THE LINUX FOUNDATION
OPEN SOURCE SUMMIT
JAPAN

# Building Dependable Systems with Open Source

Kate Stewart, The Linux Foundation

#OSSummit

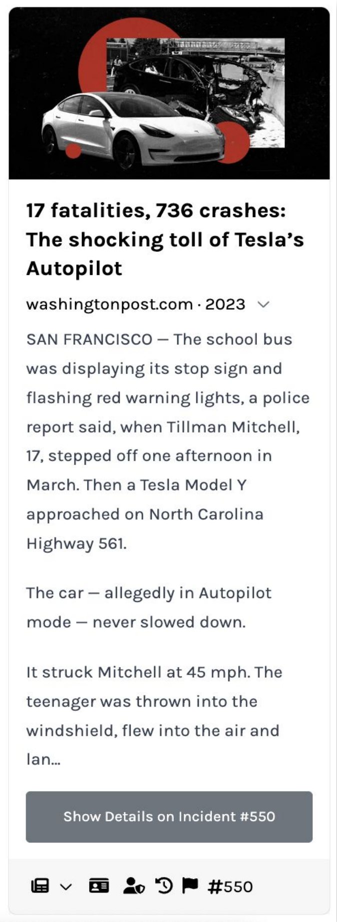
THE LINUX FOUNDATION

# Modern products are more than just hardware and software

# “Ingredients” for a Modern Car

- Hardware
  - Traditional BOM, but with more CPUs, MCUs & GPUs incorporated
- Software
  - Managing interaction between sensors, actuators, humans & environment
  - Managing trained AI/ML models that assist in the safe & efficient operation of the vehicle
- Training Data Sets
  - Data used to train, test & validate the AI/ML models in use the system
- Communication to Remote Services
  - External environment awareness for navigation support
  - Updates to the software, firmware & models

**We need to leverage a System Engineering approach to manage risk from the interactions of all these ingredients**



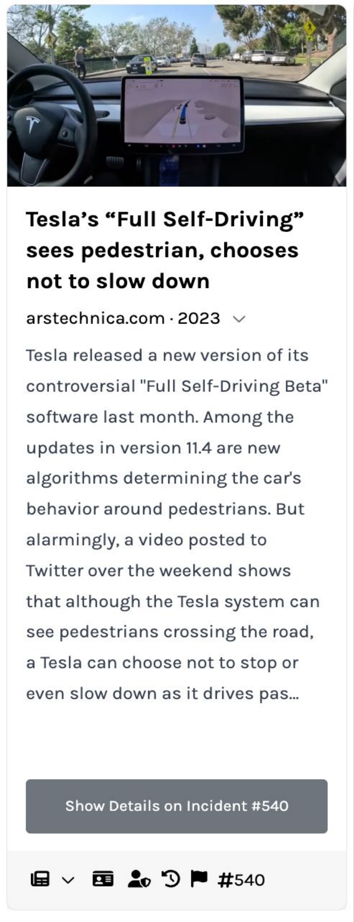
**17 fatalities, 736 crashes: The shocking toll of Tesla's Autopilot**

washingtonpost.com · 2023

SAN FRANCISCO — The school bus was displaying its stop sign and flashing red warning lights, a police report said, when Tillman Mitchell, 17, stepped off one afternoon in March. Then a Tesla Model Y approached on North Carolina Highway 561.

The car — allegedly in Autopilot mode — never slowed down.

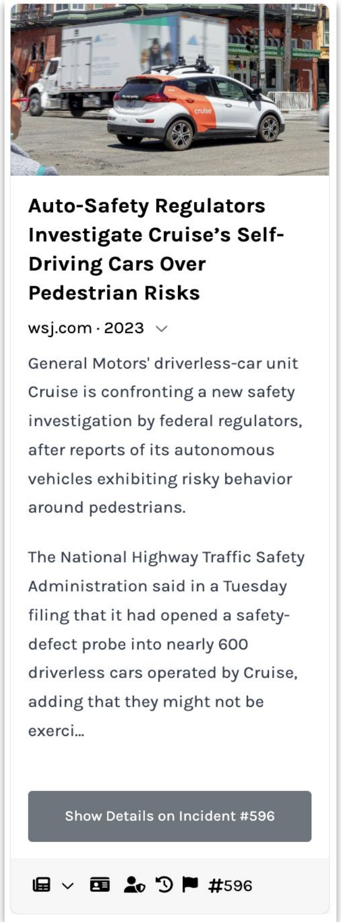
It struck Mitchell at 45 mph. The teenager was thrown into the windshield, flew into the air and lan...



**Tesla's "Full Self-Driving" sees pedestrian, chooses not to slow down**

arstechnica.com · 2023

Tesla released a new version of its controversial "Full Self-Driving Beta" software last month. Among the updates in version 11.4 are new algorithms determining the car's behavior around pedestrians. But alarmingly, a video posted to Twitter over the weekend shows that although the Tesla system can see pedestrians crossing the road, a Tesla can choose not to stop or even slow down as it drives pas...

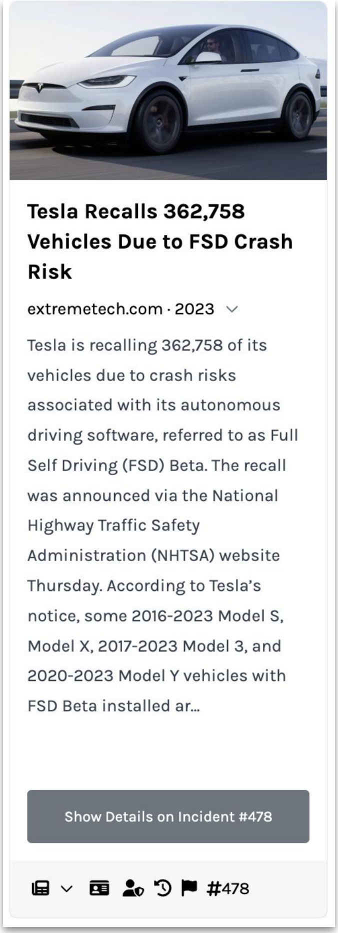


**Auto-Safety Regulators Investigate Cruise's Self-Driving Cars Over Pedestrian Risks**

wsj.com · 2023

General Motors' driverless-car unit Cruise is confronting a new safety investigation by federal regulators, after reports of its autonomous vehicles exhibiting risky behavior around pedestrians.

The National Highway Traffic Safety Administration said in a Tuesday filing that it had opened a safety-defect probe into nearly 600 driverless cars operated by Cruise, adding that they might not be exerci...

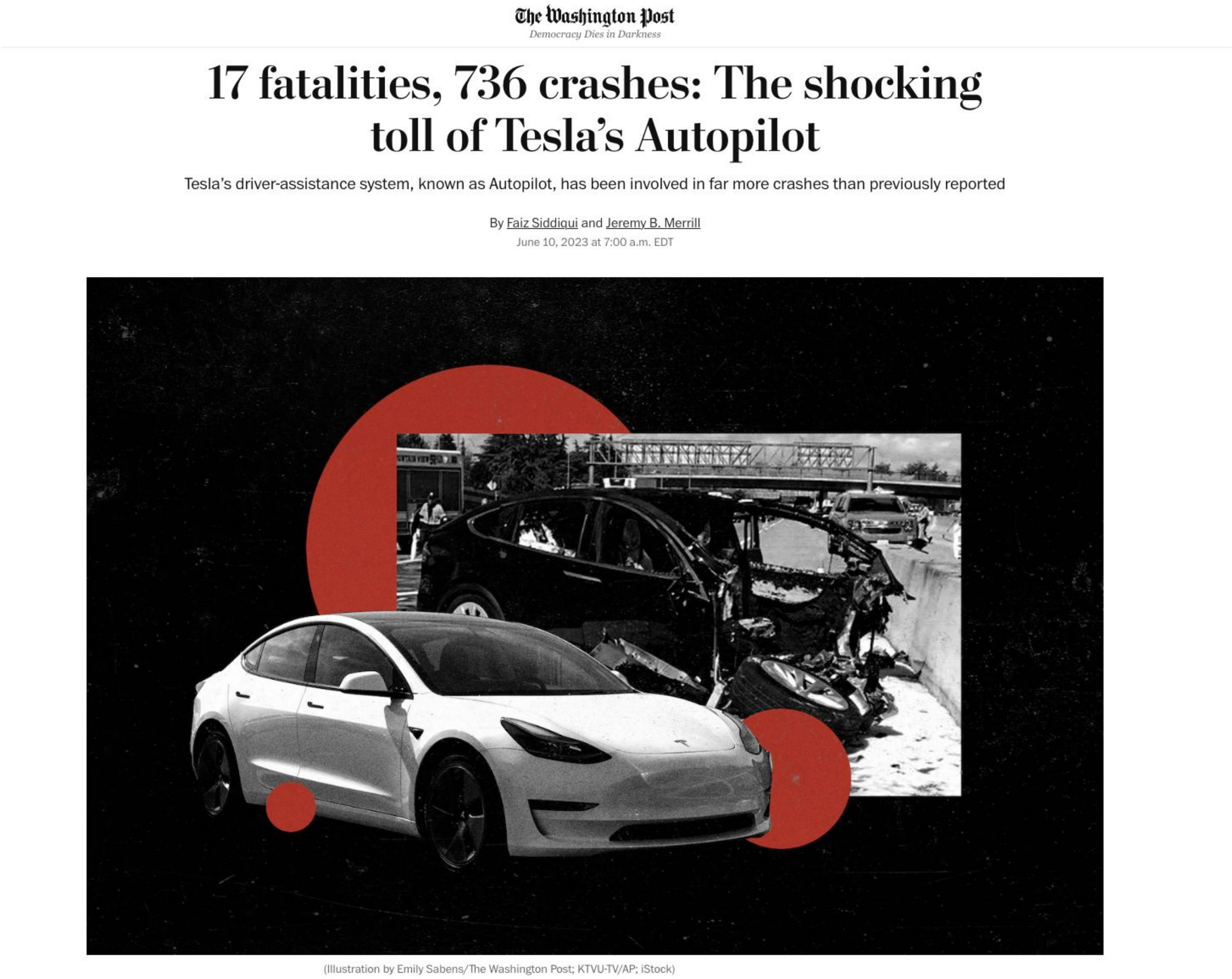


**Tesla Recalls 362,758 Vehicles Due to FSD Crash Risk**

extremetech.com · 2023

Tesla is recalling 362,758 of its vehicles due to crash risks associated with its autonomous driving software, referred to as Full Self Driving (FSD) Beta. The recall was announced via the National Highway Traffic Safety Administration (NHTSA) website Thursday. According to Tesla's notice, some 2016-2023 Model S, Model X, 2017-2023 Model 3, and 2020-2023 Model Y vehicles with FSD Beta installed ar...

Source: https://incidentdatabase.ai/



The Washington Post

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# 17 fatalities, 736 crashes: The shocking toll of Tesla's Autopilot

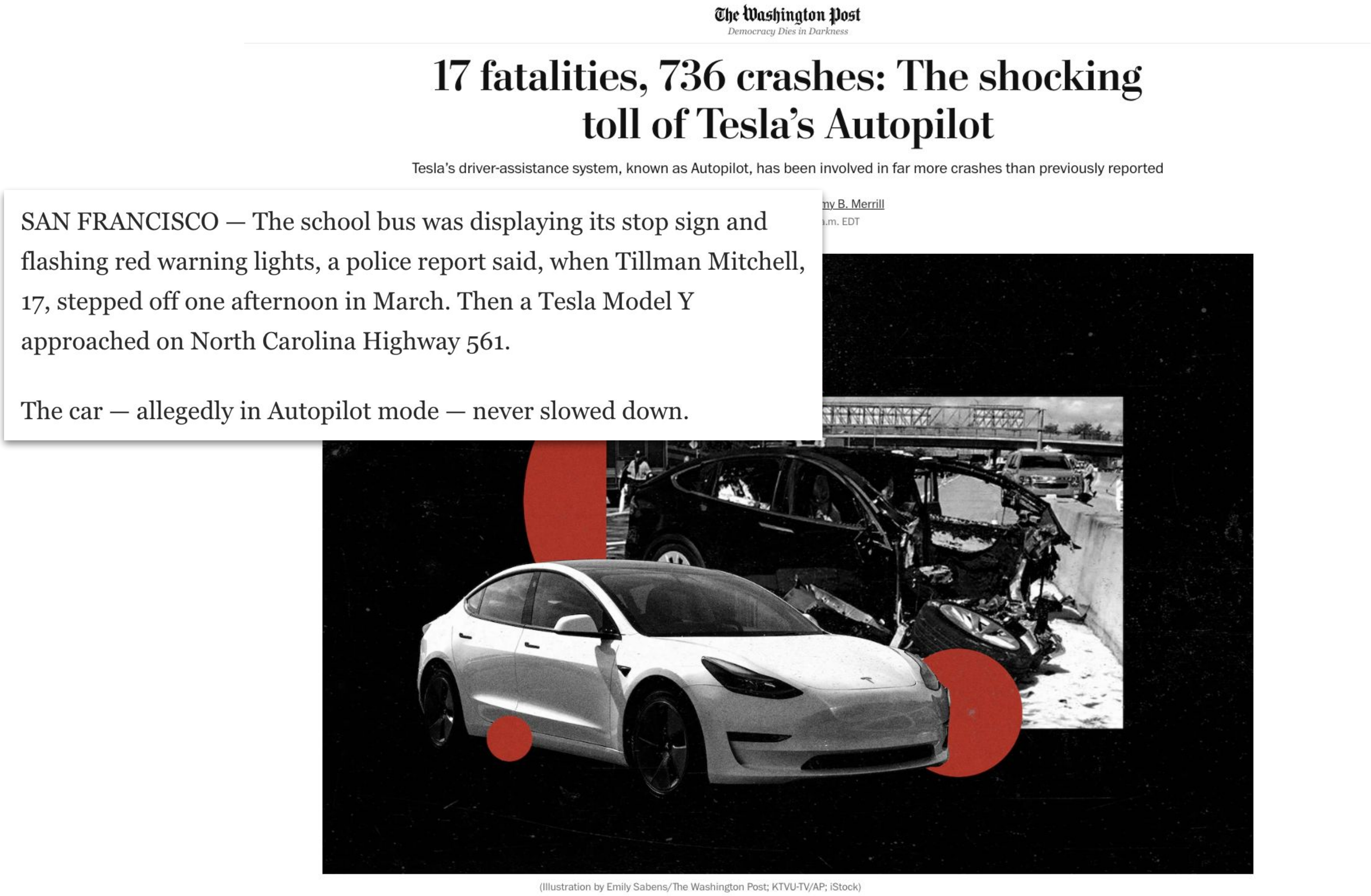
Tesla's driver-assistance system, known as Autopilot, has been involved in far more crashes than previously reported

By Faiz Siddiqui and Jeremy B. Merrill

June 10, 2023 at 7:00 a.m. EDT

(Illustration by Emily Sabens/The Washington Post; KTVU-TV/AP; iStock)

source: https://www.washingtonpost.com/technology/2023/06/10/tesla-autopilot-crashes-elon-musk/



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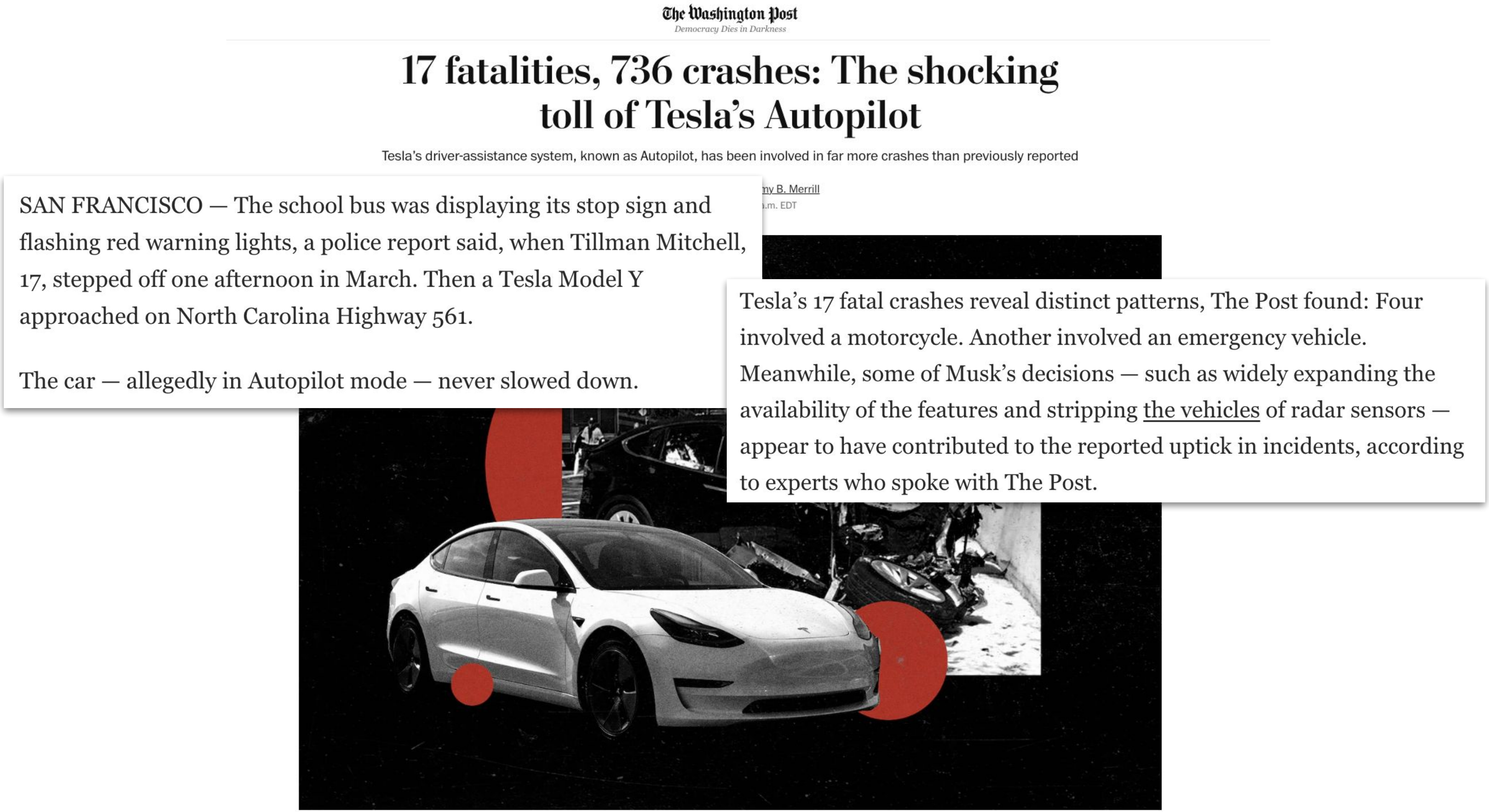

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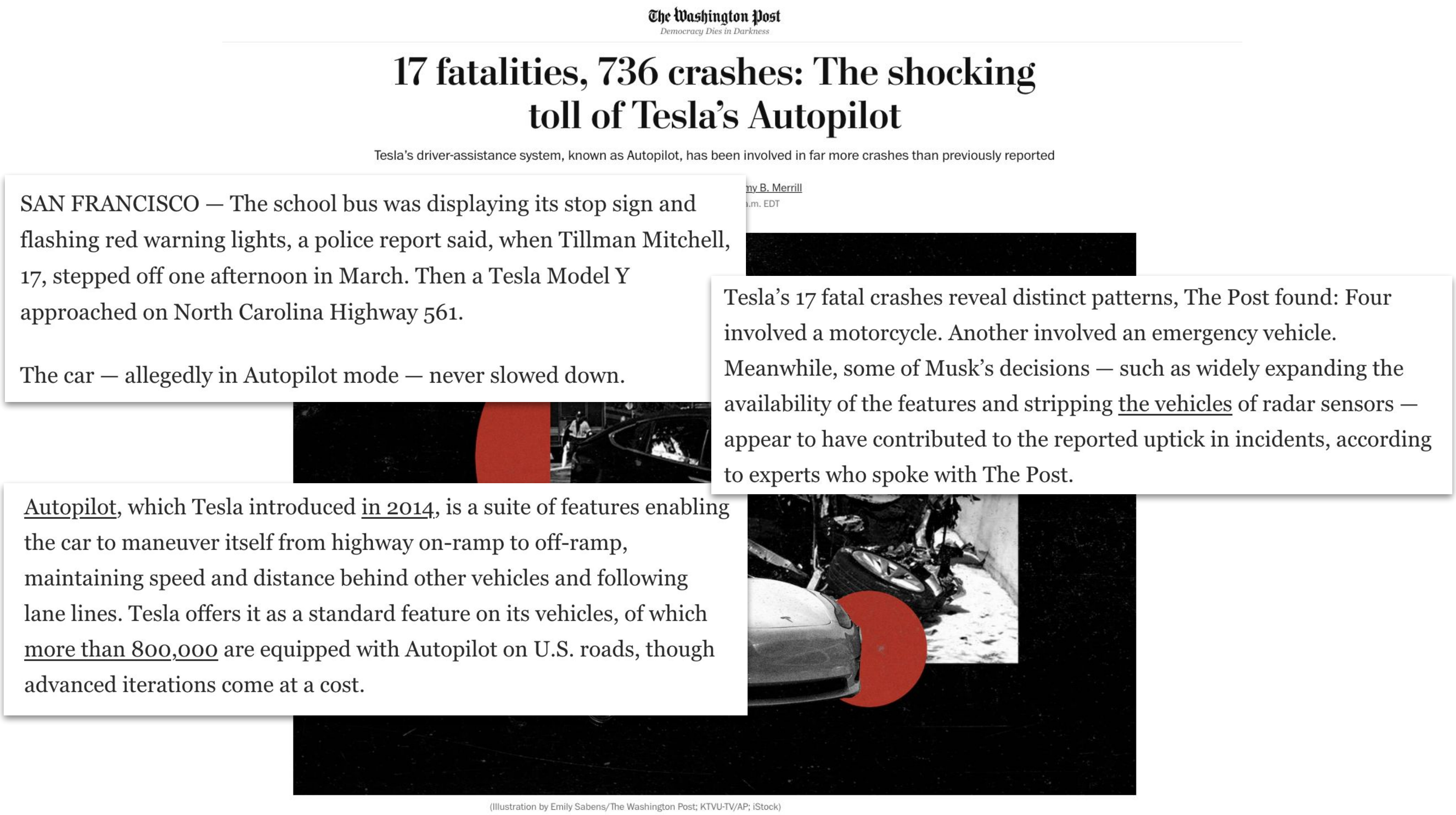

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(Illustration by Emily Sabens/The Washington Post; KTVU-TV/AP; iStock)

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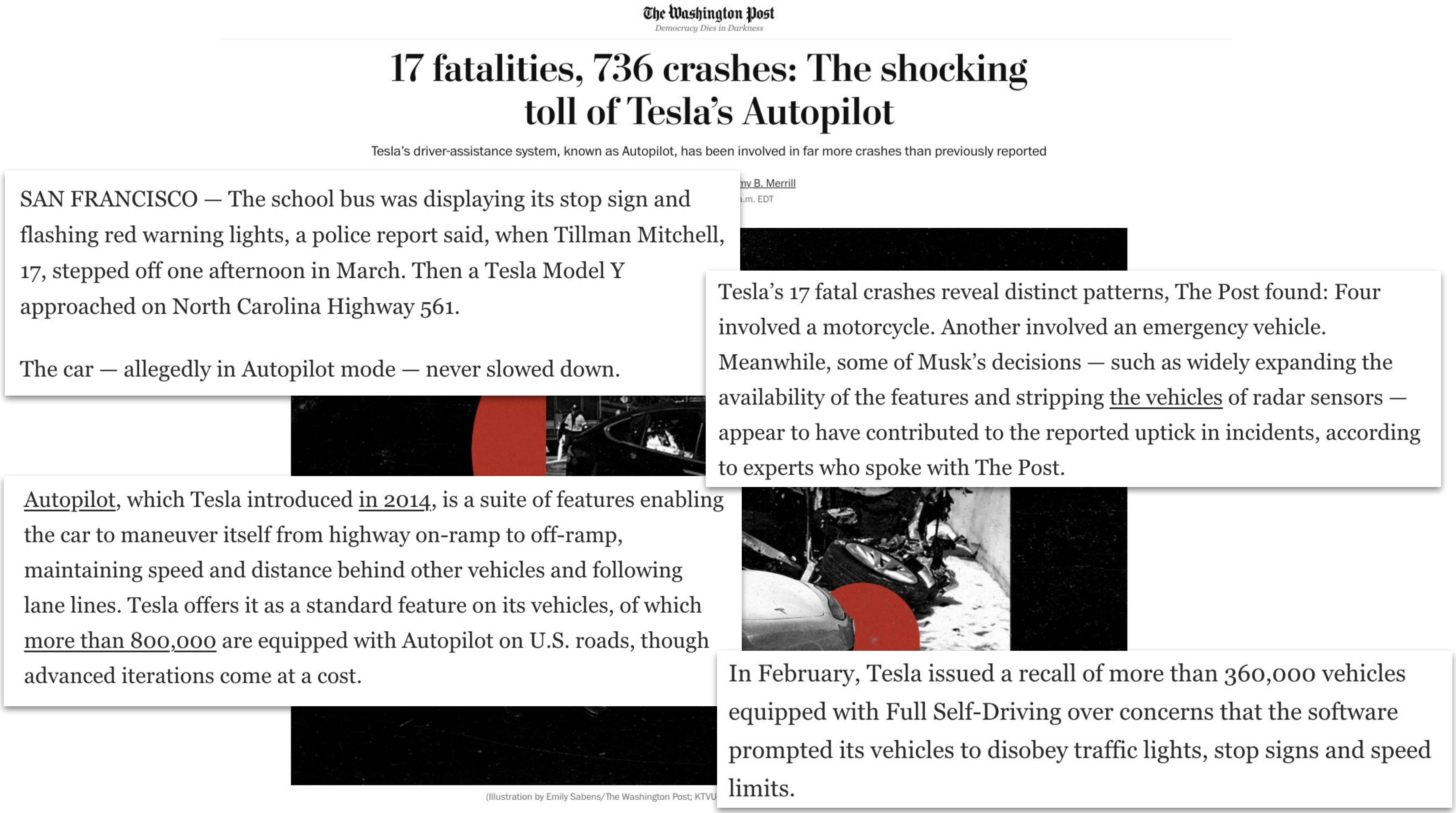

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In February, Tesla issued a recall of more than 360,000 vehicles equipped with Full Self-Driving over concerns that the software prompted its vehicles to disobey traffic lights, stop signs and speed limits.

(Illustration by Emily Sabens/The Washington Post; KTVU

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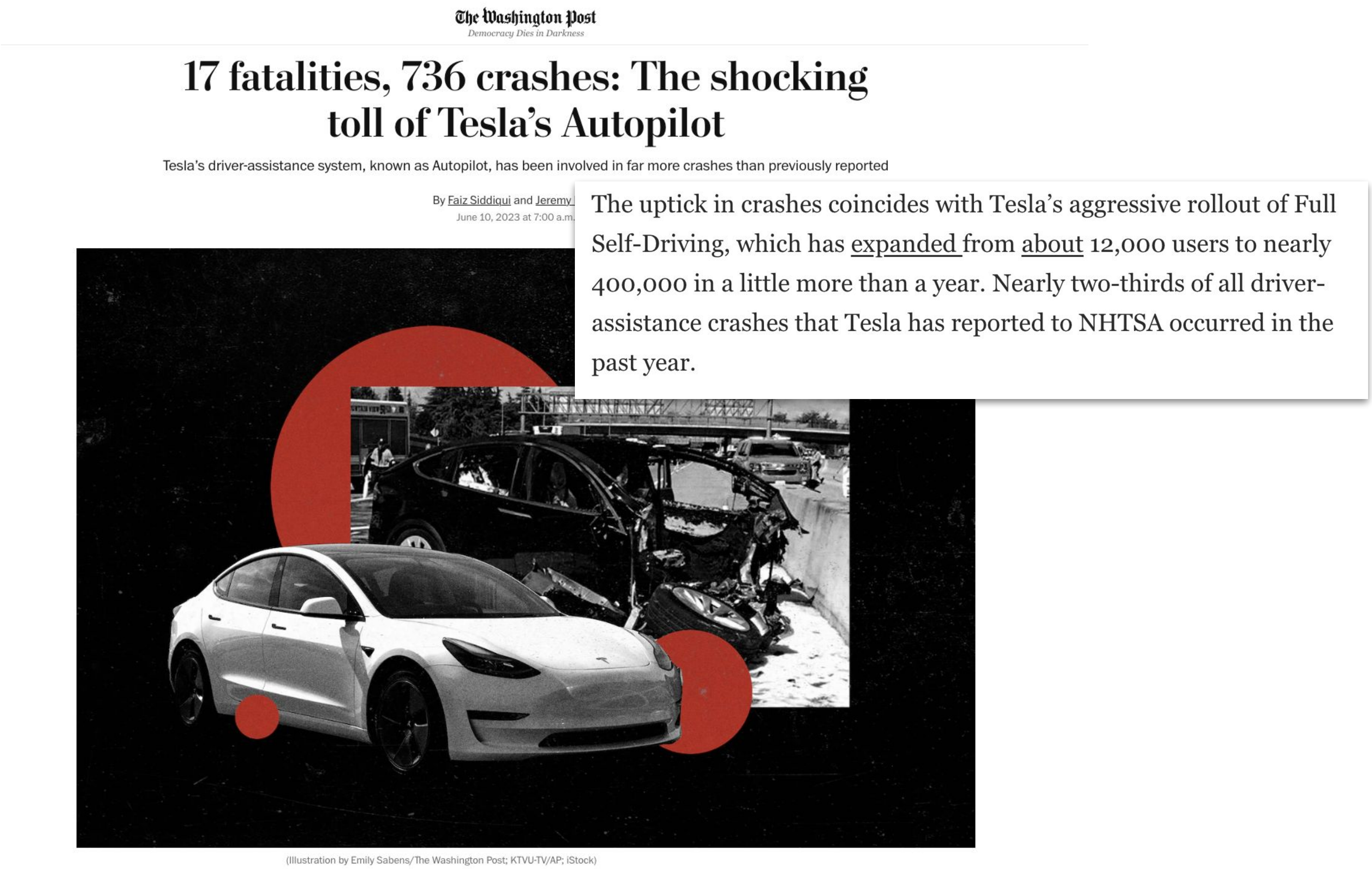

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(Illustration by Emily Sabens/The Washington Post; KTVU-TV/AP; iStock)

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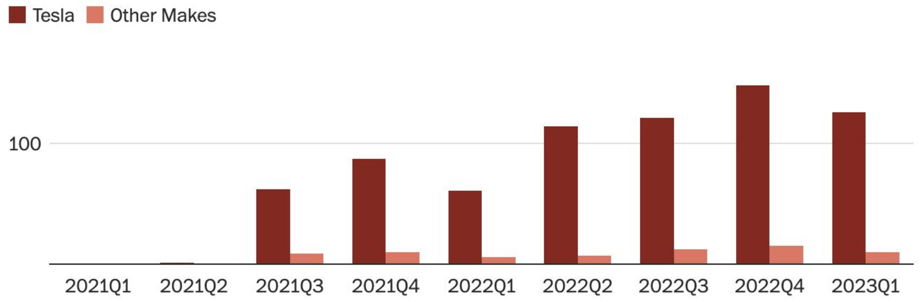
### Crashes involving Tesla's driver assistance system have grown

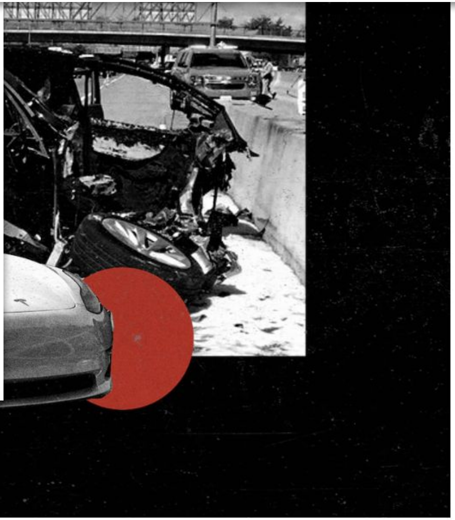
Tesla's "Full Self-Driving" and Autopilot systems have been involved in far more incidents than driver-assistance systems from all other manufacturers combined



Complete data for 2023Q2 is not yet available. A small number of incidents from 2019 and 2020 are not included.

Source: National Highway Traffic Safety Administration

THE WASHINGTON POST



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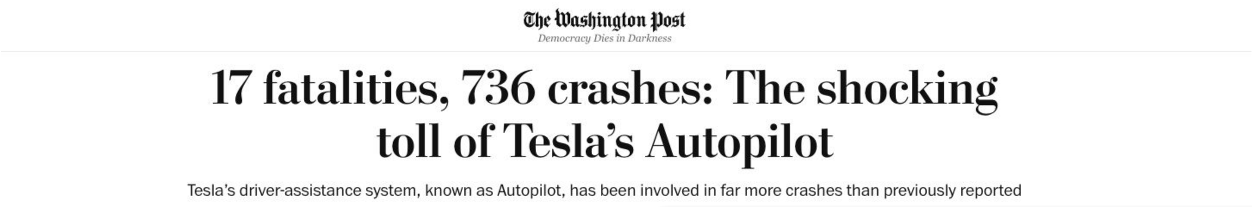

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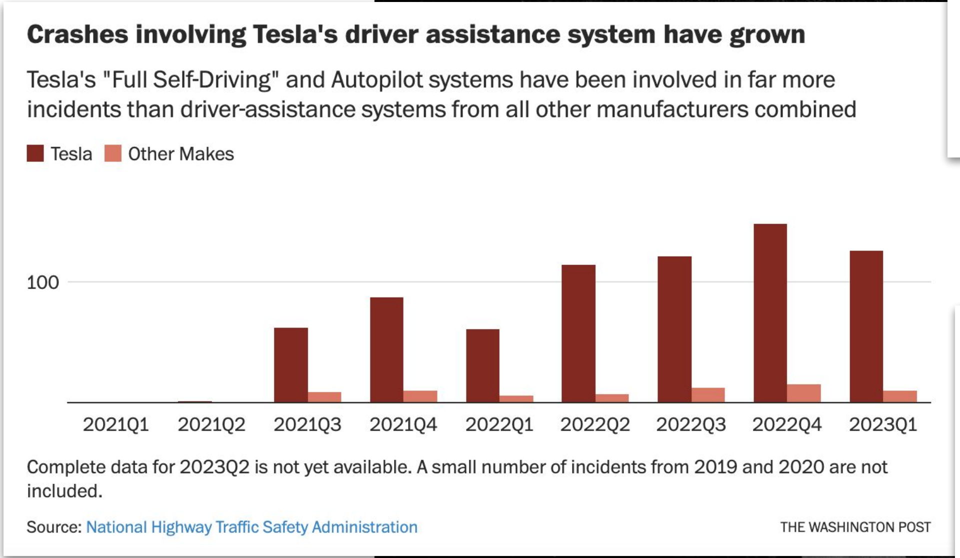

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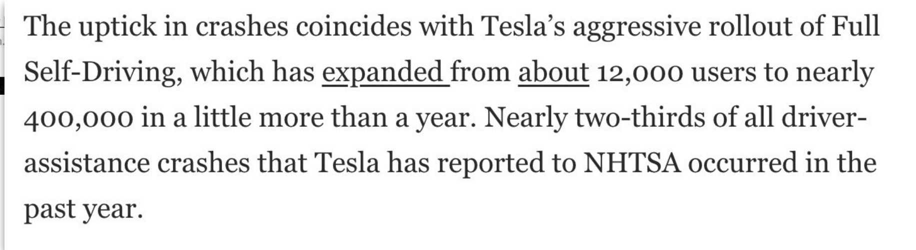

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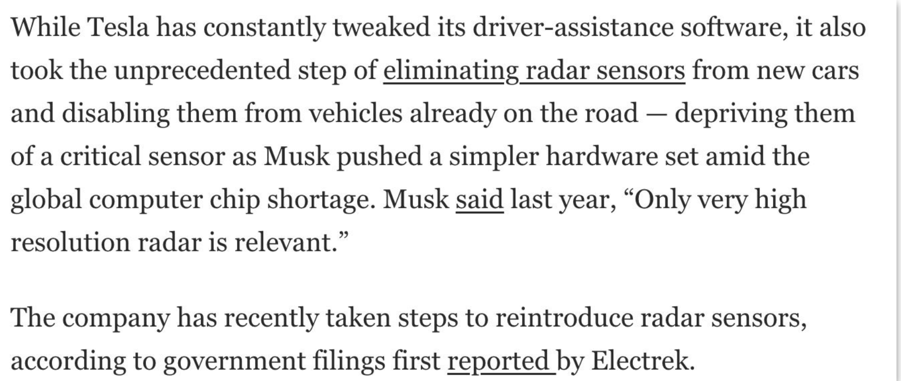


While Tesla has constantly tweaked its driver-assistance software, it also took the unprecedented step of eliminating radar sensors from new cars and disabling them from vehicles already on the road — depriving them of a critical sensor as Musk pushed a simpler hardware set amid the global computer chip shortage. Musk said last year, "Only very high resolution radar is relevant."

The company has recently taken steps to reintroduce radar sensors, according to government filings first reported by Electrek.

(Illustration by Emily Sabens/The Washington Post; KTVU-TV/AP; iStock)

source: https://www.washingtonpost.com/technology/2023/06/10/tesla-autopilot-crashes-elon-musk/

# More Ingredients ⇒ More Ways Can Go Wrong

- Software Vulnerabilities
  - Interaction between proprietary and open source components in system
  - Assessment if a mitigation needs to be applied to an incorporated image or not.
- Hazards from AI/ML model
  - Biases in training data sets
  - Interaction issues after update of model and with other software on system
- Training Data Sets
  - Data used to train, test & validate the AI/ML models in use the system
- Remote Services
  - External Environment awareness for navigation support
  - Software & model updates

We need to expand from **Software BOM ⇒ System BOM** in tracking dependencies between the “ingredients” especially when there are **safety elements**

# Standardized Metadata is Needed from the Supply Chains

**All supply chains contributing “ingredients”** (hardware, software, data sets, services) need to provide **metadata in a standard format,** so risk can be accurately assessed and managed.

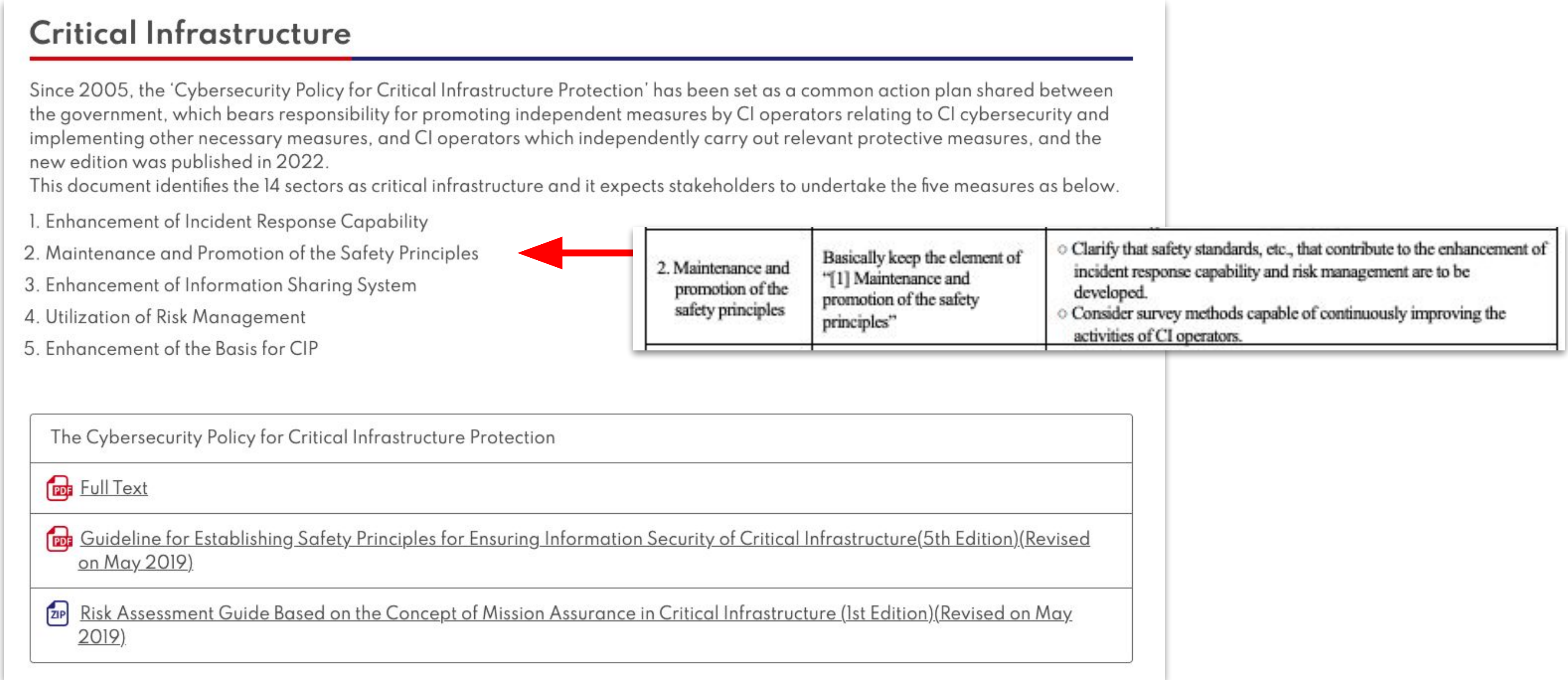
- What software component versions are executing on which specific hardware devices (and/or models, and/or simulators/FPGAs)?
- What software components direct and transitive dependencies should be monitored for vulnerabilities?
- What is the provenance of how a model was trained?  What datasets were used for testing and validation?
- How were the datasets used for training created?  Are there known biases?
- How were the software components and models integrated and tested?
- What APIs are used to manage updates though remote services?
- What remote services does the running software and trained models depend on?  What happens when the service is not available?
- How tracking updates to software, model, data sets in a product line, so current picture at any point in time?

# Standardized Metadata Needs to be Accurate

From **all supply chains** (hardware, software, datasets, services) the **standard format** should:

- **Capture the data when it is created** in the product's lifecycle
  - Design - system requirements, plans, processes
  - Source - source files, make scripts, build processes, test files, …
  - Build - built applications, libraries, firmware, build configuration, …
  - Deploy - application configuration information, installed dependencies, validation,...
  - Runtime - system configuration information, …
- **Assemble the facts into knowledge** about the **system** and it's intended behavior
  - Use **relationships** to link between facts about each component
  - Create **knowledge graph** to represent **product line** at any point in time including requirements, sources, tests, and evidence that the requirement are satisfied.

# Essential for Critical Infrastructure to have information, too!



## Critical Infrastructure

Since 2005, the 'Cybersecurity Policy for Critical Infrastructure Protection' has been set as a common action plan shared between the government, which bears responsibility for promoting independent measures by CI operators relating to CI cybersecurity and implementing other necessary measures, and CI operators which independently carry out relevant protective measures, and the new edition was published in 2022.
This document identifies the 14 sectors as critical infrastructure and it expects stakeholders to undertake the five measures as below.

1. Enhancement of Incident Response Capability
2. Maintenance and Promotion of the Safety Principles
3. Enhancement of Information Sharing System
4. Utilization of Risk Management
5. Enhancement of the Basis for CIP

| | | |
|---|---|---|
| 2. Maintenance and promotion of the safety principles | Basically keep the element of "[1] Maintenance and promotion of the safety principles" | ○ Clarify that safety standards, etc., that contribute to the enhancement of incident response capability and risk management are to be developed.<br>○ Consider survey methods capable of continuously improving the activities of CI operators. |

The Cybersecurity Policy for Critical Infrastructure Protection

PDF Full Text

PDF Guideline for Establishing Safety Principles for Ensuring Information Security of Critical Infrastructure(5th Edition)(Revised on May 2019)

ZIP Risk Assessment Guide Based on the Concept of Mission Assurance in Critical Infrastructure (1st Edition)(Revised on May 2019)

source: https://www.nisc.go.jp/eng/index.html#sec4

# Connecting a Product’s Supply Chain MetaData

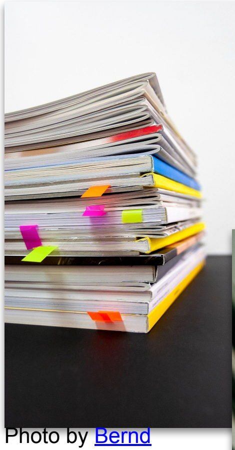


Photo by Bernd Klutsch on Unsplash

Photo by Luke Chesser on Unsplash

Database containing all product line component metadata, the relationships between components, requirements and evidence.

Evolving **SPDX profiles** to provide the **framework for connecting metadata** about components, processes, requirements and evidence to support **product line management**.

# SPDX Evolution

**SPDX 2.2+** (ISO/IEC 5962:2021) supports exchanging metadata between systems

- Software BOM metadata and relationships between components.
- Supports traceability between requirements, code, tests & evidence

**SPDX 3.0** to support the databases more efficiently

- Introduces profiles to capture domain specific metadata about components and their interactions at points in time
- Extends beyond software to capture AI/ML model and dataset provenance
- Supports product lifecycle metadata and incorporation of updates to remediate vulnerabilities
- Import from suppliers and export to customers current state at point in time

**SPDX 3.1** extend beyond software to support safety profile needs for “all ingredients”

- Work already in progress on Hardware, Services and Safety Profiles

# SPDX 3.0 Profiles

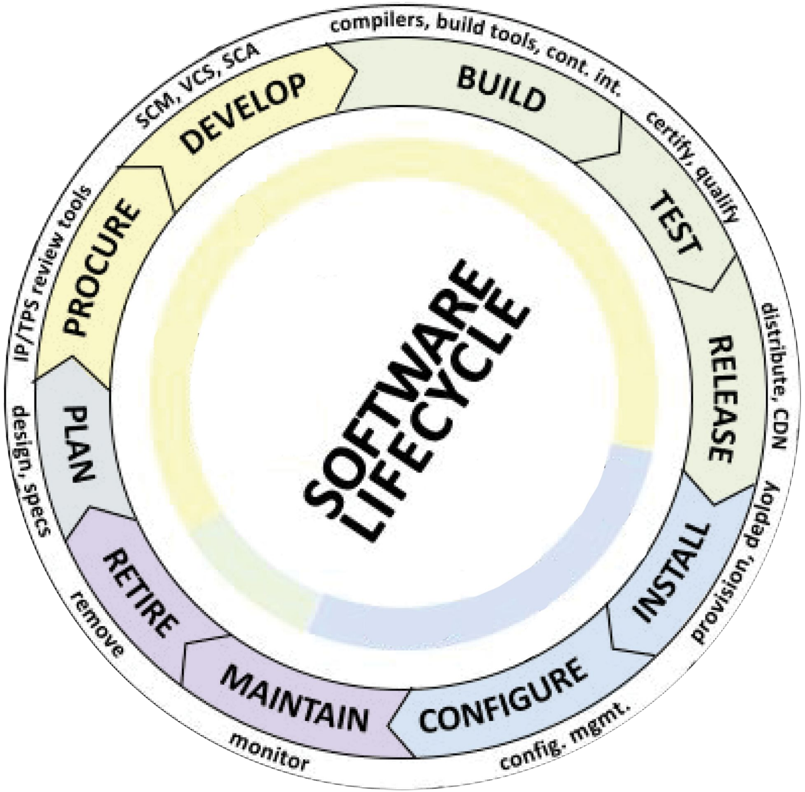
| | |
|---|---|
| SPDX SECURITY | Security information - vulnerability details related to software |
| SPDX BUILD | Build related information - provenance and reproducible builds |
| SPDX AI | Information about AI models - ethical, security, and model data |
| SPDX DATA | Information about datasets - AI and other data use cases |
| SPDX LITE | Minimal subset to support industry supply chain workflows |
| SPDX LICENSING | Information about copyrights and licenses - supports compliance |
| SPDX SOFTWARE | Information specific to software |
| SPDX CORE | Information used across all profiles |

# Support generating SBOMs when the facts are known

Source SBOM

Design SBOM

Runtime SBOM



Build SBOM

Deployed SBOM

# Align with the SBOM Types from CISA

| SBOM TYPE | DEFINITION |
|---|---|
| **Design** | SBOM of intended, planned software project or product with included components (some of which may not yet exist) for a new software artifact. |
| **Source** | SBOM created directly from the development environment, source files, and included dependencies used to build an product artifact. |
| **Build** | SBOM generated as part of the process of building the software to create a releasable artifact (e.g., executable or package) from data such as source files, dependencies, built components, build process ephemeral data, and other SBOMs. |
| **Deployed** | SBOM provides an inventory of software that is present on a system. This may be an assembly of other SBOMs that combines analysis of configuration options, and examination of execution behavior in a (potentially simulated) deployment environment. |
| **Runtime** | BOM generated through instrumenting the system running the software, to capture only components present in the system, as well as external call-outs or dynamically loaded components. In some contexts, this may also be referred to as an “Instrumented” or “Dynamic” SBOM. |
| **Analyzed** | SBOM generated through analysis of artifacts (e.g., executables, packages, containers, and virtual machine images) after its build. Such analysis generally requires a variety of heuristics. In some contexts, this may also be referred to as a “3rd party” SBOM. |

Source: Types of Software Bills of Materials (SBOM) published by CISA on 2023/4/21

# SPDX 2.3 Relationships to Clarify Dependencies

SPDX SAFETY

| | | | | |
|---|---|---|---|---|
| DESCRIBES | DEPENDENCY_OF | PREREQUISITE_FOR | GENERATES | VARIANT_OF |
| DESCRIBED_BY | RUNTIME_DEPENDENCY_OF | HAS_PREREQUISITE | TEST_OF | FILE_ADDED |
| CONTAINS | BUILD_DEPENDENCY_OF | ANCESTOR_OF | TEST_TOOL_OF | FILE_DELETED |
| CONTAINED_BY | DEV_DEPENDENCY_OF | DESCENDENT_OF | TEST_CASE_OF | FILE_MODIFIED |
| DYNAMIC_LINK | OPTIONAL_DEPENDENCY_OF | DOCUMENTATION_OF | EXAMPLE_OF | PATCH_FOR |
| STATIC_LINK | PROVIDED_DEPENDENCY_OF | BUILD_TOOL_OF | METAFILE_OF | PATCH_APPLIED |
| AMENDS | TEST_DEPENDENCY_OF | EXPANDED_FROM_ARCHIVE | PACKAGE_OF | REQUIREMENT_FOR |
| COPY_OF | OPTIONAL_COMPONENT_OF | DISTRIBUTION_ARTIFACT | DATA_FILE_OF | SPECIFICATION_FOR |
| DEPENDS_ON | DEPENDENCY_MANIFEST_OF | GENERATED_FROM | DEV_TOOL_OF | OTHER |

SPDX For more details see: https://spdx.github.io/spdx-spec/v2.3/relationships-between-SPDX-elements/

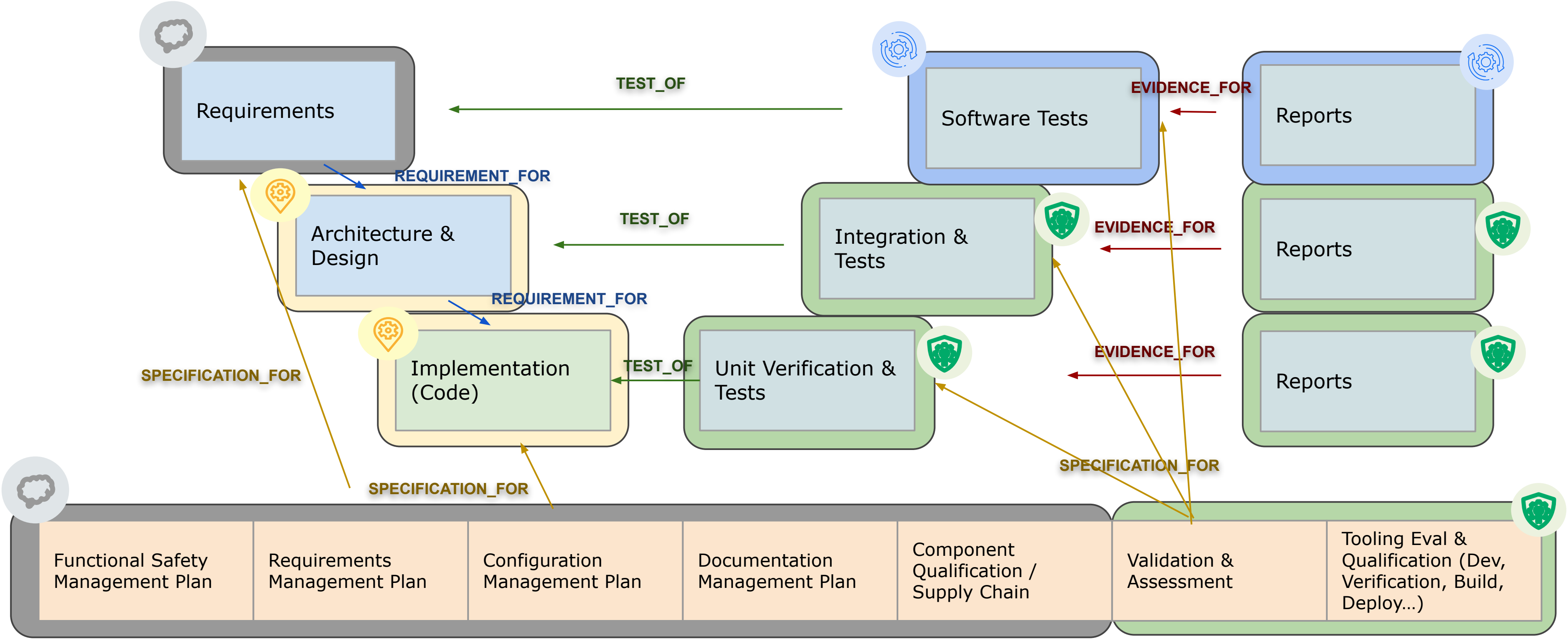
**SPDX component modularity** and **relationships between components**, allows us to create the **knowledge graph** for accurate and efficient **Safety & Security Analysis**

# Manage Safety Artifacts with SBOMs

| | | |
|---|---|---|
| | **Design SBOM** | Functional Safety Management (Plans) and Safety Concept |
| | **Source SBOM** | Requirements, Design, Safety Analysis, Source Code, Test Cases |
| | **Build SBOM** | Build Framework, Build configuration and environment data, Test Framework, Executable, Test Reports |
| | **Deploy SBOM** | Deployed configuration and environment data, Hardware architecture specific information and data, deployment tests and reports |
| | **Runtime SBOM** | Runtime relevant data (configuration data), training data, error logging data |

# SPDX Style Dependencies in a FuSa Project

SPDX SAFETY



Requirements

Architecture & Design

Implementation (Code)

Software Tests

Integration & Tests

Unit Verification & Tests

Reports

Reports

Reports

Functional Safety Management Plan

Requirements Management Plan

Configuration Management Plan

Documentation Management Plan

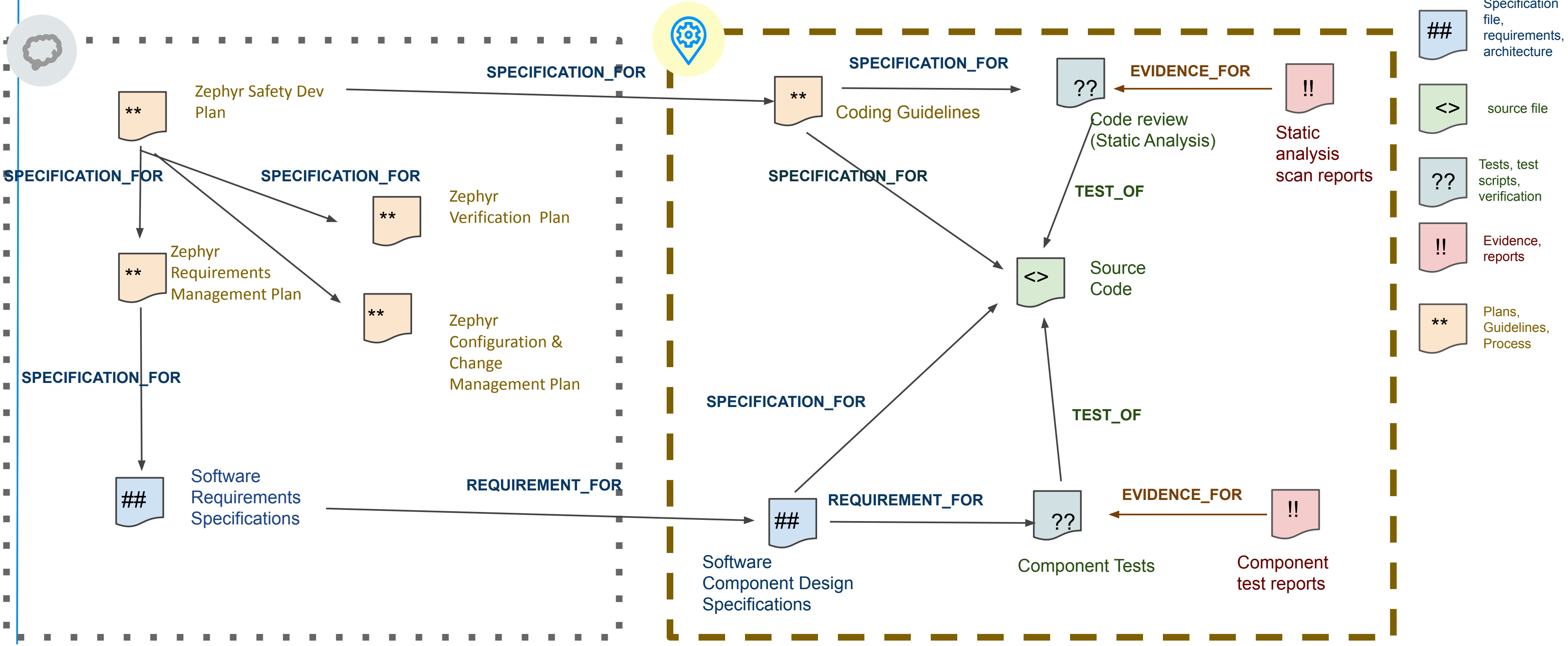
Component Qualification / Supply Chain

Validation & Assessment

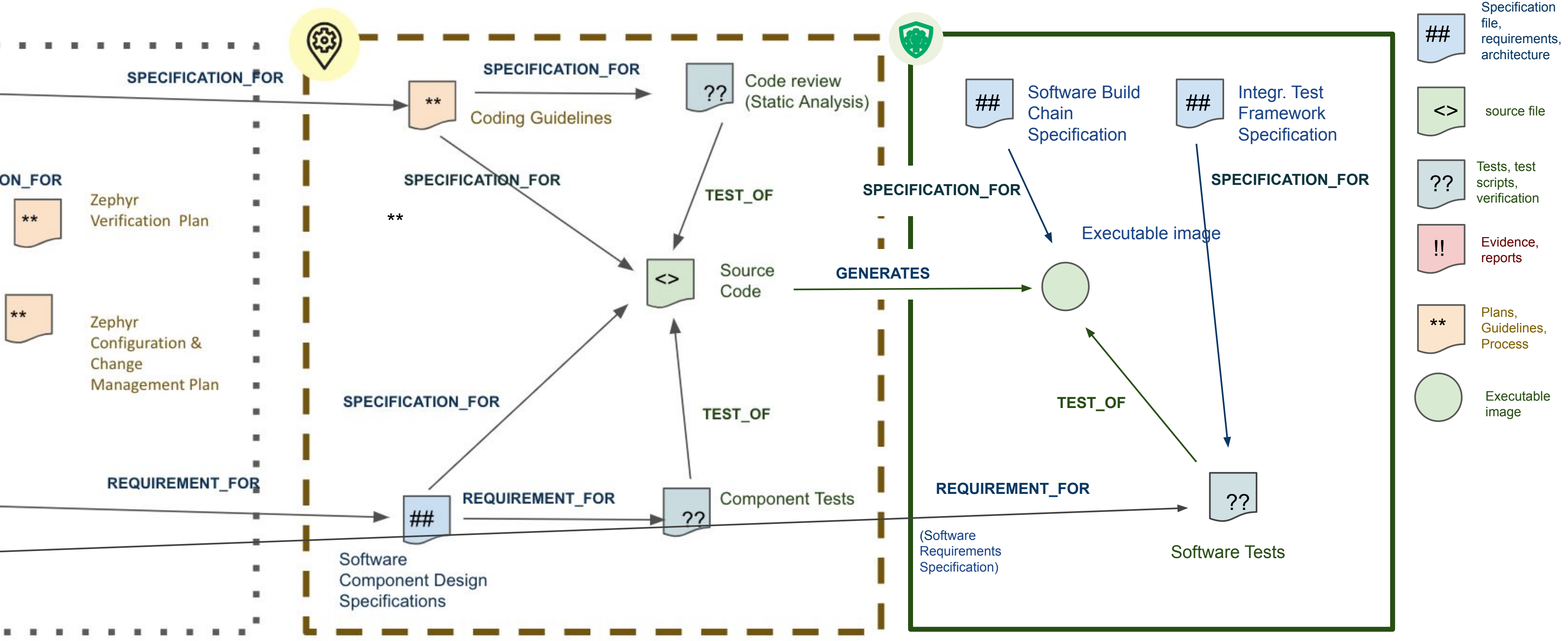
Tooling Eval & Qualification (Dev, Verification, Build, Deploy...)

SPDX

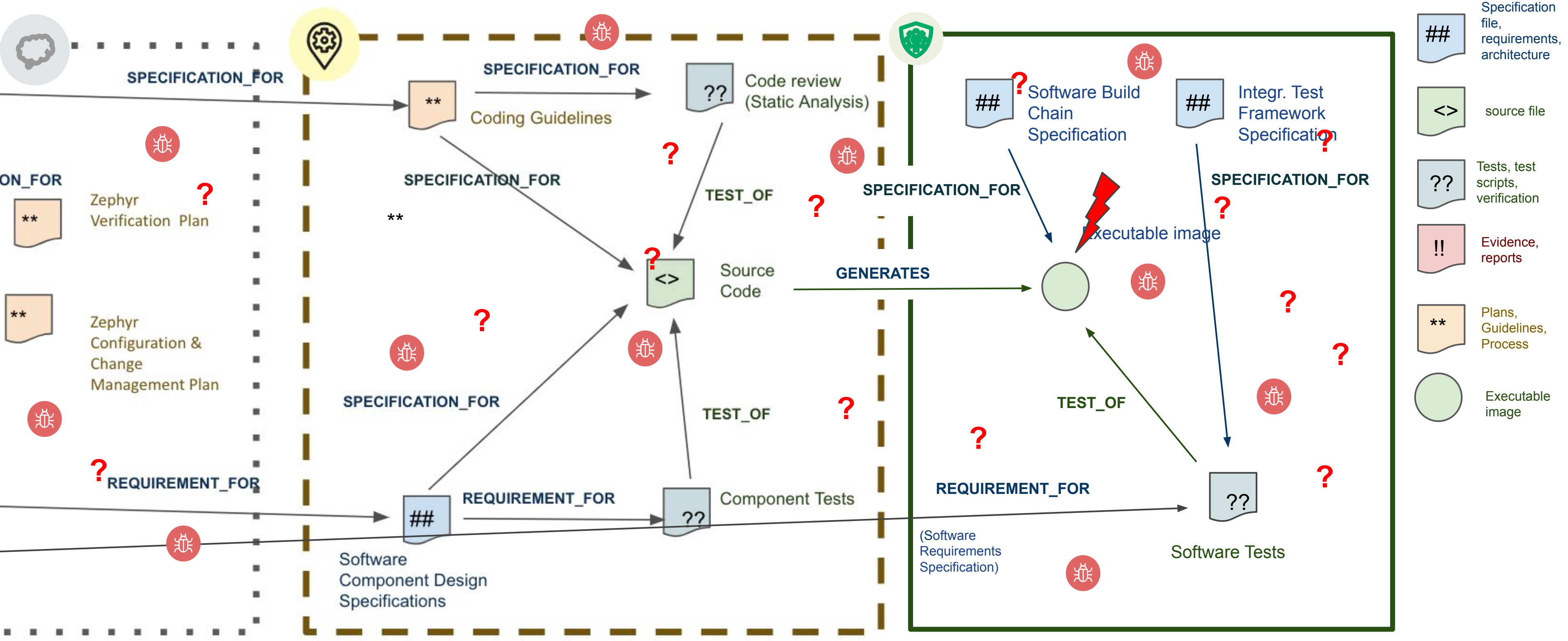
# Design SBOM to Source SBOM



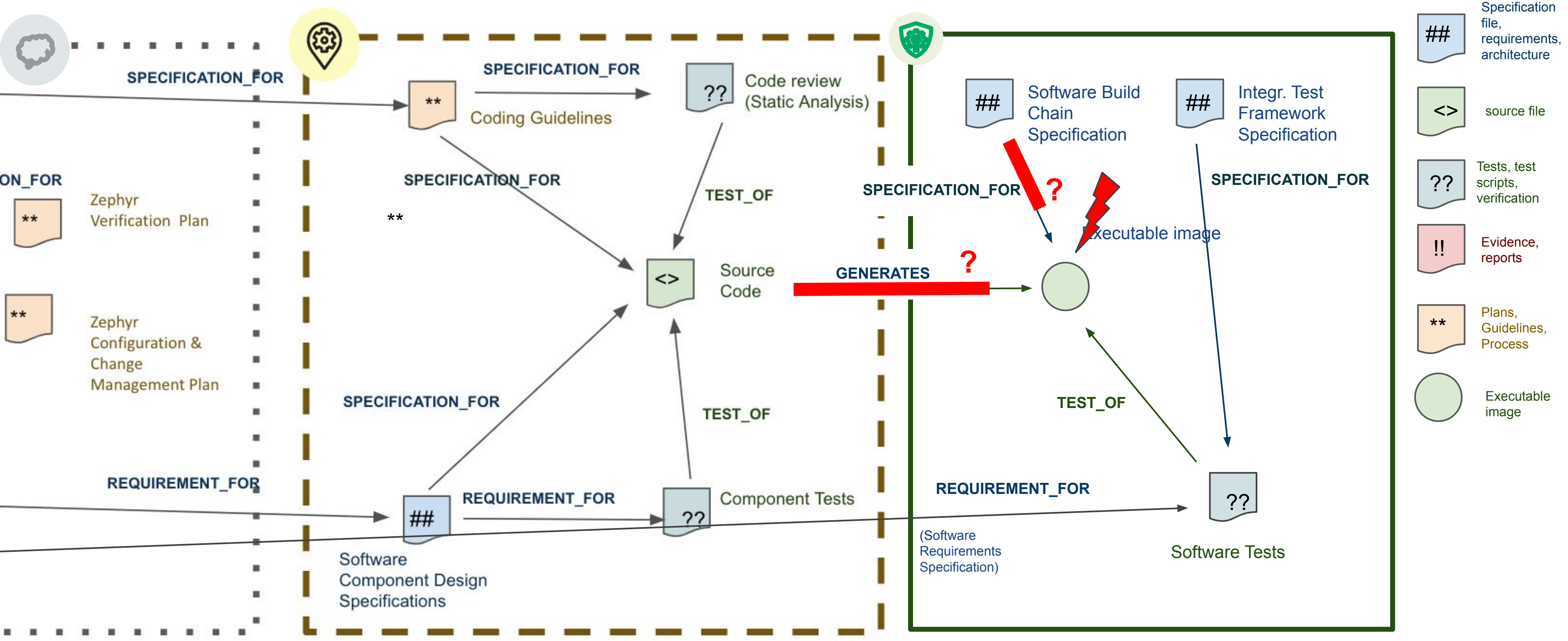
# Source SBOM to Build SBOM



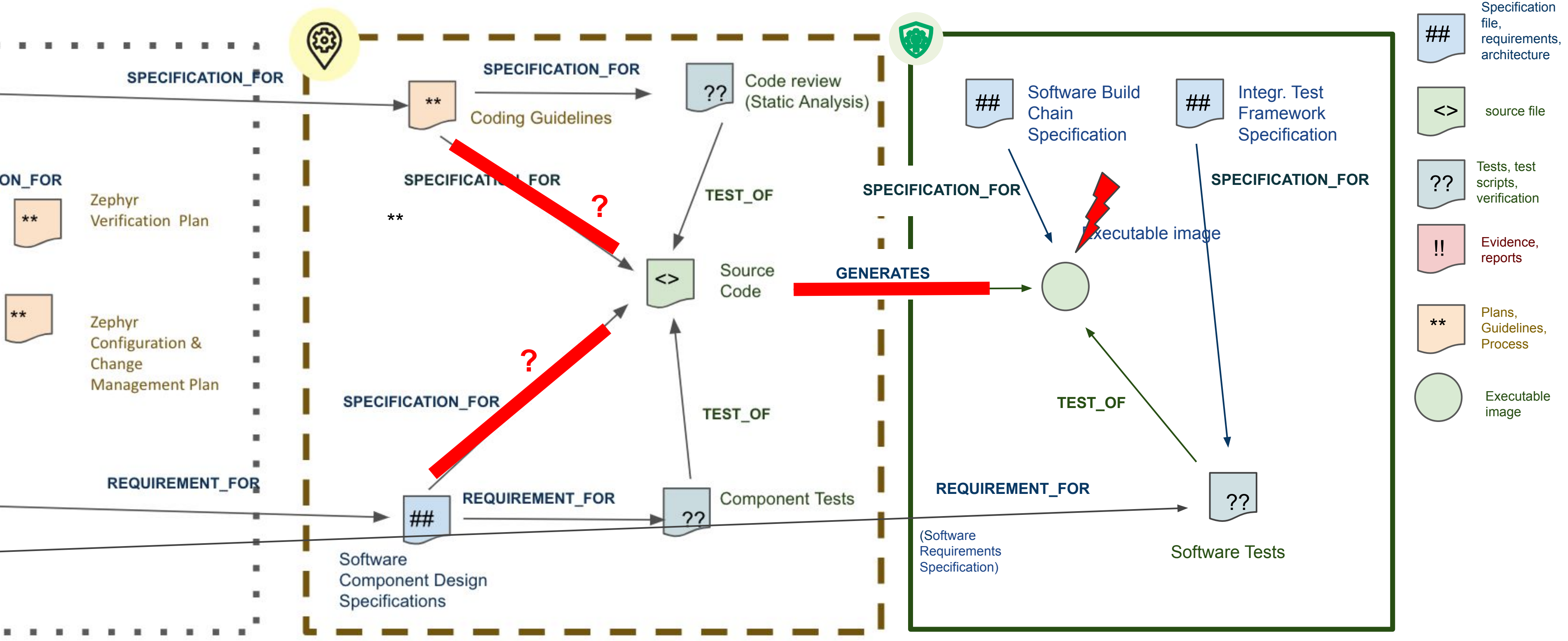
# Dependency Identification between Components



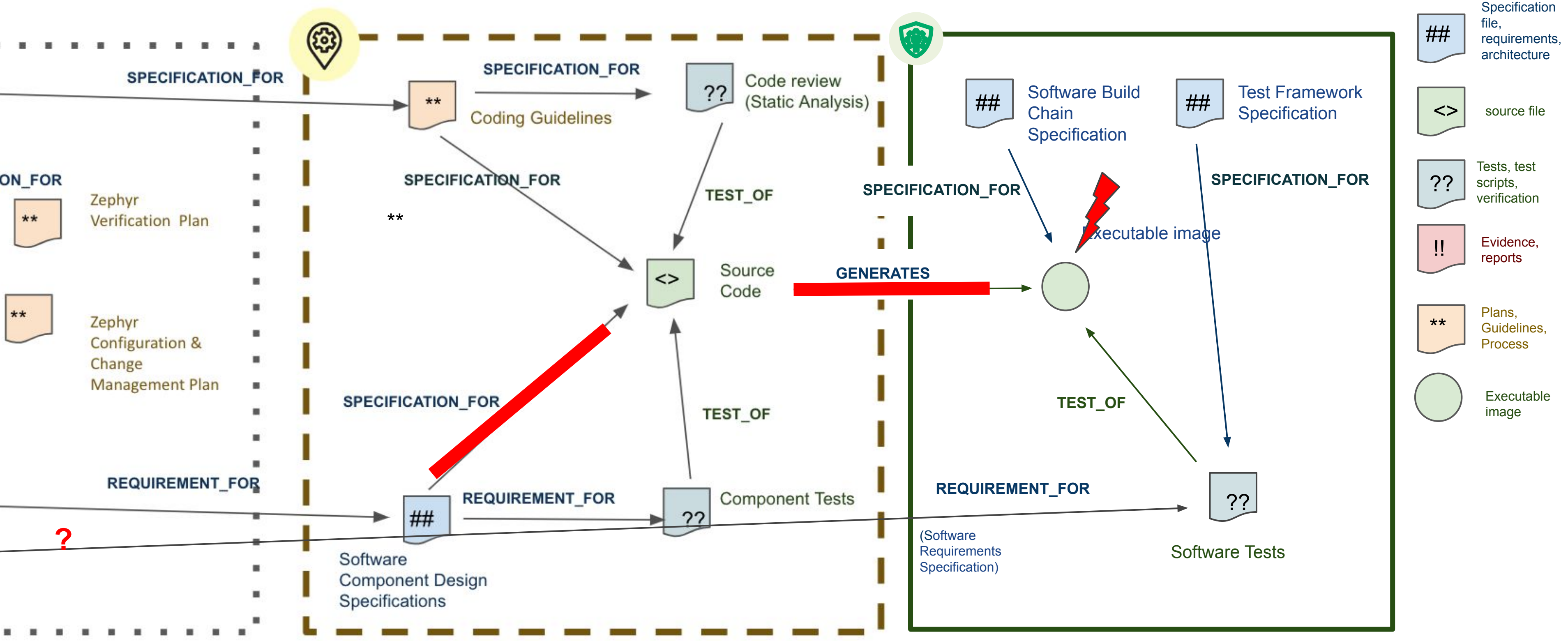
# Dependency Identification at Component Level



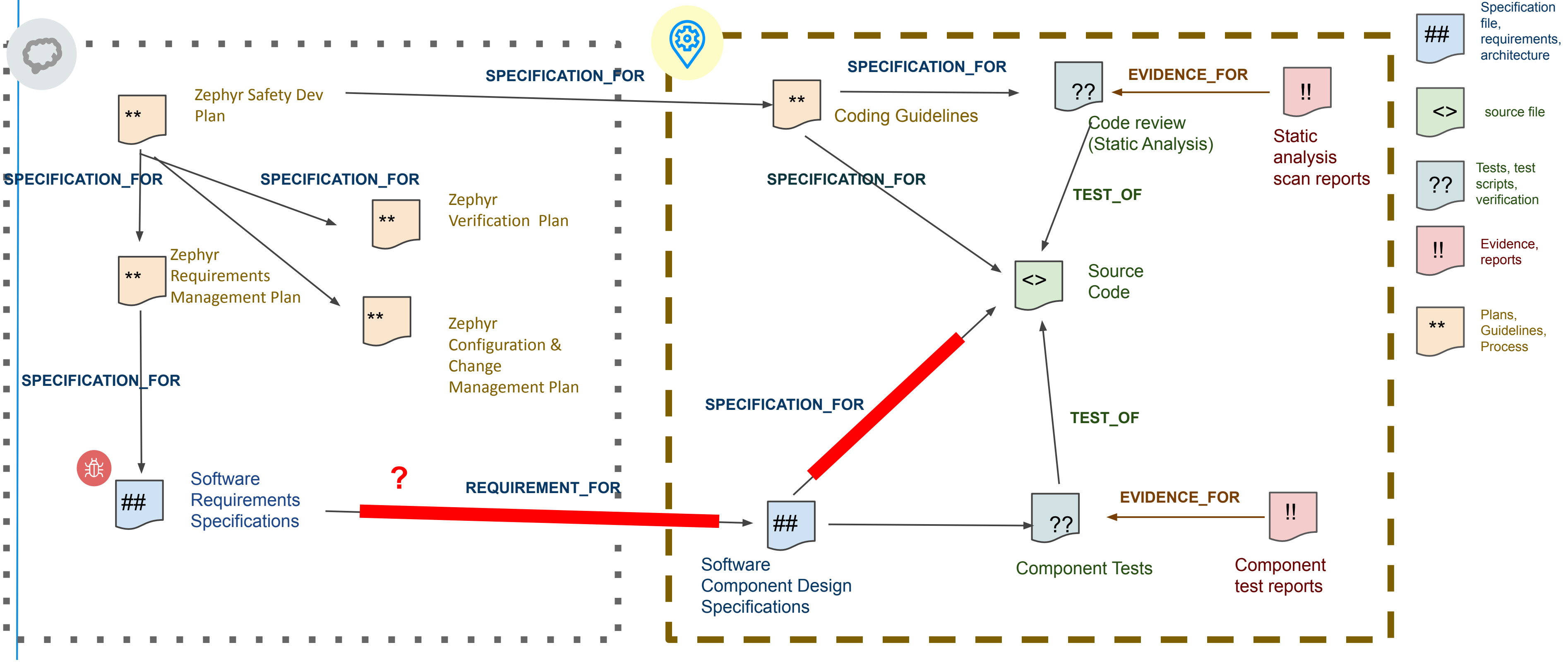
# Dependency Identification at Component Level



# Dependency Identification at Component Level



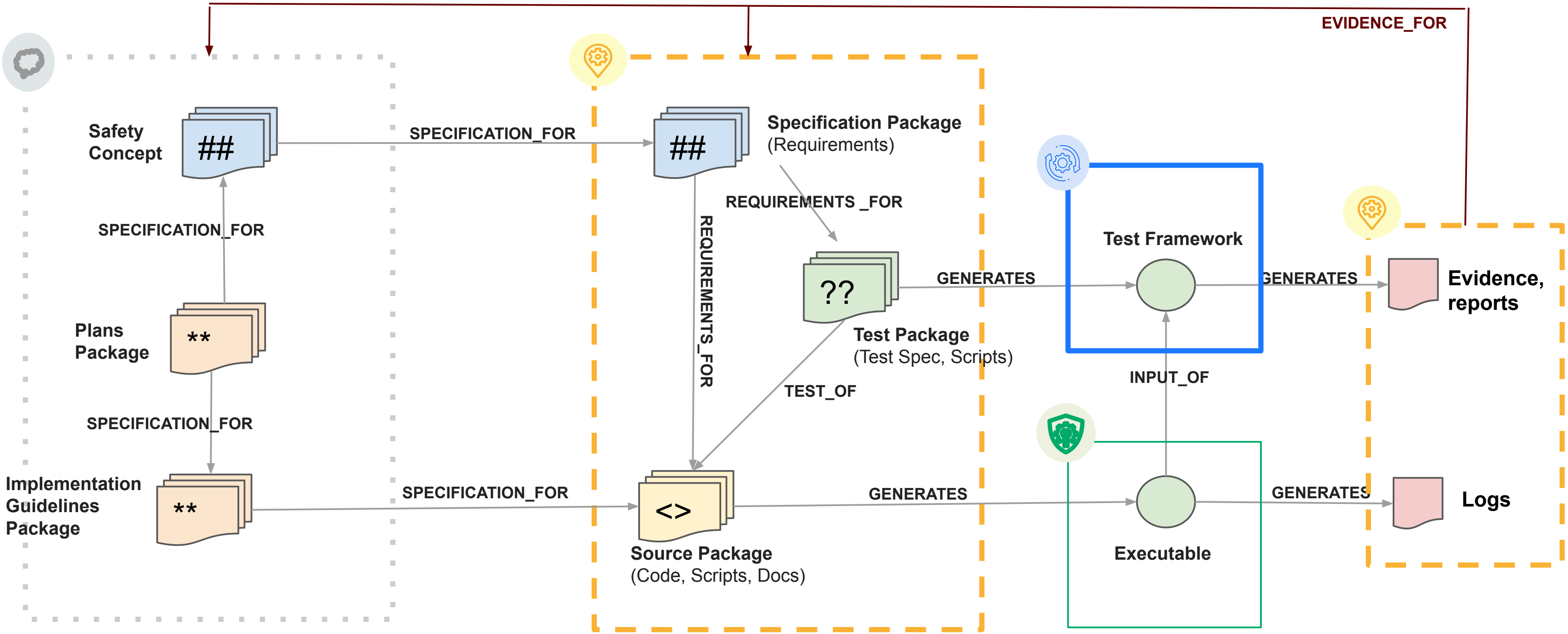
# Dependency Identification at Component Level



SPDX SAFETY

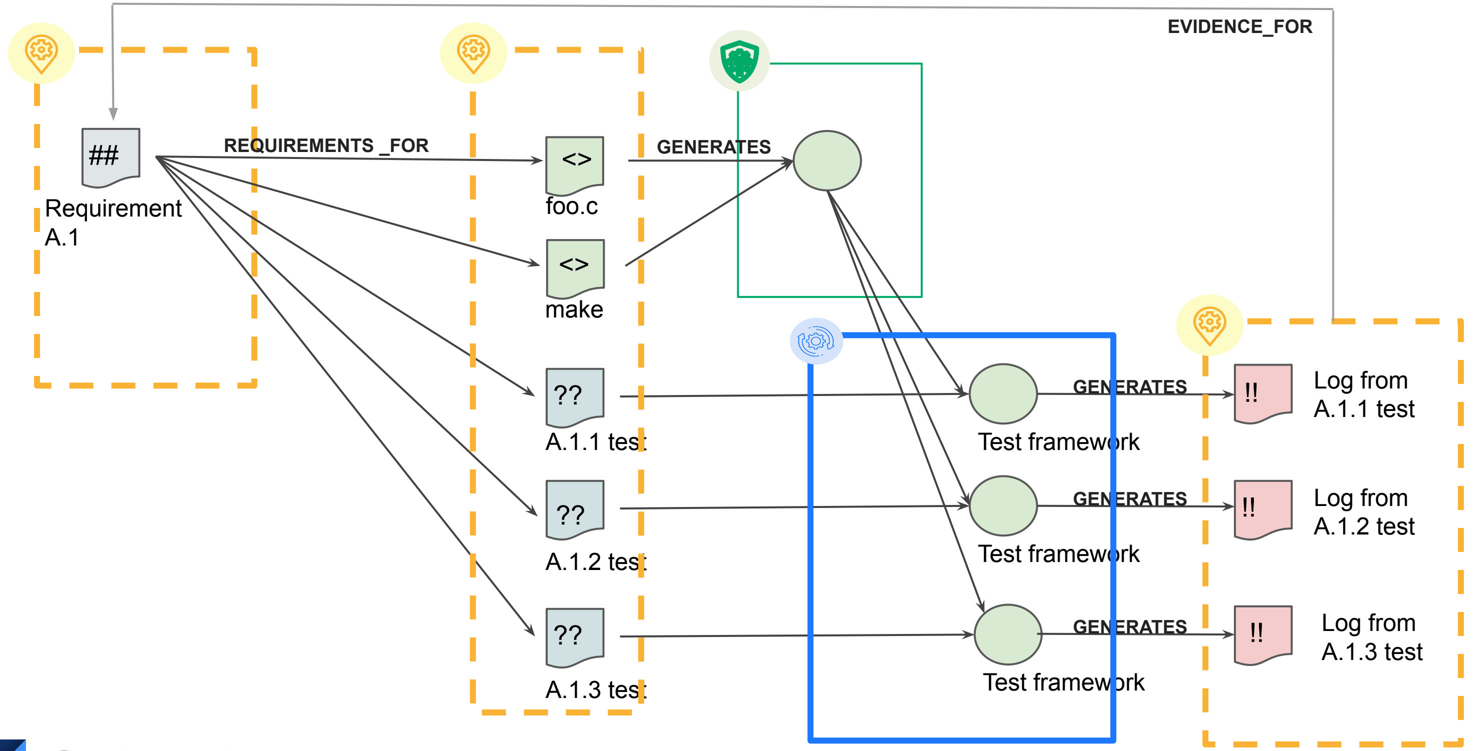
SPDX

# Component Level Requirements Traceability



# When needed: Traceability Inside Component

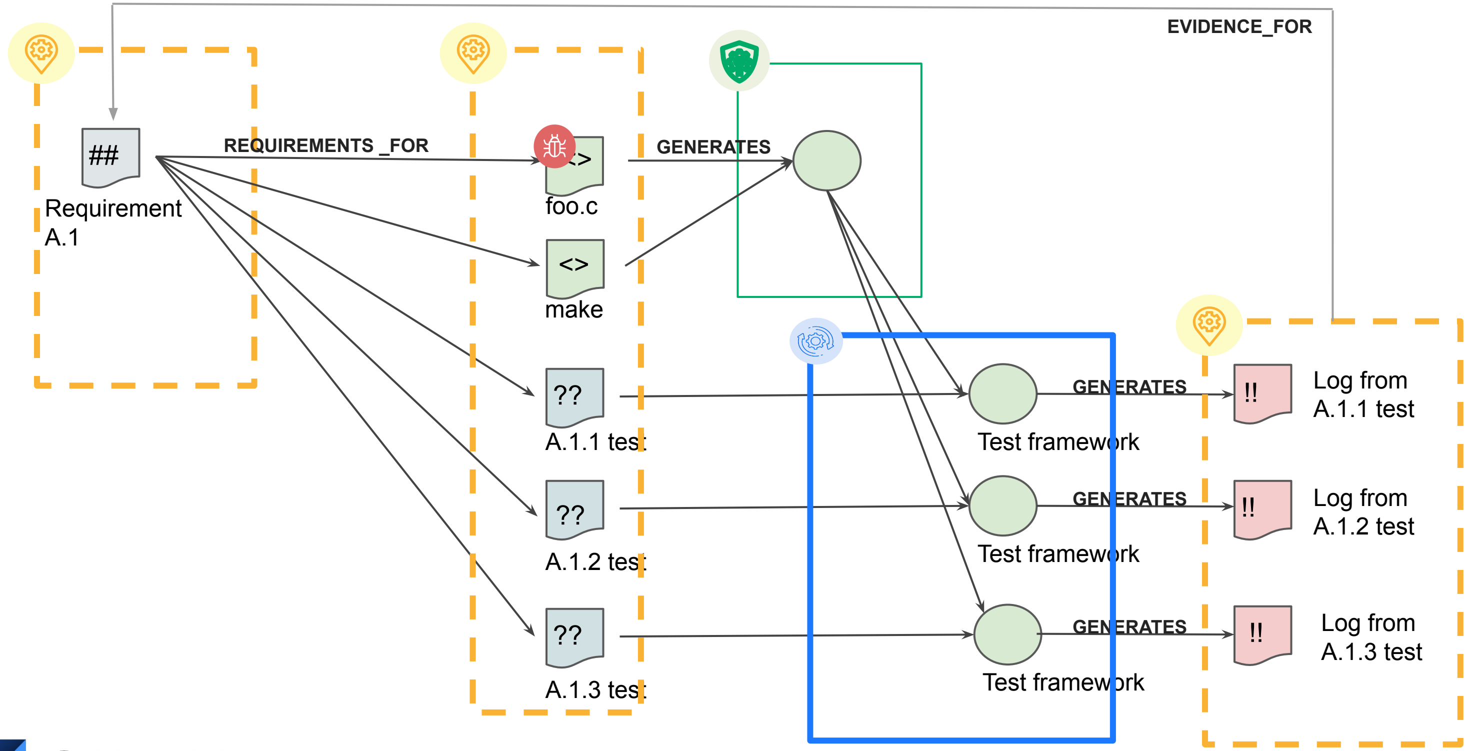
## Requirement to Code to Tests to Evidence



| | |
|---|---|
| ## | Specification file, requirements, architecture |
| <> | source file |
| ?? | Tests, test scripts |
| !! | Evidence, reports |

# When needed: Traceability Inside Component

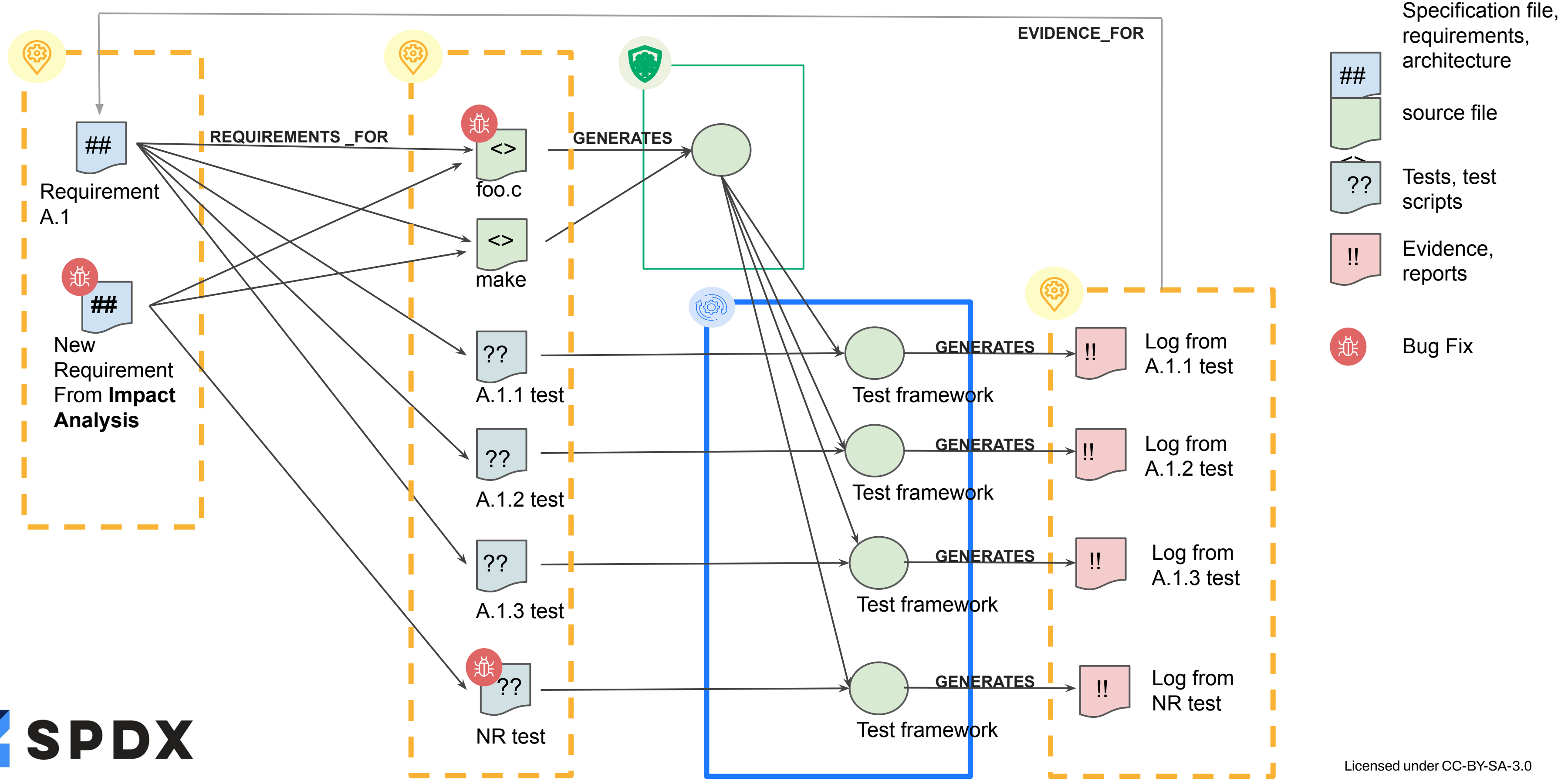
## Requirement to Code to Tests to Evidence



| | |
|---|---|
| ## | Specification file, requirements, architecture |
| <> | source file |
| ?? | Tests, test scripts |
| !! | Evidence, reports |
| 🐞 | Bug Fix |

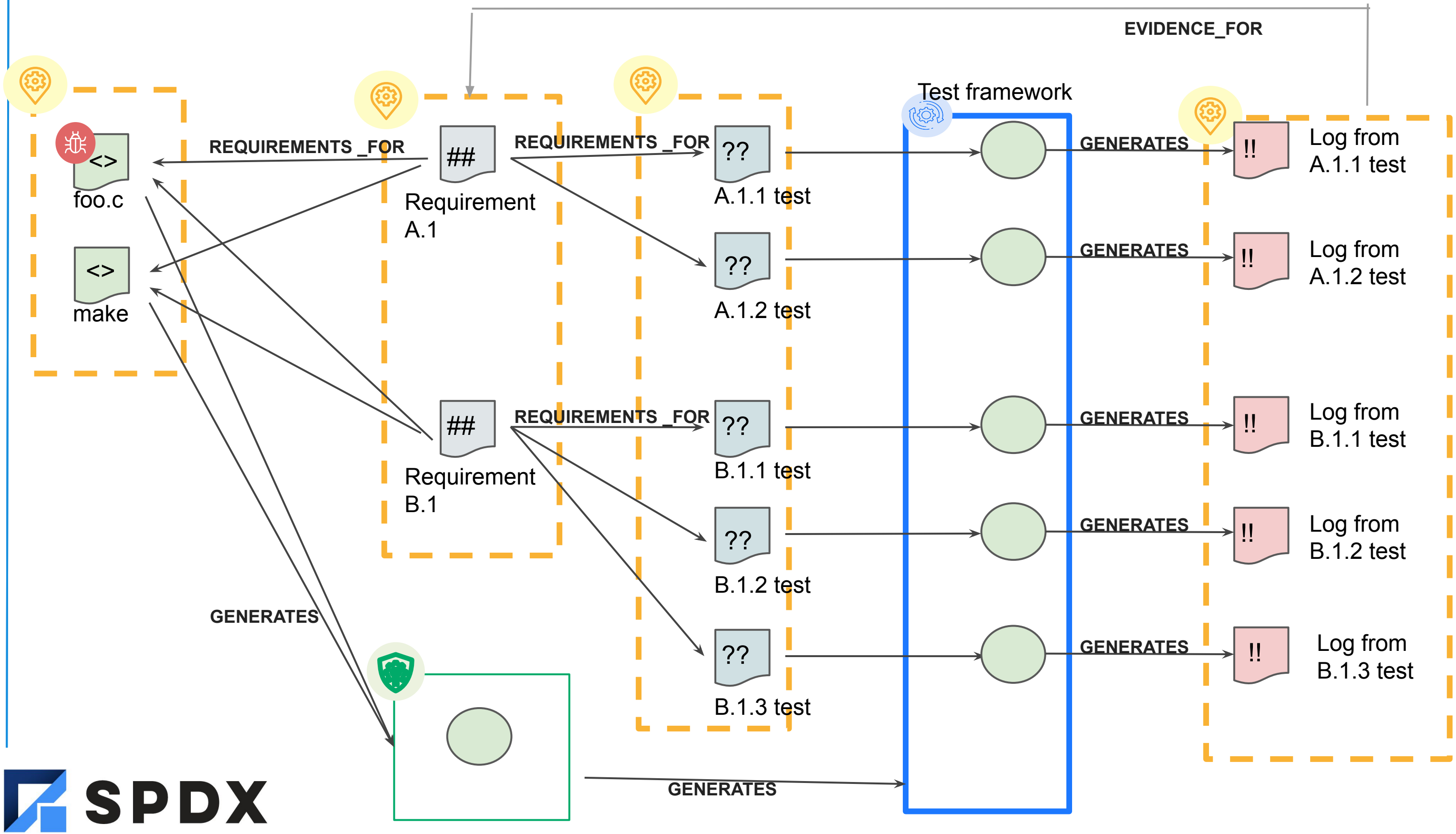
# Traceability Inside Component

## New Requirement to Code to Tests to Evidence



# Inside Component: Traceability of Source to Requirements

## Code to Requirements to Tests to Evidence



## Specification file, requirements, architecture

<> source file

○ Executable image

?? Tests, test scripts

!! Evidence, reports

Bug Fix

How can we establish “**Requirements**” for Open Source Components that **System Engineering & Safety Analysis** need?

# Open Source Projects working to Support Functional Safety

Linux: ELISA
ENABLING LINUX IN SAFETY APPLICATIONS

RTOS: Zephyr™

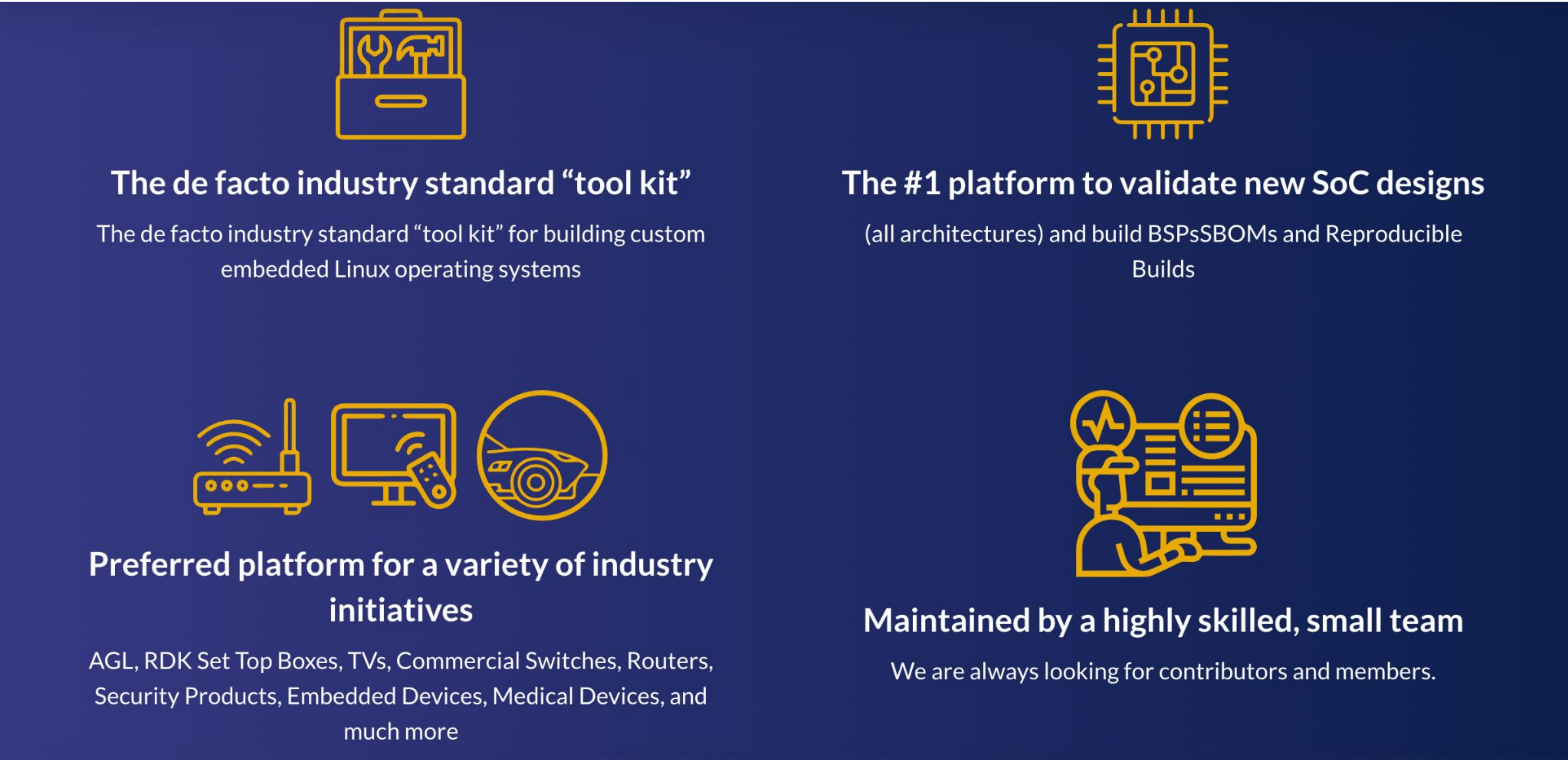
Virtualization/Hypervisor: Xen Project

yocto PROJECT

Reproducible Build Framework

# yocto PROJECT

# The Yocto Project:
# It’s not an embedded Linux distribution, it creates a custom one for you!



### The de facto industry standard “tool kit”

The de facto industry standard “tool kit” for building custom embedded Linux operating systems

### The #1 platform to validate new SoC designs

(all architectures) and build BSPsSBOMs and Reproducible Builds

### Preferred platform for a variety of industry initiatives

AGL, RDK Set Top Boxes, TVs, Commercial Switches, Routers, Security Products, Embedded Devices, Medical Devices, and much more

### Maintained by a highly skilled, small team

We are always looking for contributors and members.

# Yocto Support

Today:

- Reproducible binaries are supported
- Yocto generates SPDX SBOMs for the build toolchain & all components built by that toolchain,  to source level today, by a single configuration change
- System view is done by a master index (for UUID)today.
- Participated in creation of SPDX Build profile to capture key data

Work in Progress:

- Product Line System BOM generation with SPDX
- Linkage PTEST results with some components:  Lot of test data.

Any feature enabled by support in Yocto can scale throughout it’s ecosystem

ELISA

ENABLING LINUX IN SAFETY APPLICATIONS

THE LINUX FOUNDATION

# Project Goals

- Support safety certification of Linux-based systems with a set of  elements, processes and tools.
- Enable companies to incorporate the output of the project into products.
- The work is accepted by the open source community, safety community, regulation authorities,  standardization bodies and system developers.
- Focus the project activities using a Linux-based reference system to safety-integrity standards.

# Systems

## Goal(s):

***“Enable other working groups within ELISA to put their safety claims towards Linux in a wider system context.“***

## Activities:

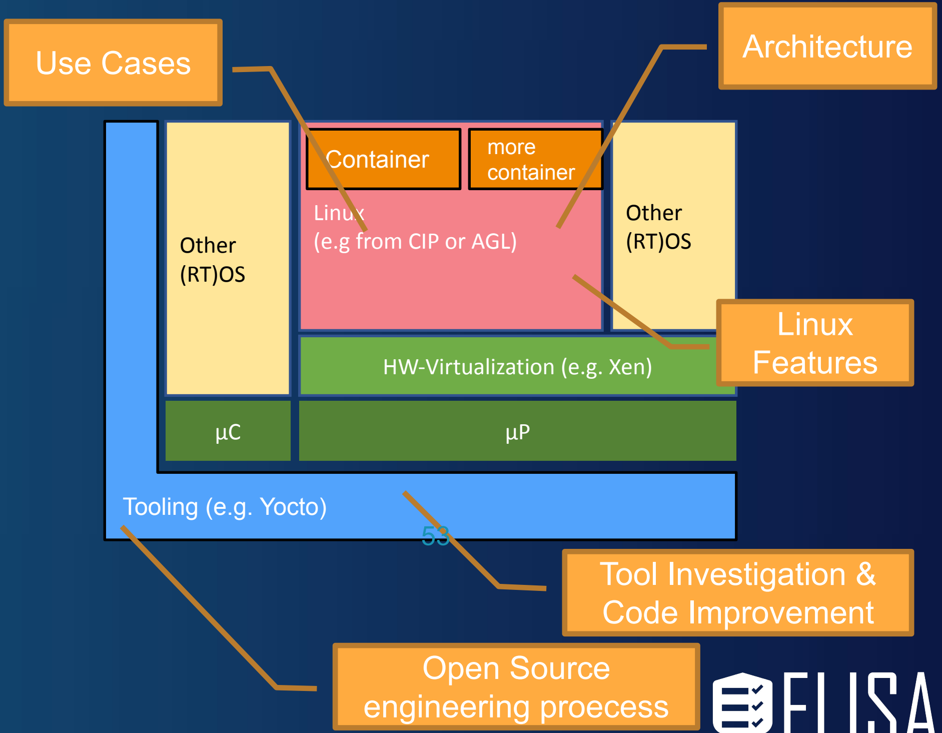
- Provide a reproducible reference system based on real world architectures.
- Reference system fully automated and fully based on Open-Source technologies.
- Interactions with other OSS projects with relevance to mixed-criticality system elements.

## In practice:

- Working on systems to connect Linux with hypervisor and RTOS & explore implications of OSS projects interacting mixed criticality systems.
- First one shown during OSS NA - illustrating Linux, Xen & Zephyr interacting. Enhancement with AGL Linux in progress.  SPDX prototyping.

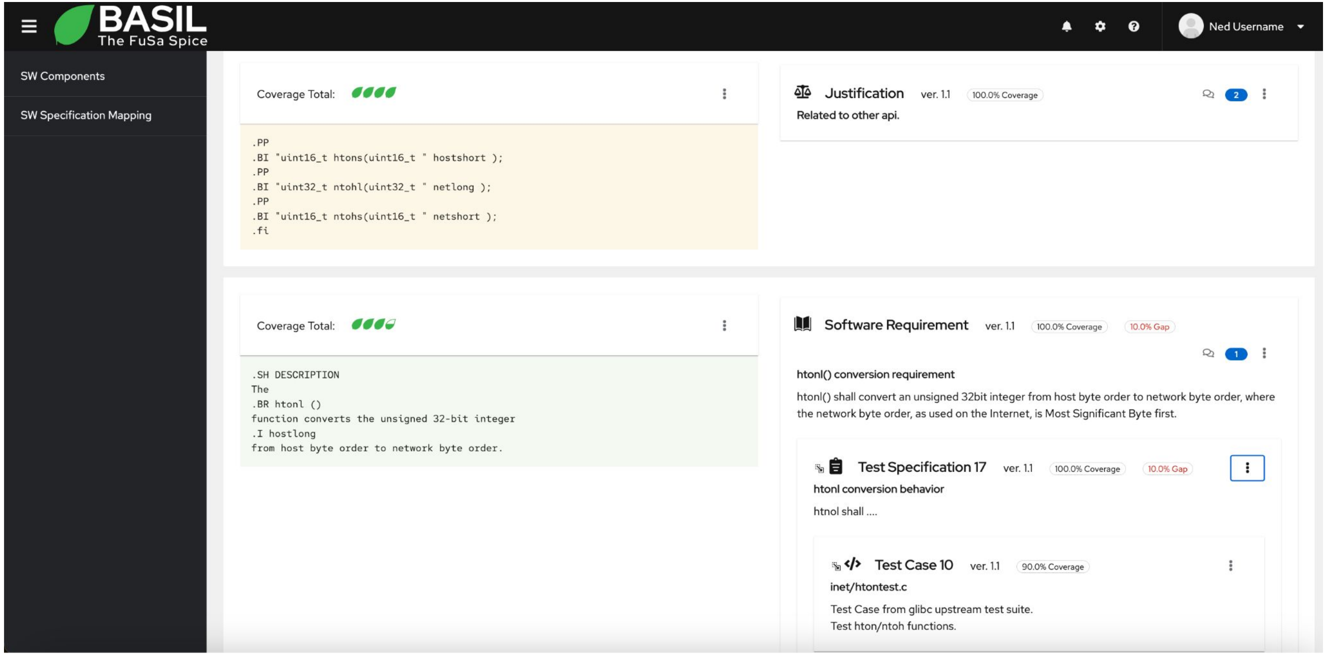
# Systems group integrates ELISA working groups

- **Linux Features, Architecture** and **Code Improvements** should be integrated into the reference system directly.
- **Tools** and **Engineering process** should fit the reproducible product creation.
- **Medical, Automotive** and future WG use cases should be able to strip down the reference system to their use case demands.



ELISA
ENABLING LINUX IN SAFETY APPLICATIONS

# New Requirements Tool: **BASIL** Open Sourced



Coverage Total:

```
.PP
.BI "uint16_t htons(uint16_t " hostshort );
.PP
.BI "uint32_t ntohl(uint32_t " netlong );
.PP
.BI "uint16_t ntohs(uint16_t " netshort );
.fi
```

Justification ver. 1.1 100.0% Coverage 2

Related to other api.

Coverage Total:

```
.SH DESCRIPTION
The
.BR htonl ()
function converts the unsigned 32-bit integer
.I hostlong
from host byte order to network byte order.
```

Software Requirement ver. 1.1 100.0% Coverage 10.0% Gap 1

htonl() conversion requirement

htonl() shall convert an unsigned 32bit integer from host byte order to network byte order, where the network byte order, as used on the Internet, is Most Significant Byte first.

Test Specification 17 ver. 1.1 100.0% Coverage 10.0% Gap

htonl conversion behavior

htnol shall ....

Test Case 10 ver. 1.1 90.0% Coverage

inet/htontest.c

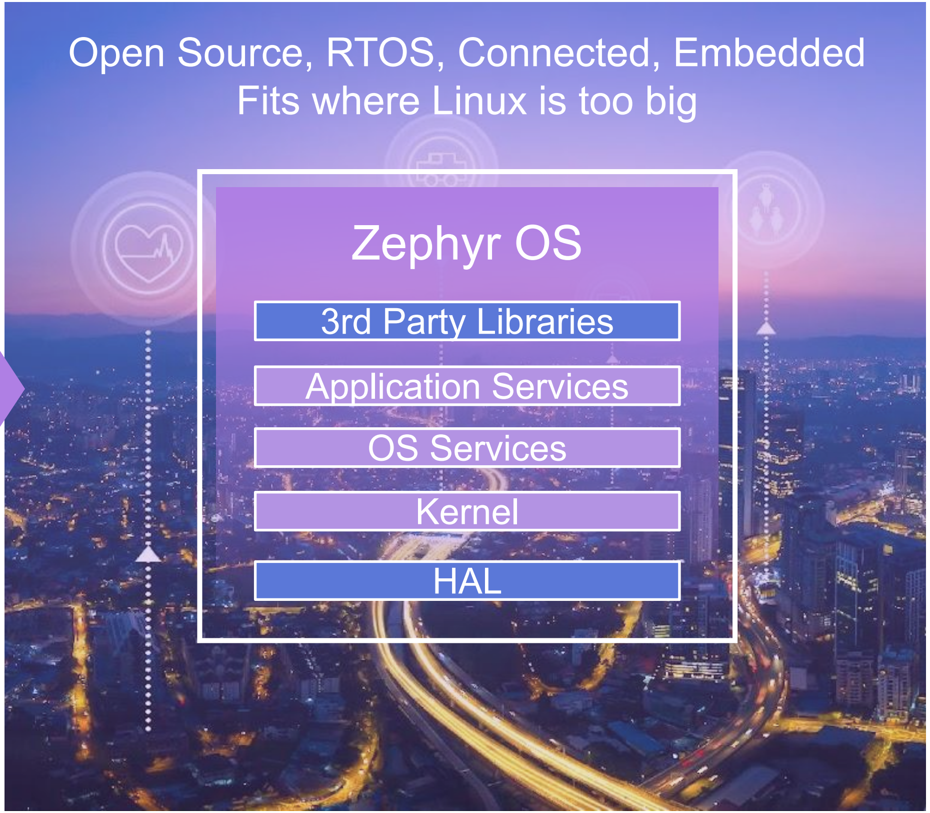
Test Case from glibc upstream test suite.
Test hton/ntoh functions.

Learn more at: https://elisa.tech/blog/2023/11/30/basil-the-fusa-spice/
Contribute to the code at: https://github.com/elisa-tech/BASIL

# Zephyr™

# Zephyr Project

- **Open source** real time operating system
- **Developer friendly** with vibrant community participation
- Built with **safety and security** in mind
- **Broad SoC, board and sensor support**.
- **Vendor Neutral** governance
- **Permissively licensed** - Apache 2.0
- **Complete**, fully integrated, highly configurable, **modular** for **flexibility**
- **Product** development ready using LTS includes **security updates**
- **Certification** ready with Zephyr Auditable



Open Source, RTOS, Connected, Embedded
Fits where Linux is too big

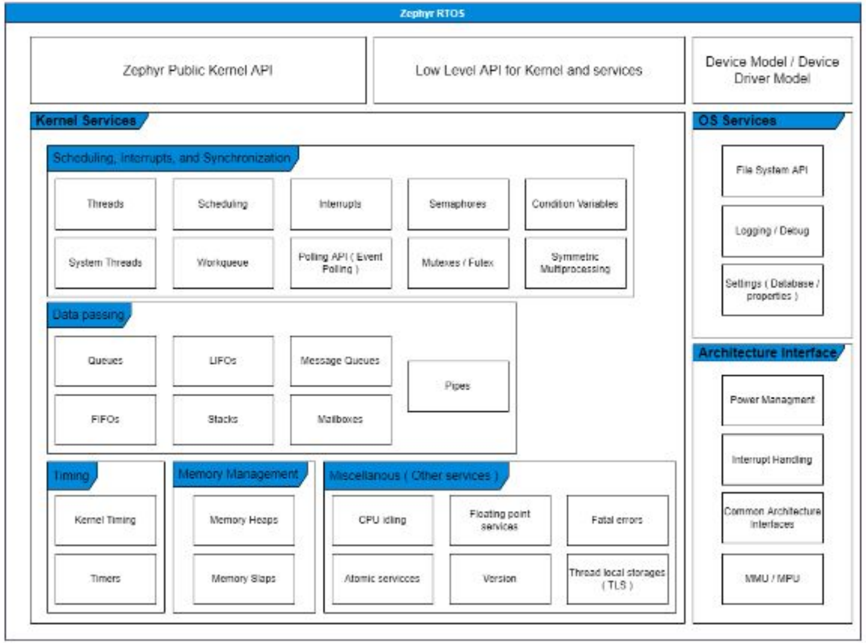
Zephyr OS

- 3rd Party Libraries
- Application Services
- OS Services
- Kernel
- HAL

THE LINUX FOUNDATION PROJECTS

# Safety: Initial certification focus

- Start with a limited scope of kernel and interfaces
- Initial target is IEC 61508 SIL 3 / SC 3 (IEC 61508-3, 7.4.2.12, Route 3s)
- Option for 26262 certification has been included in contract with certification authority should there be sufficient member interest



Zephyr RTOS

Zephyr Public Kernel API

Low Level API for Kernel and services

Device Model / Device Driver Model

Kernel Services

Scheduling, Interrupts, and Synchronization

Threads
Scheduling
Interrupts
Semaphores
Condition Variables
System Threads
Workqueue
Polling API ( Event Polling )
Mutexes / Futex
Symmetric Multiprocessing

Data passing

Queues
LIFOs
Message Queues
Pipes
FIFOs
Stacks
Mailboxes

Timing

Kernel Timing
Timers

Memory Management

Memory Heaps
Memory Slaps

Miscellanous ( Other services )

CPU idling
Floating point services
Fatal errors
Atomic servicces
Version
Thread local storages ( TLS )

OS Services

File System API
Logging / Debug
Settings ( Database / properties )

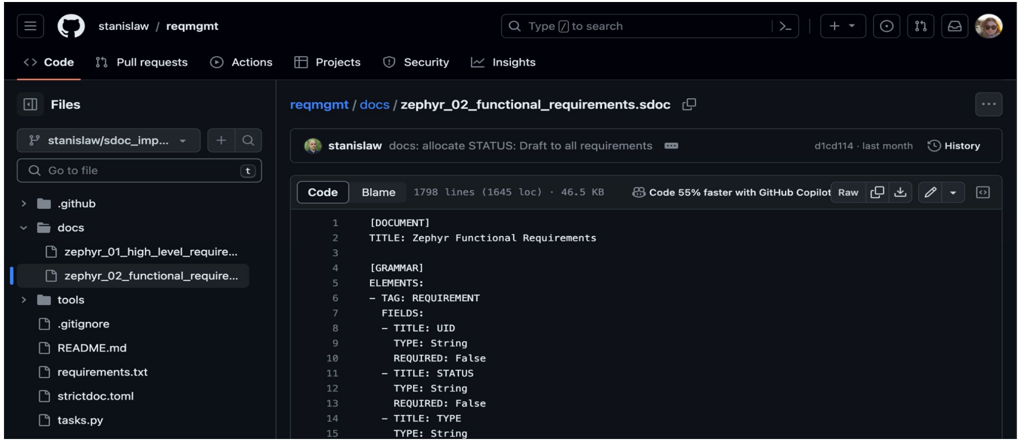
Architecture Interface

Power Managment
Interrupt Handling
Common Architecture Interfaces
MMU / MPU

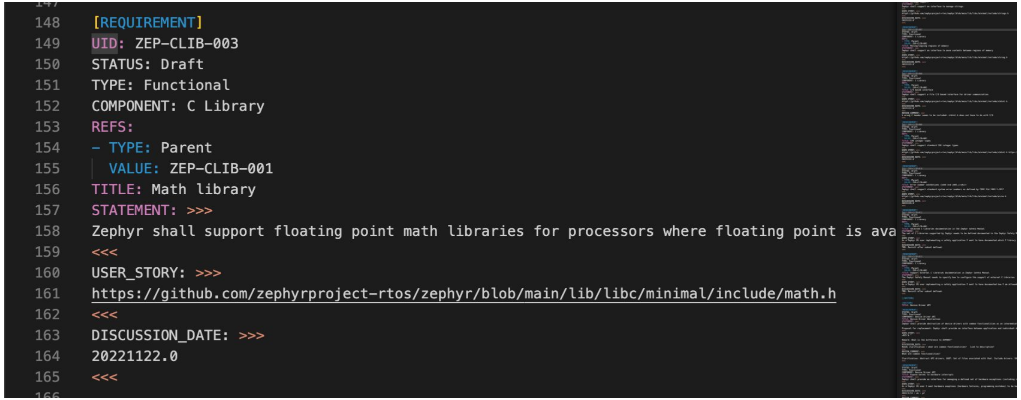
Scope can be **extended** to include **additional components** with associated **requirements** and **traceability** as determined by the safety committee

# Current requirements work

- Used tooling: StrictDoc ([https://github.com/strictdoc-project/strictdoc](https://github.com/strictdoc-project/strictdoc))
- Decision on UIDs for requirements (UID will be generated by StrictDoc)
- Hierarchical structure of requirements that works for the project
- Capturing the requirements in StrictDoc which is working towards import/export of SPDX


stanislaw / reqmgmt
Type / to search
Code
Pull requests
Actions
Projects
Security
Insights
Files
stanislaw/sdoc_imp...
Go to file
t
.github
docs
zephyr_01_high_level_require...
zephyr_02_functional_require...
tools
.gitignore
README.md
requirements.txt
strictdoc.toml
tasks.py
reqmgmt / docs / zephyr_02_functional_requirements.sdoc
stanislaw docs: allocate STATUS: Draft to all requirements
d1cd114 · last month
History
Code
Blame
1798 lines (1645 loc) · 46.5 KB
Code 55% faster with GitHub Copilot
Raw

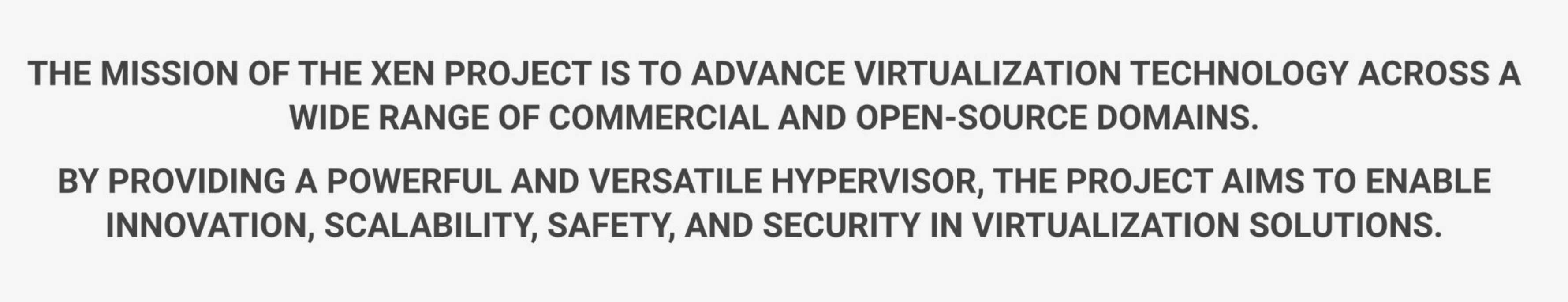
```
[DOCUMENT]
TITLE: Zephyr Functional Requirements

[GRAMMAR]
ELEMENTS:
- TAG: REQUIREMENT
  FIELDS:
  - TITLE: UID
    TYPE: String
    REQUIRED: False
  - TITLE: STATUS
    TYPE: String
    REQUIRED: False
  - TITLE: TYPE
    TYPE: String
```



```
[REQUIREMENT]
UID: ZEP-CLIB-003
STATUS: Draft
TYPE: Functional
COMPONENT: C Library
REFS:
- TYPE: Parent
  VALUE: ZEP-CLIB-001
TITLE: Math library
STATEMENT: >>>
Zephyr shall support floating point math libraries for processors where floating point is ava
<<<
USER_STORY: >>>
https://github.com/zephyrproject-rtos/zephyr/blob/main/lib/libc/minimal/include/math.h
<<<
DISCUSSION_DATE: >>>
20221122.0
<<<
```

Xen
Project

# Mission Statement



THE MISSION OF THE XEN PROJECT IS TO ADVANCE VIRTUALIZATION TECHNOLOGY ACROSS A WIDE RANGE OF COMMERCIAL AND OPEN-SOURCE DOMAINS.

BY PROVIDING A POWERFUL AND VERSATILE HYPERVISOR, THE PROJECT AIMS TO ENABLE INNOVATION, SCALABILITY, SAFETY, AND SECURITY IN VIRTUALIZATION SOLUTIONS.

# The Xen Project

- What is it?
  - Xen is a Type-1 hypervisor that plays a central role in providing isolation between different software components
- The history of Xen
  - The project started in 2003 from Cambridge University
  - Became a Linux Foundation project in 2013
  - It’s widely used for it’s safety and security first environments
  - The flexible architecture allows for diverse applications and service needs to coexist on the same hardware
- Open source project
  - Many subprojects: Hypervisor, Windows PV, XAPI, automotive etc
  - Intel and AMD x86 and ARM already supported
  - Diverse community of maintainers and contributors from Amazon, SUSE, XenServer (formerly Citrix) and more

# Xen Support

Today:

- Xen is chosen for safety critical applications due to its maturity and robust security features
- Can be configured to provide real-time scheduling for VMs
- Allows critical tasks to run within predefined time constraints

Work in Progress:

- Improve Xen coding style with MISRA-C
- Implement features to improve real-time and reduce interference
- Project members working on getting Xen safety certified for 61508 & 26262

# Next steps to continue the discussion?

## Augmenting open source components:

**Wednesday**, December 6 · 15:05 - 15:45 · Conference Room 1

✓ BOF: Open Source Projects in Safety Critical Applications - Kate Stewart, The Linux Foundation & Kelly Choi, Xen Project

- Linux: join in ELISA working groups
- Zephyr: join in the safety working group
- Xen: join the FuSa special interest group
- Yocto: join the build & release communities

## Framework for connecting "All the Ingredients":

- SPDX: join the Functional Safety(FuSa) profile group meetings and/or mailing list

Integrating Open Source efficiently into System Engineering practices is overdue, community required.

Hint: don’t expect upstream project maintainers to take the lead here.

THE LINUX FOUNDATION

# OPEN SOURCE SUMMIT

JAPAN

THE LINUX FOUNDATION

# Keynote: Building Dependable Systems with Open Source

Schedule: 10:15 Dec 5, 2023  https://sched.co/1Tyqo

Duration: 15 minute

Speaker Guide: https://events.linuxfoundation.org/open-source-summit-japan/program/in-person-speaker-guide/

**Abstract:** By looking at the press headlines, we've learned that open source is already being used in market segments (like space, automotive, industrial, medical, agricultural) applications that have safety considerations today.  Details about the safety analysis performed are behind NDAs and are not available to developers in the open source projects being used in these products.  To make the challenge even more interesting, the processes the safety standards are expecting are behind paywalls, and not readily accessible to the wider open source community maintainers and developers. Figuring out pragmatic steps to adopt in open source projects requires the safety assessor communities, the product creators, and open source developers to communicate openly. There are some tasks that can be done today that help, like knowing exactly what source is being included in a system and how it was configured and built.  Automatic creation of accurate Software Bill of Materials (SBOMs), is one pragmatic step that has emerged as a best practice for security and safety analysis. This talk will overview some of the methods being applied in some open source projects (like Linux, Xen & Zephyr), as we try to establish other pragmatic steps when open source projects are used in safety critical: