Yocto Project Autobuilders and the SWAT team

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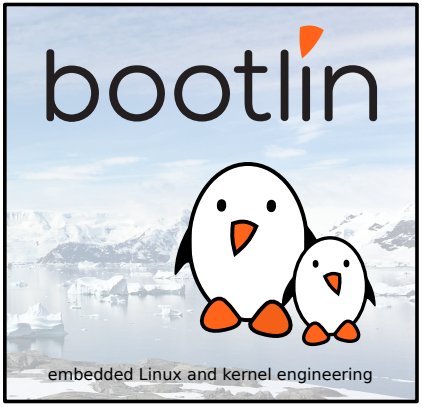

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  - Linux kernel **maintainer for the RTC and I3C subsystems**
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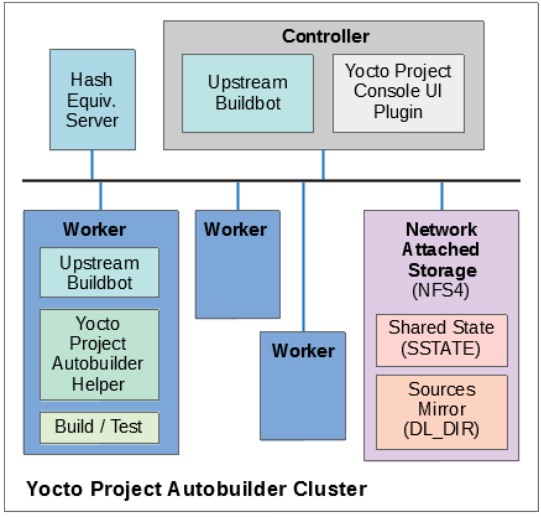
Yocto Project Autobuilders



Autobuilders - buildbot

- The Yocto Project CI is based on buildbot, a python continuous integration framework.
- It is configured using python scripts, available at https://git.yoctoproject.org/yocto-autobuilder2/
- This repository lists and defines all the `builders` (available types of builds) and `schedulers`
- `README.md` will help you set up your own autobuilders in a matter of minutes.
- More configuration is done through the https://git.yoctoproject.org/yocto-autobuilder-helper repository, especially in `config.json`
- Nice UI at https://autobuilder.yoctoproject.org/typhoon/

Autobuilders - workers

- The Yocto Project autobuilders currently have 26 workers: alma8-ty-1, alma8-ty-2, centos7-ty-4, debian11-ty-1, debian11-ty-3, fedora35-ty-1, fedora35-ty-2, fedora36-ty-1, fedora36-ty-2, fedora36-ty-3, opensuse153-ty-1, opensuse154-ty-1, opensuse154-ty-2, opensuse154-ty-3, perf-alma8, perf-debian11, stream8-ty-1, tumbleweed-ty-3, ubuntu1804-arm-1, ubuntu1804-ty-3, ubuntu2004-arm-1, ubuntu2004-ty-1, ubuntu2110-ty-2, ubuntu2204-ty-1, ubuntu2204-ty-2, ubuntu2204-ty-3
- They are necessarily heterogeneous to be able to test on many different distributions: AlmaLinux 8, CentOS 7, CentOS Stream 8, Debian 11, Fedora 35, Fedora 36, openSUSE 15.3, openSUSE 15.4, Tumbleweed, Ubuntu 18.04, Ubuntu 20.04, Ubuntu21.10, Ubuntu 22.04
- Also, two different architectures are used: x86 and aarch64

Autobuilders - workers

- x86 workers: most are 28 cores, 56 threads Intel Xeon E5, some are 24 cores, 48 threads with 128 to 384 GB of RAM
- ARM workers: one 64 core Cortex-A72 with 256GB of RAM and one 32 cores APM X-Gene with 128 GB of RAM
- This creates a fair amount of maintenance as the workers need to be configured differently.
- Two workers are specifically reserved for build performance testing (perf-alma8 and perf-debian11)
- About half of the workers now have SSDs

Autobuilders - builders

- Currently 81 different builders are defined:
  a-full, a-quick, auh, beaglebone, beaglebone-alt, bringup, bringup-fast, build-appliance, buildperf-alma8, buildperf-debian11, buildtools, check-layer, check-layer-nightly, docs, edgerouter, edgerouter-alt, genericx86, genericx86-64, genericx86-64-alt, genericx86-alt, meta-agl-core, meta-arm, meta-aws, meta-intel, meta-mingw, meta-oe, meta-virt, metrics, multilib, musl-qemux86, musl-qemux86-64, no-x11, non-gpl3, oe-selftest, oe-selftest-arm, oe-selftest-armhost, oe-selftest-centos, oe-selftest-debian, oe-selftest-fedora, oe-selftest-ubuntu, pkgman-deb-non-deb, pkgman-non-rpm, pkgman-rpm-non-rpm, poky-tiny, qa-extras, qa-extras2, qemuarm, qemuarm-alt, qemuarm-armhost, qemuarm-oecore, qemuarm64, qemuarm64-alt, qemuarm64-armhost, qemuarm64-ltp, qemuarm64-ptest, qemuarm64-ptest-fast, qemumips, qemumips-alt, qemumips64, qemuppc, qemuppc-alt, qemuppc64, qemuriscv32, qemuriscv64, qemuriscv64-ptest, qemux86, qemux86-64, qemux86-64-alt, qemux86-64-ltp, qemux86-64-ptest, qemux86-64-ptest-fast, qemux86-64-x32, qemux86-alt, qemux86-world, qemux86-world-alt, reproducible, reproducible-centos, reproducible-debian, reproducible-fedora, reproducible-ubuntu, wic

Autobuilders - builders

What is getting built?

Most of the builders build `core-image-sato` using the `poky` distro. Look at `config.json`:

config.json

```
    "overrides" : {
        "qemux86-64" : {
            "MACHINE" : "qemux86-64",
            "TEMPLATE" : "arch-qemu",
            "step1" : {
                "extravars" : [
                    "IMAGE_FSTYPES:append = ' wic wic.bmap'"
                ]
            }
        },
    }
```

Autobuilders - builders

config.json

```
    "templates" : {
        "arch-qemu" : {
            "BUILDINFO" : true,
            "BUILDHISTORY" : true,
            "extravars" : [
                "IMAGE_INSTALL:append = ' ssh-pregen-hostkeys'"
            ],
            "step1" : {
                "BBTARGETS" : "core-image-sato core-image-sato-sdk core-image-minimal core-image-minimal-dev core-image-sa
                "SANITYTARGETS" : "core-image-minimal:do_testimage core-image-sato:do_testimage core-image-sato-sdk:do_tes
            },
            "step2" : {
                "SDKMACHINE" : "x86_64",
                "BBTARGETS" : "core-image-sato:do_populate_sdk core-image-minimal:do_populate_sdk_ext core-image-sato:do_p
                "SANITYTARGETS" : "core-image-sato:do_testsdk core-image-minimal:do_testsdkext core-image-sato:do_testsdke
            },
            "step3" : {
                "shortname" : "Machine oe-selftest",
                "BUILDHISTORY" : false,
                "EXTRACMDS" : ["${SCRIPTSDIR}/checkvnc; DISPLAY=:1 oe-selftest ${HELPERSTMACHTARGS} -j 15"],
                "ADDLAYER" : ["${BUILDDIR}/../meta-selftest"]
            }
        },
    }
```

Autobuilders - builders

- Two parent builders: `a-full` and `a-quick`. They will request builds from other builders.
- auh: Tries to upgrade all the recipes to their latest upstream version
- Machine specific builders, building for Yocto Project members machines: beaglebone, beaglebone-alt, edgerouter, edgerouter-alt, genericx86, genericx86-64, genericx86-64-alt, genericx86-alt
- Qemu based machines: musl-qemux86, musl-qemux86-64, qemuarm, qemuarm-alt, qemuarm-armhost, qemuarm-oecore, qemuarm64, qemuarm64-alt, qemuarm64-armhost
- Performance builders, recording the build time and other performance related metrics: buildperf-alma8, buildperf-debian11
- Documentation: docs
- Yocto Project members layers: meta-agl-core, meta-arm, meta-aws, meta-intel
- check-layer, check-layer-nightly: checks whether the included layer are Yocto Project compatible

Autobuilders - builders

- metrics: checks the packages for existing CVEs
- selftests: oe-selftest, oe-selftest-centos, oe-selftest-debian, oe-selftest-fedora, oe-selftest-ubuntu
- ptests: qemuarm64-ptest, qemuarm64-ptest-fast, qemux86-64-ptest, qemux86-64-ptest-fast
- ltp: qemuarm64-ltp, qemux86-64-ltp
- reproducible: Ensures the generated packages are bit for bit reproducible
- wic: tests `wic` by generating multiple disk images
- non-gpl3: builds with `INCOMPATIBLE_LICENSE = '*GPLv3'` and `meta-gplv2`

Autobuilders - schedulers

- Any builder can be triggered manually through the buildbot interface
- `a-quick` runs at 1am each day Mon-Sat using the `master` branch
- `a-full` runs at 1am Sun each week using the `master` branch
- `check-layer-nightly` runs each day for `master`
- `metrics` runs at 7am each day
- `check-layer-nightly` runs twice a week for `kirkstone`
- `check-layer-nightly` runs twice a week for `dunfell`
- `AUH` twice a month on 1st and 15th
- build performance tests run at 3am, 9am, 3pm and 9pm
- `docs` runs on every commit

Autobuilders - manual buildrequests

- An `a-full` build takes from 5 to 9 hours and will load most of the workers.
- It is then not practical to start a build automatically for every commit on the `master` or LTS branches(`dunfell`, `kirkstone`)
- It is even less practical to do so for every patch series sent on the mailing list
- So, build testing is a manual process

Build testing workflow

- The process starts by reviewing and collecting patches from the mailing-lists in the appropriate repositories: `bitbake`, `meta-yocto`, `openembedded-core` and `yocto-docs`
- A `poky` branch is then created from these repositories using `combo-layer`
- This branch is pushed upstream and the autobuilders can be instructed to build `a-full` using it.
- In case of build failures, the incriminated patches are removed from the branch and the process starts over
- If the `a-full` build is successful, a final review is done and patches are merged by Richard Purdie.

Tests - selftests

The selftest builders run:

- `bitbake-selftest`: tests BitBake and its APIs, including the parser and fetchers.
- `oe-selftest`, skipping the `reproducible` test: `openembedded-core` unit tests from `meta/lib/oeqa/selftest/`. Tests `devtool`, `recipetool`, `archiver`, `bitbake-layers`, CVE checks, `INCOMPATIBLE_LICENSE`, `runqemu`, `wic`
- `oe-pylint`: runs `pylint3` when available on the python modules.

Tests - SDK

- Both the regular SDK and the extensible SDK are tested, using the `testsdk` and `testsdk_ext` tasks for the built image.
- Tests are in `meta/lib/oeqa/sdk` and `meta/lib/oeqa/sdkext`
- They assume the SDK environment is already setup.
- Tests whether the compiler can generate proper binaries for the platform, also tests make, cmake, perl, python,...

Tests - images

- The autobuilders don't have a board farm however, the qemu images are run.
- The `testimage` task of the built image is used
  - Uses `runqemu` to boot the kernel and use the generated rootfs
  - Tests network connectivity, `apt`, `dnf`, `stap`, `systemd`, `weston`, `xorg`
- `-ltp` builders add LTP in the rootfs and runs the test suite.
- `-ptest` builders add `ptest` packages in the rootfs and will run the various tests
  - `ptests` are unit tests or test suites that are in the upstream release
  - they are always built but have to be explicitly installed
  - e.g.: openssl-ptest, sed-ptest, glibc-tests-ptest, lttng-tools-ptest, python3-ptest
  - full list is in `meta/conf/distro/include/ptest-packagelists.inc`

Tests - reproducible

The output of the build is bit for bit reproducible (apart from Go and ruby docs)

- Does a first build with `Shared State` allowed (but not necessarily present)
- Then a second build with `Shared State` disabled, ensuring binaries will get built
- Both output are then compared
- All package types are tested (`ipk`, `deb`, `rpm`)
- Failures, including binaries and diffoscope output are available at `https://autobuilder.yocto.io/pub/repro-fail/`
- Results are at `https://www.yoctoproject.org/reproducible-build-results/`

Saved results

Some output of the build is saved and archived, in particular:

- `stdio` output, including separate files for warnings and errors.
- `Shared State` as all the autobuilders are populating the same sstate-cache
- `Hash equivalency` is exported through `http://typhoon.yocto.io:8687`
- `buildhistory` is pushed to `https://git.yoctoproject.org/poky-buildhistory/`
- `testresults` are committed to `https://git.yoctoproject.org/yocto-testresults/`
- `buildstats` from the performance test builds are committed to `https://git.yoctoproject.org/yocto-buildstats/`
- Most of those are also available with their logs on `https://autobuilder.yocto.io/pub/non-release/`

Buildperf output example

https://autobuilder.yocto.io/pub/non-release/20220621-14/testresults/buildperf-alma8/perf-alma8_master_20220621150024_9694ef314c.html

SWAT team

- The SWAT team looks at the build failures so none are missed
- Its goal is not directly to solve them but to raise attention to the various failures
- A specific tool allows to triage those failure: swatbot
  https://swatbot.yoctoproject.org/mainindex/swat/
- The autobuilders are feeding results to swatbot
- Person on SWAT duty will triage failures:
  - For a patch that is under testing and not in `master` yet, reply on the mailing list, pointing to the build failure.
  - For a commit that is on `master`, open a bug on bugzilla
  - For an intermittent issue (`AB-INT`), a bug needs to be open or comment added to an existing bug to allow tracking the frequency of the issue
  - Sometimes the issue has already been handled by the time the failure is triaged
- Statistics are also maintained

AB-INT issues - solved

230 tracked AB-INT have been closed

- Some are infrastructure related:
  - 14551 runtime_test.TestImage.test_testimage_virgl_headless failure

```
runqemu - ERROR - Failed to run qemu: qemu-system-x86_64: -qmp unix:./.ce0t9x2n,server,wait: info: QEMU wai
qemu-system-x86_64: egl: no drm render node available
qemu-system-x86_64: egl: render node init failed
```

This was a permission issue following an OpenSUSE upgrade

  - 14096 perl install race (pod2text)

```
Couldn't copy cpan/podlators/blib/script/pod2text to /.../usr/bin/pod2text: No such file or directory
Couldn't chmod 755 /.../usr/bin/pod2text: No such file or directory
|   /usr/local/oe-sdk-hardcoded-buildpath/sysroots/aarch64-pokysdk-linux/usr/bin/pod2text
|   /usr/local/oe-sdk-hardcoded-buildpath/sysroots/aarch64-pokysdk-linux/usr/bin/pod2usage
```

Reported upstream https://github.com/arsv/perl-cross/issues/75
This ended up being a `make` issue, happening only on an old version, shipped with ubuntu 16.04 and ubuntu 18.04

AB-INT issues - solved

- 14712 build hangs: host make is not collecting its own children, turning them into zombies
  `make` issue in version 4.2.1 shipped by centOS, Alma, Stream and openSUSE. Reported upstream `https://bugs.centos.org/view.php?id=18432` Fixed by disallowing make 4.2.1
- Many were performance related: multiple builds are allowed to run in parallel on a single worker, increasing the load.
  - e.g. Kernel RCU stalls in qemu due to I/Os and host CPU load
  - `make` load awareness is now used: `PARALLEL_MAKE = '-j 16 -l 52'`
  - `xz` limits were lowered:

```
XZ_MEMLIMIT = '5%'
XZ_THREADS = '8'
```

  - the qemu rootfs image is copied to tmpfs to avoid I/Os while running
  - the workers are getting switched to SSDs

AB-INT issues - solved

- Some upstream tests are not very well written:
  - 14840 AB-INT PTEST ARM: python3 testSockName ptest failure

```
ERROR: testSockName (test.test_socket.GeneralModuleTests)
----------------------------------------------------------------------
Traceback (most recent call last):
  File "/usr/lib/python3.10/test/test_socket.py", line 1380, in testSockName
    sock.bind(("0.0.0.0", port))
OSError: [Errno 98] Address already in use
```

test_socket.py

```
        port = socket_helper.find_unused_port()
        sock.bind(("0.0.0.0", port))
```

AB-INT issues - solved

- Some upstream tests are not very well written:
  - 14507 AB-INT PTEST: libevent monotonic_prc_fallback_FAILED
    Reported upstream https://github.com/libevent/libevent/issues/1193

```
regress:
  FAIL ../libevent-2.1.12-stable/test/regress_util.c:1478: assert(diff.tv_sec == 0): 1 vs 0 util/monotonic_
  [monotonic_prc_fallback FAILED]
 1/312 TESTS FAILED. (33 skipped)
```

Fixed by allowing the test to rerun and marking a test failed only when all runs failed. Patch upstreamed https://github.com/libevent/libevent/pull/1214.

AB-INT issues - current

49 AB-INT are still present. The most pressing or worrying are:

- 14018 efibootpartition.GenericEFITest.test_boot_efi selftest failed
- 14201 Bitbake server intermittent timeout
- 14263 lttng-tools ptest intermittent failure
- 14401 Test unable to login to serial console
- 14522 qemuppc doesn't shutdown within timeout (serial console issues)
- 14665 prservice.BitbakePrTests.test_import_export_replace_db failure
- 14775 SDK preparation failure: SState: cannot test file://[...] TimeoutError('timed out')
- 14787 systemd.SystemdServiceTests.test_systemd_status failure

AB-INT issues - help needed

What needs to be worked on?

- Better logging is needed, especially collecting the relevant output when something fails:
  - dmesg output of the target kernel
  - bitbake-cooker.log
- More tests are also needed, both for `oe-selftest` but also upstream tests to run as `ptests`
- Some tests would benefit from being more robust and especially less timing dependent.

Questions? Suggestions? Comments?

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https://bootlin.com/pub/conferences/2022/elc/belloni-yocto-autobuilders-swat/