Automated Assurance of Security Policy Enforcement

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Software Security is Putting Our Lives at Risk!

Jeep hack (July 2015)

- Remote control of a car, 1.4M recalls
- https://www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/

Airplanes, ATC control system (2012)

- No encryption or authentication between planes and ground stations
- Sniffing packets or injecting forged data (what is the impact with the autopilot?)
- https://www.youtube.com/watch?v=CXv1j3GbgLk

Medical devices

- Remote access to infusion pumps without authentication
- Hundreds of devices are **insecure by design**
- https://securityintelligence.com/news/do-no-harm-medical-device-vulnerabilities-put-patients-at-risk/

Towards an AADL Security Modeling Guide

Security is being a lot of attention recently – for a reason!

- **Fact**: Our world is becoming software intensive. It is everywhere.
- **Consequence**: It introduces vulnerabilities.
- **Impact**: New threats that needs to be handled

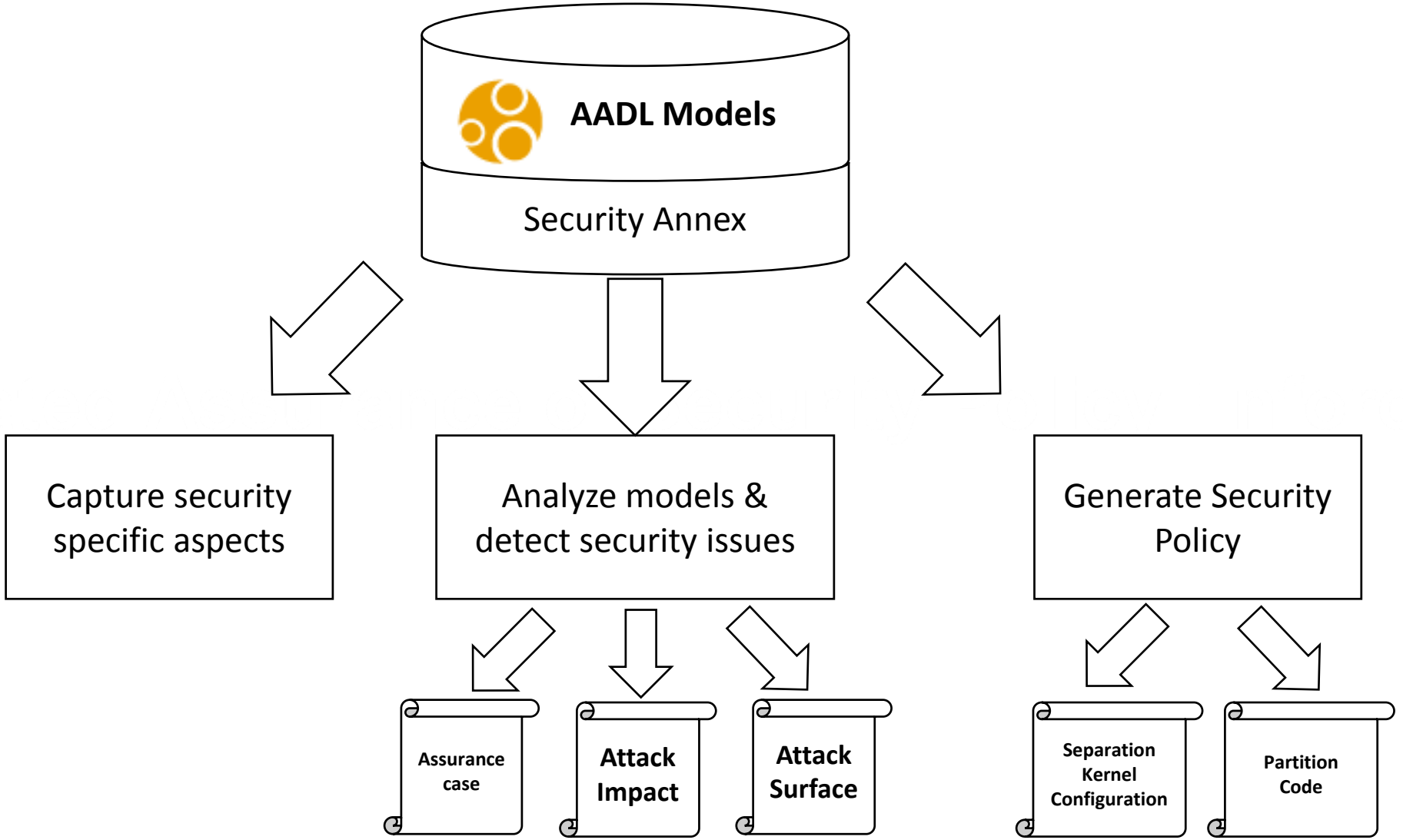
Security is not only a matter of code

- Vulnerabilities are related to software architecture
- E.g.: data protection, isolation of resources

Extend AADL with security design rules and analysis methods

- Detect common vulnerabilities in existing AADL models
- Automatically generate reports: attack surface, attack impact, etc.
- Analyze their **impact and propagation** through the architecture

Objective of an AADL Modeling Annex



The AADL Modeling Annex Document

AADL standardization document

- Modeling rules to specify architectural security aspects
- New AADL property set, compatible with existing models
- Integration with the Error-Model Annex (AADL EMV2)

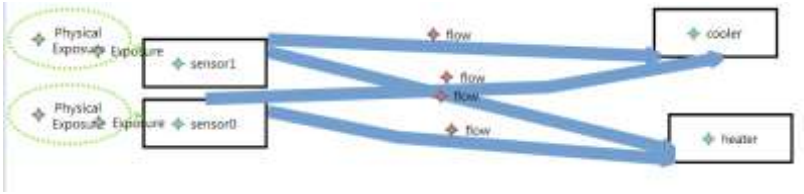
Capture security information in AADL

- Physical exposure
- Logical and physical isolation
- Encryption mechanism (algorithms, keys)
- Authentication (IP, user/pass)
- Security verification and trust

AADL-Based Security Analysis Tools

Detect vulnerabilities and their impact through the architecture

- Combine AADL semantics (e.g. connections, bindings) with security extensions
- Provide ability to analyze how architecture layers (e.g. functions, platform) impact system security

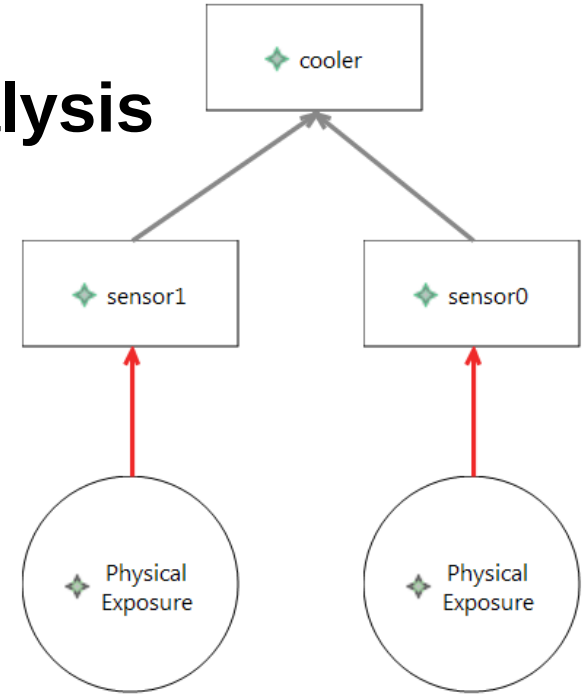


Attack Impact – similar to Failure Mode and Effects Analysis

- Visualize vulnerabilities and their propagations
- Implemented as a directed graph

Attack Tree – similar to Fault-Tree for security

- Visualize contributors (components, vulnerabilities) to a successful attack
- Implemented as a tree, vulnerabilities being leaves



Making an Impact

Integration of security annex into AADL standard

- Standardize modeling rules into the SAE AS2-C AADL standard

Demonstrate design and analysis capabilities

- Reproduce Jeep hack and analyze other automotive systems
- Application for the avionics domains (SAVI project)
- Collaboration with the Open-Source MILS working group

Publishing Security Analysis Tools

- Open Source license
- Available on SEI GitHub account

Ongoing Work

Code Generation of secure systems from AADL models

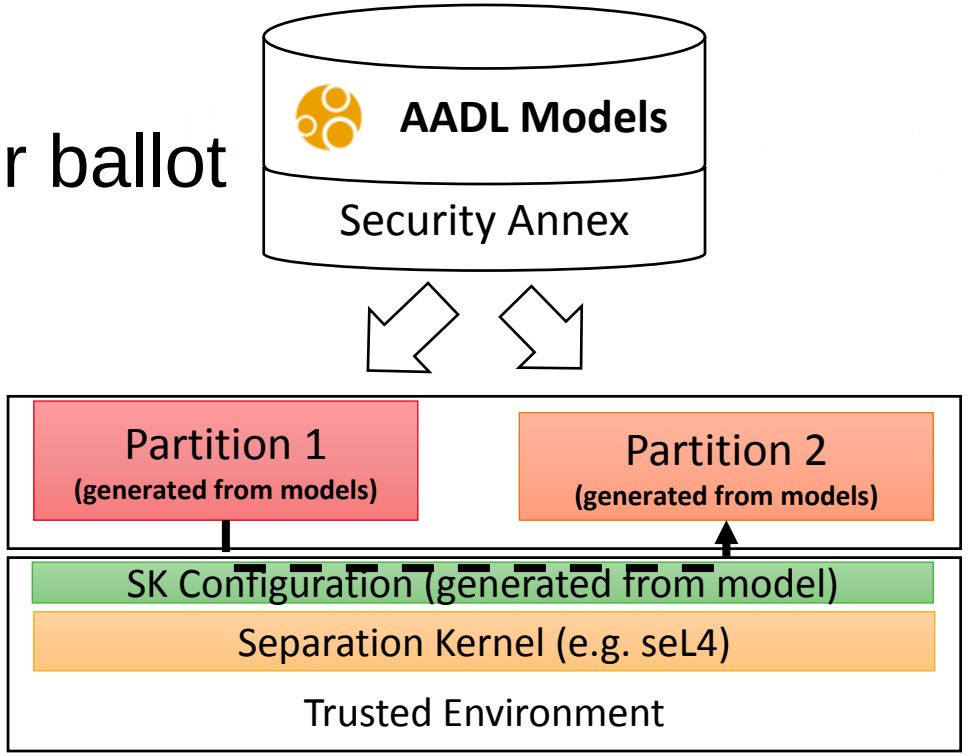
- Automatically generate security policies from AADL models
- Demonstrate using an autonomous system: create & deploy an autonomous drone on top of the formally verified seL4 kernel

Standardization activities

- Finalize the AADL annex and submit it for ballot

Dissemination activities

- SEI webinar on secure architecture design and analysis
- Academics papers and tutorials



Conclusion

Last year focus: Security Design Rules and Analysis Methods

- Integration into the AADL standard
- Security analysis (Attack Impact and Attack Tree) tools released
- Application to safety-critical systems (automotive and avionics)

Next year focus: Code Generation and Dissemination

- Auto-production of secure code from validated models
- Use the formally verified seL4 kernel (HACMS project)
- Application to an autonomous vehicle

Thank You !

AADL Tutorial at EsWeek (October 2016)

- https://github.com/osate/examples/tree/master/esweek2016-tutorial

AADL Security Analysis Tools on GitHub

- Open-source (BSD), integrated with OSATE (http://osate.org)
- https://github.com/cmu-sei/AASPE

SEI Blog: Improve System and Software Security with AADL

- https://insights.sei.cmu.edu/sei_blog/2016/02/improving-system-and-software-security-with-aadl.html