Security Annex Update

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Objectives

Get consensus on proceeding with developing a first draft SAE standard formatted document

Discuss

- Authorization
- Action/Command Protection
- Modeling Specialized Architectures
- Vulnerability/Threat Analysis

and other topics as appropriate.

Outline

Security Policies and Requirements

- Documentation
- Verification

Security Protections

- Information/Data Protection
- Access Control and Protection
- Action/Command Protection

Security Architectures

- Specialized Architectures
- Cross Domain Solutions

Analyzing Vulnerabilities/Threats

Example Models and Analyses

E_Enabled Aircraft Models

- Commercial Transport Aircraft
- Mission-Specific Aircraft (reconnaissance)

and ALISA Security Analysis Examples are available at

https://github.com/osate/examples.git

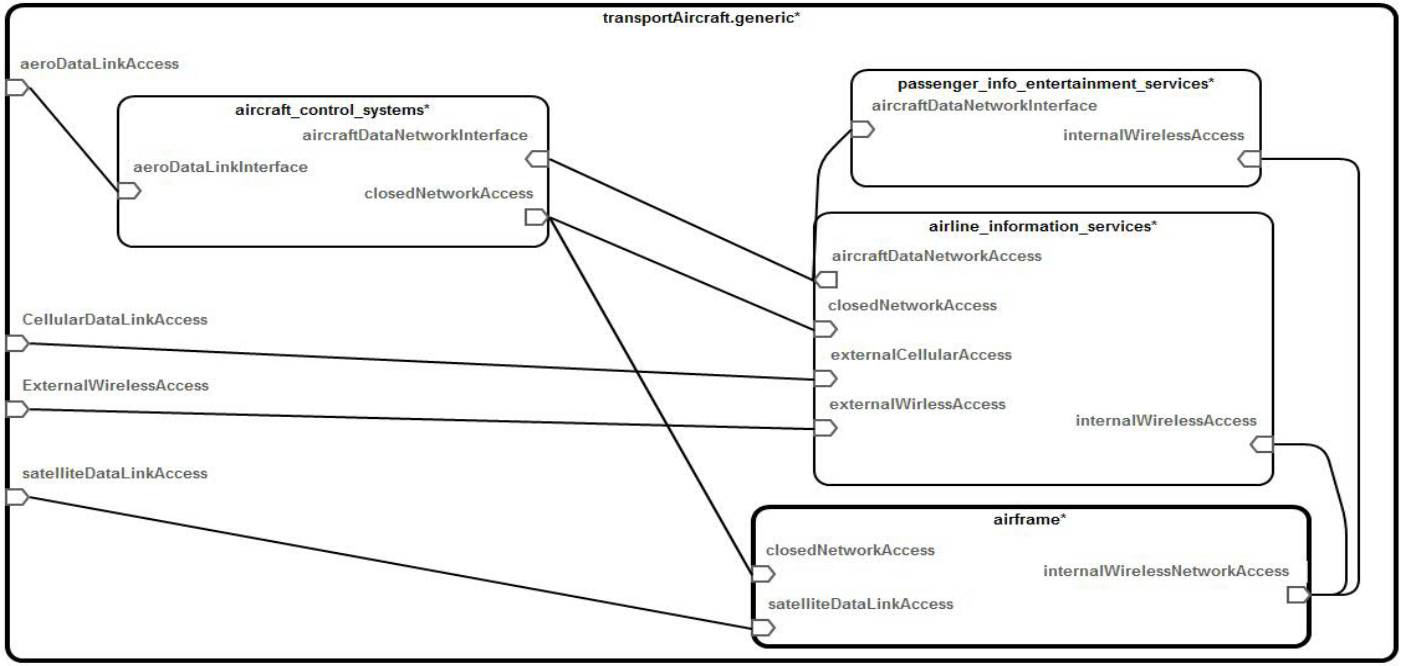
Supporting verification library files are available at

https://github.com/reteprelief/isse

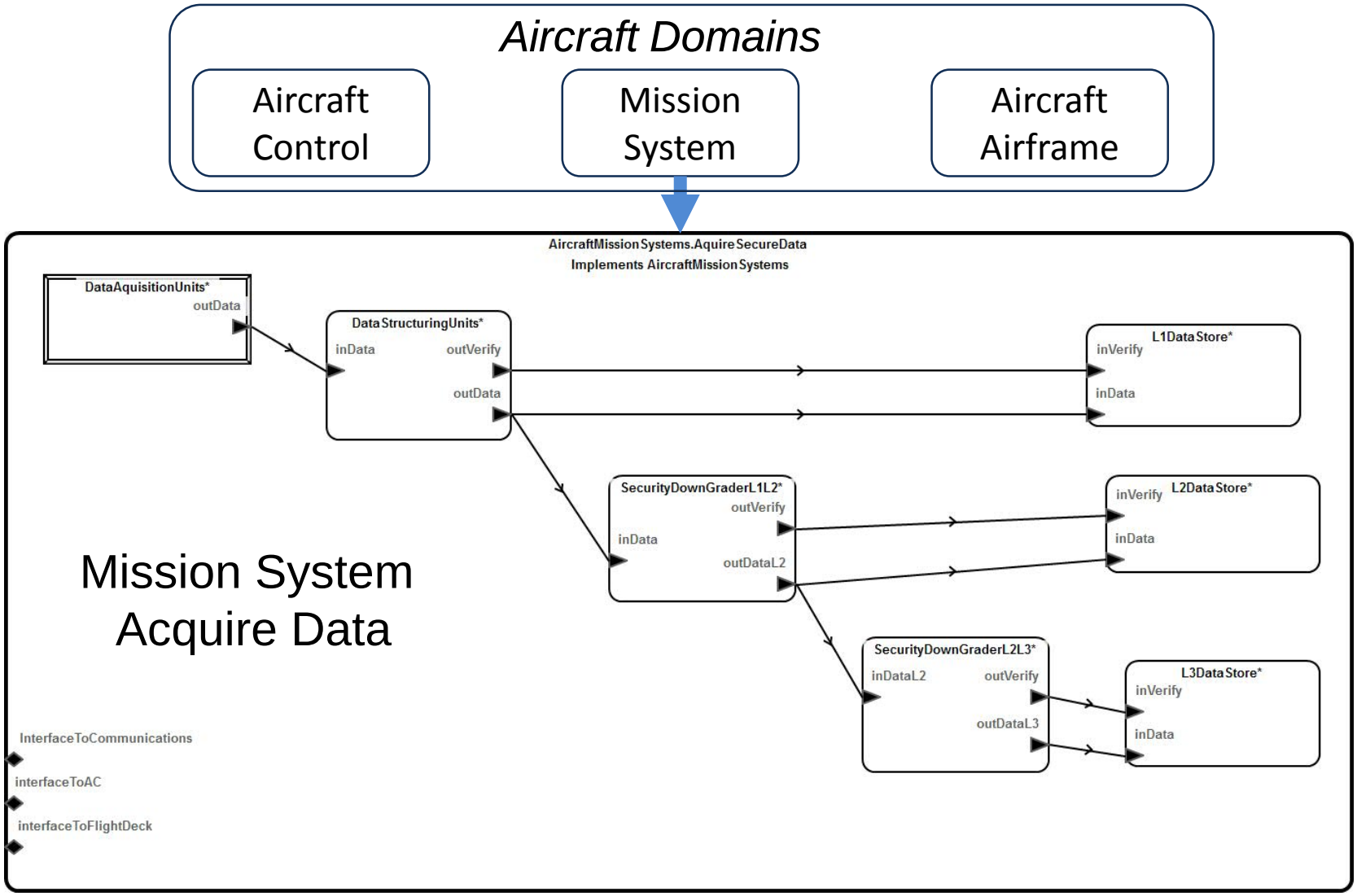
E-Enabled Transport Aircraft

Aircraft Domains

- Aircraft Control (AC)
- Airline Information Services (AIS)
- Passenger Information & Entertainment Services (PIES)



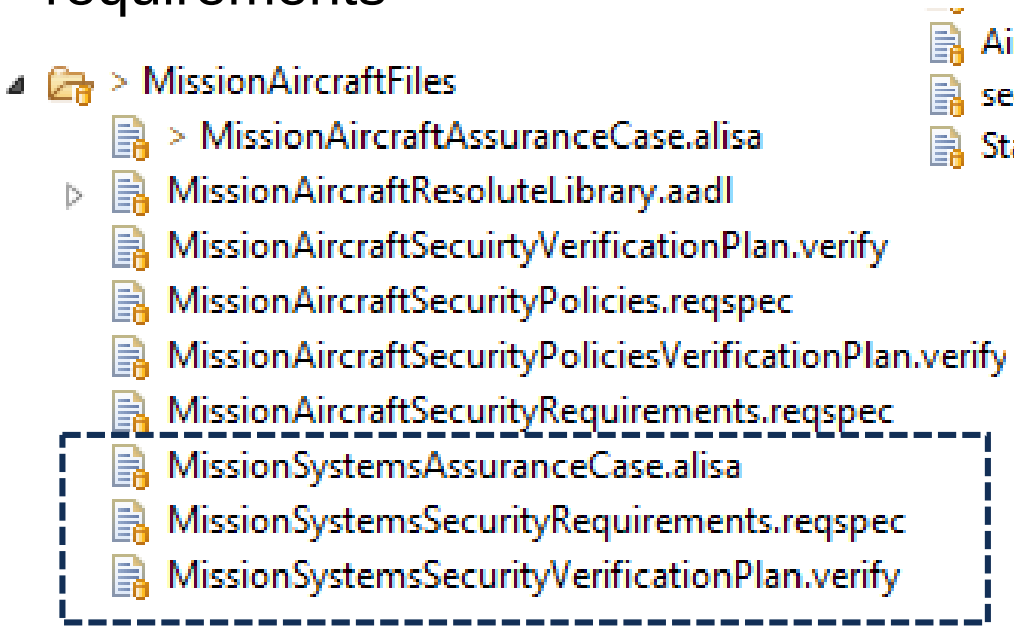
Mission-Specific Aircraft

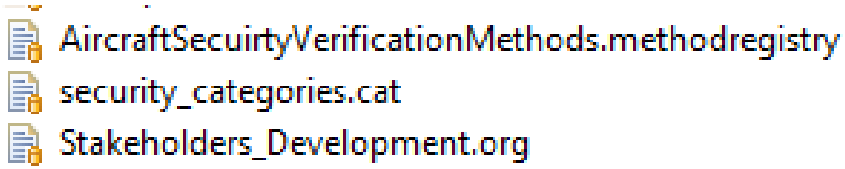


Security Policies and Requirements Overview - 1

Documentation of policies and requirements.

- ReqSpec of ALISA
- Naming convention to distinguish between policies and requirements





Security Policies and Requirements Overview - 2

Policies and Requirements Verification – ALISA

- Verification plans (.verify)
- Assurance cases (.alisa)
- Results (.assure)

MissionSystemsAssuranceCase.alisa
MissionSystemsSecurityRequirements.reqspec
MissionSystemsSecurityVerificationPlan.verify

> assure
> MissionAircraftAssuranceCase.assure
> MissionSystemsAssuranceCase.assure
> TransportAircraftAssuranceCase.assure

Methods

- Resolute
- Java

AircraftSecuirtyVerificationMethods.methodregistry

Security Policy and Requirements Examples

```
requirement SecureMissionDataPolicy: "All mission data must be secured to levels as
defined by DoD security classifications and other mission-specific classifications
of that data."

[

description "All data must be secured. This includes standard DoD classifications and related
security procedures as well as mission-specific classifications and related
procedures."

]

requirement SecureMissionDataClassify: "All mission data must be classified using
DoD or mission-specific classifications."

[

decomposes MissionAircraftSecurityPolicies.AccessControlPolicy
MissionAircraftSecurityPolicies.SecureMissionDataPolicy

]
```

ALISA Verification Plan and Assurance Case

```
claim SecretLevel : "Checks that the information security level is secret"
[
activities
check: AircraftSecurityVerificationMethods.VerifySecret ()
]

claim ExposedEncryption :"check encryption on exposed components"
[
activities
checkencrypt: SecurityVerificationMethods.ExposedConnectionEncrypted()
]
```

```
assurance case MissionSystemsAssuranceCase for
AircraftMissionSystems_pkg::AircraftMissionSystems
[
   assurance plan MissionSystemsSecurityVerificationPlan for
AircraftMissionSystems_pkg::AircraftMissionSystems.AquireSecureData [
assure MissionSystemsSecurityVerificationPlan
assure subsystem DataAquisitionUnits
description "This is the plan for the mission systems including data acquisition,
classification, and downgrading."]

]
```

ALISA Analysis

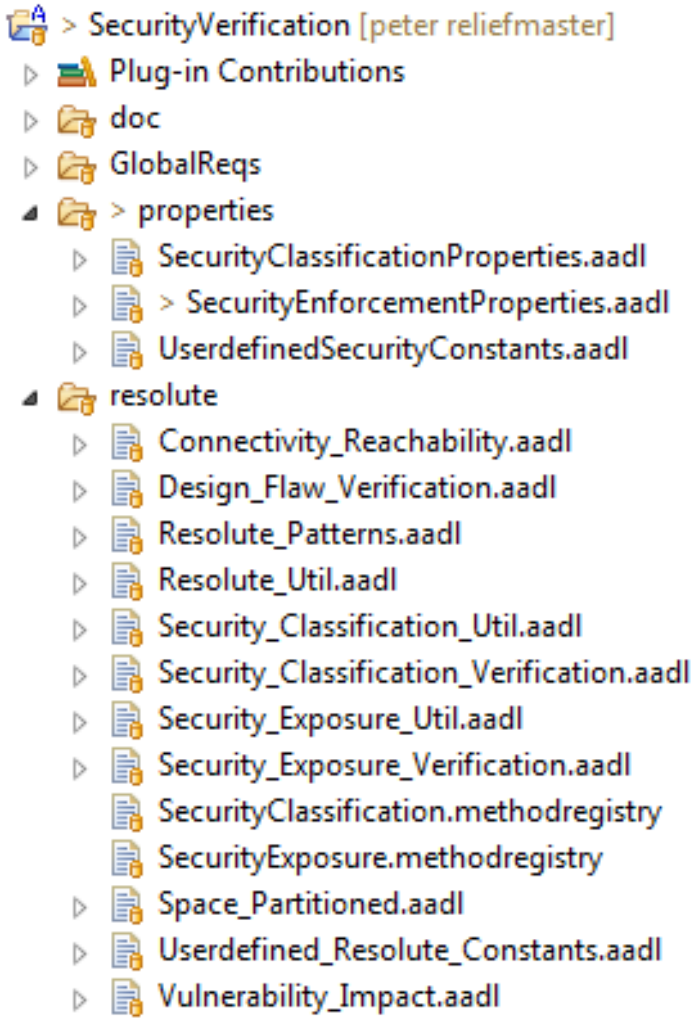
An assurance case output for the Mission System.

Problems | Properties | AADL Property Values | Assurance View

Assurance C...	Filter
TransportAir	<all>
MissionAircr	<all>
MissionSyste	<all>

Evidence	Pass	Fail	Error	Todo	Description
Case MissionSystemsAssuranceCase	2	2			
Plan MissionSystemsSecurityVerificationPlan(AircraftMissionSystems.AquireSecureData)	2	2			
Claim missionDataEncrypt		1			All mission data must be encrypted using AES-256 encryption.
Evidence VerifyEncryption		1			XXX[F]
Claim missionDataHighLevel	1				Raw mission data must be encrypted to the most secure level.
Claim SecretLevel		1			Component must have secret information security level.
Evidence check		1			component AircraftMissionSystems_AquireSecureData_Instance : A...
Claim ExposedEncryption(connection1)	1				All exposed connections must have encryption

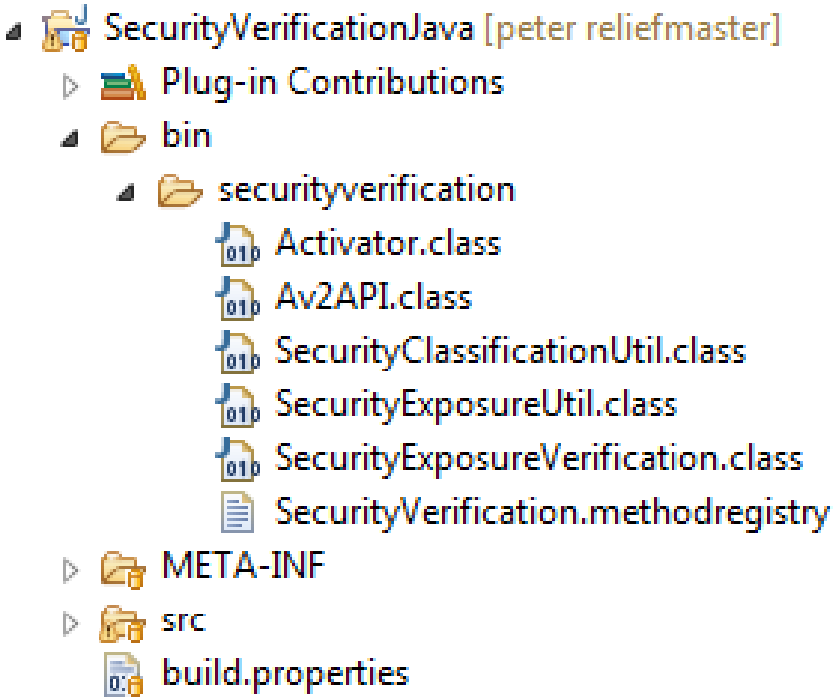
Resolute Security Verification



Resolute Security

- Properties
- Claims
- Functions
- Utilities

Java Security Verification – Methods, Classes, Utilities




```
verification methods
SecurityVerificationMethods [
method
ExposedComponentConnectionsEncrypted
(component)report: "Check that all
connections owned by a given component
are encrypted if going over exposed
physical components" [
java
securityverification.SecurityExposureVeri
fication.allExposedConnectionsEncrypted
]
method
ExposedConnectionEncrypted(connection)
boolean: "Check that all connections
owned by a given component are encrypted
if going over exposed physical
components" [
java
securityverification.SecurityExposureVeri
fication.exposedConnectionEncrypted
    ]
]
```

Outline

Policies and Requirements

- Documentation
- Verification

Protections

- Information/Data Protection
- Access Control and Protection
  - Authentication
  - Authorization
- Action/Command Protection

Security Architectures

- Specialized architectures
- Cross Domain Solutions

Analyzing Vulnerabilities/Threats

Protections - Overview

Information/Data Protection

- Properties
- Verification ALISA, Resolute, Java

Access Control and Protection

- Authentication
  - Properties
  - Verification methods (ALISA – claim, activity, methods)
  - Resolute claims
- Authorization
  - Properties
  - (work in progress)

Action/Command Protection (work in progress)

Information/Data Protection

Security Classification and Levels as Properties

- Information security levels (Principal and Caveat)
- Primary and Secondary Access Classifications
  - Each has Principal Classification and Caveat

Encryption as Properties

- Encryption Scheme (Encryption Type)

Protected Containment

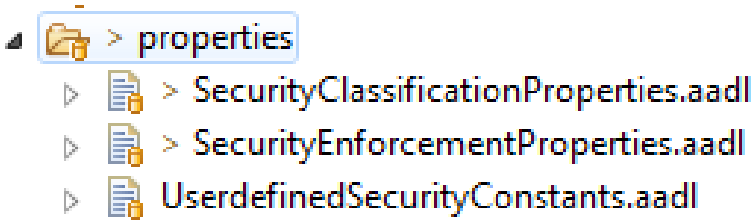
Verification

- ALISA assurance cases and methods
- Resolute
- Java

Information/Data Protection Properties

Classification Properties

- data
- access components



Encryption

- properties
- data, connections, and hardware (storage and transmission)
  - connection and supporting hardware must be consistent
- key management

Verification

- Resolute security functions and claims in libraries
- Java methods

Information/Data Protection - Security Classifications

Information security level properties include a primary security classification (e.g. Top Secret, Secret, Confidential) and a caveat (e.g. control markings) statement.

```
Information_Security_Level: aadlstring applies to (all);
Information_Security_Caveat: aadlstring applies to (all);
```

There is a primary and secondary security clearance. Each includes a principal security classification (e.g. Top Secret, Secret, Confidential) and an supplemental statement (e.g. specialized authorizations or restrictions).

```
Security_Clearance: aadlstring applies to (system, device);
Security_Clearance_Supplement: aadlstring applies to (system, device);
Secondary_Security_Clearance: aadlstring applies to (system, process,
thread, data, processor, memory);
Secondary_Security_Clearance_Supplement: aadlstring applies to (system,
process, thread, data, processor, memory);
```

Information/Data Protection – Encryption Properties

```
encryption: aadlboolean applies to (all);

encryption_scheme : Security_Properties::encryption_type applies to (all);
encryption_type : type record
(
encryption_form : enumeration (symmetric, asymmetric, hybrid,
                   authenticated_encryption, no_encryption, AEAD);

algorithm : enumeration (tripledes, des, rsa, blowfish, twofish, aes, D_H,
ECC, clear);

private_key: aadlstring;  -- maybe better as an integer?
public_key: aadlstring;
single_key: aadlstring;
authentication_type: enumeration (EtM, MtE, E_and_M, AEAD);
MAC_key : aadlstring;
```

Information/Data Protection - Analysis

Resolute and Java Verification Libraries

```
method ForallConnectionsAcrossProcessorsConnectionIsEncrypted (root):
"For all connections: encrypted when across different processors" [
resolute
Security_Exposure_Verification.Security_Exposure_Verification_public.Resolute.Resolute.forall_conne
ctions_across_processors_connection_is_encrypted
]
```

- securityverification
  - Activator.class
  - Av2API.class
  - SecurityClassificationUtil.class
  - SecurityExposureUtil.class
  - SecurityExposureVerification.class
  - SecurityVerification.methodregistry

- resolute
  - Connectivity_Reachability.aadl
  - Design_Flaw_Verification.aadl
  - Resolute_Patterns.aadl
  - Resolute_Util.aadl
  - Security_Classification_Util.aadl
  - Security_Classification_Verification.aadl
  - Security_Exposure_Util.aadl
  - Security_Exposure_Verification.aadl
  - SecurityClassification.methodregistry
  - SecurityExposure.methodregistry
  - Space_Partitioned.aadl
  - Userdefined_Resolute_Constants.aadl
  - Vulnerability_Impact.aadl

Access Control and Protection

Authentication

```
Authenticator: aadlboolean applies to (all);

AuthenticationTypeAccess: enumeration (NoValue, single_password,
smart_card,  ip_addr, two_factor, multi_layered, bio_metric) applies to
(all);

AuthenticationProtocol: enumeration (NoValue, cert_services, EAP, PAP,
SPAP, CHAP, MS_CHAP, Radius, IAS, Kerberos, SSL, NTLM)  applies to (all);
```

Authorization Protocols

- establish access rights and actions of an authenticated entity

Work in Progress

Should we include public key infrastructure (PKI) - public key and certificate modeling? Perhaps only internal key management within an architecture?

Action/Command Protection

Model, assess, and assure access control of execution of actions/commands

- Assess Control Flow
- Trusted Execution Instances

This may require modeling of control flow including subprograms.
Not sure how much is applicable within an architecture model.

Work in Progress

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  - Authorization
- Action/Command Protection

Security Architectures

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- Cross Domain Solutions

Analyzing Vulnerabilities/Threats

Security Architectures

Modeling Specialized Architectures

- AADL core modeling capabilities and ARINC 653
- Potentially specialized security constructs
- Example models
  - MILS and Cross Domain
  - Protected Containment
  - Secure Virtualization
  - Secure kernels
  - Cross Domain Solutions

Intent is to develop examples and guidance for modeling and analysis utilizing core AADL and properties, etc. of the security annex.

Analyzing Security Architectures

- ALISA, Resolute
- Adventium MILS Tool

Work in Progress

Vulnerability/Treat Analysis

Vulnerability - system state that could be exploited by an attacker involving

- Design
- Procedures and Operation
- Constraints

AADL

- Vulnerabilities Property
- EMV2

Architecture Analysis may be layered

- Attack surfaces
- Within the system architecture
  - access paths/traces
  - attack trees
  - chain of events

Should we consider a state machine based model for analysis of vulnerabilities, their impacts, attack surfaces?

Work in Progress

Vulnerabilities Property

```
Vulnerabilities: list of record(
Name : aadlstring; -- short identification phrase for the vulnerability
Description : aadlstring;     -- description of the vulnerability
CrossReference : aadlstring;  -- cross reference to an external document
Phases : list of aadlstring;  -- operational phases in which the vulnerability may be
exploited
Environment : aadlstring;     -- description of operational environment
Threat : aadlstring;          -- description of the circumstances under
                                 which the vulnerability may be exploited
Loss : aadlstring; -- description of the loss that may result
Risk : aadlstring;  -- description of risk
Severity : EMV2::SeverityRange ; -- actual risk as severity
Likelihood : EMV2::LikelihoodLabels;    -- actual risk as likelihood/probability
Probability: EMV2::ProbabilityRange;    -- probability of a exploitation (i.e. realization
of loss)
 AcceptableSeverity : EMV2::SeverityRange; -- acceptable risk as severity
  AcceptableLikelihood : EMV2::LikelihoodLabels; --acceptable risk as likelihood/probability
  DevelopmentAssuranceLevel : EMV2::DALLabels;     -- level of rigor in development
   VerificationMethod : aadlstring; -- verification method to address the vulnerability or
threat
   SecurityReport : aadlstring;     -- analysis/assessment of hazard
   Comment : aadlstring;
          )  applies to (all);
```

Summary

Develop a Draft Annex Standard Document

- Description and Guidelines
- Representative Examples (E-Enable Aircraft Models)
- Libraries of claims and methods

Annex Summary

- Core AADL with security-specific properties
- ALISA for policies and requirements capture
- Verification of requirements and other analyses with
  - ALISA assurance cases (Resolute and Java based methods)
  - Resolute Claims
- Custom plugins (modeling and analysis) - TBD