

# **BitBake User Manual**

**BitBake Team**

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# BitBake User Manual

by BitBake Team

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# Chapter 1. Introduction

## Overview

BitBake is, at its simplest, a tool for executing tasks and managing metadata. As such, its similarities to GNU make and other build tools are readily apparent. It was inspired by Portage, the package management system used by the Gentoo Linux distribution. BitBake is the basis of the OpenEmbedded [<http://www.openembedded.org/>] project, which is being used to build and maintain a number of embedded Linux distributions, including OpenZaurus and Familiar.

## Background and Goals

Prior to BitBake, no other build tool adequately met the needs of an aspiring embedded Linux distribution. All of the buildsystems used by traditional desktop Linux distributions lacked important functionality, and none of the ad-hoc *buildroot* systems, prevalent in the embedded space, were scalable or maintainable.

Some important goals for BitBake were:

- Handle crosscompilation.
- Handle interpackage dependencies (build time on target architecture, build time on native architecture, and runtime).
- Support running any number of tasks within a given package, including, but not limited to, fetching upstream sources, unpacking them, patching them, configuring them, et cetera.
- Must be linux distribution agnostic (both build and target).
- Must be architecture agnostic
- Must support multiple build and target operating systems (including cygwin, the BSDs, etc).
- Must be able to be self contained, rather than tightly integrated into the build machine's root filesystem.
- There must be a way to handle conditional metadata (on target architecture, operating system, distribution, machine).
- It must be easy for the person using the tools to supply their own local metadata and packages to operate against.
- Must make it easy to collaborate between multiple projects using BitBake for their builds.
- Should provide an inheritance mechanism to share common metadata between many packages.
- Et cetera...

BitBake satisfies all these and many more. Flexibility and power have always been the priorities. It is highly extensible, supporting embedded Python code and execution of any arbitrary tasks.

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# Chapter 2. Metadata

## Description

BitBake metadata can be classified into 3 major areas:

- Configuration Files
- .bb Files
- Classes

What follows are a large number of examples of BitBake metadata. Any syntax which isn't supported in any of the aforementioned areas will be documented as such.

## Basic variable setting

```
VARIABLE = "value"
```

In this example, VARIABLE is value.

## Variable expansion

BitBake supports variables referencing one another's contents using a syntax which is similar to shell scripting

```
A = "aval"
B = "pre${A}post"
```

This results in A containing aval and B containing preavalpost.

## Immediate variable expansion (:=)

:= results in a variable's contents being expanded immediately, rather than when the variable is actually used.

```
T = "123"
A := "${B} ${A} test ${T}"
T = "456"
B = "${T} bval"
```

```
C = "cval"
C := "${C}append"
```

In that example, A would contain test 123, B would contain 456 bval, and C would be cvalappend.

## Appending (+=) and prepending (+=)

```
B = "bval"
B += "additionaldata"
C = "cval"
C += "test"
```

In this example, B is now `bval additionaldata` and C is `test cval`.

## Appending (.=) and prepending (.=) without spaces

```
B = "bval"
B .= "additionaldata"
C = "cval"
C =. "test"
```

In this example, B is now `bvaladditionaldata` and C is `testcval`. In contrast to the above Appending and Prepending operators no additional space will be introduced.

## Conditional metadata set

OVERRIDES is a “:” separated variable containing each item you want to satisfy conditions. So, if you have a variable which is conditional on “arm”, and “arm” is in OVERRIDES, then the “arm” specific version of the variable is used rather than the non-conditional version. Example:

```
OVERRIDES = "architecture:os:machine"
TEST = "defaultvalue"
TEST_os = "osspecificvalue"
TEST_condnotinoverrides = "othercondvalue"
```

In this example, TEST would be `osspecificvalue`, due to the condition “os” being in OVERRIDES.

## Conditional appending

BitBake also supports appending and prepending to variables based on whether something is in OVERRIDES. Example:

```
DEPENDS = "glibc ncurses"
OVERRIDES = "machine:local"
DEPENDS_append_machine = " libmad"
```

In this example, DEPENDS is set to `glibc ncurses libmad`.

## Inclusion

Next, there is the `include` directive, which causes BitBake to parse in whatever file you specify, and insert it at that location, which is not unlike **make**. However, if the path specified on the `include` line is a relative path, BitBake will locate the first one it can find within BBPATH.

## Requiring Inclusion

In contrast to the `include` directive, `require` will raise an `ParseError` if the to be included file can not be found. Otherwise it will behave just like the `include` directive.

## Python variable expansion

```
DATE = "${@time.strftime('%Y%m%d',time.gmtime())}"
```

This would result in the `DATE` variable containing today's date.

## Defining executable metadata

*NOTE:* This is only supported in `.bb` and `.bbclass` files.

```
do_mytask () {  
    echo "Hello, world!"  
}
```

This is essentially identical to setting a variable, except that this variable happens to be executable shell code.

```
python do_printdate () {  
    import time  
    print time.strftime('%Y%m%d', time.gmtime())  
}
```

This is the similar to the previous, but flags it as python so that BitBake knows it is python code.

## Defining python functions into the global python namespace

*NOTE:* This is only supported in `.bb` and `.bbclass` files.

```
def get_depends(bb, d):  
    if bb.data.getVar('SOMECONDITION', d, True):  
        return "dependencywithcond"  
    else:  
        return "dependency"
```

```
SOMECONDITION = "1"  
DEPENDS = "${@get_depends(bb, d)}"
```

This would result in `DEPENDS` containing `dependencywithcond`.

## Variable Flags

Variables can have associated flags which provide a way of tagging extra information onto a variable. Several flags are used internally by bitbake but they can be used externally too if needed. The standard operations mentioned above also work on flags.

```
VARIABLE[SOMEFLAG] = "value"
```

In this example, `VARIABLE` has a flag, `SOMEFLAG` which is set to `value`.

## Inheritance

*NOTE:* This is only supported in `.bb` and `.bbclass` files.

The `inherit` directive is a means of specifying what classes of functionality your `.bb` requires. It is a rudimentary form of inheritance. For example, you can easily abstract out the tasks involved in building a



package that uses autoconf and automake, and put that into a bbclass for your packages to make use of. A given bbclass is located by searching for classes/filename.oeclass in BBPATH, where filename is what you inherited.

## Tasks

*NOTE:* This is only supported in .bb and .bbclass files.

In BitBake, each step that needs to be run for a given .bb is known as a task. There is a command `addtask` to add new tasks (must be a defined python executable metadata and must start with “do\_”) and describe intertask dependencies.

```
python do_printdate () {
    import time
    print time.strftime('%Y%m%d', time.gmtime())
}
```

```
addtask printdate before do_build
```

This defines the necessary python function and adds it as a task which is now a dependency of `do_build` (the default task). If anyone executes the `do_build` task, that will result in `do_printdate` being run first.

## Events

*NOTE:* This is only supported in .bb and .bbclass files.

BitBake allows to install event handlers. Events are triggered at certain points during operation, such as, the beginning of operation against a given .bb, the start of a given task, task failure, task success, et cetera. The intent was to make it easy to do things like email notifications on build failure.

```
addhandler myclass_eventhandler
python myclass_eventhandler() {
    from bb.event import NotHandled, getName
    from bb import data

    print "The name of the Event is %s" % getName(e)
    print "The file we run for is %s" % data.getVar('FILE', e.data, True)

    return NotHandled
}
```

This event handler gets called every time an event is triggered. A global variable `e` is defined. `e.data` contains an instance of `bb.data`. With the `getName(e)` method one can get the name of the triggered event.

The above event handler prints the name of the event and the content of the `FILE` variable.

## Dependency Handling

Bitbake 1.7.x onwards works with the metadata at the task level since this is optimal when dealing with multiple threads of execution. A robust method of specifying task dependencies is therefore needed.

### Dependencies internal to the .bb file

Where the dependencies are internal to a given .bb file, the dependencies are handled by the previously detailed addtask directive.

## DEPENDS

DEPENDS is taken to specify build time dependencies. The 'deptask' flag for tasks is used to signify the task of each DEPENDS which must have completed before that task can be executed.

```
do_configure[deptask] = "do_populate_staging"
```

means the do\_populate\_staging task of each item in DEPENDS must have completed before do\_configure can execute.

## RDEPENDS

RDEPENDS is taken to specify runtime dependencies. The 'rdeptask' flag for tasks is used to signify the task of each RDEPENDS which must have completed before that task can be executed.

```
do_package_write[rdeptask] = "do_package"
```

means the do\_package task of each item in RDEPENDS must have completed before do\_package\_write can execute.

## Recursive DEPENDS

These are specified with the 'recdeptask' flag and is used signify the task(s) of each DEPENDS which must have completed before that task can be executed. It applies recursively so also, the DEPENDS of each item in the original DEPENDS must be met and so on.

## Recursive RDEPENDS

These are specified with the 'recrdeptask' flag and is used signify the task(s) of each RDEPENDS which must have completed before that task can be executed. It applies recursively so also, the RDEPENDS of each item in the original RDEPENDS must be met and so on. It also runs all DEPENDS first too.

## Inter Task

The 'depends' flag for tasks is a more generic form of which allows an interdependency on specific tasks rather than specifying the data in DEPENDS or RDEPENDS.

```
do_patch[depends] = "quilt-native:do_populate_staging"
```

means the do\_populate\_staging task of the target quilt-native must have completed before the do\_patch can execute.

## Parsing

### Configuration Files

The first of the classifications of metadata in BitBake is configuration metadata. This metadata is global, and therefore affects *all* packages and tasks which are executed. Currently, BitBake has hardcoded knowledge of

a single configuration file. It expects to find 'conf/bitbake.conf' somewhere in the user specified `BBPATH`. That configuration file generally has include directives to pull in any other metadata (generally files specific to architecture, machine, *local* and so on).

Only variable definitions and include directives are allowed in .conf files.

## Classes

BitBake classes are our rudimentary inheritance mechanism. As briefly mentioned in the metadata introduction, they're parsed when an `inherit` directive is encountered, and they are located in `classes/` relative to the `dirs` in `BBPATH`.

## .bb Files

A BitBake (.bb) file is a logical unit of tasks to be executed. Normally this is a package to be built. Inter-.bb dependencies are obeyed. The files themselves are located via the `BBFILES` variable, which is set to a space separated list of .bb files, and does handle wildcards.

---

# Chapter 3. File Download support

## Overview

BitBake provides support to download files this procedure is called fetching. The SRC\_URI is normally used to indicate BitBake which files to fetch. The next sections will describe the available fetchers and the options they have. Each Fetcher honors a set of Variables and a per URI parameters separated by a “;” consisting of a key and a value. The semantic of the Variables and Parameters are defined by the Fetcher. BitBake tries to have a consistent semantic between the different Fetchers.

## Local File Fetcher

The URN for the Local File Fetcher is *file*. The filename can be either absolute or relative. If the filename is relative FILESPATH and FILESDIR will be used to find the appropriate relative file depending on the OVERRIDES. Single files and complete directories can be specified.

```
SRC_URI= "file://relativefile.patch"
SRC_URI= "file://relativefile.patch;this=ignored"
SRC_URI= "file:///Users/ich/very_important_software"
```

## CVS File Fetcher

The URN for the CVS Fetcher is *cvs*. This Fetcher honors the variables DL\_DIR, SRCDATE, FETCHCOMMAND\_cvs, UPDATECOMMAND\_cvs. DL\_DIRS specifies where a temporary checkout is saved, SRCDATE specifies which date to use when doing the fetching (the special value of "now" will cause the checkout to be updated on every build), FETCHCOMMAND and UPDATECOMMAND specify which executables should be used when doing the CVS checkout or update.

The supported Parameters are module, tag, date, method, localdir, rsh. The module specifies which module to check out, the tag describes which CVS TAG should be used for the checkout by default the TAG is empty. A date can be specified to override the SRCDATE of the configuration to checkout a specific date. The special value of "now" will cause the checkout to be updated on every build. method is by default *pserver*, if *ext* is used the rsh parameter will be evaluated and CVS\_RSH will be set. Finally localdir is used to checkout into a special directory relative to CVSDIR>.

```
SRC_URI = "cvs://CVSROOT;module=mymodule;tag=some-version;method=ext "
SRC_URI = "cvs://CVSROOT;module=mymodule;date=20060126;localdir=usethat "
```

## HTTP/FTP Fetcher

The URNs for the HTTP/FTP are *http*, *https* and *ftp*. This Fetcher honors the variables DL\_DIR, FETCHCOMMAND\_wget, PREMIRRORS, MIRRORS. The DL\_DIR defines where to store the fetched file, FETCHCOMMAND contains the command used for fetching. “\${URI}” and “\${FILES}” will be replaced by the uri and basename of the to be fetched file. PREMIRRORS will be tried first when fetching a file if that fails the actual file will be tried and finally all MIRRORS will be tried.

The only supported Parameter is md5sum. After a fetch the md5sum of the file will be calculated and the two sums will be compared.

```
SRC_URI = "http://oe.handhelds.org/not_there.aac;md5sum=12343"
SRC_URI = "ftp://oe.handhelds.org/not_there_as_well.aac;md5sum=1234"
```

```
SRC_URI = "ftp://you@oe.handheld.sorg/home/you/secret.plan;md5sum=1234"
```

## SVK Fetcher

*Currently NOT supported*

## SVN Fetcher

The URN for the SVN Fetcher is *svn*.

This Fetcher honors the variables `FETCHCOMMAND_svn`, `DL_DIR`, `SRCDATE`. `FETCHCOMMAND` contains the subversion command, `DL_DIR` is the directory where tarballs will be saved, `SRCDATE` specifies which date to use when doing the fetching (the special value of "now" will cause the checkout to be updated on every build).

The supported Parameters are *proto*, *rev*. *proto* is the subversion prototype, *rev* is the subversions revision.

```
SRC_URI = "svn://svn.oe.handhelds.org/svn;module=vip;proto=http;rev=667"  
SRC_URI = "svn://svn.oe.handhelds.org/svn/module=opie;proto=svn+ssh;date=20060126"
```

## GIT Fetcher

The URN for the GIT Fetcher is *git*.

The Variables `DL_DIR`, `GITDIR` are used. `DL_DIR` will be used to store the checkedout version. `GITDIR` will be used as the base directory where the git tree is cloned to.

The Parameters are *tag*, *protocol*. *tag* is a git tag, the default is "master". *protocol* is the git protocol to use and defaults to "rsync".

```
SRC_URI = "git://git.oe.handhelds.org/git/vip.git;tag=version-1"  
SRC_URI = "git://git.oe.handhelds.org/git/vip.git;protocol=http"
```

---

# Chapter 4. Commands

## bbread

bbread is a command for displaying BitBake metadata. When run with no arguments, it has the core parse 'conf/bitbake.conf', as located in BBPATH, and displays that. If you supply a file on the commandline, such as a .bb, then it parses that afterwards, using the aforementioned configuration metadata.

*NOTE: the stand a lone bbread command was removed. Instead of bbread use bitbake -e.*

## bitbake

### Introduction

bitbake is the primary command in the system. It facilitates executing tasks in a single .bb file, or executing a given task on a set of multiple .bb files, accounting for interdependencies amongst them.

### Usage and Syntax

```
$ bitbake --help
usage: bitbake [options] [package ...]
```

Executes the specified task (default is 'build') for a given set of BitBake files.

It expects that BBFILES is defined, which is a space separated list of files to be executed. BBFILES does support wildcards.

Default BBFILES are the .bb files in the current directory.

options:

<code>--version</code>	show program's version number and exit
<code>-h, --help</code>	show this help message and exit
<code>-b BUILDFILE, --buildfile=BUILDFILE</code>	execute the task against this .bb file, rather than a package from BBFILES.
<code>-k, --continue</code>	continue as much as possible after an error. While the target that failed, and those that depend on it, cannot be remade, the other dependencies of these targets can be processed all the same.
<code>-f, --force</code>	force run of specified cmd, regardless of stamp status
<code>-i, --interactive</code>	drop into the interactive mode also called the BitBake shell.
<code>-c CMD, --cmd=CMD</code>	Specify task to execute. Note that this only executes the specified task for the providee and the packages it depends on, i.e. 'compile' does not implicitly call stage for the dependencies (IOW: use only if you know what you are doing). Depending on the base.bbclass a listtasks tasks is defined and will show available tasks
<code>-r FILE, --read=FILE</code>	read the specified file before bitbake.conf
<code>-v, --verbose</code>	output more chit-chat to the terminal
<code>-D, --debug</code>	Increase the debug level. You can specify this more than once.
<code>-n, --dry-run</code>	don't execute, just go through the motions
<code>-p, --parse-only</code>	quit after parsing the BB files (developers only)
<code>-d, --disable-psyco</code>	disable using the psyco just-in-time compiler (not

```
recommended)
-s, --show-versions  show current and preferred versions of all packages
-e, --environment    show the global or per-package environment (this is
                      what used to be bbread)
-g, --graphviz       emit the dependency trees of the specified packages in
                      the dot syntax
-I IGNORED_DOT_DEPS, --ignore-deps=IGNORED_DOT_DEPS
                      Stop processing at the given list of dependencies when
                      generating dependency graphs. This can help to make
                      the graph more appealing
-l DEBUG_DOMAINS, --log-domains=DEBUG_DOMAINS
                      Show debug logging for the specified logging domains
```

### Example 4.1. Executing a task against a single .bb

Executing tasks for a single file is relatively simple. You specify the file in question, and bitbake parses it and executes the specified task (or “build” by default). It obeys intertask dependencies when doing so.

“clean” task:

```
$ bitbake -b blah_1.0.bb -c clean
```

“build” task:

```
$ bitbake -b blah_1.0.bb
```

### Example 4.2. Executing tasks against a set of .bb files

There are a number of additional complexities introduced when one wants to manage multiple .bb files. Clearly there needs to be a way to tell bitbake what files are available, and of those, which we want to execute at this time. There also needs to be a way for each .bb to express its dependencies, both for build time and runtime. There must be a way for the user to express their preferences when multiple .bb’s provide the same functionality, or when there are multiple versions of a .bb.

The next section, Metadata, outlines how one goes about specifying such things.

Note that the bitbake command, when not using --buildfile, accepts a PROVIDER, not a filename or anything else. By default, a .bb generally PROVIDES its packagename, packagename-version, and packagename-version-revision.

```
$ bitbake blah
```

```
$ bitbake blah-1.0
```

```
$ bitbake blah-1.0-r0
```

```
$ bitbake -c clean blah
```

```
$ bitbake virtual/whatever
```

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

### Example 4.3. Generating dependency graphs

BitBake is able to generate dependency graphs using the dot syntax. These graphs can be converted to images using the dot application from graphviz [<http://www.graphviz.org>]. Two files will be written into the current working directory, *depends.dot* containing dependency information at the package level and *task-depends.dot* containing a breakdown of the dependencies at the task level. To stop depending on common depends one can use the `-I` depend to omit these from the graph. This can lead to more readable graphs. E.g. this way `DEPENDS` from inherited classes, e.g. `base.bbclass`, can be removed from the graph.

```
$ bitbake -g blah
```

```
$ bitbake -g -I virtual/whatever -I bloom blah
```

## Special variables

Certain variables affect bitbake operation:

### **BB\_NUMBER\_THREADS**

The number of threads bitbake should run at once (default: 1).

## Metadata

As you may have seen in the usage information, or in the information about .bb files, the `BBFILES` variable is how the bitbake tool locates its files. This variable is a space separated list of files that are available, and supports wildcards.

### Example 4.4. Setting BBFILES

```
BBFILES = "/path/to/bbfiles/*.bb"
```

With regard to dependencies, it expects the .bb to define a `DEPENDS` variable, which contains a space separated list of “package names”, which themselves are the `PN` variable. The `PN` variable is, in general, by default, set to a component of the .bb filename.

### Example 4.5. Depending on another .bb

a.bb:

```
PN = "package-a"  
DEPENDS += "package-b"
```

b.bb:



```
PN = "package-b"
```

### Example 4.6. Using PROVIDES

This example shows the usage of the PROVIDES variable, which allows a given .bb to specify what functionality it provides.

package1.bb:

```
PROVIDES += "virtual/package"
```

package2.bb:

```
DEPENDS += "virtual/package"
```

package3.bb:

```
PROVIDES += "virtual/package"
```

As you can see, here there are two different .bb's that provide the same functionality (virtual/package). Clearly, there needs to be a way for the person running bitbake to control which of those providers gets used. There is, indeed, such a way.

The following would go into a .conf file, to select package1:

```
PREFERRED_PROVIDER_virtual/package = "package1"
```

### Example 4.7. Specifying version preference

When there are multiple “versions” of a given package, bitbake defaults to selecting the most recent version, unless otherwise specified. If the .bb in question has a DEFAULT\_PREFERENCE set lower than the other .bb's (default is 0), then it will not be selected. This allows the person or persons maintaining the repository of .bb files to specify their preferences for the default selected version. In addition, the user can specify their preferences with regard to version.

If the first .bb is named a\_1.1.bb, then the PN variable will be set to “a”, and the PV variable will be set to 1.1.

If we then have an a\_1.2.bb, bitbake will choose 1.2 by default. However, if we define the following variable in a .conf that bitbake parses, we can change that.

```
PREFERRED_VERSION_a = "1.1"
```

### Example 4.8. Using “bbfile collections”

bbfile collections exist to allow the user to have multiple repositories of bbfiles that contain the same exact package. For example, one could easily use them to make one's own local copy of an upstream repository, but with custom modifications that one does not want upstream. Usage:

```
BBFILES = "/stuff/openembedded/*/*.bb /stuff/openembedded.modified/*/*.bb"
BBFILE_COLLECTIONS = "upstream local"
BBFILE_PATTERN_upstream = "^/stuff/openembedded/"
BBFILE_PATTERN_local = "^/stuff/openembedded.modified/"
BBFILE_PRIORITY_upstream = "5"
BBFILE_PRIORITY_local = "10"
```