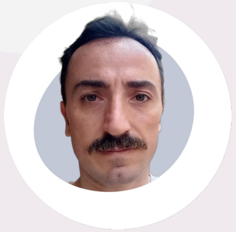
BASIL an open source tool that supports requirements traceability with design SBOM

Luigi Pellecchia
Principal Software Quality Engineer - Red Hat

FOSDEM 25

Who I am



Luigi Pellecchia
Principal
Software Quality Engineer
Quality Engineering
In-vehicle OS
Red Hat

Agenda

- What is BASIL
- Traceability in a SDLC: V-Model
- BASIL applied to the V-Model
- BASIL SBOM with SPDX Model 3
- BASIL Test Infrastructure and Test Results traceability

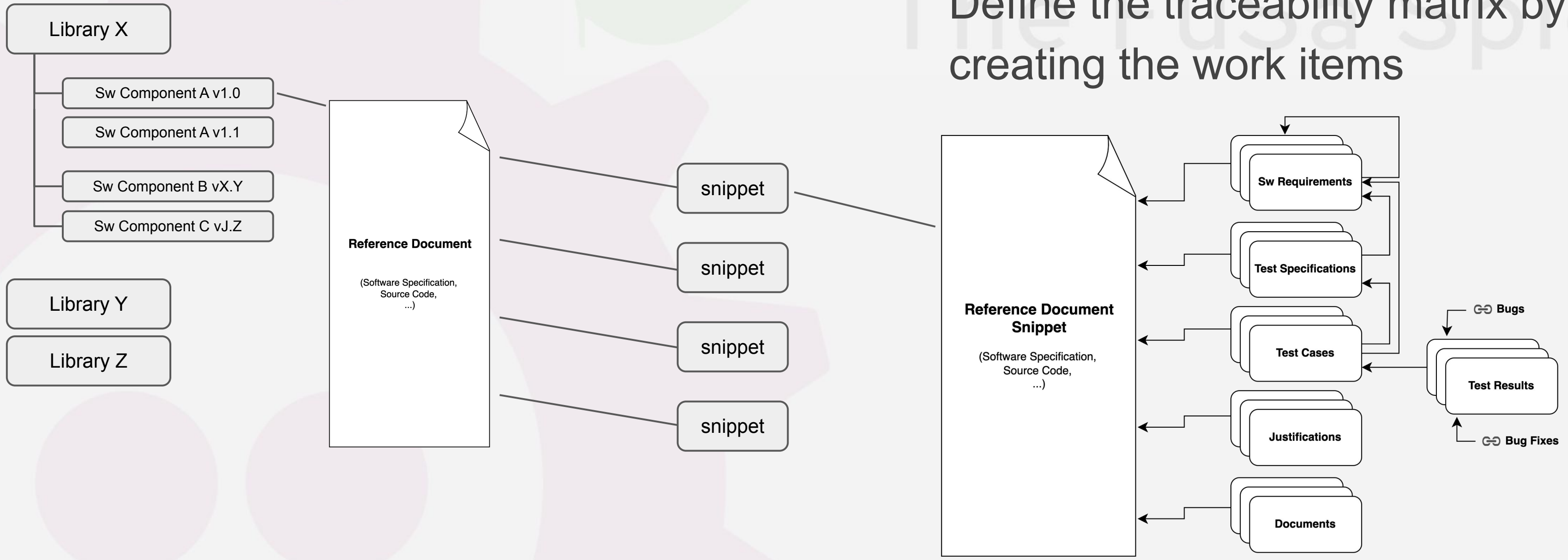
BASIL The FuSa Spice

Tool developed to manage software related work items, design their traceability towards specifications and ensure completeness of analysis

- Born at Red Hat to support RHIVOS Functional Safety ISO 26262 Compliance Certification
- BASIL name comes from ASIL B
- Presented to ELISA Project on June 2023 during the Berlin Workshop
- Open Sourced and hosted at ELISA github

BASIL The FuSa Spice

Define the traceability matrix by creating the work items



BASIL The FuSa Spice - Work Items overview

- Software Requirement
- Test Specification
- Test Case
- Justification
- Document
- Test Run
- Test Run Configuration

BASIL The FuSa Spice - Work Items overview

- Software Requirement
- Test Specification
- Test Case
- Justification
- Document
- Test Run
- Test Run Configuration

Key points:

- Hierarchical mapping

BASIL The FuSa Spice - Work Items overview

- Software Requirement
- Test Specification
- Test Case
- Justification
- Document
- Test Run
- Test Run Configuration

Key points:

- Describes how to test a software functionality.
  The preconditions, the maneuver that a tester should perform and the expected behavior.

BASIL The FuSa Spice - Work Items overview

- Software Requirement
- Test Specification
- **Test Case**
- Justification
- Document
- Test Run
- Test Run Configuration

Key points:

- It is the test implementation
- Can link to a remote file in a git repo or to a local file in the machine running the BASIL instance

BASIL The FuSa Spice - Work Items overview

- Software Requirement
- Test Specification
- Test Case
- Justification
- Document
- Test Run
- Test Run Configuration

Key points:

- Completeness of analysis

BASIL The FuSa Spice - Work Items overview

- Software Requirement
- Test Specification
- Test Case
- Justification
- Document
- Test Run
- Test Run Configuration

Key points:

- Types: File, Text
- Text document supports snippet definition and automatic validation
- SPDX Model 3 based Relationship Type to the Reference Document
- Can be used to trace the source code to the specification

Next Steps:

- Hierarchical mapping
  (e.g. Ref Doc ← AI Model ← Training Dataset)

BASIL The FuSa Spice - Work Items overview

- Software Requirement
- Test Specification
- Test Case
- Justification
- Document
- **Test Run**
- Test Run Configuration

Key points:

- It is related to a Test Case Mapping as we can reuse a test case multiple times inside a Software Component (configurable test cases: e.g. ltp syscall test in BASIL examples)
- We can use the same Test Case with different Test Run Configuration (environment variables, SUT, …)
- Link to bugs, fixes, artifacts
- Can refer test runs executed on external test infrastructures

BASIL The FuSa Spice - Work Items overview

- Software Requirement
- Test Specification
- Test Case
- Justification
- Document
- Test Run
- Test Run Configuration

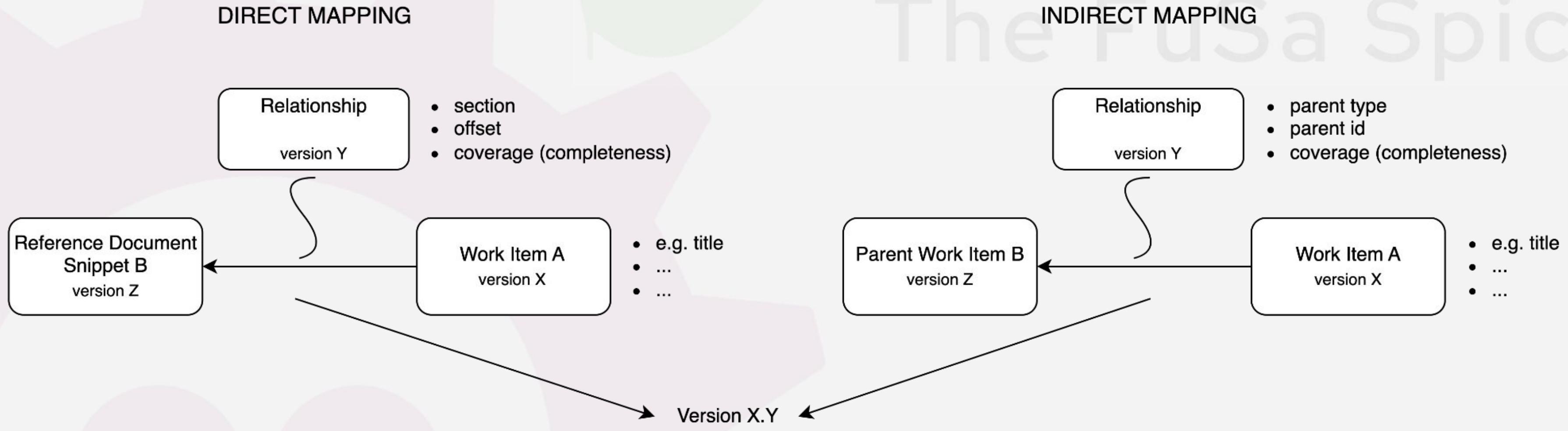
Key points:

- Can change the test behavior and the SUT
- Can leverage external test infrastructures
- Reusable
- Con use preset configuration defined by the BASIL Admin in a yaml file

BASIL The FuSa Spice - Work Items Mapping

- Direct Mapping
  - Multiple views based on work item type
  - Link to a snippet of the reference document using section and offset
  - Completeness percentage (basil coverage)
- Indirect Mapping
  - Waterfall propagation of completeness percentage
- Broken Mapping
  - Changes of the Reference document can lead in broken mapping
  - Broken mapping are displayed in a dedicated section
  - Can be automatically fixed by the tool
  - Prediction of broken mapping analyzing a different version of the reference document

BASIL - Work Items Version Control



BASIL The FuSa Spice - key points

- Web App with user management
- Clarifies the gaps
- Support collaboration through comments, notifications and work item workflow
- Multiple mapping views to parallelize teams work
- Follow the project evolution
- Allow integration in CI and automated workflows via REST API
- Simplified deployment via containers

Traceability in Safety Critical Application

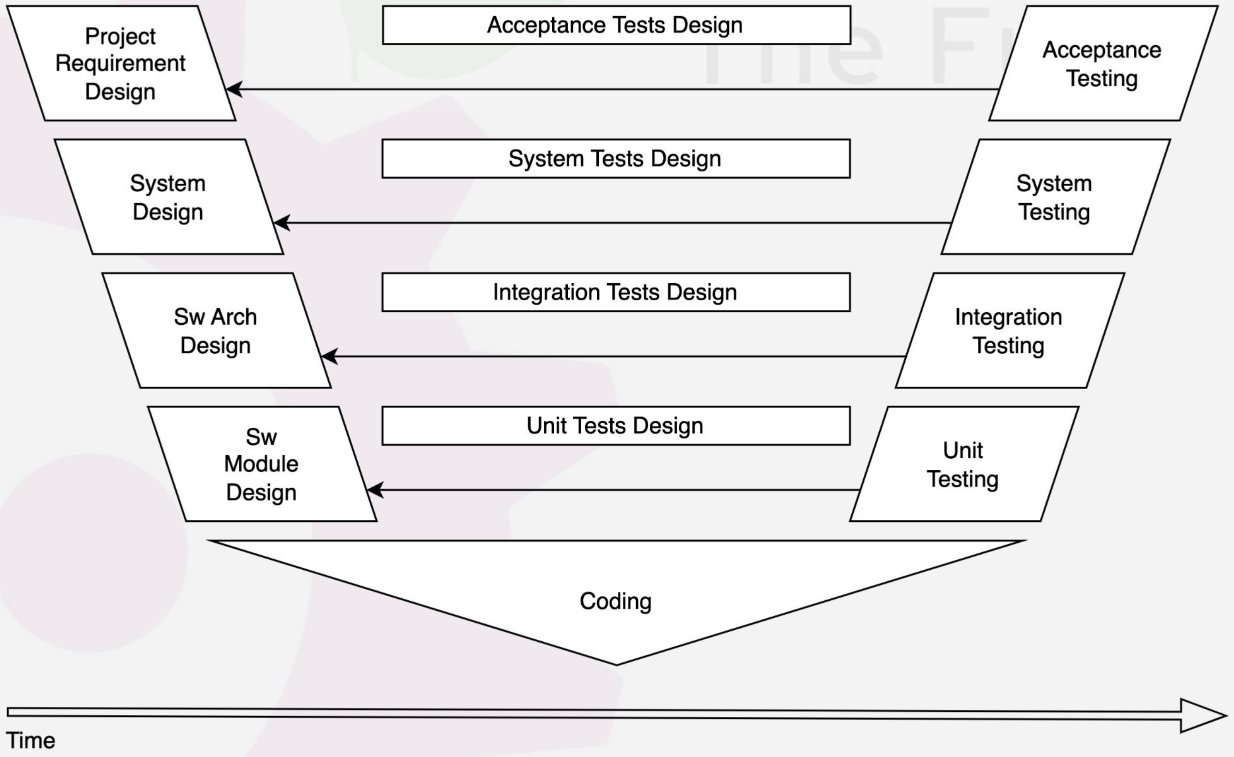
A **safety-critical system** or **life-critical system** is a system whose failure or malfunction may result in one (or more) of the following outcomes:

- death or serious injury to people
- loss or severe damage to equipment/property
- environmental harm

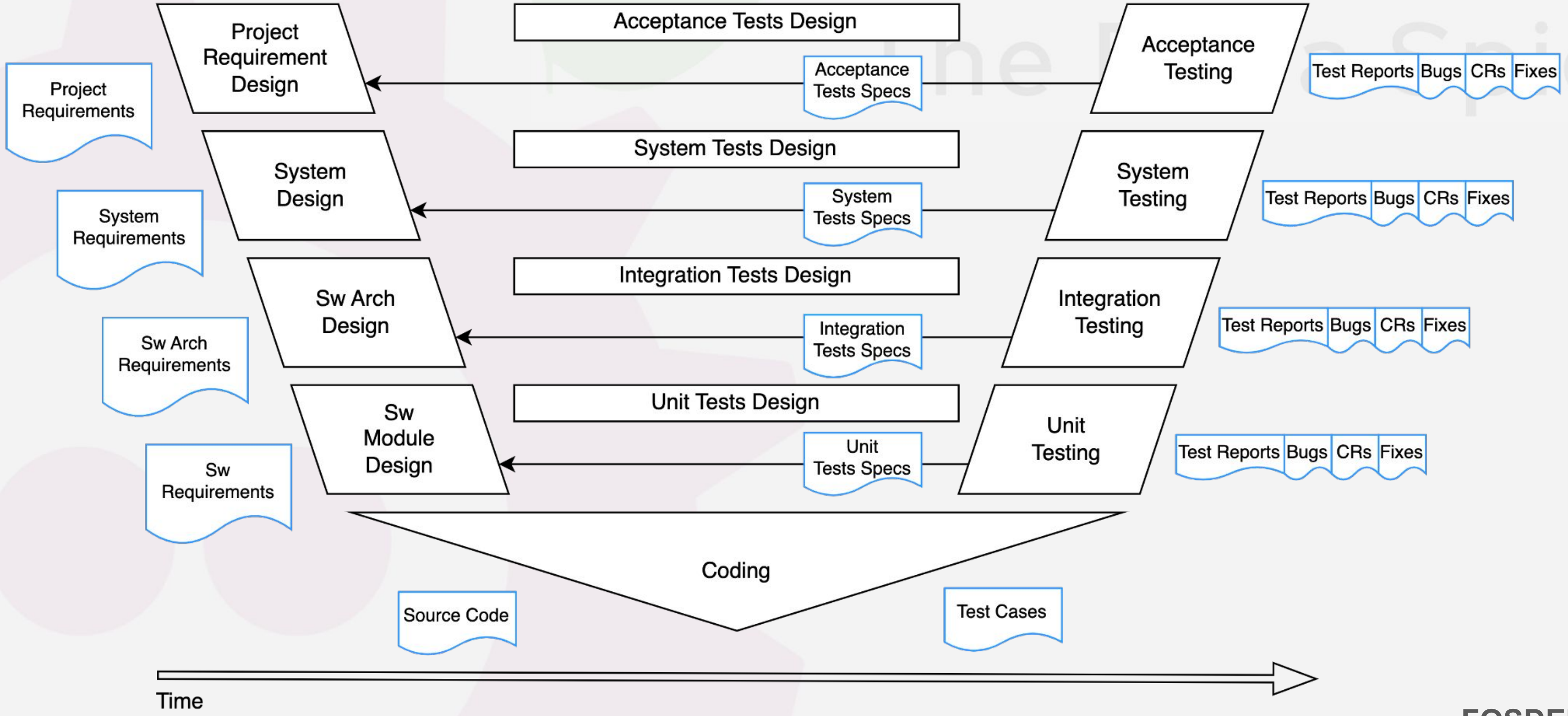
[https://en.wikipedia.org/wiki/Safety-critical_system]

- Required by international standards (ISO 26262, 15504, DO-178C…)
- Establishes and demonstrates control over the process
- Simplifies impact analysis
- Highlights gaps (helps estimate effort)

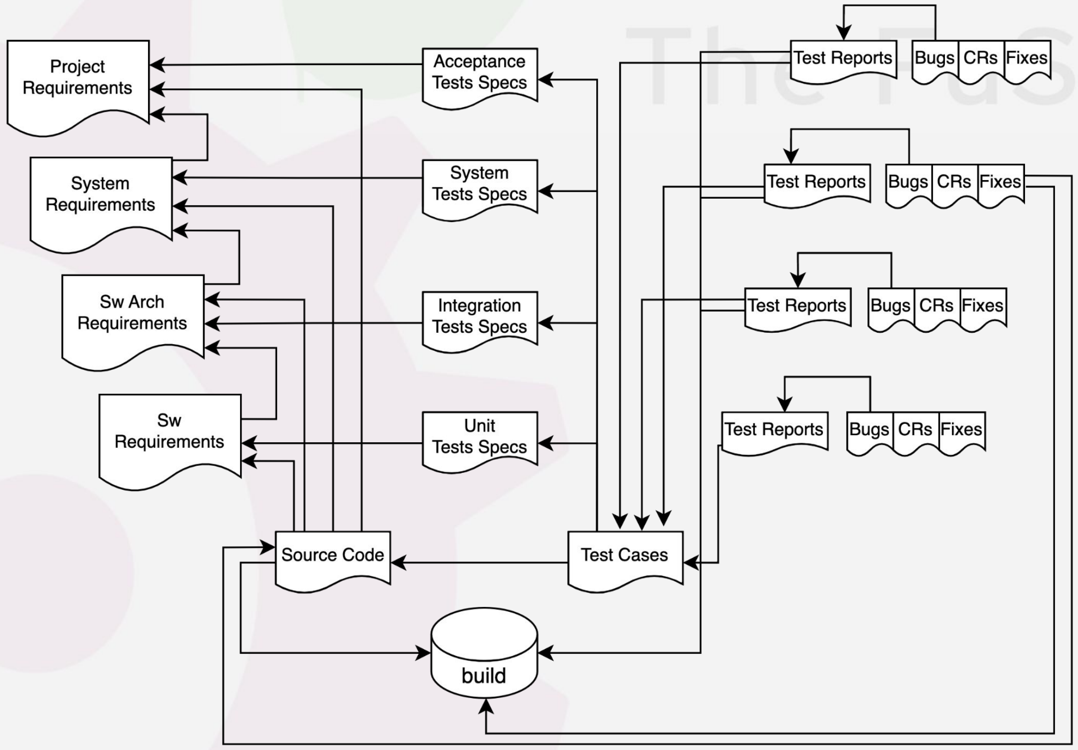
SDLC V-Model


Project Requirement Design
Acceptance Tests Design
Acceptance Testing
System Design
System Tests Design
System Testing
Sw Arch Design
Integration Tests Design
Integration Testing
Sw Module Design
Unit Tests Design
Unit Testing
Coding
Time

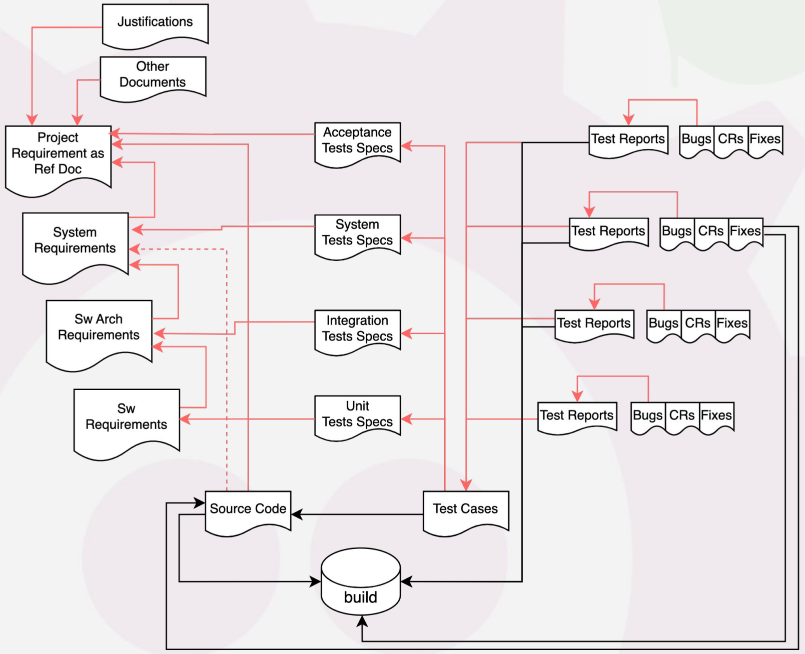
SDLC V-Model Artifacts

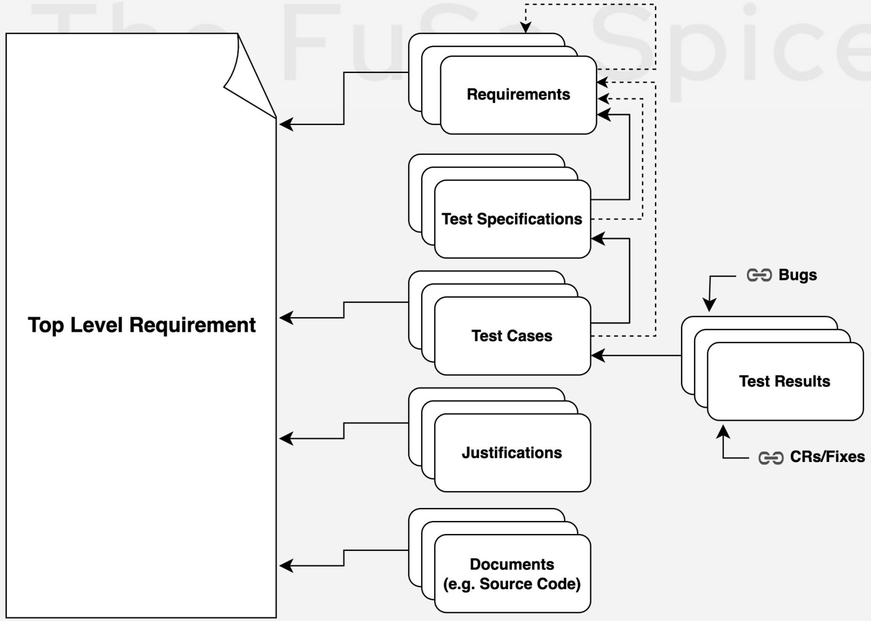


V-Model - Traceability



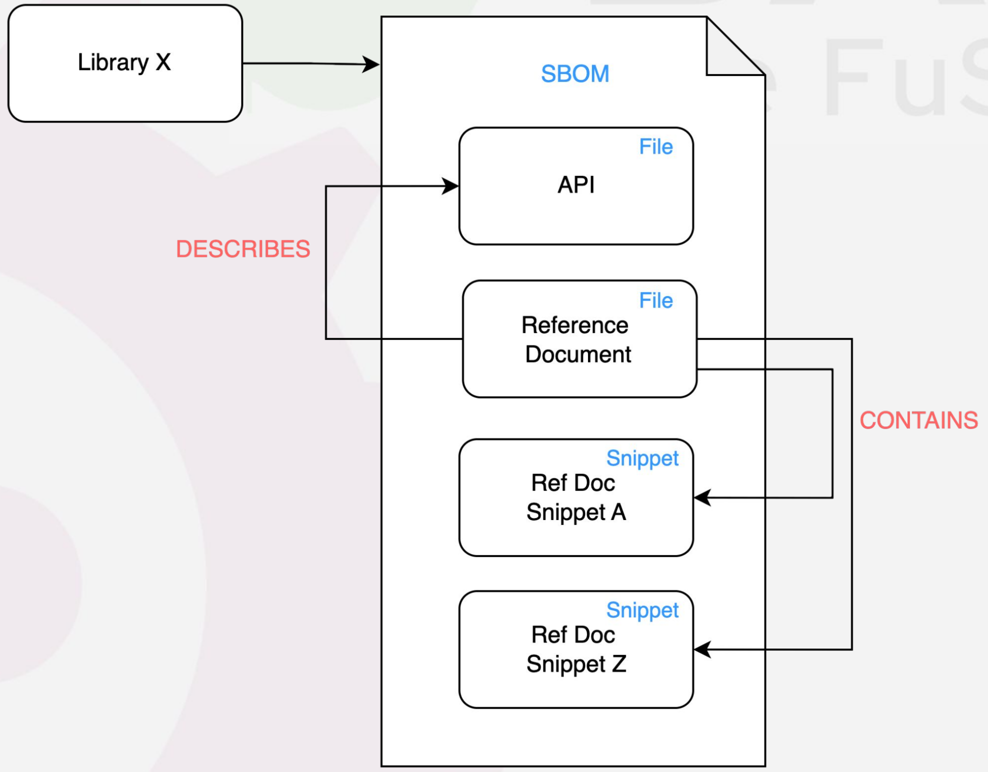
V-Model - System Requirements - BASIL example



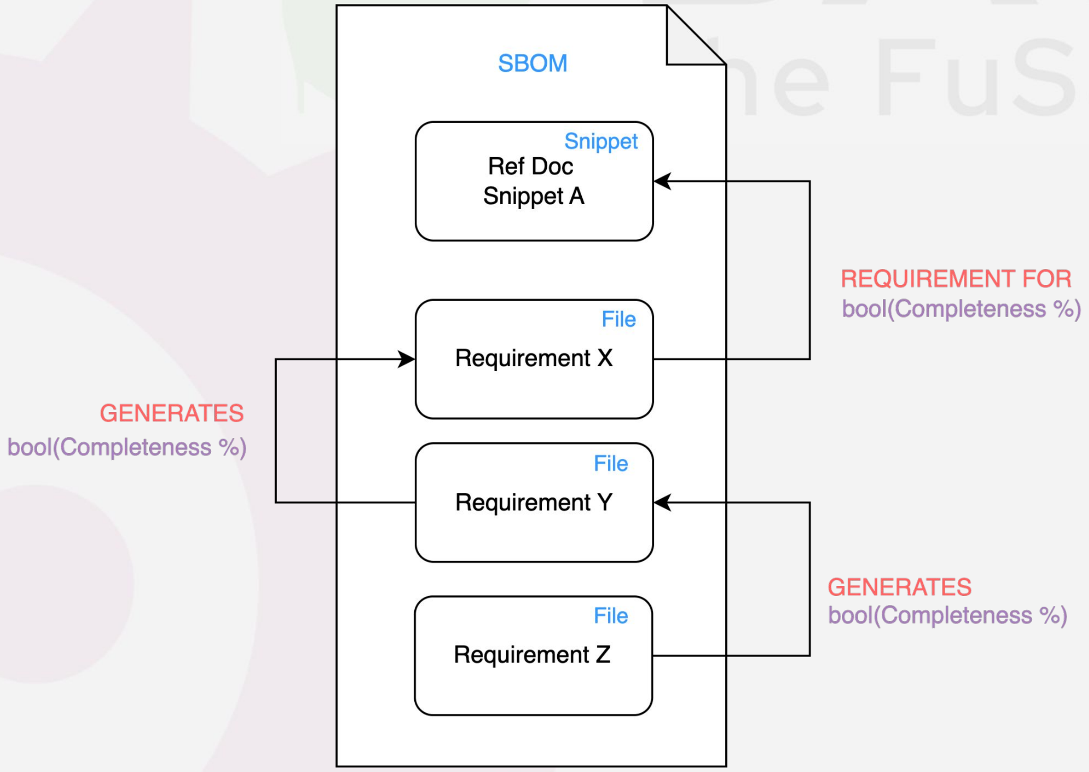


NOTE: the same traceability can be established focusing con other types of requirements

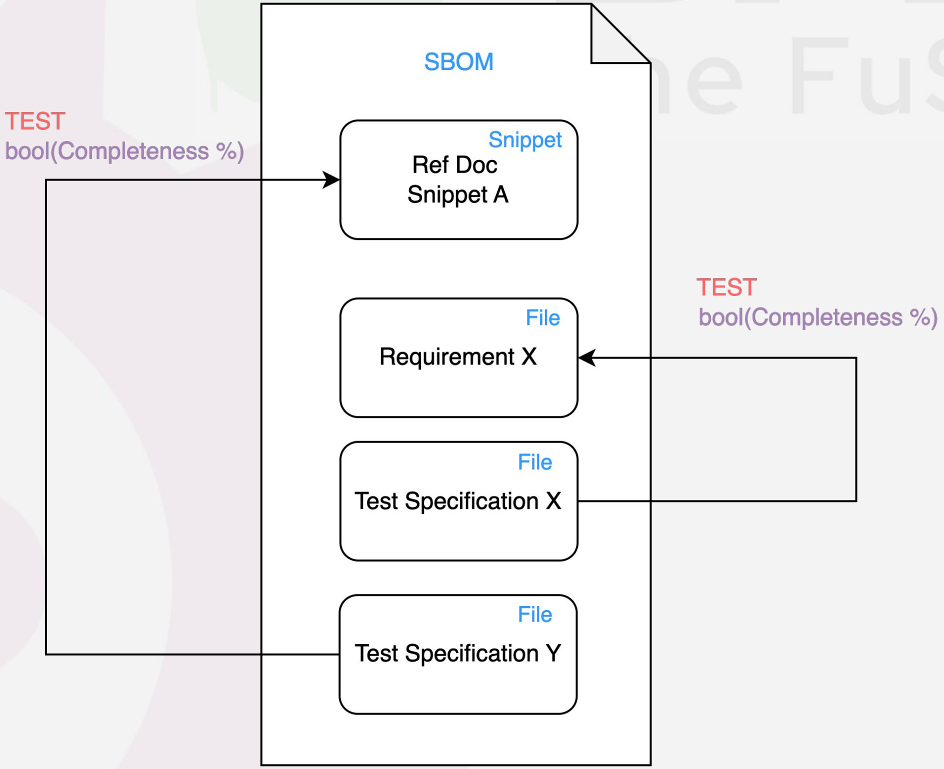
BASIL - Reference Document Snippets



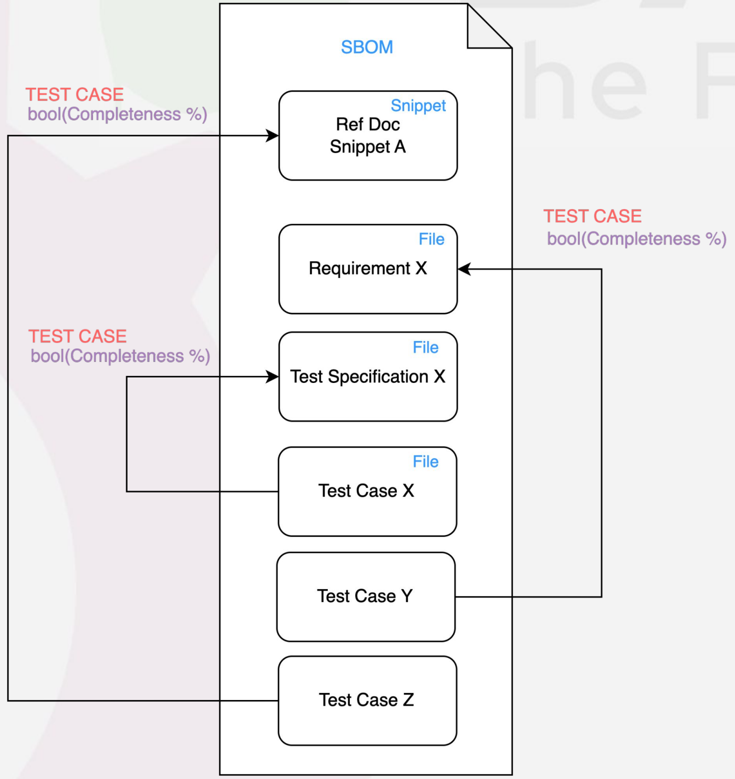
BASIL - Sw Requirements



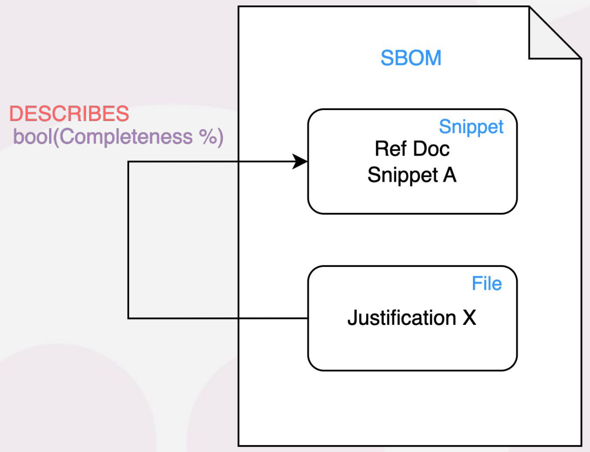
BASIL - Test Specifications

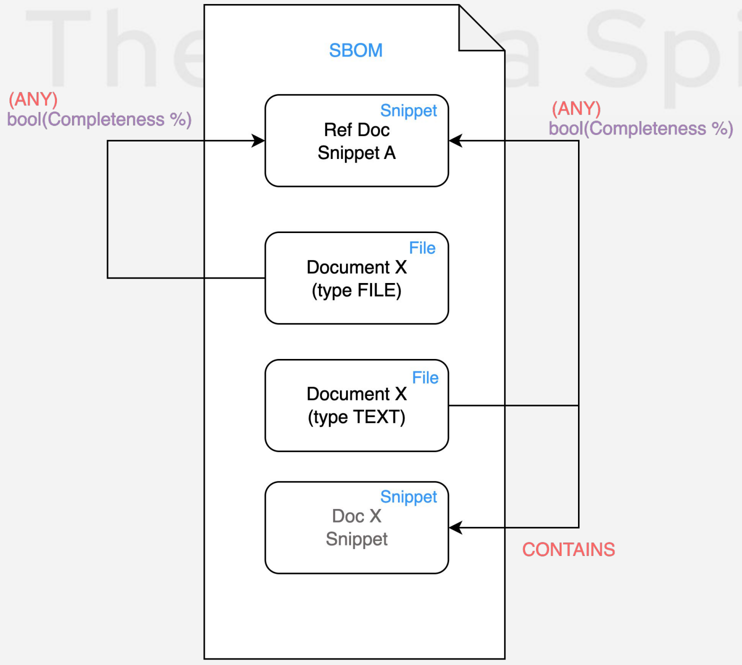


BASIL - Test Cases

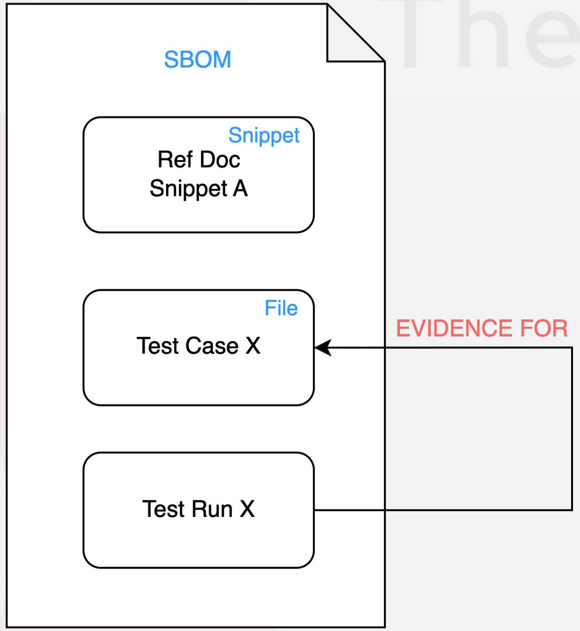


BASIL - Justifications and Documents





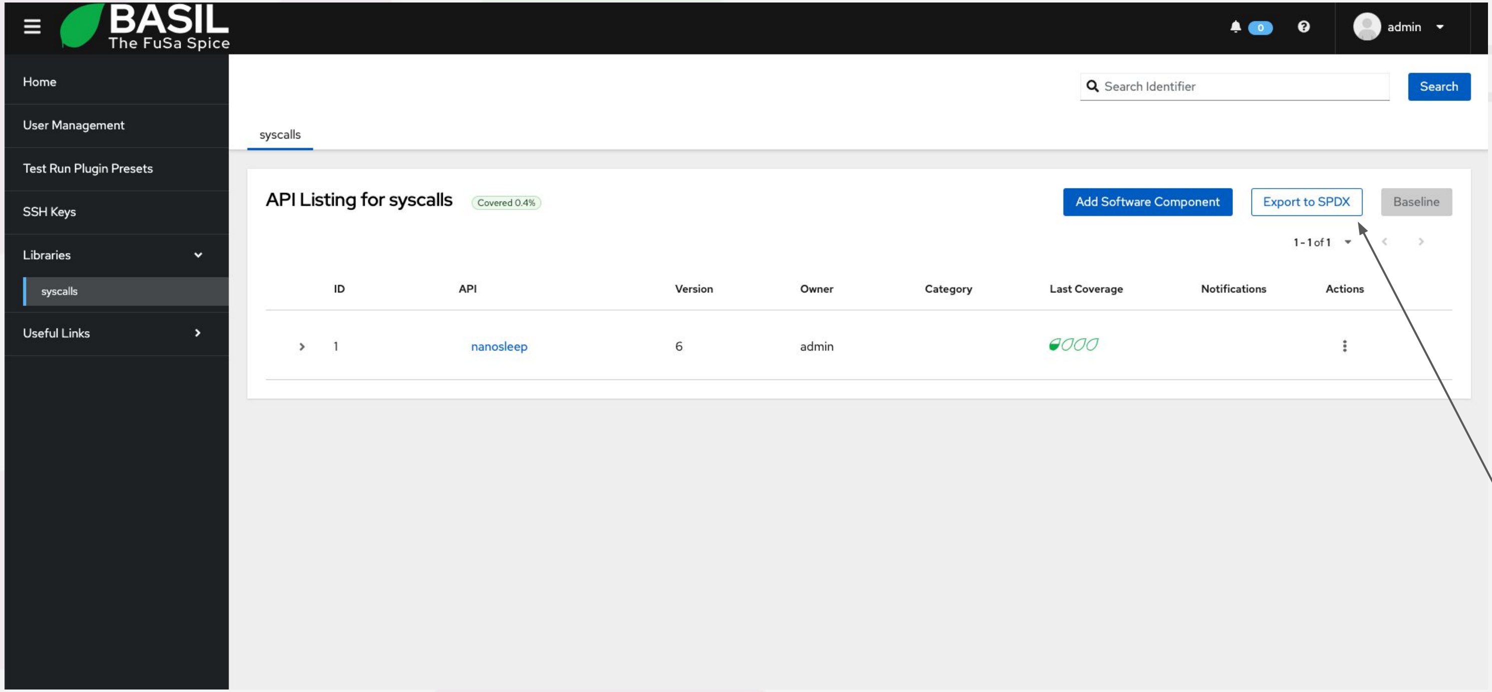
BASIL - Test Results



BASIL - Export work items data in SPDX

- Which Data
  - Stringified python dictionary of the work item
- Exported to
  - Attribution text
- Used also to
  - Calculate the hash used to populate verified_using
- Pros
  - All data collected the same way/place
  - Can iterate through the keys of the dictionary to know the data struct

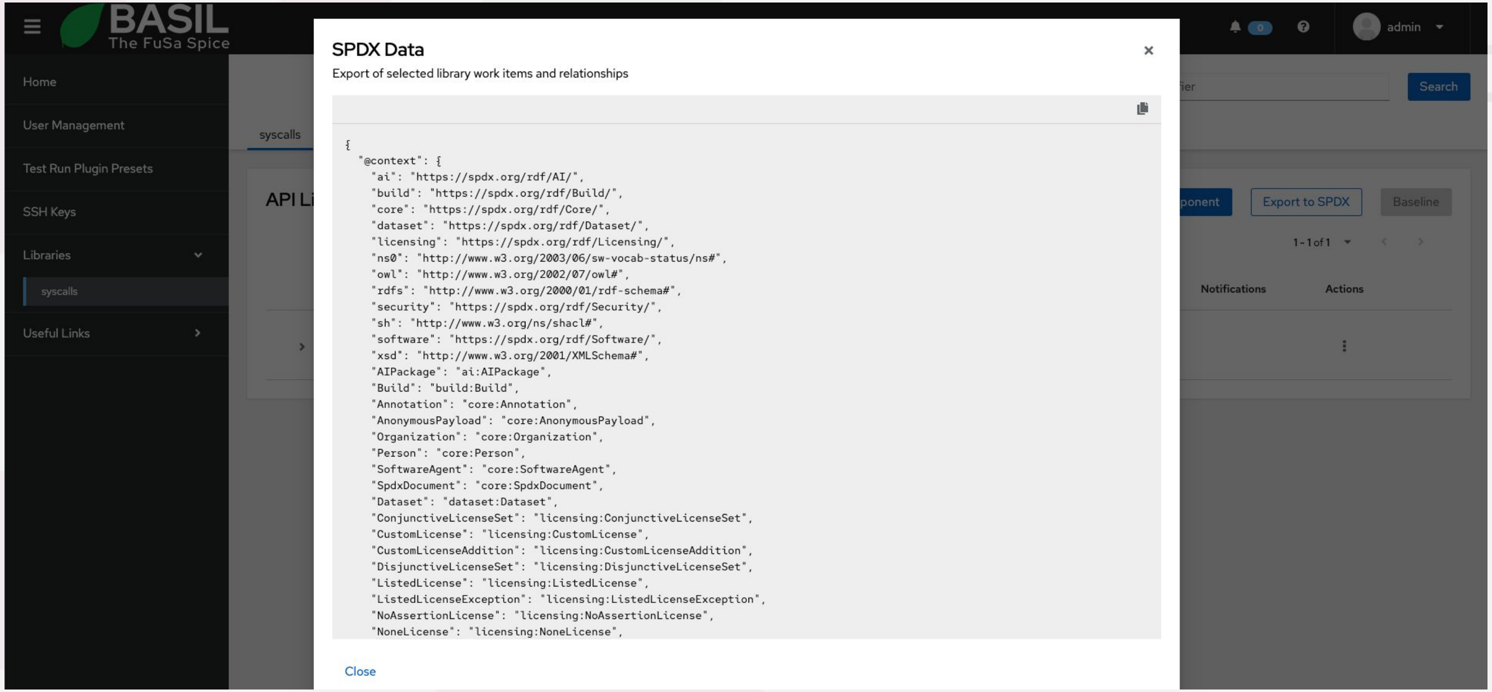
BASIL - Export library



API Listing for syscalls Covered 0.4%

	ID	API	Version	Owner	Category	Last Coverage	Notifications	Actions
›	1	nanosleep	6	admin				⋮

BASIL - Export library



SPDX Data

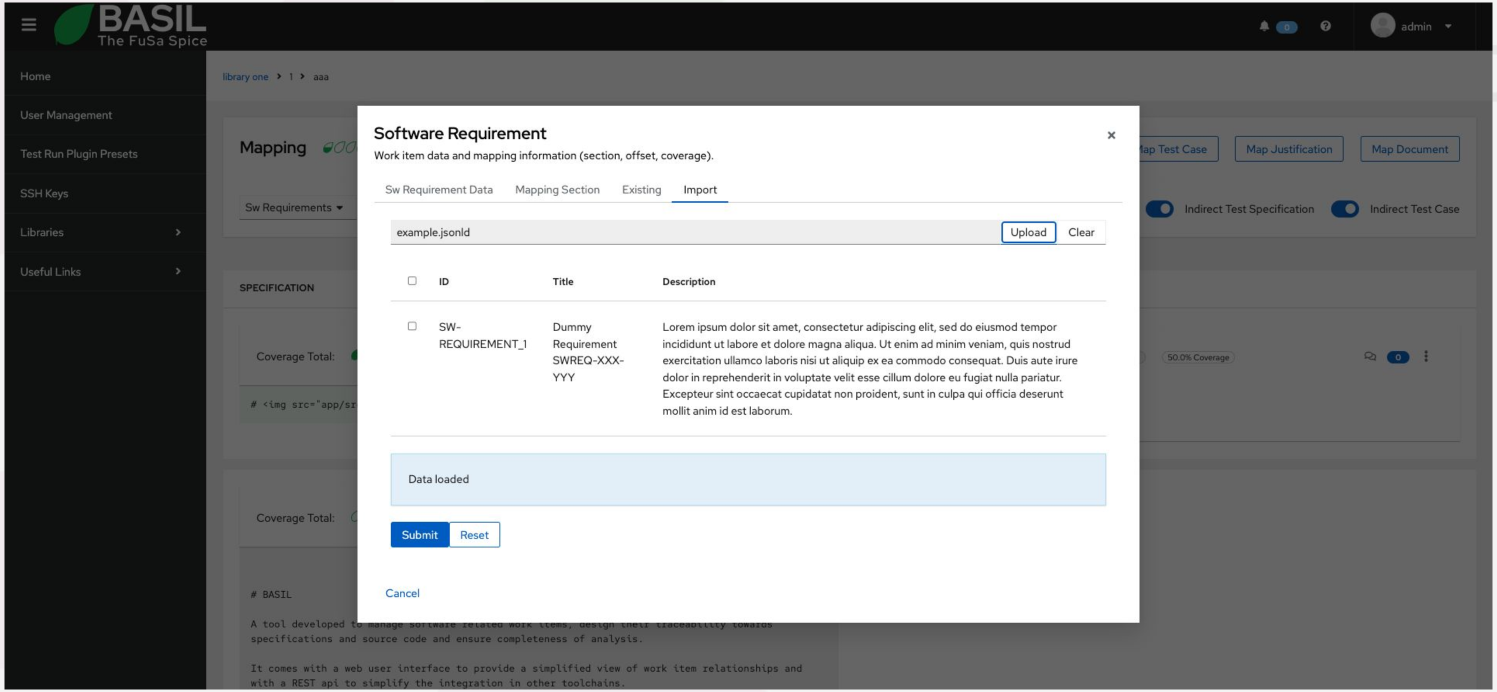
Export of selected library work items and relationships

```
{
  "@context": {
    "ai": "https://spdx.org/rdf/AI/",
    "build": "https://spdx.org/rdf/Build/",
    "core": "https://spdx.org/rdf/Core/",
    "dataset": "https://spdx.org/rdf/Dataset/",
    "licensing": "https://spdx.org/rdf/Licensing/",
    "ns0": "http://www.w3.org/2003/06/sw-vocab-status/ns#",
    "owl": "http://www.w3.org/2002/07/owl#",
    "rdfs": "http://www.w3.org/2000/01/rdf-schema#",
    "security": "https://spdx.org/rdf/Security/",
    "sh": "http://www.w3.org/ns/shacl#",
    "software": "https://spdx.org/rdf/Software/",
    "xsd": "http://www.w3.org/2001/XMLSchema#",
    "AIPackage": "ai:AIPackage",
    "Build": "build:Build",
    "Annotation": "core:Annotation",
    "AnonymousPayload": "core:AnonymousPayload",
    "Organization": "core:Organization",
    "Person": "core:Person",
    "SoftwareAgent": "core:SoftwareAgent",
    "SpdxDocument": "core:SpdxDocument",
    "Dataset": "dataset:Dataset",
    "ConjunctiveLicenseSet": "licensing:ConjunctiveLicenseSet",
    "CustomLicense": "licensing:CustomLicense",
    "CustomLicenseAddition": "licensing:CustomLicenseAddition",
    "DisjunctiveLicenseSet": "licensing:DisjunctiveLicenseSet",
    "ListedLicense": "licensing:ListedLicense",
    "ListedLicenseException": "licensing:ListedLicenseException",
    "NoAssertionLicense": "licensing:NoAssertionLicense",
    "NoneLicense": "licensing:NoneLicense",
```

BASIL - Import sw requirements data in SPDX

- Filtering the @graph
  - @type == File
  - summary == 'Software Requirement'
- Import work item data from
  - Attribution text
- User can select which one to import (backend is using spdx_id)

BASIL - Import Software Requirements



Software Requirement

Work item data and mapping information (section, offset, coverage).

Sw Requirement Data | Mapping Section | Existing | Import

example.jsonld — Upload — Clear

☐	ID	Title	Description
☐	SW-REQUIREMENT_1	Dummy Requirement SWREQ-XXX-YYY	Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed do eiusmod tempor incididunt ut labore et dolore magna aliqua. Ut enim ad minim veniam, quis nostrud exercitation ullamco laboris nisi ut aliquip ex ea commodo consequat. Duis aute irure dolor in reprehenderit in voluptate velit esse cillum dolore eu fugiat nulla pariatur. Excepteur sint occaecat cupidatat non proident, sunt in culpa qui officia deserunt mollit anim id est laborum.

Data loaded

Submit — Reset

Cancel

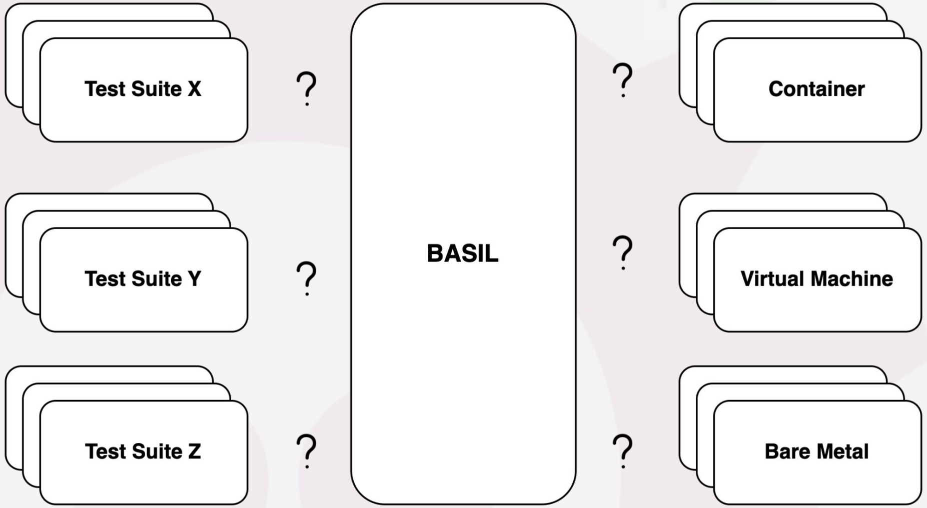
```
# <img src="app/sr
```

```
# BASIL

A tool developed to manage software related work items, design their traceability towards
specifications and source code and ensure completeness of analysis.

It comes with a web user interface to provide a simplified view of work item relationships and
with a REST api to simplify the integration in other toolchains.
```

BASIL Embedded Test Infrastructure



tmt (Test Management Tool)

Python project that uses **fmf** metadata file (yaml) to abstract test case, test plans and user stories.

Can provision different test environments.

BASIL Plugin based Test Infrastructure

Test Infrastructure	Trigger and Trace	Trace pre existing runs	Test Infrastructure	BASIL Version
tmt	✅	❌	Embedded	>= 1.4
Gitlab CI	✅	✅	External	>= 1.5
Github Actions	✅	✅	External	>= 1.5
KernelCI	❌	✅	External	>= 1.5
Testing Farm	✅	❌	External	>= 1.5

BASIL - roadmap

- Import Software Requirements from BASIL export file #82 - ✅
- Import Software Requirements from BASIL export file documentation #86
- Hierarchical Document Mapping #81
- Import Software Requirements from other tools #83
- Extend the traceability to
  - Test Run Configuration
  - Bugs, Fixes
  - Document (TEXT) Snippet

Questions?

Mine

- Which SBOM should collect Test Cases, Test Results, Bugs, MR/PR? (Runtime SBOM?)
- There is a standard on where to put custom work item data in spdx tool?

Luigi Pellecchia
Principal Software Quality Engineer - Red Hat

Thanks

Luigi Pellecchia
Principal Software Quality Engineer - Red Hat

https://github.com/elisa-tech/BASIL