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2025

The Importance of Linux Kernel Functional Testing (LKFT)

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Why LKFT Matters?

The Linux Kernel

Powers everything from phones to supercomputers.

Frequent Updates + Diverse ARM Hardware

Create a risk of regressions.

Functional Stability

LKFT ensures stability across arm and arm64 platforms.

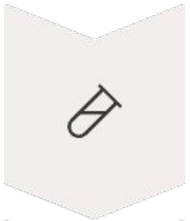
Automated Testing

Test builds, test runs, and regression detection.

Long-term support

Supports long-term and mainline kernel versions.

Agenda

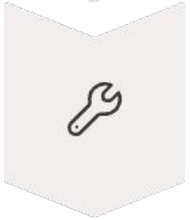


Why kernel testing is critical?

What is LKFT?

Platforms Covered

Test Suites Used in LKFT



LKFT Infrastructure Tools

Agenda (Contd.)

Special Kernel configs Variants vs Toolchains

Our Testing Philosophy

Active Branch Testing

LKFT as Software as a Service (SaaS)

Why Kernel Testing is Critical?

1 **Prevent Regressions**

Detects issues early in development.

2 **Code Stability**

Maintains stable code for users and vendors.

3 **LTS Support**

Supports long-term stable kernel releases.

4 **Developer Confidence**

Increases confidence in code quality.

5 **ARM Competitiveness**

Keeps Linux competitive in the ARM ecosystem.

What is LKFT?

1

Build & Boot

LKFT builds and boots the Linux kernel.

2

Run Automated Tests

Runs LTP, kselftest, and other suites.

3

Real Hardware

Tests on real ARM/ARM64 boards.

4

Virtual Platforms

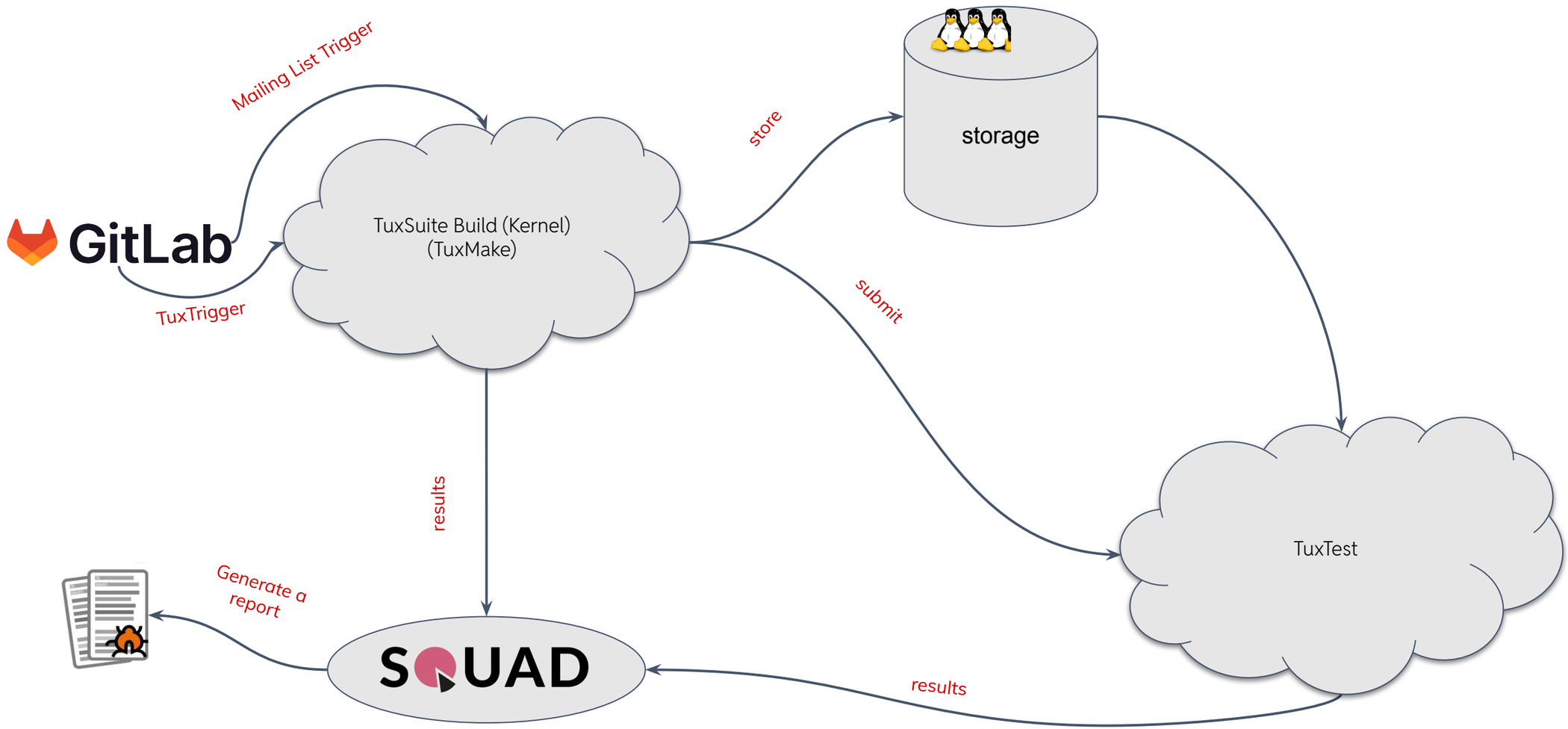
Tests on QEMU and FVP virtual platforms.

5

Regression Detection

Detects regressions to ensure Linux stability.

LKFT Infrastructure



LKFT Infrastructure Tools

GitLab Pipelines

Automates the build and test orchestration process.

TuxMake

Provides standardized kernel build automation.

TuxRun

Orchestrates test execution on diverse devices.

LAVA

Manages job submission for real hardware testing.

SQUAD Dashboards

Tracks results, trends, and regressions over time.

HAY regression detection tool

coming soon …

Platforms Covered

Hardware Platforms

- E850-96
- Juno r2 ARM®
- DragonBoard™ 410c & 845c
- WinLink E850-96Board
- Rock Pi 4 Model B
- Raspberry Pi 4
- Beaglebone X15

Baremetal & VMs

- Ampere Altra
- Graviton4
- x86_64 Server

Virtual Test Platforms

- Arm FVP (Fixed Virtual Platforms)
- QEMU

https://lkft.linaro.org/boards/

Test Suites Used in LKFT

- **Device Tree (DT) validation:** Ensures correctness of board DTs for platforms.
- **KUnit:** Unit tests for kernel logic.
- **KVM-unit-tests:** Virtualization testing.
- **kselftests:** kernel selftests set of tests for the Linux kernel functionality
- **LTP:** syscalls, mm, sched, cgroups, fs, CVE, crypto, kvm, hugetlb, pty, ipc, math, tracing, nptl, math validation.
- **Libhugetlbfs:** Huge page tests.
- **libgpiod:** validates gpiodetect, gpioinfo, gpioget, and gpioset commands
- **Perf Tests:** Performance counters.
- **RCU torture testing:** Stresses and validates Read-Copy-Update (RCU) subsystem under load.
- **Xfstests:** Filesystem stress tests.

https://lkft.linaro.org/tests/

Special Kernel Configs, Variants & Toolchains

Kernel Configs & Variants

- PREEMPT_RT
- 64K PAGE SIZE
- 16K PAGE SIZE
- KASAN
- Device Tree (DT)
- Debug Info reduced

Toolchains


Clang-20


Clang-nightly


GCC-13


GCC-8

LKFT Linux Stats (2024)

- LTS Releases: 271
- Regressions: 116
- Total Tests: 204,487,984
- Kernel triggers: 1,229
  - Builds: ~400 builds, ~2500 boots
- Kernel built: 431k

https://stats.lkft.linaro.org/

Active Branch Testing

Mainline Linux (Linus Torvalds)

Master branch and tags

Linux-next (Stephen Rothwell)

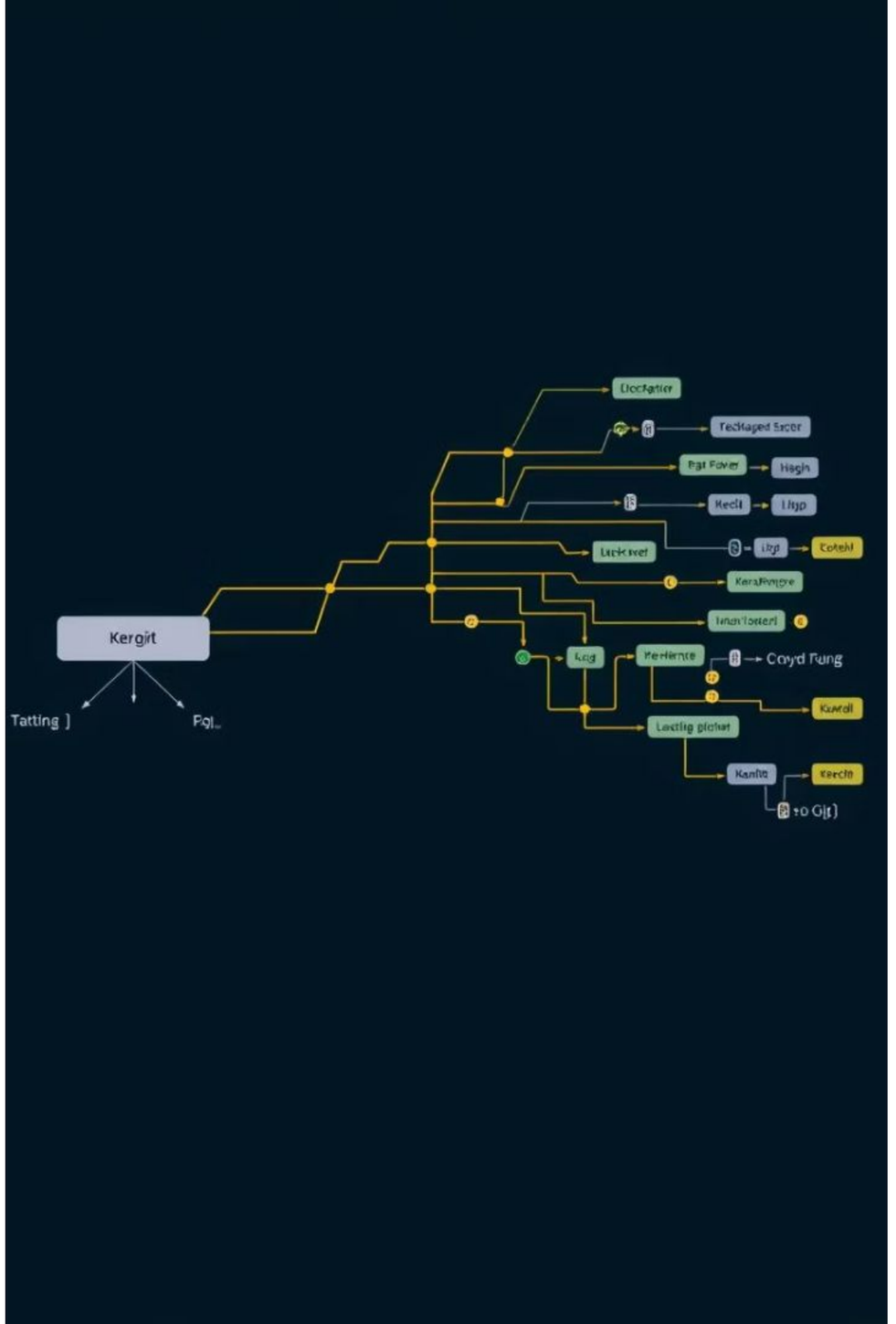
Daily tags

Linus-next (Sasha Levin)

Master branch

Linux Stable-rc (Greg KH and Sasha Levin)

Latest released kernel and all active LTS kernels



Report Lifecycle

1

Reports

Daily and weekly reports are sent to maintainers. This keeps them informed of the latest test results.

2

Bugs

Bugs are filed with logs and bisects. This helps developers quickly identify and fix issues.

3

Collaboration

We work with maintainers to confirm and fix issues. Open communication is key.

4

Transparency

Results are publicly available via LKFT dashboards. Anyone can track progress.

Sample regressions 1

The following 3 issue were reported on stable-rc review

1) Regression on qemu-arm64 and FVP noticed this kernel warning running selftests: arm64: check_hugetlb_options test case on 6.6.76-rc1 and 6.6.76-rc2.

   Test regression: WARNING-arch-arm64-mm-copypage-copy_highpage

2) Regression on Gravition-V4 boot has noticed this kernel warning while booting the 6.6.76-rc1 and 6.6.76-rc2.

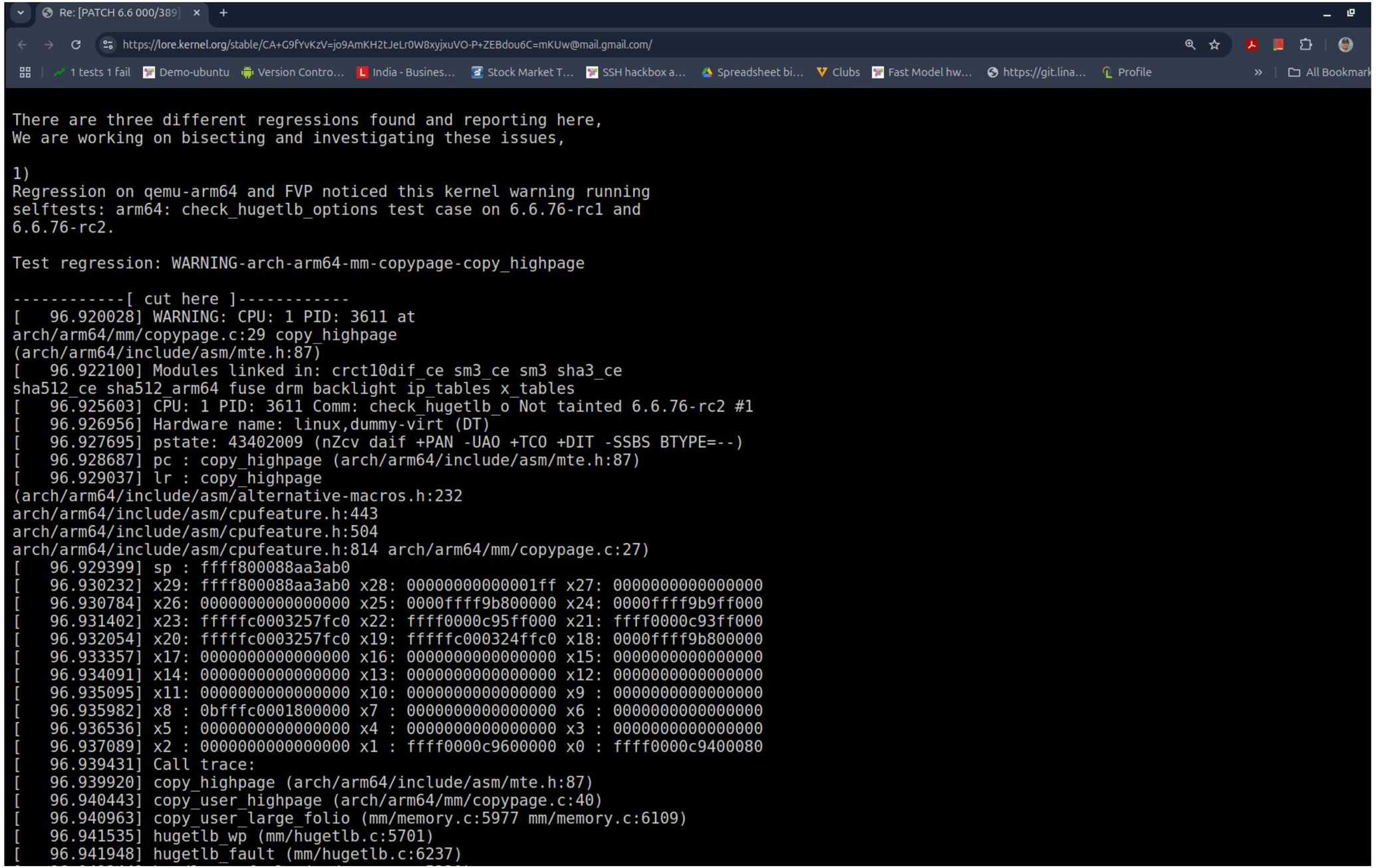
   Boot regression: WARNING-crypto-testmgr-alg_test

3) Regression on qemu-arm64 while running LTP fs fs_fill the following kernel warning found this was seen from the last rc round also.

   Boot regression: WARNING-fs-buffer-mark_buffer_dirty

Link:

https://lore.kernel.org/stable/CA+G9fYvKzV=jo9AmKH2tJeLr0W8xyjxuVO-P+ZEBdou6C=mKUw@mail.gmail.com/


Re: [PATCH 6.6 000/389]
https://lore.kernel.org/stable/CA+G9fYvKzV=jo9AmKH2tJeLr0W8xyjxuVO-P+ZEBdou6C=mKUw@mail.gmail.com/
1 tests 1 fail
Demo-ubuntu
Version Contro…
India - Busines…
Stock Market T…
SSH hackbox a…
Spreadsheet bi…
Clubs
Fast Model hw…
https://git.lina…
Profile
All Bookmark
There are three different regressions found and reporting here,
We are working on bisecting and investigating these issues,
1)
Regression on qemu-arm64 and FVP noticed this kernel warning running
selftests: arm64: check_hugetlb_options test case on 6.6.76-rc1 and
6.6.76-rc2.
Test regression: WARNING-arch-arm64-mm-copypage-copy_highpage
------------[cut here]------------
[96.920028] WARNING: CPU: 1 PID: 3611 at
arch/arm64/mm/copypage.c:29 copy_highpage
(arch/arm64/include/asm/mte.h:87)
[96.922100] Modules linked in: crct10dif_ce sm3_ce sm3 sha3_ce
sha512_ce sha512_arm64 fuse drm backlight ip_tables x_tables
[96.925603] CPU: 1 PID: 3611 Comm: check_hugetlb_o Not tainted 6.6.76-rc2 #1
[96.926956] Hardware name: linux,dummy-virt (DT)
[96.927695] pstate: 43402009 (nZcv daif +PAN -UAO +TCO +DIT -SSBS BTYPE=--)
[96.928687] pc : copy_highpage (arch/arm64/include/asm/mte.h:87)
[96.929037] lr : copy_highpage
(arch/arm64/include/asm/alternative-macros.h:232
arch/arm64/include/asm/cpufeature.h:443
arch/arm64/include/asm/cpufeature.h:504
arch/arm64/include/asm/cpufeature.h:814 arch/arm64/mm/copypage.c:27)
[96.929399] sp : ffff800088aa3ab0
[96.930232] x29: ffff800088aa3ab0 x28: 00000000000001ff x27: 0000000000000000
[96.930784] x26: 0000000000000000 x25: 0000ffff9b800000 x24: 0000ffff9b9ff000
[96.931402] x23: fffffc0003257fc0 x22: ffff0000c95ff000 x21: ffff0000c93ff000
[96.932054] x20: fffffc0003257fc0 x19: fffffc000324ffc0 x18: 0000ffff9b800000
[96.933357] x17: 0000000000000000 x16: 0000000000000000 x15: 0000000000000000
[96.934091] x14: 0000000000000000 x13: 0000000000000000 x12: 0000000000000000
[96.935095] x11: 0000000000000000 x10: 0000000000000000 x9 : 0000000000000000
[96.935982] x8 : 0bfffc0001800000 x7 : 0000000000000000 x6 : 0000000000000000
[96.936536] x5 : 0000000000000000 x4 : 0000000000000000 x3 : 0000000000000000
[96.937089] x2 : 0000000000000000 x1 : ffff0000c9600000 x0 : ffff0000c9400080
[96.939431] Call trace:
[96.939920] copy_highpage (arch/arm64/include/asm/mte.h:87)
[96.940443] copy_user_highpage (arch/arm64/mm/copypage.c:40)
[96.940963] copy_user_large_folio (mm/memory.c:5977 mm/memory.c:6109)
[96.941535] hugetlb_wp (mm/hugetlb.c:5701)
[96.941948] hugetlb_fault (mm/hugetlb.c:6237)

Sample regressions 2

Regressions on rk3399-rock-pi-4b, dragonboard-410c and dragonboard-845c

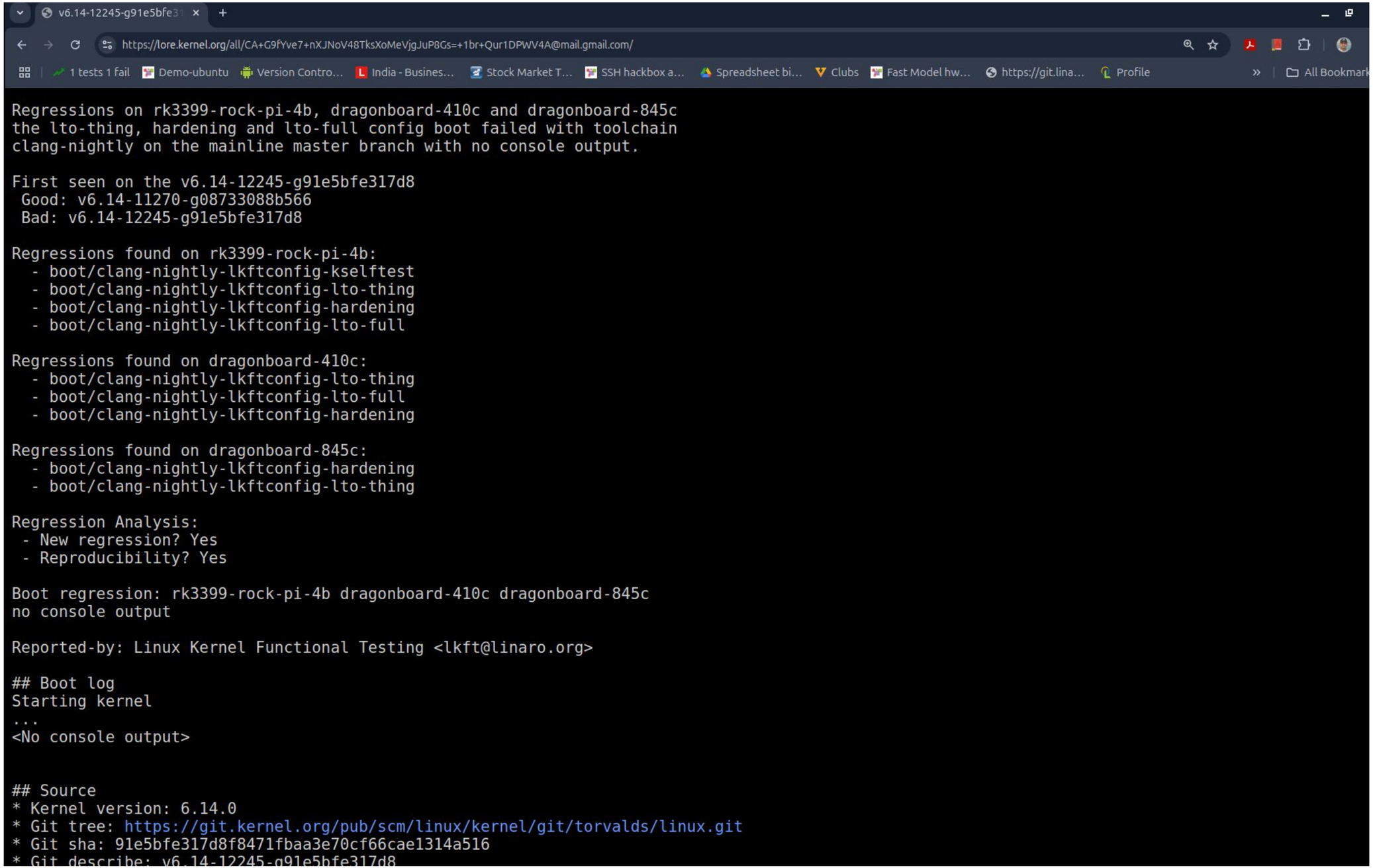
the lto-thing, hardening and lto-full config boot failed with toolchain

clang-nightly on the mainline master branch with no console output.

Boot regression: rk3399-rock-pi-4b dragonboard-410c dragonboard-845c no console output

Link

https://lore.kernel.org/all/CA+G9fYve7+nXJNoV48TksXoMeVjgJuP8Gs=+1br+Qur1DPWV4A@mail.gmail.com/




```
Regressions on rk3399-rock-pi-4b, dragonboard-410c and dragonboard-845c
the lto-thing, hardening and lto-full config boot failed with toolchain
clang-nightly on the mainline master branch with no console output.

First seen on the v6.14-12245-g91e5bfe317d8
 Good: v6.14-11270-g08733088b566
 Bad: v6.14-12245-g91e5bfe317d8

Regressions found on rk3399-rock-pi-4b:
  - boot/clang-nightly-lkftconfig-kselftest
  - boot/clang-nightly-lkftconfig-lto-thing
  - boot/clang-nightly-lkftconfig-hardening
  - boot/clang-nightly-lkftconfig-lto-full

Regressions found on dragonboard-410c:
  - boot/clang-nightly-lkftconfig-lto-thing
  - boot/clang-nightly-lkftconfig-lto-full
  - boot/clang-nightly-lkftconfig-hardening

Regressions found on dragonboard-845c:
  - boot/clang-nightly-lkftconfig-hardening
  - boot/clang-nightly-lkftconfig-lto-thing

Regression Analysis:
 - New regression? Yes
 - Reproducibility? Yes

Boot regression: rk3399-rock-pi-4b dragonboard-410c dragonboard-845c
no console output

Reported-by: Linux Kernel Functional Testing <lkft@linaro.org>

## Boot log
Starting kernel
...
<No console output>


## Source
* Kernel version: 6.14.0
* Git tree: https://git.kernel.org/pub/scm/linux/kernel/git/torvalds/linux.git
* Git sha: 91e5bfe317d8f8471fbaa3e70cf66cae1314a516
* Git describe: v6.14-12245-g91e5bfe317d8
```

Community Impact

- Reports sent to mailing list
  - LKML
  - Kernel maintainers
  - SoC and subsystem maintainers
  - Open feedback loops
  - Contributes to upstream quality

Summary

- LKFT helps maintain Linux quality across ARM
- Critical for LTS & mainline stability
- Uses powerful test suites & real devices
- Developers and maintainers benefit from our reports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Thank You!