

Silicon Blade

Yocto is more than BitBake

A shallow dive into some of the tools and utilities

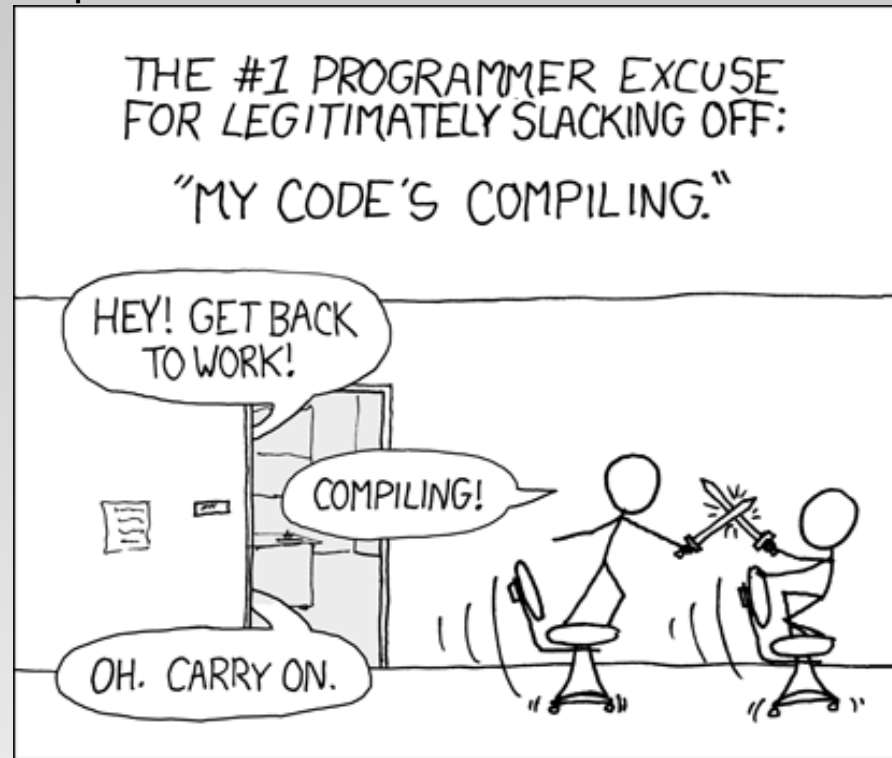
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- Linux & Unix Consultant for over 30 years
- Created Silicon Blade Consultants
- Embedded Linux Consultant and Trainer for over 15 years
- Spend my days building applications and systems with The Yocto Project



What to do while Building?

<https://xkcd.com/303>



As a student of Historical European Martial Arts
this seems like a good option!

Or... Examine your Tools

Most people know about tools like `devtool`

But Poky comes with many useful scripts that often get overlooked

Take a look at:

- `./poky/scripts`
- `./poky/scripts/contrib`

Setup VSCode (Scarthgap+)

```
./poky/scripts/oe-setup-vscode
```

Adds useful configuration settings to your .vscode directory

Done by `oe-init-build-env` but only if you have VSCode installed

```
$ oe-setup-vscode /home/ming/wip/training/yocto-training .  
You had no /home/ming/wip/training/yocto-training/.vscode configuration.  
These configuration files have therefore been created for you.
```

settings.json

```
"bitbake.pathToBitbakeFolder": "${workspaceFolder}/bitbake",  
"bitbake.pathToEnvScript": "${workspaceFolder}/oe-init-build-env",  
"bitbake.pathToBuildFolder": "${workspaceFolder}/build",  
"bitbake.commandWrapper": "",  
"bitbake.workingDirectory": "${workspaceFolder}",  
"files.exclude": {  
    A List of directories  
},  
"files.watcherExclude": {  
    A List of directories  
},
```

extensions.json

```
{  
    "recommendations": [  
        "yocto-project.yocto-bitbake"  
    ]  
}
```

Layer Information – What, Where & Order

bitbake-layers

What layers are enabled and their location

```
$ bitbake-layers show-layers
NOTE: Starting bitbake server...
layer                path                                                    priority
=====
core                 /work/build/./layers/third-party/poky/meta            5
yocto                /work/build/./layers/third-party/poky/meta-poky       5
yoctobsp             /work/build/./layers/third-party/poky/meta-yocto-bsp  5
raspberrypi          /work/build/./layers/third-party/meta-raspberrypi     9
openembedded-layer  /work/build/./layers/third-party/meta-openembedded/meta-oe  5
meta-python          /work/build/./layers/third-party/meta-openembedded/meta-python  5
networking-layer    /work/build/./layers/third-party/meta-openembedded/meta-networking  5
meta-my_bsp          /work/build/./layers/project/meta-my_bsp              20
meta-my_distro       /work/build/./layers/project/meta-my_distro           20
workspacelayer       /work/build/workspace                                  99
```

Layer Information – Source Information

```
./poky/scripts/contrib/image-manifest list-layers
```

Show the URLs and Git Hashes of your layers

```
$ ./image-manifest list-layers
{
  "meta": {
    "actual_branch": "scarthgap",
    "vcs_url": "git://git.yoctoproject.org/poky",
    "vcs_subdir": "meta",
    "vcs_commit": "4b07a5316ed4b858863dfdb7cab63859d46d1810"
  },
  "meta-poky": {
    "actual_branch": "scarthgap",
    "vcs_url": "git://git.yoctoproject.org/poky",
    "vcs_subdir": "meta-poky",
    "vcs_commit": "4b07a5316ed4b858863dfdb7cab63859d46d1810"
  },
  "meta-yocto-bsp": {
    "actual_branch": "scarthgap",
    "vcs_url": "git://git.yoctoproject.org/poky",
    "vcs_subdir": "meta-yocto-bsp",
    "vcs_commit": "4b07a5316ed4b858863dfdb7cab63859d46d1810"
  },
  --- 8< --- A lot more data that can fit one one page! --- 8< ---
```

Browse Packages

`./poky/scripts/oe-pkgdata-browser`

Graphical Browser of Packages

- See your *built* packages
 - Options
 - Files
 - Licences

The screenshot shows the 'Package Data Browser' application. It features a list of packages on the left, a central table of package details, and a right-hand pane showing the details for the selected 'ppp' package.

Package	Size
ppp	350.84 kB
ppp-dbg	1.41 MB
ppp-dev	96.64 kB
ppp-doc	121.96 kB
ppp-l2tp	23.45 kB
ppp-locale	0 B
ppp-minconn	5.33 kB
ppp-oa	13.95 kB
ppp-oe	48.4 kB
ppp-password	14.99 kB
ppp-radius	67.02 kB
ppp-src	1.5 MB
ppp-staticdev	0 B
ppp-tools	44.4 kB
ppp-winbind	13.63 kB

ppp 2.5.0-r0
BSD-3-Clause & BSD-3-Clause-Attribution & GPL-2.0-or-later & I
Point-to-Point Protocol (PPP) support

Depends: [glibc](#) >= 2.39+git0+e8f5217097, [libcrypto](#) >= 3.2.2, [libxcrypt](#) >= 4.4.36

18 files take 350.84 kB.

Name	Size
/etc/chatscripts/pap	653 B
/etc/ppp/chap-secrets	78 B
/etc/ppp/eaptls-client	349 B
/etc/ppp/eaptls-server	405 B
/etc/ppp/ip-down	1.45 kB
/etc/ppp/ip-down.d/92removedns	118 B
/etc/ppp/ip-up	1.45 kB
/etc/ppp/ip-up.d/08setupdns	292 B
/etc/ppp/openssl.cnf	261 B
/etc/ppp/options	5 B
/etc/ppp/pap-secrets	77 B
/etc/ppp/peers/provider	1.09 kB
/etc/ppp/ppp_on_boot	573 B
/usr/bin/poff	653 B
/usr/bin/pon	116 B
/usr/lib/systemd/system/ppp@.service	153 B
/usr/sbin/chat	21.9 kB
/usr/sbin/pppd	321.21 kB

Find a Variable Value

`./poky/bitbake/bin/bitbake-getvar`

Shows the value of a variable *and how it got set*

```
$ bitbake-getvar IMAGE_FSTYPES
NOTE: Starting bitbake server...
#
# $IMAGE_FSTYPES [3 operations]
#   set? /work/build/./layers/third-party/meta-raspberrypi/conf/machine/include/rpi-base.inc:8
#     "tar.bz2 ext3 wic.bz2 wic.bmap"
#   set /work/build/./layers/third-party/poky/meta/conf/documentation.conf:215
#     [doc] "Formats of root filesystem images that you want to have created."
#   set? /work/build/./layers/third-party/poky/meta/conf/bitbake.conf:845
#     "tar.gz"
# pre-expansion value:
#   "tar.bz2 ext3 wic.bz2 wic.bmap"
IMAGE_FSTYPES="tar.bz2 ext3 wic.bz2 wic.bmap"
```

Working with Package Information

./poky/scripts/oe-pkgdata-util

```
$ oe-pkgdata-util -h
usage: oe-pkgdata-util [-h] [-d] [-p PKGDATA_DIR] <subcommand> ...

OpenEmbedded pkgdata tool - queries the pkgdata files written out during do_package

options:
  -h, --help            show this help message and exit
  -d, --debug           Enable debug output
  -p PKGDATA_DIR, --pkgdata-dir PKGDATA_DIR
                        Path to pkgdata directory (determined automatically if not specified)

subcommands:
  lookup-pkg            Translate between recipe-space package names and runtime package names
  list-pkgs             List packages
  list-pkg-files       List files within a package
  lookup-recipe        Find recipe producing one or more packages
  package-info        Show version, recipe and size information for one or more packages
  find-path           Find package providing a target path
  read-value          Read any pkgdata value for one or more packages
  glob                Expand package name glob expression
Use oe-pkgdata-util <subcommand> --help to get help on a specific command
```

Working with Package Information Examples

Find which package installed a file

```
$ oe-pkgdata-util find-path /usr/lib/python3.12/crypt.py
python3-crypt: /usr/lib/python3.12/crypt.py
```

Get a list of files installed by a package

```
$ oe-pkgdata-util list-pkg-files python3-crypt
python3-crypt:
  /usr/lib/python3.12/__pycache__/crypt.cpython-312.pyc
  /usr/lib/python3.12/__pycache__/hashlib.cpython-312.pyc
  /usr/lib/python3.12/crypt.py
  /usr/lib/python3.12/hashlib.py
  /usr/lib/python3.12/lib-dynload/_blake2.cpython-312-arm-linux-gnueabi.so
  /usr/lib/python3.12/lib-dynload/_crypt.cpython-312-arm-linux-gnueabi.so
  /usr/lib/python3.12/lib-dynload/_hashlib.cpython-312-arm-linux-gnueabi.so
  /usr/lib/python3.12/lib-dynload/_md5.cpython-312-arm-linux-gnueabi.so
  /usr/lib/python3.12/lib-dynload/_sha1.cpython-312-arm-linux-gnueabi.so
  /usr/lib/python3.12/lib-dynload/_sha2.cpython-312-arm-linux-gnueabi.so
  /usr/lib/python3.12/lib-dynload/_sha3.cpython-312-arm-linux-gnueabi.so62
```

Working with Package Information Examples

Get information about a package (Version, Recipe & Size)

```
$ oe-pkgdata-util package-info python3-crypt  
python3-crypt 3.12.3-r0 python3 3.12.3-r0 243262
```

Find the recipe that produced the package

```
$ oe-pkgdata-util lookup-recipe python3-crypt  
python3
```

Dependencies

Before being able to determine dependencies, you will need to generate a graph description of your image

```
bitbake -g <your image>
```

e.g.

```
bitbake -g my-production-image
```

This will create a file `task-depends.dot`

How did that get installed?

```
./poky/scripts/oe-depends-dot
```

Why did that package get installed (-w)

```
$ oe-depends-dot -k <PKG> -w <PATH TO DOT FILE>
```

```
$ oe-depends-dot -k nettle -w ./task-depends.dot
```

```
Because: gnutls my-production-image wget
```

```
my-production-image -> wget -> gnutls -> nettle
```

Determining Dependencies

```
./poky/scripts/oe-depends.dot
```

What are the dependencies for a package (-d)

```
$ oe-depends-dot -k <PKG> -d <PATH TO DOT FILE>
```

```
$ oe-depends-dot -k nettle -d ./task-depends.dot
```

```
Depends: automake-native dwarfsrcfiles-native binutils-cross-arm quilt-  
native glibc patch-native gmp opkg-utils-native zstd-native pseudo-  
native autoconf-native libtool-native gcc-cross-arm libtool-cross gcc-  
runtime rpm-native
```

Build Dependencies

```
./poky/scripts/contrib/image-manifest list-depends
```

Show what is needed to build a package

```
$ ./image-manifest list-depends xz
Loaded 5154 entries from dependency cache.

The following packages are required to build xz
libgcc (libgcc)
libgcc-initial (libgcc-initial)
linux-libc-headers (linux-libc-headers)
gcc-runtime (virtual/arm-oe-linux-gnueabi-compilerlibs)
glibc (virtual/libc)
opkg-utils (virtual/update-alternatives)
```

Packageconfig Flags

```
./poky/scripts/contrib/ list-packageconfig-flags.py
```

Show PACKAGECONFIG Flags for recipes

```
list-packageconfig-flags.py
Loading cache...done.
Loaded 5153 entries from dependency cache.
Gathering recipe data...
RECIPE NAME                PACKAGECONFIG FLAGS
=====
alsa-plugins                aaf jack libav maemo-plugin maemo-resource-manager pulseaudio samplerate
speexdsp
alsa-tools                  as10k1 echomixer envy24control hda-verb hdajackretask hdajacksensetest
                             hdspconf hdsploder hdspmixer hwmixvolume ld10k1 mixartloader pcxhr
                             loader ql010k1 rmedigicontrol sb16_csp seq--sbiload sscape_ctl us428control
                             usx2yloader vxloader
alsa-utils                  bat manpages udev
apitrace                    x11
appstream                   stemming systemd
appstream-glib              manpages
```

Build History

When developing your images, it can be useful to know what effect your changes are having.

There is an option to save a build history...

<https://docs.yoctoproject.org/dev-manual/build-quality.html>

Add the following to your configuration

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

See what has Changed

`./poky/scripts/buildstats-diff`

Added python3-crypt to my image as an example

```
$ buildhistory-diff -a
Changes to images/raspberrypi0_wifi/glibc/my-production-image (files-in-image.txt):
  /usr/lib/python3.12/crypt.py was added
  /usr/lib/python3.12/hashlib.py was added
  /usr/lib/python3.12/lib-dynload/_blake2.cpython-312-arm-linux-gnueabi.so was added

----8< ----- Lines cut to save Space on Slide ----8< -----

  /var/lib/opkg/info/python3-stringold.control was added
  /var/lib/opkg/info/python3-stringold.list was added
images/raspberrypi0_wifi/glibc/my-production-image: IMAGESIZE changed from 135392 to 135808 (+0%)
images/raspberrypi0_wifi/glibc/my-production-image: IMAGE_INSTALL: added "python3-crypt"
Changes to images/raspberrypi0_wifi/glibc/my-production-image (installed-package-names.txt):
  python3-stringold was added
  python3-crypt was added
  python3-math was added
```

How long did that take?

Build Statistics are enabled by default in local.conf

```
USER_CLASSES ?= "buildstats"
```

This stores the data in `${TMPDIR}/buildstats/`

See

<https://docs.yoctoproject.org/ref-manual/classes.html#buildstats>

Using Buildstats – Examine a Single Build

- `/poky/scripts/buildstats-summary <path to stats>`

See how long each task took

```
$ buildstats-summary tmp-glibc/buildstats/20250108161806/  
0:00:02 quilt-native:do_fetch  
0:00:38 gettext-minimal-native:do_fetch  
0:00:02 gnu-config-native:do_fetch  
0:00:35 binutils-cross-arm:do_fetch  
0:00:05 m4-native:do_fetch  
0:00:02 libtool-native:do_fetch  
0:00:01 zlib-native:do_fetch  
0:00:02 patch-native:do_fetch  
----8< ----- Lines cut to save Space on Slide ----8< -----  
0:00:14 my-production-image:do_rootfs  
0:00:01 my-production-image:do_image_ext3  
0:00:09 my-production-image:do_image_wic  
0:00:01 my-production-image:do_image_complete
```

Using Buildstats – Effects of Changes

```
./poky/scripts/buildstats-diff <stats1> <stats2>
```

See the differences between two builds

```
$ buildstats-diff tmp/buildstats/20241216180650/ tmp/buildstats/20241216181500/  
Ignoring tasks less than 00:03.0 (3.0s)  
Ignoring differences less than 00:01.0 (1.0s)  
  
PKG                TASK                ABSDIFF  RELDIFF  CPUTIME1 -> CPUTIME2  
my-development-image do_rootfs           3.8s    +12.2%   31.3s -> 35.1s  
my-development-image do_image_mender     5.8s    +15.1%   38.2s -> 43.9s  
my-development-image do_image_tar        13.5s   +54.2%   24.8s -> 38.3s  
  
Cumulative cputime:  
115.1s    +42.4%    04:31.2 (271.2s) -> 06:26.3 (386.3s)
```

Checking Patches

```
./poky/scripts/contrib/patchreview.py <path>
```

Check your Patches

```
$ patchreview.py ../layers/project/meta-my-bsp/  
Found layers meta-my-bsp  
Total patches found: 6  
Patches missing Signed-off-by: 3 (50%)  
Patches with malformed Signed-off-by: 0 (0%)  
Patches missing CVE: 0 (0%)  
Patches missing Upstream-Status: 0 (0%)  
Patches with malformed Upstream-Status: 0 (0%)  
Patches in Pending state: 0 (0%)
```

May need to go and sign off on some of my patches!

Write an Image to SD Card

`/poky/scripts/contrib/ddimage`

Writes an image to a device.

```
$ sudo ./ddimage ~/images/my-production-image-raspberrypi0-wifi.rootfs.wic /dev/sde
Image details
=====
  image: my-production-image-raspberrypi0-wifi.rootfs.wic
  size: 14101250048 bytes
modified: 2024-12-16 14:24:10.000000000 +0100
  type: DOS/MBR boot sector; partition 1 : ID=0xc, active, start-CHS (0x40,0,1), end-CHS (0x3ff,3,32), startsector
8192, 266240 sectors; partition 2 : ID=0x83, start-CHS (0x3ff,3,32), end-CHS (0x3ff,3,32), startsector 278528,
27262976 sectors

Device details
=====
  device: /dev/sde
  vendor: Generic
  model: STORAGE DEVICE
  size: 15634268160 bytes

Write my-production-image-raspberrypi0-wifi.rootfs.wic to /dev/sde [y/N]? y
Writing image...
4.49GiB 0:01:46 [6.19MiB/s] [=====>] 34% ETA 0:03:24
```

Your Turn!

What are your favourite tools that you think people should know about?

Contacts

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