

A decorative graphic of a green pipe network with various fittings, valves, and elbows, set against a white background. The pipes are arranged in a complex, interconnected pattern, with some sections being vertical, horizontal, or curved.

The Emerging of the Virtual QA Team for Linux Kernel

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Agenda

- Status Quo of the Trend
- Involvement of 0-Day CI
- Challenges and Discussion



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Linux Kernel Testing

- The community has established the decentralized and independent quality assurance.
- The testing equips more capabilities and becomes modern along the way.
- Eventually it results in a full functional QA team that works virtually across the community ...



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Test Plan/Suites

Test Execution

Bug Report/Scrubs

Bug Fix/Release



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Test Plan/Suites

Test Execution

Bug Report/Scrubs

Bug Fix/Release

sparse



kismet

trinity

ltp

syzkaller

kunit

kselftests

xfstests

- The advancement in test methodology decouples the traditional need to map code change to test case in a few areas.
- The adoption of engineering in each testing level.
- New ideas keep coming.



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Test Plan/Suites

Test Execution

Bug Report/Scrubs

Bug Fix/Release

users
lava



hulk
abaci



- More and more players join in this field to have their own focus and priority to contribute to the kernel.
- The connection with developer has different models to ease the adoption.
- Test services are moved to cloud (if not all).



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Test Plan/Suites

Test Execution

Bug Report/Scrubs

Bug Fix/Release

maintainers

regzbot

Bugzilla

email

lore.kernel.org

kcidb

- Bisection becomes a standard part to provide firsthand analysis.
- A central place for result storage and report customization.
- Volunteers form the roles such like “regression maintainer” to remind/drive the closure of regression.



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```
graph TD; A[Test Plan/Suites] --> B[Test Execution]; B --> C[Bug Report/Scrubs]; C --> D[Bug Fix/Release];
```

Test Plan/Suites

Test Execution

Bug Report/Scrubs

Bug Fix/Release

lkp-tests

repro.c

- The collaboration with developers is more supportive, with ease to reproduce tools.
- The focus on release quality (criteria) to assist maintainers to decide whether it is all ready.



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A decorative graphic of a green pipe network with various fittings, valves, and elbows, framing the text on the slide.

Now Link them All

- The full functional testing effort is established with modernized methodology (advancement but not necessary replacement).
- Conceptually, a virtual QA team merges. It does the testing by less solos of various testing effort, tighter connection with developer, and extra volunteered ownerships.



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A decorative graphic of a green pipe network with various fittings, valves, and elbows, framing the central text. The pipes are a vibrant green color and are set against a white background with soft shadows.

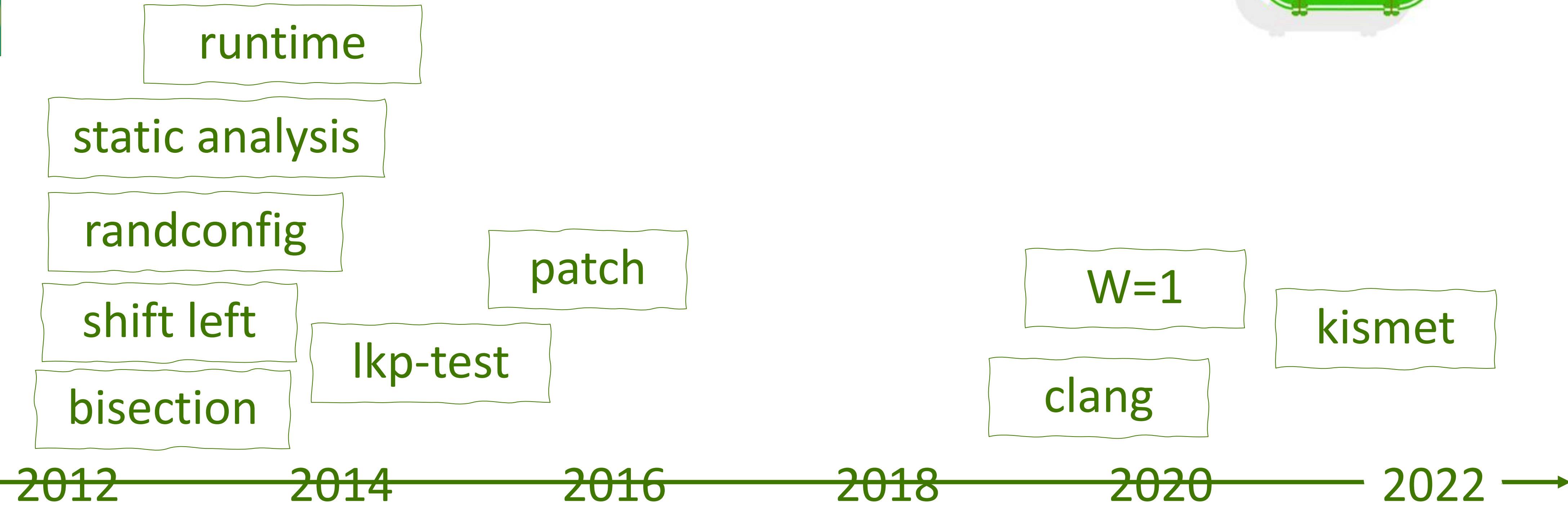
0-Day CI Involvement



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Day



Yearly Reports

8K 11K 9K 9K 11K 8K 13K 16K



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A decorative graphic of a green pipe network with various fittings, valves, and elbows, framing the central text area.

Recent Focus

- Expand the coverage of shift left to reduce the direct reports against mainline.
- Improve bisection effectiveness.
- Introduce machine learning, such as log analysis and test selection.
- Involve to contribute more to community.



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A decorative graphic of a green pipe network with various fittings, valves, and elbows, framing the central text.

Challenges and Discussion

There're a lot of discussions regarding improving the overall testing. And this is one more :)



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Test Plan/Coding – Code Change

- Large scale testing (usually by the robots) is involved late sometimes (for most sub-systems).
- Is there purposely designed coverage for the change like new feature to be tested reasonably (need exposed by submitter).



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Test Plan/Coding – Test Coverage

- The constraints of platforms
- Test resource is not enough to achieve systematic testing

view: top level

Test: gcov-combined-x86_64-rhel-8.3-gcov-gcc-11-8bb7eca972ad531c9b149c0a51ab43a417385813.info.all

Date: 2022-09-06 00:26:43

	Hit	Total	Coverage
Lines:	723843	2150185	33.7 %
Functions:	57210	154204	37.1 %

Directory	Line Coverage	Functions
arch/x86/crypto	18.8 % (405 / 2151)	24.1 % (66 / 274)
arch/x86/entry	100.0 % (2 / 2)	100.0 % (1 / 1)
arch/x86/entry/vsyscall	68.5 % (98 / 143)	56.2 % (9 / 16)
arch/x86/events	74.5 % (1232 / 1654)	83.9 % (120 / 143)
arch/x86/events/amd	1.2 % (8 / 672)	3.1 % (2 / 65)
arch/x86/events/intel	46.3 % (3692 / 7974)	48.7 % (390 / 801)
arch/x86/events/zhaoxin	0.0 % (0 / 168)	0.0 % (0 / 18)
arch/x86/ia32	81.3 % (152 / 187)	87.5 % (7 / 8)
arch/x86/include/asm	79.8 % (2215 / 2776)	74.5 % (143 / 192)
arch/x86/include/asm/e820	100.0 % (2 / 2)	100.0 % (1 / 1)
arch/x86/include/asm/fpu	90.9 % (130 / 143)	66.7 % (8 / 12)
arch/x86/include/asm/trace	66.7 % (28 / 42)	25.5 % (35 / 137)
arch/x86/include/asm/uv	1.9 % (2 / 103)	0.0 % (0 / 10)
arch/x86/include/asm/vdso	100.0 % (7 / 7)	- (0 / 0)
arch/x86/kernel	55.3 % (7062 / 12770)	61.8 % (717 / 1160)



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Test Plan/Coding – Test Suites

- Test compatibility.
- Test applicability, same version to run on mainline, stables.



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Test Execution – Shift Left

- Shift left to reduce the finding on mainline.



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Test Execution – Test Methodology

- For example ...
 - Bisection.
 - Test scope selection.
 - Test duplication, like randconfig.



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A decorative graphic of green pipes with valves and elbows, running vertically on the left side of the slide and curving at the top and bottom.

Test Execution – Developer

- How could the specialized tests running by developer be integrated to existing test framework if feasible?



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Test Execution – AI

- What is the feasible AI we can adopt? Any practical examples.



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Bug Reports/Scrubs - Long Tail Bug Findings

- Long tail bug findings, the top 10 “reported by” covers ~50%. Can automation further help here?

```
v5.19 - v6.0-rc4
=====
reported-by [992]
-----
195 19.7% kernel test robot
 72  7.3% syzbot
 66  6.7% Abaci Robot
 50  5.0% Stephen Rothwell
 44  4.4% Hulk Robot
 32  3.2% Dan Carpenter
 16  1.6% Zeal Robot
 10  1.0% Hacash Robot
 10  1.0% Nathan Chancellor
 10  1.0% Randy Dunlap
487 49.1% <others>
```



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A decorative graphic of a green pipe system with various fittings, elbows, and valves, running along the top and left sides of the slide.

Bug Reports/Scrubs – Regression

- Is every valid regression going to be solved?
- How to prevent regression being missed?



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Bug Reports/Scrubs – Data Mining

- High level picture regarding trend and comparison between releases.
- The status of remaining issues (not necessary regression).
- ...



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Bug Fix/Release

- Assist developer to reproduce and root cause
 - Reproduce and debug but may be lack of environment (HW).
 - Leverage qemu or docker image if issue can be reproduced there.
- Assist maintainer to judge the quality in time analysis for the component
 - Acceptable criteria from corresponding maintainer.



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A decorative graphic of green pipes with valves and fittings, forming a large 'L' shape on the left and a smaller 'L' shape on the top right. The word 'Discussion' is written in green text on the top horizontal pipe of the left 'L'.

Discussion

This is not to make a grand unified theory, but a step to look for more collaborations and hints for future testing

Transparency and trust

Enhanced traceability

Highest quality possible validation



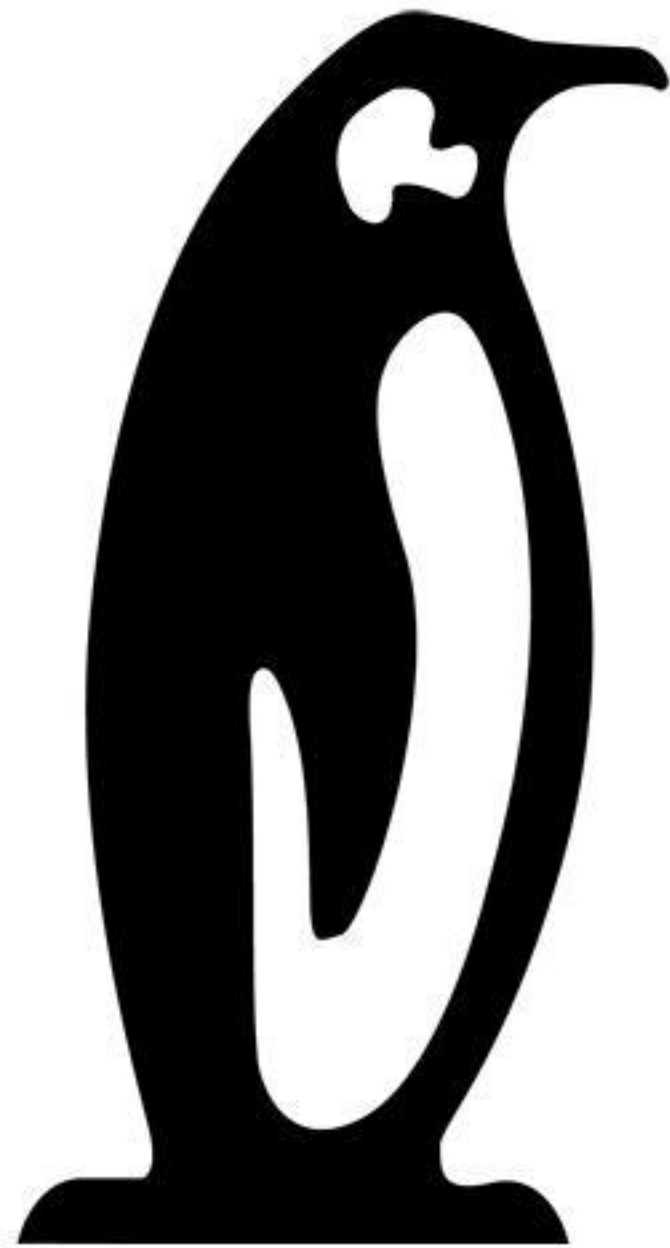
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Q&A



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