The Open Source AADL Tool Environment (OSATE)

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Feb 2019
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OSATE

Eclipse-based Open Source AADL Tool Environment (OSATE)

- No cost license under EPL license
- Download site: osate.org
- Issue tracking: https://github.com/osate/osate2/issues
- Release cycle: bi-monthly stable, nightly builds

- Reference implementation of core AADL and annex standards
  - AADL core language V2.2 plus any approved errata
  - Error Model V2 Annex, ARINC653 Annex, Behavior Annex, Data Modeling Annex, Code Generation Annex
- Research prototyping platform
  - University and industrial research and pilot projects at international level

OSATE Workbench Capabilities

Modeling Capabilities

- AADL
- EMV2
- Behavior
- Data Model
- ARINC 653
- Type Consistency
- Semantic Consistency
- Team Mgmt Version Control

Analysis Capabilities

- Resource Budget
- Latency Analysis
- Safety (FHA, FTA, FMEA)
- RMA/EDF Scheduling
- Resource Allocation
- Functional Integration
- ARINC653 verification

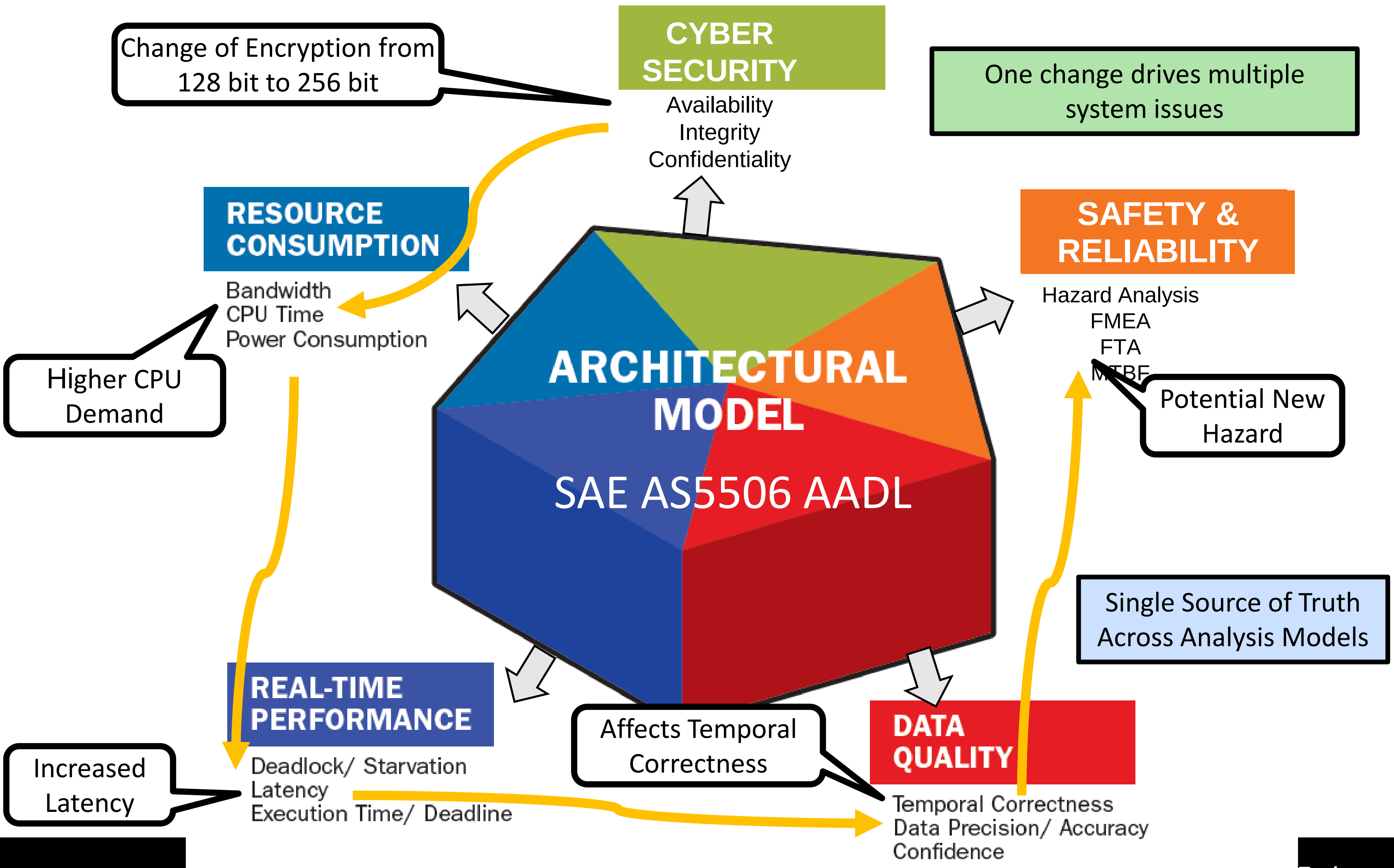
Usability Capabilities

- Syntax Sensitive Text Editor
- Graphical Editor
- Context sensitive assist
- Role specific workflow
- Automated Requirement Driven Verification

Other SEI & External Contributions

- Resolute & Agree Rockwell Collins SMACCM
- Ocarina Partition Code Generation for DeOS, VxWorks
- Multi core Scheduling Mixed-criticality (zero slack) scheduling
- MAST Scheduling
- SPICA Scheduling FASTAR Global Timing

Analysis of System Properties via Architecture Model A Contribution to Single Source of Truth



Demonstration of Three OSATE Capabilities

Flow latency analysis early and throughout development life cycle

Safety and reliability analysis at different system levels

Architecture-Led Incremental System Assurance (ALISA) through requirements driven continuous integration

Flow Latency Analysis

Early and throughout development life cycle

Worst-case latency and latency jitter

Functional architecture with mapping to physical architecture

Impact of application task & communication and embedded platform design decisions

Latency Contributors

Specified component latency across multiple tiers

Specified connection, protocol, network latency

Sampling latency & port queuing

Network & protocol sampling, fixed & data size based

Partition allocation, rates, schedules

Synchronous and asynchronous platform components

Explore design alternatives

Synchronous vs asynchronous system

Partition end vs. major frame delayed send

Deadline vs. max execution time

Full vs. empty queue

Alternative deployment mappings

Alternative platforms

Alternative application configurations

Uses deadline rather than completion time

FASTAR includes scheduling analysis results

Sensitivity to completion time variation

Safety Analyses

Early and throughout development life cycle

Analyze impact of exceptional conditions at all levels of design

Based on Error Model V2 (EMV2) annotations in AADL models

Functional & physical architectures, application and platform systems including deployment mappings

Capabilities

Functional hazard assessment (FHA) reports in three formats

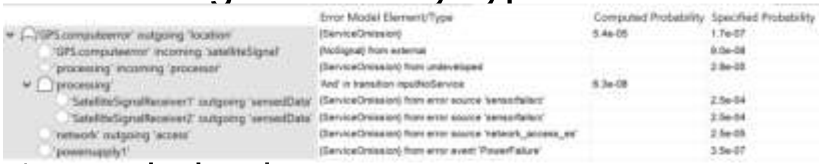
Reliability block diagram (RBD) like parts based system reliability

- Based on composite error state specifications

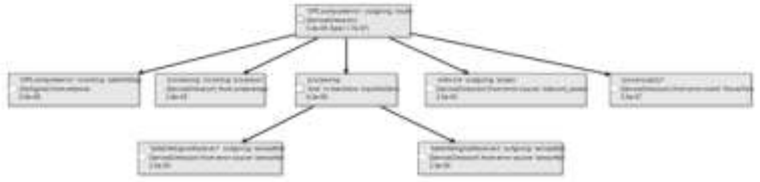
Fault impact analysis (FMEA) : forward chaining of type specific error sources

Probabilistic fault tree analysis (FTA): backward chaining to identify type specific contributors

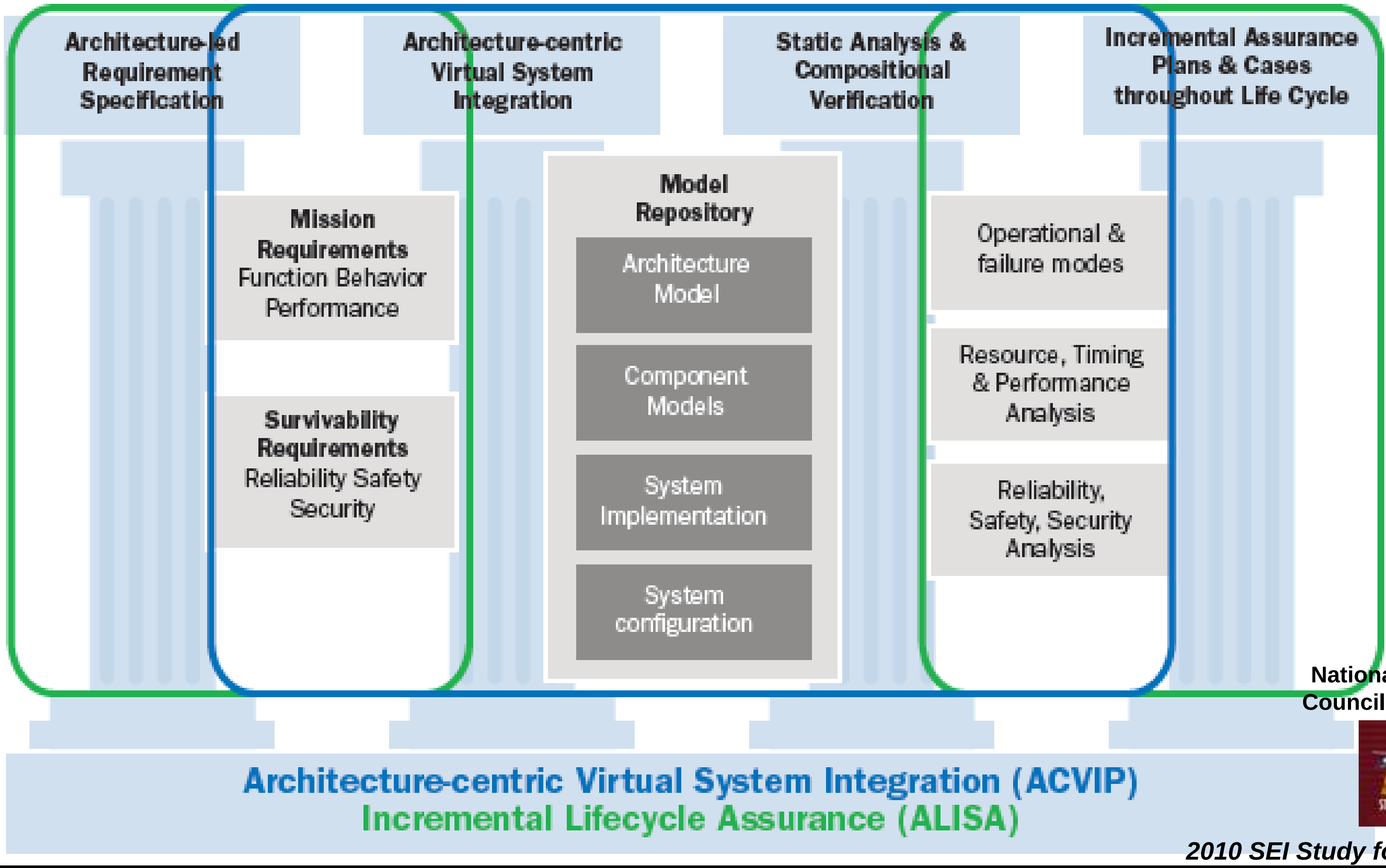
- Based on error flows and propagation paths
- Based on error events and specified component error behavior
- Fault trace, fault tree, and minimal cut sets
- Graphical and tabular results



	Error Model Element/Type	Computed Probability	Specified Probability
'GPS.computeerror' outgoing 'location'	{ServiceOmission}	5.4e-05	1.7e-07
'GPS.computeerror' incoming 'satelliteSignal'	{NoSignal} from external		9.0e-08
'processing' incoming 'processor'	{ServiceOmission} from undeveloped		2.8e-05
'processing'	'And' in transition inputNoService	6.3e-08	
'SatelliteSignalReceiver1' outgoing 'sensedData'	{ServiceOmission} from error source 'sensorfailure'		2.5e-04
'SatelliteSignalReceiver2' outgoing 'sensedData'	{ServiceOmission} from error source 'sensorfailure'		2.5e-04
'network' outgoing 'access'	{ServiceOmission} from error source 'network_access_es'		2.5e-05
'powersupply1'	{ServiceOmission} from error event 'PowerFailure'		3.5e-07



Automated Verification of Functional and Non-functional System Properties

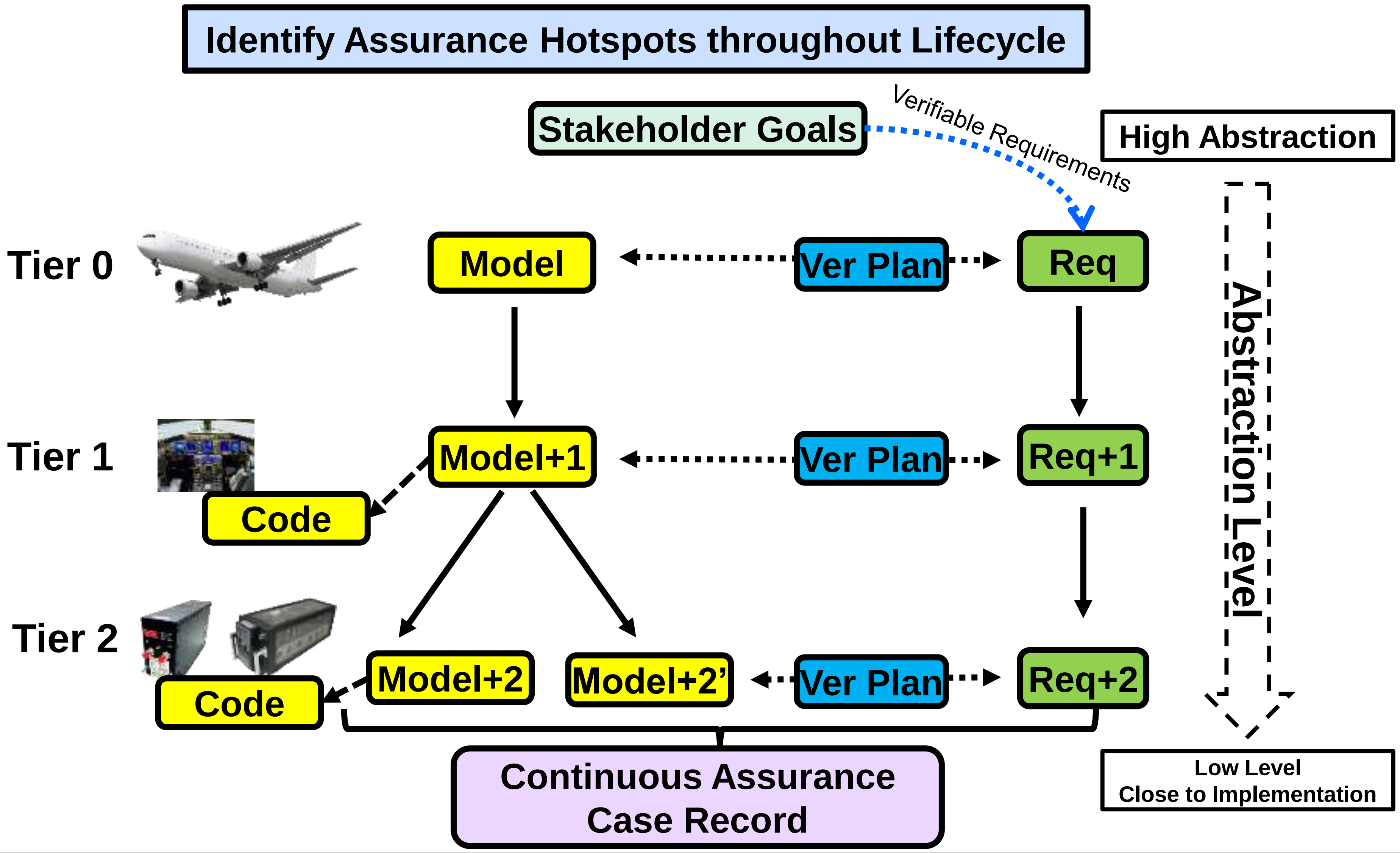


Assurance: Sufficient evidence that a system implementation meets system requirements
Architecture-led Requirement Specification
Architecture-centric Virtual System Integration
Static Analysis & Compositional Verification
Incremental Assurance Plans & Cases throughout Life Cycle
Mission Requirements Function Behavior Performance
Survivability Requirements Reliability Safety Security
Model Repository
Architecture Model
Component Models
System Implementation
System configuration
Operational & failure modes
Resource, Timing & Performance Analysis
Reliability, Safety, Security Analysis
Architecture-centric Virtual System Integration (ACVIP)
Incremental Lifecycle Assurance (ALISA)

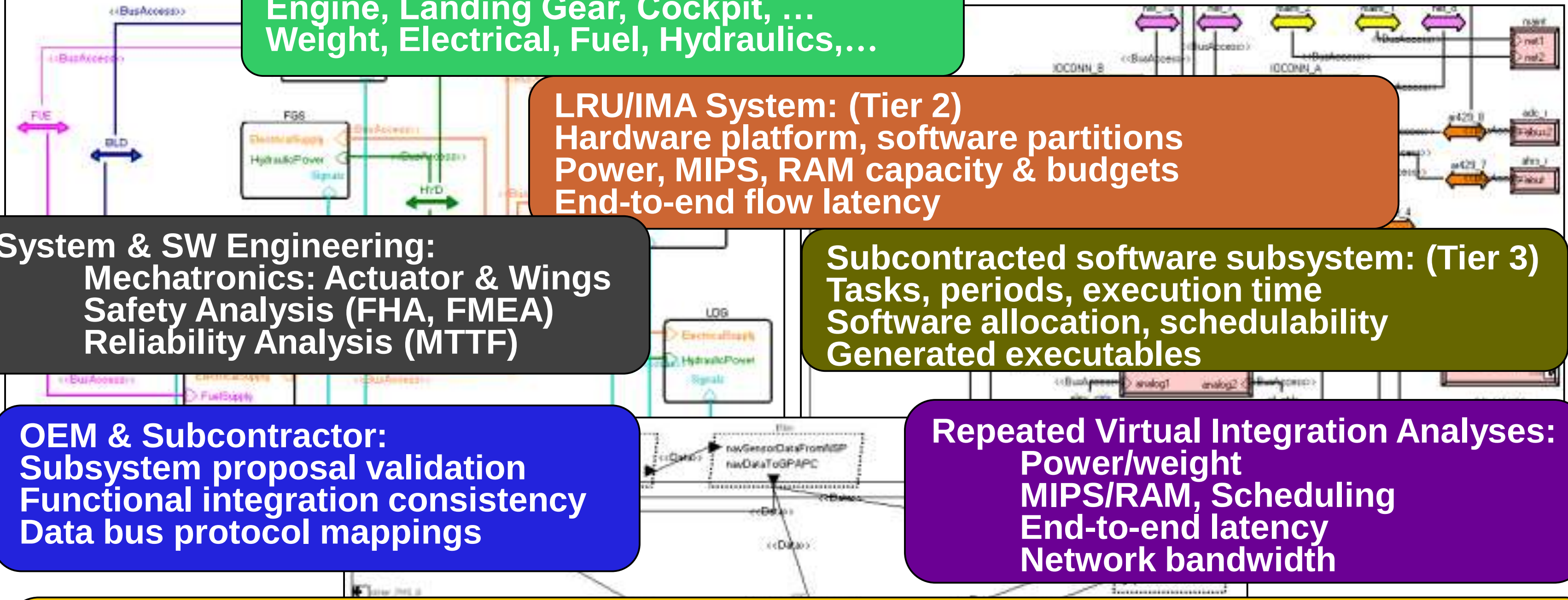
National Research Council Study 2007

2010 SEI Study for AMRDEC

Automated Incremental Assurance with ALISA



Incremental Multi-Tier Assurance of an Aircraft



Aircraft: (Tier 0)

Aircraft system: (Tier 1)
Engine, Landing Gear, Cockpit, …
Weight, Electrical, Fuel, Hydraulics,…

LRU/IMA System: (Tier 2)
Hardware platform, software partitions
Power, MIPS, RAM capacity & budgets
End-to-end flow latency

System & SW Engineering:
Mechatronics: Actuator & Wings
Safety Analysis (FHA, FMEA)
Reliability Analysis (MTTF)

Subcontracted software subsystem: (Tier 3)
Tasks, periods, execution time
Software allocation, schedulability
Generated executables

OEM & Subcontractor:
Subsystem proposal validation
Functional integration consistency
Data bus protocol mappings

Repeated Virtual Integration Analyses:
Power/weight
MIPS/RAM, Scheduling
End-to-end latency
Network bandwidth

Proof of Concept Demonstration and Transition by Aerospace industry initiative
- **Architecture-centric model-based software and system engineering**
- **Architecture-centric model-based acquisition and development process**
- **Multi notation, multi team model repository & standardized model interchange**

- Multi-tier system & software architecture (in AADL)
- Incremental end-to-end verification of system properties