




## Society of Automotive Engineer's Architecture Design & Analysis Language Standard (SAE AADL) & OMG RFC Status


Ed Colbert  
Senior Research Associate  
Center for Software Engineering  
University of Southern California  
ecolbert@usc.edu  
(213) 821-1240  
-----  
President  
Absolute Software Co., Inc.  
colbert@abssw.com  
(760) 929-0612



Copyright 2001-5. Absolute Software Co., Inc.

## Objectives

- Provide overview
  - Propose of
    - SAE AADL
    - UML Profile for SAE AADL
  - Principles
  - Status
- Preview of tomorrow 10AM presentation in MARS section
- Lay groundwork for OMG RFC



2

## Outline

- ➔ AADL Concept
  - AADL Notations
  - Extending UML
  - AADL-UML/Example
  - Summary



3

## AADL Overview

- Society of Automotive Engineers (SAE) **approved standard** *Architecture Analysis & Design Language (AADL)*
  - ~Nov 2004
- Basic research funded by
  - U.S. Defense Advanced Research Projects Agency (DARPA)
  - Office of U.S. Secretary of Defense's Open Systems – Joint Task Force (OS – JTF)
- Based on
  - MetaH
    - Design by Honeywell for specification of real-time, fault-tolerant, securely partitioned, dynamically reconfigurable multi-processor system architectures
  - Unified Modeling language (UML)
    - Object Management Group's (OMG) standard language for object-oriented software development



4

## MetaH Development & Evaluation

1991 DARPA DSSA program begins  
 1992 Partitioned PFP target (Tartan MAR/i960MC)  
 1994 Multi-processor target (VME i960MC)  
 1995 Slack stealing scheduler  
 1998 Portable Ada 95 and POSIX middleware configurations  
 1999 Hybrid automata verification of core middleware modules

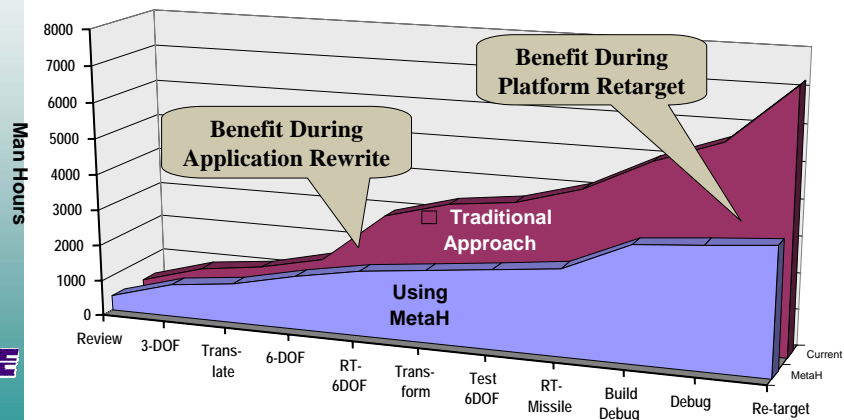
1992-present Evaluation and demonstration projects include

- Missile G&C reference architecture, demos, others (AMCOM SED)
- Hybrid automata formal verification (AFOSR, Honeywell)
- Missile defense (Boeing)
- Fighter guidance SW fault tolerance (DARPA, CMU, Lockheed-Martin)
- Incremental Upgrade of Legacy Systems (AFRL, Boeing, Honeywell)
- Comanche study (AMCOM, Comanche PO, Boeing, Honeywell)
- Tactical Mobile Robotics (DARPA, Honeywell, Georgia Tech)
- Advanced Intercept Technology CWE (BMDO, MaxTech)
- Adaptive Computer Systems (DARPA, Honeywell)
- Avionics System Performance Management (AFRL, Honeywell)
- Ada Software Integrated Development/Verification (AFRL, Honeywell)
- FMS reference architecture (Honeywell)
- JSF vehicle control (Honeywell)
- IFMU reengineering (Honeywell),



## AMCOM Effort Saved Using MetaH

Total project savings 50%, re-target savings 90%



6

## SAE AS-2C AADL Subcommittee

- Bruce Lewis (US Army AMRDEC): Chair
- Peter Feiler (SEI): technical lead, author & editor
- Steve Vestal (Honeywell): co-author
- Ed Colbert (USC): UML Profile of AADL
- Joyce Tokar (Pyrrhus Software): Ada & C Annex
- Other voting members
  - Boeing, Rockwell, Honeywell, Lockheed Martin, Raytheon, Smith Industries, General Dynamics, Airbus, Axlog, European Space Agency, TNI, Dassault, EADS, High Integrity Solutions
- Coordination with
  - NATO Aviation, NATO Plug and Play, French Government COTRE, SAE AS-1 Weapons Plug and Play, OMG UML & SysML



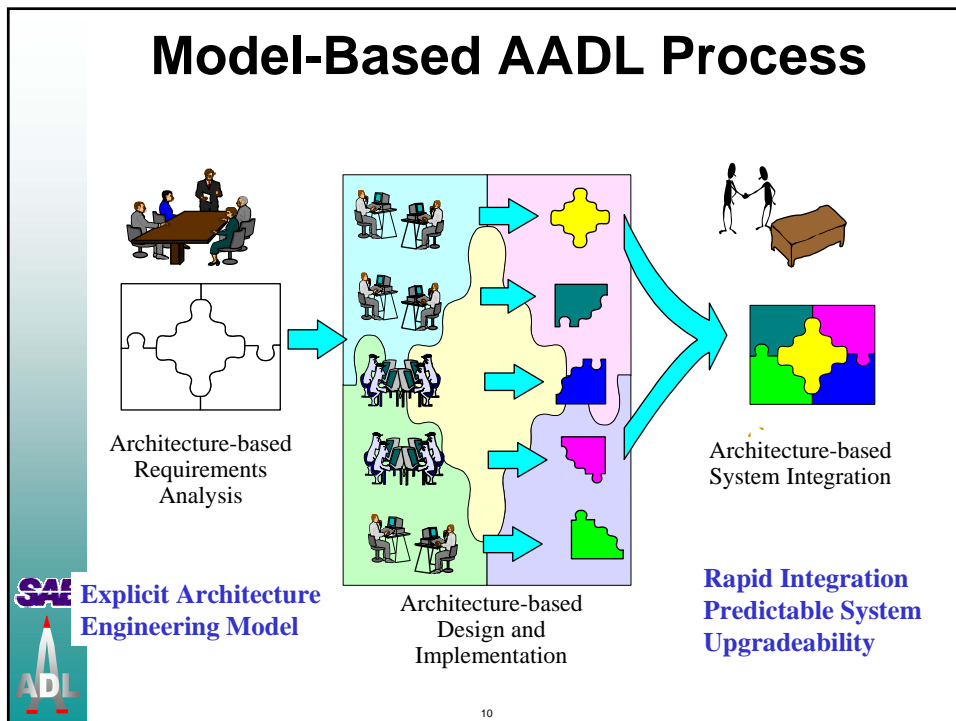
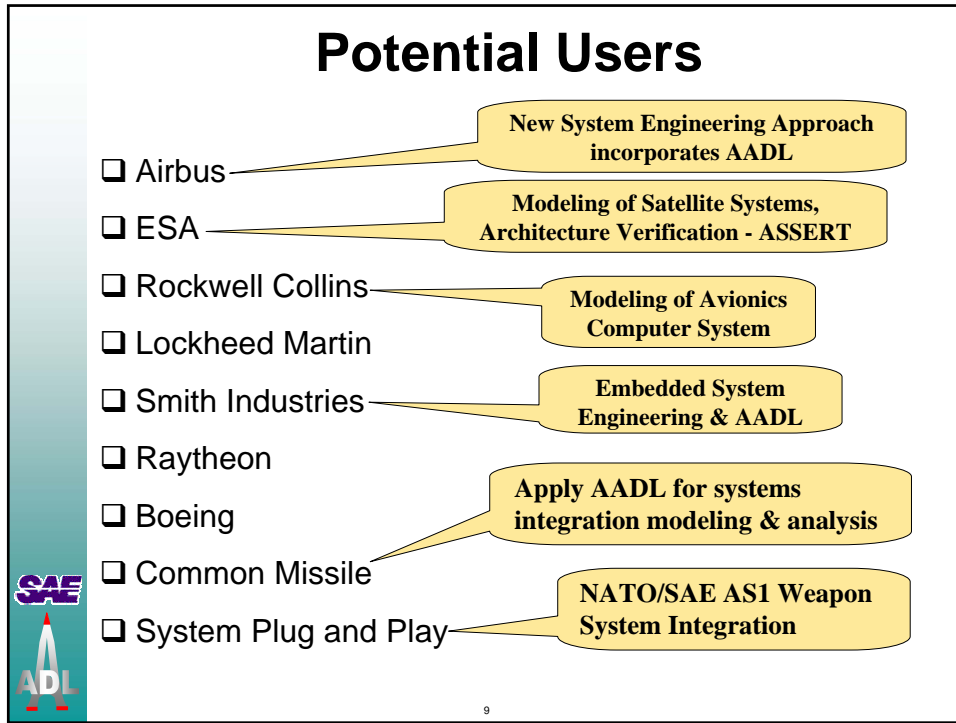
7

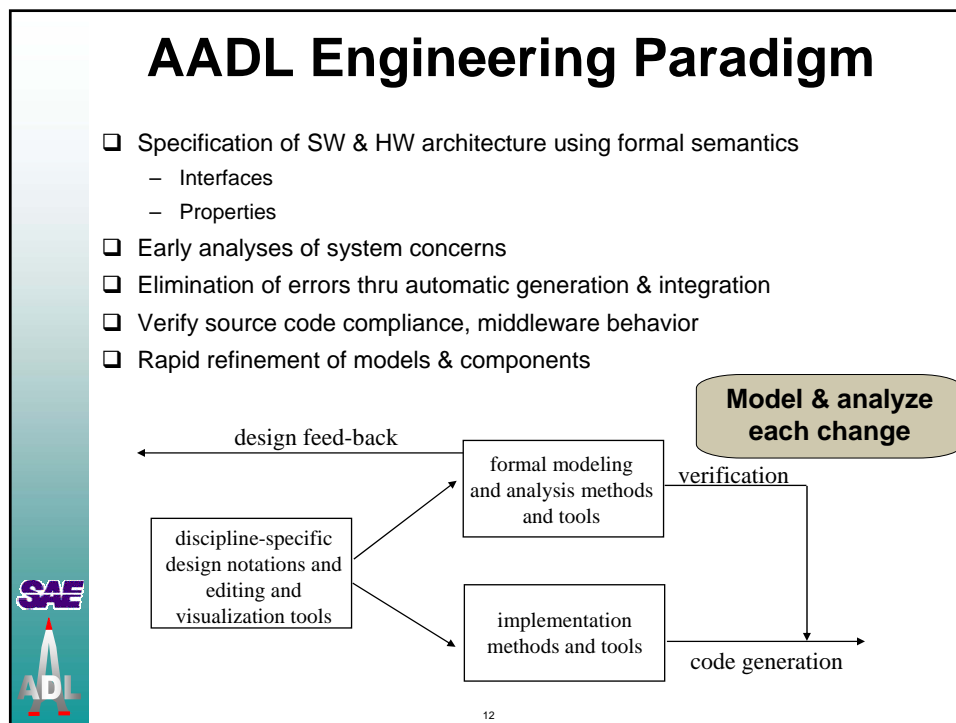
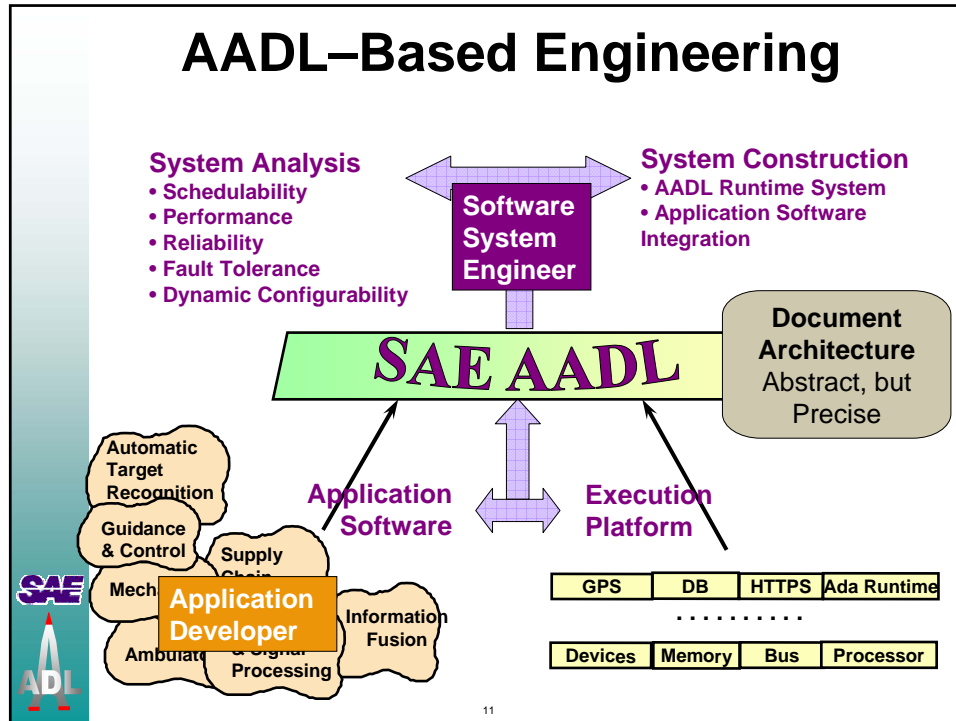
## Applications Supported Predictable Systems

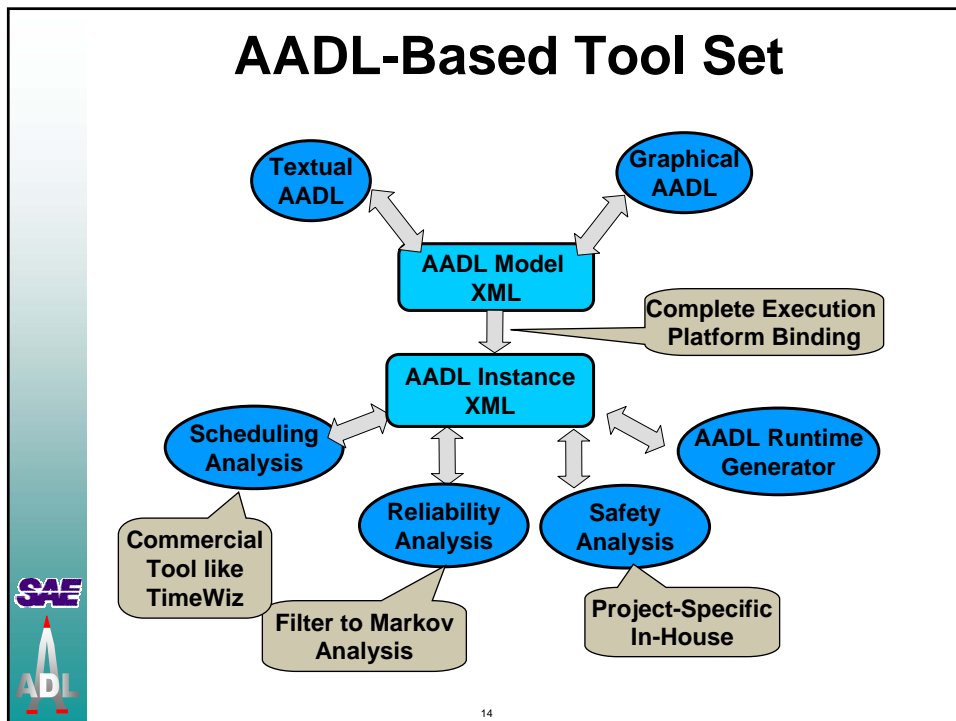
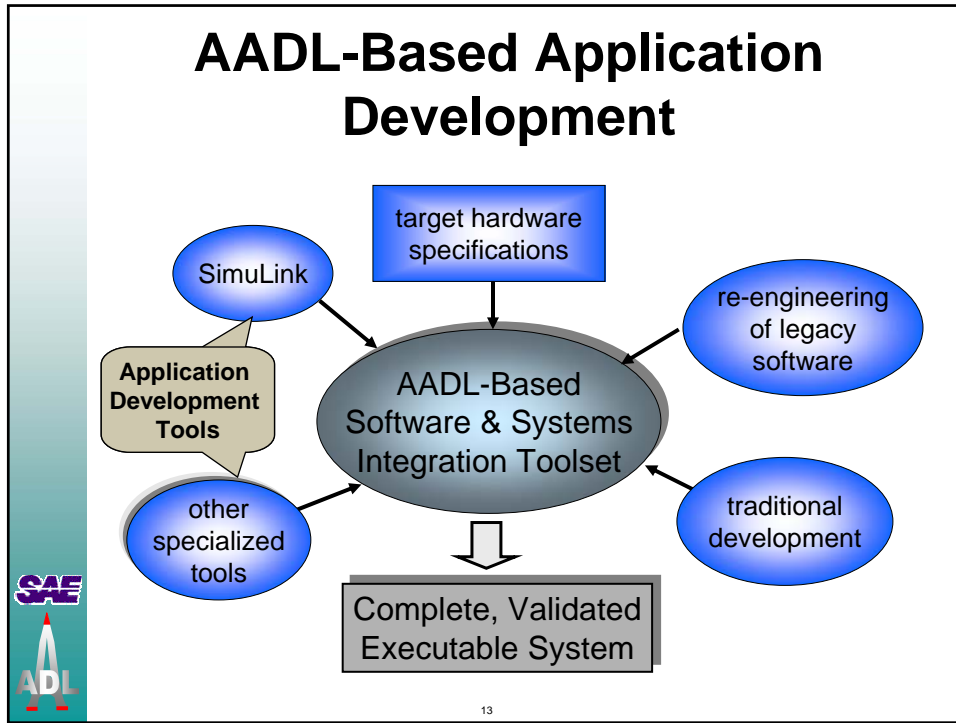
- Kinds of systems
  - Avionics
  - Space
  - Robotics
  - Industrial Control
  - Medical
  - Automotive
- Systems with characteristics like
  - Fixed sampling & processing rates
  - Variable sampling & processing rates
  - Stochastic event & processing rates
  - Operational modes & configurations
  - Large-scale system integration

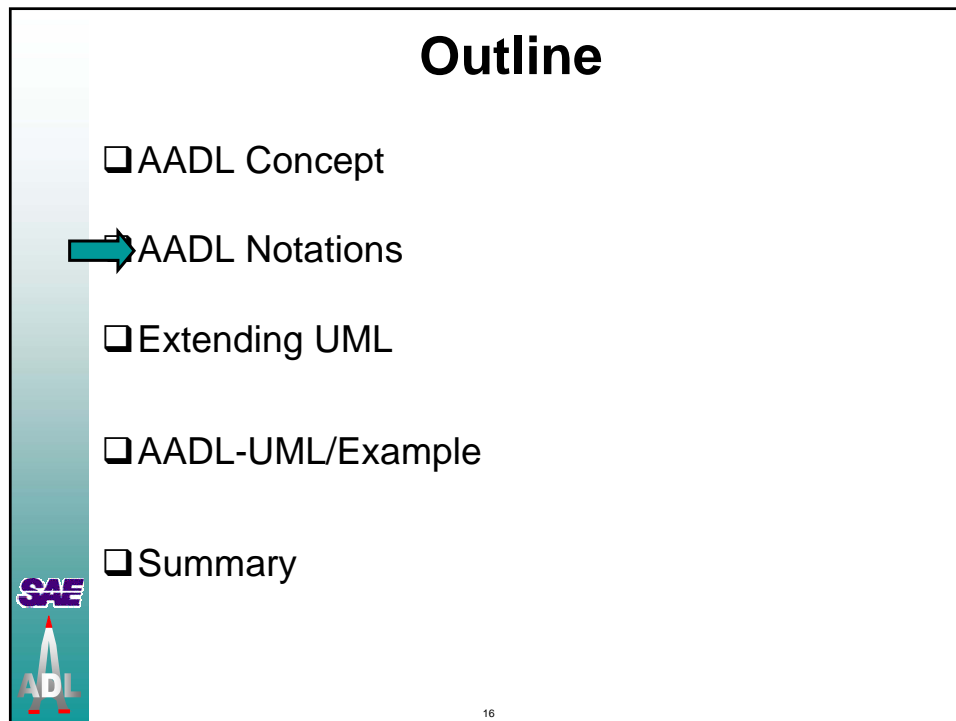
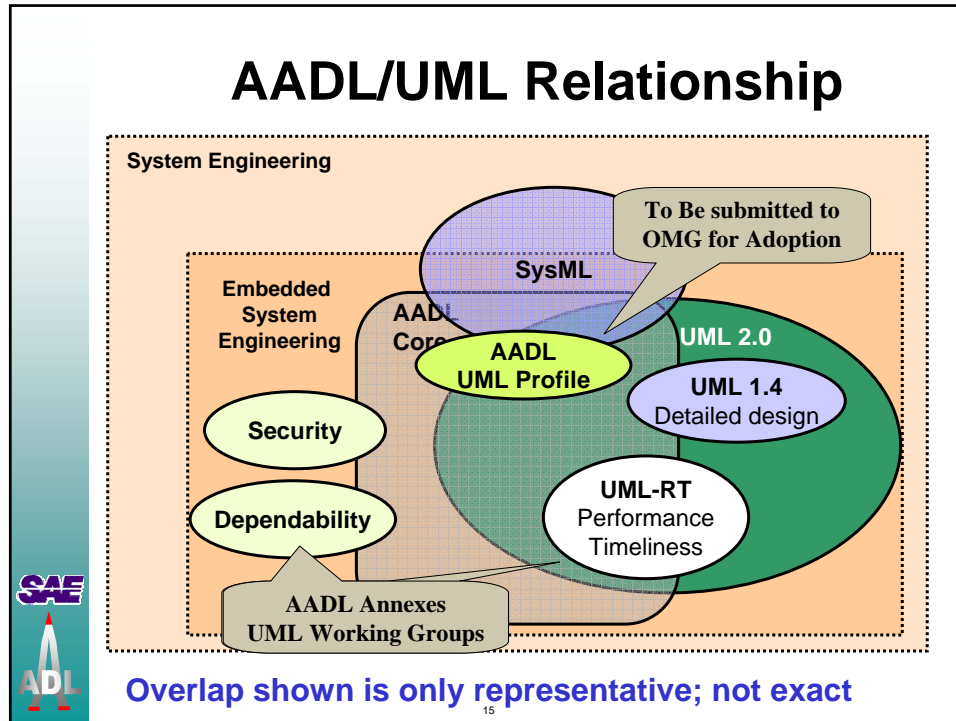


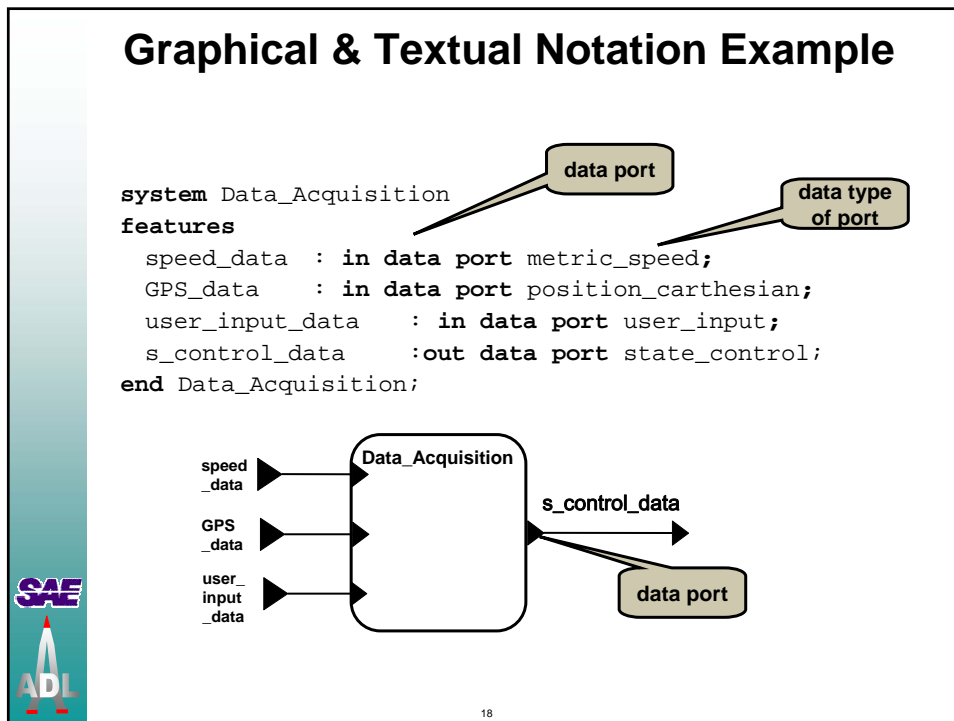
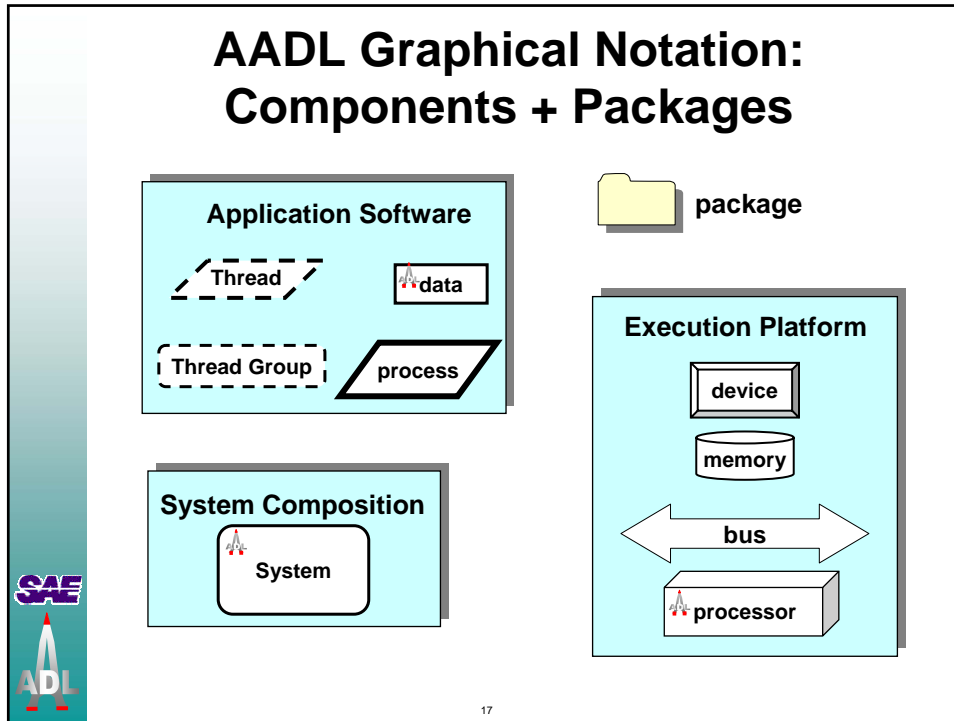
8

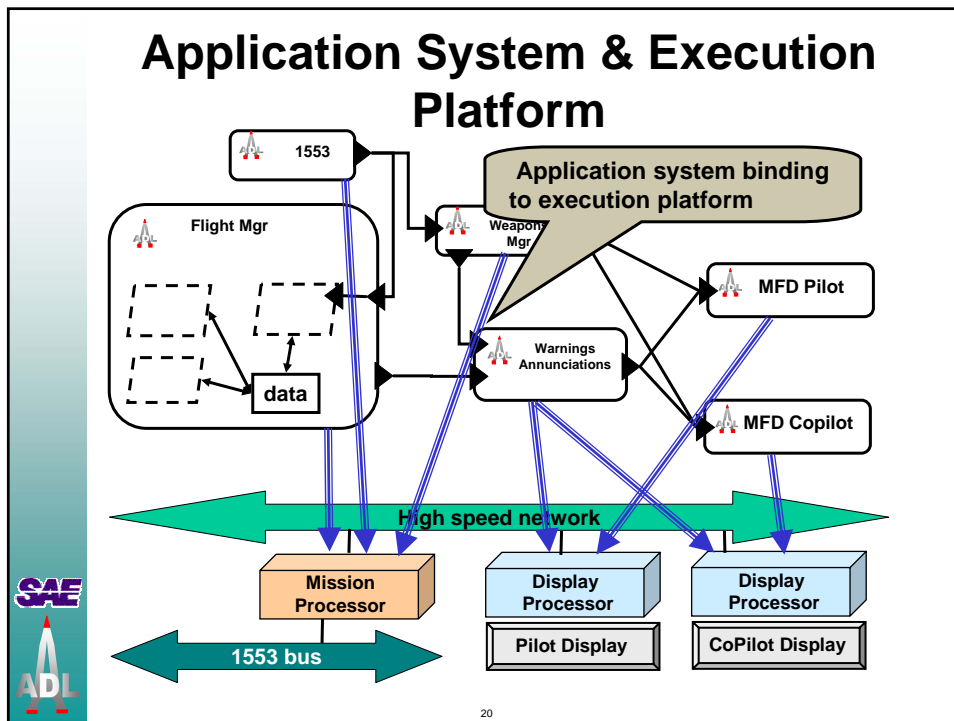
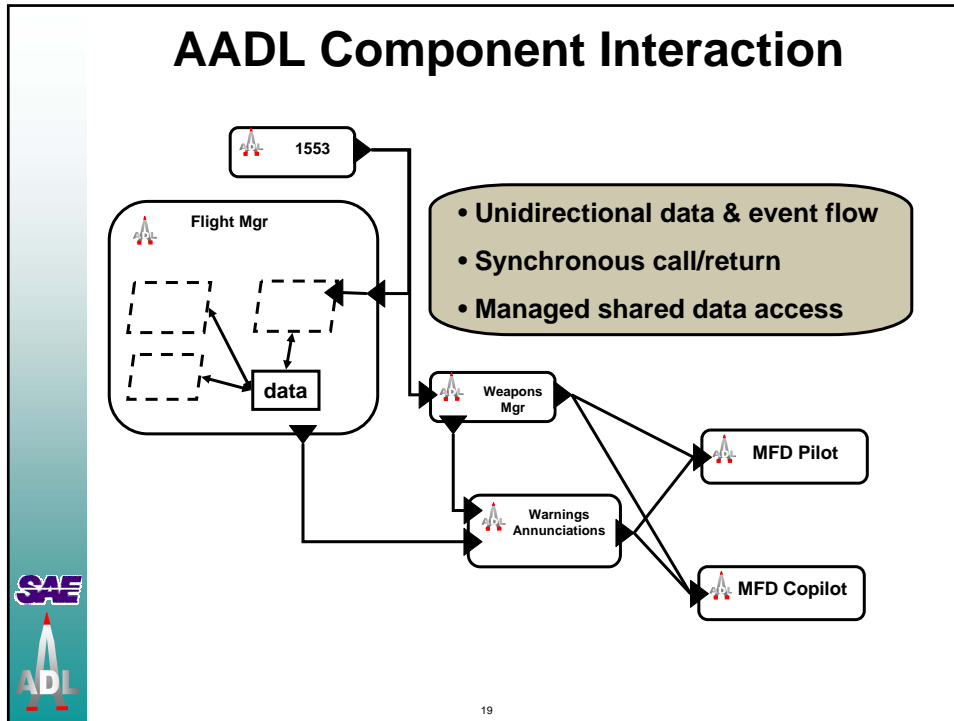


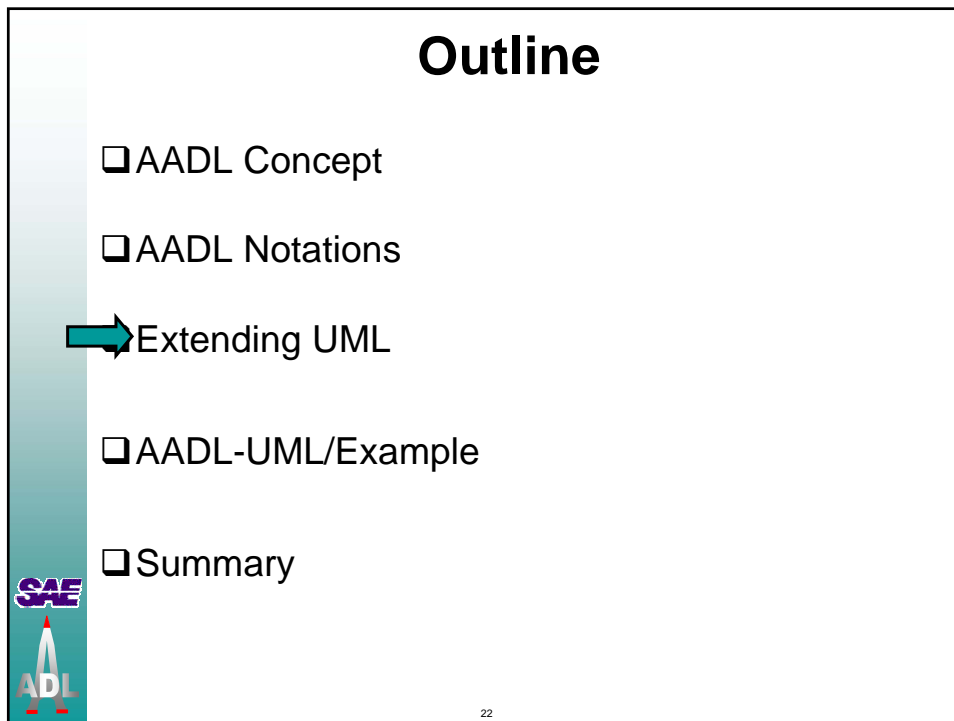
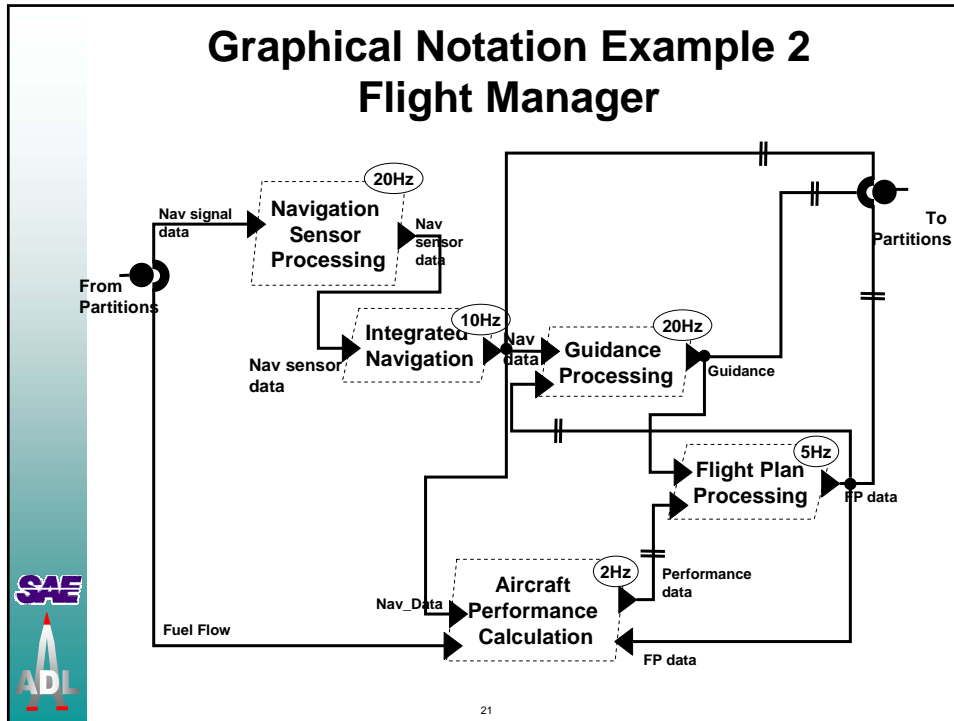












## Benefits of Extending UML

- ❑ Architects can represent system architecture graphically using commonly available UML tools
- ❑ UML tool developers can add advance support for AADL to existing tools rather than developing new tools
  - e.g. safety analysis
- ❑ Software designers can take defined architecture & refine software components
  - rather than common practice of re-creating architecture in software development tools
- ❑ System integrators should have easier time integrating
  - Software components generated by UML tools, or hand-code based on UML specification
  - Executive and architectural glue code that is generated by AADL tool
  - Target hardware.



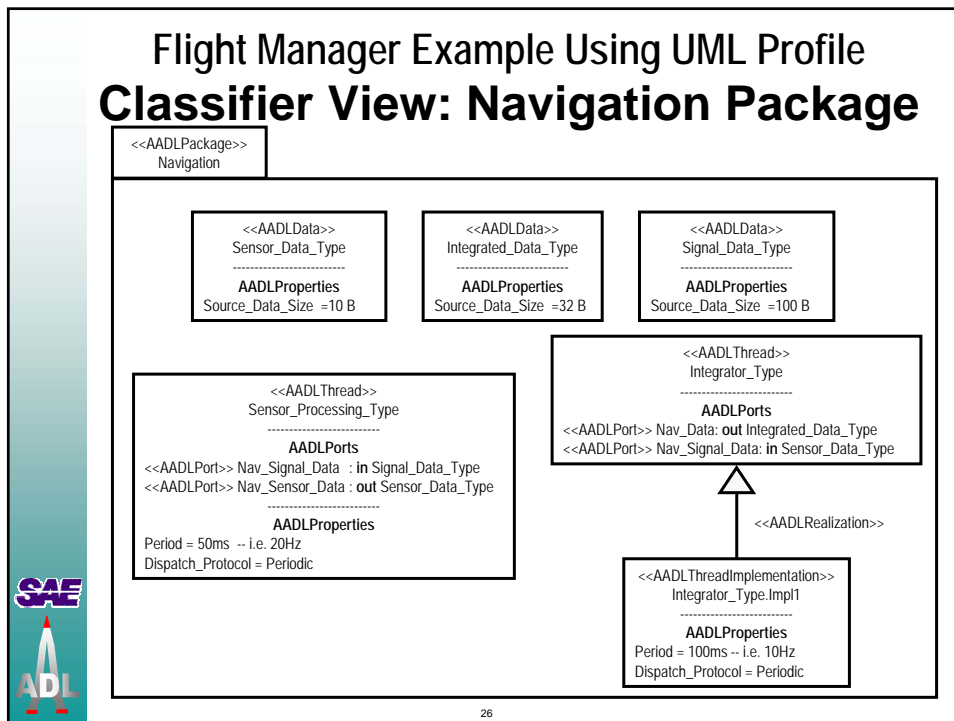
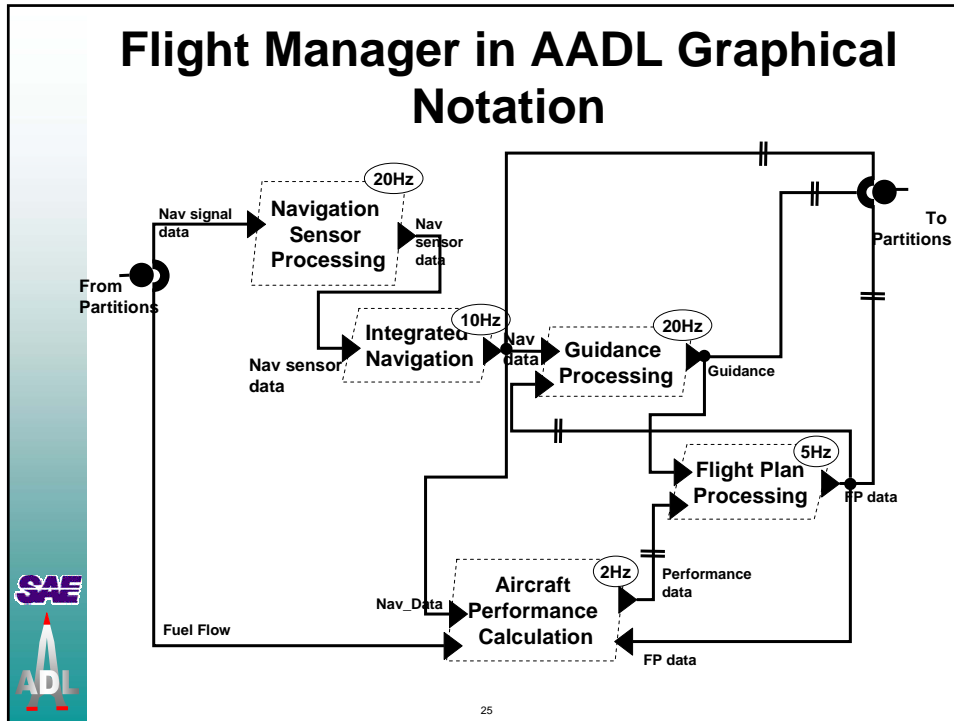
23

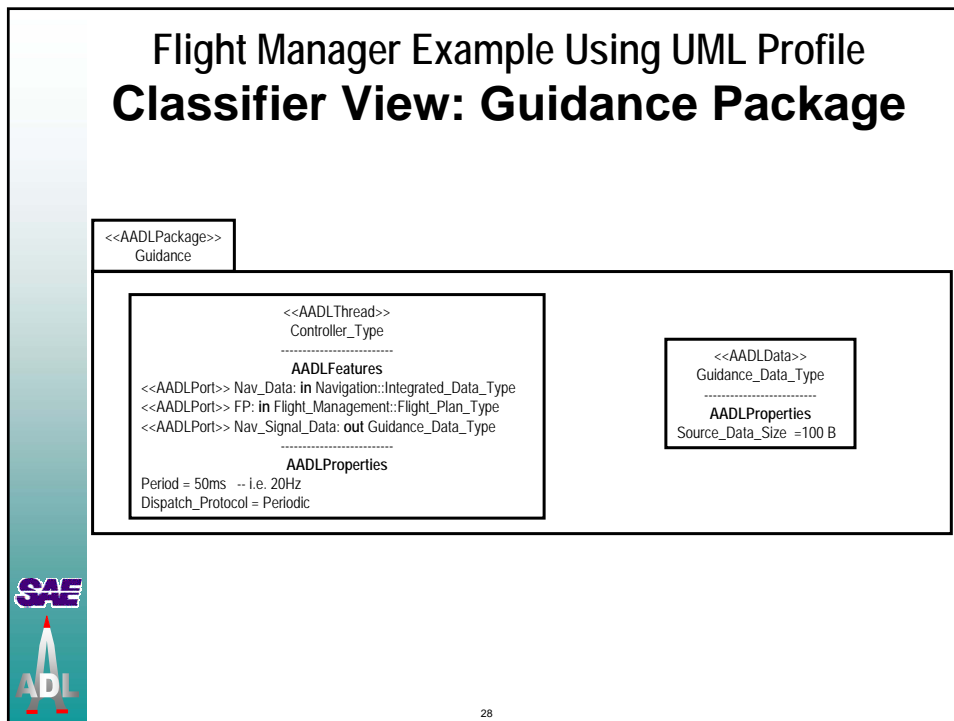
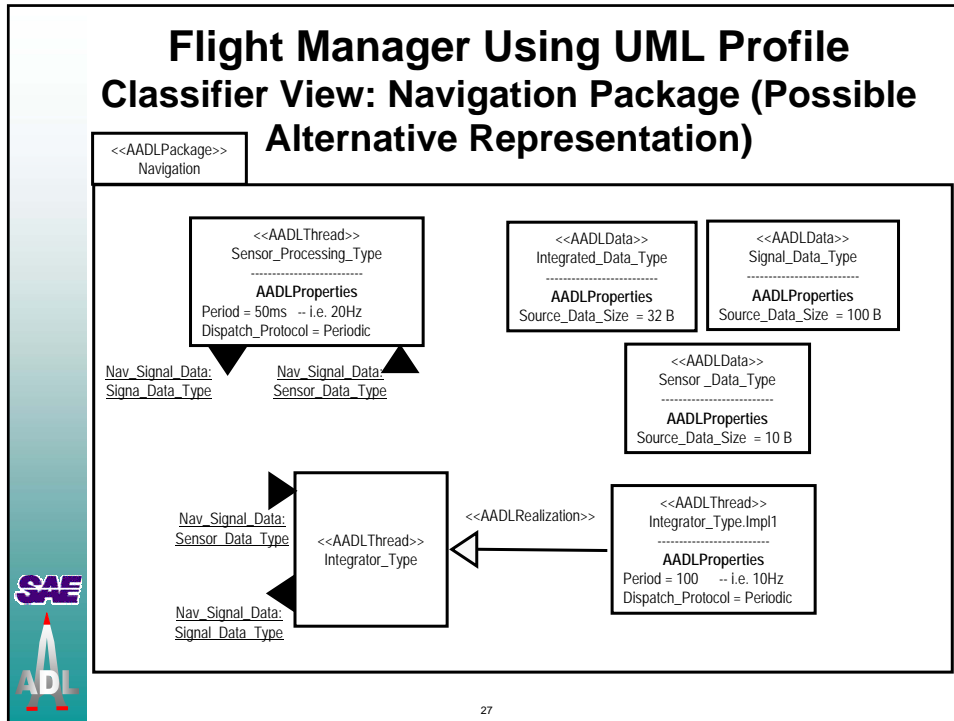
## Outline

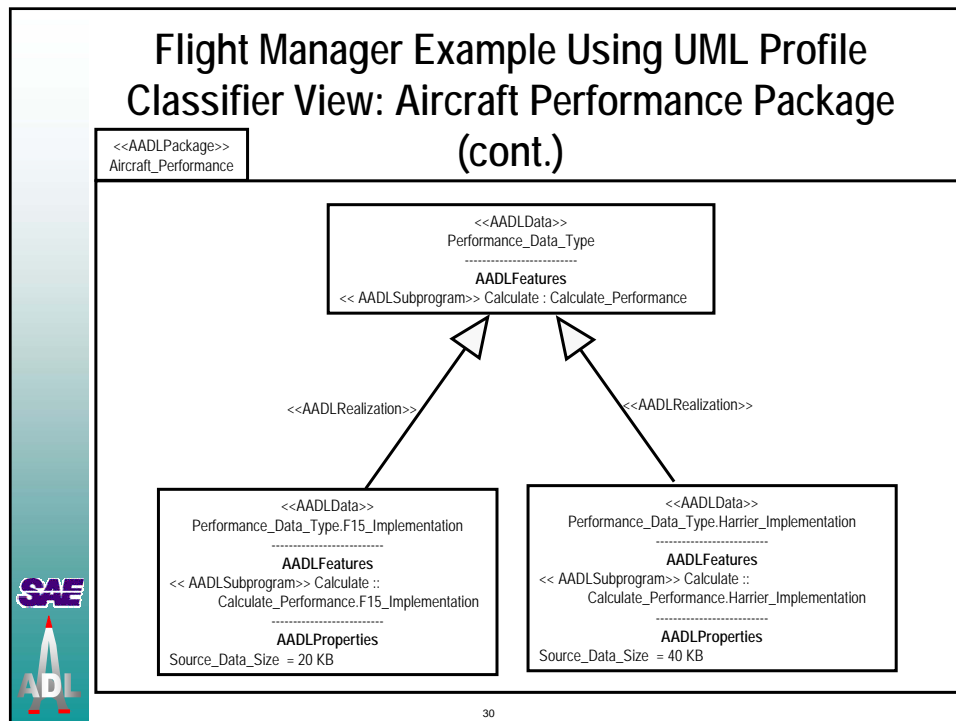
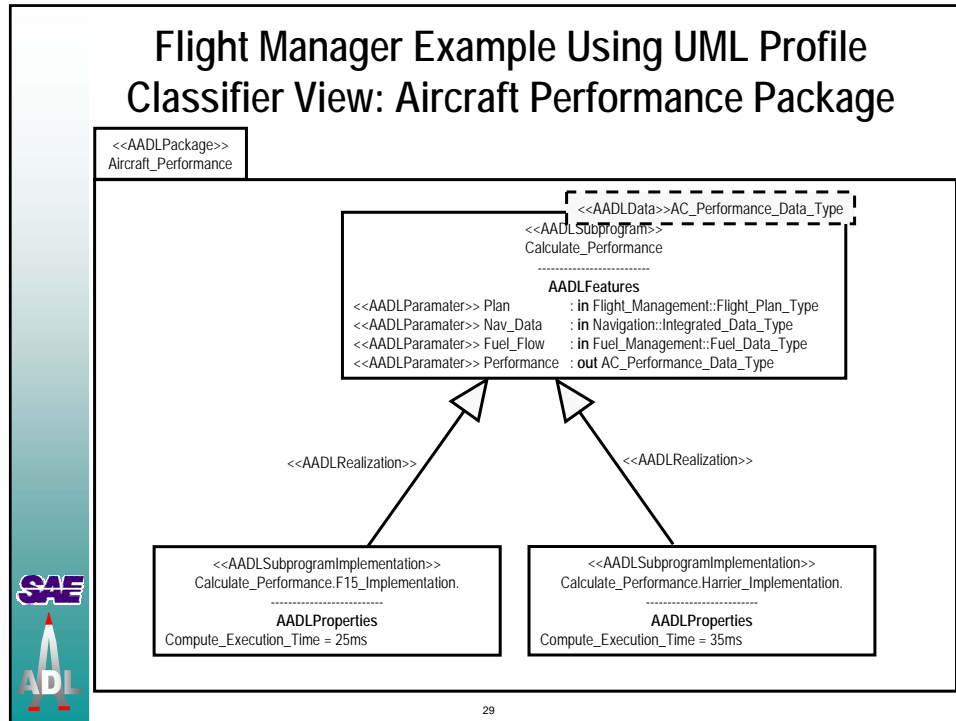
- ❑ AADL Concept
- ❑ AADL Notations
- ❑ Extending UML
- ➔ AADL-UML/Example
- ❑ Summary

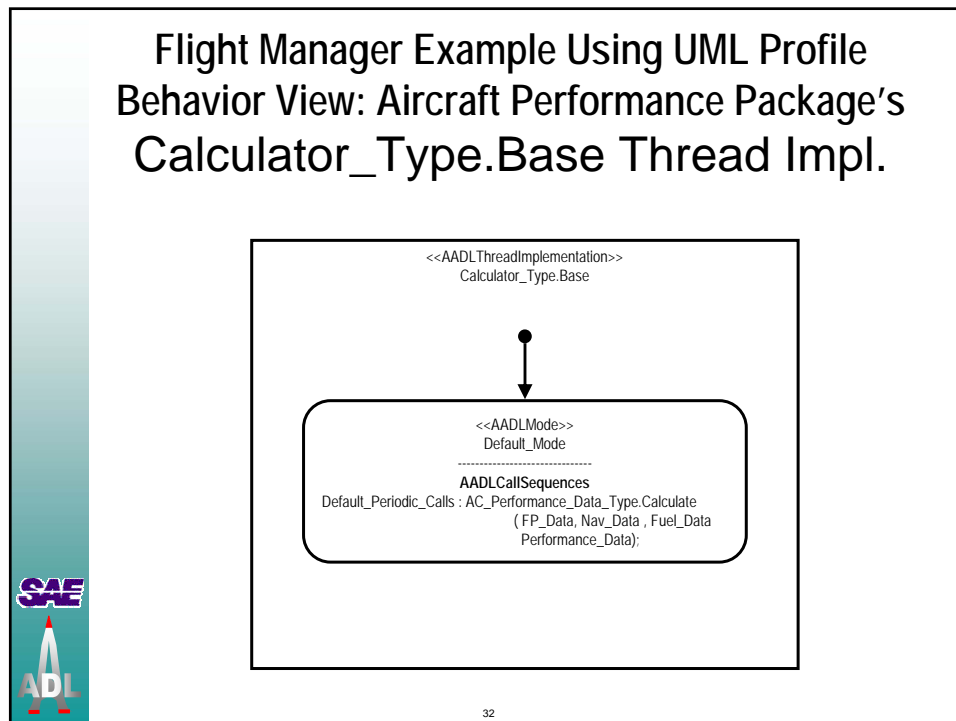
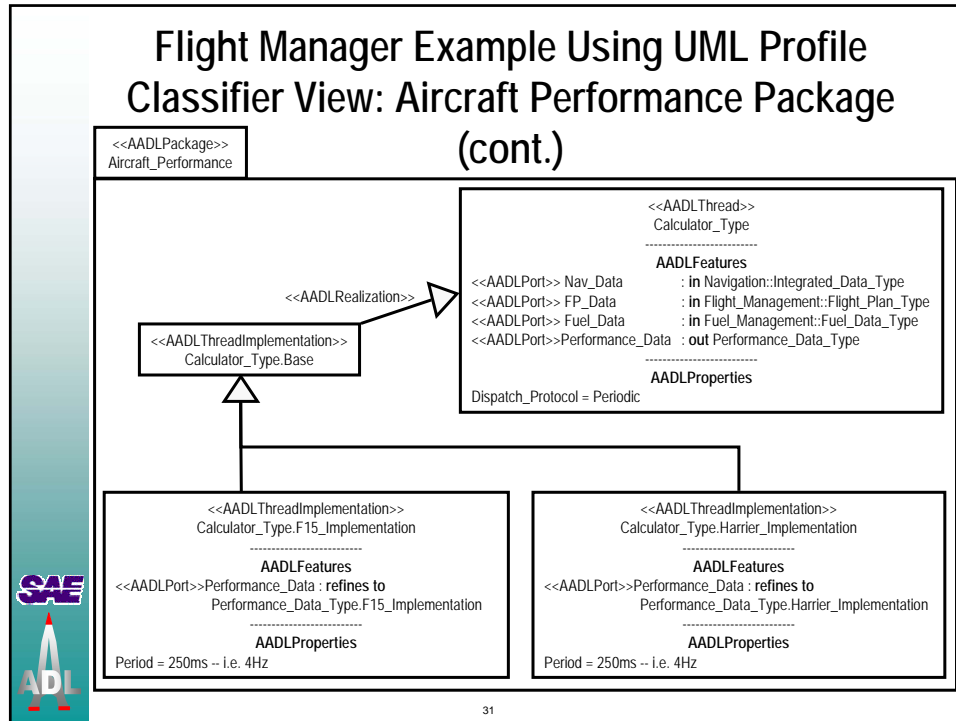


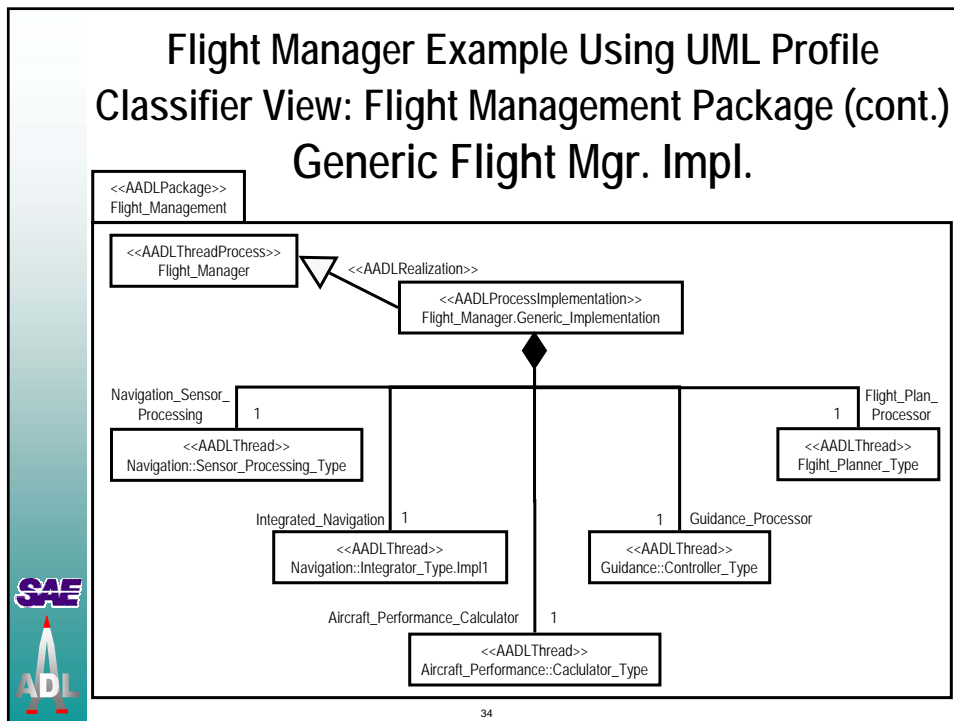
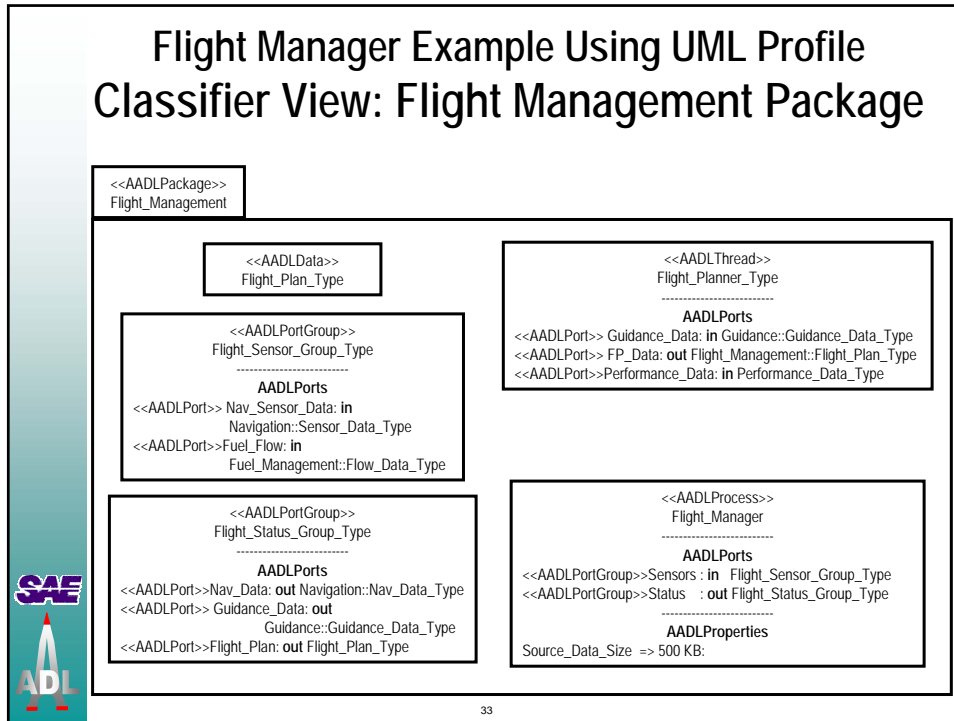
24

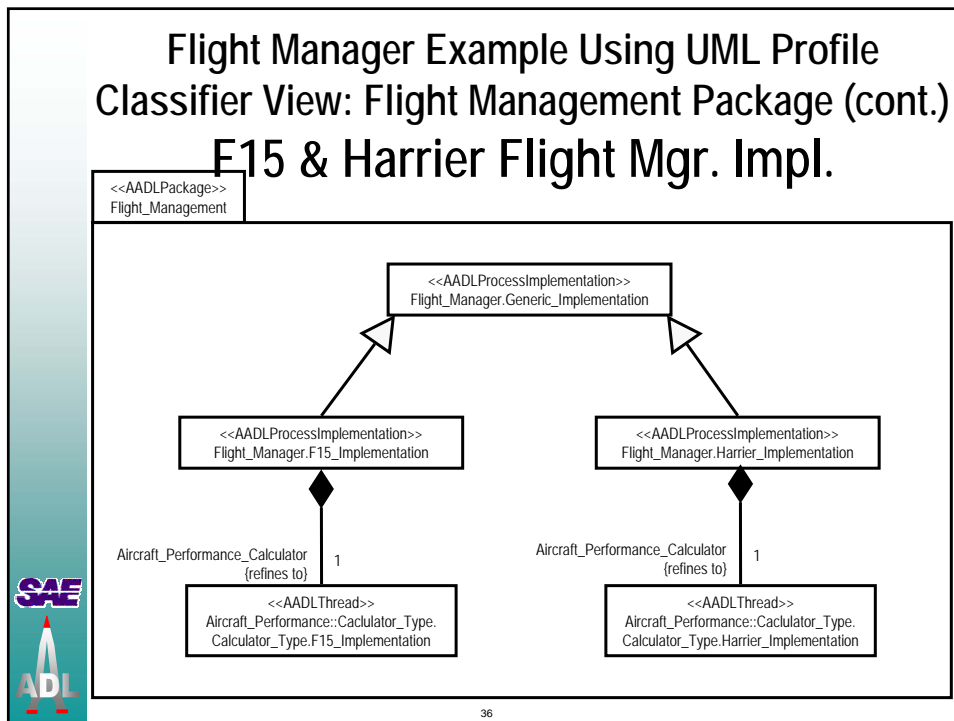
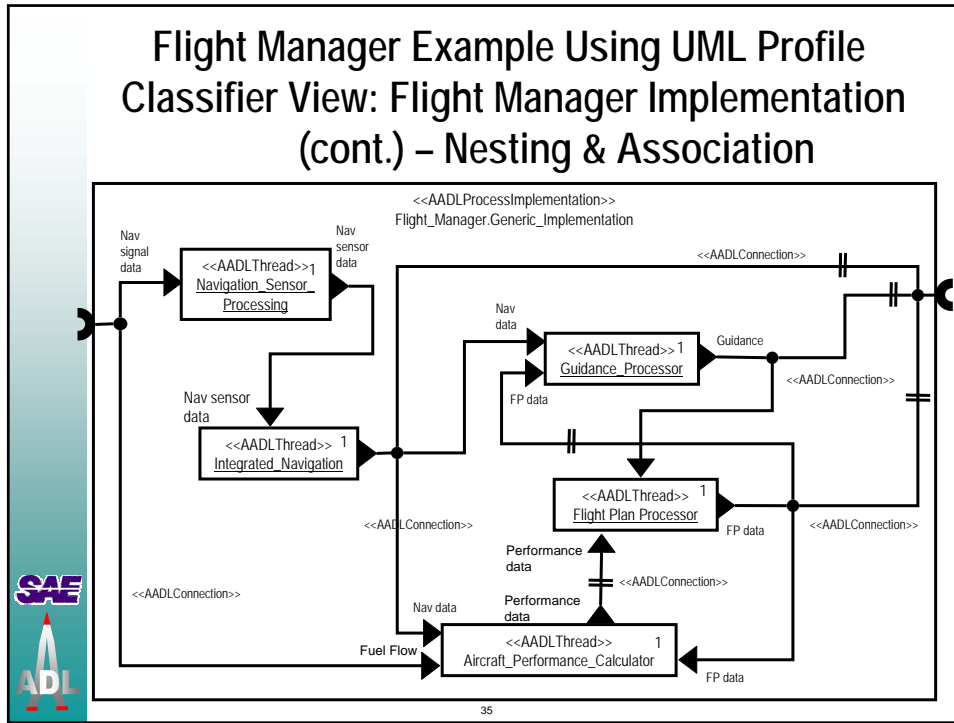












## Outline

- AADL Concept
- AADL Notations
- Extending UML
- AADL-UML/Example

→ Summary



37

## SAE AADL Summary UML Profile

- **Symbiotic Relationship**
  - System Architects can graphically using commonly available UML tools to represent software & hardware architecture
    - Can make use of UML tools that provide capabilities like simulation of state models
  - UML tool developers can easily integrate AADL tools for advance analysis techniques rather than developing new tools
    - e.g. safety analysis
  - Software designers can take defined architecture & refine software components
    - Rather than common practice of re-creating architecture in software development tools
  - System integrators should have easier time integrating
    - Software components generated by UML tools, or hand-code based on UML specification
    - Executive & architectural glue code that is generated by AADL tool
    - Target hardware



38

## Standardization

- ❑ SAE approved core language specification
  - Published
- ❑ Expect SAE approval of UML profile for AADL ~March/April '05
- ❑ Plan to propose UML profile for AADL as OMG standard ~June '05 using RFC process
  - Issues:
    - 3 weeks rule
    - Does OMG RFC proposal need to be self contained or can it refer to SAE Document



39

## References

- ❑ As-2 Embedded Computing Systems ADL Subcommittee (2004). Architecture Analysis and Design Language (AADL) AS5506, 1 ed., Society of Automotive Engineers, <http://www.sae.org>.
- ❑ Colbert, E., Lewis, B., et al. (2000). "Developing Evolvable, Embedded, Time-Critical Systems with MetaH", 34th International Conference on Technology of Object-Oriented Languages and Systems (TOOLS 34) Proceedings. Santa Barbara, CA: IEEE Computer Society.
- ❑ Feiler, P., and Colbert, E., et al. (2004). "The SAE AADL Standard: an Architecture Analysis & Design Language for Embedded Real-time Systems", OMG Model Integration Conference. Object Management Group (OMG).
- ❑ Vestal, S. (1998). *MetaH User's Manual*, 1.27 ed., Honeywell Technology Center: Minneapolis, MN.



40