discussed in the previous section, solve half the problem. The other part of the problem is being able to use checksum information during the build and being able to reuse or rebuild specific components.

The shared state class (`sstate.bbclass`) is a relatively generic implementation of how to "capture" a snapshot of a given task. The idea is that the build process does not care about the source of a task's output. Output could be freshly built or it could be downloaded and unpacked from somewhere - the build process does not need to worry about its source.

There are two types of output, one is just about creating a directory in `WORKDIR`. A good example is the output of either `do_install` or `do_package`. The other type of output occurs when a set of data is merged into a shared directory tree such as the `sysroot`.

The Yocto Project team has tried to keep the details of the implementation hidden in `sstate.bbclass`. From a user's perspective, adding shared state wrapping to a task is as simple as this `do_deploy` example taken from `do_deploy.bbclass`:

```
DEPLOYDIR = "${WORKDIR}/deploy-${PN}"
SSTATETASKS += "do_deploy"
do_deploy[sstate-name] = "deploy"
do_deploy[sstate-inputdirs] = "${DEPLOYDIR}"
do_deploy[sstate-outputdirs] = "${DEPLOY_DIR_IMAGE}"

python do_deploy_setscene () {
    sstate_setscene(d)
}
addtask do_deploy_setscene
```

In the example, we add some extra flags to the task, a name field ("deploy"), an input directory where the task sends data, and the output directory where the data from the task should eventually be copied. We also add a `_setscene` variant of the task and add the task name to the `SSTATETASKS` list.

If you have a directory whose contents you need to preserve, you can do this with a line like the following:

```
do_package[sstate-plaindir] = "${PKGDIR} ${PKGDEST}"
```

This method, as well as the following example, also works for multiple directories.

```
do_package[sstate-inputdirs] = "${PKGDESTWORK} ${SHLIBSWORKDIR}"
do_package[sstate-outputdirs] = "${PKGDATA_DIR} ${SHLIBSDIR}"
do_package[sstate-lockfile] = "${PACKAGELOCK}"
```

These methods also include the ability to take a lockfile when manipulating shared state directory structures since some cases are sensitive to file additions or removals.

Behind the scenes, the shared state code works by looking in `SSTATE_DIR` and `SSTATE_MIRRORS` for shared state files. Here is an example:

```
SSTATE_MIRRORS ?= "\
file://.* http://someserver.tld/share/sstate/PATH \n \
file://.* file:///some/local/dir/sstate/PATH"
```

Note

The shared state directory (`SSTATE_DIR`) is organized into two-character subdirectories, where the subdirectory names are based on the first two characters of the hash. If the shared state directory structure for a mirror has the same structure as `SSTATE_DIR`, you must specify "PATH" as part of the URI to enable the build system to map to the appropriate subdirectory.

The shared state package validity can be detected just by looking at the filename since the filename contains the task checksum (or signature) as described earlier in this section. If a valid shared state package is found, the build process downloads it and uses it to accelerate the task.

The build processes use the `*_setscene` tasks for the task acceleration phase. BitBake goes through this phase before the main execution code and tries to accelerate any tasks for which it can find shared state packages. If a shared state package for a task is available, the shared state package is used. This means the task and any tasks on which it is dependent are not executed.

As a real world example, the aim is when building an IPK-based image, only the `do_package_write_ipk` tasks would have their shared state packages fetched and extracted. Since the `sysroot` is not used, it would never get extracted. This is another reason why a task-based approach is preferred over a recipe-based approach, which would have to install the output from every task.

4.3.4. Tips and Tricks

The code in the build system that supports incremental builds is not simple code. This section presents some tips and tricks that help you work around issues related to shared state code.

4.3.4.1. Debugging

When things go wrong, debugging needs to be straightforward. Because of this, the Yocto Project team included strong debugging tools:

- Whenever a shared state package is written out, so is a corresponding `.siginfo` file. This practice results in a pickled Python database of all the metadata that went into creating the hash for a given shared state package.
- If you run BitBake with the `--dump-signatures` (or `-S`) option, BitBake dumps out `.siginfo` files in the stamp directory for every task it would have executed instead of building the specified target package.
- There is a `bitbake-diffsigs` command that can process `.siginfo` files. If you specify one of these files, BitBake dumps out the dependency information in the file. If you specify two files, BitBake compares the two files and dumps out the differences between the two. This more easily helps answer the question of "What changed between X and Y?"

4.3.4.2. Invalidating Shared State

The shared state code uses checksums and shared state cache to avoid unnecessarily rebuilding tasks. As with all schemes, this one has some drawbacks. It is possible that you could make implicit changes that are not factored into the checksum calculation, but do affect a task's output. A good example is perhaps when a tool changes its output. Assume that the output of `rpmdeps` needed to change. The result of the change should be that all the `package`, `package_write_rpm`, and `package_deploy-rpm` shared state cache items would become invalid. But, because this is a change that is external to the code and therefore implicit, the associated shared state cache items do not become invalidated. In this case, the build process uses the cached items rather than running the task again. Obviously, these types of implicit changes can cause problems.

To avoid these problems during the build, you need to understand the effects of any change you make. Note that any changes you make directly to a function automatically are factored into the checksum calculation and thus, will invalidate the associated area of sstate cache. You need to be aware of any implicit changes that are not obvious changes to the code and could affect the output of a given task. Once you are aware of such changes, you can take steps to invalidate the cache and force the tasks to run. The steps to take are as simple as changing function's comments in the source code. For example, to invalidate package shared state files, change the comment statements of `do_package` or the comments of one of the functions it calls. The change is purely cosmetic, but it causes the checksum to be recalculated and forces the task to be run again.

Note

For an example of a commit that makes a cosmetic change to invalidate a shared state, see this commit [<http://git.yoctoproject.org/cgi/poky/commit/meta/classes/package.bbclass?id=737f8bbb4f27b4837047cb9b4fbfe01dfde36d54>].

4.4. x32

x32 is a processor-specific Application Binary Interface (psABI) for x86_64. An ABI defines the calling conventions between functions in a processing environment. The interface determines what registers are used and what the sizes are for various C data types.

Some processing environments prefer using 32-bit applications even when running on Intel 64-bit platforms. Consider the i386 psABI, which is a very old 32-bit ABI for Intel 64-bit platforms. The i386 psABI does not provide efficient use and access of the Intel 64-bit processor resources, leaving the system underutilized. Now consider the x86_64 psABI. This ABI is newer and uses 64-bits for data sizes and program pointers. The extra bits increase the footprint size of the programs, libraries, and also increases the memory and file system size requirements. Executing under the x32 psABI enables user programs to utilize CPU and system resources more efficiently while keeping the memory footprint of the applications low. Extra bits are used for registers but not for addressing mechanisms.

4.4.1. Support

While the x32 psABI specifications are not fully finalized, this Yocto Project release supports current development specifications of x32 psABI. As of this release of the Yocto Project, x32 psABI support exists as follows:

- You can create packages and images in x32 psABI format on x86_64 architecture targets.
- You can successfully build many recipes with the x32 toolchain.
- You can create and boot `core-image-minimal` and `core-image-sato` images.

4.4.2. Stabilizing and Completing x32

As of this Yocto Project release, the x32 psABI kernel and library interfaces specifications are not finalized.

Future Plans for the x32 psABI in the Yocto Project include the following:

- Enhance and fix the few remaining recipes so they work with and support x32 toolchains.
- Enhance RPM Package Manager (RPM) support for x32 binaries.
- Support larger images.

4.4.3. Using x32 Right Now

Follow these steps to use the x32 psABI:

- Enable the x32 psABI tuning file for x86_64 machines by editing the `conf/local.conf` like this:

```
MACHINE = "qemux86-64"
```

```
DEFAULTTUNE = "x86-64-x32"  
baselib = "${@d.getVar('BASE_LIB_tune-' + (d.getVar('DEFAULTTUNE', True) \ or 'INVALID'), True) or 'lib'}"  
#MACHINE = "genericx86"  
#DEFAULTTUNE = "core2-64-x32"
```

- As usual, use BitBake to build an image that supports the x32 psABI. Here is an example:

```
$ bitbake core-image-sato
```

- As usual, run your image using QEMU:

```
$ runqemu qemux86-64 core-image-sato
```

4.5. Wayland

Wayland [[http://en.wikipedia.org/wiki/Wayland_\(display_server_protocol\)#Weston](http://en.wikipedia.org/wiki/Wayland_(display_server_protocol)#Weston)] is a computer display server protocol that when implemented provides a method for compositing window managers to communicate directly with applications and video hardware and expects them to communicate with input hardware using other libraries. Using Wayland with supporting targets can result in better control over graphics frame rendering than an application might otherwise achieve.

The Yocto Project provides the Wayland protocol libraries and the reference Weston compositor as part of it release. This section describes what you need to do to implement Wayland and use the compositor when building an image for a supporting target.

4.5.1. Support

The Wayland protocol libraries and the reference Weston compositor ship as integrated packages in the meta layer of the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. Specifically, you can find the recipes that build both Wayland and Weston at `meta/recipes-graphics/wayland`.

You can build both the Wayland and Weston packages for use only with targets that accept the Mesa 3D and Direct Rendering Infrastructure [<http://dri.freedesktop.org/wiki/>], which is also known as Mesa DRI. This implies that you cannot build and use the packages if your target uses, for example, the Intel® Embedded Media and Graphics Driver (Intel® EMGD) that overrides Mesa DRI.

Note

Due to lack of EGL support, Weston 1.0.3 will not run directly on the emulated QEMU hardware. However, this version of Weston will run under X emulation without issues.

4.5.2. Enabling Wayland in an Image

To enable Wayland, you need to enable it to be built and enable it to be included in the image.

4.5.2.1. Building

To cause Mesa to build the `wayland-egl` platform and Weston to build Wayland with Kernel Mode Setting (KMS [https://wiki.archlinux.org/index.php/Kernel_Mode_Setting]) support, include the "wayland" flag in the `DISTRO_FEATURES` statement in your `local.conf` file:

```
DISTRO_FEATURES_append = " wayland"
```

Note

If X11 has been enabled elsewhere, Weston will build Wayland with X11 support

4.5.2.2. Installing

To install the Wayland feature into an image, you must include the following `CORE_IMAGE_EXTRA_INSTALL` statement in your `local.conf` file:

```
CORE_IMAGE_EXTRA_INSTALL += "wayland weston"
```

4.5.3. Running Weston

To run Weston inside X11, enabling it as described earlier and building a Sato image is sufficient. If you are running your image under Sato, a Weston Launcher appears in the "Utility" category.

Alternatively, you can run Weston through the command-line interpreter (CLI), which is better suited for development work. To run Weston under the CLI you need to do the following after your image is built:

1. Run these commands to export `XDG_RUNTIME_DIR`:

```
mkdir -p /tmp/$USER-weston
chmod 0700 /tmp/$USER-weston
export XDG_RUNTIME_DIR=/tmp/$USER=weston
```

2. Launch Weston in the shell:

```
weston
```

4.6. Licenses

This section describes the mechanism by which the OpenEmbedded build system tracks changes to licensing text. The section also describes how to enable commercially licensed recipes, which by default are disabled.

For information that can help you maintain compliance with various open source licensing during the lifecycle of the product, see the "Maintaining Open Source License Compliance During Your Project's Lifecycle [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#maintaining-open-source-license-compliance-during-your-products-lifecycle>]" section in the Yocto Project Development Manual.

4.6.1. Tracking License Changes

The license of an upstream project might change in the future. In order to prevent these changes going unnoticed, the `LIC_FILES_CHKSUM` variable tracks changes to the license text. The checksums are validated at the end of the configure step, and if the checksums do not match, the build will fail.

4.6.1.1. Specifying the `LIC_FILES_CHKSUM` Variable

The `LIC_FILES_CHKSUM` variable contains checksums of the license text in the source code for the recipe. Following is an example of how to specify `LIC_FILES_CHKSUM`:

```
LIC_FILES_CHKSUM = "file://COPYING;md5=xxxx \
                    file://licfile1.txt;beginline=5;endline=29;md5=yyyy \
                    file://licfile2.txt;endline=50;md5=zzzz \
                    ..."
```

The build system uses the `S` variable as the default directory used when searching files listed in `LIC_FILES_CHKSUM`. The previous example employs the default directory.

Consider this next example:

```
LIC_FILES_CHKSUM = "file://src/ls.c;beginline=5;endline=16;\n                    md5=bb14ed3c4cda583abc85401304b5cd4e"\nLIC_FILES_CHKSUM = "file://${WORKDIR}/license.html;md5=5c94767cedb5d6987c902ac850ded2c6"
```

The first line locates a file in `${S}/src/ls.c`. The second line refers to a file in `WORKDIR`.

Note that `LIC_FILES_CHKSUM` variable is mandatory for all recipes, unless the `LICENSE` variable is set to `"CLOSED"`.

4.6.1.2. Explanation of Syntax

As mentioned in the previous section, the `LIC_FILES_CHKSUM` variable lists all the important files that contain the license text for the source code. It is possible to specify a checksum for an entire file, or a specific section of a file (specified by beginning and ending line numbers with the `"beginline"` and `"endline"` parameters, respectively). The latter is useful for source files with a license notice header, README documents, and so forth. If you do not use the `"beginline"` parameter, then it is assumed that the text begins on the first line of the file. Similarly, if you do not use the `"endline"` parameter, it is assumed that the license text ends with the last line of the file.

The `"md5"` parameter stores the md5 checksum of the license text. If the license text changes in any way as compared to this parameter then a mismatch occurs. This mismatch triggers a build failure and notifies the developer. Notification allows the developer to review and address the license text changes. Also note that if a mismatch occurs during the build, the correct md5 checksum is placed in the build log and can be easily copied to the recipe.

There is no limit to how many files you can specify using the `LIC_FILES_CHKSUM` variable. Generally, however, every project requires a few specifications for license tracking. Many projects have a `"COPYING"` file that stores the license information for all the source code files. This practice allows you to just track the `"COPYING"` file as long as it is kept up to date.

Tip

If you specify an empty or invalid `"md5"` parameter, BitBake returns an md5 mis-match error and displays the correct `"md5"` parameter value during the build. The correct parameter is also captured in the build log.

Tip

If the whole file contains only license text, you do not need to use the `"beginline"` and `"endline"` parameters.

4.6.2. Enabling Commercially Licensed Recipes

By default, the OpenEmbedded build system disables components that have commercial or other special licensing requirements. Such requirements are defined on a recipe-by-recipe basis through the `LICENSE_FLAGS` variable definition in the affected recipe. For instance, the `$HOME/poky/meta/recipes-multimedia/gstreamer/gst-plugins-ugly` recipe contains the following statement:

```
LICENSE_FLAGS = "commercial"
```

Here is a slightly more complicated example that contains both an explicit recipe name and version (after variable expansion):

```
LICENSE_FLAGS = "license_${PN}_${PV}"
```

In order for a component restricted by a `LICENSE_FLAGS` definition to be enabled and included in an image, it needs to have a matching entry in the global `LICENSE_FLAGS_WHITELIST` variable, which is a variable typically defined in your `local.conf` file. For example, to enable the `$HOME/poky/meta/recipes-multimedia/gstreamer/gst-plugins-ugly` package, you could

add either the string "commercial_gst-plugins-ugly" or the more general string "commercial" to LICENSE_FLAGS_WHITELIST. See the "License Flag Matching" section for a full explanation of how LICENSE_FLAGS matching works. Here is the example:

```
LICENSE_FLAGS_WHITELIST = "commercial_gst-plugins-ugly"
```

Likewise, to additionally enable the package built from the recipe containing LICENSE_FLAGS = "license_\${PN}_\${PV}", and assuming that the actual recipe name was emgd_1.10.bb, the following string would enable that package as well as the original gst-plugins-ugly package:

```
LICENSE_FLAGS_WHITELIST = "commercial_gst-plugins-ugly license_emgd_1.10"
```

As a convenience, you do not need to specify the complete license string in the whitelist for every package. you can use an abbreviated form, which consists of just the first portion or portions of the license string before the initial underscore character or characters. A partial string will match any license that contains the given string as the first portion of its license. For example, the following whitelist string will also match both of the packages previously mentioned as well as any other packages that have licenses starting with "commercial" or "license".

```
LICENSE_FLAGS_WHITELIST = "commercial license"
```

4.6.2.1. License Flag Matching

License flag matching allows you to control what recipes the OpenEmbedded build system includes in the build. Fundamentally, the build system attempts to match LICENSE_FLAG strings found in recipes against LICENSE_FLAGS_WHITELIST strings found in the whitelist. A match, causes the build system to include a recipe in the build, while failure to find a match causes the build system to exclude a recipe.

In general, license flag matching is simple. However, understanding some concepts will help you correctly and effectively use matching.

Before a flag defined by a particular recipe is tested against the contents of the whitelist, the expanded string `_${PN}` is appended to the flag. This expansion makes each LICENSE_FLAGS value recipe-specific. After expansion, the string is then matched against the whitelist. Thus, specifying LICENSE_FLAGS = "commercial" in recipe "foo", for example, results in the string "commercial_foo". And, to create a match, that string must appear in the whitelist.

Judicious use of the LICENSE_FLAGS strings and the contents of the LICENSE_FLAGS_WHITELIST variable allows you a lot of flexibility for including or excluding recipes based on licensing. For example, you can broaden the matching capabilities by using license flags string subsets in the whitelist.

Note

When using a string subset, be sure to use the part of the expanded string that precedes the appended underscore character (e.g. `usethispart_1.3`, `usethispart_1.4`, and so forth). For example, simply specifying the string "commercial" in the whitelist matches any expanded LICENSE_FLAGS definition that starts with the string "commercial" such as "commercial_foo" and "commercial_bar", which are the strings the build system automatically generates for hypothetical recipes named "foo" and "bar" assuming those recipes simply specify the following:

```
LICENSE_FLAGS = "commercial"
```

Thus, you can choose to exhaustively enumerate each license flag in the whitelist and allow only specific recipes into the image, or you can use a string subset that causes a broader range of matches to allow a range of recipes into the image.

This scheme works even if the LICENSE_FLAG string already has `_${PN}` appended. For example, the build system turns the license flag "commercial_1.2_foo" into "commercial_1.2_foo_foo" and would

match both the general "commercial" and the specific "commercial_1.2_foo" strings found in the whitelist, as expected.

Here are some other scenarios:

- You can specify a versioned string in the recipe such as "commercial_foo_1.2" in a "foo" recipe. The build system expands this string to "commercial_foo_1.2_foo". Combine this license flag with a whitelist that has the string "commercial" and you match the flag along with any other flag that starts with the string "commercial".
- Under the same circumstances, you can use "commercial_foo" in the whitelist and the build system not only matches "commercial_foo_1.2" but also matches any license flag with the string "commercial_foo", regardless of the version.
- You can be very specific and use both the package and version parts in the whitelist (e.g. "commercial_foo_1.2") to specifically match a versioned recipe.

4.6.2.2. Other Variables Related to Commercial Licenses

Other helpful variables related to commercial license handling exist and are defined in the \$HOME/poky/meta/conf/distro/include/default-distrovars.inc file:

```
COMMERCIAL_AUDIO_PLUGINS ?= ""
COMMERCIAL_VIDEO_PLUGINS ?= ""
COMMERCIAL_QT = ""
```

If you want to enable these components, you can do so by making sure you have statements similar to the following in your local.conf configuration file:

```
COMMERCIAL_AUDIO_PLUGINS = "gst-plugins-ugly-mad \
    gst-plugins-ugly-mpegaudioparse"
COMMERCIAL_VIDEO_PLUGINS = "gst-plugins-ugly-mpeg2dec \
    gst-plugins-ugly-mpegstream gst-plugins-bad-mpegvideoparse"
COMMERCIAL_QT ?= "qmmmp"
LICENSE_FLAGS_WHITELIST = "commercial_gst-plugins-ugly commercial_gst-plugins-bad commercial_qt"
```

Of course, you could also create a matching whitelist for those components using the more general "commercial" in the whitelist, but that would also enable all the other packages with LICENSE_FLAGS containing "commercial", which you may or may not want:

```
LICENSE_FLAGS_WHITELIST = "commercial"
```

Specifying audio and video plug-ins as part of the COMMERCIAL_AUDIO_PLUGINS and COMMERCIAL_VIDEO_PLUGINS statements or commercial Qt components as part of the COMMERCIAL_QT statement (along with the enabling LICENSE_FLAGS_WHITELIST) includes the plug-ins or components into built images, thus adding support for media formats or components.

Chapter 5. Migrating to a Newer Yocto Project Release

This chapter provides information you can use to migrate work to a newer Yocto Project release. You can find the same information in the release notes for a given release.

5.1. Moving to the Yocto Project 1.3 Release

This section provides migration information for moving to the Yocto Project 1.3 Release from the prior release.

5.1.1. Local Configuration

Differences include changes for `SSTATE_MIRRORS` and `bblayers.conf`.

5.1.1.1. SSTATE_MIRRORS

The shared state cache (`sstate-cache`), as pointed to by `SSTATE_DIR`, by default now has two-character subdirectories to prevent issues rising from too many files in the same directory. Also, native `sstate-cache` packages will go into a subdirectory named using the distro ID string. If you copy the newly structured `sstate-cache` to a mirror location (either local or remote) and then point to it in `SSTATE_MIRRORS`, you need to append "PATH" to the end of the mirror URL so that the path used by BitBake before the mirror substitution is appended to the path used to access the mirror. Here is an example:

```
SSTATE_MIRRORS = "file:///.* http://someserver.tld/share/sstate/PATH"
```

5.1.1.2. bblayers.conf

The meta-yocto layer consists of two parts that correspond to the Poky reference distribution and the reference hardware Board Support Packages (BSPs), respectively: `meta-yocto` and `meta-yocto-bsp`. When running BitBake or Hob for the first time after upgrading, your `conf/bblayers.conf` file will be updated to handle this change and you will be asked to re-run or restart for the changes to take effect.

5.1.2. Recipes

Differences include changes for the following:

- Python function whitespace
- `proto=` in `SRC_URI`
- `nativesdk`
- Task recipes
- `IMAGE_FEATURES`
- Removed recipes

5.1.2.1. Python Function Whitespace

All Python functions must now use four spaces for indentation. Previously, an inconsistent mix of spaces and tabs existed, which made extending these functions using `_append` or `_prepend` complicated given that Python treats whitespace as syntactically significant. If you are defining or extending any Python functions (e.g. `populate_packages`, `do_unpack`, `do_patch` and so forth) in custom recipes or classes, you need to ensure you are using consistent four-space indentation.

5.1.2.2. proto= in SRC_URI

Any use of `proto=` in `SRC_URI` needs to be changed to `protocol=`. In particular, this applies to the following URIs:

- `svn://`
- `bzr://`
- `hg://`
- `osc://`

Other URIs were already using `protocol=`. This change improves consistency.

5.1.2.3. nativesdk

The suffix `nativesdk` is now implemented as a prefix, which simplifies a lot of the packaging code for `nativesdk` recipes. All custom `nativesdk` recipes and any references need to be updated to use `nativesdk-*` instead of `*-nativesdk`.

5.1.2.4. Task Recipes

"Task" recipes are now known as "Package groups" and have been renamed from `task-*.bb` to `packagegroup-*.bb`. Existing references to the previous `task-*` names should work in most cases as there is an automatic upgrade path for most packages. However, you should update references in your own recipes and configurations as they could be removed in future releases. You should also rename any custom `task-*` recipes to `packagegroup-*`, and change them to inherit `packagegroup.bbclass` instead of `task`, as well as taking the opportunity to remove anything now handled by `packagegroup.bbclass`, such as providing `-dev` and `-dbg` packages, setting `LIC_FILES_CHKSUM`, and so forth. See the "Package Groups - `packagegroup.bbclass`" section for further details.

5.1.2.5. IMAGE_FEATURES

Image recipes that previously included "apps-console-core" in `IMAGE_FEATURES` should now include "splash" instead to enable the boot-up splash screen. Retaining "apps-console-core" will still include the splash screen but generates a warning. The "apps-x11-core" and "apps-x11-games" `IMAGE_FEATURES` features have been removed.

5.1.2.6. Removed Recipes

The following recipes have been removed. For most of them, it is unlikely that you would have any references to them in your own Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>]. However, you should check your metadata against this list to be sure:

- `libx11-trim`: Replaced by `libx11`, which has a negligible size difference with modern Xorg.
- `xserver-xorg-lite`: Use `xserver-xorg`, which has a negligible size difference when DRI and GLX modules are not installed.
- `xserver-kdrive`: Effectively unmaintained for many years.
- `mesa-xlib`: No longer serves any purpose.
- `galago`: Replaced by `telepathy`.
- `gail`: Functionality was integrated into GTK+ 2.13.
- `eggdbus`: No longer needed.
- `gcc-*-intermediate`: The build has been restructured to avoid the need for this step.
- `libgsmd`: Unmaintained for many years. Functionality now provided by `ofono` instead.
- `contacts`, `dates`, `tasks`, `eds-tools`: Largely unmaintained PIM application suite. It has been moved to `meta-gnome` in `meta-openembedded`.

In addition to the previously listed changes, the meta-demoapps directory has also been removed because the recipes in it were not being maintained and many had become obsolete or broken. Additionally, these recipes were not parsed in the default configuration. Many of these recipes are already provided in an updated and maintained form within the OpenEmbedded community layers such as meta-oe and meta-gnome. For the remainder, you can now find them in the meta-extras repository, which is in the Yocto Project Source Repositories [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-repositories>].

5.1.3. Linux Kernel Naming

The naming scheme for kernel output binaries has been changed to now include PE as part of the filename:

```
KERNEL_IMAGE_BASE_NAME ?= "${KERNEL_IMAGETYPE}-${PE}-${PV}-${PR}-${MACHINE}-${DATETIME}"
```

Because the PE variable is not set by default, these binary files could result with names that include two dash characters. Here is an example:

```
bzImage--3.10.9+git0+cd502a8814_7144bcc4b8-r0-qemux86-64-20130830085431.bin
```

5.2. Moving to the Yocto Project 1.4 Release

This section provides migration information for moving to the Yocto Project 1.4 Release from the prior release.

5.2.1. BitBake

Differences include the following:

- **Comment Continuation:** If a comment ends with a line continuation (\) character, then the next line must also be a comment. Any instance where this is not the case, now triggers a warning. You must either remove the continuation character, or be sure the next line is a comment.
- **Package Name Overrides:** The runtime package specific variables RDEPENDS, RRECOMMENDS, RSUGGESTS, RPROVIDES, RCONFLICTS, RREPLACES, FILES, ALLOW_EMPTY, and the pre, post, install, and uninstall script functions pkg_preinst, pkg_postinst, pkg_prerm, and pkg_postrm should always have a package name override. For example, use RDEPENDS_\${PN} for the main package instead of RDEPENDS. BitBake uses more strict checks when it parses recipes.

5.2.2. Build Behavior

Differences include the following:

- **Shared State Code:** The shared state code has been optimized to avoid running unnecessary tasks. For example, `bitbake -c rootfs some-image` from shared state no longer populates the target sysroot since that is not necessary. Instead, the system just needs to extract the output package contents, re-create the packages, and construct the root filesystem. This change is unlikely to cause any problems unless you have missing declared dependencies.
- **Scanning Directory Names:** When scanning for files in SRC_URI, the build system now uses FILESOVERRIDES instead of OVERRIDES for the directory names. In general, the values previously in OVERRIDES are now in FILESOVERRIDES as well. However, if you relied upon an additional value you previously added to OVERRIDES, you might now need to add it to FILESOVERRIDES unless you are already adding it through the MACHINEOVERRIDES or DISTROOVERRIDES variables, as appropriate. For more related changes, see the "Variables" section.

5.2.3. Proxies and Fetching Source

A new oe-git-proxy script has been added to replace previous methods of handling proxies and fetching source from Git. See the meta-yocto/conf/site.conf.sample file for information on how to use this script.

5.2.4. Custom Interfaces File (netbase change)

If you have created your own custom `etc/network/interfaces` file by creating an append file for the `netbase` recipe, you now need to create an append file for the `init-ifupdown` recipe instead, which you can find in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] at `meta/recipes-core/init-ifupdown`. For information on how to use append files, see the "Using `.bbappend` Files [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#using-bbappend-files>]" in the Yocto Project Development Manual.

5.2.5. Remote Debugging

Support for remote debugging with the Eclipse IDE is now separated into an image feature (`eclipse-debug`) that corresponds to the `packagegroup-core-eclipse-debug` package group. Previously, the debugging feature was included through the `tools-debug` image feature, which corresponds to the `packagegroup-core-tools-debug` package group.

5.2.6. Variables

The following variables have changed:

- `SANITY_TESTED_DISTROS`: This variable now uses a distribution ID, which is composed of the host distributor ID followed by the release. Previously, `SANITY_TESTED_DISTROS` was composed of the description field. For example, "Ubuntu 12.10" becomes "Ubuntu_12.10". You do not need to worry about this change if you are not specifically setting this variable, or if you are specifically setting it to "".
- `SRC_URI`: The `${PN}`, `${PF}`, `${P}`, and `FILE_DIRNAME` directories have been dropped from the default value of the `FILESPATH` variable, which is used as the search path for finding files referred to in `SRC_URI`. If you have a recipe that relied upon these directories, which would be unusual, then you will need to add the appropriate paths within the recipe or, alternatively, rearrange the files. The most common locations are still covered by `${BP}`, `${BPN}`, and "files", which all remain in the default value of `FILESPATH`.

5.2.7. Target Package Management with RPM

If runtime package management is enabled and the RPM backend is selected, Smart is now installed for package download, dependency resolution, and upgrades instead of Zypper. For more information on how to use Smart, run the following command on the target:

```
smart --help
```

5.2.8. Recipes Moved

The following recipes were moved from their previous locations because they are no longer used by anything in the OpenEmbedded-Core:

- `clutter-box2d`: Now resides in the meta-oe layer.
- `evolution-data-server`: Now resides in the meta-gnome layer.
- `gthumb`: Now resides in the meta-gnome layer.
- `gtkhtml2`: Now resides in the meta-oe layer.
- `gupnp`: Now resides in the meta-multimedia layer.
- `gypsy`: Now resides in the meta-oe layer.
- `libcanberra`: Now resides in the meta-gnome layer.
- `libgdata`: Now resides in the meta-gnome layer.
- `libmusicbrainz`: Now resides in the meta-multimedia layer.

- `metacity`: Now resides in the meta-gnome layer.
- `polkit`: Now resides in the meta-oe layer.
- `zeroconf`: Now resides in the meta-networking layer.

5.2.9. Removals and Renames

The following list shows what has been removed or renamed:

- `evieext`: Removed because it has been removed from `xserver` since 2008.
- `Gtk+ DirectFB`: Removed support because upstream `Gtk+` no longer supports it as of version 2.18.
- `libxfontcache` / `xfontcacheprot`: Removed because they were removed from the Xorg server in 2008.
- `libxp` / `libxprintapputil` / `libxprintutil` / `printproto`: Removed because the XPrint server was removed from Xorg in 2008.
- `libxtrap` / `xtrapproto`: Removed because their functionality was broken upstream.
- `linux-yocto 3.0` kernel: Removed with `linux-yocto 3.8` kernel being added. The `linux-yocto 3.2` and `linux-yocto 3.4` kernels remain as part of the release.
- `lsbsetup`: Removed with functionality now provided by `lsbtest`.
- `matchbox-stroke`: Removed because it was never more than a proof-of-concept.
- `matchbox-wm-2` / `matchbox-theme-sato-2`: Removed because they are not maintained. However, `matchbox-wm` and `matchbox-theme-sato` are still provided.
- `mesa-dri`: Renamed to `mesa`.
- `mesa-xlib`: Removed because it was no longer useful.
- `mutter`: Removed because nothing ever uses it and the recipe is very old.
- `orinoco-conf`: Removed because it has become obsolete.
- `update-modules`: Removed because it is no longer used. The kernel module `postinstall` and `postrm` scripts can now do the same task without the use of this script.
- `web`: Removed because it is not maintained. Superseded by `web-webkit`.
- `xf86bigfontproto`: Removed because upstream it has been disabled by default since 2007. Nothing uses `xf86bigfontproto`.
- `xf86rushproto`: Removed because its dependency in `xserver` was spurious and it was removed in 2005.
- `zypper` / `libzypp` / `sat-solver`: Removed and been functionally replaced with `Smart` (`python-smartpm`) when `RPM` packaging is used and package management is enabled on the target.

5.3. Moving to the Yocto Project 1.5 Release

This section provides migration information for moving to the Yocto Project 1.5 Release from the prior release.

5.3.1. Host Dependency Changes

The OpenEmbedded build system now has some additional requirements on the host system:

- Python 2.7.3+
- Tar 1.24+

- Git 1.7.5+
- Patched version of Make if you are using 3.82. Most distributions that provide Make 3.82 use the patched version.

If the Linux distribution you are using on your build host does not provide packages for these, you can install and use the Buildtools tarball, which provides an SDK-like environment containing them.

For more information on this requirement, see the "Required Git, tar, and Python Versions" section.

5.3.2. **atom-pc** Board Support Package (BSP)

The atom-pc hardware reference BSP has been replaced by a genericx86 BSP. This BSP is not necessarily guaranteed to work on all x86 hardware, but it will run on a wider range of systems than the atom-pc did.

Note

Additionally, a genericx86-64 BSP has been added for 64-bit systems.

5.3.3. BitBake

The following changes have been made that relate to BitBake:

- BitBake now supports a `_remove` operator. The addition of this operator means you will have to rename any items in recipe space (functions, variables) whose names currently contain `_remove_` or end with `_remove` to avoid unexpected behavior.
- BitBake's global method pool has been removed. This method is not particularly useful and led to clashes between recipes containing functions that had the same name.
- The "none" server backend has been removed. The "process" server backend has been serving well as the default for a long time now.
- The `bitbake-runtask` script has been removed.
- `${P}` and `${PF}` are no longer added to `PROVIDES` by default in `bitbake.conf`. These version-specific `PROVIDES` items were seldom used. Attempting to use them could result in two versions being built simultaneously rather than just one version due to the way BitBake resolves dependencies.

5.3.4. QA Warnings

The following changes have been made to the package QA checks:

- If you have customized `ERROR_QA` or `WARN_QA` values in your configuration, check that they contain all of the issues that you wish to be reported. Previous Yocto Project versions contained a bug that meant that any item not mentioned in `ERROR_QA` or `WARN_QA` would be treated as a warning. Consequently, several important items were not already in the default value of `WARN_QA`. All of the possible QA checks are now documented in the "insane.bbclass" section.
- An additional QA check has been added to check if `/usr/share/info/dir` is being installed. Your recipe should delete this file within `do_install` if "make install" is installing it.
- If you are using the `buildhistory` class, the check for the package version going backwards is now controlled using a standard QA check. Thus, if you have customized your `ERROR_QA` or `WARN_QA` values and still wish to have this check performed, you should add "version-going-backwards" to your value for one or the other variables depending on how you wish it to be handled. See the documented QA checks in the "insane.bbclass" section.

5.3.5. Directory Layout Changes

The following directory changes exist:

- Output SDK installer files are now named to include the image name and tuning architecture through the `SDK_NAME` variable.

- Images and related files are now installed into a directory that is specific to the machine, instead of a parent directory containing output files for multiple machines. The `DEPLOY_DIR_IMAGE` variable continues to point to the directory containing images for the current `MACHINE` and should be used anywhere there is a need to refer to this directory. The `runqemu` script now uses this variable to find images and kernel binaries and will use BitBake to determine the directory. Alternatively, you can set the `DEPLOY_DIR_IMAGE` variable in the external environment.
- When `buildhistory` is enabled, its output is now written under the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] rather than `TMPDIR`. Doing so makes it easier to delete `TMPDIR` and preserve the build history. Additionally, data for produced SDKs is now split by `IMAGE_NAME`.
- The `pkgdata` directory produced as part of the packaging process has been collapsed into a single machine-specific directory. This directory is located under `sysroots` and uses a machine-specific name (i.e. `tmp/sysroots/<machine>/pkgdata`).

5.3.6. Shortened GitSRCREV Values

BitBake will now shorten revisions from Git repositories from the normal 40 characters down to 10 characters within `SRCPV` for improved usability in path and file names. This change should be safe within contexts where these revisions are used because the chances of spatially close collisions is very low. Distant collisions are not a major issue in the way the values are used.

5.3.7. IMAGE_FEATURES

The following changes have been made that relate to `IMAGE_FEATURES`:

- The value of `IMAGE_FEATURES` is now validated to ensure invalid feature items are not added. Some users mistakenly add package names to this variable instead of using `IMAGE_INSTALL` in order to have the package added to the image, which does not work. This change is intended to catch those kinds of situations. Valid `IMAGE_FEATURES` are drawn from `PACKAGE_GROUP` definitions, `COMPLEMENTARY_GLOB` and a new "validitems" varflag on `IMAGE_FEATURES`. The "validitems" varflag change allows additional features to be added if they are not provided using the previous two mechanisms.
- The previously deprecated "apps-console-core" `IMAGE_FEATURES` item is no longer supported. Add "splash" to `IMAGE_FEATURES` if you wish to have the splash screen enabled, since this is all that apps-console-core was doing.

5.3.8. /run

The `/run` directory from the Filesystem Hierarchy Standard 3.0 has been introduced. You can find some of the implications for this change here [<http://cgkit.openembedded.org/openembedded-core/commit/?id=0e326280a15b0f2c4ef2ef4ec441f63f55b75873>]. The change also means that recipes that install files to `/var/run` must be changed. You can find a guide on how to make these changes here [<http://permalink.gmane.org/gmane.comp.handhelds.openembedded/58530>].

5.3.9. Removal of Package Manager Database Within Image Recipes

The image `core-image-minimal` no longer adds `remove_packaging_data_files` to `ROOTFS_POSTPROCESS_COMMAND`. This addition is now handled automatically when "package-management" is not in `IMAGE_FEATURES`. If you have custom image recipes that make this addition, you should remove the lines, as they are not needed and might interfere with correct operation of postinstall scripts.

5.3.10. Images Now Rebuild Only on Changes Instead of Every Time

The `do_rootfs` and other related image construction tasks are no longer marked as "nostamp". Consequently, they will only be re-executed when their inputs have changed. Previous versions of the OpenEmbedded build system always rebuilt the image when requested rather than when necessary.

5.3.11. Task Recipes

The previously deprecated task `.bbclass` has now been dropped. For recipes that previously inherited from this task, you should rename them from `task-*` to `packagegroup-*` and inherit `packagegroup` instead.

For more information, see the "Package Groups - `packagegroup.bbclass`" section.

5.3.12. BusyBox

By default, we now split BusyBox into two binaries: one that is `suid root` for those components that need it, and another for the rest of the components. Splitting BusyBox allows for optimization that eliminates the `tinylogin` recipe as recommended by upstream. You can disable this split by setting `BUSYBOX_SPLIT_SUID` to "0".

5.3.13. Automated Image Testing

A new automated image testing framework has been added through the `testimage*.bbclass` class. This framework replaces the older `imagetest-qemu` framework.

You can learn more about performing automated image tests in the "Performing Automated Runtime Testing [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#performing-automated-runtime-testing>]" section.

5.3.14. Build History

Following are changes to Build History:

- Installed package sizes: `installed-package-sizes.txt` for an image now records the size of the files installed by each package instead of the size of each compressed package archive file.
- The dependency graphs (`depends*.dot`) now use the actual package names instead of replacing dashes, dots and plus signs with underscores.
- The `buildhistory-diff` and `buildhistory-collect-srcrrevs` utilities have improved command-line handling. Use the `##help` option for each utility for more information on the new syntax.

For more information on Build History, see the "Maintaining Build Output Quality" section.

5.3.15. udev

Following are changes to udev:

- udev no longer brings in `udev-extraconf` automatically through `RRECOMMENDS`, since this was originally intended to be optional. If you need the extra rules, then add `udev-extraconf` to your image.
- udev no longer brings in `pciutils-ids` or `usbutils-ids` through `RRECOMMENDS`. These are not needed by udev itself and removing them saves around 350KB.

5.3.16. Removed and Renamed Recipes

- The `linux-yocto 3.2` kernel has been removed.
- `libtool-nativesdk` has been renamed to `nativesdk-libtool`.
- `tinylogin` has been removed. It has been replaced by a `suid` portion of Busybox. See the "BusyBox" section for more information.
- `external-python-tarball` has been renamed to `buildtools-tarball`.
- `web-webkit` has been removed. It has been functionally replaced by `midori`.
- `imake` has been removed. It is no longer needed by any other recipe.

- `transfig-native` has been removed. It is no longer needed by any other recipe.
- `anjuta-remote-run` has been removed. Anjuta IDE integration has not been officially supported for several releases.

5.3.17. Other Changes

Following is a list of short entries describing other changes:

- `run-postinsts`: Make this generic.
- `base-files`: Remove the unnecessary `/media/xxx` directories.
- `alsa-state`: Provide an empty `asound.conf` by default.
- `classes/image`: Ensure `BAD_RECOMMENDATIONS` supports pre-renamed package names.
- `classes/rootfs_rpm`: Implement `BAD_RECOMMENDATIONS` for RPM.
- `systemd`: Remove `systemd_unitdir` if `systemd` is not in `DISTRO_FEATURES`.
- `systemd`: Remove `init.d` dir if `systemd` unit file is present and `sysvinit` is not a distro feature.
- `libpam`: Deny all services for the `OTHER` entries.
- `image.bbclass`: Move `runtime_mapping_rename` to avoid conflict with `multilib`. See Y0CT0 #4993 [https://bugzilla.yoctoproject.org/show_bug.cgi?id=4993] in Bugzilla for more information.
- `linux-dtb`: Use kernel build system to generate the dtb files.
- `kern-tools`: Switch from `guilt` to new `kgit-s2q` tool.

Chapter 6. Source Directory Structure

The Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] consists of several components. Understanding them and knowing where they are located is key to using the Yocto Project well. This chapter describes the Source Directory and gives information about the various files and directories.

For information on how to establish a local Source Directory on your development system, see the "Getting Set Up [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#getting-setup>]" section in the Yocto Project Development Manual.

Note

The OpenEmbedded build system does not support file or directory names that contain spaces. Be sure that the Source Directory you use does not contain these types of names.

6.1. Top-Level Core Components

This section describes the top-level components of the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

6.1.1. **bitbake/**

This directory includes a copy of BitBake for ease of use. The copy usually matches the current stable BitBake release from the BitBake project. BitBake, a Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] interpreter, reads the Yocto Project metadata and runs the tasks defined by that data. Failures are usually from the metadata and not from BitBake itself. Consequently, most users do not need to worry about BitBake.

When you run the `bitbake` command, the wrapper script in `scripts/` is executed to run the main BitBake executable, which resides in the `bitbake/bin/` directory. Sourcing the `oe-init-build-env` script places the `scripts` and `bitbake/bin` directories (in that order) into the shell's `PATH` environment variable.

For more information on BitBake, see the BitBake documentation included in the `bitbake/doc/manual` directory of the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

6.1.2. **build/**

This directory contains user configuration files and the output generated by the OpenEmbedded build system in its standard configuration where the source tree is combined with the output. The Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] is created initially when you source the OpenEmbedded build environment setup script (i.e. `oe-init-build-env` or `oe-init-build-env-memres`).

It is also possible to place output and configuration files in a directory separate from the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] by providing a directory name when you source the setup script. For information on separating output from your local Source Directory files, see the "oe-init-build-env" and "oe-init-build-env-memres" sections.

6.1.3. **documentation**

This directory holds the source for the Yocto Project documentation as well as templates and tools that allow you to generate PDF and HTML versions of the manuals. Each manual is contained in a sub-folder. For example, the files for this manual reside in `ref-manual`.

6.1.4. meta/

This directory contains the OpenEmbedded Core metadata. The directory holds recipes, common classes, and machine configuration for emulated targets (qemux86, qemuarm, and so forth.)

6.1.5. meta-yocto/

This directory contains the configuration for the Poky reference distribution.

6.1.6. meta-yocto-bsp/

This directory contains the Yocto Project reference hardware Board Support Packages (BSPs). For more information on BSPs, see the Yocto Project Board Support Package (BSP) Developer's Guide [<http://www.yoctoproject.org/docs/1.5/bsp-guide/bsp-guide.html>].

6.1.7. meta-hob/

This directory contains template recipes used by Hob, which is a Yocto Project build user interface. For more information on the Hob, see the Hob Project [<http://www.yoctoproject.org/tools-resources/projects/hob>] web page.

6.1.8. meta-skeleton/

This directory contains template recipes for BSP and kernel development.

6.1.9. scripts/

This directory contains various integration scripts that implement extra functionality in the Yocto Project environment (e.g. QEMU scripts). The `oe-init-build-env` and `oe-init-build-env-memres` scripts append this directory to the shell's PATH environment variable.

The `scripts` directory has useful scripts that assist contributing back to the Yocto Project, such as `create_pull_request` and `send_pull_request`.

6.1.10. oe-init-build-env

This script is one of two scripts that set up the OpenEmbedded build environment. For information on the other script, see the "`oe-init-build-env-memres`" section.

Running this script with the `source` command in a shell makes changes to PATH and sets other core BitBake variables based on the current working directory. You need to run an environment setup script before running BitBake commands. The script uses other scripts within the `scripts` directory to do the bulk of the work.

By default, running this script without a Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] argument creates the build directory. If you provide a Build Directory argument when you `source` the script, you direct the OpenEmbedded build system to create a Build Directory of your choice. For example, the following command creates a Build Directory named `mybuilds` that is outside of the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]:

```
$ source oe-init-build-env ~/mybuilds
```

Note

The OpenEmbedded build system does not support file or directory names that contain spaces. If you attempt to run the `oe-init-build-env` script from a Source Directory that contains spaces in either the filenames or directory names, the script returns an error indicating no such file or directory. Be sure to use a Source Directory free of names containing spaces.

6.1.11. **oe-init-build-env-memres**

This script is one of two scripts that set up the OpenEmbedded build environment. Setting up the environment with this script uses a memory-resident BitBake. For information on the other setup script, see the "oe-init-build-env" section.

Memory-resident BitBake resides in memory until you specifically remove it using the following BitBake command:

```
$ bitbake -m
```

Running this script with the source command in a shell makes changes to PATH and sets other core BitBake variables based on the current working directory. One of these variables is the BBSERVER variable, which allows the OpenEmbedded build system to locate the server that is running BitBake.

You need to run an environment setup script before running BitBake commands. Following is the script syntax:

```
$ source oe-init-build-env-memres <port_number> <build_dir>
```

The script uses other scripts within the scripts directory to do the bulk of the work.

If you do not provide a port number with the script, the default port "12345" is used.

By default, running this script without a Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] argument creates the build directory. If you provide a Build Directory argument when you source the script, you direct the OpenEmbedded build system to create a Build Directory of your choice. For example, the following command uses the default port number "12345" and creates a Build Directory named mybuilds that is outside of the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]:

```
$ source oe-init-build-env-memres ~/mybuilds
```

Note

The OpenEmbedded build system does not support file or directory names that contain spaces. If you attempt to run the oe-init-build-env-memres script from a Source Directory that contains spaces in either the filenames or directory names, the script returns an error indicating no such file or directory. Be sure to use a Source Directory free of names containing spaces.

6.1.12. **LICENSE, README, and README.hardware**

These files are standard top-level files.

6.2. The Build Directory -**build/**

The OpenEmbedded build system creates the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] during the build. By default, this directory is named build.

6.2.1. **build/pseudodone**

This tag file indicates that the initial pseudo binary was created. The file is built the first time BitBake is invoked.

6.2.2. **build/conf/local.conf**

This configuration file contains all the local user configurations for your build environment. The local.conf file contains documentation on the various configuration options. Any variable set here

overrides any variable set elsewhere within the environment unless that variable is hard-coded within a file (e.g. by using '=' instead of '?='). Some variables are hard-coded for various reasons but these variables are relatively rare.

Edit this file to set the MACHINE for which you want to build, which package types you wish to use (PACKAGE_CLASSES), the location from which you want to download files (DL_DIR), and how you want your host machine to use resources (BB_NUMBER_THREADS and PARALLEL_MAKE).

If local.conf is not present when you start the build, the OpenEmbedded build system creates it from local.conf.sample when you source the top-level build environment setup script (i.e. oe-init-build-env or oe-init-build-env-memres).

The source local.conf.sample file used depends on the \$TEMPLATECONF script variable, which defaults to /meta-yocto/conf when you are building from the Yocto Project development environment and defaults to /meta/conf when you are building from the OpenEmbedded Core environment. Because the script variable points to the source of the local.conf.sample file, this implies that you can configure your build environment from any layer by setting the variable in the top-level build environment setup script as follows:

```
TEMPLATECONF=<your_layer>/conf
```

Once the build process gets the sample file, it uses sed to substitute final \${OEROOT} values for all ##OEROOT## values.

Note

You can see how the TEMPLATECONF variable is used by looking at the /scripts/oe-setup-builddir script in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. You can find the Yocto Project version of the local.conf.sample file in the /meta-yocto/conf directory.

6.2.3. build/conf/bblayers.conf

This configuration file defines layers [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#understanding-and-creating-layers>], which are directory trees, traversed (or walked) by BitBake. The bblayers.conf file uses the BBLAYERS variable to list the layers BitBake tries to find, and uses the BBLAYERS_NON_REMOVABLE variable to list layers that must not be removed.

If bblayers.conf is not present when you start the build, the OpenEmbedded build system creates it from bblayers.conf.sample when you source the top-level build environment setup script (i.e. oe-init-build-env or oe-init-build-env-memres).

The source bblayers.conf.sample file used depends on the \$TEMPLATECONF script variable, which defaults to /meta-yocto/conf when you are building from the Yocto Project development environment and defaults to /meta/conf when you are building from the OpenEmbedded Core environment. Because the script variable points to the source of the bblayers.conf.sample file, this implies that you can base your build from any layer by setting the variable in the top-level build environment setup script as follows:

```
TEMPLATECONF=<your_layer>/conf
```

Once the build process gets the sample file, it uses sed to substitute final \${OEROOT} values for all ##OEROOT## values.

Note

You can see how the TEMPLATECONF variable /scripts/oe-setup-builddir script in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. You can find the Yocto Project version of the bblayers.conf.sample file in the /meta-yocto/conf directory.

6.2.4. build/conf/sanity_info

This file indicates the state of the sanity checks and is created during the build.

6.2.5. **build/downloads/**

This directory contains downloaded upstream source tarballs. You can reuse the directory for multiple builds or move the directory to another location. You can control the location of this directory through the `DL_DIR` variable.

6.2.6. **build/sstate-cache/**

This directory contains the shared state cache. You can reuse the directory for multiple builds or move the directory to another location. You can control the location of this directory through the `SSTATE_DIR` variable.

6.2.7. **build/tmp/**

This directory receives all the OpenEmbedded build system's output. BitBake creates this directory if it does not exist. As a last resort, to clean up a build and start it from scratch (other than the downloads), you can remove everything in the tmp directory or get rid of the directory completely. If you do, you should also completely remove the build/sstate-cache directory.

6.2.8. **build/tmp/buildstats/**

This directory stores the build statistics.

6.2.9. **build/tmp/cache/**

When BitBake parses the metadata, it creates a cache file of the result that can be used when subsequently running commands. BitBake stores these results here on a per-machine basis.

6.2.10. **build/tmp/deploy/**

This directory contains any "end result" output from the OpenEmbedded build process. The `DEPLOY_DIR` variable points to this directory. For more detail on the contents of the deploy directory, see the "Images" and "Application Development SDK" sections.

6.2.11. **build/tmp/deploy/deb/**

This directory receives any .deb packages produced by the build process. The packages are sorted into feeds for different architecture types.

6.2.12. **build/tmp/deploy/rpm/**

This directory receives any .rpm packages produced by the build process. The packages are sorted into feeds for different architecture types.

6.2.13. **build/tmp/deploy/licenses/**

This directory receives package licensing information. For example, the directory contains sub-directories for bash, busybox, and eglibc (among others) that in turn contain appropriate COPYING license files with other licensing information. For information on licensing, see the "Maintaining Open Source License Compliance During Your Product's Lifecycle" [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#maintaining-open-source-license-compliance-during-your-products-lifecycle>] section.

6.2.14. **build/tmp/deploy/images/**

This directory receives complete filesystem images. If you want to flash the resulting image from a build onto a device, look here for the image.

Be careful when deleting files in this directory. You can safely delete old images from this directory (e.g. core-image-*, hob-image-*, etc.). However, the kernel (*zImage*, *uImage*, etc.), bootloader

and other supplementary files might be deployed here prior to building an image. Because these files are not directly produced from the image, if you delete them they will not be automatically re-created when you build the image again.

If you do accidentally delete files here, you will need to force them to be re-created. In order to do that, you will need to know the target that produced them. For example, these commands rebuild and re-create the kernel files:

```
$ bitbake -c clean virtual/kernel
$ bitbake virtual/kernel
```

6.2.15. **build/tmp/deploy/ipk/**

This directory receives .ipk packages produced by the build process.

6.2.16. **build/tmp/sysroots/**

This directory contains shared header files and libraries as well as other shared data. Packages that need to share output with other packages do so within this directory. The directory is subdivided by architecture so multiple builds can run within the one Build Directory.

6.2.17. **build/tmp/stamps/**

This directory holds information that BitBake uses for accounting purposes to track what tasks have run and when they have run. The directory is sub-divided by architecture, package name, and version. Following is an example:

```
stamps/all-poky-linux/distcc-config/1.0-r0.do_build-2fdd...2do
```

Although the files in the directory are empty of data, BitBake uses the filenames and timestamps for tracking purposes.

6.2.18. **build/tmp/log/**

This directory contains general logs that are not otherwise placed using the package's WORKDIR. Examples of logs are the output from the check_pkg or distro_check tasks. Running a build does not necessarily mean this directory is created.

6.2.19. **build/tmp/pkgdata/**

This directory contains intermediate packaging data that is used later in the packaging process. For more information, see the "Packaging - package*.bbclass" section.

6.2.20. **build/tmp/work/**

This directory contains architecture-specific work sub-directories for packages built by BitBake. All tasks execute from the appropriate work directory. For example, the source for a particular package is unpacked, patched, configured and compiled all within its own work directory. Within the work directory, organization is based on the package group and version for which the source is being compiled as defined by the WORKDIR.

It is worth considering the structure of a typical work directory. As an example, consider linux-yocto-kernel-3.0 on the machine qemux86 built within the Yocto Project. For this package, a work directory of tmp/work/qemux86-poky-linux/linux-yocto/3.0+git1+<...>, referred to as the WORKDIR, is created. Within this directory, the source is unpacked to linux-qemux86-standard-build and then patched by Quilt. (See the "Using a Quilt Flow [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#using-a-quilt-workflow>]" section in the Yocto Project Development Manual for more information.) Within the linux-qemux86-standard-build directory, standard Quilt directories linux-3.0/patches and linux-3.0/.pc are created, and standard Quilt commands can be used.

There are other directories generated within WORKDIR. The most important directory is WORKDIR/temp/, which has log files for each task (log.do_*.pid) and contains the scripts BitBake runs for each task (run.do_*.pid). The WORKDIR/image/ directory is where "make install" places its output that is then split into sub-packages within WORKDIR/packages-split/.

6.3. The Metadata -meta/

As mentioned previously, Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] is the core of the Yocto Project. Metadata has several important subdivisions:

6.3.1. meta/classes/

This directory contains the *.bbclass files. Class files are used to abstract common code so it can be reused by multiple packages. Every package inherits the base.bbclass file. Examples of other important classes are autotools.bbclass, which in theory allows any Autotool-enabled package to work with the Yocto Project with minimal effort. Another example is kernel.bbclass that contains common code and functions for working with the Linux kernel. Functions like image generation or packaging also have their specific class files such as image.bbclass, rootfs_*.bbclass and package*.bbclass.

For reference information on classes, see the "Classes" chapter.

6.3.2. meta/conf/

This directory contains the core set of configuration files that start from bitbake.conf and from which all other configuration files are included. See the include statements at the end of the bitbake.conf file and you will note that even local.conf is loaded from there. While bitbake.conf sets up the defaults, you can often override these by using the (local.conf) file, machine file or the distribution configuration file.

6.3.3. meta/conf/machine/

This directory contains all the machine configuration files. If you set MACHINE = "qemux86", the OpenEmbedded build system looks for a qemux86.conf file in this directory. The include directory contains various data common to multiple machines. If you want to add support for a new machine to the Yocto Project, look in this directory.

6.3.4. meta/conf/distro/

The contents of this directory controls any distribution-specific configurations. For the Yocto Project, the defaultsetup.conf is the main file here. This directory includes the versions and the SRCDATE definitions for applications that are configured here. An example of an alternative configuration might be poky-bleeding.conf. Although this file mainly inherits its configuration from Poky.

6.3.5. meta/files/

This directory contains common license files and several text files used by the build system. The text files contain minimal device information and lists of files and directories with known permissions.

6.3.6. meta/lib/

This directory contains OpenEmbedded Python library code used during the build process.

6.3.7. meta/recipes-bsp/

This directory contains anything linking to specific hardware or hardware configuration information such as "u-boot" and "grub".

6.3.8. meta/recipes-connectivity/

This directory contains libraries and applications related to communication with other devices.

6.3.9. **meta/recipes-core/**

This directory contains what is needed to build a basic working Linux image including commonly used dependencies.

6.3.10. **meta/recipes-devtools/**

This directory contains tools that are primarily used by the build system. The tools, however, can also be used on targets.

6.3.11. **meta/recipes-extended/**

This directory contains non-essential applications that add features compared to the alternatives in core. You might need this directory for full tool functionality or for Linux Standard Base (LSB) compliance.

6.3.12. **meta/recipes-gnome/**

This directory contains all things related to the GTK+ application framework.

6.3.13. **meta/recipes-graphics/**

This directory contains X and other graphically related system libraries

6.3.14. **meta/recipes-kernel/**

This directory contains the kernel and generic applications and libraries that have strong kernel dependencies.

6.3.15. **meta/recipes-lsb4/**

This directory contains recipes specifically added to support the Linux Standard Base (LSB) version 4.x.

6.3.16. **meta/recipes-multimedia/**

This directory contains codecs and support utilities for audio, images and video.

6.3.17. **meta/recipes-qt/**

This directory contains all things related to the Qt application framework.

6.3.18. **meta/recipes-rt/**

This directory contains package and image recipes for using and testing the PREEMPT_RT kernel.

6.3.19. **meta/recipes-sato/**

This directory contains the Sato demo/reference UI/UX and its associated applications and configuration data.

6.3.20. **meta/recipes-support/**

This directory contains recipes used by other recipes, but that are not directly included in images (i.e. dependencies of other recipes).

6.3.21. **meta/site/**

This directory contains a list of cached results for various architectures. Because certain "autoconf" test results cannot be determined when cross-compiling due to the tests not able to run on a live system, the information in this directory is passed to "autoconf" for the various architectures.

6.3.22. **meta/recipes.txt**

This file is a description of the contents of recipes-.*.

Chapter 7. BitBake

BitBake is a program written in Python that interprets the Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] used by the OpenEmbedded build system. At some point, developers wonder what actually happens when you enter:

```
$ bitbake core-image-sato
```

This chapter provides an overview of what happens behind the scenes from BitBake's perspective.

Note

BitBake strives to be a generic "task" executor that is capable of handling complex dependency relationships. As such, it has no real knowledge of what the tasks being executed actually do. BitBake just considers a list of tasks with dependencies and handles Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] consisting of variables in a certain format that get passed to the tasks.

7.1. Parsing

BitBake parses configuration files, classes, and .bb files.

The first thing BitBake does is look for the `bitbake.conf` file. This file resides in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] within the `meta/conf/` directory. BitBake finds it by examining its `BBPATH` environment variable and looking for the `meta/conf/` directory.

The `bitbake.conf` file lists other configuration files to include from a `conf/` directory below the directories listed in `BBPATH`. In general, the most important configuration file from a user's perspective is `local.conf`, which contains a user's customized settings for the OpenEmbedded build environment. Other notable configuration files are the distribution configuration file (set by the `DISTRO` variable) and the machine configuration file (set by the `MACHINE` variable). The `DISTRO` and `MACHINE` BitBake environment variables are both usually set in the `local.conf` file. Valid distribution configuration files are available in the `meta/conf/distro/` directory and valid machine configuration files in the `meta/conf/machine/` directory. Within the `meta/conf/machine/include/` directory are various `tune-*.inc` configuration files that provide common "tuning" settings specific to and shared between particular architectures and machines.

After the parsing of the configuration files, some standard classes are included. The `base.bbclass` file is always included. Other classes that are specified in the configuration using the `INHERIT` variable are also included. Class files are searched for in a `classes` subdirectory under the paths in `BBPATH` in the same way as configuration files.

After classes are included, the variable `BBFILES` is set, usually in `local.conf`, and defines the list of places to search for .bb files. By default, the `BBFILES` variable specifies the `meta/recipes-*/` directory within Poky. Adding extra content to `BBFILES` is best achieved through the use of BitBake layers as described in the "Understanding and Creating Layers" [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#understanding-and-creating-layers>] section of the Yocto Project Development Manual.

BitBake parses each .bb file in `BBFILES` and stores the values of various variables. In summary, for each .bb file the configuration plus the base class of variables are set, followed by the data in the .bb file itself, followed by any `inherit` commands that .bb file might contain.

Because parsing .bb files is a time consuming process, a cache is kept to speed up subsequent parsing. This cache is invalid if the timestamp of the .bb file itself changes, or if the timestamps of any of the include, configuration files or class files on which the .bb file depends change.

7.2. Preferences and Providers

Once all the .bb files have been parsed, BitBake starts to build the target (`core-image-sato` in the previous section's example) and looks for providers of that target. Once a provider is selected,

BitBake resolves all the dependencies for the target. In the case of `core-image-sato`, it would lead to `packagegroup-core-x11-sato`, which in turn leads to recipes like `matchbox-terminal`, `pcmanfm` and `gthumb`. These recipes in turn depend on `eglibc` and the toolchain.

Sometimes a target might have multiple providers. A common example is "virtual/kernel", which is provided by each kernel package. Each machine often selects the best kernel provider by using a line similar to the following in the machine configuration file:

```
PREFERRED_PROVIDER_virtual/kernel = "linux-yocto"
```

The default `PREFERRED_PROVIDER` is the provider with the same name as the target.

Understanding how providers are chosen is made complicated by the fact that multiple versions might exist. BitBake defaults to the highest version of a provider. Version comparisons are made using the same method as Debian. You can use the `PREFERRED_VERSION` variable to specify a particular version (usually in the distro configuration). You can influence the order by using the `DEFAULT_PREFERENCE` variable. By default, files have a preference of "0". Setting the `DEFAULT_PREFERENCE` to "-1" makes the package unlikely to be used unless it is explicitly referenced. Setting the `DEFAULT_PREFERENCE` to "1" makes it likely the package is used. `PREFERRED_VERSION` overrides any `DEFAULT_PREFERENCE` setting. `DEFAULT_PREFERENCE` is often used to mark newer and more experimental package versions until they have undergone sufficient testing to be considered stable.

In summary, BitBake has created a list of providers, which is prioritized, for each target.

7.3. Dependencies

Each target BitBake builds consists of multiple tasks such as `fetch`, `unpack`, `patch`, `configure`, and `compile`. For best performance on multi-core systems, BitBake considers each task as an independent entity with its own set of dependencies.

Dependencies are defined through several variables. You can find information about variables BitBake uses in the BitBake documentation, which is found in the `bitbake/doc/manual` directory within the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. At a basic level, it is sufficient to know that BitBake uses the `DEPENDS` and `RDEPENDS` variables when calculating dependencies.

7.4. The Task List

Based on the generated list of providers and the dependency information, BitBake can now calculate exactly what tasks it needs to run and in what order it needs to run them. The build now starts with BitBake forking off threads up to the limit set in the `BB_NUMBER_THREADS` variable. BitBake continues to fork threads as long as there are tasks ready to run, those tasks have all their dependencies met, and the thread threshold has not been exceeded.

It is worth noting that you can greatly speed up the build time by properly setting the `BB_NUMBER_THREADS` variable. See the "Building an Image [<http://www.yoctoproject.org/docs/1.5/yocto-project-qs/yocto-project-qs.html#building-image>]" section in the Yocto Project Quick Start for more information.

As each task completes, a timestamp is written to the directory specified by the `STAMP` variable. On subsequent runs, BitBake looks within the `/build/tmp/stamps` directory and does not rerun tasks that are already completed unless a timestamp is found to be invalid. Currently, invalid timestamps are only considered on a per `.bb` file basis. So, for example, if the `configure` stamp has a timestamp greater than the `compile` timestamp for a given target, then the `compile` task would rerun. Running the `compile` task again, however, has no effect on other providers that depend on that target. This behavior could change or become configurable in future versions of BitBake.

Note

Some tasks are marked as "nostamp" tasks. No timestamp file is created when these tasks are run. Consequently, "nostamp" tasks are always rerun.

7.5. Running a Task

Tasks can either be a shell task or a Python task. For shell tasks, BitBake writes a shell script to `${WORKDIR}/temp/run.do_taskname.pid` and then executes the script. The generated shell script contains all the exported variables, and the shell functions with all variables expanded. Output from the shell script goes to the file `${WORKDIR}/temp/log.do_taskname.pid`. Looking at the expanded shell functions in the run file and the output in the log files is a useful debugging technique.

For Python tasks, BitBake executes the task internally and logs information to the controlling terminal. Future versions of BitBake will write the functions to files similar to the way shell tasks are handled. Logging will be handled in a way similar to shell tasks as well.

Once all the tasks have been completed BitBake exits.

When running a task, BitBake tightly controls the execution environment of the build tasks to make sure unwanted contamination from the build machine cannot influence the build. Consequently, if you do want something to get passed into the build task's environment, you must take a few steps:

1. Tell BitBake to load what you want from the environment into the data store. You can do so through the `BB_ENV_EXTRAWHITE` variable. For example, assume you want to prevent the build system from accessing your `$HOME/.ccache` directory. The following command tells BitBake to load `CCACHE_DIR` from the environment into the data store:

```
export BB_ENV_EXTRAWHITE="$BB_ENV_EXTRAWHITE CCACHE_DIR"
```

2. Tell BitBake to export what you have loaded into the environment store to the task environment of every running task. Loading something from the environment into the data store (previous step) only makes it available in the datastore. To export it to the task environment of every running task, use a command similar to the following in your `local.conf` or distro configuration file:

```
export CCACHE_DIR
```

Note

A side effect of the previous steps is that BitBake records the variable as a dependency of the build process in things like the shared state checksums. If doing so results in unnecessary rebuilds of tasks, you can whitelist the variable so that the shared state code ignores the dependency when it creates checksums. For information on this process, see the `BB_HASHBASE_WHITELIST` example in the "Checksums (Signatures)" section.

7.6. BitBake Command Line

Following is the BitBake help output:

```
$ bitbake --help
```

```
Usage: bitbake [options] [recipeName/target ...]
```

```
Executes the specified task (default is 'build') for a given set of target recipes (.bb files)
It is assumed there is a conf/bblayers.conf available in cwd or in BBPATH which
will provide the layer, BBFILES and other configuration information.
```

Options:

```
--version          show program's version number and exit
-h, --help         show this help message and exit
-b BUILDFILE, --buildfile=BUILDFILE
                    Execute tasks from a specific .bb recipe directly.
                    WARNING: Does not handle any dependencies from other
                    recipes.
-k, --continue     Continue as much as possible after an error. While the
                    target that failed and anything depending on it cannot
```

be built, as much as possible will be built before stopping.

`-a, --tryaltconfigs` Continue with builds by trying to use alternative providers where possible.

`-f, --force` Force the specified targets/task to run (invalidating any existing stamp file).

`-c CMD, --cmd=CMD` Specify the task to execute. The exact options available depend on the metadata. Some examples might be 'compile' or 'populate_sysroot' or 'listtasks' may give a list of the tasks available.

`-C INVALIDATE_STAMP, --clear-stamp=INVALIDATE_STAMP` Invalidate the stamp for the specified task such as 'compile' and then run the default task for the specified target(s).

`-r PREFILE, --read=PREFILE` Read the specified file before bitbake.conf.

`-R POSTFILE, --postread=POSTFILE` Read the specified file after bitbake.conf.

`-v, --verbose` Output more log message data to the terminal.

`-D, --debug` Increase the debug level. You can specify this more than once.

`-n, --dry-run` Don't execute, just go through the motions.

`-S, --dump-signatures` Don't execute, just dump out the signature construction information.

`-p, --parse-only` Quit after parsing the BB recipes.

`-s, --show-versions` Show current and preferred versions of all recipes.

`-e, --environment` Show the global or per-package environment complete with information about where variables were set/changed.

`-g, --graphviz` Save dependency tree information for the specified targets in the dot syntax.

`-I EXTRA_ASSUME_PROVIDED, --ignore-deps=EXTRA_ASSUME_PROVIDED` Assume these dependencies don't exist and are already provided (equivalent to ASSUME_PROVIDED). Useful to make dependency graphs more appealing

`-l DEBUG_DOMAINS, --log-domains=DEBUG_DOMAINS` Show debug logging for the specified logging domains

`-P, --profile` Profile the command and save reports.

`-u UI, --ui=UI` The user interface to use (e.g. knotty, hob, depexp).

`-t SERVERTYPE, --servertype=SERVERTYPE` Choose which server to use, process or xmlrpc.

`--revisions-changed` Set the exit code depending on whether upstream floating revisions have changed or not.

`--server-only` Run bitbake without a UI, only starting a server (cooker) process.

`-B BIND, --bind=BIND` The name/address for the bitbake server to bind to.

`--no-setsцене` Do not run any setsцене tasks. sstate will be ignored and everything needed, built.

`--remote-server=REMOTE_SERVER` Connect to the specified server.

`-m, --kill-server` Terminate the remote server.

`--observe-only` Connect to a server as an observing-only client.

7.7. Fetchers

BitBake also contains a set of "fetcher" modules that allow retrieval of source code from various types of sources. For example, BitBake can get source code from a disk with the metadata, from websites, from remote shell accounts, or from Source Code Management (SCM) systems like cvs/subversion/git.

Fetchers are usually triggered by entries in SRC_URI. You can find information about the options and formats of entries for specific fetchers in the BitBake manual located in the bitbake/doc/

manual directory of the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

One useful feature for certain Source Code Manager (SCM) fetchers is the ability to "auto-update" when the upstream SCM changes version. Since this ability requires certain functionality from the SCM, not all systems support it. Currently Subversion, Bazaar and to a limited extent, Git support the ability to "auto-update". This feature works using the SRCREV variable. See the "Using an External SCM [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#platdev-appdev-srcrev>]" section in the Yocto Project Development Manual for more information.

Chapter 8. Classes

Class files are used to abstract common functionality and share it amongst multiple .bb files. Any Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] usually found in a .bb file can also be placed in a class file. Class files are identified by the extension .bbclass and are usually placed in a classes/ directory beneath the meta*/ directory found in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. Class files can also be pointed to by BUILDDIR (e.g. build/) in the same way as .conf files in the conf directory. Class files are searched for in BBPATH using the same method by which .conf files are searched.

In most cases inheriting the class is enough to enable its features, although for some classes you might need to set variables or override some of the default behavior.

This chapter discusses only the most useful and important classes. Other classes do exist within the meta/classes directory in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. You can reference the .bbclass files directly for more information.

8.1. The base Class -**base.bbclass**

The base class is special in that every .bb file inherits it automatically. This class contains definitions for standard basic tasks such as fetching, unpacking, configuring (empty by default), compiling (runs any Makefile present), installing (empty by default) and packaging (empty by default). These classes are often overridden or extended by other classes such as autotools.bbclass or package.bbclass. The class also contains some commonly used functions such as oe_runmake.

8.2. Autotooled Packages -**autotools.bbclass**

Autotools (autoconf, automake, and libtool) bring standardization. This class defines a set of tasks (configure, compile etc.) that work for all Autotooled packages. It should usually be enough to define a few standard variables and then simply inherit autotools. This class can also work with software that emulates Autotools. For more information, see the "Autotooled Package [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#usingpoky-extend-addpkg-autotools>]" section in the Yocto Project Development Manual.

It's useful to have some idea of how the tasks defined by this class work and what they do behind the scenes.

- `do_configure` # Regenerates the configure script (using autoreconf) and then launches it with a standard set of arguments used during cross-compilation. You can pass additional parameters to configure through the EXTRA_OECONF variable.
- `do_compile` # Runs make with arguments that specify the compiler and linker. You can pass additional arguments through the EXTRA_OEMAKE variable.
- `do_install` # Runs make install and passes in \${D} as DESTDIR.

8.3. Alternatives -**update-alternatives.bbclass**

This class helps the alternatives system when multiple sources provide the same command. This situation occurs when several programs that have the same or similar function are installed with the same name. For example, the `ar` command is available from the `busybox`, `binutils` and `elfutils` packages. The `update-alternatives.bbclass` class handles renaming the binaries so that multiple packages can be installed without conflicts. The `ar` command still works regardless of which packages are installed or subsequently removed. The class renames the conflicting binary in each package and symlinks the highest priority binary during installation or removal of packages.

To use this class, you need to define a number of variables:

- `ALTERNATIVE`
- `ALTERNATIVE_LINK_NAME`
- `ALTERNATIVE_TARGET`
- `ALTERNATIVE_PRIORITY`

These variables list alternative commands needed by a package, provide pathnames for links, default links for targets, and so forth. For details on how to use this class, see the comments in the `update-alternatives.bbclass` [<http://git.yoctoproject.org/cgit/cgit.cgi/poky/tree/meta/classes/update-alternatives.bbclass>].

Note

You can use the `update-alternatives` command directly in your recipes. However, this class simplifies things in most cases.

8.4. `Initscripts -update-rc.d.bbclass`

This class uses `update-rc.d` to safely install an initialization script on behalf of the package. The OpenEmbedded build system takes care of details such as making sure the script is stopped before a package is removed and started when the package is installed. Three variables control this class: `INITSCRIPT_PACKAGES`, `INITSCRIPT_NAME` and `INITSCRIPT_PARAMS`. See the variable links for details.

8.5. `binconfig.bbclass`

This class helps to correct paths in shell scripts.

Before `pkg-config` had become widespread, libraries shipped shell scripts to give information about the libraries and include paths needed to build software (usually named `LIBNAME-config`). This class assists any recipe using such scripts.

During staging, the OpenEmbedded build system installs such scripts into the `sysroots/` directory. Inheriting this class results in all paths in these scripts being changed to point into the `sysroots/` directory so that all builds that use the script use the correct directories for the cross compiling layout. See the `BINCONFIG_GLOB` variable for more information.

8.6. Debian Renaming `-debian.bbclass`

This class renames packages so that they follow the Debian naming policy (i.e. `eglibc` becomes `libc6` and `eglibc-devel` becomes `libc6-dev`.)

8.7. `Pkg-config -pkgconfig.bbclass`

`pkg-config` provides a standard way to get header and library information. This class aims to smooth integration of `pkg-config` into libraries that use it.

During staging, BitBake installs `pkg-config` data into the `sysroots/` directory. By making use of `sysroot` functionality within `pkg-config`, this class no longer has to manipulate the files.

8.8. Archiving Sources `-archive*.bbclass`

Many software licenses require that source code and other materials be released with the binaries. To help with that task, the following classes are provided:

- `archive-original-sources.bbclass`
- `archive-patched-sources.bbclass`
- `archive-configured-sources.bbclass`
- `archiver.bbclass`

For more details on the source archiver, see the "Maintaining Open Source License Compliance During Your Product's Lifecycle [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#maintaining-open-source-license-compliance-during-your-products-lifecycle>]" section in the Yocto Project Development Manual.

8.9. Perl Modules -**cpan.bbclass**

Recipes for Perl modules are simple. These recipes usually only need to point to the source's archive and then inherit the proper `.bbclass` file. Building is split into two methods depending on which method the module authors used.

- Modules that use old `Makefile.PL`-based build system require `cpan.bbclass` in their recipes.
- Modules that use `Build.PL`-based build system require using `cpan_build.bbclass` in their recipes.

8.10. Python Extensions -**distutils.bbclass**

Recipes for Python extensions are simple. These recipes usually only need to point to the source's archive and then inherit the proper `.bbclass` file. Building is split into two methods depending on which method the module authors used.

- Extensions that use an Autotools-based build system require Autotools and `distutils-based.bbclass` files in their recipes.
- Extensions that use `distutils`-based build systems require `distutils.bbclass` in their recipes.

8.11. Developer Shell -**devshell.bbclass**

This class adds the `devshell` task. Distribution policy dictates whether to include this class. See the "Using a Development Shell [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#platdev-appdev-devshell>]" section in the Yocto Project Development Manual for more information about using `devshell`.

8.12. Package Groups -**packagegroup.bbclass**

This class sets default values appropriate for package group recipes (e.g. `PACKAGES`, `PACKAGE_ARCH`, `ALLOW_EMPTY`, and so forth). It is highly recommended that all package group recipes inherit this class.

For information on how to use this class, see the "Customizing Images Using Custom Package Groups [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#usingpoky-extend-customimage-customtasks>]" section in the Yocto Project Development Manual.

Previously, this class was named `task.bbclass`.

8.13. Packaging -**package*.bbclass**

The packaging classes add support for generating packages from a build's output. The core generic functionality is in `package.bbclass`. The code specific to particular package types is contained in various sub-classes such as `package_deb.bbclass`, `package_ipk.bbclass`, and `package_rpm.bbclass`. Most users will want one or more of these classes.

You can control the list of resulting package formats by using the `PACKAGE_CLASSES` variable defined in the `local.conf` configuration file, which is located in the `conf` folder of the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. When defining the variable, you can specify one or more package types. Since images are generated from packages, a packaging class is needed to enable image generation. The first class listed in this variable is used for image generation.

If you take the optional step to set up a repository (package feed) on the development host that can be used by Smart, you can install packages from the feed while you are running the image on the target (i.e. runtime installation of packages). For more information, see the "Using Runtime

Package Management [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#using-runtime-package-management>]" section in the Yocto Project Development Manual.

The package class you choose can affect build-time performance and has space ramifications. In general, building a package with IPK takes about thirty percent less time as compared to using RPM to build the same or similar package. This comparison takes into account a complete build of the package with all dependencies previously built. The reason for this discrepancy is because the RPM package manager creates and processes more Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] than the IPK package manager. Consequently, you might consider setting `PACKAGE_CLASSES` to `"package_ipk"` if you are building smaller systems.

Before making your decision on package manager, however, you should consider some further things about using RPM:

- RPM starts to provide more abilities than IPK due to the fact that it processes more metadata. For example, this information includes individual file types, file checksum generation and evaluation on install, sparse file support, conflict detection and resolution for Multilib systems, ACID style upgrade, and repackaging abilities for rollbacks.
- For smaller systems, the extra space used for the Berkley Database and the amount of metadata when using RPM can affect your ability to perform on-device upgrades.

You can find additional information on the effects of the package class at these two Yocto Project mailing list links:

- <https://lists.yoctoproject.org/pipermail/poky/2011-May/006362.html> [<http://lists.yoctoproject.org/pipermail/poky/2011-May/006362.html>]
- <https://lists.yoctoproject.org/pipermail/poky/2011-May/006363.html> [<http://lists.yoctoproject.org/pipermail/poky/2011-May/006363.html>]

8.14. Building Kernels -**kernel.bbclass**

This class handles building Linux kernels. The class contains code to build all kernel trees. All needed headers are staged into the `STAGING_KERNEL_DIR` directory to allow out-of-tree module builds using `module.bbclass`.

This means that each built kernel module is packaged separately and inter-module dependencies are created by parsing the `modinfo` output. If all modules are required, then installing the `kernel-modules` package installs all packages with modules and various other kernel packages such as `kernel-vmlinux`.

Various other classes are used by the kernel and module classes internally including `kernel-arch.bbclass`, `module_strip.bbclass`, `module-base.bbclass`, and `linux-kernel-base.bbclass`.

8.15. Creating Images -**image.bbclass** and **rootfs*.bbclass**

These classes add support for creating images in several formats. First, the root filesystem is created from packages using one of the `rootfs_*.bbclass` files (depending on the package format used) and then the image is created.

- The `IMAGE_FSTYPES` variable controls the types of images to generate.
- The `IMAGE_INSTALL` variable controls the list of packages to install into the image.

8.16. Host System Sanity Checks -**sanity.bbclass**

This class checks to see if prerequisite software is present on the host system so that users can be notified of potential problems that might affect their build. The class also performs basic user

configuration checks from the `local.conf` configuration file to prevent common mistakes that cause build failures. Distribution policy usually determines whether to include this class.

8.17. `insane.bbclass`

This class adds a step to the package generation process so that output quality assurance checks are generated by the OpenEmbedded build system. A range of checks are performed that check the build's output for common problems that show up during runtime. Distribution policy usually dictates whether to include this class.

You can configure the sanity checks so that specific test failures either raise a warning or an error message. Typically, failures for new tests generate a warning. Subsequent failures for the same test would then generate an error message once the metadata is in a known and good condition.

Use the `WARN_QA` and `ERROR_QA` variables to control the behavior of these checks at the global level (i.e. in your custom distro configuration). However, to skip one or more checks in recipes, you should use `INSANE_SKIP`. For example, to skip the check for symbolic link `.so` files in the main package of a recipe, add the following to the recipe. You need to realize that the package name override, in this example `${PN}`, must be used:

```
INSANE_SKIP_${PN} += "dev-so"
```

Please keep in mind that the QA checks exist in order to detect real or potential problems in the packaged output. So exercise caution when disabling these checks.

The following list shows the tests you can list with the `WARN_QA` and `ERROR_QA` variables:

- `ldflags`: Ensures that the binaries were linked with the `LDFLAGS` options provided by the build system. If this test fails, check that the `LDFLAGS` variable is being passed to the linker command.
- `useless-rpaths`: Checks for dynamic library load paths (`rpaths`) in the binaries that by default on a standard system are searched by the linker (e.g. `/lib` and `/usr/lib`). While these paths will not cause any breakage, they do waste space and are unnecessary.
- `rpaths`: Checks for `rpaths` in the binaries that contain build system paths such as `TMPDIR`. If this test fails, bad `-rpath` options are being passed to the linker commands and your binaries have potential security issues.
- `dev-so`: Checks that the `.so` symbolic links are in the `-dev` package and not in any of the other packages. In general, these symlinks are only useful for development purposes. Thus, the `-dev` package is the correct location for them. Some very rare cases do exist for dynamically loaded modules where these symlinks are needed instead in the main package.
- `debug-files`: Checks for `.debug` directories in anything but the `-dbg` package. The debug files should all be in the `-dbg` package. Thus, anything packaged elsewhere is incorrect packaging.
- `arch`: Checks the Executable and Linkable Format (ELF) type, bit size, and endianness of any binaries to ensure they match the target architecture. This test fails if any binaries don't match the type since there would be an incompatibility. Sometimes software, like bootloaders, might need to bypass this check.
- `debug-deps`: Checks that `-dbg` packages only depend on other `-dbg` packages and not on any other types of packages, which would cause a packaging bug.
- `dev-deps`: Checks that `-dev` packages only depend on other `-dev` packages and not on any other types of packages, which would be a packaging bug.
- `pkgconfig`: Checks `.pc` files for any `TMPDIR`/`WORKDIR` paths. Any `.pc` file containing these paths is incorrect since `pkg-config` itself adds the correct `sysroot` prefix when the files are accessed.
- `textrel`: Checks for ELF binaries that contain relocations in their `.text` sections, which can result in a performance impact at runtime.
- `pkgvarcheck`: Checks through the variables `RDEPENDS`, `RRECOMMENDS`, `RSUGGESTS`, `RCONFLICTS`, `RPROVIDES`, `RREPLACES`, `FILES`, `ALLOW_EMPTY`, `pkg_preinst`, `pkg_postinst`, `pkg_prerm` and

pkg_postrm, and reports if there are variable sets that are not package-specific. Using these variables without a package suffix is bad practice, and might unnecessarily complicate dependencies of other packages within the same recipe or have other unintended consequences.

- **xorg-driver-abi**: Checks that all packages containing Xorg drivers have ABI dependencies. The xserver-xorg recipe provides driver ABI names. All drivers should depend on the ABI versions that they have been built against. Driver recipes that include xorg-driver-input.inc or xorg-driver-video.inc will automatically get these versions. Consequently, you should only need to explicitly add dependencies to binary driver recipes.
- **libexec**: Checks if a package contains files in /usr/libexec. This check is not performed if the libexecdir variable has been set explicitly to /usr/libexec.
- **staticdev**: Checks for static library files (*.a) in non-staticdev packages.
- **la**: Checks .la files for any TMPDIR paths. Any .la file containing these paths is incorrect since libtool adds the correct sysroot prefix when using the files automatically itself.
- **desktop**: Runs the desktop-file-validate program against any .desktop files to validate their contents against the specification for .desktop files.
- **already-stripped**: Checks that produced binaries have not already been stripped prior to the build system extracting debug symbols. It is common for upstream software projects to default to stripping debug symbols for output binaries. In order for debugging to work on the target using -dbg packages, this stripping must be disabled.
- **split-strip**: Reports that splitting or stripping debug symbols from binaries has failed.
- **arch**: Checks to ensure the architecture, bit size, and endianness of all output binaries matches that of the target. This test can detect when the wrong compiler or compiler options have been used.
- **installed-vs-shipped**: Reports when files have been installed within do_install but have not been included in any package by way of the FILES variable. Files that do not appear in any package cannot be present in an image later on in the build process. Ideally, all installed files should be packaged or not installed at all. These files can be deleted at the end of do_install if the files are not needed in any package.
- **dep-cmp**: Checks for invalid version comparison statements in runtime dependency relationships between packages (i.e. in RDEPENDS, RRECOMMENDS, RSUGGESTS, RPROVIDES, RREPLACES, and RCONFLICTS variable values). Any invalid comparisons might trigger failures or undesirable behavior when passed to the package manager.
- **files-invalid**: Checks for FILES variable values that contain "/", which is invalid.
- **incompatible-license**: Report when packages are excluded from being created due to being marked with a license that is in INCOMPATIBLE_LICENSE.
- **compile-host-path**: Checks the do_compile log for indications that paths to locations on the build host were used. Using such paths might result in host contamination of the build output.
- **install-host-path**: Checks the do_install log for indications that paths to locations on the build host were used. Using such paths might result in host contamination of the build output.
- **libdir**: Checks for libraries being installed into incorrect (possibly hardcoded) installation paths. For example, this test will catch recipes that install /lib/bar.so when \${base_libdir} is "lib32". Another example is when recipes install /usr/lib64/foo.so when \${libdir} is "/usr/lib".
- **packages-list**: Checks for the same package being listed multiple times through the PACKAGES variable value. Installing the package in this manner can cause errors during packaging.
- **perm-config**: Reports lines in fs-perms.txt that have an invalid format.
- **perm-line**: Reports lines in fs-perms.txt that have an invalid format.
- **perm-link**: Reports lines in fs-perms.txt that specify 'link' where the specified target already exists.
- **pkgname**: Checks that all packages in PACKAGES have names that do not contain invalid characters (i.e. characters other than 0-9, a-z, ., +, and -).

- **pn-overrides:** Checks that a recipe does not have a name (PN) value that appears in `OVERRIDES`. If a recipe is named such that its PN value matches something already in `OVERRIDES` (e.g. PN happens to be the same as `MACHINE` or `DISTR0`), it can have unexpected consequences. For example, assignments such as `FILES_${PN} = "xyz"` effectively turn into `FILES = "xyz"`.
- **unsafe-references-in-binaries:** Reports when a binary installed in `${base_libdir}`, `${base_bindir}`, or `${base_sbindir}`, depends on another binary installed under `${exec_prefix}`. This dependency is a concern if you want the system to remain basically operable if `/usr` is mounted separately and is not mounted.

Note

Defaults for binaries installed in `${base_libdir}`, `${base_bindir}`, and `${base_sbindir}` are `/lib`, `/bin`, and `/sbin`, respectively. The default for a binary installed under `${exec_prefix}` is `/usr`.

- **unsafe-references-in-scripts:** Reports when a script file installed in `${base_libdir}`, `${base_bindir}`, or `${base_sbindir}`, depends on files installed under `${exec_prefix}`. This dependency is a concern if you want the system to remain basically operable if `/usr` is mounted separately and is not mounted.

Note

Defaults for binaries installed in `${base_libdir}`, `${base_bindir}`, and `${base_sbindir}` are `/lib`, `/bin`, and `/sbin`, respectively. The default for a binary installed under `${exec_prefix}` is `/usr`.

- **var-undefined:** Reports when variables fundamental to packaging (i.e. `WORKDIR`, `DEPLOY_DIR`, `D`, `PN`, and `PKGID`) are undefined during `do_package`.
- **pkgv-undefined:** Checks to see if the `PKGID` variable is undefined during `do_package`.
- **buildpaths:** Checks for paths to locations on the build host inside the output files. Currently, this test triggers too many false positives and thus is not normally enabled.
- **perms:** Currently, this check is unused but reserved.
- **version-going-backwards:** If Build History is enabled, reports when a package being written out has a lower version than the previously written package under the same name. If you are placing output packages into a feed and upgrading packages on a target system using that feed, the version of a package going backwards can result in the target system not correctly upgrading to the "new" version of the package.

Note

If you are not using runtime package management on your target system, then you do not need to worry about this situation.

8.18. Removing Work Files During the Build - `rm_work.bbclass`

The OpenEmbedded build system can use a substantial amount of disk space during the build process. A portion of this space is the work files under the `${TMPDIR}/work` directory for each recipe. Once the build system generates the packages for a recipe, the work files for that recipe are no longer needed. However, by default, the build system preserves these files for inspection and possible debugging purposes. If you would rather have these files deleted to save disk space as the build progresses, you can enable `rm_work` by adding the following to your `local.conf` file, which is found in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>].

```
INHERIT += "rm_work"
```

If you are modifying and building source code out of the work directory for a recipe, enabling `rm_work` will potentially result in your changes to the source being lost. To exclude some recipes from having their work directories deleted by `rm_work`, you can add the names of the recipe or recipes you are

working on to the `RM_WORK_EXCLUDE` variable, which can also be set in your `local.conf` file. Here is an example:

```
RM_WORK_EXCLUDE += "busybox eglibc"
```

8.19. Autotools Configuration Data Cache - **siteinfo.bbclass**

Autotools can require tests that must execute on the target hardware. Since this is not possible in general when cross compiling, site information is used to provide cached test results so these tests can be skipped over but still make the correct values available. The `meta/site` directory contains test results sorted into different categories such as architecture, endianness, and the `libc` used. Site information provides a list of files containing data relevant to the current build in the `CONFIG_SITE` variable that Autotools automatically picks up.

The class also provides variables like `SITEINFO_ENDIANNESS` and `SITEINFO_BITS` that can be used elsewhere in the metadata.

Because this class is included from `base.bbclass`, it is always active.

8.20. Adding Users -**useradd.bbclass**

If you have packages that install files that are owned by custom users or groups, you can use this class to specify those packages and associate the users and groups with those packages. The `meta-skeleton/recipes-skeleton/useradd/useradd-example.bb` recipe in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] provides a simple example that shows how to add three users and groups to two packages. See the `useradd-example.bb` for more information on how to use this class.

8.21. **externalsrc.bbclass**

You can use this class to build software from source code that is external to the OpenEmbedded build system. Building software from an external source tree means that the build system's normal fetch, unpack, and patch process is not used.

By default, the OpenEmbedded build system uses the `S` and `B` variables to locate unpacked recipe source code and to build it, respectively. When your recipe inherits `externalsrc.bbclass`, you use the `EXTERNALSRC` and `EXTERNALSRC_BUILD` variables to ultimately define `S` and `B`.

By default, this class expects the source code to support recipe builds that use the `B` variable to point to the directory in which the OpenEmbedded build system places the generated objects built from the recipes. By default, the `B` directory is set to the following, which is separate from the source directory (`S`):

```
${WORKDIR}/${BPN}/${PV}/
```

See the glossary entries for the `WORKDIR`, `BPN`, `PV`,

For more information on `externalsrc.bbclass`, see the comments in `meta/classes/externalsrc.bbclass` in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. For information on how to use `externalsrc.bbclass`, see the "Building Software from an External Source [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#building-software-from-an-external-source>]" section in the Yocto Project Development Manual.

8.22. **testimage.bbclass**

You can use this class to enable running a series of automated tests for images. The class handles loading the tests and starting the image.

Note

Currently, there is only support for running these tests under QEMU.

To use the class, you need to perform steps to set up the environment. The tests are commands that run on the target system over ssh. they are written in Python and make use of the unittest module.

For information on how to enable, run, and create new tests, see the "Performing Automated Runtime Testing [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#performing-automated-runtime-testing>]" section.

8.23. Other Classes

Thus far, this chapter has discussed only the most useful and important classes. However, other classes exist within the meta/classes directory in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. You can examine the .bbclass files directly for more information.

Chapter 9. Images

The OpenEmbedded build system provides several example images to satisfy different needs. When you issue the `bitbake` command you provide a “top-level” recipe that essentially begins the build for the type of image you want.

Note

Building an image without GNU General Public License Version 3 (GPLv3) components is only supported for minimal and base images. Furthermore, if you are going to build an image using non-GPLv3 components, you must make the following changes in the `local.conf` file before using the `BitBake` command to build the minimal or base image:

1. Comment out the `EXTRA_IMAGE_FEATURES` line
2. Set `INCOMPATIBLE_LICENSE = "GPLv3"`

From within the poky Git repository, use the following command to list the supported images:

```
$ ls meta*/recipes*/images/*.bb
```

These recipes reside in the `meta/recipes-core/images`, `meta/recipes-extended/images`, `meta/recipes-graphics/images`, `meta/recipes-qt/images`, `meta/recipes-rt/images`, `meta/recipes-sato/images`, and `meta-skeleton/recipes-multilib/images` directories within the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. Although the recipe names are somewhat explanatory, here is a list that describes them:

- `build-appliance-image`: An example virtual machine that contains all the pieces required to run builds using the build system as well as the build system itself. You can boot and run the image using either the VMware Player [<http://www.vmware.com/products/player/overview.html>] or VMware Workstation [<http://www.vmware.com/products/workstation/overview.html>]. For more information on this image, see the Build Appliance [<http://www.yoctoproject.org/documentation/build-appliance>] page on the Yocto Project website.
- `core-image-base`: A console-only image that fully supports the target device hardware.
- `core-image-minimal`: A small image just capable of allowing a device to boot.
- `core-image-minimal-dev`: A `core-image-minimal` image suitable for development work using the host. The image includes headers and libraries you can use in a host development environment.
- `core-image-minimal-initramfs`: A `core-image-minimal` image that has the Minimal RAM-based Initial Root Filesystem (`initramfs`) as part of the kernel, which allows the system to find the first “init” program more efficiently.
- `core-image-minimal-mtdutils`: A `core-image-minimal` image that has support for the Minimal MTD Utilities, which let the user interact with the MTD subsystem in the kernel to perform operations on flash devices.
- `core-image-basic`: A console-only image with more full-featured Linux system functionality installed.
- `core-image-lsb`: An image that conforms to the Linux Standard Base (LSB) specification.
- `core-image-lsb-dev`: A `core-image-lsb` image that is suitable for development work using the host. The image includes headers and libraries you can use in a host development environment.
- `core-image-lsb-sdk`: A `core-image-lsb` that includes everything in `meta-toolchain` but also includes development headers and libraries to form a complete standalone SDK. This image is suitable for development using the target.
- `core-image-clutter`: An image with support for the Open GL-based toolkit Clutter, which enables development of rich and animated graphical user interfaces.

- `core-image-gtk-directfb`: An image that uses gtk+ over directfb instead of X11. In order to build, this image requires specific distro configuration that enables gtk over directfb.
- `core-image-x11`: A very basic X11 image with a terminal.
- `qt4e-demo-image`: An image that launches into the demo application for the embedded (not based on X11) version of Qt.
- `core-image-rt`: A `core-image-minimal` image plus a real-time test suite and tools appropriate for real-time use.
- `core-image-rt-sdk`: A `core-image-rt` image that includes everything in meta-toolchain. The image also includes development headers and libraries to form a complete stand-alone SDK and is suitable for development using the target.
- `core-image-sato`: An image with Sato support, a mobile environment and visual style that works well with mobile devices. The image supports X11 with a Sato theme and applications such as a terminal, editor, file manager, media player, and so forth.
- `core-image-sato-dev`: A `core-image-sato` image suitable for development using the host. The image includes libraries needed to build applications on the device itself, testing and profiling tools, and debug symbols. This image was formerly `core-image-sdk`.
- `core-image-sato-sdk`: A `core-image-sato` image that includes everything in meta-toolchain. The image also includes development headers and libraries to form a complete standalone SDK and is suitable for development using the target.
- `core-image-multilib-example`: An example image that includes a lib32 version of Bash into an otherwise standard sato image. The image assumes a "lib32" multilib has been enabled in the your configuration.

Tip

From the Yocto Project release 1.1 onwards, `-live` and `-directdisk` images have been replaced by a "live" option in `IMAGE_FSTYPES` that will work with any image to produce an image file that can be copied directly to a CD or USB device and run as is. To build a live image, simply add "live" to `IMAGE_FSTYPES` within the `local.conf` file or wherever appropriate and then build the desired image as normal.

Chapter 10. Reference: Features

This chapter provides a reference of shipped machine and distro features you can include as part of the image, a reference on image types you can build, and a reference on feature backfilling.

Features provide a mechanism for working out which packages should be included in the generated images. Distributions can select which features they want to support through the `DISTRO_FEATURES` variable, which is set in the `poky.conf` distribution configuration file. Machine features are set in the `MACHINE_FEATURES` variable, which is set in the machine configuration file and specifies the hardware features for a given machine.

These two variables combine to work out which kernel modules, utilities, and other packages to include. A given distribution can support a selected subset of features so some machine features might not be included if the distribution itself does not support them.

One method you can use to determine which recipes are checking to see if a particular feature is contained or not is to `grep` through the Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] for the feature. Here is an example that discovers the recipes whose build is potentially changed based on a given feature:

```
$ cd $HOME/poky
$ git grep 'contains.*MACHINE_FEATURES.*<feature>'
```

10.1. Distro

The items below are features you can use with `DISTRO_FEATURES`. Features do not have a one-to-one correspondence to packages, and they can go beyond simply controlling the installation of a package or packages. Sometimes a feature can influence how certain recipes are built. For example, a feature might determine whether a particular configure option is specified within `do_configure` for a particular recipe.

This list only represents features as shipped with the Yocto Project metadata:

- `alsa`: Include ALSA support (OSS compatibility kernel modules installed if available).
- `bluetooth`: Include bluetooth support (integrated BT only).
- `cramfs`: Include CramFS support.
- `ext2`: Include tools for supporting for devices with internal HDD/Microdrive for storing files (instead of Flash only devices).
- `ipsec`: Include IPSec support.
- `ipv6`: Include IPv6 support.
- `irda`: Include Irda support.
- `keyboard`: Include keyboard support (e.g. keymaps will be loaded during boot).
- `nfs`: Include NFS client support (for mounting NFS exports on device).
- `opengl`: Include the Open Graphics Library, which is a cross-language, multi-platform application programming interface used for rendering two and three-dimensional graphics.
- `pci`: Include PCI bus support.
- `pcmcia`: Include PCMCIA/CompactFlash support.
- `ppp`: Include PPP dialup support.
- `smbfs`: Include SMB networks client support (for mounting Samba/Microsoft Windows shares on device).

- **systemd**: Include support for this `init` manager, which is a full replacement of `for init` with parallel starting of services, reduced shell overhead, and other features. This `init` manager is used by many distributions.
- **usb gadget**: Include USB Gadget Device support (for USB networking/serial/storage).
- **usb host**: Include USB Host support (allows to connect external keyboard, mouse, storage, network etc).
- **wayland**: Include the Wayland display server protocol and the library that supports it.
- **wifi**: Include WiFi support (integrated only).

10.2. Machine

The items below are features you can use with `MACHINE_FEATURES`. Features do not have a one-to-one correspondence to packages, and they can go beyond simply controlling the installation of a package or packages. Sometimes a feature can influence how certain recipes are built. For example, a feature might determine whether a particular configure option is specified within `do_configure` for a particular recipe.

This feature list only represents features as shipped with the Yocto Project metadata:

- **acpi**: Hardware has ACPI (x86/x86_64 only)
- **alsa**: Hardware has ALSA audio drivers
- **apm**: Hardware uses APM (or APM emulation)
- **bluetooth**: Hardware has integrated BT
- **ext2**: Hardware HDD or Microdrive
- **irda**: Hardware has Irda support
- **keyboard**: Hardware has a keyboard
- **pci**: Hardware has a PCI bus
- **pcmcia**: Hardware has PCMCIA or CompactFlash sockets
- **screen**: Hardware has a screen
- **serial**: Hardware has serial support (usually RS232)
- **touchscreen**: Hardware has a touchscreen
- **usb gadget**: Hardware is USB gadget device capable
- **usb host**: Hardware is USB Host capable
- **wifi**: Hardware has integrated WiFi

10.3. Images

The contents of images generated by the OpenEmbedded build system can be controlled by the `IMAGE_FEATURES` and `EXTRA_IMAGE_FEATURES` variables that you typically configure in your image recipes. Through these variables, you can add several different predefined packages such as development utilities or packages with debug information needed to investigate application problems or profile applications.

Current list of `IMAGE_FEATURES` contains the following:

- **dbg-pkgs**: Installs debug symbol packages for all packages installed in a given image.
- **dev-pkgs**: Installs development packages (headers and extra library links) for all packages installed in a given image.

- `doc-pkgs`: Installs documentation packages for all packages installed in a given image.
- `nfs-server`: Installs an NFS server.
- `read-only-rootfs`: Creates an image whose root filesystem is read-only. See the "Creating a Read-Only Root Filesystem [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#creating-a-read-only-root-filesystem>]" section in the Yocto Project Development Manual for more information.
- `splash`: Enables showing a splash screen during boot. By default, this screen is provided by `psplash`, which does allow customization. If you prefer to use an alternative splash screen package, you can do so by setting the `SPLASH` variable to a different package name (or names) within the image recipe or at the distro configuration level.
- `ssh-server-dropbear`: Installs the Dropbear minimal SSH server.
- `ssh-server-openssh`: Installs the OpenSSH SSH server, which is more full-featured than Dropbear. Note that if both the OpenSSH SSH server and the Dropbear minimal SSH server are present in `IMAGE_FEATURES`, then OpenSSH will take precedence and Dropbear will not be installed.
- `staticdev-pkgs`: Installs static development packages (i.e. static libraries containing *.a files) for all packages installed in a given image.
- `tools-debug`: Installs debugging tools such as `strace` and `gdb`. For information on GDB, see the "Debugging With the GNU Project Debugger (GDB) Remotely [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#platdev-gdb-remotedebug>]" section in the Yocto Project Development Manual. For information on tracing and profiling, see the Yocto Project Profiling and Tracing Manual [<http://www.yoctoproject.org/docs/1.5/profile-manual/profile-manual.html>].
- `tools-profile`: Installs profiling tools such as `oprofile`, `exmap`, and `LTTng`. For general information on user-space tools, see the "User-Space Tools [<http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html#user-space-tools>]" section in the Yocto Project Application Developer's Guide.
- `tools-sdk`: Installs a full SDK that runs on the device.
- `tools-testapps`: Installs device testing tools (e.g. touchscreen debugging).
- `x11`: Installs the X server
- `x11-base`: Installs the X server with a minimal environment.
- `x11-sato`: Installs the OpenedHand Sato environment.

10.4. Feature Backfilling

Sometimes it is necessary in the OpenEmbedded build system to extend `MACHINE_FEATURES` or `DISTRO_FEATURES` to control functionality that was previously enabled and not able to be disabled. For these cases, we need to add an additional feature item to appear in one of these variables, but we do not want to force developers who have existing values of the variables in their configuration to add the new feature in order to retain the same overall level of functionality. Thus, the OpenEmbedded build system has a mechanism to automatically "backfill" these added features into existing distro or machine configurations. You can see the list of features for which this is done by finding the `DISTRO_FEATURES_BACKFILL` and `MACHINE_FEATURES_BACKFILL` variables in the `meta/conf/bitbake.conf` file.

Because such features are backfilled by default into all configurations as described in the previous paragraph, developers who wish to disable the new features need to be able to selectively prevent the backfilling from occurring. They can do this by adding the undesired feature or features to the `DISTRO_FEATURES_BACKFILL_CONSIDERED` or `MACHINE_FEATURES_BACKFILL_CONSIDERED` variables for distro features and machine features respectively.

Here are two examples to help illustrate feature backfilling:

- The "pulseaudio" distro feature option: Previously, PulseAudio support was enabled within the Qt and GStreamer frameworks. Because of this, the feature is backfilled and thus enabled for all distros through the `DISTRO_FEATURES_BACKFILL` variable in the `meta/conf/bitbake.conf` file. However, your distro needs to disable the feature. You can disable the feature without affecting

other existing distro configurations that need PulseAudio support by adding "pulseaudio" to `DISTRO_FEATURES_BACKFILL_CONSIDERED` in your distro's `.conf` file. Adding the feature to this variable when it also exists in the `DISTRO_FEATURES_BACKFILL` variable prevents the build system from adding the feature to your configuration's `DISTRO_FEATURES`, effectively disabling the feature for that particular distro.

- The "rtc" machine feature option: Previously, real time clock (RTC) support was enabled for all target devices. Because of this, the feature is backfilled and thus enabled for all machines through the `MACHINE_FEATURES_BACKFILL` variable in the `meta/conf/bitbake.conf` file. However, your target device does not have this capability. You can disable RTC support for your device without affecting other machines that need RTC support by adding the feature to your machine's `MACHINE_FEATURES_BACKFILL_CONSIDERED` list in the machine's `.conf` file. Adding the feature to this variable when it also exists in the `MACHINE_FEATURES_BACKFILL` variable prevents the build system from adding the feature to your configuration's `MACHINE_FEATURES`, effectively disabling RTC support for that particular machine.

Chapter 11. Variables Glossary

This chapter lists common variables used in the OpenEmbedded build system and gives an overview of their function and contents.

Glossary

A B C D E F H I K L M O P R S T U W

A

ALLOW_EMPTY

Specifies if an output package should still be produced if it is empty. By default, BitBake does not produce empty packages. This default behavior can cause issues when there is an RDEPENDS or some other runtime hard-requirement on the existence of the package.

Like all package-controlling variables, you must always use them in conjunction with a package name override. Here is an example:

```
ALLOW_EMPTY_${PN} = "1"
```

ALTERNATIVE

Lists commands in a package that need an alternative binary naming scheme. Sometimes the same command is provided in multiple packages. When this occurs, the OpenEmbedded build system needs to use the alternatives system to create a different binary naming scheme so the commands can co-exist.

To use the variable, list out the package's commands that also exist as part of another package. For example, if the busybox package has four commands that also exist as part of another package, you identify them as follows:

```
ALTERNATIVE_busybox = "sh sed test bracket"
```

For more information on the alternatives system, see the "Alternatives - update-alternatives.bbclass" section.

ALTERNATIVE_LINK_NAME

Used by the alternatives system to map duplicated commands to actual locations. For example, if the bracket command provided by the busybox package is duplicated through another package, you must use the ALTERNATIVE_LINK_NAME variable to specify the actual location:

```
ALTERNATIVE_LINK_NAME[bracket] = "/usr/bin/["
```

In this example, the binary for the bracket command (i.e. [) from the busybox package resides in /usr/bin/.

Note

If ALTERNATIVE_LINK_NAME is not defined, it defaults to `${bindir}/<name>`.

For more information on the alternatives system, see the "Alternatives - update-alternatives.bbclass" section.

ALTERNATIVE_PRIORITY

Used by the alternatives system to create default priorities for duplicated commands. You can use the variable to create a single

default regardless of the command name or package, a default for specific duplicated commands regardless of the package, or a default for specific commands tied to particular packages. Here are the available syntax forms:

```
ALTERNATIVE_PRIORITY = "<priority>"
ALTERNATIVE_PRIORITY[<name>] = "<priority>"
ALTERNATIVE_PRIORITY_<pkg>[<name>] = "<priority>"
```

For more information on the alternatives system, see the "Alternatives - update-alternatives.bbclass" section.

ALTERNATIVE_TARGET

Used by the alternatives system to create default link locations for duplicated commands. You can use the variable to create a single default location for all duplicated commands regardless of the command name or package, a default for specific duplicated commands regardless of the package, or a default for specific commands tied to particular packages. Here are the available syntax forms:

```
ALTERNATIVE_TARGET = "<target>"
ALTERNATIVE_TARGET[<name>] = "<target>"
ALTERNATIVE_TARGET_<pkg>[<name>] = "<target>"
```

Note

If ALTERNATIVE_TARGET is not defined, it inherits the value from the ALTERNATIVE_LINK_NAME variable.

If ALTERNATIVE_LINK_NAME and ALTERNATIVE_TARGET are the same, the target for ALTERNATIVE_TARGET has ".{BPN}" appended to it.

Finally, if the file referenced has not been renamed, the alternatives system will rename it to avoid the need to rename alternative files in the do_install task while retaining support for the command if necessary.

For more information on the alternatives system, see the "Alternatives - update-alternatives.bbclass" section.

AUTHOR

The email address used to contact the original author or authors in order to send patches and forward bugs.

AUTOREV

When SRCREV is set to the value of this variable, it specifies to use the latest source revision in the repository. Here is an example:

```
SRCREV = "${AUTOREV}"
```

B

B

The directory within the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] in which the OpenEmbedded build system places generated objects during a recipe's build process. By default, this directory is the same as the S directory:

```
B = "${WORKDIR}/${BPN}/${PV}/"
```


You can separate the (S) directory and the directory pointed to by the B variable. Most Autotools-based recipes support separating these directories. The build system defaults to using separate directories for gcc and some kernel recipes.

BAD_RECOMMENDATIONS

Lists "recommended-only" packages to not install. Recommended-only packages are packages installed only through the RRECOMMENDS variable. You can prevent any of these "recommended" packages from being installed by listing them with the BAD_RECOMMENDATIONS variable:

```
BAD_RECOMMENDATIONS = "<package_name> <package_name> <package_name> ..."
```

You can set this variable globally in your `local.conf` file or you can attach it to a specific image recipe by using the recipe name override:

```
BAD_RECOMMENDATIONS_pn-<target_image> = "<package_name>"
```

It is important to realize that if you choose to not install packages using this variable and some other packages are dependent on them (i.e. listed in a recipe's RDEPENDS variable), the OpenEmbedded build system ignores your request and will install the packages to avoid dependency errors.

Support for this variable exists only when using the IPK and RPM packaging backend. Support does not exist for DEB.

See the NO_RECOMMENDATIONS and the PACKAGE_EXCLUDE variables for related information.

BB_DANGLINGAPPENDS_WARNONLY

Defines how BitBake handles situations where an append file (`.bbappend`) has no corresponding recipe file (`.bb`). This condition often occurs when layers get out of sync (e.g. `oe-core` bumps a recipe version and the old recipe no longer exists and the other layer has not been updated to the new version of the recipe yet).

The default fatal behavior is safest because it is the sane reaction given something is out of sync. It is important to realize when your changes are no longer being applied.

You can change the default behavior by setting this variable to "1" in the `local.conf` file in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] as follows:

```
BB_DANGLINGAPPENDS_WARNONLY = "1"
```

BB_DISKMON_DIRS

Monitors disk space and available inodes during the build and allows you to control the build based on these parameters.

Disk space monitoring is disabled by default. To enable monitoring, add the BB_DISKMON_DIRS variable to your `conf/local.conf` file found in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]. Use the following form:

```
BB_DISKMON_DIRS = "<action>,<dir>,<threshold> [...]"
```

where:

<action> is:

ABORT: Immediately abort the build when a threshold is broken.

STOPTASKS: Stop the build after the currently executing tasks have finished when a threshold is broken.

WARN: Issue a warning but continue the build when a threshold is broken. Subsequent warnings are issued as defined by the `BB_DISKMON_WARNINTERVAL` variable, which must be defined in the `conf/local.conf` file.

<dir> is:

Any directory you choose. You can specify one or more directories to monitor by separating the groupings with a space. If two directories are on the same device, only the first directory is monitored.

<threshold> is:

Either the minimum available disk space, the minimum number of free inodes, or both. You must specify at least one. To omit one or the other, simply omit the value. Specify the threshold using G, M, K for Gbytes, Mbytes, and Kbytes, respectively. If you do not specify G, M, or K, Kbytes is assumed by default. Do not use GB, MB, or KB.

Here are some examples:

```
BB_DISKMON_DIRS = "ABORT,${TMPDIR},1G,100K WARN,${SSTATE_DIR},1G,  
BB_DISKMON_DIRS = "STOPTASKS,${TMPDIR},1G"  
BB_DISKMON_DIRS = "ABORT,${TMPDIR},,100K"
```

The first example works only if you also provide the `BB_DISKMON_WARNINTERVAL` variable in the `conf/local.conf`. This example causes the build system to immediately abort when either the disk space in `${TMPDIR}` drops below 1 Gbyte or the available free inodes drops below 100 Kbytes. Because two directories are provided with the variable, the build system also issue a warning when the disk space in the `${SSTATE_DIR}` directory drops below 1 Gbyte or the number of free inodes drops below 100 Kbytes. Subsequent warnings are issued during intervals as defined by the `BB_DISKMON_WARNINTERVAL` variable.

The second example stops the build after all currently executing tasks complete when the minimum disk space in the `${TMPDIR}` directory drops below 1 Gbyte. No disk monitoring occurs for the free inodes in this case.

The final example immediately aborts the build when the number of free inodes in the `${TMPDIR}` directory drops below 100 Kbytes. No disk space monitoring for the directory itself occurs in this case.

BB_DISKMON_WARNINTERVAL Defines the disk space and free inode warning intervals. To set these intervals, define the variable in your `conf/local.conf` file in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>].

If you are going to use the `BB_DISKMON_WARNINTERVAL` variable, you must also use the `BB_DISKMON_DIRS` variable and define its action as "WARN". During the build, subsequent warnings are issued each time disk space or number of free inodes further reduces by the respective interval.

If you do not provide a `BB_DISKMON_WARNINTERVAL` variable and you do use `BB_DISKMON_DIRS` with the "WARN" action, the disk monitoring interval defaults to the following:

```
BB_DISKMON_WARNINTERVAL = "50M,5K"
```

When specifying the variable in your configuration file, use the following form:

```
BB_DISKMON_WARNINTERVAL = "<disk_space_interval>,<disk_inode_inte
```

where:

<disk_space_interval> is:

An interval of memory expressed in either G, M, or K for Gbytes, Mbytes, or Kbytes, respectively. You cannot use GB, MB, or KB.

<disk_inode_interval> is:

An interval of free inodes expressed in either G, M, or K for Gbytes, Mbytes, or Kbytes, respectively. You cannot use GB, MB, or KB.

Here is an example:

```
BB_DISKMON_DIRS = "WARN,${SSTATE_DIR},1G,100K"
BB_DISKMON_WARNINTERVAL = "50M,5K"
```

These variables cause the OpenEmbedded build system to issue subsequent warnings each time the available disk space further reduces by 50 Mbytes or the number of free inodes further reduces by 5 Kbytes in the `${SSTATE_DIR}` directory. Subsequent warnings based on the interval occur each time a respective interval is reached beyond the initial warning (i.e. 1 Gbytes and 100 Kbytes).

BB_GENERATE_MIRROR_TARBALLS Causes tarballs of the Git repositories to be placed in the `DL_DIR` directory. For performance reasons, creating and placing tarballs of the Git repositories is not the default action by the OpenEmbedded build system.

```
BB_Generate_MIRROR_TARBALLS = "1"
```

Set this variable in your `local.conf` file in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>].

BB_NUMBER_THREADS

The maximum number of tasks BitBake should run in parallel at any one time. If your host development system supports multiple cores a good rule of thumb is to set this variable to twice the number of cores.

BBCLASSEXTEND

Allows you to extend a recipe so that it builds variants of the software. Common variants for recipes exist such as "natives" like quilt-

native, which is a copy of Quilt built to run on the build system; "crosses" such as gcc-cross, which is a compiler built to run on the build machine but produces binaries that run on the target MACHINE; "nativesdk", which targets the SDK machine instead of MACHINE; and "multilibs" in the form "multilib:<multilib_name>".

To build a different variant of the recipe with a minimal amount of code, it usually is as simple as adding the following to your recipe:

```
BBCLASSEXTEND += "native nativesdk"
BBCLASSEXTEND += "multilib:<multilib_name>"
```

BBFILE_COLLECTIONS Lists the names of configured layers. These names are used to find the other BBFILE_* variables. Typically, each layer will append its name to this variable in its conf/layer.conf file.

BBFILE_PATTERN Variable that expands to match files from BBFILES in a particular layer. This variable is used in the conf/layer.conf file and must be suffixed with the name of the specific layer (e.g. BBFILE_PATTERN_emenlow).

BBFILE_PRIORITY Assigns the priority for recipe files in each layer.

This variable is useful in situations where the same recipe appears in more than one layer. Setting this variable allows you to prioritize a layer against other layers that contain the same recipe - effectively letting you control the precedence for the multiple layers. The precedence established through this variable stands regardless of a recipe's version (PV variable). For example, a layer that has a recipe with a higher PV value but for which the BBFILE_PRIORITY is set to have a lower precedence still has a lower precedence.

A larger value for the BBFILE_PRIORITY variable results in a higher precedence. For example, the value 6 has a higher precedence than the value 5. If not specified, the BBFILE_PRIORITY variable is set based on layer dependencies (see the LAYERDEPENDS variable for more information). The default priority, if unspecified for a layer with no dependencies, is the lowest defined priority + 1 (or 1 if no priorities are defined).

Tip

You can use the command `bitbake-layers show_layers` to list all configured layers along with their priorities.

BBFILES List of recipe files used by BitBake to build software.

BBINCLUDELOGS Variable that controls how BitBake displays logs on build failure.

BBLAYERS Lists the layers to enable during the build. This variable is defined in the bblayers.conf configuration file in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]. Here is an example:

```
BBLAYERS = " \
/home/scottrif/poky/meta \
/home/scottrif/poky/meta-yocto \
/home/scottrif/poky/meta-yocto-bsp \
/home/scottrif/poky/meta-mykernel \
"

BBLAYERS_NON_REMOVABLE ?= " \
/home/scottrif/poky/meta \
/home/scottrif/poky/meta-yocto \
```

"

This example enables four layers, one of which is a custom, user-defined layer named meta-mykernel.

BBLAYERS_NON_REMOVABLE Lists core layers that cannot be removed from the `bblayers.conf` file. In order for BitBake to build your image, your `bblayers.conf` file must include the meta and meta-yocto core layers. Here is an example that shows these two layers listed in the `BBLAYERS_NON_REMOVABLE` statement:

```
BBLAYERS = " \
/home/scottrif/poky/meta \
/home/scottrif/poky/meta-yocto \
/home/scottrif/poky/meta-yocto-bsp \
/home/scottrif/poky/meta-mykernel \
"
```

```
BBLAYERS_NON_REMOVABLE ?= " \
/home/scottrif/poky/meta \
/home/scottrif/poky/meta-yocto \
"
```

BBMASK

Prevents BitBake from processing recipes and recipe append files. Use the `BBMASK` variable from within the `conf/local.conf` file found in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>].

You can use the `BBMASK` variable to "hide" these `.bb` and `.bbappend` files. BitBake ignores any recipe or recipe append files that match the expression. It is as if BitBake does not see them at all. Consequently, matching files are not parsed or otherwise used by BitBake.

The value you provide is passed to Python's regular expression compiler. The expression is compared against the full paths to the files. For complete syntax information, see Python's documentation at <http://docs.python.org/release/2.3/lib/re-syntax.html>.

The following example uses a complete regular expression to tell BitBake to ignore all recipe and recipe append files in the `/meta-ti/recipes-misc/` directory:

```
BBMASK = "/meta-ti/recipes-misc/"
```

If you want to mask out multiple directories or recipes, use the vertical bar to separate the regular expression fragments. This next example masks out multiple directories and individual recipes:

```
BBMASK = "meta-ti/recipes-misc/|meta-ti/recipes-ti/packagegroup/"
BBMASK .= "|.*meta-oe/recipes-support/"
BBMASK .= "|.*openldap"
BBMASK .= "|.*opencv"
BBMASK .= "|.*lzma"
```

Notice how the vertical bar is used to append the fragments.

Note

When specifying a directory name, use the trailing slash character to ensure you match just that directory name.

BBPATH Used by BitBake to locate .bbclass and configuration files. This variable is analogous to the PATH variable.

Note

If you run BitBake from a directory outside of the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>], you must be sure to set BBPATH to point to the Build Directory. Set the variable as you would any environment variable and then run BitBake:

```
$ BBPATH = "<build_directory>"
$ export BBPATH
$ bitbake <target>
```

BBSERVER Points to the server that runs memory-resident BitBake. This variable is set by the oe-init-build-env-memres setup script and should not be hand-edited. The variable is only used when you employ memory-resident BitBake. The setup script exports the value as follows:

```
export BBSERVER=localhost:$port
```

For more information on how the BBSERVER is used, see the oe-init-build-env-memres script, which is located in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

BINCONFIG_GLOB When inheriting binconfig.bbclass from a recipe, this variable specifies a wildcard for configuration scripts that need editing. The scripts are edited to correct any paths that have been set up during compilation so that they are correct for use when installed into the sysroot and called by the build processes of other recipes.

For more information on how this variable works, see meta/classes/binconfig.bbclass in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. You can also find general information on the class in the "binconfig.bbclass" section.

BP The base recipe name and version but without any special recipe name suffix (i.e. -native, lib64-, and so forth). BP is comprised of the following:

```
${BPN}-${PV}
```

BPN The bare name of the recipe. This variable is a version of the PN variable but removes common suffixes such as "-native" and "-cross" as well as removes common prefixes such as multilib's "lib64-" and "lib32-". The exact list of suffixes removed is specified by the SPECIAL_PKGSUFFIX variable. The exact list of prefixes removed is specified by the MLPREFIX variable. Prefixes are removed for multilib and nativesdk cases.

BUILDDIR Points to the location of the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]. You can define this directory indirectly through the oe-init-build-env and oe-init-build-env-memres scripts by passing in a Build Directory path when you run the scripts. If you run the scripts and do not provide a Build Directory path, the BUILDDIR defaults to build in the current directory.

BUSYBOX_SPLIT_SUID For the BusyBox recipe, specifies whether to split the output executable file into two parts: one for features that require `setuid root`, and one for the remaining features (i.e. those that do not require `setuid root`).

The `BUSYBOX_SPLIT_SUID` variable defaults to "1", which results in a single output executable file. Set the variable to "0" to split the output file.

C

CFLAGS Flags passed to the C compiler for the target system. This variable evaluates to the same as `TARGET_CFLAGS`.

COMBINED_FEATURES A set of features common between `MACHINE_FEATURES` and `DISTRO_FEATURES`. See the glossary descriptions for these variables for more information.

COMMON_LICENSE_DIR Points to `meta/files/common-licenses` in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>], which is where generic license files reside.

COMPATIBLE_HOST A regular expression that resolves to one or more hosts (when the recipe is native) or one or more targets (when the recipe is non-native) with which a recipe is compatible. The regular expression is matched against `HOST_SYS`. You can use the variable to stop recipes from being built for classes of systems with which the recipes are not compatible. Stopping these builds is particularly useful with kernels. The variable also helps to increase parsing speed since the build system skips parsing recipes not compatible with the current system.

COMPATIBLE_MACHINE A regular expression that resolves to one or more target machines with which a recipe is compatible. The regular expression is matched against `MACHINEOVERRIDES`. You can use the variable to stop recipes from being built for machines with which the recipes are not compatible. Stopping these builds is particularly useful with kernels. The variable also helps to increase parsing speed since the build system skips parsing recipes not compatible with the current machine.

COMPLEMENTARY_GLOB Defines wildcards to match when installing a list of complementary packages for all the packages explicitly (or implicitly) installed in an image. The resulting list of complementary packages is associated with an item that can be added to `IMAGE_FEATURES`. An example usage of this is the "dev-pkgs" item that when added to `IMAGE_FEATURES` will install -dev packages (containing headers and other development files) for every package in the image.

To add a new feature item pointing to a wildcard, use a variable flag to specify the feature item name and use the value to specify the wildcard. Here is an example:

```
COMPLEMENTARY_GLOB[dev-pkgs] = '*-dev'
```

CONFFILES Identifies editable or configurable files that are part of a package. If the Package Management System (PMS) is being used to update packages on the target system, it is possible that configuration files you have changed after the original installation and that you now want to remain unchanged are overwritten. In other words, editable files might exist in the package that you do not want reset as part of the package update process. You can use the `CONFFILES` variable

to list the files in the package that you wish to prevent the PMS from overwriting during this update process.

To use the `CONFFILES` variable, provide a package name override that identifies the resulting package. Then, provide a space-separated list of files. Here is an example:

```
CONFFILES_${PN} += "${sysconfdir}/file1 \  
                  ${sysconfdir}/file2 ${sysconfdir}/file3"
```

A relationship exists between the `CONFFILES` and `FILES` variables. The files listed within `CONFFILES` must be a subset of the files listed within `FILES`. Because the configuration files you provide with `CONFFILES` are simply being identified so that the PMS will not overwrite them, it makes sense that the files must already be included as part of the package through the `FILES` variable.

Note

When specifying paths as part of the `CONFFILES` variable, it is good practice to use appropriate path variables. For example, `${sysconfdir}` rather than `/etc` or `${bindir}` rather than `/usr/bin`. You can find a list of these variables at the top of the `/meta/conf/bitbake.conf` file in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

| | |
|---------------------------------------|---|
| <code>CONFIG_SITE</code> | A list of files that contains autoconf test results relevant to the current build. This variable is used by the Autotools utilities when running <code>configure</code> . |
| <code>CORE_IMAGE_EXTRA_INSTALL</code> | <p>Specifies the list of packages to be added to the image. You should only set this variable in the <code>local.conf</code> configuration file found in the Build Directory [http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory].</p> <p>This variable replaces <code>POKY_EXTRA_INSTALL</code>, which is no longer supported.</p> |
| <code>COREBASE</code> | <p>Specifies the parent directory of the OpenEmbedded Core Metadata layer (i.e. <code>/meta</code>).</p> <p>It is an important distinction that <code>COREBASE</code> points to the parent of this layer and not the layer itself. Consider an example where you have cloned the Poky Git repository and retained the poky name for your local copy of the repository. In this case, <code>COREBASE</code> points to the poky folder because it is the parent directory of the poky/meta layer.</p> |

D

| | |
|---------------------------------|---|
| <code>D</code> | The destination directory. |
| <code>DATETIME</code> | The date and time on which the current build started. The format is suitable for timestamps. |
| <code>DEBUG_BUILD</code> | Specifies to build packages with debugging information. This influences the value of the <code>SELECTED_OPTIMIZATION</code> variable. |
| <code>DEBUG_OPTIMIZATION</code> | The options to pass in <code>TARGET_CFLAGS</code> and <code>CFLAGS</code> when compiling a system for debugging. This variable defaults to <code>"-O -fno-omit-frame-pointer -g"</code> . |
| <code>DEFAULT_PREFERENCE</code> | Specifies a weak bias for recipe selection priority. |

The most common usage of this variable is to set it to "-1" within a recipe for a development version of a piece of software. Using the variable in this way causes the stable version of the recipe to build by default in the absence of `PREFERRED_VERSION` being used to build the development version.

Note

The bias provided by `DEFAULT_PREFERENCE` is weak and is overridden by `BBFILE_PRIORITY` if the that variable is different between two layers that contain different versions of the same recipe.

DEPENDS

Lists a recipe's build-time dependencies (i.e. other recipe files). The system ensures that all the dependencies listed have been built and have their contents in the appropriate sysroots before the recipe's configure task is executed.

Consider this simple example for two recipes named "a" and "b" that produce similarly named packages. In this example, the `DEPENDS` statement appears in the "a" recipe:

```
DEPENDS = "b"
```

Here, the dependency is such that the `do_configure` task for recipe "a" depends on the `do_populate_sysroot` task of recipe "b". This means anything that recipe "b" puts into sysroot is available when recipe "a" is configuring itself.

For information on runtime dependencies, see the `RDEPENDS` variable.

DEPLOY_DIR

Points to the general area that the OpenEmbedded build system uses to place images, packages, SDKs and other output files that are ready to be used outside of the build system. By default, this directory resides within the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] as `tmp/deploy`.

For more information on the structure of the Build Directory, see "The Build Directory - build/" section. For more detail on the contents of the deploy directory, see the "Images" and "Application Development SDK" sections.

DEPLOY_DIR_IMAGE

Points to the area that the OpenEmbedded build system uses to place images and other associated output files that are ready to be deployed onto the target machine. The directory is machine-specific as it contains the `${MACHINE}` name. By default, this directory resides within the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] as `tmp/deploy/images/${MACHINE}/`.

For more information on the structure of the Build Directory, see "The Build Directory - build/" section. For more detail on the contents of the deploy directory, see the "Images" and "Application Development SDK" sections.

DESCRIPTION

The package description used by package managers. If not set, `DESCRIPTION` takes the value of the `SUMMARY` variable.

DISTRO

The short name of the distribution. This variable corresponds to a file with the extension `.conf` located in a `conf/distro` directory within the Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] that contains the distribution configuration. The value must not contain spaces, and is typically all lower-case.

| | |
|-------------------------------------|--|
| | If the variable is blank, a set of default configuration will be used, which is specified within meta/conf/distro/defaultsetup.conf. |
| DISTRO_EXTRA_RDEPENDS | Specifies a list of distro-specific packages to add to all images. This variable takes affect through packagegroup-base so the variable only really applies to the more full-featured images that include packagegroup-base. You can use this variable to keep distro policy out of generic images. As with all other distro variables, you set this variable in the distro .conf file. |
| DISTRO_EXTRA_RRECOMMENDS | Specifies a list of distro-specific packages to add to all images if the packages exist. The packages might not exist or be empty (e.g. kernel modules). The list of packages are automatically installed but you can remove them. |
| DISTRO_FEATURES | The features enabled for the distribution. For a list of supported features that ship with the Yocto Project, see the "Distro" section. |
| DISTRO_FEATURES_BACKFILL | Features to be added to DISTRO_FEATURES if not also present in DISTRO_FEATURES_BACKFILL_CONSIDERED. This variable is set in the meta/conf/bitbake.conf file. It is not intended to be user-configurable. It is best to just reference the variable to see which distro features are being backfilled for all distro configurations. See the Feature backfilling section for more information. |
| DISTRO_FEATURES_BACKFILL_CONSIDERED | From DISTRO_FEATURES_BACKFILL that should not be backfilled (i.e. added to DISTRO_FEATURES) during the build. See the "Feature Backfilling" section for more information. |
| DISTRO_NAME | The long name of the distribution. |
| DISTRO_PN_ALIAS | Alias names used for the recipe in various Linux distributions. See the "Handling a Package Name Alias [http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#usingpoky-configuring-DISTRO_PN_ALIAS]" section in the Yocto Project Development Manual for more information. |
| DISTRO_VERSION | the version of the distribution. |
| DISTROOVERRIDES | This variable lists overrides specific to the current distribution. By default, the variable list includes the value of the DISTRO variable. You can extend the variable to apply any variable overrides you want as part of the distribution and are not already in OVERRIDES through some other means. |
| DL_DIR | The central download directory used by the build process to store downloads. By default, DL_DIR gets suitable for mirroring for everything except Git repositories. If you want tarballs of Git repositories, use the BB_GENERATE_MIRROR_TARBALLS variable. You can set this directory by defining the DL_DIR variable in the /conf/local.conf file. This directory is self-maintaining and you should not have to touch it. By default, the directory is downloads in the Build Directory [http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory]. <pre>#DL_DIR ?= "\${TOPDIR}/downloads"</pre> To specify a different download directory, simply remove the comment from the line and provide your directory. |

During a first build, the system downloads many different source code tarballs from various upstream projects. Downloading can take a while, particularly if your network connection is slow. Tarballs are all stored in the directory defined by `DL_DIR` and the build system looks there first to find source tarballs.

Note

When wiping and rebuilding, you can preserve this directory to speed up this part of subsequent builds.

You can safely share this directory between multiple builds on the same development machine. For additional information on how the build process gets source files when working behind a firewall or proxy server, see this specific question in the "FAQ [149]" chapter.

E

`ENABLE_BINARY_LOCALE_GENERATION`

Variable that controls which locales for `glibc` are generated during the build (useful if the target device has 64Mbytes of RAM or less).

`ERROR_QA`

Specifies the quality assurance checks whose failures are reported as errors by the OpenEmbedded build system. You set this variable in your distribution configuration file. For a list of the checks you can control with this variable, see the "insane.bbclass" section.

`EXCLUDE_FROM_WORLD`

Directs BitBake to exclude a recipe from world builds (i.e. `bitbake world`). During world builds, BitBake locates, parses and builds all recipes found in every layer exposed in the `bbayers.conf` configuration file.

To exclude a recipe from a world build using this variable, set the variable to "1" in the recipe.

Note

Recipes added to `EXCLUDE_FROM_WORLD` may still be built during a world build in order to satisfy dependencies of other recipes. Adding a recipe to `EXCLUDE_FROM_WORLD` only ensures that the recipe is not explicitly added to the list of build targets in a world build.

`EXTENDPE`

Used with file and pathnames to create a prefix for a recipe's version based on the recipe's PE value. If PE is set and greater than zero for a recipe, `EXTENDPE` becomes that value (e.g if PE is equal to "1" then `EXTENDPE` becomes "1_"). If a recipe's PE is not set (the default) or is equal to zero, `EXTENDPE` becomes "".

See the `STAMP` variable for an example.

`EXTENDPKGVS`

The full package version specification as it appears on the final packages produced by a recipe. The variable's value is normally used to fix a runtime dependency to the exact same version of another package in the same recipe:

```
RDEPENDS_${PN}-additional-module = "${PN} (= ${EXTENDPKGVS})"
```

The dependency relationships are intended to force the package manager to upgrade these types of packages in lock-step.

`EXTERNALSRC`

If `externalsrc.bbclass` is inherited, this variable points to the source tree, which is outside of the OpenEmbedded build system.

When set, this variable sets the `S` variable, which is what the OpenEmbedded build system uses to locate unpacked recipe source code.

For more information on `externalsrc.bbclass`, see the "externalsrc.bbclass" section. You can also find information on how to use this variable in the "Building Software from an External Source" [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#building-software-from-an-external-source>] section in the Yocto Project Development Manual.

EXTERNALSRC_BUILD

If `externalsrc.bbclass` is inherited, this variable points to the directory in which the recipe's source code is built, which is outside of the OpenEmbedded build system. When set, this variable sets the `B` variable, which is what the OpenEmbedded build system uses to locate the Build Directory.

For more information on `externalsrc.bbclass`, see the "externalsrc.bbclass" section. You can also find information on how to use this variable in the "Building Software from an External Source" [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#building-software-from-an-external-source>] section in the Yocto Project Development Manual.

EXTRA_IMAGE_FEATURES

The list of additional features to include in an image. Typically, you configure this variable in your `local.conf` file, which is found in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]. Although you can use this variable from within a recipe, best practices dictate that you do not.

Note

To enable primary features from within the image recipe, use the `IMAGE_FEATURES` variable.

Here are some examples of features you can add:

"dbg-pkgs" - Adds `-dbg` packages for all installed packages including symbol information for debugging and profiling.

"debug-tweaks" - Makes an image suitable for development. For example, `ssh` root access has a blank password. You should remove this feature before you produce a production image.

"dev-pkgs" - Adds `-dev` packages for all installed packages. This is useful if you want to develop against the libraries in the image.

"read-only-rootfs" - Creates an image whose root filesystem is read-only. See the "Creating a Read-Only Root Filesystem" [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#creating-a-read-only-root-filesystem>] section in the Yocto Project Development Manual for more information

"tools-debug" - Adds debugging tools such as `gdb` and `strace`.

"tools-profile" - Adds profiling tools such as `oprofile`, `exmap`, `lttng` and `valgrind` (x86 only).

"tools-sdk" - Adds development tools such as `gcc`, `make`,

pkgconfig and so forth.

"tools-testapps" - Adds useful testing tools such as ts_print, aplay, arecord and so forth.

For a complete list of image features that ships with the Yocto Project, see the "Images" section.

For an example that shows how to customize your image by using this variable, see the "Customizing Images Using Custom IMAGE_FEATURES and EXTRA_IMAGE_FEATURES [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#usingpoky-extend-customimage-imagefeatures>]" section in the Yocto Project Development Manual.

EXTRA_IMAGEDEPENDS

A list of recipes to build that do not provide packages for installing into the root filesystem.

Sometimes a recipe is required to build the final image but is not needed in the root filesystem. You can use the EXTRA_IMAGEDEPENDS variable to list these recipes and thus, specify the dependencies. A typical example is a required bootloader in a machine configuration.

Note

To add packages to the root filesystem, see the various *RDEPENDS and *RRECOMMENDS variables.

EXTRA_OECMAKE

Additional cmake options.

EXTRA_OECONF

Additional configure script options.

EXTRA_OEMAKE

Additional GNU make options.

F

FILES

The list of directories or files that are placed in packages.

To use the FILES variable, provide a package name override that identifies the resulting package. Then, provide a space-separated list of files or paths that identifies the files you want included as part of the resulting package. Here is an example:

```
FILES_${PN} += "${bindir}/mydir1/ ${bindir}/mydir2/myfile"
```

Note

When specifying paths as part of the FILES variable, it is good practice to use appropriate path variables. For example, \${sysconfdir} rather than /etc or \${bindir} rather than /usr/bin. You can find a list of these variables at the top of the /meta/conf/bitbake.conf file in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

If some of the files you provide with the FILES variable are editable and you know they should not be overwritten during the package update process by the Package Management System (PMS), you can identify these files so that the PMS will not overwrite them. See the CONFFILES variable for information on how to identify these files to the PMS.

FILESEXTRAPATHS

Extends the search path the OpenEmbedded build system uses when looking for files and patches as it processes recipes and append files. The default directories BitBake uses when it processes recipes are initially defined by the `FILESPATH` variable. You can extend `FILESPATH` variable by using `FILESEXTRAPATHS`.

Best practices dictate that you accomplish this by using `FILESEXTRAPATHS` from within a `.bbappend` file and that you prepend paths as follows:

```
FILESEXTRAPATHS_prepend := "${THISDIR}/${PN}:"
```

In the above example, the build system first looks for files in a directory that has the same name as the corresponding append file.

Note

When extending `FILESEXTRAPATHS`, be sure to use the immediate expansion (`:=`) operator. Immediate expansion makes sure that BitBake evaluates `THISDIR` at the time the directive is encountered rather than at some later time when expansion might result in a directory that does not contain the files you need.

Also, include the trailing separating colon character if you are prepending. The trailing colon character is necessary because you are directing BitBake to extend the path by prepending directories to the search path.

Here is another common use:

```
FILESEXTRAPATHS_prepend := "${THISDIR}/files:"
```

In this example, the build system extends the `FILESPATH` variable to include a directory named `files` that is in the same directory as the corresponding append file.

Here is a final example that specifically adds three paths:

```
FILESEXTRAPATHS_prepend := "path_1:path_2:path_3:"
```

By prepending paths in `.bbappend` files, you allow multiple append files that reside in different layers but are used for the same recipe to correctly extend the path.

FILESOVERRIDES

A subset of `OVERRIDES` used by the OpenEmbedded build system for creating `FILESPATH`. You can find more information on how overrides are handled in the BitBake Manual that is located at `bitbake/doc/manual` in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

By default, the `FILESOVERRIDES` variable is defined as:

```
FILESOVERRIDES = "${TRANSLATED_TARGET_ARCH}:${MACHINEOVERRIDES}:$
```

Note

Do not hand-edit the `FILESOVERRIDES` variable. The values match up with expected overrides and are used in an expected manner by the build system.

FILESPATH The default set of directories the OpenEmbedded build system uses when searching for patches and files. During the build process, BitBake searches each directory in FILESPATH in the specified order when looking for files and patches specified by each file:// URI in a recipe.

The default value for the FILESPATH variable is defined in the base.bbclass class found in meta/classes in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]:

```
FILESPATH = "${@base_set_files_path(["${FILE_DIRNAME}/${BP}", \
    "${FILE_DIRNAME}/${BPN}", "${FILE_DIRNAME}/files"], d)}
```

Note

Do not hand-edit the FILESPATH variable. If you want the build system to look in directories other than the defaults, extend the FILESPATH variable by using the FILESEXTRAPATHS variable.

Be aware that the default FILESPATH directories do not map to directories in custom layers where append files (.bbappend) are used. If you want the build system to find patches or files that reside with your append files, you need to extend the FILESPATH variable by using the FILESEXTRAPATHS variable.

FILESYSTEM_PERMS_TABLES Allows you to define your own file permissions settings table as part of your configuration for the packaging process. For example, suppose you need a consistent set of custom permissions for a set of groups and users across an entire work project. It is best to do this in the packages themselves but this is not always possible.

By default, the OpenEmbedded build system uses the fs-perms.txt, which is located in the meta/files folder in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]. If you create your own file permissions setting table, you should place it in your layer or the distros layer.

You define the FILESYSTEM_PERMS_TABLES variable in the conf/local.conf file, which is found in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>], to point to your custom fs-perms.txt. You can specify more than a single file permissions setting table. The paths you specify to these files must be defined within the BBPATH variable.

For guidance on how to create your own file permissions settings table file, examine the existing fs-perms.txt.

FULL_OPTIMIZATION The options to pass in TARGET_CFLAGS and CFLAGS when compiling an optimized system. This variable defaults to "-fexpensive-optimizations -fomit-frame-pointer -frename-registers -O2".

H

HOMEPAGE Website where more information about the software the recipe is building can be found.

HOST_SYS Specifies the system, including the architecture and the operating system, for which the build is occurring in the context of the current recipe. The OpenEmbedded build system automatically sets this variable. You do not need to set the variable yourself.

Here are two examples:

- Given a native recipe on a 32-bit x86 machine running Linux, the value is "i686-linux".
- Given a recipe being built for a little-endian MIPS target running Linux, the value might be "mipsel-linux".

I

| | |
|----------------|--|
| IMAGE_BASENAME | The base name of image output files. This variable defaults to the recipe name (<code>\${PN}</code>). |
| IMAGE_CLASSES | <p>A list of classes that all images should inherit. You typically use this variable to specify the list of classes that register the different types of images the OpenEmbedded build system creates.</p> <p>The default value for <code>IMAGE_CLASSES</code> is <code>image_types</code>. You can set this variable in your <code>local.conf</code> or in a distribution configuration file.</p> <p>For more information, see <code>meta/classes/image_types.bbclass</code> in the Source Directory [http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory].</p> |
| IMAGE_FEATURES | <p>The primary list of features to include in an image. Typically, you configure this variable in an image recipe. Although you can use this variable from your <code>local.conf</code> file, which is found in the Build Directory [http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory], best practices dictate that you do not.</p> <p>Note</p> <p>To enable extra features from outside the image recipe, use the <code>EXTRA_IMAGE_FEATURES</code> variable.</p> <p>For a list of image features that ships with the Yocto Project, see the "Images" section.</p> <p>For example that shows how to customize your image by using this variable, see the "Customizing Images Using Custom <code>IMAGE_FEATURES</code> and <code>EXTRA_IMAGE_FEATURES</code>" [http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#usingpoky-extend-customimage-imagefeatures] section in the Yocto Project Development Manual.</p> |
| IMAGE_FSTYPES | Specifies the formats of the root filesystem created by the OpenEmbedded build system. Available formats are a subset of the supported images listed in <code>IMAGE_TYPES</code> . |
| IMAGE_INSTALL | <p>Specifies the packages to install into an image. The <code>IMAGE_INSTALL</code> variable is a mechanism for an image recipe and you should use it with care to avoid ordering issues.</p> <p>Image recipes set <code>IMAGE_INSTALL</code> to specify the packages to install into an image through <code>image.bbclass</code>. Additionally, "helper" classes exist, such as <code>core-image.bbclass</code>, that can take <code>IMAGE_FEATURES</code> lists and turn these into auto-generated entries in <code>IMAGE_INSTALL</code> in addition to its default contents.</p> <p>Using <code>IMAGE_INSTALL</code> with the <code>+=</code> operator from the <code>/conf/local.conf</code> file or from within an image recipe is not recommended as it can cause ordering issues. Since <code>core-image.bbclass</code> sets <code>IMAGE_INSTALL</code> to a default value using the <code>?=</code> operator, using a <code>+=</code> operation against <code>IMAGE_INSTALL</code> will result in unexpected behavior when used in <code>/conf/local.conf</code>. Furthermore, the same operation</p> |

from with an image recipe may or may not succeed depending on the specific situation. In both these cases, the behavior is contrary to how most users expect the += operator to work.

When you use this variable, it is best to use it as follows:

```
IMAGE_INSTALL_append = " package-name"
```

Be sure to include the space between the quotation character and the start of the package name.

IMAGE_LINGUAS

Specifies the list of locales to install into the image during the root filesystem construction process. The OpenEmbedded build system automatically splits locale files, which are used for localization, into separate packages. Setting the IMAGE_LINGUAS variable ensures that any locale packages that correspond to packages already selected for installation into the image are also installed. Here is an example:

```
IMAGE_LINGUAS = "pt-br de-de"
```

In this example, the build system ensures any Brazilian Portuguese and German locale files that correspond to packages in the image are installed (i.e. *-locale-pt-br and *-locale-de-de as well as *-locale-pt and *-locale-de, since some software packages only provide locale files by language and not by country-specific language).

IMAGE_NAME

The name of the output image files minus the extension. This variable is derived using the IMAGE_BASENAME, MACHINE, and DATETIME variables:

```
IMAGE_NAME = "${IMAGE_BASENAME}-${MACHINE}-${DATETIME}"
```

IMAGE_OVERHEAD_FACTOR

Defines a multiplier that the build system applies to the initial image size for cases when the multiplier times the returned disk usage value for the image is greater than the sum of IMAGE_ROOTFS_SIZE and IMAGE_ROOTFS_EXTRA_SPACE. The result of the multiplier applied to the initial image size creates free disk space in the image as overhead. By default, the build process uses a multiplier of 1.3 for this variable. This default value results in 30% free disk space added to the image when this method is used to determine the final generated image size. You should be aware that post install scripts and the package management system uses disk space inside this overhead area. Consequently, the multiplier does not produce an image with all the theoretical free disk space. See IMAGE_ROOTFS_SIZE for information on how the build system determines the overall image size.

The default 30% free disk space typically gives the image enough room to boot and allows for basic post installs while still leaving a small amount of free disk space. If 30% free space is inadequate, you can increase the default value. For example, the following setting gives you 50% free space added to the image:

```
IMAGE_OVERHEAD_FACTOR = "1.5"
```

Alternatively, you can ensure a specific amount of free disk space is added to the image by using IMAGE_ROOTFS_EXTRA_SPACE the variable.

IMAGE_POSTPROCESS_COMMAND Added by classes to run post processing commands once the OpenEmbedded build system has created the image. You can specify shell commands separated by semicolons:

```
IMAGE_POSTPROCESS_COMMAND += "<shell_command>; ... "
```

If you need to pass the path to the root filesystem within the command, you can use `${IMAGE_ROOTFS}`, which points to the root filesystem image.

IMAGE_ROOTFS The location of the root filesystem while it is under construction (i.e. during `do_rootfs`). This variable is not configurable. Do not change it.

IMAGE_ROOTFS_EXTRA_SPACE Defines additional free disk space created in the image in Kbytes. By default, this variable is set to "0". This free disk space is added to the image after the build system determines the image size as described in `IMAGE_ROOTFS_SIZE`.

This variable is particularly useful when you want to ensure that a specific amount of free disk space is available on a device after an image is installed and running. For example, to be sure 5 Gbytes of free disk space is available, set the variable as follows:

```
IMAGE_ROOTFS_EXTRA_SPACE = "5242880"
```

IMAGE_ROOTFS_SIZE Defines the size in Kbytes for the generated image. The OpenEmbedded build system determines the final size for the generated image using an algorithm that takes into account the initial disk space used for the generated image, a requested size for the image, and requested additional free disk space to be added to the image. Programatically, the build system determines the final size of the generated image as follows:

```
if (image-du * overhead) < rootfs-size:
    internal-rootfs-size = rootfs-size + xspace
else:
    internal-rootfs-size = (image-du * overhead) + xspace
```

where:

`image-du` = Returned value of the `du` command on the image.

`overhead` = `IMAGE_OVERHEAD_FACTOR`

`rootfs-size` = `IMAGE_ROOTFS_SIZE`

`internal-rootfs-size` = Initial root filesystem size before any modifications.

`xspace` = `IMAGE_ROOTFS_EXTRA_SPACE`

See the `IMAGE_OVERHEAD_FACTOR` and `IMAGE_ROOTFS_EXTRA_SPACE` variables for related information.

IMAGE_TYPES Specifies the complete list of supported image types by default:

```
jffs2
```

```
sum.jffs2
cramfs
ext2
ext2.gz
ext2.bz2
ext3
ext3.gz
ext2.lzma
btrfs
live
squashfs
squashfs-xz
ubi
ubifs
tar
tar.gz
tar.bz2
tar.xz
cpio
cpio.gz
cpio.xz
cpio.lzma
vmdk
elf
```

For more information on how these types of images, see `meta/classes/image_types*.bbclass` in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

INC_PR

Helps define the recipe revision for recipes that share a common include file. You can think of this variable as part of the recipe revision as set from within an include file.

Suppose, for example, you have a set of recipes that are used across several projects. And, within each of those recipes the revision (its PR value) is set accordingly. In this case, when the revision of those recipes changes, the burden is on you to find all those recipes and be sure that they get changed to reflect the updated version of the recipe. In this scenario, it can get complicated when recipes that are used in many places and provide common functionality are upgraded to a new revision.

A more efficient way of dealing with this situation is to set the `INC_PR` variable inside the include files that the recipes share and then expand the `INC_PR` variable within the recipes to help define the recipe revision.

The following provides an example that shows how to use the `INC_PR` variable given a common include file that defines the variable. Once the variable is defined in the include file, you can use the variable to set the PR values in each recipe. You will notice that when you set a recipe's PR you can provide more granular revisioning by appending values to the `INC_PR` variable:

```
recipes-graphics/xorg-font/xorg-font-common.inc:INC_PR = "r2"
recipes-graphics/xorg-font/encodings_1.0.4.bb:PR = "${INC_PR}.1"
recipes-graphics/xorg-font/font-util_1.3.0.bb:PR = "${INC_PR}.0"
recipes-graphics/xorg-font/font-alias_1.0.3.bb:PR = "${INC_PR}.3"
```

The first line of the example establishes the baseline revision to be used for all recipes that use the include file. The remaining lines in

| | |
|-----------------------|---|
| | the example are from individual recipes and show how the PR value is set. |
| INCOMPATIBLE_LICENSE | <p>Specifies a space-separated list of license names (as they would appear in LICENSE) that should be excluded from the build. Recipes that provide no alternatives to listed incompatible licenses are not built. Packages that are individually licensed with the specified incompatible licenses will be deleted.</p> <p>Note</p> <p>This functionality is only regularly tested using the following setting:</p> <pre>INCOMPATIBLE_LICENSE = "GPLv3"</pre> <p>Although you can use other settings, you might be required to remove dependencies on or provide alternatives to components that are required to produce a functional system image.</p> |
| INHIBIT_DEFAULT_DEPS | <p>Prevents the default dependencies, namely the C compiler and standard C library (libc), from being added to DEPENDS. This variable is usually used within recipes that do not require any compilation using the C compiler.</p> <p>Set the variable to "1" to prevent the default dependencies from being added.</p> |
| INHIBIT_PACKAGE_STRIP | <p>If set to "1", causes the build to not strip binaries in resulting packages.</p> |
| INHERIT | <p>Causes the named class to be inherited at this point during parsing. The variable is only valid in configuration files.</p> |
| INITRAMFS_FSTYPES | <p>Defines the format for the output image of an initial RAM disk (initramfs), which is used during boot. Supported formats are the same as those supported by the IMAGE_FSTYPES variable.</p> |
| INITSCRIPT_NAME | <p>The filename of the initscript as installed to <code>\${etcdir}/init.d</code>.</p> <p>This variable is used in recipes when using <code>update-rc.d.bbclass</code>. The variable is Mandatory.</p> |
| INITSCRIPT_PACKAGES | <p>A list of the packages that contain initscripts. If multiple packages are specified, you need to append the package name to the other <code>INITSCRIPT_*</code> as an override.</p> <p>This variable is used in recipes when using <code>update-rc.d.bbclass</code>. The variable is optional and defaults to the <code>PN</code> variable.</p> |
| INITSCRIPT_PARAMS | <p>Specifies the options to pass to <code>update-rc.d</code>. Here is an example:</p> <pre>INITSCRIPT_PARAMS = "start 99 5 2 . stop 20 0 1 6 ."</pre> <p>In this example, the script has a runlevel of 99, starts the script in initlevels 2 and 5, and stops the script in levels 0, 1 and 6.</p> <p>The variable is mandatory and is used in recipes when using <code>update-rc.d.bbclass</code>.</p> |
| INSANE_SKIP | <p>Specifies the QA checks to skip for a specific package within a recipe. For example, to skip the check for symbolic link .so files in the main package of a recipe, add the following to the recipe. The package name override must be used, which in this example is <code>\${PN}</code>:</p> |

```
INSANE_SKIP_${PN} += "dev-so"
```

See the "insane.bbclass" section for a list of the valid QA checks you can specify using this variable.

IPK_FEED_URIS

When the IPK backend is in use and package management is enabled on the target, you can use this variable to set up opkg in the target image to point to package feeds on a nominated server. Once the feed is established, you can perform installations or upgrades using the package manager at runtime.

K

KARCH

Defines the kernel architecture used when assembling the configuration. Architectures supported for this release are:

```
powerpc
i386
x86_64
arm
qemu
mips
```

You define the KARCH variable in the BSP Descriptions [<http://www.yoctoproject.org/docs/1.5/kernel-dev/kernel-dev.html#bsp-descriptions>].

KBRANCH

A regular expression used by the build process to explicitly identify the kernel branch that is validated, patched and configured during a build. The KBRANCH variable is optional. You can use it to trigger checks to ensure the exact kernel branch you want is being used by the build process.

Values for this variable are set in the kernel's recipe file and the kernel's append file. For example, if you are using the Yocto Project kernel that is based on the Linux 3.4 kernel, the kernel recipe file is the meta/recipes-kernel/linux/linux-yocto_3.4.bb file. Following is the default value for KBRANCH and the default override for the architectures the Yocto Project supports:

```
KBRANCH_DEFAULT = "standard/base"
KBRANCH = "${KBRANCH_DEFAULT}"
```

This branch exists in the linux-yocto-3.4 kernel Git repository <http://git.yoctoproject.org/cgi/linux-yocto-3.4/refs/heads>.

This variable is also used from the kernel's append file to identify the kernel branch specific to a particular machine or target hardware. The kernel's append file is located in the BSP layer for a given machine. For example, the kernel append file for the Crown Bay BSP is in the meta-intel Git repository and is named meta-crownbay/recipes-kernel/linux/linux-yocto_3.4.bbappend. Here are the related statements from the append file:

```
COMPATIBLE_MACHINE_crownbay = "crownbay"
KMACHINE_crownbay = "crownbay"
KBRANCH_crownbay = "standard/crownbay"
```

```
COMPATIBLE_MACHINE_crownbay-noemgd = "crownbay-noemgd"
KMACHINE_crownbay-noemgd = "crownbay"
KBRANCH_crownbay-noemgd = "standard/crownbay"
```

The KBRANCH_* statements identify the kernel branch to use when building for the Crown Bay BSP. In this case there are two identical statements: one for each type of Crown Bay machine.

KBRANCH_DEFAULT

Defines the Linux kernel source repository's default branch used to build the Linux kernel. The KBRANCH_DEFAULT value is the default value for KBRANCH. Unless you specify otherwise, KBRANCH_DEFAULT initializes to "master".

KERNEL_EXTRA_ARGS

Specifies additional make command-line arguments the OpenEmbedded build system passes on when compiling the kernel.

KERNEL_FEATURES

Includes additional metadata from the Yocto Project kernel Git repository. In the OpenEmbedded build system, the default Board Support Packages (BSPs) Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] is provided through the KMACHINE and KBRANCH variables. You can use the KERNEL_FEATURES variable to further add metadata for all BSPs.

The metadata you add through this variable includes config fragments and features descriptions, which usually includes patches as well as config fragments. You typically override the KERNEL_FEATURES variable for a specific machine. In this way, you can provide validated, but optional, sets of kernel configurations and features.

For example, the following adds netfilter to all the Yocto Project kernels and adds sound support to the qemu86 machine:

```
# Add netfilter to all linux-yocto kernels
KERNEL_FEATURES="features/netfilter"

# Add sound support to the qemu86 machine
KERNEL_FEATURES_append_qemu86=" cfg/sound"
```

KERNEL_IMAGETYPE

The type of kernel to build for a device, usually set by the machine configuration files and defaults to "zImage". This variable is used when building the kernel and is passed to make as the target to build.

KERNEL_PATH

The location of the kernel sources. This variable is set to the value of the STAGING_KERNEL_DIR within the module.bbclass class. For information on how this variable is used, see the "Incorporating Out-of-Tree Modules" [<http://www.yoctoproject.org/docs/1.5/kernel-dev/kernel-dev.html#incorporating-out-of-tree-modules>] section.

The KERNEL_SRC variable is identical to the KERNEL_PATH variable.

KERNEL_SRC

The location of the kernel sources. This variable is set to the value of the STAGING_KERNEL_DIR within the module.bbclass class. For information on how this variable is used, see the "Incorporating Out-of-Tree Modules" [<http://www.yoctoproject.org/docs/1.5/kernel-dev/kernel-dev.html#incorporating-out-of-tree-modules>] section.

The KERNEL_PATH variable is identical to the KERNEL_SRC variable.

KFEATURE_DESCRIPTION

Provides a short description of a configuration fragment. You use this variable in the .scc file that describes a configuration fragment file. Here is the variable used in a file named smp.scc to describe SMP being enabled:

```
define KFEATURE_DESCRIPTION "Enable SMP"
```

KMACHINE

The machine as known by the kernel. Sometimes the machine name used by the kernel does not match the machine name used by the OpenEmbedded build system. For example, the machine name that the OpenEmbedded build system understands as `qemuarm` goes by a different name in the Linux Yocto kernel. The kernel understands that machine as `arm_versatile926ejs`. For cases like these, the `KMACHINE` variable maps the kernel machine name to the OpenEmbedded build system machine name.

Kernel machine names are initially defined in the Yocto Linux Kernel's meta branch. From the meta branch, look in the `meta/cfg/kernel-cache/bsp/<bsp_name>/<bsp_name>-<kernel-type>.scc` file. For example, from the meta branch in the `linux-yocto-3.0` kernel, the `meta/cfg/kernel-cache/bsp/cedartrail/cedartrail-standard.scc` file has the following:

```
define KMACHINE cedartrail
define KTYPE standard
define KARCH i386

include ktypes/standard
branch cedartrail

include cedartrail.scc
```

You can see that the kernel understands the machine name for the Cedar Trail Board Support Package (BSP) as `cedartrail`.

If you look in the Cedar Trail BSP layer in the meta-intel Source Repositories [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-repositories>] at `meta-cedartrail/recipes-kernel/linux/linux-yocto_3.0.bbappend`, you will find the following statements among others:

```
COMPATIBLE_MACHINE_cedartrail = "cedartrail"
KMACHINE_cedartrail = "cedartrail"
KBRANCH_cedartrail = "yocto/standard/cedartrail"
KERNEL_FEATURES_append_cedartrail += "bsp/cedartrail/cedartrail-p
KERNEL_FEATURES_append_cedartrail += "cfg/efi-ext.scc"

COMPATIBLE_MACHINE_cedartrail-nopvr = "cedartrail"
KMACHINE_cedartrail-nopvr = "cedartrail"
KBRANCH_cedartrail-nopvr = "yocto/standard/cedartrail"
KERNEL_FEATURES_append_cedartrail-nopvr += "cfg/smp.scc"
```

The `KMACHINE` statements in the kernel's append file make sure that the OpenEmbedded build system and the Yocto Linux kernel understand the same machine names.

This append file uses two `KMACHINE` statements. The first is not really necessary but does ensure that the machine known to the OpenEmbedded build system as `cedartrail` maps to the machine in the kernel also known as `cedartrail`:

```
KMACHINE_cedartrail = "cedartrail"
```

The second statement is a good example of why the `KMACHINE` variable is needed. In this example, the OpenEmbedded build system uses the `cedartrail-nopvr` machine name to refer to the Cedar Trail BSP that does not support the proprietary PowerVR driver. The kernel, however, uses the machine name `cedartrail`. Thus, the append file must map the `cedartrail-nopvr` machine name to the kernel's `cedartrail` name:

```
KMACHINE_cedartrail-nopvr = "cedartrail"
```

BSPs that ship with the Yocto Project release provide all mappings between the Yocto Project kernel machine names and the OpenEmbedded machine names. Be sure to use the `KMACHINE` if you create a BSP and the machine name you use is different than that used in the kernel.

KTYPE

Defines the kernel type to be used in assembling the configuration. The linux-yocto recipes define "standard", "tiny", and "preempt-rt" kernel types. See the "Kernel Types [<http://www.yoctoproject.org/docs/1.5/kernel-dev/kernel-dev.html#kernel-types>]" section in the Yocto Project Linux Kernel Development Manual for more information on kernel types.

You define the `KTYPE` variable in the BSP Descriptions [<http://www.yoctoproject.org/docs/1.5/kernel-dev/kernel-dev.html#bsp-descriptions>]. The value you use must match the value used for the `LINUX_KERNEL_TYPE` value used by the kernel recipe.

L

LAYERDEPENDS

Lists the layers that this recipe depends upon, separated by spaces. Optionally, you can specify a specific layer version for a dependency by adding it to the end of the layer name with a colon, (e.g. "anotherlayer:3" to be compared against `LAYERVERSION_anotherlayer` in this case). An error will be produced if any dependency is missing or the version numbers do not match exactly (if specified). This variable is used in the `conf/layer.conf` file and must be suffixed with the name of the specific layer (e.g. `LAYERDEPENDS_mylayer`).

LAYERDIR

When used inside the `layer.conf` configuration file, this variable provides the path of the current layer. This variable is not available outside of `layer.conf` and references are expanded immediately when parsing of the file completes.

LAYERVERSION

Optionally specifies the version of a layer as a single number. You can use this within `LAYERDEPENDS` for another layer in order to depend on a specific version of the layer. This variable is used in the `conf/layer.conf` file and must be suffixed with the name of the specific layer (e.g. `LAYERVERSION_mylayer`).

LIC_FILES_CHKSUM

Checksums of the license text in the recipe source code.

This variable tracks changes in license text of the source code files. If the license text is changed, it will trigger a build failure, which gives the developer an opportunity to review any license change.

This variable must be defined for all recipes (unless `LICENSE` is set to "CLOSED")

For more information, see the [Tracking License Changes](#) section

LICENSE

The list of source licenses for the recipe. Follow these rules:

- Do not use spaces within individual license names.
- Separate license names using | (pipe) when there is a choice between licenses.
- Separate license names using & (ampersand) when multiple licenses exist that cover different parts of the source.
- You can use spaces between license names.

Here are some examples:

```
LICENSE = "LGPLv2.1 | GPLv3"
LICENSE = "MPL-1 & LGPLv2.1"
LICENSE = "GPLv2+"
```

The first example is from the recipes for Qt, which the user may choose to distribute under either the LGPL version 2.1 or GPL version 3. The second example is from Cairo where two licenses cover different parts of the source code. The final example is from sysstat, which presents a single license.

You can also specify licenses on a per-package basis to handle situations where components of the output have different licenses. For example, a piece of software whose code is licensed under GPLv2 but has accompanying documentation licensed under the GNU Free Documentation License 1.2 could be specified as follows:

```
LICENSE = "GFDL-1.2 & GPLv2"
LICENSE_${PN} = "GPLv2"
LICENSE_${PN}-doc = "GFDL-1.2"
```

LICENSE_PATH

Path to additional licenses used during the build. By default, the OpenEmbedded build system uses `COMMON_LICENSE_DIR` to define the directory that holds common license text used during the build. The `LICENSE_PATH` variable allows you to extend that location to other areas that have additional licenses:

```
LICENSE_PATH += "/path/to/additional/common/licenses"
```

LINUX_KERNEL_TYPE

Defines the kernel type to be used in assembling the configuration. The linux-yocto recipes define "standard", "tiny", and "preempt-rt" kernel types. See the "Kernel Types [<http://www.yoctoproject.org/docs/1.5/kernel-dev/kernel-dev.html#kernel-types>]" section in the Yocto Project Linux Kernel Development Manual for more information on kernel types.

If you do not specify a `LINUX_KERNEL_TYPE`, it defaults to "standard". Together with `KMACHINE`, the `LINUX_KERNEL_TYPE` variable defines the search arguments used by the kernel tools to find the appropriate description within the kernel Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>] with which to build out the sources and configuration.

LINUX_VERSION

The Linux version from `kernel.org` on which the Linux kernel image being built using the OpenEmbedded build system is based. You define this variable in the kernel recipe. For example, the `linux-yocto-3.4.bb` kernel recipe found in `meta/recipes-kernel/linux` defines the variables as follows:

```
LINUX_VERSION ?= "3.4.24"
```

The `LINUX_VERSION` variable is used to define PV for the recipe:

```
PV = "${LINUX_VERSION}+git${SRCPV}"
```

LINUX_VERSION_EXTENSION A string extension compiled into the version string of the Linux kernel built with the OpenEmbedded build system. You define this variable in the kernel recipe. For example, the linux-yocto kernel recipes all define the variable as follows:

```
LINUX_VERSION_EXTENSION ?= "-yocto-${LINUX_KERNEL_TYPE}"
```

Defining this variable essentially sets the Linux kernel configuration item `CONFIG_LOCALVERSION`, which is visible through the `uname` command. Here is an example that shows the extension assuming it was set as previously shown:

```
$ uname -r
3.7.0-rc8-custom
```

LOG_DIR Specifies the directory to which the OpenEmbedded build system writes overall log files. The default directory is `${TMPDIR}/log`.

For the directory containing logs specific to each task, see the `T` variable.

M

MACHINE Specifies the target device for which the image is built. You define `MACHINE` in the `local.conf` file found in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]. By default, `MACHINE` is set to "qemux86", which is an x86-based architecture machine to be emulated using QEMU:

```
MACHINE ?= "qemux86"
```

The variable corresponds to a machine configuration file of the same name, through which machine-specific configurations are set. Thus, when `MACHINE` is set to "qemux86" there exists the corresponding `qemux86.conf` machine configuration file, which can be found in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] in `meta/conf/machine`.

The list of machines supported by the Yocto Project as shipped include the following:

```
MACHINE ?= "qemuarm"
MACHINE ?= "qemumips"
MACHINE ?= "qemuappc"
MACHINE ?= "qemux86"
MACHINE ?= "qemux86-64"
MACHINE ?= "genericx86"
```

```
MACHINE ?= "beagleboard"
MACHINE ?= "mpc8315e-rdb"
MACHINE ?= "routerstationpro"
```

The last four are Yocto Project reference hardware boards, which are provided in the meta-yocto-bsp layer.

Note

Adding additional Board Support Package (BSP) layers to your configuration adds new possible settings for MACHINE.

MACHINE_ESSENTIAL_EXTRA_RDEPENDS

A list of required machine-specific packages to install as part of the image being built. The build process depends on these packages being present. Furthermore, because this is a "machine essential" variable, the list of packages are essential for the machine to boot. The impact of this variable affects images based on packagegroup-core-boot, including the core-image-minimal image.

This variable is similar to the MACHINE_ESSENTIAL_EXTRA_RRECOMMENDS variable with the exception that the image being built has a build dependency on the variable's list of packages. In other words, the image will not build if a file in this list is not found.

As an example, suppose the machine for which you are building requires example-init to be run during boot to initialize the hardware. In this case, you would use the following in the machine's .conf configuration file:

```
MACHINE_ESSENTIAL_EXTRA_RDEPENDS += "example-init"
```

MACHINE_ESSENTIAL_EXTRA_RRECOMMENDS

A list of recommended machine-specific packages to install as part of the image being built. The build process does not depend on these packages being present. However, because this is a "machine essential" variable, the list of packages are essential for the machine to boot. The impact of this variable affects images based on packagegroup-core-boot, including the core-image-minimal image.

This variable is similar to the MACHINE_ESSENTIAL_EXTRA_RDEPENDS variable with the exception that the image being built does not have a build dependency on the variable's list of packages. In other words, the image will still build if a package in this list is not found. Typically, this variable is used to handle essential kernel modules, whose functionality may be selected to be built into the kernel rather than as a module, in which case a package will not be produced.

Consider an example where you have a custom kernel where a specific touchscreen driver is required for the machine to be usable. However, the driver can be built as a module or into the kernel depending on the kernel configuration. If the driver is built as a module, you want it to be installed. But, when the driver is built into the kernel, you still want the build to succeed. This variable sets up a "recommends" relationship so that in the latter case, the build will not fail due to the missing package. To accomplish this, assuming the package for the module was called kernel-module-ab123, you would use the following in the machine's .conf configuration file:

```
MACHINE_ESSENTIAL_EXTRA_RRECOMMENDS += "kernel-module-ab123"
```

Some examples of these machine essentials are flash, screen, keyboard, mouse, or touchscreen drivers (depending on the machine).

MACHINE_EXTRA_RDEPENDS

A list of machine-specific packages to install as part of the image being built that are not essential for the machine to boot. However, the build process for more fully-featured images depends on the packages being present.

This variable affects all images based on `packagegroup-base`, which does not include the `core-image-minimal` or `core-image-basic` images.

The variable is similar to the `MACHINE_EXTRA_RRECOMMENDS` variable with the exception that the image being built has a build dependency on the variable's list of packages. In other words, the image will not build if a file in this list is not found.

An example is a machine that has WiFi capability but is not essential for the machine to boot the image. However, if you are building a more fully-featured image, you want to enable the WiFi. The package containing the firmware for the WiFi hardware is always expected to exist, so it is acceptable for the build process to depend upon finding the package. In this case, assuming the package for the firmware was called `wifidriver-firmware`, you would use the following in the `.conf` file for the machine:

```
MACHINE_EXTRA_RDEPENDS += "wifidriver-firmware"
```

MACHINE_EXTRA_RRECOMMENDS

A list of machine-specific packages to install as part of the image being built that are not essential for booting the machine. The image being built has no build dependency on this list of packages.

This variable affects only images based on `packagegroup-base`, which does not include the `core-image-minimal` or `core-image-basic` images.

This variable is similar to the `MACHINE_EXTRA_RDEPENDS` variable with the exception that the image being built does not have a build dependency on the variable's list of packages. In other words, the image will build if a file in this list is not found.

An example is a machine that has WiFi capability but is not essential for the machine to boot the image. However, if you are building a more fully-featured image, you want to enable WiFi. In this case, the package containing the WiFi kernel module will not be produced if the WiFi driver is built into the kernel, in which case you still want the build to succeed instead of failing as a result of the package not being found. To accomplish this, assuming the package for the module was called `kernel-module-examplerwifi`, you would use the following in the `.conf` file for the machine:

```
MACHINE_EXTRA_RRECOMMENDS += "kernel-module-examplerwifi"
```

MACHINE_FEATURES

Specifies the list of hardware features the MACHINE supports. For example, including the "bluetooth" feature causes the `bluez` bluetooth daemon to be built and added to the image. It also causes the `connman` recipe to look at `MACHINE_FEATURES` and when it finds "bluetooth" there it enables the bluetooth support in `ConnMan`.

For a list of features supported by the Yocto Project as shipped, see the "Machine" section.

MACHINE_FEATURES_BACKFILL Features to be added to MACHINE_FEATURES if not also present in MACHINE_FEATURES_BACKFILL_CONSIDERED.

This variable is set in the meta/conf/bitbake.conf file. It is not intended to be user-configurable. It is best to just reference the variable to see which machine features are being backfilled for all machine configurations. See the "Feature backfilling" section for more information.

MACHINE_FEATURES_BACKFILL_CONSIDERED Features from MACHINE_FEATURES_BACKFILL that should not be backfilled (i.e. added to MACHINE_FEATURES) during the build. See the "Feature backfilling" section for more information.

MACHINEOVERRIDES Lists overrides specific to the current machine. By default, this list includes the value of MACHINE. You can extend the list to apply variable overrides for classes of machines. For example, all QEMU emulated machines (e.g. qemuarm, qemux86, and so forth) include a common file named meta/conf/machine/include/qemu.inc that prepends MACHINEOVERRIDES with the following variable override:

```
MACHINEOVERRIDES =. "qemuall:"
```

Applying an override like qemuall affects all QEMU emulated machines elsewhere. Here is an example from the connman-conf recipe:

```
SRC_URI_append_qemuall = "file://wired.config \
                           file://wired-setup \
                           "
```

MAINTAINER The email address of the distribution maintainer.

MIRRORS Specifies additional paths from which the OpenEmbedded build system gets source code. When the build system searches for source code, it first tries the local download directory. If that location fails, the build system tries locations defined by PREMIRRORS, the upstream source, and then locations specified by MIRRORS in that order.

Assuming your distribution (DISTRO) is "poky", the default value for MIRRORS is defined in the conf/distro/poky.conf file in the meta-yocto Git repository.

MLPREFIX Specifies a prefix has been added to PN to create a special version of a recipe or package, such as a Multilib version. The variable is used in places where the prefix needs to be added to or removed from a the name (e.g. the BPN variable). MLPREFIX gets set when a prefix has been added to PN.

MODULE_TARBALL_DEPLOY Controls creation of the modules-*.tgz file. Set this variable to "0" to disable creation of this file, which contains all of the kernel modules resulting from a kernel build.

MULTIMACH_TARGET_SYS Separates files for different machines such that you can build for multiple target machines using the same output directories. See the STAMP variable for an example.

N

NATIVESBSTRING

A string identifying the host distribution. Strings consist of the host distributor ID followed by the release, as reported by the `lsb_release` tool or as read from `/etc/lsb-release`. For example, when running a build on Ubuntu 12.10, the value is "Ubuntu-12.10". If this information is unable to be determined, the value resolves to "Unknown".

This variable is used by default to isolate native shared state packages for different distributions (e.g. to avoid problems with `glibc` version incompatibilities). Additionally, the variable is checked against `SANITY_TESTED_DISTROS` if that variable is set.

NO_RECOMMENDATIONS

Prevents installation of all "recommended-only" packages. Recommended-only packages are packages installed only through the `RRECOMMENDS` variable). Setting the `NO_RECOMMENDATIONS` variable to "1" turns this feature on:

```
NO_RECOMMENDATIONS = "1"
```

You can set this variable globally in your `local.conf` file or you can attach it to a specific image recipe by using the recipe name override:

```
NO_RECOMMENDATIONS_pn-<target_image> = "<package_name>"
```

It is important to realize that if you choose to not install packages using this variable and some other packages are dependent on them (i.e. listed in a recipe's `RDEPENDS` variable), the OpenEmbedded build system ignores your request and will install the packages to avoid dependency errors.

Note

Some recommended packages might be required for certain system functionality, such as kernel modules. It is up to you to add packages with `IMAGE_INSTALL` variable.

Support for this variable exists only when using the IPK and RPM packaging backend. Support does not exist for DEB.

See the `BAD_RECOMMENDATIONS` and the `PACKAGE_EXCLUDE` variables for related information.

O

OE_BINCONFIG_EXTRA_MANGLE When a recipe inherits the `binconfig.bbclass` class, this variable specifies additional arguments passed to the "sed" command. The sed command alters any paths in configuration scripts that have been set up during compilation. Inheriting this class results in all paths in these scripts being changed to point into the `sysroots/` directory so that all builds that use the script will use the correct directories for the cross compiling layout.

See the `meta/classes/binconfig.bbclass` in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] for details on how this class applies these additional sed command arguments. For general information on the `binconfig.bbclass` class, see the "Binary Configuration Scripts - `binconfig.bbclass`" section.

OE_IMPORTS An internal variable used to tell the OpenEmbedded build system what Python modules to import for every Python function run by the system.

Note

Do not set this variable. It is for internal use only.

OE_TERMINAL Controls how the OpenEmbedded build system spawns interactive terminals on the host development system (e.g. using the BitBake command with the `-c devshell` command-line option). For more information, see the "Using a Development Shell [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#platdev-appdev-devshell>]" section in the Yocto Project Development Manual.

You can use the following values for the `OE_TERMINAL` variable:

```
auto
gnome
xfce
rxvt
screen
konsole
none
```

Note

Konsole support only works for KDE 3.x. Also, "auto" is the default behavior for `OE_TERMINAL`.

OEROOT The directory from which the top-level build environment setup script is sourced. The Yocto Project makes two top-level build environment setup scripts available: `oe-init-build-env` and `oe-init-build-env-memres`. When you run one of these scripts, the `OEROOT` variable resolves to the directory that holds the script.

For additional information on how this variable is used, see the initialization scripts.

OLDEST_KERNEL Declares the oldest version of the Linux kernel that the produced binaries must support. This variable is passed into the build of the Embedded GNU C Library (eglibc).

The default for this variable comes from the `meta/conf/bitbake.conf` configuration file. You can override this default by setting the variable in a custom distribution configuration file.

OVERRIDES BitBake uses `OVERRIDES` to control what variables are overridden after BitBake parses recipes and configuration files. You can find more information on how overrides are handled in the BitBake Manual that is located at `bitbake/doc/manual` in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

P

P The recipe name and version. `P` is comprised of the following:

```
${PN} - ${PV}
```

PACKAGE_ARCH The architecture of the resulting package or packages.

PACKAGE_BEFORE_PN Enables easily adding packages to `PACKAGES` before `${PN}` so that the packages can pick up files that would normally be included in the default package.

PACKAGE_CLASSES This variable, which is set in the `local.conf` configuration file found in the `conf` folder of the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>], specifies the package manager to use when packaging data. You can provide one or more arguments for the variable with the first argument being the package manager used to create images:

```
PACKAGE_CLASSES ?= "package_rpm package_deb package_ipk"
```

For information on build performance effects as a result of the package manager use, see `Packaging - package*.bbclass` in this manual.

PACKAGE_EXCLUDE Lists packages that should not be installed into an image. For example:

```
PACKAGE_EXCLUDE = "<package_name> <package_name> <package_name> .
```

You can set this variable globally in your `local.conf` file or you can attach it to a specific image recipe by using the recipe name override:

```
PACKAGE_EXCLUDE_pn-<target_image> = "<package_name>"
```

If you choose to not install a package using this variable and some other package is dependent on it (i.e. listed in a recipe's `RDEPENDS` variable), the OpenEmbedded build system generates a fatal installation error. Because the build system halts the process with a fatal error, you can use the variable with an iterative development process to remove specific components from a system.

Support for this variable exists only when using the IPK and RPM packaging backend. Support does not exist for DEB.

See the `NO_RECOMMENDATIONS` and the `BAD_RECOMMENDATIONS` variables for related information.

PACKAGE_EXTRA_ARCHS Specifies the list of architectures compatible with the device CPU. This variable is useful when you build for several different devices that use miscellaneous processors such as XScale and ARM926-EJS).

PACKAGE_GROUP Defines one or more packages to include in an image when a specific item is included in `IMAGE_FEATURES`. When setting the value, `PACKAGE_GROUP` should have the name of the feature item as an override. Here is an example:

```
PACKAGE_GROUP_widget = "package1 package2"
```

In this example, if `"widget"` were added to `IMAGE_FEATURES`, `"package1"` and `"package2"` would be included in the image.

Note

Packages installed by features defined through `PACKAGE_GROUP` are often package groups. While similarly

named, you should not confuse the `PACKAGE_GROUP` variable with package groups, which are discussed elsewhere in the documentation.

PACKAGE_INSTALL

The final list of packages passed to the package manager for installation into the image. Because the package manager controls actual installation of all packages, the list of packages passed using `PACKAGE_INSTALL` is not the final list of packages that are actually installed.

This variable is internal to the image construction code. Use the `IMAGE_INSTALL` variable to specify packages for installation.

PACKAGECONFIG

This variable provides a means of enabling or disabling features of a recipe on a per-recipe basis. `PACKAGECONFIG` blocks are defined in recipes when you specify features and then arguments that define feature behaviors. Here is the basic block structure:

```
PACKAGECONFIG ??= "f1 f2 f3 ..."
PACKAGECONFIG[f1] = "--with-f1,--without-f1,build-deps-f1,rt-deps
PACKAGECONFIG[f2] = "--with-f2,--without-f2,build-deps-f2,rt-deps
PACKAGECONFIG[f3] = "--with-f3,--without-f3,build-deps-f3,rt-deps
```

The `PACKAGECONFIG` variable itself specifies a space-separated list of the features to enable. Following the features, you can determine the behavior of each feature by providing up to four order-dependent arguments, which are separated by commas. You can omit any argument you like but must retain the separating commas. The order is important and specifies the following:

1. Extra arguments that should be added to the configure script argument list (`EXTRA_OECONF`) if the feature is enabled.
2. Extra arguments that should be added to `EXTRA_OECONF` if the feature is disabled.
3. Additional build dependencies (`DEPENDS`) that should be added if the feature is enabled.
4. Additional runtime dependencies (`RDEPENDS`) that should be added if the feature is enabled.

Consider the following `PACKAGECONFIG` block taken from the `librsvg` recipe. In this example the feature is `croco`, which has three arguments that determine the feature's behavior.

```
PACKAGECONFIG ??= "croco"
PACKAGECONFIG[croco] = "--with-croco,--without-croco,libcroco"
```

The `--with-croco` and `libcroco` arguments apply only if the feature is enabled. In this case, `--with-croco` is added to the configure script argument list and `libcroco` is added to `DEPENDS`. On the other hand, if the feature is disabled say through a `.bbappend` file in another layer, then the second argument `--without-croco` is added to the configure script rather than `--with-croco`.

The basic `PACKAGECONFIG` structure previously described holds true regardless of whether you are creating a block or changing a block. When creating a block, use the structure inside your recipe.

If you want to change an existing `PACKAGECONFIG` block, you can do so one of two ways:

- Append file: Create an append file named <recipename>.bbappend in your layer and override the value of PACKAGECONFIG. You can either completely override the variable:

```
PACKAGECONFIG="f4 f5"
```

Or, you can just amended the variable:

```
PACKAGECONFIG_append = " f4"
```

- Configuration file: This method is identical to changing the block through an append file except you edit your local.conf or <mydistro>.conf file. As with append files previously described, you can either completely override the variable:

```
PACKAGECONFIG_pn-<recipename>="f4 f5"
```

Or, you can just amended the variable:

```
PACKAGECONFIG_append_pn-<recipename> = " f4"
```

PACKAGES

The list of packages to be created from the recipe. The default value is the following:

```
${PN}-dbg ${PN}-staticdev ${PN}-dev ${PN}-doc ${PN}-locale ${PACK
```

PACKAGES_DYNAMIC

A promise that your recipe satisfies runtime dependencies for optional modules that are found in other recipes. PACKAGES_DYNAMIC does not actually satisfy the dependencies, it only states that they should be satisfied. For example, if a hard, runtime dependency (RDEPENDS) of another package is satisfied at build time through the PACKAGES_DYNAMIC variable, but a package with the module name is never actually produced, then the other package will be broken. Thus, if you attempt to include that package in an image, you will get a dependency failure from the packaging system during do_rootfs.

Typically, if there is a chance that such a situation can occur and the package that is not created is valid without the dependency being satisfied, then you should use RRECOMMENDS (a soft runtime dependency) instead of RDEPENDS.

For an example of how to use the PACKAGES_DYNAMIC variable when you are splitting packages, see the "Handling Optional Module Packaging [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#handling-optional-module-packaging>]" section in the Yocto Project Development Manual.

PARALLEL_MAKE

Extra options that are passed to the make command during the do_compile task in order to specify parallel compilation. This variable is usually in the form -j 4, where the number represents the maximum number of parallel threads make can run. If your development host supports multiple cores a good rule of thumb is to set this variable to twice the number of cores on the host.

Note

Individual recipes might clear out this variable if the software being built has problems running its make process in parallel.

PARALLEL_MAKEINST

Extra options passed to the `make install` command during the `do_install` task in order to specify parallel installation. This variable defaults to the value of `PARALLEL_MAKE`.

Note

Individual recipes might clear out this variable if the software being built has problems running its make install process in parallel.

PATCHRESOLVE

Determines the action to take when a patch fails. You can set this variable to one of two values: "noop" and "user".

The default value of "noop" causes the build to simply fail when the OpenEmbedded build system cannot successfully apply a patch. Setting the value to "user" causes the build system to launch a shell and places you in the right location so that you can manually resolve the conflicts.

Set this variable in your `local.conf` file.

PATCHTOOL

Specifies the utility used to apply patches for a recipe during `do_patch`. You can specify one of three utilities: "patch", "quilt", or "git". The default utility used is "quilt" except for the quilt-native recipe itself. Because the quilt tool is not available at the time quilt-native is being patched, it uses "patch".

If you wish to use an alternative patching tool, set the variable in the recipe using one of the following:

```
PATCHTOOL = "patch"
PATCHTOOL = "quilt"
PATCHTOOL = "git"
```

PE

the epoch of the recipe. By default, this variable is unset. The field is used to make upgrades possible when the versioning scheme changes in some backwards incompatible way.

PF

Specifies the recipe or package name and includes all version and revision numbers (i.e. `eglibc-2.13-r20+svnr15508/` and `bash-4.2-r1/`). This variable is comprised of the following:

```
${PN} - ${EXTENDPE} ${PV} - ${PR}
```

PKGD

Points to the destination directory for files to be packaged before they are split into individual packages. This directory defaults to the following:

```
${WORKDIR}/package
```

Do not change this default.

PKGDATA_DIR

Points to a shared, global-state directory that holds data generated during the packaging process. During the packaging process, the `do_packagedata` task packages data for each recipe and installs it into this temporary, shared area.

PKGDEST Points to the parent directory for files to be packaged after they have been split into individual packages. This directory defaults to the following:

`${WORKDIR}/packages-split`

Under this directory, the build system creates directories for each package specified in PACKAGES. Do not change this default.

PKGDESTWORK Points to a temporary work area used by the `do_package` task to write output from the `do_packagedata` task. The `PKGDESTWORK` location defaults to the following:

`${WORKDIR}/pkgdata`

The `do_packagedata` task then packages the data in the temporary work area and installs it into a shared directory pointed to by `PKGDATA_DIR`.

Do not change this default.

PN This variable can have two separate functions depending on the context: a recipe name or a resulting package name.

`PN` refers to a recipe name in the context of a file used by the OpenEmbedded build system as input to create a package. The name is normally extracted from the recipe file name. For example, if the recipe is named `expat_2.0.1.bb`, then the default value of `PN` will be "expat".

The variable refers to a package name in the context of a file created or produced by the OpenEmbedded build system.

If applicable, the `PN` variable also contains any special suffix or prefix. For example, using `bash` to build packages for the native machine, `PN` is `bash-native`. Using `bash` to build packages for the target and for Multilib, `PN` would be `bash` and `lib64-bash`, respectively.

PR The revision of the recipe. The default value for this variable is "r0".

PREFERRED_PROVIDER If multiple recipes provide an item, this variable determines which recipe should be given preference. You should always suffix the variable with the name of the provided item, and you should set it to the `PN` of the recipe to which you want to give precedence. Here is an example:

`PREFERRED_PROVIDER_virtual/xserver = "xserver-xf86"`

PREFERRED_VERSION If there are multiple versions of recipes available, this variable determines which recipe should be given preference. You must always suffix the variable with the `PN` you want to select, and you should set to the `PV` accordingly for precedence. You can use the "%" character as a wildcard to match any number of characters, which can be useful when specifying versions that contain long revision numbers that could potentially change. Here are two examples:

`PREFERRED_VERSION_python = "2.6.6"`
`PREFERRED_VERSION_linux-yocto = "3.0+git%"`

PREMIRRORS

Specifies additional paths from which the OpenEmbedded build system gets source code. When the build system searches for source code, it first tries the local download directory. If that location fails, the build system tries locations defined by PREMIRRORS, the upstream source, and then locations specified by MIRRORS in that order.

Assuming your distribution (DISTR0) is "poky", the default value for PREMIRRORS is defined in the conf/distro/poky.conf file in the meta-yocto Git repository.

Typically, you could add a specific server for the build system to attempt before any others by adding something like the following to the local.conf configuration file in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>]:

```
PREMIRRORS_prepend = "\
git://.*/*.* http://www.yoctoproject.org/sources/ \n \
ftp://.*/*.* http://www.yoctoproject.org/sources/ \n \
http://.*/*.* http://www.yoctoproject.org/sources/ \n \
https://.*/*.* http://www.yoctoproject.org/sources/ \n"
```

These changes cause the build system to intercept Git, FTP, HTTP, and HTTPS requests and direct them to the http:// sources mirror. You can use file:// URLs to point to local directories or network shares as well.

PRINC

Causes the PR variable of .bbappend files to dynamically increment. This increment minimizes the impact of layer ordering.

In order to ensure multiple .bbappend files can co-exist, PRINC should be self referencing. This variable defaults to 0.

Following is an example that increments PR by two:

```
PRINC := "${@int(PRINC) + 2}"
```

It is advisable not to use strings such as ".= '1'" with the variable because this usage is very sensitive to layer ordering. You should avoid explicit assignments as they cannot adequately represent multiple .bbappend files.

PROVIDES

A list of aliases that a recipe also provides. These aliases are useful for satisfying dependencies of other recipes during the build (as specified by DEPENDS).

Note

A recipe's own PN is implicitly already in its PROVIDES list.

PV

The version of the recipe. The version is normally extracted from the recipe filename. For example, if the recipe is named expat_2.0.1.bb, then the default value of PV will be "2.0.1". PV is generally not overridden within a recipe unless it is building an unstable (i.e. development) version from a source code repository (e.g. Git or Subversion).

R

RCONFLICTS

The list of packages that conflict with packages. Note that packages will not be installed if conflicting packages are not first removed.

Like all package-controlling variables, you must always use them in conjunction with a package name override. Here is an example:

```
RCONFLICTS_${PN} = "another-conflicting-package-name"
```

BitBake, which the OpenEmbedded build system uses, supports specifying versioned dependencies. Although the syntax varies depending on the packaging format, BitBake hides these differences from you. Here is the general syntax to specify versions with the RCONFLICTS variable:

```
RCONFLICTS_${PN} = "<package> (<operator> <version>)"
```

For operator, you can specify the following:

```
=  
<  
>  
<=  
>=
```

For example, the following sets up a dependency on version 1.2 or greater of the package foo:

```
RCONFLICTS_${PN} = "foo (>= 1.2)"
```

RDEPENDS

Lists a package's runtime dependencies (i.e. other packages) that must be installed in order for the built package to run correctly. If a package in this list cannot be found during the build, you will get a build error.

When you use the RDEPENDS variable in a recipe, you are essentially stating that the recipe's `do_build` task depends on the existence of a specific package. Consider this simple example for two recipes named "a" and "b" that produce similarly named packages. In this example, the RDEPENDS statement appears in the "a" recipe:

```
RDEPENDS_${PN} = "b"
```

Here, the dependency is such that the `do_build` task for recipe "a" depends on the `do_package_write` task of recipe "b". This means the package file for "b" must be available when the output for recipe "a" has been completely built. More importantly, package "a" will be marked as depending on package "b" in a manner that is understood by the package manager in use (i.e. rpm, opkg, or dpkg).

The names of the packages you list within RDEPENDS must be the names of other packages - they cannot be recipe names. Although package names and recipe names usually match, the important point here is that you are providing package names within the RDEPENDS variable. For an example of the default list of packages created from a recipe, see the PACKAGES variable.

Because the RDEPENDS variable applies to packages being built, you should always use the variable in a form with an attached package name. For example, suppose you are building a development

package that depends on the perl package. In this case, you would use the following RDEPENDS statement:

```
RDEPENDS_${PN}-dev += "perl"
```

In the example, the development package depends on the perl package. Thus, the RDEPENDS variable has the \${PN}-dev package name as part of the variable.

The package name you attach to the RDEPENDS variable must appear as it would in the PACKAGES namespace before any renaming of the output package by classes like `debian.bbclass`.

In many cases you do not need to explicitly add runtime dependencies using RDEPENDS since some automatic handling occurs:

- `shlibdeps`: If a runtime package contains a shared library (`.so`), the build processes the library in order to determine other libraries to which it is dynamically linked. The build process adds these libraries to RDEPENDS when creating the runtime package.
- `pcdeps`: If the package ships a `pkg-config` information file, the build process uses this file to add items to the RDEPENDS variable to create the runtime packages.

BitBake, which the OpenEmbedded build system uses, supports specifying versioned dependencies. Although the syntax varies depending on the packaging format, BitBake hides these differences from you. Here is the general syntax to specify versions with the RDEPENDS variable:

```
RDEPENDS_${PN} = "<package> (<operator> <version>)"
```

For operator, you can specify the following:

```
=  
<  
>  
<=  
>=
```

For example, the following sets up a dependency on version 1.2 or greater of the package `foo`:

```
RDEPENDS_${PN} = "foo (>= 1.2)"
```

For information on build-time dependencies, see the `DEPENDS` variable.

RM_OLD_IMAGE

Reclaims disk space by removing previously built versions of the same image from the `images` directory pointed to by the `DEPLOY_DIR` variable.

Set this variable to "1" in your `local.conf` file to remove these images.

RM_WORK_EXCLUDE With `rm_work` enabled, this variable specifies a list of recipes whose work directories should not be removed. See the "Removing Work Files During the Build - `rm_work.bbclass`" section for more details.

ROOTFS_POSTPROCESS_COMMAND Added by classes to run post processing commands once the OpenEmbedded build system has created the root filesystem. You can specify shell commands separated by semicolons:

```
ROOTFS_POSTPROCESS_COMMAND += "<shell_command>; ... "
```

If you need to pass the path to the root filesystem within the command, you can use `${IMAGE_ROOTFS}`, which points to the root filesystem image.

RPROVIDES A list of package name aliases that a package also provides. These aliases are useful for satisfying runtime dependencies of other packages both during the build and on the target (as specified by `RDEPENDS`).

Note

A package's own name is implicitly already in its `RPROVIDES` list.

As with all package-controlling variables, you must always use the variable in conjunction with a package name override. Here is an example:

```
RPROVIDES_${PN} = "widget-abi-2"
```

RRECOMMENDS A list of packages that extends the usability of a package being built. The package being built does not depend on this list of packages in order to successfully build, but needs them for the extended usability. To specify runtime dependencies for packages, see the `RDEPENDS` variable.

The OpenEmbedded build process automatically installs the list of packages as part of the built package. However, you can remove these packages later if you want. If, during the build, a package from the `RRECOMMENDS` list cannot be found, the build process continues without an error.

You can also prevent packages in the list from being installed by using several variables. See the `BAD_RECOMMENDATIONS`, `NO_RECOMMENDATIONS`, and `PACKAGE_EXCLUDE` variables for more information.

Because the `RRECOMMENDS` variable applies to packages being built, you should always attach an override to the variable to specify the particular package whose usability is being extended. For example, suppose you are building a development package that is extended to support wireless functionality. In this case, you would use the following:

```
RRECOMMENDS_${PN}-dev += "<wireless_package_name>"
```

In the example, the package name (`${PN}-dev`) must appear as it would in the `PACKAGES` namespace before any renaming of the output package by classes such as `debian.bbclass`.

BitBake, which the OpenEmbedded build system uses, supports specifying versioned recommends. Although the syntax varies depending on the packaging format, BitBake hides these differences from you. Here is the general syntax to specify versions with the RRECOMMENDS variable:

```
RRECOMMENDS_${PN} = "<package> (<operator> <version>)"
```

For operator, you can specify the following:

```
=  
<  
>  
<=  
>=
```

For example, the following sets up a recommend on version 1.2 or greater of the package foo:

```
RRECOMMENDS_${PN} = "foo (>= 1.2)"
```

RREPLACES

A list of packages replaced by a package. The package manager uses this variable to determine which package should be installed to replace other package(s) during an upgrade. In order to also have the other package(s) removed at the same time, you must add the name of the other package to the RCONFLICTS variable.

As with all package-controlling variables, you must use this variable in conjunction with a package name override. Here is an example:

```
RREPLACES_${PN} = "other-package-being-replaced"
```

BitBake, which the OpenEmbedded build system uses, supports specifying versioned replacements. Although the syntax varies depending on the packaging format, BitBake hides these differences from you. Here is the general syntax to specify versions with the RREPLACES variable:

```
RREPLACES_${PN} = "<package> (<operator> <version>)"
```

For operator, you can specify the following:

```
=  
<  
>  
<=  
>=
```

For example, the following sets up a replacement using version 1.2 or greater of the package foo:

```
RREPLACES_${PN} = "foo (>= 1.2)"
```

RSUGGESTS A list of additional packages that you can suggest for installation by the package manager at the time a package is installed. Not all package managers support this functionality.

As with all package-controlling variables, you must always use this variable in conjunction with a package name override. Here is an example:

```
RSUGGESTS_${PN} = "useful-package another-package"
```

S

S The location in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] where unpacked recipe source code resides. This location is within the working directory (WORKDIR), which is not static. The unpacked source location depends on the recipe name (PN) and recipe version (PV) as follows:

```
${WORKDIR}/${PN}-${PV}
```

As an example, assume a Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] top-level folder named poky and a default Build Directory at poky/build. In this case, the working directory the build system uses to keep the unpacked recipe for db is the following:

```
~/poky/build/tmp/work/qemux86-poky-linux/db/5.1.19-r3/db-5.1.19
```

SANITY_TESTED_DISTROS A list of the host distribution identifiers that the build system has been tested against. Identifiers consist of the host distributor ID followed by the release, as reported by the `lsb_release` tool or as read from `/etc/lsb-release`. Separate the list items with explicit newline characters (`\n`). If `SANITY_TESTED_DISTROS` is not empty and the current value of `NATIVELSBSTRING` does not appear in the list, then the build system reports a warning that indicates the current host distribution has not been tested as a build host.

SDK_ARCH The target architecture for the SDK. Typically, you do not directly set this variable. Instead, use `SDKMACHINE`.

SDK_NAME The base name for SDK output files. The name is derived from the `DISTRO`, `TCLIBC`, `SDK_ARCH`, `IMAGE_BASENAME`, and `TUNE_PKGARCH` variables:

```
SDK_NAME = "${DISTRO}-${TCLIBC}-${SDK_ARCH}-${IMAGE_BASENAME}-${TUNE_PKGARCH}
```

SDKIMAGE_FEATURES Equivalent to `IMAGE_FEATURES`. However, this variable applies to the SDK generated from an image using the following command:

```
$ bitbake -c populate_sdk imagename
```

SDKMACHINE The architecture of the machine that runs Application Development Toolkit (ADT) items. In other words, packages are built so that they will run on the target you specify with the argument. This implies that

you can build out ADT/SDK items that run on an architecture other than that of your build host. For example, you can use an x86_64-based build host to create packages that will run on an i686-based SDK Machine.

You can use "i686" and "x86_64" as possible values for this variable. The variable defaults to "i686" and is set in the `local.conf` file in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>].

```
SDKMACHINE ?= "i686"
```

SECTION The section in which packages should be categorized. Package management utilities can make use of this variable.

SELECTED_OPTIMIZATION The variable takes the value of `FULL_OPTIMIZATION` unless `DEBUG_BUILD = "1"`. In this case the value of `DEBUG_OPTIMIZATION` is used.

SERIAL_CONSOLE Defines a serial console (TTY) to enable using getty. Provide a value that specifies the baud rate followed by the TTY device name separated by a space. You cannot specify more than one TTY device:

```
SERIAL_CONSOLE = "115200 ttyS0"
```

Note

The `SERIAL_CONSOLE` variable is deprecated. Please use the `SERIAL_CONSOLES` variable.

SERIAL_CONSOLES Defines the serial consoles (TTYs) to enable using getty. Provide a value that specifies the baud rate followed by the TTY device name separated by a semicolon. Use spaces to separate multiple devices:

```
SERIAL_CONSOLES = "115200;ttyS0 115200;ttyS1"
```

SERIAL_CONSOLES_CHECK Similar to `SERIAL_CONSOLES` except the device is checked for existence before attempting to enable it. This variable is currently only supported with SysVinit (i.e. not with systemd).

SIGGEN_EXCLUDE_SAFE_RECIPE_DEPS List of recipe dependencies that should not be used to determine signatures of tasks from one recipe when they depend on tasks from another recipe. For example:

```
SIGGEN_EXCLUDE_SAFE_RECIPE_DEPS += "intone->mplayer2"
```

In this example, `intone` depends on `mplayer2`.

Use of this variable is one mechanism to remove dependencies that affect task signatures and thus force rebuilds when a recipe changes.

Caution

If you add an inappropriate dependency for a recipe relationship, the software might break during runtime if the interface of the second recipe was changed after the first recipe had been built.

SIGGEN_EXCLUDERECIPIES_ABIS List of recipes that are completely stable and will never change. The ABI for the recipes in the list are presented by output from the tasks run to build the recipe. Use of this variable is one way to remove

dependencies from one recipe on another that affect task signatures and thus force rebuilds when the recipe changes.

Caution

If you add an inappropriate variable to this list, the software might break at runtime if the interface of the recipe was changed after the other had been built.

| | |
|---------------------|---|
| SITEINFO_BITS | Specifies the number of bits for the target system CPU. The value should be either "32" or "64". |
| SITEINFO_ENDIANNESS | Specifies the endian byte order of the target system. The value should be either "le" for little-endian or "be" for big-endian. |
| SOC_FAMILY | Groups together machines based upon the same family of SOC (System On Chip). You typically set this variable in a common .inc file that you include in the configuration files of all the machines. |

Note

You must include `conf/machine/include/soc-family.inc` for this variable to appear in `MACHINEOVERRIDES`.

| | |
|-------------------|--|
| SOLIBS | <p>Defines the suffix for shared libraries used on the target platform. By default, this suffix is ".so.*" for all Linux-based systems and is defined in the <code>meta/conf/bitbake.conf</code> configuration file.</p> <p>You will see this variable referenced in the default values of <code>FILES_\${PN}</code>.</p> |
| SOLIBSDEV | <p>Defines the suffix for the development symbolic link (symlink) for shared libraries on the target platform. By default, this suffix is ".so" for Linux-based systems and is defined in the <code>meta/conf/bitbake.conf</code> configuration file.</p> <p>You will see this variable referenced in the default values of <code>FILES_\${PN}-dev</code>.</p> |
| SPECIAL_PKGSUFFIX | A list of prefixes for PN used by the OpenEmbedded build system to create variants of recipes or packages. The list specifies the prefixes to strip off during certain circumstances such as the generation of the BPN variable. |
| SRC_URI | The list of source files - local or remote. This variable tells the OpenEmbedded build system which bits to pull in for the build and how to pull them in. For example, if the recipe or append file only needs to fetch a tarball from the Internet, the recipe or append file uses a single SRC_URI entry. On the other hand, if the recipe or append file needs to fetch a tarball, apply two patches, and include a custom file, the recipe or append file would include four instances of the variable. |

The following list explains the available URI protocols:

- `file://` - Fetches files, which are usually files shipped with the Metadata [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#metadata>], from the local machine. The path is relative to the `FILESPATH` variable. Thus, the build system searches, in order, from the following directories, which are assumed to be subdirectories of the directory in which the recipe file (.bb) or append file (.bbappend) resides:
 - `${BPN}` - The base recipe name without any special suffix or version numbers.
 - `${BP}` - `${BPN}-${PV}`. The base recipe name and version but without any special package name suffix.

- `files` - Files within a directory, which is named `files` and is also alongside the recipe or append file.

Note

If you want the build system to pick up files specified through a `SRC_URI` statement from your append file, you need to be sure to extend the `FILESPATH` variable by also using the `FILESEXTRAPATHS` variable from within your append file.

- `bzr://` - Fetches files from a Bazaar revision control repository.
- `git://` - Fetches files from a Git revision control repository.
- `osc://` - Fetches files from an OSC (OpenSUSE Build service) revision control repository.
- `repo://` - Fetches files from a repo (Git) repository.
- `svk://` - Fetches files from an SVK revision control repository.
- `http://` - Fetches files from the Internet using `http`.
- `https://` - Fetches files from the Internet using `https`.
- `ftp://` - Fetches files from the Internet using `ftp`.
- `cvs://` - Fetches files from a CVS revision control repository.
- `hg://` - Fetches files from a Mercurial (`hg`) revision control repository.
- `p4://` - Fetches files from a Perforce (`p4`) revision control repository.
- `ssh://` - Fetches files from a secure shell.
- `svn://` - Fetches files from a Subversion (`svn`) revision control repository.

Standard and recipe-specific options for `SRC_URI` exist. Here are standard options:

- `apply` - Whether to apply the patch or not. The default action is to apply the patch.
- `striplevel` - Which `striplevel` to use when applying the patch. The default level is 1.
- `patchdir` - Specifies the directory in which the patch should be applied. The default is `${S}`.

Here are options specific to recipes building code from a revision control system:

- `mindate` - Apply the patch only if `SRCDATE` is equal to or greater than `mindate`.
- `maxdate` - Apply the patch only if `SRCDATE` is not later than `mindate`.
- `minrev` - Apply the patch only if `SRCREV` is equal to or greater than `minrev`.
- `maxrev` - Apply the patch only if `SRCREV` is not later than `maxrev`.
- `rev` - Apply the patch only if `SRCREV` is equal to `rev`.
- `notrev` - Apply the patch only if `SRCREV` is not equal to `rev`.

Here are some additional options worth mentioning:

- `unpack` - Controls whether or not to unpack the file if it is an archive. The default action is to unpack the file.
- `subdir` - Places the file (or extracts its contents) into the specified subdirectory of `WORKDIR`. This option is useful for unusual tarballs or other archives that do not have their files already in a subdirectory within the archive.
- `name` - Specifies a name to be used for association with `SRC_URI` checksums when you have more than one file specified in `SRC_URI`.
- `downloadfilename` - Specifies the filename used when storing the downloaded file.

`SRC_URI_OVERRIDES_PACKAGE_ARCH`

By default, the OpenEmbedded build system automatically detects whether `SRC_URI` contains files that are machine-specific. If so, the build system automatically changes `PACKAGE_ARCH`. Setting this variable to "0" disables this behavior.

`SRCDATE`

The date of the source code used to build the package. This variable applies only if the source was fetched from a Source Code Manager (SCM).

`SRCPV`

Returns the version string of the current package. This string is used to help define the value of `PV`.

The `SRCPV` variable is defined in the `meta/conf/bitbake.conf` configuration file in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] as follows:

```
SRCPV = "${@bb.fetch2.get_srcrev(d)}"
```

Recipes that need to define `PV` do so with the help of the `SRCPV`. For example, the `ofono` recipe (`ofono_git.bb`) located in `meta/recipes-connectivity` in the Source Directory defines `PV` as follows:

```
PV = "1.5.0+git${SRCPV}"
```

`SRCREV`

The revision of the source code used to build the package. This variable applies to Subversion, Git, Mercurial and Bazaar only. Note that if you wish to build a fixed revision and you wish to avoid performing a query on the remote repository every time BitBake parses your recipe, you should specify a `SRCREV` that is a full revision identifier and not just a tag.

`SSTATE_DIR`

The directory for the shared state cache.

`SSTATE_MIRRORS`

Configures the OpenEmbedded build system to search other mirror locations for prebuilt cache data objects before building out the data. This variable works like `fetcher MIRRORS` and `PREMIRRORS` and points to the cache locations to check for the shared objects.

You can specify a filesystem directory or a remote URL such as HTTP or FTP. The locations you specify need to contain the shared state cache (`sstate-cache`) results from previous builds. The `sstate-cache` you point to can also be from builds on other machines.

If a mirror uses the same structure as `SSTATE_DIR`, you need to add "PATH" at the end as shown in the examples below. The build system substitutes the correct path within the directory structure.

```
SSTATE_MIRRORS ?= "\n\
file://.* http://someserver.tld/share/sstate/PATH \n \
file://.* file:///some/local/dir/sstate/PATH"
```

STAGING_KERNEL_DIR The directory with kernel headers that are required to build out-of-tree modules.

STAMP Specifies the base path used to create recipe stamp files. The path to an actual stamp file is constructed by evaluating this string and then appending additional information. Currently, the default assignment for `STAMP` as set in the `meta/conf/bitbake.conf` file is:

```
STAMP = "${STAMPS_DIR}/${MULTIMACH_TARGET_SYS}/${PN}/${EXTENDPE}${PV}
```

See `STAMPS_DIR`, `MULTIMACH_TARGET_SYS`, `PN`, `EXTENDPE`, `PV`, and `PR` for related variable information.

STAMPS_DIR Specifies the base directory in which the OpenEmbedded build system places stamps. The default directory is `${TMPDIR}/stamps`.

SUMMARY The short (72 characters or less) summary of the binary package for packaging systems such as `opkg`, `rpm` or `dpkg`. By default, `SUMMARY` is used to define the `DESCRIPTION` variable if `DESCRIPTION` is not set in the recipe.

SYSROOT_PREPROCESS_FUNCS A list of functions to execute after files are staged into the `sysroot`. These functions are usually used to apply additional processing on the staged files, or to stage additional files.

T

T This variable points to a directory where BitBake places temporary files, which consist mostly of task logs and scripts, when building a particular recipe. The variable is typically set as follows:

```
T = "${WORKDIR}/temp"
```

The `WORKDIR` is the directory into which BitBake unpacks and builds the recipe. The default `bitbake.conf` file sets this variable.

The `T` variable is not to be confused with the `TMPDIR` variable, which points to the root of the directory tree where BitBake places the output of an entire build.

TARGET_ARCH The target machine's architecture. The OpenEmbedded build system supports many architectures. Here is an example list of architectures supported. This list is by no means complete as the architecture is configurable:

```
arm
i586
x86_64
powerpc
powerpc64
mips
```

mipsel

| | |
|---------------|--|
| TARGET_CFLAGS | Flags passed to the C compiler for the target system. This variable evaluates to the same as CFLAGS. |
| TARGET_FPU | Specifies the method for handling FPU code. For FPU-less targets, which include most ARM CPUs, the variable must be set to "soft". If not, the kernel emulation gets used, which results in a performance penalty. |
| TARGET_OS | Specifies the target's operating system. The variable can be set to "linux" for glibc-based systems and to "linux-uclibc" for uclibc. For ARM/EABI targets, there are also "linux-gnueabi" and "linux-uclibc-gnueabi" values possible. |
| TCLIBC | Specifies which variant of the GNU standard C library (libc) to use during the build process. This variable replaces POKYLIBC, which is no longer supported. |

You can select eglibc or uclibc.

Note

This release of the Yocto Project does not support the glibc implementation of libc.

| | |
|--------|--|
| TCMODE | <p>The toolchain selector. This variable replaces POKYMODE, which is no longer supported.</p> <p>The TCMODE variable selects the external toolchain built using the OpenEmbedded build system or a few supported combinations of the upstream GCC or CodeSourcery Labs toolchain. The variable identifies the tcmode-* files used in the meta/conf/distro/include directory, which is found in the Source Directory [http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory].</p> <p>By default, TCMODE is set to "default", which chooses the tcmode-default.inc file. The variable is similar to TCLIBC, which controls the variant of the GNU standard C library (libc) used during the build process: eglibc or uclibc.</p> |
|--------|--|

| | |
|------------|--|
| TEST_IMAGE | Automatically runs the series of automated tests for images when an image is successfully built. |
|------------|--|

Note

Currently, there is only support for running these tests under QEMU.

These tests are written in Python making use of the unittest module, and the majority of them run commands on the target system over ssh. You can set this variable to "1" in your local.conf file in the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] to have the OpenEmbedded build system automatically run these tests after an image successfully builds:

```
TEST_IMAGE = "1"
```

For more information on enabling, running, and writing these tests, see the "Performing Automated Runtime Testing" [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#performing-automated-runtime-testing>] section in the Yocto Project Development Manual and the "testimage.bbclass" section.

TEST_QEMUBOOT_TIMEOUT The time in seconds allowed for an image to boot before automated runtime tests begin to run against an image. The default timeout period to allow the boot process to reach the login prompt is 500 seconds. You can specify a different value in the `local.conf` file.

For more information on testing images, see the "Performing Automated Runtime Testing [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#performing-automated-runtime-testing>]" section in the Yocto Project Development Manual.

TEST_SUITES An ordered list of tests (modules) to run against an image when performing automated runtime testing.

The OpenEmbedded build system provides a core set of tests that can be used against images.

Note

Currently, there is only support for running these tests under QEMU.

Tests include ping, ssh, df among others. You can add your own tests to the list of tests by appending `TEST_SUITES` as follows:

```
TEST_SUITES_append = " mytest"
```

Alternatively, you can provide the "auto" option to have all applicable tests run against the image.

```
TEST_SUITES_append = " auto"
```

Using this option causes the build system to automatically run tests that are applicable to the image. Tests that are not applicable are skipped.

The order in which tests are run is important. Tests that depend on another test must appear later in the list than the test on which they depend. For example, if you append the list of tests with two tests (`test_A` and `test_B`) where `test_B` is dependent on `test_A`, then you must order the tests as follows:

```
TEST_SUITES = " test_A test_B"
```

For more information on testing images, see the "Performing Automated Runtime Testing [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#performing-automated-runtime-testing>]" section in the Yocto Project Development Manual.

THISDIR The directory in which the file BitBake is currently parsing is located. Do not manually set this variable.

TMPDIR This variable is the base directory the OpenEmbedded build system uses for all build output and intermediate files (other than the shared state cache). By default, the `TMPDIR` variable points to `tmp` within the Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>].

If you want to establish this directory in a location other than the default, you can uncomment and edit the following statement in the `conf/local.conf` file in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>]:

```
#TMPDIR = "${TOPDIR}/tmp"
```

| | |
|------------------------|--|
| TOOLCHAIN_HOST_TASK | <p>This variable lists packages the OpenEmbedded build system uses when building an SDK, which contains a cross-development environment. The packages specified by this variable are part of the toolchain set that runs on the SDKMACHINE, and each package should usually have the prefix "nativesdk-". When building an SDK using <code>bitbake -c populate_sdk <imagename></code>, a default list of packages is set in this variable, but you can add additional packages to the list.</p> <p>For background information on cross-development toolchains in the Yocto Project development environment, see the "Cross-Development Toolchain Generation" section. For information on setting up a cross-development environment, see the "Installing the ADT and Toolchains [http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html#installing-the-adt]" section in the Yocto Project Application Developer's Guide.</p> |
| TOOLCHAIN_TARGET_TASK | <p>This variable lists packages the OpenEmbedded build system uses when it creates the target part of an SDK (i.e. the part built for the target hardware), which includes libraries and headers.</p> <p>For background information on cross-development toolchains in the Yocto Project development environment, see the "Cross-Development Toolchain Generation" section. For information on setting up a cross-development environment, see the "Installing the ADT and Toolchains [http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html#installing-the-adt]" section in the Yocto Project Application Developer's Guide.</p> |
| TOPDIR | <p>This variable points to the Build Directory [http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory]. BitBake automatically sets this variable.</p> |
| TRANSLATED_TARGET_ARCH | <p>A sanitized version of TARGET_ARCH. This variable is used where the architecture is needed in a value where underscores are not allowed, for example within package filenames. In this case, dash characters replace any underscore characters used in TARGET_ARCH.</p> <p>Do not edit this variable.</p> |
| TUNE_PKGARCH | <p>The package architecture understood by the packaging system to define the architecture, ABI, and tuning of output packages.</p> |

U

| | |
|-------------------|---|
| UBOOT_ENTRYPOINT | <p>Specifies the entry point for the U-Boot image. During U-Boot image creation, the UBOOT_ENTRYPOINT variable is passed as a command-line parameter to the <code>uboot-mkimage</code> utility.</p> |
| UBOOT_LOADADDRESS | <p>Specifies the load address for the U-Boot image. During U-Boot image creation, the UBOOT_LOADADDRESS variable is passed as a command-line parameter to the <code>uboot-mkimage</code> utility.</p> |
| UBOOT_MACHINE | <p>Specifies the value passed on the make command line when building a U-Boot image. The value indicates the target platform configuration. You typically set this variable from the machine configuration file (i.e. <code>conf/machine/<machine_name>.conf</code>).</p> |
| UBOOT_TARGET | <p>Specifies the target used for building U-Boot. The target is passed directly as part of the "make" command (e.g. SPL and AIS). If you do</p> |

not specifically set this variable, the OpenEmbedded build process passes and uses "all" for the target during the U-Boot building process.

USER_CLASSES

A list of classes to globally inherit. These classes are used by the OpenEmbedded build system to enable extra features (e.g. buildstats, image-mklibs, and so forth).

The default list is set in your local.conf file:

```
USER_CLASSES ?= "buildstats image-mklibs image-prelink"
```

For more information, see meta-yocto/conf/local.conf.sample in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

W

WARN_QA

Specifies the quality assurance checks whose failures are reported as warnings by the OpenEmbedded build system. You set this variable in your distribution configuration file. For a list of the checks you can control with this variable, see the "insane.bbclass" section.

WORKDIR

The pathname of the working directory in which the OpenEmbedded build system builds a recipe. This directory is located within the TMPDIR directory structure and changes as different packages are built.

The actual WORKDIR directory depends on several things:

- The temporary directory - TMPDIR
- The package architecture - PACKAGE_ARCH
- The target machine - MACHINE
- The target operating system - TARGET_OS
- The recipe name - PN
- The recipe version - PV
- The recipe revision - PR

For packages that are not dependent on a particular machine, WORKDIR is defined as follows:

```
${TMPDIR}/work/${PACKAGE_ARCH}-poky-${TARGET_OS}/${PN}/${PV}-${PR}
```

As an example, assume a Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>] top-level folder name poky and a default Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] at poky/build. In this case, the working directory the build system uses to build the v86d package is the following:

```
~/poky/build/tmp/work/qemux86-poky-linux/v86d/01.9-r0
```

For packages that are dependent on a particular machine, WORKDIR is defined slightly different:

`${TMPDIR}/work/${MACHINE}-poky-${TARGET_OS}/${PN}/${PV}-${PR}`

As an example, again assume a Source Directory top-level folder named poky and a default Build Directory at poky/build. In this case, the working directory the build system uses to build the acl recipe, which is being built for a MIPS-based device, is the following:

`~/poky/build/tmp/work/mips-poky-linux/acl/2.2.51-r2`

Chapter 12. Variable Context

While you can use most variables in almost any context such as `.conf`, `.bbclass`, `.inc`, and `.bb` files, some variables are often associated with a particular locality or context. This chapter describes some common associations.

12.1. Configuration

The following subsections provide lists of variables whose context is configuration: distribution, machine, and local.

12.1.1. Distribution (Distro)

This section lists variables whose configuration context is the distribution, or distro.

- `DISTRO`
- `DISTRO_NAME`
- `DISTRO_VERSION`
- `MAINTAINER`
- `PACKAGE_CLASSES`
- `TARGET_OS`
- `TARGET_FPU`
- `TCMODE`
- `TCLIBC`

12.1.2. Machine

This section lists variables whose configuration context is the machine.

- `TARGET_ARCH`
- `SERIAL_CONSOLES`
- `PACKAGE_EXTRA_ARCHS`
- `IMAGE_FSTYPES`
- `MACHINE_FEATURES`
- `MACHINE_EXTRA_RDEPENDS`
- `MACHINE_EXTRA_RRECOMMENDS`
- `MACHINE_ESSENTIAL_EXTRA_RDEPENDS`
- `MACHINE_ESSENTIAL_EXTRA_RRECOMMENDS`

12.1.3. Local

This section lists variables whose configuration context is the local configuration through the `local.conf` file.

- `DISTRO`
- `MACHINE`
- `DL_DIR`

- BBFILES
- EXTRA_IMAGE_FEATURES
- PACKAGE_CLASSES
- BB_NUMBER_THREADS
- BBINCLUDELOGS
- ENABLE_BINARY_LOCALE_GENERATION

12.2. Recipes

The following subsections provide lists of variables whose context is recipes: required, dependencies, path, and extra build information.

12.2.1. Required

This section lists variables that are required for recipes.

- LICENSE
- LIC_FILES_CHKSUM
- SRC_URI - used in recipes that fetch local or remote files.

12.2.2. Dependencies

This section lists variables that define recipe dependencies.

- DEPENDS
- RDEPENDS
- RRECOMMENDS
- RCONFLICTS
- RREPLACES

12.2.3. Paths

This section lists variables that define recipe paths.

- WORKDIR
- S
- FILES

12.2.4. Extra Build Information

This section lists variables that define extra build information for recipes.

- EXTRA_OECMAKE
- EXTRA_OECONF
- EXTRA_OEMAKE
- PACKAGES
- DEFAULT_PREFERENCE

Chapter 13. FAQ

13.1. How does Poky differ from OpenEmbedded [<http://www.openembedded.org/>]?

The term "Poky [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#poky>]" refers to the specific reference build system that the Yocto Project provides. Poky is based on OE-Core [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#oe-core>] and BitBake [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#bitbake-term>]. Thus, the generic term used here for the build system is the "OpenEmbedded build system." Development in the Yocto Project using Poky is closely tied to OpenEmbedded, with changes always being merged to OE-Core or BitBake first before being pulled back into Poky. This practice benefits both projects immediately.

13.2. I only have Python 2.4 or 2.5 but BitBake requires Python 2.6 or 2.7. Can I still use the Yocto Project?

You can use a stand-alone tarball to provide Python 2.6. You can find pre-built 32 and 64-bit versions of Python 2.6 at the following locations:

- 32-bit tarball [<http://downloads.yoctoproject.org/releases/miscsupport/python-nativesdk-standalone-i686.tar.bz2>]
- 64-bit tarball [http://downloads.yoctoproject.org/releases/miscsupport/python-nativesdk-standalone-x86_64.tar.bz2]

These tarballs are self-contained with all required libraries and should work on most Linux systems. To use the tarballs extract them into the root directory and run the appropriate command:

```
$ export PATH=/opt/poky/sysroots/i586-pokysdk-linux/usr/bin:$PATH
$ export PATH=/opt/poky/sysroots/x86_64-pokysdk-linux/usr/bin:$PATH
```

Once you run the command, BitBake uses Python 2.6.

13.3. How can you claim Poky / OpenEmbedded-Core is stable?

There are three areas that help with stability;

- The Yocto Project team keeps OE-Core [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#oe-core>] small and focused, containing around 830 recipes as opposed to the thousands available in other OpenEmbedded community layers. Keeping it small makes it easy to test and maintain.
- The Yocto Project team runs manual and automated tests using a small, fixed set of reference hardware as well as emulated targets.
- The Yocto Project uses an autobuilder, which provides continuous build and integration tests.

13.4. How do I get support for my board added to the Yocto Project?

Support for an additional board is added by creating a Board Support Package (BSP) layer for it. For more information on how to create a BSP layer, see the "Understanding and Creating Layers [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#understanding-and-creating-layers>]" section in the Yocto Project Development Manual and the Yocto Project Board Support Package (BSP) Developer's Guide [<http://www.yoctoproject.org/docs/1.5/bsp-guide/bsp-guide.html>].

Usually, if the board is not completely exotic, adding support in the Yocto Project is fairly straightforward.

13.5. Are there any products built using the OpenEmbedded build system?

The software running on the Vernier LabQuest [<http://vernier.com/labquest/>] is built using the OpenEmbedded build system. See the Vernier LabQuest [<http://www.vernier.com/products/>]

interfaces/labq/] website for more information. There are a number of pre-production devices using the OpenEmbedded build system and the Yocto Project team announces them as soon as they are released.

13.6. What does the OpenEmbedded build system produce as output?

Because you can use the same set of recipes to create output of various formats, the output of an OpenEmbedded build depends on how you start it. Usually, the output is a flashable image ready for the target device.

13.7. How do I add my package to the Yocto Project?

To add a package, you need to create a BitBake recipe. For information on how to add a package, see the section "Writing a Recipe to Add a Package to Your Image [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#usingpoky-extend-addpkg>]" in the Yocto Project Development Manual.

13.8. Do I have to reflash my entire board with a new Yocto Project image when recompiling a package?

The OpenEmbedded build system can build packages in various formats such as IPK for OPKG, Debian package (.deb), or RPM. You can then upgrade the packages using the package tools on the device, much like on a desktop distribution such as Ubuntu or Fedora. However, package management on the target is entirely optional.

13.9. What is GNOME Mobile and what is the difference between GNOME Mobile and GNOME?

GNOME Mobile is a subset of the GNOME [<http://www.gnome.org>] platform targeted at mobile and embedded devices. The main difference between GNOME Mobile and standard GNOME is that desktop-orientated libraries have been removed, along with deprecated libraries, creating a much smaller footprint.

13.10. I see the error 'chmod: XXXXX new permissions are r-xrwxrwx, not r-xr-xr-x'. What is wrong?

You are probably running the build on an NTFS filesystem. Use ext2, ext3, or ext4 instead.

13.11. How do I make the Yocto Project work in RHEL/CentOS?

To get the Yocto Project working under RHEL/CentOS 5.1 you need to first install some required packages. The standard CentOS packages needed are:

- "Development tools" (selected during installation)
- texi2html
- compat-gcc-34

On top of these, you need the following external packages:

- python-sqlite2 from DAG repository [<http://dag.wieers.com/rpm/packages/python-sqlite2/>]
- help2man from Karan repository [http://centos.karan.org/el4/extras/stable/x86_64/RPMS/repodata/repoview/help2man-0-1.33.1-2.html]

Once these packages are installed, the OpenEmbedded build system will be able to build standard images. However, there might be a problem with the QEMU emulator segfaulting. You can either disable the generation of binary locales by setting `ENABLE_BINARY_LOCALE_GENERATION` to "0" or by removing the `linux-2.6-execshield.patch` from the kernel and rebuilding it since that is the patch that causes the problems with QEMU.

Note

For information on distributions that the Yocto Project uses during validation, see the Distribution Support [https://wiki.yoctoproject.org/wiki/Distribution_Support] Wiki page.

For notes about using the Yocto Project on a RHEL 4-based host, see the Building on RHEL4 [<https://wiki.yoctoproject.org/wiki/BuildingOnRHEL4>] Wiki page.

- 13.12] see lots of 404 responses for files on <http://www.yoctoproject.org/sources/> *. Is something wrong?

Nothing is wrong. The OpenEmbedded build system checks any configured source mirrors before downloading from the upstream sources. The build system does this searching for both source archives and pre-checked out versions of SCM-managed software. These checks help in large installations because it can reduce load on the SCM servers themselves. The address above is one of the default mirrors configured into the build system. Consequently, if an upstream source disappears, the team can place sources there so builds continue to work.

- 13.13] I have machine-specific data in a package for one machine only but the package is being marked as machine-specific in all cases, how do I prevent this?

Set `SRC_URI_OVERRIDES_PACKAGE_ARCH = "0"` in the `.bb` file but make sure the package is manually marked as machine-specific for the case that needs it. The code that handles `SRC_URI_OVERRIDES_PACKAGE_ARCH` is in the `meta/classes/base.bbclass` file.

- 13.14] I'm behind a firewall and need to use a proxy server. How do I do that?

Most source fetching by the OpenEmbedded build system is done by `wget` and you therefore need to specify the proxy settings in a `.wgetrc` file in your home directory. Here are some example settings:

```
http_proxy = http://proxy.yoyodyne.com:18023/
ftp_proxy = http://proxy.yoyodyne.com:18023/
```

The Yocto Project also includes a `site.conf.sample` file that shows how to configure CVS and Git proxy servers if needed.

- 13.15] What's the difference between `foo` and `foo-native`?

The `*-native` targets are designed to run on the system being used for the build. These are usually tools that are needed to assist the build in some way such as `quilt-native`, which is used to apply patches. The non-native version is the one that runs on the target device.

- 13.16] I'm seeing random build failures. Help?!

If the same build is failing in totally different and random ways, the most likely explanation is:

- The hardware you are running the build on has some problem.
- You are running the build under virtualization, in which case the virtualization probably has bugs.

The OpenEmbedded build system processes a massive amount of data that causes lots of network, disk and CPU activity and is sensitive to even single-bit failures in any of these areas. True random failures have always been traced back to hardware or virtualization issues.

- 13.17] What do we need to ship for license compliance?

This is a difficult question and you need to consult your lawyer for the answer for your specific case. It is worth bearing in mind that for GPL compliance, there needs to be enough information shipped to allow someone else to rebuild and produce the same end result you are shipping. This means sharing the source code, any patches applied to it, and also any configuration information about how that package was configured and built.

You can find more information on licensing in the "Licensing" [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#licensing>] and "Maintaining Open Source License Compliance During Your Product's Lifecycle" [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#maintaining-open-source-license-compliance-during-your-products-lifecycle>] sections, both of which are in the Yocto Project Development Manual.

13.18. How do I disable the cursor on my touchscreen device?

You need to create a form factor file as described in the "Miscellaneous BSP-Specific Recipe Files [<http://www.yoctoproject.org/docs/1.5/bsp-guide/bsp-guide.html#bsp-filelayout-misc-recipes>]" section in the Yocto Project Board Support Packages (BSP) Developer's Guide. Set the `HAVE_TOUCHSCREEN` variable equal to one as follows:

```
HAVE_TOUCHSCREEN=1
```

13.19. How do I make sure connected network interfaces are brought up by default?

The default interfaces file provided by the netbase recipe does not automatically bring up network interfaces. Therefore, you will need to add a BSP-specific netbase that includes an interfaces file. See the "Miscellaneous BSP-Specific Recipe Files [<http://www.yoctoproject.org/docs/1.5/bsp-guide/bsp-guide.html#bsp-filelayout-misc-recipes>]" section in the Yocto Project Board Support Packages (BSP) Developer's Guide for information on creating these types of miscellaneous recipe files.

For example, add the following files to your layer:

```
meta-MACHINE/recipes-bsp/netbase/netbase/MACHINE/interfaces
meta-MACHINE/recipes-bsp/netbase/netbase_5.0.bbappend
```

13.20. How do I create images with more free space?

By default, the OpenEmbedded build system creates images that are 1.3 times the size of the populated root filesystem. To affect the image size, you need to set various configurations:

- **Image Size:** The OpenEmbedded build system uses the `IMAGE_R00TFS_SIZE` variable to define the size of the image in Kbytes. The build system determines the size by taking into account the initial root filesystem size before any modifications such as requested size for the image and any requested additional free disk space to be added to the image.
- **Overhead:** Use the `IMAGE_OVERHEAD_FACTOR` variable to define the multiplier that the build system applies to the initial image size, which is 1.3 by default.
- **Additional Free Space:** Use the `IMAGE_R00TFS_EXTRA_SPACE` variable to add additional free space to the image. The build system adds this space to the image after it determines its `IMAGE_R00TFS_SIZE`.

13.21. Why don't you support directories with spaces in the pathnames?

The Yocto Project team has tried to do this before but too many of the tools the OpenEmbedded build system depends on, such as `autoconf`, break when they find spaces in pathnames. Until that situation changes, the team will not support spaces in pathnames.

13.22. How do I use an external toolchain?

The toolchain configuration is very flexible and customizable. It is primarily controlled with the `TCMODE` variable. This variable controls which `tcmode-*.inc` file to include from the `meta/conf/distro/include` directory within the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].

The default value of `TCMODE` is "default" (i.e. `tcmode-default.inc`). However, other patterns are accepted. In particular, "external-*" refers to external toolchains of which there are some basic examples included in the OpenEmbedded Core (meta). You can use your own custom toolchain definition in your own layer (or as defined in the `local.conf` file) at the location `conf/distro/include/tcmode-*.inc`.

In addition to the toolchain configuration, you also need a corresponding toolchain recipe file. This recipe file needs to package up any pre-built objects in the toolchain such as `libgcc`, `libstdc++`, any locales, and `libc`. An example is the `external-sourcery-toolchain.bb`, which is located in `meta/recipes-core/meta/` within the Source Directory.

For information on installing and using cross-development toolchains, see the "Installing the ADT and Toolchains [<http://www.yoctoproject.org/docs/1.5/adt-manual/adt-manual.html#installing-the-adt>]" section in the Yocto Project Application Developer's Guide. For general information on cross-development toolchains, see the "Cross-Development Toolchain Generation" section.

13.23 How does the OpenEmbedded build system obtain source code and will it work behind my firewall or proxy server?

The way the build system obtains source code is highly configurable. You can setup the build system to get source code in most environments if HTTP transport is available.

When the build system searches for source code, it first tries the local download directory. If that location fails, Poky tries PREMIRRORS, the upstream source, and then MIRRORS in that order.

Assuming your distribution is "poky", the OpenEmbedded build system uses the Yocto Project source PREMIRRORS by default for SCM-based sources, upstreams for normal tarballs, and then falls back to a number of other mirrors including the Yocto Project source mirror if those fail.

As an example, you could add a specific server for the build system to attempt before any others by adding something like the following to the `local.conf` configuration file:

```
PREMIRRORS_prepend = "\
git://.*/* http://www.yoctoproject.org/sources/ \n \
ftp://.*/* http://www.yoctoproject.org/sources/ \n \
http://.*/* http://www.yoctoproject.org/sources/ \n \
https://.*/* http://www.yoctoproject.org/sources/ \n"
```

These changes cause the build system to intercept Git, FTP, HTTP, and HTTPS requests and direct them to the `http://sources` mirror. You can use `file://` URLs to point to local directories or network shares as well.

Aside from the previous technique, these options also exist:

```
BB_NO_NETWORK = "1"
```

This statement tells BitBake to issue an error instead of trying to access the Internet. This technique is useful if you want to ensure code builds only from local sources.

Here is another technique:

```
BB_FETCH_PREMIRRORONLY = "1"
```

This statement limits the build system to pulling source from the PREMIRRORS only. Again, this technique is useful for reproducing builds.

Here is another technique:

```
BB_GENERATE_MIRROR_TARBALLS = "1"
```

This statement tells the build system to generate mirror tarballs. This technique is useful if you want to create a mirror server. If not, however, the technique can simply waste time during the build.

Finally, consider an example where you are behind an HTTP-only firewall. You could make the following changes to the `local.conf` configuration file as long as the PREMIRRORS server is current:

```
PREMIRRORS_prepend = "\
ftp://.*/*.* http://www.yoctoproject.org/sources/ \n \
http://.*/*.* http://www.yoctoproject.org/sources/ \n \
https://.*/*.* http://www.yoctoproject.org/sources/ \n"
BB_FETCH_PREMIRRORONLY = "1"
```

These changes would cause the build system to successfully fetch source over HTTP and any network accesses to anything other than the PREMIRRORS would fail.

The build system also honors the standard shell environment variables `http_proxy`, `ftp_proxy`, `https_proxy`, and `all_proxy` to redirect requests through proxy servers.

13.24. Can I get rid of build output so I can start over?

Yes - you can easily do this. When you use BitBake to build an image, all the build output goes into the directory created when you run the build environment setup script (i.e. `oe-init-build-env` or `oe-init-build-env-memres`). By default, this Build Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#build-directory>] is named `build` but can be named anything you want.

Within the Build Directory, is the `tmp` directory. To remove all the build output yet preserve any source code or downloaded files from previous builds, simply remove the `tmp` directory.

Chapter 14. Contributing to the Yocto Project

14.1. Introduction

The Yocto Project team is happy for people to experiment with the Yocto Project. A number of places exist to find help if you run into difficulties or find bugs. To find out how to download source code, see the "Yocto Project Release [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#local-yp-release>]" section in the Yocto Project Development Manual.

14.2. Tracking Bugs

If you find problems with the Yocto Project, you should report them using the Bugzilla application at <http://bugzilla.yoctoproject.org>.

14.3. Mailing lists

A number of mailing lists maintained by the Yocto Project exist as well as related OpenEmbedded mailing lists for discussion, patch submission and announcements. To subscribe to one of the following mailing lists, click on the appropriate URL in the following list and follow the instructions:

- <http://lists.yoctoproject.org/listinfo/yocto> - General Yocto Project discussion mailing list.
- <http://lists.linuxtogo.org/cgi-bin/mailman/listinfo/openembedded-core> - Discussion mailing list about OpenEmbedded-Core (the core metadata).
- <http://lists.linuxtogo.org/cgi-bin/mailman/listinfo/openembedded-devel> - Discussion mailing list about OpenEmbedded.
- <http://lists.linuxtogo.org/cgi-bin/mailman/listinfo/bitbake-devel> - Discussion mailing list about the BitBake [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#bitbake-term>] build tool.
- <http://lists.yoctoproject.org/listinfo/poky> - Discussion mailing list about Poky [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#poky>].
- <http://lists.yoctoproject.org/listinfo/yocto-announce> - Mailing list to receive official Yocto Project release and milestone announcements.

14.4. Internet Relay Chat (IRC)

Two IRC channels on freenode are available for the Yocto Project and Poky discussions:

- #yocto
- #poky

14.5. Links

Here is a list of resources you will find helpful:

- The Yocto Project website [<http://www.yoctoproject.org>]: The home site for the Yocto Project.
- Intel Corporation [<http://www.intel.com/>]: The company who acquired OpenedHand in 2008 and began development on the Yocto Project.
- OpenEmbedded [<http://www.openembedded.org>]: The upstream, generic, embedded distribution used as the basis for the build system in the Yocto Project. Poky derives from and contributes back to the OpenEmbedded project.

- BitBake [<http://developer.berlios.de/projects/bitbake/>]: The tool used to process metadata.
- BitBake User Manual: A comprehensive guide to the BitBake tool. You can find the BitBake User Manual in the `bitbake/doc/manual` directory, which is found in the Source Directory [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#source-directory>].
- QEMU [<http://wiki.qemu.org/Index.html>]: An open source machine emulator and virtualizer.

14.6. Contributions

The Yocto Project gladly accepts contributions. You can submit changes to the project either by creating and sending pull requests, or by submitting patches through email. For information on how to do both as well as information on how to find out who is the maintainer for areas of code, see the "How to Submit a Change [<http://www.yoctoproject.org/docs/1.5/dev-manual/dev-manual.html#how-to-submit-a-change>]" section in the Yocto Project Development Manual.