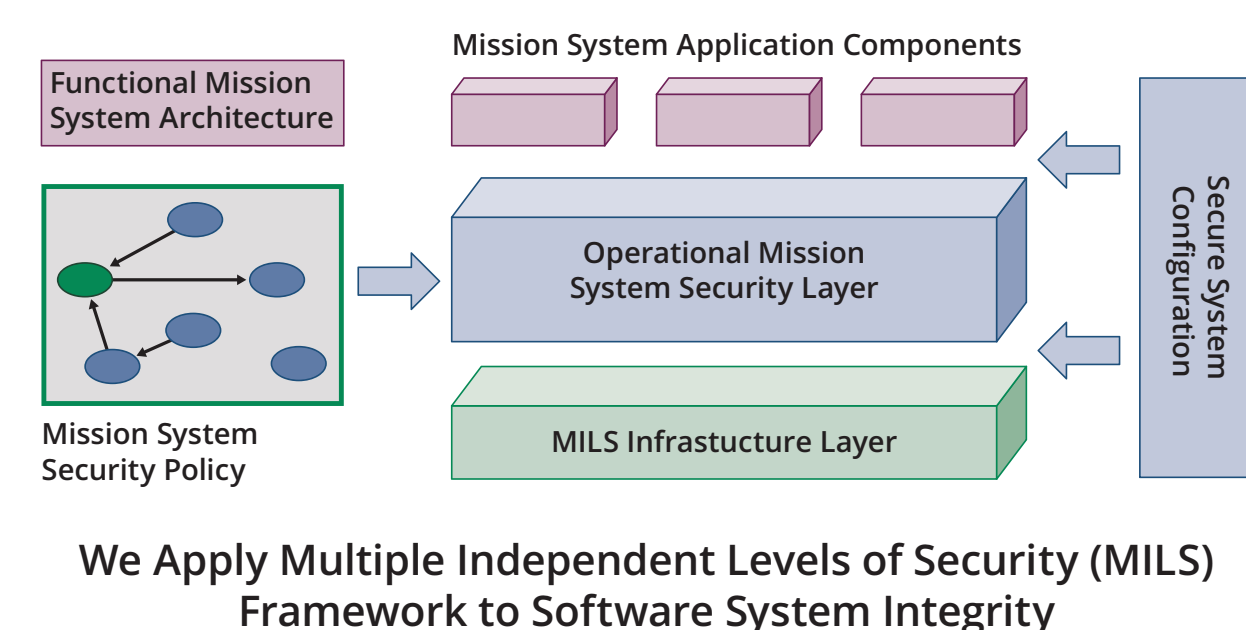


Automated Assurance of Security Policy Enforcement

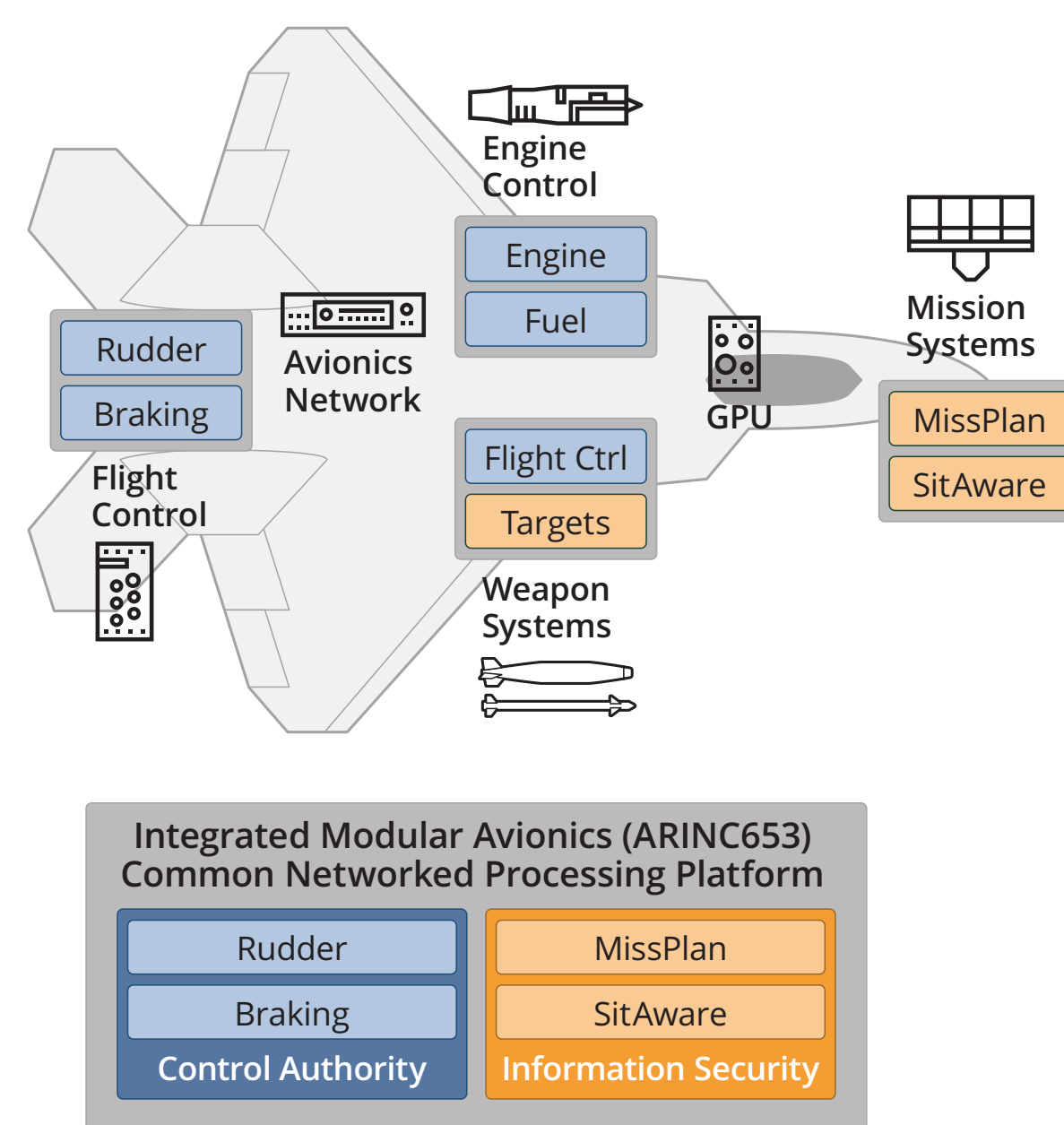
As safety-critical systems have become more connected, “closed” system assumptions are no longer valid and security threats affect safe system operation.

Virtual system integration and analysis of embedded software systems has been embraced by the safety-critical system community to address exponential growth in system development cost due to increased interaction complexity and mismatched assumptions in embedded software systems.

In this project, we demonstrate how the virtual system integration approach can be extended to address security concerns at the architecture level to complement code level security analysis.



Security Challenges as Safety-critical Systems Become Connected

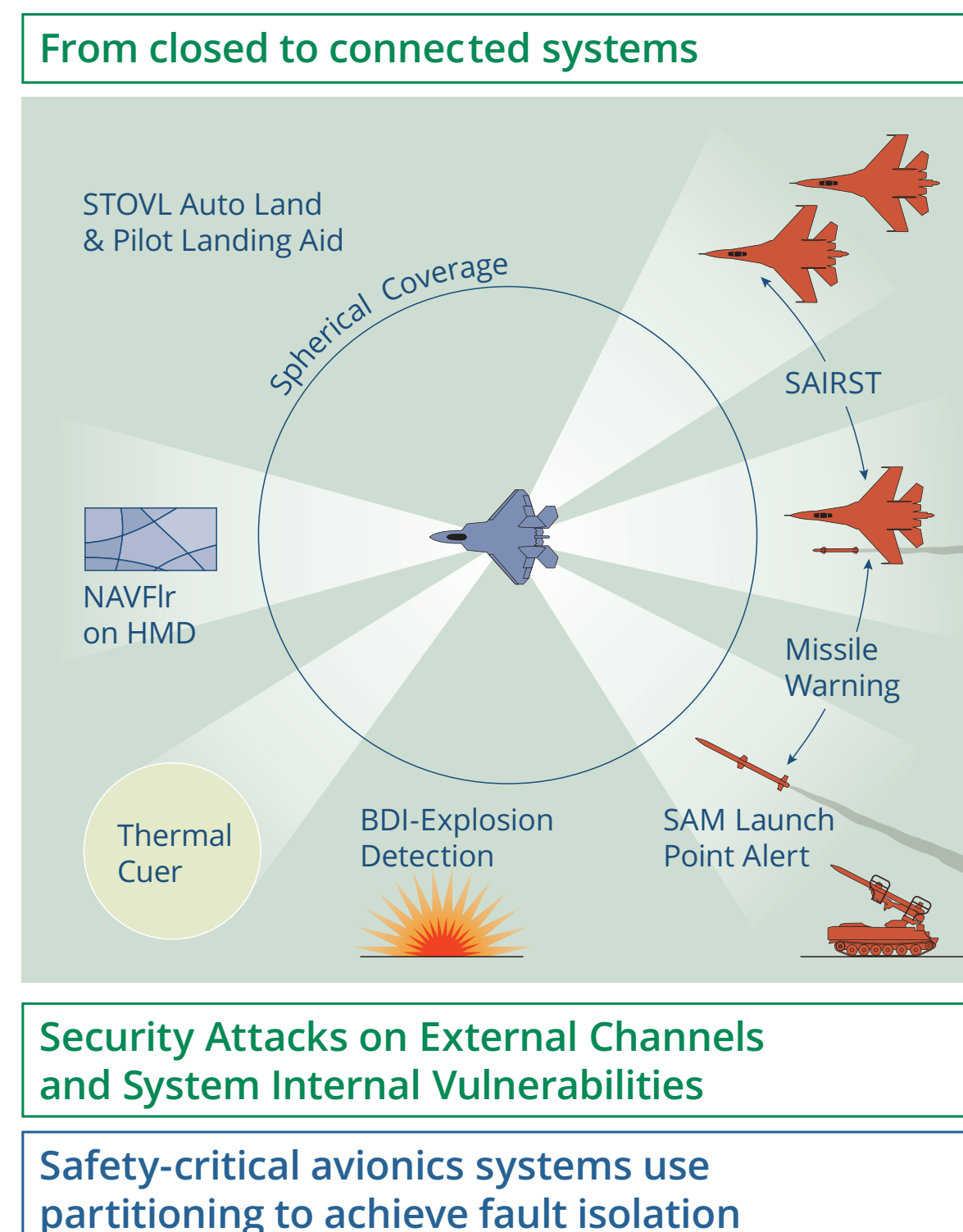
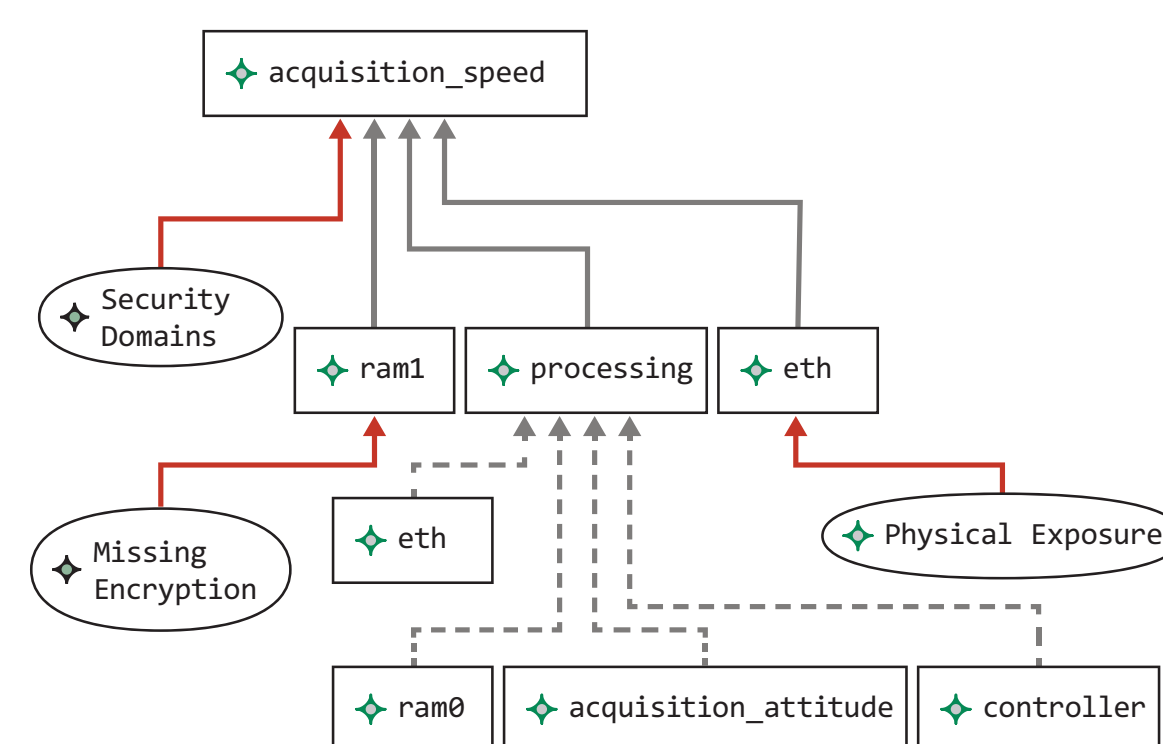


Our focus is on security policy specification and its enforcement

We utilize the SAE International Architecture Analysis & Design Language (AADL) industry standard to model and analyze embedded software systems. It includes an annex for fault modeling and analysis.

We analyze security policy specifications for consistency and gaps in flow constraints and isolation requirements.

We analyze the software system architecture for potential enforcement vulnerabilities due to incorrect deployment of security mechanisms.



Automated Assurance through Continuous Analysis of Potential Architecture Level Security Policy and Enforcement Vulnerabilities

We leverage the Architecture-Led Incremental System Assurance (ALISA) capability in the Open Source AADL Tool Environment (OSATE).

Executable verification plans identify how potential architecture level security vulnerabilities are addressed through model-based analysis.

- MILS-R0:** Components sharing a bus should have the same security level.
- MILS-R1:** Inter-communicating components should have the same security level.
- MILS-R2:** Processes with different security levels use isolated memory regions.
- MILS-R3:** Components associated with identical processing resources share the same security level.
- MILS-R4:** Threads inside the same process share the same security levels.
- CWE-131:** Incorrect calculation of buffer size.
- CWE-311:** Missing encryption of sensitive data.
- CWE-805:** Buffer Access with Incorrect Length Value.

- System case JeepSecurityCase: (S94 F9 T0 E0 tbd0 ELO TS0)
 - Model JeepSecurityCase.JeepSecurityPlan(integration.attack)
 - Claim MILS_R5(integration.attack): MILS_R5: All non-verified com
 - Claim CWE131(integration.attack): CWE131: incorrect calc
 - Evidence vaCWE131a (203 ms): check connections for c
 - Evidence vaCWE131b (252 ms): Check that timing requ
 - Claim CWE311(integration.attack): CWE311: Missing Encry
 - Claim CWE805(integration.attack): CWE805: Buffer Access
 - Subsystem cellular: (S4 F2 T0 E0 tbd0 ELO TS0)
 - Claim MILS_R0(cellular): MILS_R0: Components sharing
 - Claim MILS_R1(cellular): R1: Components with different
 - Claim MILS_R5(cellular): MILS_R5: All non-verified com
 - Claim CWE311(cellular): CWE311: Missing Encryption o
 - Claim CWE805(cellular): CWE805: Buffer Access with In
 - Claim MILS_R6(cellular): R6: All communication that ar
 - Subsystem internet: (S5 F1 T0 E0 tbd0 ELO TS0)
 - Claim MILS_R0(internet): MILS_R0: Components sharing
 - Claim MILS_R1(internet): R1: Components with differen
 - Claim MILS_R5(internet): MILS_R5: All non-verified com
 - Claim CWE311(internet): CWE311: Missing Encryption c
 - Claim CWE805(internet): CWE805: Buffer Access with Ir
 - Claim MILS_R6(internet): R6: All communication that ar
 - Subsystem router_cel: (S3 F0 T0 E0 tbd0 ELO TS0)
 - Subsystem car: (S62 F6 T0 E0 tbd0 ELO TS0)
 - Subsystem attacker_cel: (S5 F0 T0 E0 tbd0 ELO TS0)
 - Subsystem attacker_wifi: (S5 F0 T0 E0 tbd0 ELO TS0)
 - Subsystem attacker_internet: (S5 F0 T0 E0 tbd0 ELO TS0)

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