

Linux Plumbers Conference

Richmond, Virginia | November 13-15, 2023



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Conference | Richmond, VA | Nov. 13-15, 2023

Android Kernel & Platform CI Testing

Linux Plumber Android Micro Conference

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Agenda

- Introduction
- Presubmit
- Postsubmit
- Challenges
- Questions





Kernel & Platform Integration Test matrix

Android Common Kernels	Android Platform Releases					
	Main	14	13	12	11	10
android-mainline	✓	✗	✗	✗	✗	✗
android15-6.1	✓	✗	✗	✗	✗	✗
android14-6.1 android14-5.14	✓	✓	✗	✗	✗	✗
android13-5.15 android13-5.10	✓	✓	✓	✗	✗	✗
android12-5.10 android12-5.4	✓	✓	✓	✓	✗	✗
android11-5.4 android-4.19-stable	✓	✓	✓	✓	✓	✗
android-4.14-stable	✗	✓	✓	✓	✓	✓



Upstream android-mainline testing

- **Push Android kernel testing upstream with android-mainline**
 - Early kernel and platform **integration**
 - **Catch** breakages & regressions **close to** when they are **introduced**
 - Work with upstream maintainers and developers for **quicker resolutions**
 - **Early regression detection** and **resolution** to ensure no surprise on uprev
 - **NO** late and accumulated integration **headaches**
- **Partner with LINARO for mainline and LTS release candidate testing**



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Catch breakage at presubmit

Android
Open Source Project

CHANGES ▾ YOUR ▾ DOCUMENTATION ▾ BROWSE ▾

🔍

Merged ☆ 2583551 ▾ ANDROID: ABI: update symbol list for galaxy 📄

Change Info

Submitted May 15

Owner YOUNGJIN JOO

Uploader Matthias Männich +2

Reviewers Greg Kroah-H... +2 Matthias Män... +2 Treehugger R... 📝

Repo | Branch kernel/common | android14-6.1

Submit Requirements

- ✓ Code-Review +2
- ✓ Presubmit-Verified +1
- ✓ Code-Owners Approved ? ADD OWNERS
- ✓ Open-Source-Licensing No votes
- ✓ Lint No votes

Links [builds](#) [automerger](#)

SHOW ALL ▾

REPLY

ANDROID: ABI: update symbol list for galaxy

27 function symbol(s) added

```
'void __blk_req_zone_write_lock(struct request*)'
'void __blk_req_zone_write_unlock(struct request*)'
'int __traceiter_block_rq_insert(void*, struct request*)'
'void blk_mq_sched_mark_restart_hctx(struct blk_mq_hw_ctx*)'
'bool blk_mq_sched_try_insert_merge(struct request_queue*, struct request*, struct list_head*)'
'bool blk_mq_sched_try_merge(struct request_queue*, struct bio*, unsigned int, struct request*)'
'void blk_queue_rq_timeout(struct request_queue*, unsigned int)'
'bool blk_req_needs_zone_write_lock(struct request*)'
'void blk_stat_enable_accounting(struct request_queue*)'
'int blkcg_activate_policy(struct request_queue*, const struct blkcg_policy*)'
```

SHOW ALL ▾

Comments 🗨 2 resolved

Checks No results

RUN PRESUBMIT

Files Comments Checks Where is my CL

Runs

Filter runs by regular expression

^ Completed (52)

- KernelSymbolTracker
- STG ABI Changes
- kernel_platform_integration_master_pixel6... 📄
- ABI Fidelity Changes
- AbiAnalyzer
- Automerger Linter
- BloatBuster

Results

Filter results by tag or regular expression

GO TO LATEST PATCHSET Patchset 5 ▾

RUN PRESUBMIT RUN ON TIP-OF-TREE ⋮

Error (0)

Warning (3)

Run	Summary
KernelSymbolTracker	Symbol presence status for new symbols in related branches is as follows (✗ - Absent, ✓ - Present, ? - To be decided, — - Unknown): Analyzer D... AyeAye ▾
STG ABI Changes	📄 ABI for 'kernel_abi_aarch64' has changed. Location: "Kernel ABI difference" Analyzer Description: Report STG ABI changes between builds ('stgdif... AyeAye ▾
kernel_platform_integration_master_pixel6_...	📄 [error] [Test] v2/android-gki/kernel_platform_integration_master_pixel6_vts on kernel_raviole_kleaf on kernel-android14-gs-pixel-6... Already Flaky Head ▾

Info (0)

- Build time checks & tests: ABI stability analysis and symbol allow listing
- Run time platform integration tests: platform and kernel integration including BootTest, [test-mapping](#) kernel-presubmit (cts/vts/etc)



What tests are enabled at presubmit?

The presubmit tests are enabled on Android common kernel **dev**, **lts**, and **release** branches:

- arm64 kernel integration on **physical phone/watch/foldable/tablet**
- use **virtual** devices to increase test coverage on arm64 & x86_64 kernels
- kernels are tested with all compatible **Android versions**
- **BootTest**, selected **CTS** & **VTS**, and more

Android Open Source Project			CHANGES ▾	YOUR ▾	DOCUMENTATION ▾	BROWSE ▾
Active			☆ 2574174 ▾	FROMLIST: dt-bindings: hypervisor: Add MediaTek GenieZone hypervisor		
ack_platform_integration_aosp-master_aosp...	✓ [Test]	v2/android-gki/ack_platform_integration_aosp-master_aosp_cf_x86_64_boot_test on kernel_virt_x86_64 on aosp_kernel-common-android14-6.1	Head			
ack_platform_integration_aosp-master_aosp...	✓ [Test]	v2/android-gki/ack_platform_integration_aosp-master_aosp_cf_x86_64_test_mapping_kernel_presubmit on kernel_virt_x86_64 on aosp_kernel-common-android14-6.1	Head			
ack_platform_integration_master_cf_x86_64...	✓ [Test]	v2/android-gki/ack_platform_integration_master_cf_x86_64_boot_test on kernel_virt_x86_64 on aosp_kernel-common-android14-6.1	Head			
ack_platform_integration_master_cf_x86_64...	✓ [Test]	v2/android-gki/ack_platform_integration_master_cf_x86_64_test_mapping_kernel_presubmit on kernel_virt_x86_64 on aosp_kernel-common-android14-6.1	Head			
ack_platform_integration_udc_cf_x86_64_b...	✓ [Test]	v2/android-gki/ack_platform_integration_udc_cf_x86_64_boot_test on kernel_virt_x86_64 on aosp_kernel-common-android14-6.1	Head			
ack_platform_integration_udc_cf_x86_64_t...	✓ [Test]	v2/android-gki/ack_platform_integration_udc_cf_x86_64_test_mapping_kernel_presubmit on kernel_virt_x86_64 on aosp_kernel-common-android14-6.1	Head			
ack_platform_integration_udc_pixel6_boot...	✓ [Test]	v2/android-gki/ack_platform_integration_udc_pixel6_boot_test on kernel_aarch64 on aosp_kernel-common-android14-6.1	Head			
kernel/kleaf/kernel_aarch64_tests	✓ [Test]	v2/android-gki/kernel/kleaf/kernel_aarch64_tests on kernel_aarch64 on aosp_kernel-common-android14-6.1	Head			
kernel/kleaf/kernel_x86_64_tests	✓ [Test]	v2/android-gki/kernel/kleaf/kernel_x86_64_tests on kernel_x86_64 on aosp_kernel-common-android14-6.1	Head			
kernel/kleaf/quick_tests	✓ [Test]	v2/android-gki/kernel/kleaf/quick_tests on kleaf_tests on aosp_kernel-common-android14-6.1	Head			
kernel/kleaf/slider_tests	✓ [Test]	v2/android-gki/kernel/kleaf/slider_tests on kernel_raviole_kleaf on kernel-android14-gs-p...	Good Build			
kernel_platform_integration_master_pixel6...	✓ [Test]	v2/android-gki/kernel_platform_integration_master_pixel6_boot_test on kernel_raviole_kl...	Good Build			
kernel_platform_integration_master_pixel6...	✓ [Test]	v2/android-gki/kernel_platform_integration_master_pixel6_test_mapping_kernel_presub...	Good Build			
kernel_platform_integration_udc_pixel6_bo...	✓ [Test]	v2/android-gki/kernel_platform_integration_udc_pixel6_boot_test on kernel_raviole_kleaf ...	Good Build			
kernel_platform_integration_udc_pixel6_tes...	✓ [Test]	v2/android-gki/kernel_platform_integration_udc_pixel6_test_mapping_kernel_presubmit ...	Good Build			
kernel_platform_integration_udc_pixel7_bo...	✓ [Test]	v2/android-gki/kernel_platform_integration_udc_pixel7_boot_test on kernel_pantah on ke...	Good Build			



Add test to kernel presubmit in Android platform tree

The presubmit test plan is maintained with [test-mapping](#) **kernel-presubmit** test group in the AOSP **main** platform source code.

Example: [test/vts/tests/kernel_proc_file_api_test/TEST_MAPPING](#)

```
{  
  "kernel-presubmit": [  
    {  
      "name": "vts_kernel_proc_file_api_test"  
    }  
  ]  
}
```



Run kernel presubmit tests locally

The tests added with [test-mapping](#) in **test group** **kernel-presubmit** in Android platform source tree can be run with [atest](#).

```
$ cd $ANDROID_BUILD_TOP  
$ m atest  
$ atest -a --include-subdirs :kernel-presubmit
```

To list the tests without actually running them, you may include the `--collect-tests-only` argument:

```
$ atest --collect-tests-only --include-subdirs  
:kernel-presubmit
```

To run only tests located in a specific directory, cd to the directory where its `TEST_MAPPING` file is defined and run:

```
$ atest :kernel-presubmit
```




Search for kernel presubmit tests in cs.android.com

The screenshot shows the Android Code Search interface with the search term 'kernel-presubmit'. The results are scoped to the repository 'platform/superproject/main'. Five results are displayed, each showing a snippet of code from a 'TEST_MAPPING' file. The code snippets show a JSON-like structure with a 'kernel-presubmit' key. The first snippet is from 'kernel/tests/net/test/TEST_MAPPING', the second from 'test/vts/tests/kernel_proc_file_api_test/TEST_MAPPING', the third from 'test/vts-testcase/kernel/dynamic_partitions/TEST_MAPPING', the fourth from 'test/vts-testcase/kernel/linux_kselftest/TEST_MAPPING', and the fifth from 'test/vts-testcase/kernel/ltp/TEST_MAPPING'.

```
6: ],  
7: "kernel-presubmit": [  
8:   {  
  
1: {  
2:   "kernel-presubmit": [  
3:     {  
  
1: {  
2:   "kernel-presubmit": [  
3:     {  
  
30: ],  
31: "kernel-presubmit": [  
32:   {  
  
525: ],  
526: "kernel-presubmit": [  

```

❖ Search by **kernel-presubmit** in cs.android.com [\[link\]](#)



A snapshot of existing kernel-presubmit

▼ CtsAslrMallocTestCases(module-abi=arm64-v8a)

▼ CtsAslrMallocTestCases(module-abi=armeabi-v7a)

▼ CtsBionicTestCases(module-abi=arm64-v8a)

▼ CtsBionicTestCases(module-abi=armeabi-v7a)

▼ CtsBluetoothTestCases(module-abi=arm64-v8a)

▼ CtsBluetoothTestCases(module-abi=armeabi-v7a)

▼ CtsCameraTestCases(module-abi=arm64-v8a)

▼ CtsCameraTestCases(module-abi=armeabi-v7a)

▼ CtsDisplayTestCases(module-abi=arm64-v8a)

▼ CtsDisplayTestCases(module-abi=armeabi-v7a)

▼ CtsDrmTestCases(module-abi=arm64-v8a)

▼ CtsDrmTestCases(module-abi=armeabi-v7a)

▼ CtsHardwareTestCases(module-abi=arm64-v8a)

▼ CtsHardwareTestCases(module-abi=armeabi-v7a)

▼ CtsIncrementalInstallHostTestCases(module-abi=arm64-v8a)

▼ CtsIncrementalInstallHostTestCases(module-abi=armeabi-v7a)

▼ CtsJniTestCases(module-abi=arm64-v8a)

▼ CtsJniTestCases(module-abi=armeabi-v7a)

▼ CtsLibcoreLegacy22TestCases(module-abi=arm64-v8a)

▼ CtsLibcoreLegacy22TestCases(module-abi=armeabi-v7a)

▼ CtsLibcoreTestCases(module-abi=armeabi-v7a)

▼ CtsOsTestCases(module-abi=arm64-v8a)

▼ CtsOsTestCases(module-abi=armeabi-v7a)

▼ CtsSystemUITestCases(module-abi=arm64-v8a)

▼ CtsUsbTests(module-abi=arm64-v8a)

▼ CtsUsbTests(module-abi=armeabi-v7a)

▼ KernelLibcutilsTest(module-abi=arm64-v8a)

▼ KernelLibcutilsTest(module-abi=armeabi-v7a)

▼ KernelSelinuxFileApiTest(module-abi=arm64-v8a)

▼ KernelSelinuxFileApiTest(module-abi=armeabi-v7a)

▼ VtsAidlHalSensorsTargetTest(module-abi=arm64-v8a)

▼ VtsAidlHalSensorsTargetTest(module-abi=armeabi-v7a)

▼ VtsBootconfigTest(module-abi=arm64-v8a)

▼ VtsBootconfigTest(module-abi=armeabi-v7a)

▼ VtsHalGraphicsComposerV2_4TargetTest(module-abi=arm64-v8a)

▼ VtsHalGraphicsComposerV2_4TargetTest(module-abi=armeabi-v7a)

▼ VtsHalSensorsV2_1TargetTest(module-abi=arm64-v8a)

▼ VtsHalSensorsV2_1TargetTest(module-abi=armeabi-v7a)

▼ binderDriverInterfaceTest(module-abi=arm64-v8a)

▼ binderDriverInterfaceTest(module-abi=armeabi-v7a)

▼ binderLibTest(module-abi=arm64-v8a)

▼ binderLibTest(module-abi=armeabi-v7a)

▼ binderSafeInterfaceTest(module-abi=arm64-v8a)

▼ binderSafeInterfaceTest(module-abi=armeabi-v7a)

▼ bpf_module_test(module-abi=arm64-v8a)

▼ bpf_module_test(module-abi=armeabi-v7a)

▼ memunreachable_binder_test(module-abi=arm64-v8a)

▼ memunreachable_binder_test(module-abi=armeabi-v7a)

▼ vts_kernel_encryption_test(module-abi=arm64-v8a)

▼ vts_kernel_encryption_test(module-abi=armeabi-v7a)

▼ vts_libsnapshot_test(module-abi=arm64-v8a)

▼ vts_libsnapshot_test(module-abi=armeabi-v7a)

▼ vts_linux_kselftest_arm_32(module-abi=arm64-v8a)

▼ vts_linux_kselftest_arm_32(module-abi=armeabi-v7a)

▼ vts_linux_kselftest_arm_64(module-abi=arm64-v8a)

▼ vts_linux_kselftest_arm_64(module-abi=armeabi-v7a)

▼ vts_linux_kselftest_x86_32(module-abi=arm64-v8a)

▼ vts_linux_kselftest_x86_32(module-abi=armeabi-v7a)

▼ vts_linux_kselftest_x86_64(module-abi=arm64-v8a)

▼ vts_linux_kselftest_x86_64(module-abi=armeabi-v7a)

▼ vts_ltp_test_arm(module-abi=arm64-v8a)

▼ vts_ltp_test_arm(module-abi=armeabi-v7a)



Kernel presubmit code coverage

cf_x86_64_updated_paths_cov

cf_arm64_updated_paths_cov

p21_cov

merged_cov

Table



	Total Files	Hit Line Percentage	Hit Lines/Total Lines	Hit Function Percentage	Hit Functions/Total Functions
-All	5,208	30.84%	457033/1482039	38.13%	45092/118248
+arch/	659	23.08%	29192/126481	29.48%	3839/13022
+block/	64	57.09%	11240/19688	62.71%	1105/1762
+certs/	1	20.27%	15/74	33.33%	2/6
+crypto/	83	25.09%	3939/15701	29.84%	381/1277
+drivers/	1,441	21.33%	103205/483960	26.63%	8838/33190
+fs/	368	56.71%	88047/155272	69.11%	6704/9700
+include/	1,107	57.78%	21836/37789	48.18%	6910/14343
+init/	8	42.96%	806/1876	52.48%	74/141
+io_uring/	37	28.10%	2688/9566	41.24%	266/645
+kernel/	309	46.52%	67360/144812	52.81%	6745/12771
+lib/	215	33.10%	14334/43308	39.85%	1127/2828
+mm/	96	56.36%	29798/52867	66.09%	2426/3671
+net/	646	20.19%	65018/321980	24.71%	5056/20458
+scripts/	10	23.14%	346/1495	27.27%	36/132
+security/	55	53.28%	10753/20183	68.97%	918/1331
+sound/	97	20.18%	8344/41341	25.46%	654/2569
+tools/	1	0.00%	0/895	0.00%	0/29
+virt/	11	2.36%	112/4751	2.95%	11/373



What's next in presubmit?

- ❖ **Performance regression detector** at presubmit
- ❖ **Tests from kernel source code: KUnit, KSelftests**
- ❖ **Targeted & quick presubmit testing with increased kernel code coverage**
- ❖ **New verticals: Android TV, Android Auto**



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Tests at Postsubmit

- ❖ **App Compatibility Tests**
- ❖ **Performance Regression Testing**
 - **Boot performance**
 - **Syscall latency benchmarks**
 - **GEEK benchmarks**
 - **App launch benchmarks**
 - **DVFS benchmarks**
- ❖ **CTS & VTS**



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Challenges

- ❖ **Kernel & platform combinations keep growing**
- ❖ **Hard to triage kernel bugs and more tools are needed**
- ❖ **Hard to bisect device boot failure or test failure on LTS update with hundreds of file changes**



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Questions

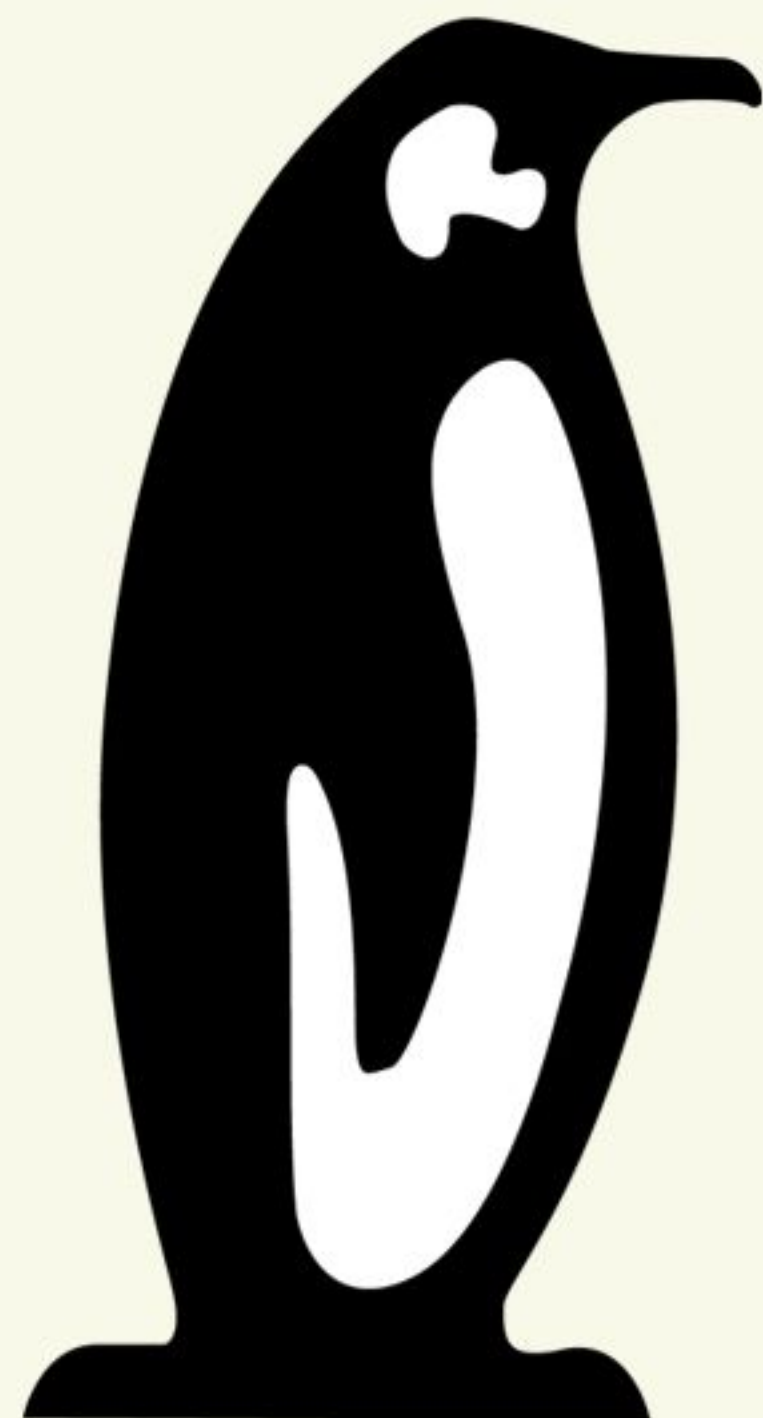
- ❖ How we can collaborate better?
- ❖ What areas we should pay more attention to?
- ❖ What performance metrics or tests you would like us to put into CI testing?



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Q & A





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