LAVA + OpenQA = Automated, Continuous System Testing

Laurence Urhegyi & James Thomas
Introductions

- Laurence Urhegyi
  - Project Manager
  - laurence.urhegyi@codethink.co.uk

- James Thomas
  - Senior Engineer
  - james.thomas@codethink.co.uk

Both have a wealth of experience in the Automotive Industry, and are passionate about FOSS
Contents

- Long Term Maintainability
  - What is this and why do we care?
- What is the problem?
  - Upstream / downstream gap for LTM
- How we can help towards solving it?
  - Start testing in upstream directly
  - Heavy automation of testing
- What have we used?
  - LAVA
  - OpenQA
- What we have done?
  - Case study 1: openQA in GNOME upstream
  - Case study 2: LAVA/openQA in kernel testing
- Future plans
The problem
Why Long Term Maintainability?

Many software systems / devices / products are intended to function over a long-term lifetime.

They rely on open-source components.

Software complexity is increasing.

More features = more loc = more bugs = more testing is needed.

The cost and complexity of maintaining such systems will continue to grow over time.

Organisations need to be mature enough to handle increasing complexity and volume, whilst remaining competitive.
Don't you mean Long Term Maintenance?

- Well, yes and no...
- Typical scenario:
  - Organisations rely on components (such as the kernel) that are supported for less time than the lifecycle of their product
  - Backporting from upstream is required for updates
  - Full system upgrades are rare or avoided
- The status quo is to ‘keep systems on life support’

We can do better...
Long Term Maintainability (again)

- Systems designed from the outset to:
  - Be as close as upstream as possible
    - Integrate new upstream with minimal overhead, reduce local patch carrying
  - Have robust deployment mechanisms in place, to roll-back if something goes wrong (atomic upgrades)
  - Have processes that allow you to know how to repeat a build done in the past, and also keep track of every component version deployed
  - Have robust testing pipelines that makes you comfortable to update
Everyone wants the same thing: stable software, including the latest features, for the long term.

To achieve this you need to have confidence in your software and confidence in the software you depend on.

This has to come from testing.
What do upstream propose?

- Always use the latest!
- Makes complete sense... BUT
What downstream says

- Kernel is support for only 2 / 6 years
- We need to support this product for 10 years
- We do not want to support own own kernel fork
- We are not confident enough upgrading to next kernel version is not going to cause regressions!

- Not every organisation is willing / able to commit resources for testing that allows for such long term maintenance
- [https://lore.kernel.org/linux-arm-kernel/YCzknUTDytY8gRA8@kroah.com/](https://lore.kernel.org/linux-arm-kernel/YCzknUTDytY8gRA8@kroah.com/)
Mind the gap!

- Testing modern software platforms is extremely complex and time consuming
- Companies often miss out on the latest fixes and features in Linux, for fear of the time-consuming manual regression tests required
What we can do to help?
Automated, continuous embedded system testing FTW!

- Increased automation improves robustness and transparency of tests
- Reduce manual efforts = increased testing capacity
  - Machines can be utilised 24 hours per day
- Catch major errors more easily, and earlier
  - Eventually increase focus on more complex testing
- This is not new:
  [https://security.googleblog.com/2021/08/linux-kernel-security-done-right.html](https://security.googleblog.com/2021/08/linux-kernel-security-done-right.html)
Intro to the tooling: LAVA & openQA
LAVA

- LAVA “continuous integration system for deploying operating systems onto physical and virtual hardware for running tests”
- Hardware orchestration for physical devices
- Central server that dispatches jobs to clients
- Used by KernelCI (https://linux.kernelci.org/job/) to test new kernel versions
OpenQA

- OpenQA for testing *software* (UI)
- Tests based on screenshot comparisons (Needles)
- Central server to view test results, and to dispatch test jobs to workers
- Workers provide a specific machine type (e.g. qemu-x86_64)
- Tests performed how the majority of users actually use the software
Help upstream 1: openQA and GNOME
CI Integration

- Integrated into Gitlab CI pipeline
- Ad-hoc workers using the same build infrastructure, no “pets”, no dedicated test hardware needed
- Workers only need KVM
CI Integration

- Tests in the same git repo
- Different workers can run different tests if needed
- Needles in a separate repository
- Workers clone needles (OPENQA_NEEDLES_GIT, OPENQA_NEEDLES_SHA)
- Workers then register with OpenQA with a unique machine type (e.g. qemu-x86_64-12345) and start the test run previously built GnomeOS image
CI Integration
CI Integration
Being used already: openqa.gnome.org
Help upstream 2:
LAVA & openQA & Linux kernel
LAVA and OpenQA

- Testing on hardware rather than emulators
- Utilise the existing KernelCI tests
- OpenQA testing to check for regressions (e.g. in the graphics driver)
- Check out the blog post for details of the setup
Architecture

Laptop
- LAVA
- openQA
- QEMU

Display

Rpi4
- openQA client
- SD Card
- USB Drive

SSH

Serial

VNC

Controllable PDU
It’s being used!

- [https://lava.qa.codethink.co.uk](https://lava.qa.codethink.co.uk)
- [https://openqa.qa.codethink.co.uk/](https://openqa.qa.codethink.co.uk/)
- Positve feedback received
  - [https://lore.kernel.org/lkml/CAHk-=wjz+RhR8rr4rAZBPf-mxZXvn2RQe-XTQcL8X+HX BAFxBA@mail.gmail.com/](https://lore.kernel.org/lkml/CAHk-=wjz+RhR8rr4rAZBPf-mxZXvn2RQe-XTQcL8X+HX BAFxBA@mail.gmail.com/)
What next?
Future Work

- More tests!
- Connect to KernelCI APIs
- Better Test/Needle synchronisation between workers and OpenQA
- Board deployment and testing added to Gitlab pipelines
- More backends! (e.g RDP)
Thanks for listening!
www.codethink.co.uk
Resources

- GNOME testing blog post
  - https://openqa.gnome.org/
  - https://gitlab.gnome.org/GNOME/gnome-build-meta/-/merge_requests/1251

- Kernel Testing blog post: LAVA + OpenQA
  - https://lava.qa.codethink.co.uk
  - https://openqa.qa.codethink.co.uk/