Safety Analysis Approach

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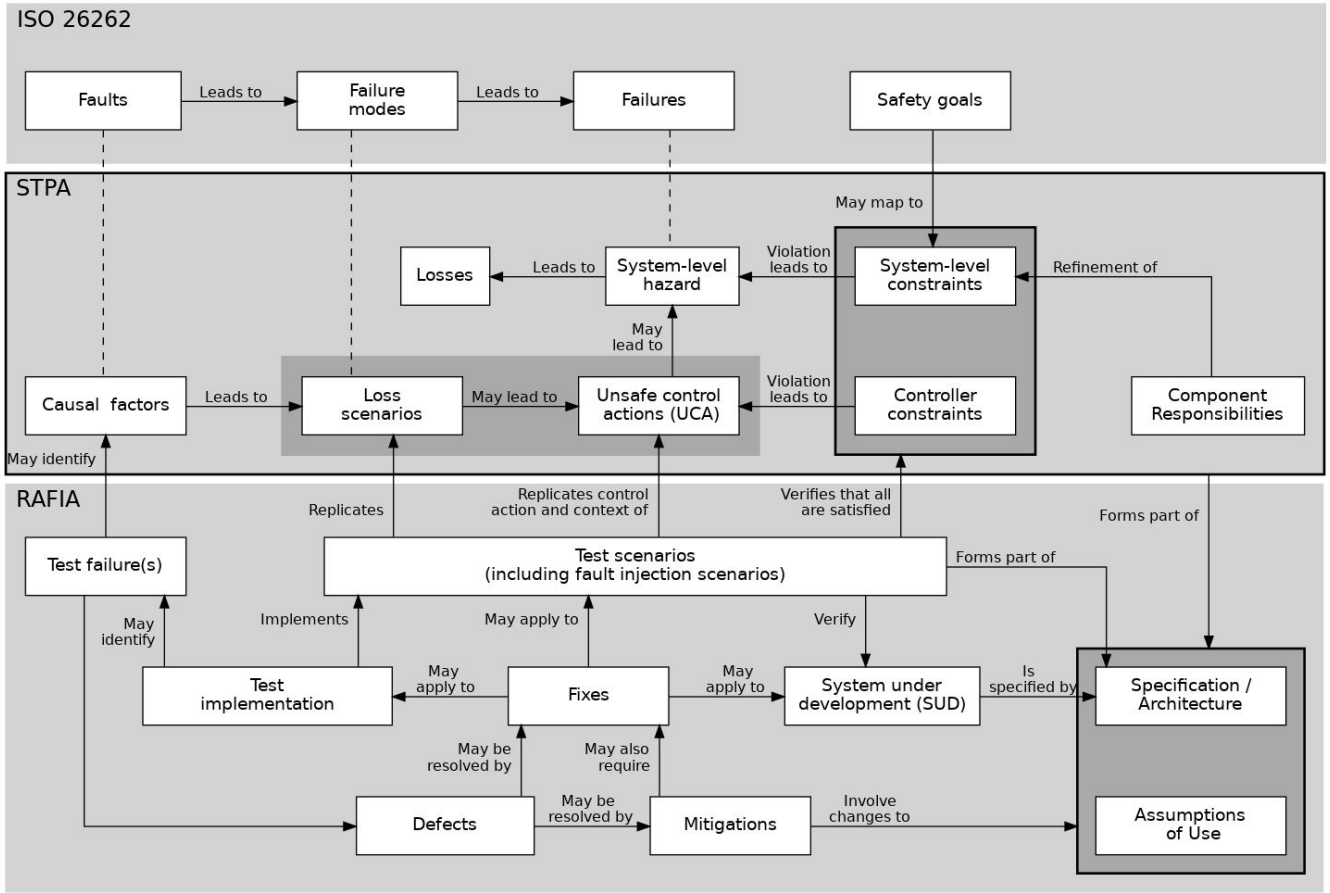
Background

- Safety as a system property
  - Achieving safety goals depends on many components working in concert
  - Focus on component-level properties can mean that problems are missed or discovered late
  - Incompatible assumptions for ‘safe’ components lead to integration problems and recalls
- Open source software does not follow the standards
  - Evidence of good engineering practice, but projects are organised on diverse principles
  - Often value breadth and immediacy of use, rapid iteration and adaptability
  - Formal requirements and designs specifications are frequently absent
- Increasing use of complex software in safety-related systems
  - Makes use of ‘traditional’ methods infeasible
    - Predicated on small, purpose-built and exhaustively-specified software components
  - Requires ongoing maintenance of software and both build and runtime dependencies
  - Demands greater focus on system integration and verification

RAFIA: Risk Analysis, Fault Injection and Automation

- Software engineering process developed by Codethink to address these challenges
  - Introduced and discussed at previous ELISA workshops
    - https://elisaworkshopmay2021.sched.com/event/j3T7
    - https://elisaworkshopspring2022.sched.com/event/za1z
- Risk analysis using STPA to describe, explore and verify system design
  - Requirements defined by STPA *system-level* and *controller constraints*
  - Test cases derived from *unsafe control actions* and *loss scenarios*
- Automated construction and system-level testing to verify requirements
  - Including soak and stress testing to identify unspecified behaviour
- Fault injection to confirm that tests *and* system-level safety mechanisms work
  - Break software to force *loss scenarios* and verify that tests fail and report results as expected
  - Use to extend test scenarios to verify *exception handling* behaviour and *safety mechanisms*
- Iteration and refinement based on the results of these processes

RAFIA



STPA and RAFIA concepts and their relationship to ISO 26262 terms

ELISA WORKSHOPS

ELISA Safety Analysis: Objectives

- Applying the *Risk Analysis* approach of RAFIA
  - Examining example roles of Linux as part of a safety-related system
- Specify a *system context*
  - Concrete system design, or an abstraction representing a class of system designs
  - May have both safety and non-safety functions
- Specify *safety goals* for the system and context
  - System-level criteria that must be satisfied to avoid specific negative outcomes
  - May relate to more than one safety function
- Specify *safety responsibilities* for components of the system
  - Behaviour or properties required to avoid violating the safety goals for the system context
  - Focus is on responsibilities assigned to Linux, but specifying our assumptions about the assumed responsibilities of other components is just as important

ELISA Safety Analysis: Motivations

- Establish and document a common process
  - For use across ELISA and by other FOSS projects
  - Provide a *lingua franca* for recording safety analysis to aid component integration
- Example analyses as building blocks
  - Common system context definitions and approach
  - Accumulate analysis focusing on different aspects of Linux
  - Build on and refine earlier analysis
- Basis for cooperation between working groups
  - LFSCS - investigation of Linux features to support analysis
  - Medical Devices - analysis of OpenAPS using STPA
  - Safety Architecture - STPA-like analysis of kernel
  - Automotive - Telltale use case
  - Systems - define a common reference system context for analyses?
  - Aerospace - define a use case as a future subject of analysis?
  - Tools - identify supporting tools?

OSEP: Initial work

- Call for input and participation on ELISA blog
  - https://elisa.tech/blog/2023/05/17/elisa-project-safety-analysis-approach-using-stpa/
- Plan to document process and examples in OSEP GitHub repository
  - Structured and peer-reviewed documentation in the main repository
  - Informal journal of discussions in parallel in Wiki
    - https://github.com/elisa-tech/wg-osep/wiki/Telltale-Safety-Analysis
- Starting to apply the approach to Automotive WG use case
  - https://github.com/elisa-tech/wg-osep/pull/18
  - Would welcome input and participation from the Automotive WG!

Discussion and next steps

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