Tools WG 2025 Update

Matt Kelly, The Boeing Company

ELISA
Enabling Linux in Safety Applications

Aerospace · Automotive · Linux Features
Medical Devices · OS Engineering Process
Safety Architecture · Space Grade Linux · Systems · Tools

Tools WG

- WG Mission Statement

  “The Tool Investigation and Code Improvement WG focuses on creation, analysis, and application of tools and techniques to contribute to the improvement of the kernel for use in safety cases.”

- Focus on tooling around the kernel, ELISA CI setups, and addressing static analysis issues against the kernel

2024 Recap

- 22 unique attendees across 17 meetings
- Broadened the WG's mission statement
- Pulled 4 different tool efforts under this umbrella
    - Ks-nav, BASIL, DeltaKernel, llvm-cov
- First cross-company contribution (ks-nav)
- First known outside users of a WG tool (BASIL)
- Engaged with several outside groups on possible collaboration
    - Cregit, stress-ng
- Still welcome discussion on kernel static analysis results and patching
    - 1 upstream kernel contribution on this last year

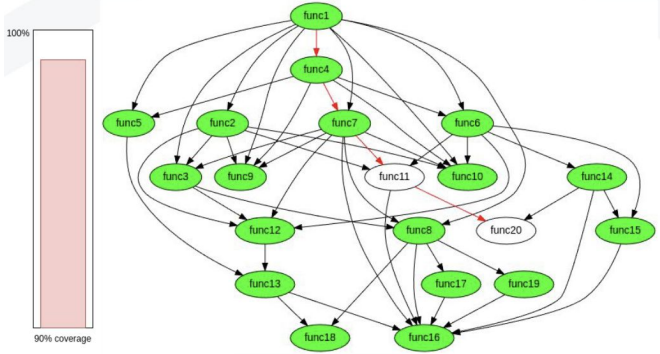
ks-nav

What is it?

- Kernel binary analysis tool to assist with IS26262 FFI analysis
- Get it: https://github.com/elisa-tech/ks-nav

2024 Updates

- Improvements to the web interface
- Improvements to the way global variables are tracked and presented
- Integrated ftrace-based coverage analysis (https://youtu.be/ghUBAndh_uA)



2025 Plan

- Resolve the “indirect function calls” problem

BASIL

What is it?

- Lifecycle artifact traceability tooling with many excellent features!
- Get it: https://github.com/elisa-tech/BASIL
- Try it: http://elisa-builder-00.iol.unh.edu:9056/

2024 Updates

- Established a public instance for people to experiment
- Various new features linking test cases to requirements specs, etc.
- Triggering test in external CI systems and linking to results

2025 Plan

- SDPX3.0 and SBOM Integration

DeltaKernel

What is it?

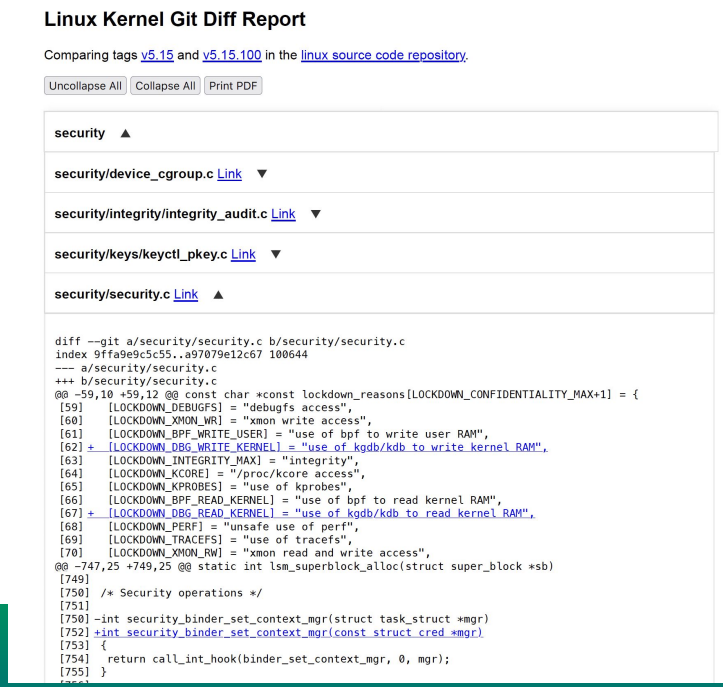
- Provides a visual report of change impact between two kernel versions
- Get it: https://github.com/elisa-tech/delta-kernel/

2024 Updates

- Initial release of the tooling

2025 Plan

- No active plan for 2025 at this moment
- Extend analysis to the kernel configuration



llvm-cov

What is it?

- Joint effort between Boeing/UIUC to enhance llvm-cov to achieve MC/DC and object code coverage of the kernel
- Get it: LLVM 19.1 and later!

2024 Updates

- Demo of MC/DC coverage of the kernel at Linux Plumbers
- Started DO-330 qualification effort

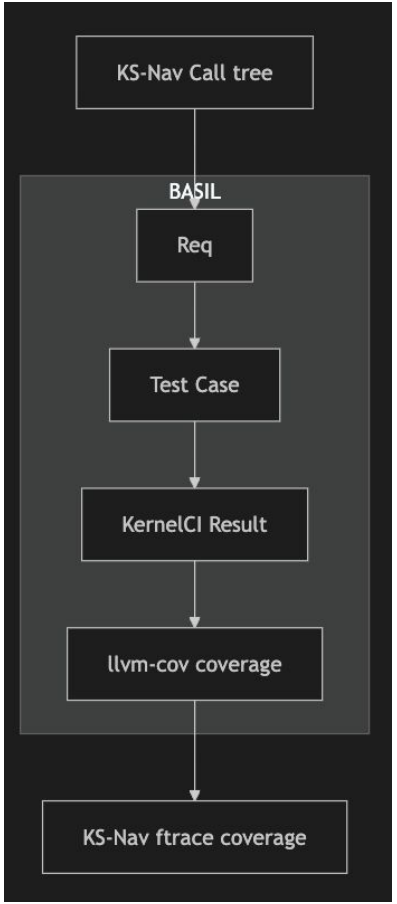
2025 Plan

- Initial implementation of object code coverage tooling

```
if (pending && !ksoftirqd_running(pending))
MC/DC Decision Region (458:6) to (458:44)

Number of Conditions: 2
   Condition C1 --> (458:6)
   Condition C2 --> (458:17)

Executed MC/DC Test Vectors:

   C1, C2    Result
1 { T,  F  = F      }
2 { T,  T  = T      }

C1-Pair: not covered
C2-Pair: covered: (1,2)
MC/DC Coverage for Expression: 50.00%
```

2025 Vision

- Present a use case which connects several existing tools/efforts
  - Leverage ks-nav call trees to inform requirements understanding
  - Kernel requirements / documentation effort: Create a req in the ftrace area against an existing test case
  - (NEW) Create CI which loads kernel data into a live instance of ELISA
  - (NEW) Work to get llvm-cov coverage data capture in KernelCI testing
  - Demonstrate linkage of Req □ Test Case □ Test Result □ Coverage
  - Demonstrate ftrace-based coverage on the same test
- Big Stretch: Demonstrate how this data can be used for change impact analysis



Get Involved

- Join our meetings!
  - 2nd Tuesday of the month @ 9:30 AM EST / 2:30 PM UTC
  - 4th Thursday of the month @ 11:00 AM EST / 4:00 PM UTC
- Hit the Mailing List!
  - https://lists.elisa.tech/g/tool-investigation
- Participate in our GitHub
  - Tools WG: https://github.com/elisa-tech/wg-tools
  - BASIL: https://github.com/elisa-tech/BASIL
  - ks-nav: https://github.com/elisa-tech/ks-nav
  - DeltaKernel: https://github.com/elisa-tech/delta-kernel/

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Thank you!