Security Annex Update

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Security Annex

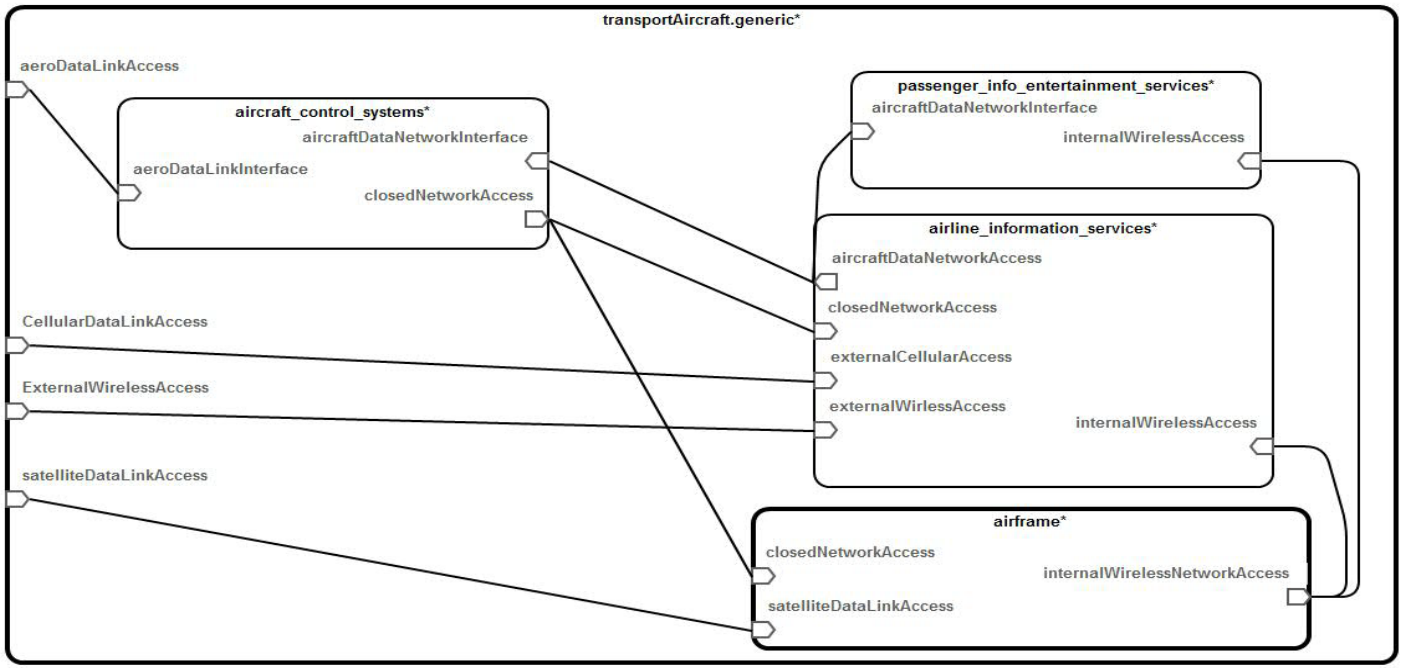
The AADL security annex provides guidance and support for security modeling and analysis throughout the system lifecycle.

- Policies and Requirements
  - Documentation
  - Verification
- Protections
  - Access Control and Protection
  - Information/Data Protection
  - Action/Command Protection
- Architectures
  - Specialized architectures
  - Secure kernels
- Vulnerabilities
- Threats/Attacks

E-Enabled Transport Aircraft

Aircraft Domains

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



Security Policies and Requirements Documentation

Documentation of policies, requirements.

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

TransportAircraftSecuirtyPolicies.reqspec

AircraftControlSecurityReqs.reqspec

Security policies considered as general statements (rules) about security attributes of a system

Security requirements considered statements that define the functions and capabilities that must exist to provide security

Examples – Security Policies

File: *TransportAircraftSecuirtyPolicies.reqspec*

```
system requirements TransportAircraftSystemSecurityPolicies : "System-Wide Security Policies"
for TransportAircraftSystem_Generic::AirTransportOperationalSystem.multipassenger
[
description "These are the high level (system) security policies for the Aircraft."
requirement Secuirty:  "System Security must be provided"
[
description "Security protections that meets FAA aircraft security and
flight worthiness certification standards must be provided ."
]
requirement MasterSecurityPolicy: "A Master System Security Policy must be developed and
certified."
[
description "A master system security policy document must be developed and certified by all of the
agencies and organizations involved in flight certification of the aircraft."
]
requirement  AccessControlPolicy: "Security Controlled Access to all Aircraft Systems and Resources
must be provided."
[
description "Access to all Aircraft operational and maintenance Systems and Resources shall be
permitted
only by authorized personnel."
development stakeholder DevelopmentTeam.PrincipalEngineer DevelopmentTeam.SecurityEngineer
]
```

Examples – Security Requirements

File: *AircraftControlSecurityReqs.reqspec*

```
system requirements securityReqs for AircraftControl_pkg::aircraftControl.basic
[
requirement aircraftSystemsInformationSecurity: "Aircraft Systems Information
Security/Protection (ASISP) must be provided"
[
description "All aircraft control and flight information systems must have security
protection to ensure confidentiality, integrity, and availability."
]
requirement securityAccessReq:  "Access to all aircraft data must be only by authorized and
authenticated entities"
[
description "All aircraft operational and performance data systems must have security
protection to ensure access only by authorized and authenticated entities."
]
requirement communicationProtectionReq0: "All external and internal communications relating
to aircraft control and operation must be secure."
[
description "All aircraft communication systems must have security protection to ensure
access only by authorized and authenticated entities."
]
requirement  communicationProtectionReq1: "All aircraft external and internal communication
for aircraft control and flight operations must employ encryption algorithms"
  [
   description "All aircraft external and internal communication for aircraft control and
flight operations must employ encryption algorithms that meet or exceed the standards
defined in NIST publication FIPS 140-2 or any superseding document that have been released
for use."
  ]
```

Security Policies and Requirements Verification

Verification and Assurance

TransportAircraftSecurityVerificationPlan.verify

TransportAircraftSecuityVerifyMethods.methodregistry

TransportAircraftSecurityAssuranceCases.alisa

```
verification methods TransportAircraftSecurityVerifyMethods : "These are
the top-level methods.
[
method ReviewMasterSecurityPolicy (document:string) boolean: "A formal
document inspection and review"
[
manual FormalReview
description “Formal Team review of policy documentation."
]
]
```

Security Protections – Access Control and Protection

Authentication Protocols

```
authentication_type_access: enumeration (NoValue, single_password, smart_card,
ip_addr, two_factor, multi_layered, bio_metric) applies to (all);
--
--  two_factor is a subset of multi_layered but is included since it is a
prevalent multi-layered type.
--
-- The NoValue entry is used as the default in the Resolute built-in property
function,
-- i.e., property (namedelement, property, default value* )
--
authentication_protocol: 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

Information/Data Protection - Security Classifications

United States DoD and DOE classifications

```
        Security_Levels_US: type enumeration (NoValue, SSBI, SCI, SAP, Top_Secret,
Secret, Public_Trust, Confidential, Controlled_Unclassified, Unclassified,
Q_Clearance, L_Clearance);
--
-- Security level property (assumes only one level assigned and encompasses both
-- information classification as well as security clearance.
--
        Security_Level_US: Security_Properties::Security_Levels_US
        applies to (all);
--
-- The secondary security level is provided in the event of multiple clearances
-- (e.g. a clearance from two different agencies.)
--
-- No assumption is made about the relationship between the Security_Level_US
property and the Secondary_Security_Level_US.
--
-- NOTE: the resolute library does not include checks for secondary security levels.
--
        Secondary_Security_Level_US:Security_Properties::Security_Levels_US
        applies to (all);
```

Information/Data Protection - Security Analysis

Resolute security functions and claims in the Resolute annex library *Security_Resolute_Lib*

- basic set for use
- exemplars for users to develop additional functions and claims

```
has_top_secret_security (cp: component) <=
  ** " Component " cp " has Top Secret security level or clearance" **
 property (cp, Security_Properties::Security_Level_US, NoValue) = topSecret

all_subcomponents_have_secret_security(cp: component) <=
** "all subcomponents of component " cp " have secret security level." **
        forall (p: subcomponents(s)).has_secret_security (p)
-- only checks direct subcomponents of the instance; does not include
subcomponents of subcomponents

--
```

Information/Data Protection – Cryptography

From Security_Properties property set

```
        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, 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 Encryption Analysis

Example Claims from Security_Resolute_Lib

```
has_encryption (aadl1: aadl) <=
    ** "AADL element" aadl1 "has encryption" **
    has_property(aadl1, Security_Properties::encryption)
--
   has_an_encryption_scheme (aadl1: aadl) <=
   ** "AADL element "  aadl1 " has a value for encryption_scheme"
**
   has_property (aadl1,Security_Properties::encryption_scheme)

all_contained_buses_have_encryption (cp:component) <=
       ** "all buses contained in component " cp " have encryption"
**
       -- the exists claim ensures that there is one bus in cp;
      -- without this, the claim is true if there are no buses
       (exists(bx: bus).contained(bx,cp) and
       (forall( bt: bus).contained(bt,cp) and (has_encryption(bt) or
has_an_encryption_scheme(bt)))
```

Information/Data Protection
Protected Containment and Access

Secure Virtualization

- AADL core modeling capabilities
- ARINC 653

Data access control

- Authentication
- Authorization

Action/Command Protection

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

- Security kernels (e.g. seL4)
- Operating system security controls
- Specialized operating systems
- Protected Containment
- Virtual Trusted Execution Environments
- External Actions
- Virtual machines, and partitions

Security Architectures (Modeling)

Specialized Architectures

- AADL core modeling capabilities and ARINC 653
  - temporal and spatial isolation
  - potentially specialized security constructs

Secure kernels

- AADL core modeling capabilities & ARINC 653

Vulnerabilities – Documenting1

AADL 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)
```

Vulnerabilities – Documenting and Analysis

Vulnerabilities Property (continued)

```
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);
```

Analyzing Vulnerabilities

- EMV2
- Integrated security and safety analysis

Threat/Attack Modeling

Capture and analyze threat/attack models including:

- Threat models
- Attack/attacker models
- Attack surface models
- Attack trees
- Chain of events models
- Attack patterns
- Denial of Service

May not be included?

Summary

Security Property Set

Security Resolute Library

Test Cases for Claims

ALISA Exemplar Files

E-Enable Aircraft Models