

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

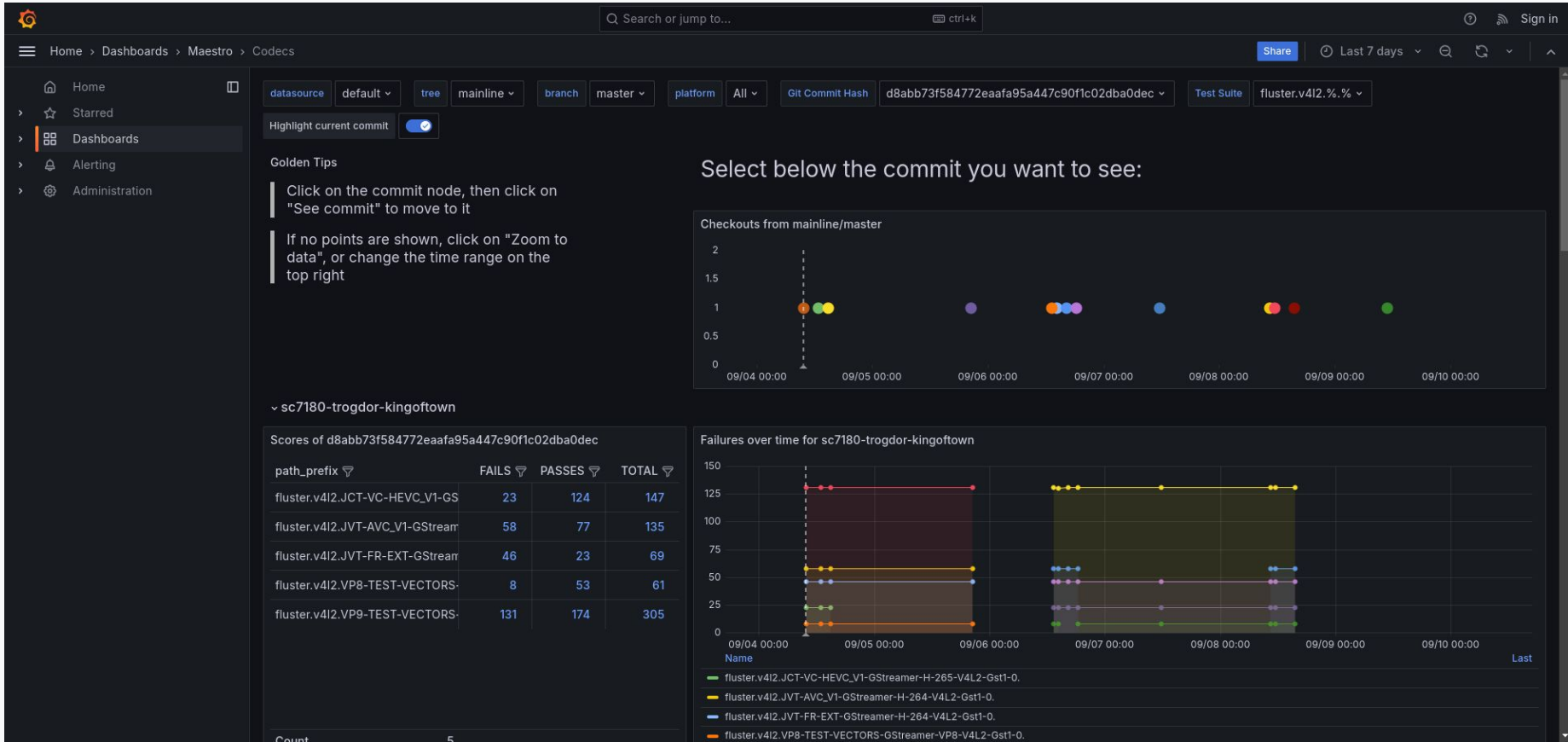
Tree / Branch used in KernelCI

- 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



Test Config and Log - Demo

The screenshot displays a web interface for test configuration and log viewing. The interface is divided into several sections:

- Navigation:** Home > Dashboards > Test. Includes a search bar and a "Share" button.
- Filters:** Database: default, Issue presence: All.
- Overview:**
 - Origin: maestro
 - Node path: fluster.v412.AV1-TEST-VECTORS-GStreamer-AV1-V4L2SL-Gst1-0.a
 - Comment: av1-1-b10-23-film_grain-50 on mt8195-cherry-tomato-r2 in lava-c
 - Start time: 2024-09-04 17:48:19.208+00
 - Duration:
 - Log: <https://kciapistagingstorage1.file.core.windows.net/early-access/>
 - Status: **FAIL**
- Build:**
 - Architecture: arm64
 - Compiler: gcc-12
 - Command:
 - Configuration: defconfig
 - Comment: v6.11-rc6-55-gd8abb73f58477
- Checkout:**
 - Repository: <https://git.kernel.org/pub/scm/linux/kernel/git/torvalds/linux.git>
- Log excerpt:**

```
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-34x34 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-34x64 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-34x66 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-64x16 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-64x18 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-64x32 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-64x34 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-64x64 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-64x66 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-66x16 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-66x18 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-66x32 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-66x34 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-66x64 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-01-size-66x66 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-02-allintra RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-03-sizedown RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-03-sizeup RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-04-cdfupdate RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-05-mv RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-06-mfmv RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-22-svc-L1T2 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-22-svc-L2T1 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-22-svc-L2T2 RESULT=pass>
<LAVA_SIGNAL_TESTCASE TEST_CASE_ID=av1-1-b8-23-film_grain-50 RESULT=fail>
<LAVA_SIGNAL_TESTSET STOP>
+ set +x
<LAVA_SIGNAL_ENDRUN 0_v412-decoder-conformance-av1 15486506_1.6.2.3.1>
<LAVA_TEST_RUNNER EXIT>
/ #
```

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

Welcome to LAVA

LAVA is an automated validation architecture primarily aimed at testing deployments of systems based around the Linux kernel on ARM devices, specifically ARMv7 and later. The current range of boards ([device types](#)) supported by this LAVA instance can be seen on the [scheduler status](#) page which includes details of how many boards of each type are available for tests and currently running jobs.

LAVA components

- [Results](#) - viewing results of tests run by you or others.
- [Scheduler](#) - jobs are scheduled on available devices and the scheduler pages allow you to view current and past jobs as well as submit new jobs.
- [API](#) - information on how to interact with LAVA and export data from LAVA using XMLRPC.
- [Help](#) - documentation on using LAVA, worked examples and use cases, developing your own tests and how to administer a LAVA instance of your own.
- [Sign In](#) - once you are logged in, LAVA will build a profile for you which provides access to jobs you have submitted or marked as favourites and details of devices owned by you.

Guides to LAVA

[Introduction to LAVA](#)[Administering a LAVA instance](#)[More about LAVA & Linaro](#)[Developing LAVA](#)

Test using LAVA

[Use cases and worked examples.](#)[Logging into a LAVA device.](#)[Writing a LAVA test definition.](#)

Video Decode Test Runs

[LAVA](#) / [Scheduler](#) / [Jobs](#)

All Jobs

[* All Jobs](#)
[Active Jobs](#)
[Queued Jobs](#)
[Healthcheck Jobs](#)
[Job Errors](#)

Show entries

Search [?](#)

ID	Actions	State	Device	Device type	Description	Submitter	Submit time	End time	Duration
15635984		Running	sc7180-trogdorz-lazor-limozeen-cbg-0	sc7180-trogdorz-lazor-limozeen	[prod] 66e2014a4b60fc968194d81a v4I2-decoder-conformance-vp9 v6.11-rc7-39-g77f587896757	kernel-ci	Sept. 11, 8:44p.m.	—	—
15635983		Running	sc7180-trogdorz-kingoftown-cbg-10	sc7180-trogdorz-kingoftown	[prod] 66e201494b60fc968194d819 v4I2-decoder-conformance-vp9 v6.11-rc7-39-g77f587896757	kernel-ci	Sept. 11, 8:44p.m.	—	—
15635982		Running	sc7180-trogdorz-lazor-limozeen-cbg-5	sc7180-trogdorz-lazor-limozeen	[prod] 66e201484b60fc968194d818 v4I2-decoder-conformance-vp8 v6.11-rc7-39-g77f587896757	kernel-ci	Sept. 11, 8:44p.m.	—	—
15635981		Complete	sc7180-trogdorz-kingoftown-cbg-0	sc7180-trogdorz-kingoftown	[prod] 66e201474b60fc968194d817 v4I2-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-trogdorz-lazor-limozeen-cbg-3	sc7180-trogdorz-lazor-limozeen	[prod] 66e201474b60fc968194d816 v4I2-decoder-conformance-h265 v6.11-rc7-39-g77f587896757	kernel-ci	Sept. 11, 8:44p.m.	—	—
15635979		Running	sc7180-trogdorz-kingoftown-cbg-6	sc7180-trogdorz-kingoftown	[prod] 66e201464b60fc968194d815 v4I2-decoder-conformance-h265 v6.11-rc7-39-g77f587896757	kernel-ci	Sept. 11, 8:44p.m.	—	—
15635977		Complete	sc7180-trogdorz-lazor-limozeen-cbg-7	sc7180-trogdorz-lazor-limozeen	[prod] 66e201454b60fc968194d814 v4I2-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

This CL adds a video test to Chromi
test and monitor it's functionality

Note that this CL runs this test in
the "Include-Ci-Only-Tests" footer.
cq.

Bug: [b:364353510](#)

Validate-Test-Flakiness: skip
Include-Ci-Only-Tests: true
Change-Id: [I42f85d0f32884081d8c574d](#)

Comments 1 resolved

Checks 5

CHOOSE TRYJOBS

Tree Status ? ✓ Revert landed chromeos-arm64-generic-rel- lacros-arm64-generic-rel

luci.chrome.try

- chromeos-arm64-generic-cfi-thin-lto-chrome
- lacros-arm64-generic-chrome

Don't see the bots you want? Edit this repo's [buildbucket.config](#) to add them.

Cq-Include-Trybots: luci.chromium.try:chromeos-arm64-gene

ADD CANCEL

Pre-Submit Testing (as requested)

LUCI
chromium
Builders

stevecho@google.com

Builds

Builder search

Builders

Builder groups (Consoles)

Scheduler

Bisection

Tests

Test history

Failure clusters

Recent regressions

Monitoring

Sheriff-o-Matic

Releases

ChromiumDash

Click above to hide this menu.

Builder: chromium / try / chromeos-arm64-generic-rel

> Builder Description

Machine Pool (35)

Idle	0
Busy	35
Quarantined	0
Offline	0

> Bots: 35

Started Builds (34)

- 6076 5.9m ago
- 6075 6.0m ago
- 6074 6.2m ago
- 6073 6.3m ago
- 6072 6.5m ago
- 6071 7.5m ago
- 6070 7.8m ago
- 6089 8.1m ago
- 6088 8.2m ago
- 6087 8.5m ago
- 6086 9.5m ago
- 6085 11m ago
- 6083 13m ago
- 6082 12m ago
- 6081 14m ago
- 6055 15m ago
- 6053 16m ago
- 6052 16m ago
- 6044 20m ago
- 6041 20m ago
- 6024 26m ago
- 6006 31m ago

Scheduled Builds (20)

- 6109 50s ago
- 6108 52s ago
- 6107 1.2m ago
- 6106 1.5m ago
- 6105 1.6m ago
- 6104 1.7m ago
- 6103 2.0m ago
- 6102 2.0m ago
- 6101 2.1m ago
- 6100 3.2m ago
- 6099 4.0m ago
- 6098 4.6m ago
- 6097 4.7m ago
- 6096 5.2m ago
- 6095 5.2m ago
- 6094 6.4m ago
- 6093 6.4m ago
- 6092 6.5m ago
- 6091 7.7m ago
- 6090 8.0m ago

Views

- luci.chromium.try
- try
- tryserver.chromium.chromiumos

Ended Builds

S	Build #	Create Time	End Time	Run D.	Commit	Changes	Summary
✓	6081	2024-09-12 13:28	2024-09-12 13:47	2.8m	refs/heads/main@(#1354800)	5857347#2	No Summary.
✓	6064	2024-09-12 13:16	2024-09-12 13:39	2.8m	refs/heads/main@(#1354793)	5757847#5	No Summary.
✓	6060	2024-09-12 13:14	2024-09-12 13:47	14m	refs/heads/main@(#1354792)	5858456#1	No Summary.
✗	6059	2024-09-12 13:13	2024-09-12 13:34	7.6s	N/A	5858178#1	LUCI CV no longer needs this Tryjob
✗	6058	2024-09-12 13:11	2024-09-12 13:29	0ms	N/A	5840551#12	LUCI CV no longer needs this Tryjob
✗	6057	2024-09-12 13:11	2024-09-12 13:31	0ms	N/A	5857347#1	LUCI CV no longer needs this Tryjob
✓	6056	2024-09-12 13:11	2024-09-12 13:36	3.0m	refs/heads/main@(#1354792)	5837438#3	No Summary.
✓	6054	2024-09-12 13:09	2024-09-12 13:46	14m	refs/heads/main@(#1354791)	5854923#6	No Summary.
✓	6051	2024-09-12 13:05	2024-09-12 13:45	15m	refs/heads/main@(#1354789)	5842597#2	No Summary.
✗	6050	2024-09-12 13:04	2024-09-12 13:32	2.4m	N/A	5858332#1	Patch failure: See patch error log attached to bot_update. Try rebasing?
✓	6049	2024-09-12 13:04	2024-09-12 13:33	3.1m	refs/heads/main@(#1354789)	5857956#1	No Summary.
✓	6048	2024-09-12 13:03	2024-09-12 13:32	2.5m	refs/heads/main@(#1354789)	5847217#8	No Summary.

Log from Chromium Builders

☰
LUCI | chromium | Builders
stevecho@google.com ↗

Builds

🔍 Builder search

🔧 Builders

📄 Builder groups (Consoles)

🕒 Scheduler ↗

🌀 Bisection

Tests

🕒 Test history

👤 Failure clusters ↗

🔄 Recent regressions

Monitoring

👤 Sheriff-o-Matic ↗

Releases

📄 ChromiumDash ↗

Click ☰ above to hide this menu.

- > ✔ 1.9m 35. isolate tests (with patch)
- > ✔ 259ms 36. find command lines (with patch)
- > ✔ 0ms 37. mark: before_tests
- > ✔ 2.6s 38. test_pre_run (with patch)
- > ✔ 158ms 39. update invocation instructions with patch
- > ✔ 13m 40. collect tasks (with patch)
- ▼ ✔ 3.1s 41. video_decode_accelerator_tests_v4l2_vp9 (with patch, experimental) on Ubuntu-22.04 📄

This is an experimental test that was selected for this build, failures will not cause build failures
 This test is being run due to the Include-Ci-Only-Tests gerrit footer
 Run on OS: 'Ubuntu-22.04'

UTR command to reproduce from your Chromium checkout:
 vpython3 tools/utr -p chromium -B try -b chromeos-arm64-generic-rel -t video_decode_accelerator_tests_v4l2_vp9 compile-and-test

Test command to run from the build dir:
 bin/run_video_decode_accelerator_tests --logs-dir=tmp --test-launcher-summary-output=tmp/output.json --as-root --validator_type=none ../../media/test/data/test-25fps.vp9
 ../../media/test/data/test-25fps.vp9.json --magic-vm-cache=magic_cros_vm_cache

Note: Run mkdir tmp if tmp dir does not exist

Shard runtime (11m 39s) + overhead (1m 38s): 13m 17s

- [shard #0 test results](#)
- [shard #0 \(runtime \(11m 39s\) + overhead \(1m 38s\): 13m 17s\)](#)

- stdout [raw]
- raw_io_output[Merge script log]
- chromium_swarming.summary
- step_metadata

Debug logs:

- \$debug
- \$execution_details

> Tags: resultdb.instruction.id: tag_8b8b01d3017a3ced1e90dc02fee6f6830e037a19c

- > ✔ 6.3m 42. collect tasks (with patch) (2)
- > ✔ 1.6s 43. video_decode_accelerator_tests_v4l2_vp8 (with patch, experimental) on Ubuntu-22.04 📄 This is an experimental test that was selected for this build, failures will not cause build failures
- > ✔ 1ms 44. \$debug - all results (with patch) 5.21 KB
- > ✔ 0ms 45. proceed with retry
- > ✔ 38ms 46. record test suite statuses
- > ✔ 1ms 47. Test statistics

Post-Submit Testing

LUCI | [chromium](#) | Builders

 stevecho@google.com

Builder [chromium](#) / ci / chromeos-arm64-generic-rel Health Healthy

> Builder Description

Machine Pool (411)

Idle	104	<div style="width: 100%; height: 10px; background-color: green;"></div>
Busy	307	<div style="width: 100%; height: 10px; background-color: orange;"></div>
Quarantined	0	
Offline	0	

> Bots: 411

Started Builds (1)

- 47966 39m ago

Scheduled Builds (0)

Views

- chromium.chromiumos
- main

Ended Builds

S	Build #	Create Time	End Time	Run D.	Commit	Summary
✓	47965	2024-09-12 11:01	2024-09-12 13:05	2.1h	refs/heads/main@(#1354692)	No Summary.
✓	47964	2024-09-12 09:33	2024-09-12 11:01	1.4h	refs/heads/main@(#1354617)	No Summary.
✓	47963	2024-09-12 07:38	2024-09-12 09:33	1.9h	refs/heads/main@(#1354529)	No Summary.
✓	47962	2024-09-12 05:50	2024-09-12 07:38	1.6h	refs/heads/main@(#1354492)	No Summary.
✓	47961	2024-09-12 04:43	2024-09-12 05:50	1.1h	refs/heads/main@(#1354476)	No Summary.
✓	47960	2024-09-12 03:31	2024-09-12 04:43	1.2h	refs/heads/main@(#1354452)	No Summary.
✓	47959	2024-09-12 02:28	2024-09-12 03:31	1.0h	refs/heads/main@(#1354429)	No Summary.
✓	47958	2024-09-12 01:13	2024-09-12 02:27	1.2h	refs/heads/main@(#1354406)	No Summary.
✓	47957	2024-09-12 00:23	2024-09-12 01:13	50m	refs/heads/main@(#1354384)	No Summary.
✓	47956	2024-09-11 23:41	2024-09-12 00:23	41m	refs/heads/main@(#1354375)	No Summary.
✓	47955	2024-09-11 22:53	2024-09-11 23:41	48m	refs/heads/main@(#1354365)	No Summary.
✓	47954	2024-09-11 22:01	2024-09-11 22:53	52m	refs/heads/main@(#1354353)	No Summary.
✓	47953	2024-09-11 21:11	2024-09-11 22:01	49m	refs/heads/main@(#1354345)	No Summary.
✓	47952	2024-09-11 20:16	2024-09-11 21:11	55m	refs/heads/main@(#1354334)	No Summary.

Click above to hide this menu.

 ↑
↓

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