Better video decode testing for V4L2

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Agenda

1. Kernel CI for Video Decode on Debian & ChromeOS
2. Using Virtual Driver for Video Decode Testing on Chromium

01
Kernel CI for Video Decode

How do we make sure upstream kernel is healthy?

What is KernelCI?

- CI (Continuous Integration) of code changes
- Open source distributed test automation system for upstream kernel development
- Primary goal
  - Ensure the quality, stability and long-term maintenance of the Linux kernel
  - Detects regressions early, makes upstream healthy
- https://foundation.kernelci.org/

Benefits (also for ChromeOS)

- Reduces long term maintenance cost for devices
- Upstreaming first development.
- Kernel uprev will be more straightforward.
- Driver uprev, forklifting will be easier.
- Catches regressions early before reaching downstream.
- Reduces different driver behaviors between different MTK platforms.
- Makes bringup, new feature development faster.

Kernel CI for Video Decode

- Video decode tests for upstream
  - supports GStreamer, ChromOS testing clients
  - supported on Debian, ChromeOS
- Collabora has been working on the project. ChromeOS is also supporting it.
- Supports all video codecs: VP8, VP9, H.264, H.265, AV1
- Supported on MTK/QC platforms for ChromeOS
  - MT8183 kukui, MT8192 asurada, MT8195 cherry, MT8186 corsola
  - QC7180 trogdor

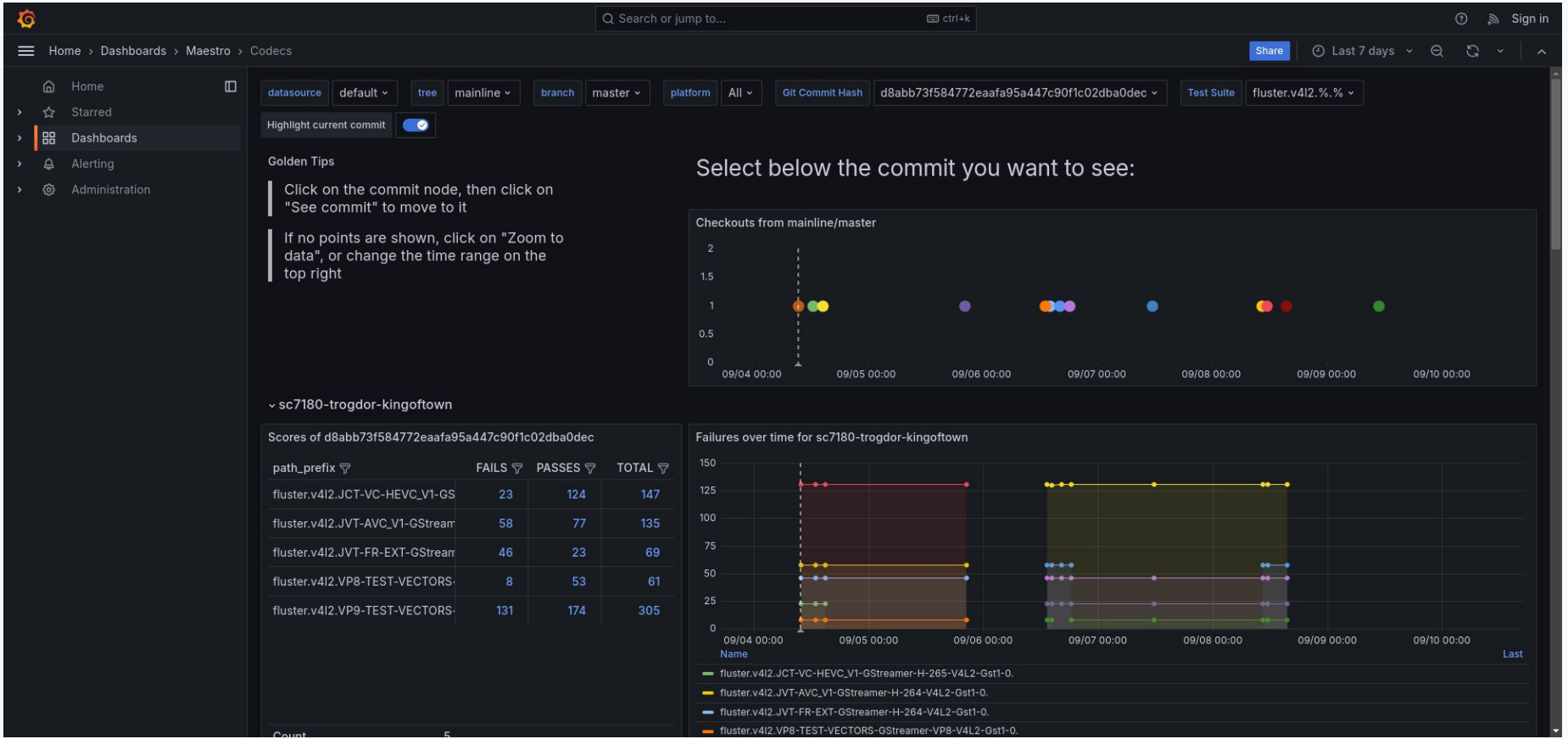
Tree / Branch used in KernelCI

- Linux (Debian)
  - mainline tree / master branch
  - next tree / master branch
  - media tree
- ChromeOS
  - kernelci tree / linux-6.6.y-arm64-chromeos branch
    - LTS (v6.6, v6.1) + patches backported to support ARM64 Chromebooks
  - collabora-chromeos-kernel tree / for-kernelci branch
    - integration branch, not updated on regular basis, close to mainline
    - used to test certain patches that Collabora has submitted upstream but have not been merged upstream yet

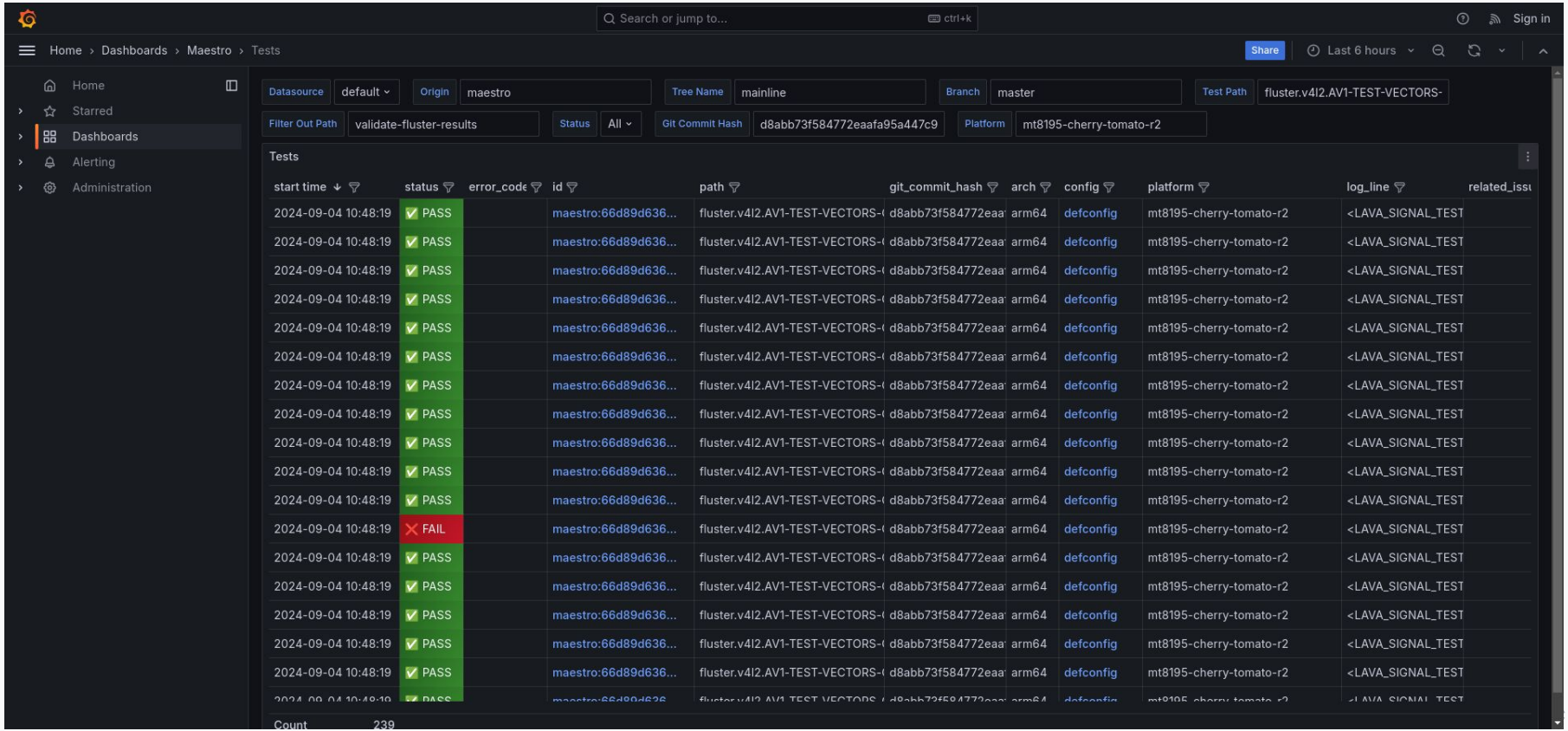
Challenges

- Kernel CI infra transition
  - blocked for late 2023 ~ early 2024
- Platform specific work on ChromeOS
  - older platform with older kernel
- New testing configurations
  - gstreamer on ChromeOS
  - ChromeOS testing client on Debian

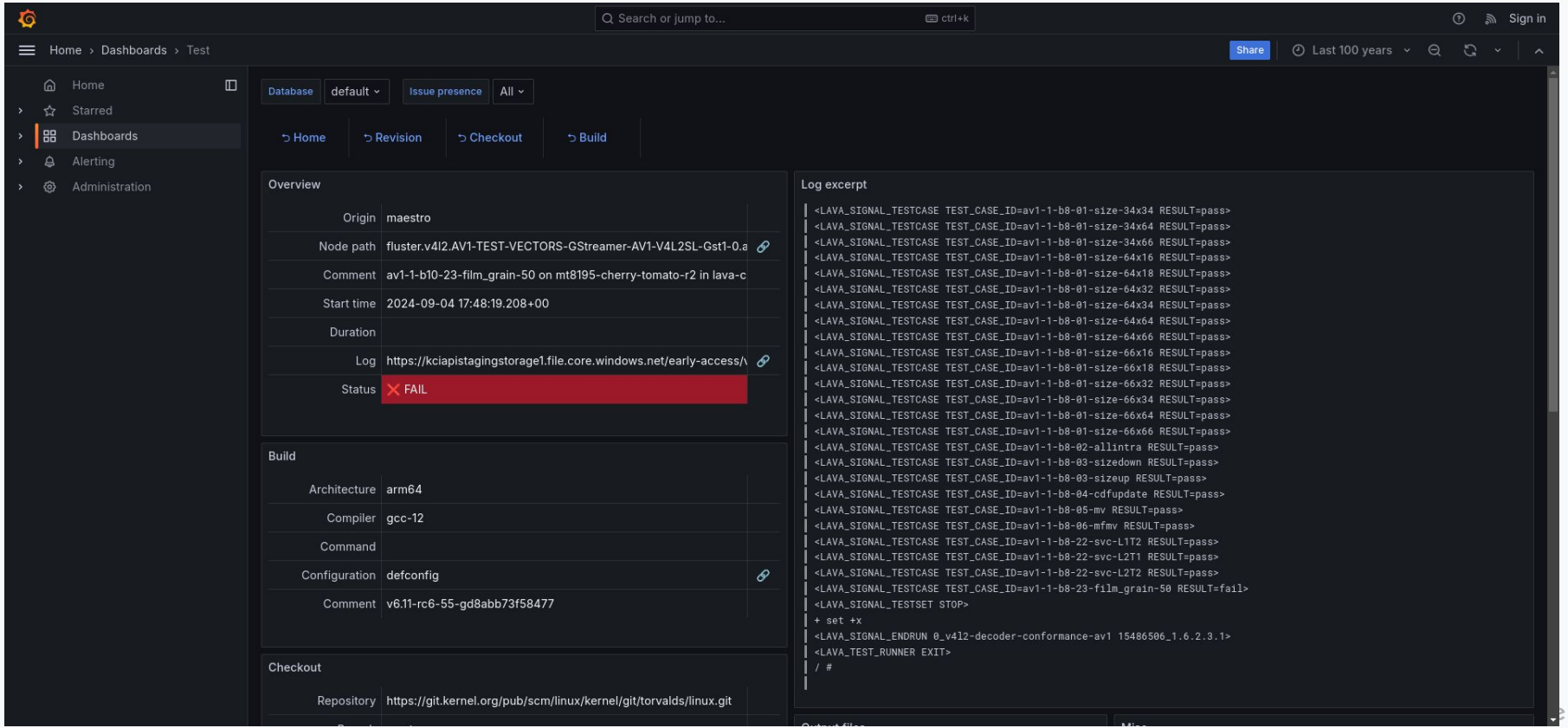
Kernel CI Dashboard



AV1 Test Results on Cherry



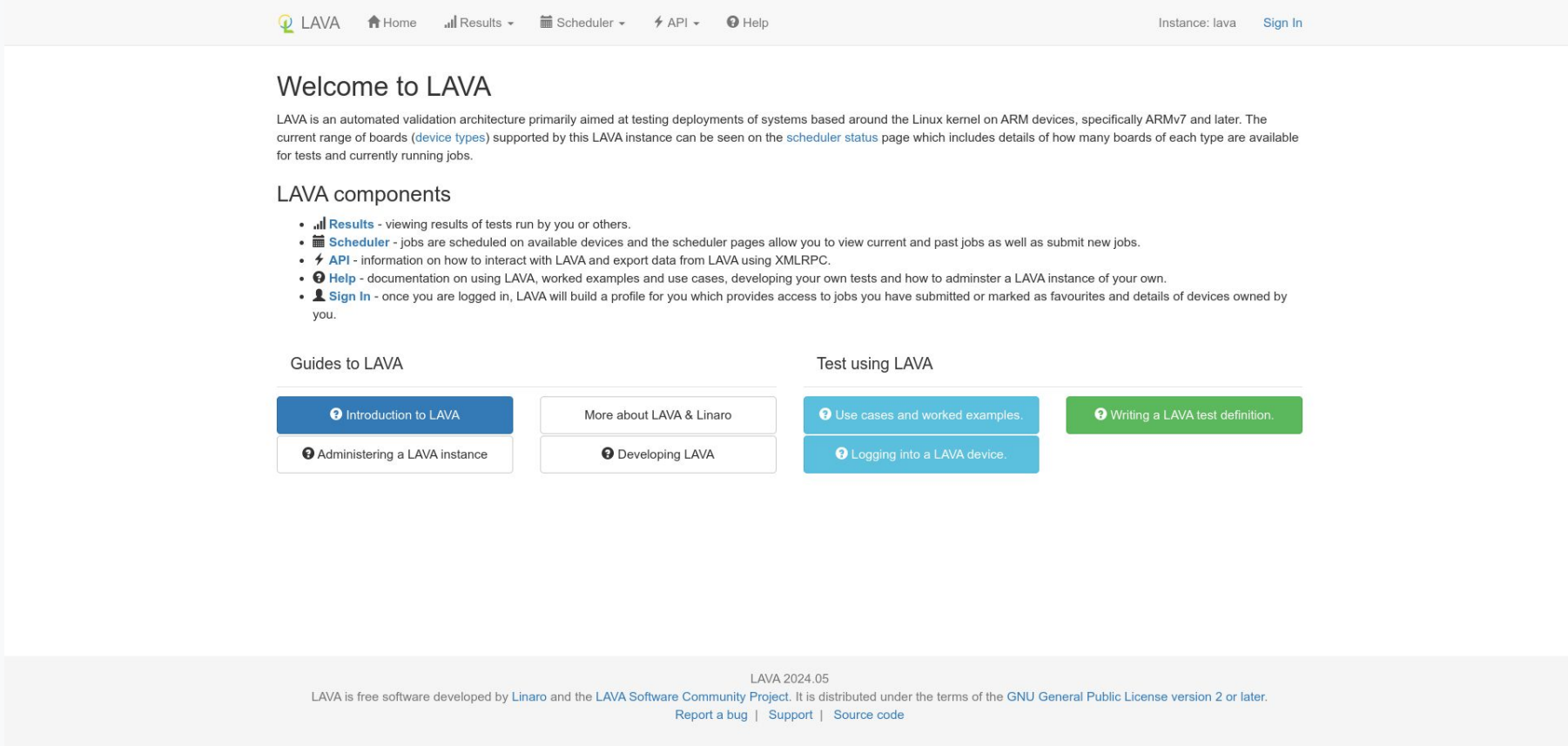
Test Config and Log - Demo



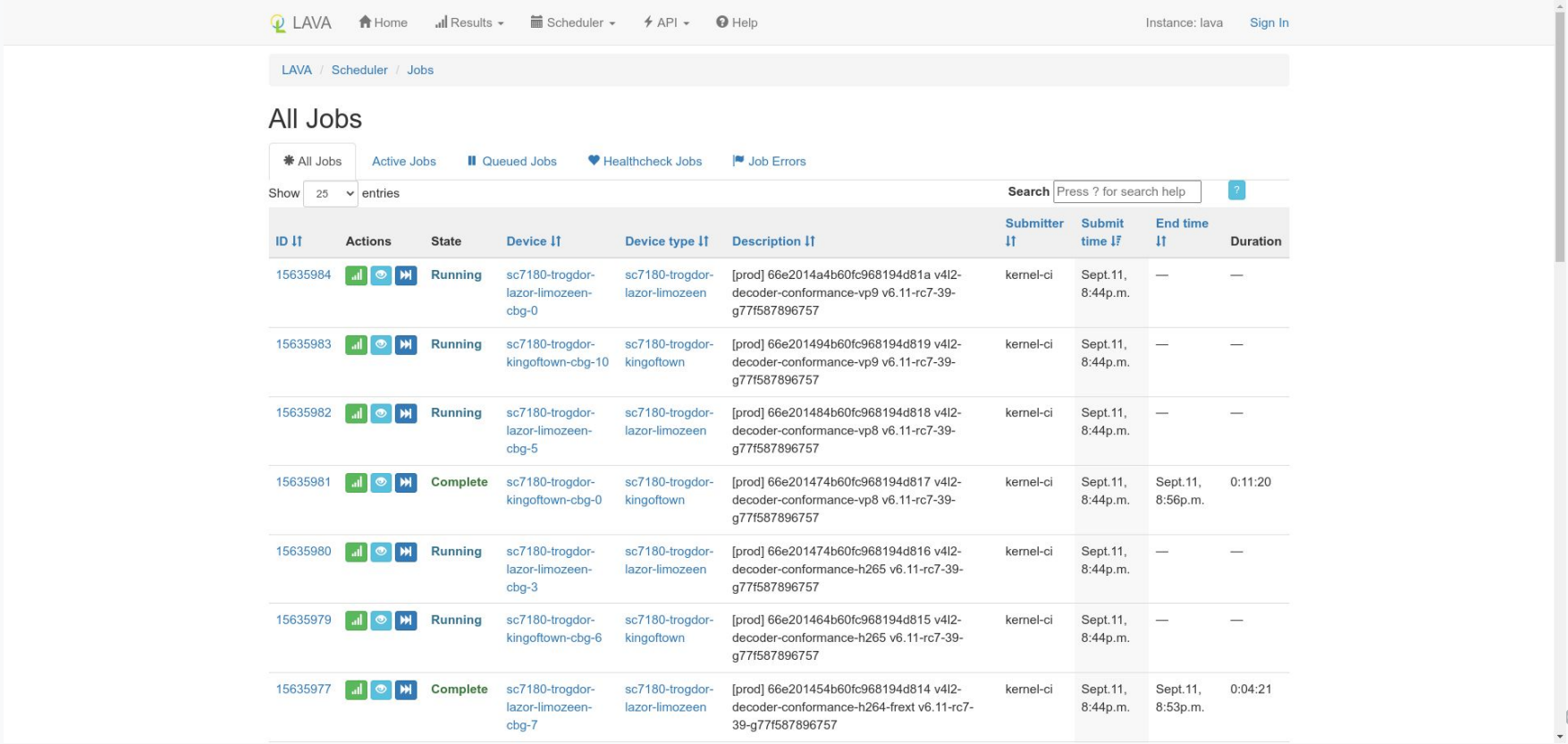
Infrastructure for KernelCI

- LAVA
  - Used to run tests for KernelCI behind the scene
  - Linaro Automation and Validation Architecture
  - Infrastructure to enable users to run their own tests
    - Boot boards, run tests on them and collect results
  - Collabora maintains a LAVA lab also with Chromebooks

LAVA



Video Decode Test Runs



LAVA Home Results Scheduler API Help Instance: lava Sign In

LAVA / Scheduler / Jobs

All Jobs

All Jobs | Active Jobs | Queued Jobs | Healthcheck Jobs | Job Errors

Show 25 entries Search Press ? for search help

ID	Actions	State	Device	Device type	Description	Submitter	Submit time	End time	Duration
15635984		Running	sc7180-trogdor-lazor-limozeen-cbg-0	sc7180-trogdor-lazor-limozeen	[prod] 66e2014a4b60fc968194d81a v4l2-decoder-conformance-vp9 v6.11-rc7-39-g77f587896757	kernel-ci	Sept.11, 8:44p.m.	—	—
15635983		Running	sc7180-trogdor-kingoftown-cbg-10	sc7180-trogdor-kingoftown	[prod] 66e201494b60fc968194d819 v4l2-decoder-conformance-vp9 v6.11-rc7-39-g77f587896757	kernel-ci	Sept.11, 8:44p.m.	—	—
15635982		Running	sc7180-trogdor-lazor-limozeen-cbg-5	sc7180-trogdor-lazor-limozeen	[prod] 66e201484b60fc968194d818 v4l2-decoder-conformance-vp8 v6.11-rc7-39-g77f587896757	kernel-ci	Sept.11, 8:44p.m.	—	—
15635981		Complete	sc7180-trogdor-kingoftown-cbg-0	sc7180-trogdor-kingoftown	[prod] 66e201474b60fc968194d817 v4l2-decoder-conformance-vp8 v6.11-rc7-39-g77f587896757	kernel-ci	Sept.11, 8:44p.m.	Sept.11, 8:56p.m.	0:11:20
15635980		Running	sc7180-trogdor-lazor-limozeen-cbg-3	sc7180-trogdor-lazor-limozeen	[prod] 66e201474b60fc968194d816 v4l2-decoder-conformance-h265 v6.11-rc7-39-g77f587896757	kernel-ci	Sept.11, 8:44p.m.	—	—
15635979		Running	sc7180-trogdor-kingoftown-cbg-6	sc7180-trogdor-kingoftown	[prod] 66e201464b60fc968194d815 v4l2-decoder-conformance-h265 v6.11-rc7-39-g77f587896757	kernel-ci	Sept.11, 8:44p.m.	—	—
15635977		Complete	sc7180-trogdor-lazor-limozeen-cbg-7	sc7180-trogdor-lazor-limozeen	[prod] 66e201454b60fc968194d814 v4l2-decoder-conformance-h264-frext v6.11-rc7-39-g77f587896757	kernel-ci	Sept.11, 8:44p.m.	Sept.11, 8:53p.m.	0:04:21

Current Status

- Started using new Kernel CI UI this month!
  - Enabled gstreamer on Debian result
- Test runs without new Kernel CI UI
  - gstreamer on Debian 90%
  - Tast on ChromeOS 60%
  - gstreamer on ChromeOS 40%
  - Tast on Debian 0%
- Q3 target, trying to wrap up by EOY

Future Work

- Enable everything on testing configurations, platforms, trees/branches
- Make sure all current test failures are expected
- Fix reported regressions
- KernelCI Regressions Tracker
  - automatic detection and notification
- Pre-merge testing on ChromeOS HWs

KernelCI events & talks at LPC this week

- Sep 19 Thu
  - 12pm, Meet the new KernelCI
  - 3:30pm-6pm - KernelCI booth in the hallway track
  - 7pm - KernelCI Happy Hour - Location TBD
- Sep 20 Fri
  - 12:30pm - Towards common mainline device testing [Testing MC]
  - 1pm - Interacting with kernel test results [Testing MC]
  - 3:30pm - Boot time testing with ftrace [IoT/Embedded MC]
  - 5pm - BoF: Continuously testing the Linux kernel

References

- Kernel CI: new UI, old UI
- LAVA https://lava.collabora.dev/
- KernelCI Regressions Tracker https://kernel.pages.collabora.com/kernelci-regressions-tracker/
- b/263250405 umbrella bug: kernel ci - add video decode tests on MTK/QC platforms
- Video Decode on Kernel CI for MTK Platforms tinyurl.com/video-decode-kernel-ci
- Video Decode on Kernel CI - Current Plan tinyurl.com/video-decode-kernel-ci-plan
- KernelCI Project overview and Collabora's role slides
- Rethinking device support for the long-term presentation

02
Using Virtual Driver for Video Decode Testing on Chromium

How can we do more V4L2 testing without actual HWs?

Problem Statement

- Regressions on ChromeOS HWs caught very late
  - V4L2 SW stack & testing client code
- Why?
  - V4L2 code exist on Chromium codebase
  - But ChromeOS code exists on ChromeOS codebase
  - NO way to test V4L2 code on different ChromeOS HWs automatically
    - Commit Queue (CQ) testing in Chromium

- Can we run tests on Virtual Machine (VM)?

Virtual Stateless Decoder Driver (VISL)

- Developed by Daniel Almeida from Collabora with ChromeOS support patch
- Objective
  - Help the development and testing of userspace applications that use the V4L2 stateless API to decode media
    - When no hardware is available
    - When the kernel uAPI for the codec has not been upstreamed yet
- md5 verification, AV1 support added later
- actual decoding doesn't happen

Current v4l2 stateless support on ChromeOS

- MTK platforms
  - MT8183 kukui
  - MT8192 asurada
  - MT8195 cherry
  - MT8186 corsola
  - MT8188G geralt
- MT8173 and QC7180 uses stateful

Video Testing on ChromeOS using ARM VM

- Environment
  - Driver: VISL
  - ChromeOS image: arm64-generic-vm vs. x86
  - Testing client used in ChromeOS for V4L2
- arm64 QEMU is launched through ChromeOS VM
  - customization from x86 was needed
- added in Chromium CQ infra

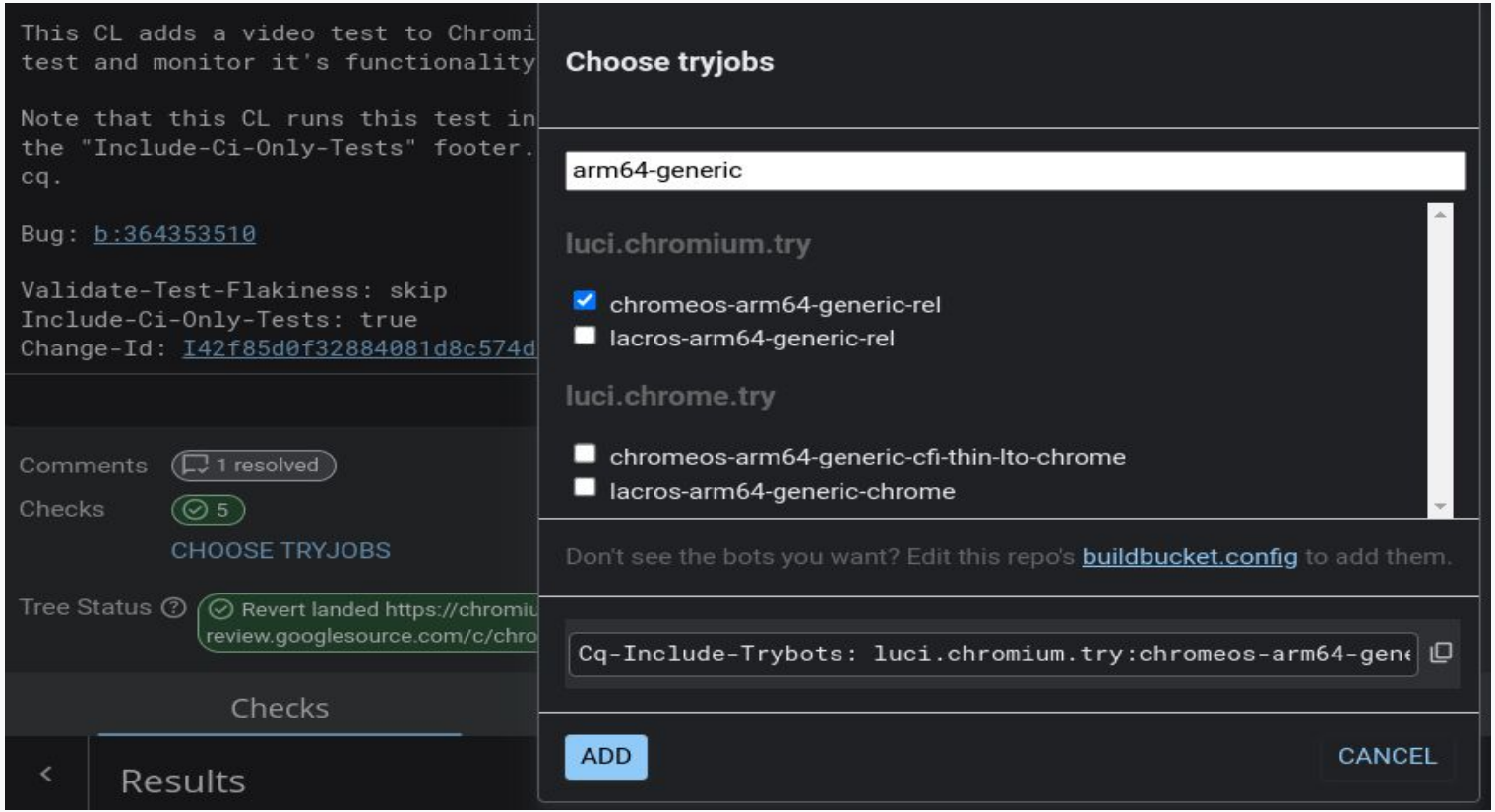
Challenges

- Only x86 VMs was supported for ChromeOS
  - ARM VM was too slow to be useful
- gfx buffer allocation
  - dummy Minigbm backend needed with vkms (virtual display)
  - primary node access instead of render node
- No ARM VM native cloud machines supported
  - limited cros vm & QEMU support
  - ARM VM on top of x86
- Strict requirements from Chromium CQ
  - additional installation (e.g. virgl render) not allowed
  - need to run through cros vm
  - unique problems for ARM: slow execution speed

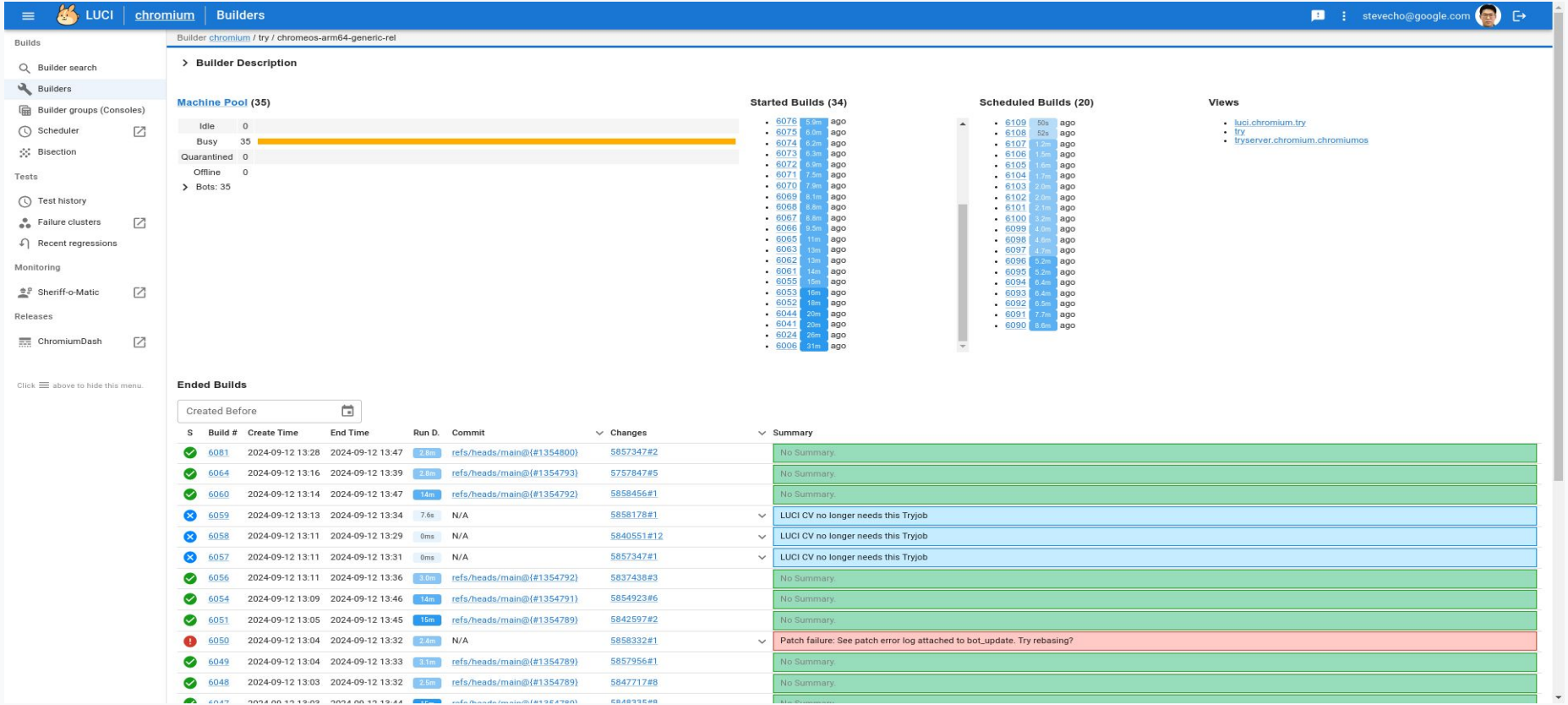
Testing from Chromium Gerrit

- Select from UI or add in a commit comment
  - tryjob *chromeos-arm64-generic-rel*
  - adding the comment
    - Include-Ci-Only-Tests: true
- automatically triggered by mega CQ

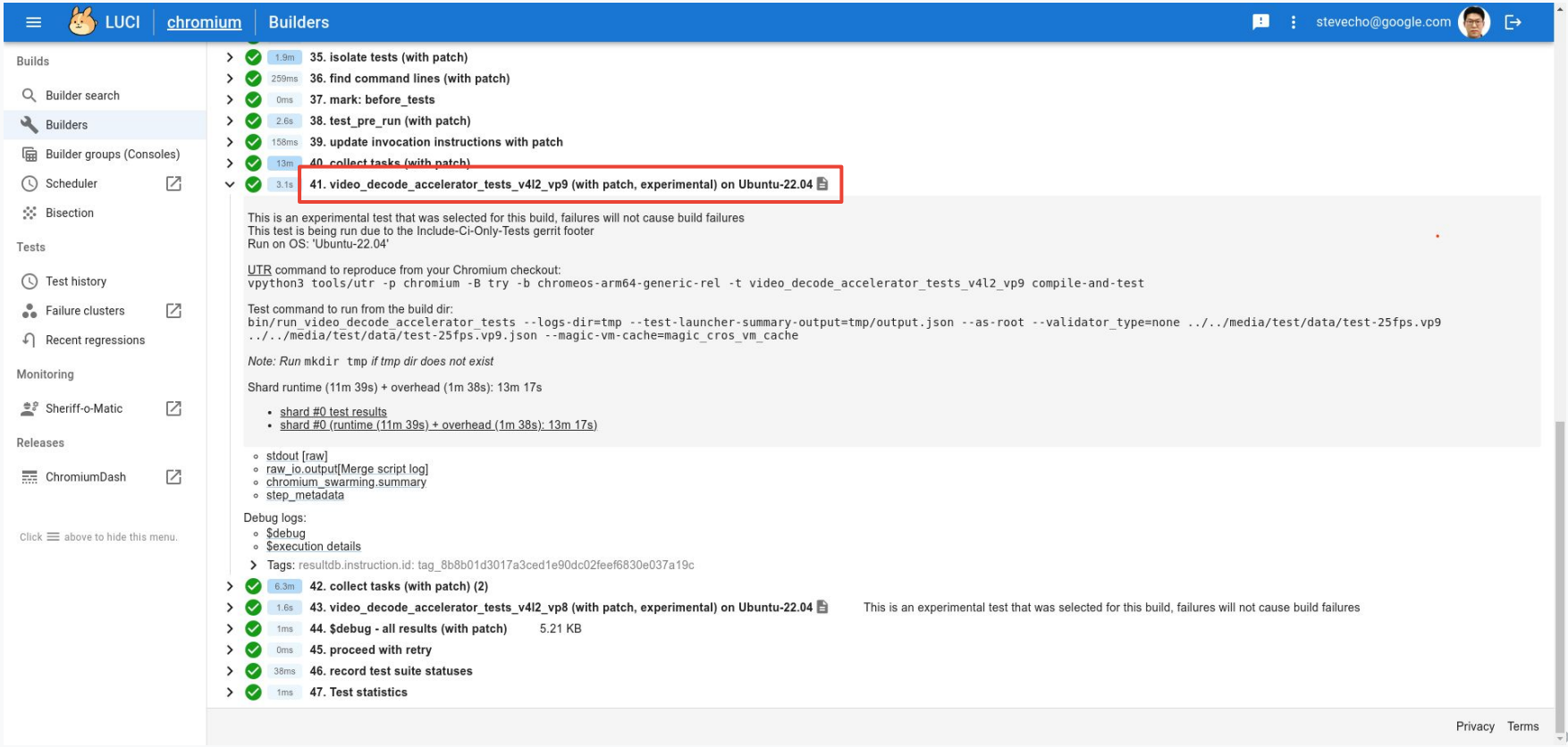
Select the test from Gerrit UI



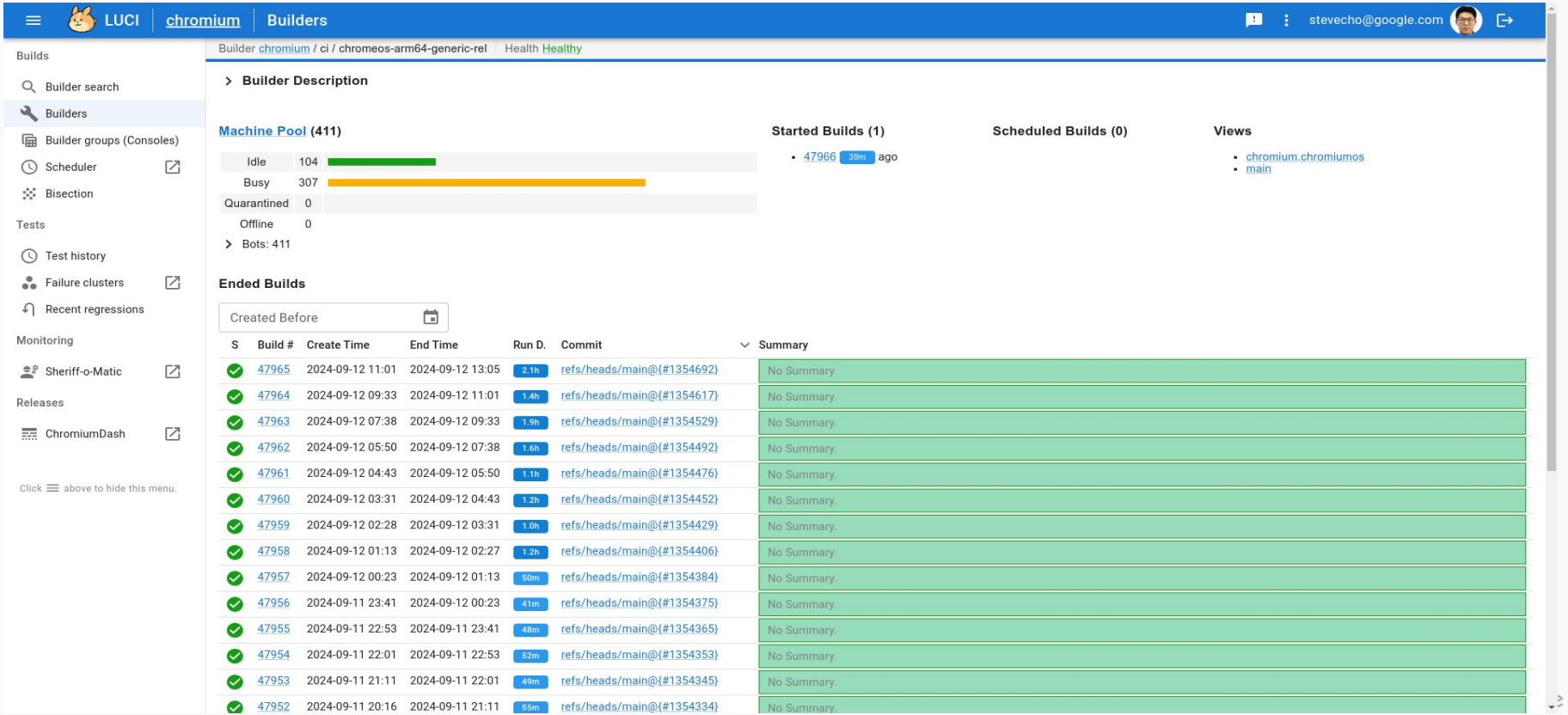
Pre-Submit Testing (as requested)



Log from Chromium Builders



Post-Submit Testing



Current Status

- Chromium CQ runs vp8 & vp9 tests
- Made tests consistently passing
  - ARM VM limitation: boot time, decoding time expectation
- Post-submit runs

Future Work

- Promote to pre-merge testing
- Extend to all codecs (h264, hevc, av1)
- Add md5 verification