

AADL Tools

AADL Committee, Toulouse
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UK based company
aka. TNI Europe Ltd
Tools sales office



Fr based company
New tools development
R&D center

20 years + support to major industrial projects:

- HOOD Software design tools for Ada and C
- Eurofighter Typhoon
- Airbus A340, A380, A400M, A350
- Tiger Helicopter (mission calculator)
- Rafale (engine control)



10 years + investement in new technology:

- SAE AS-5506: Architecture Analysis & Design Language
- AADL graphical modeling tools: Stood for AADL
- AADL analysis framework: AADL Inspector
- European Space Agency (TASTE Frame Contract)
- DSM graphical editors: TASTE, COMPASS,...
- Generic model processing technologies: GMP, LMP



HOOD

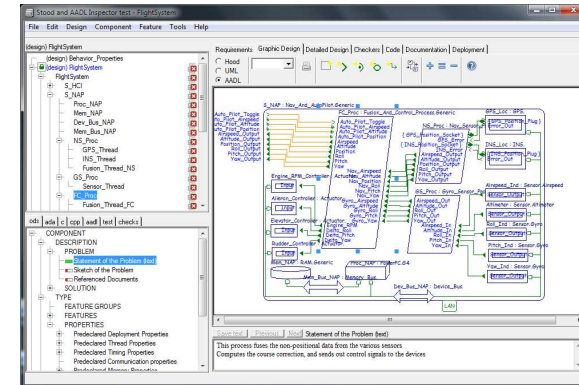
AADL

LMP

COTS Tools for AADL

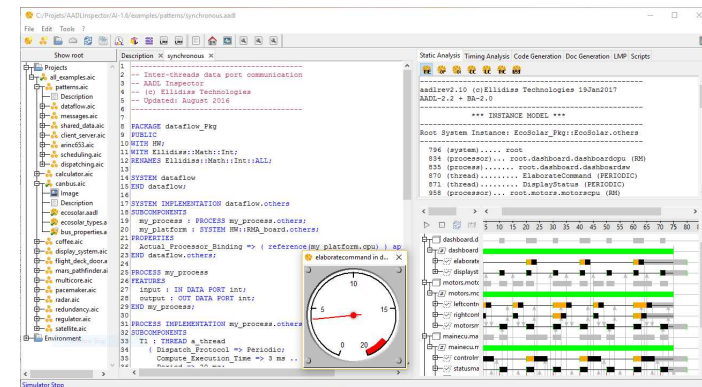
- **Design: Stood for AADL**

- AADL project management
- AADL Instance Model graphical editor
- Requirement traceability
- Documentation generator
- Export textual AADL



- **Verification: AADL Inspector**

- Import textual AADL
- Model processing plugins
 - Static rules checkers
 - Scheduling analysis (Cheddar)
- Simulation (Marzhin)
- Pre-processors:
 - Import UML profiles (MARTE, SysML, ...)
 - Import Domain Specific Models (XML)



- **Model Processing Toolbox: LMP**

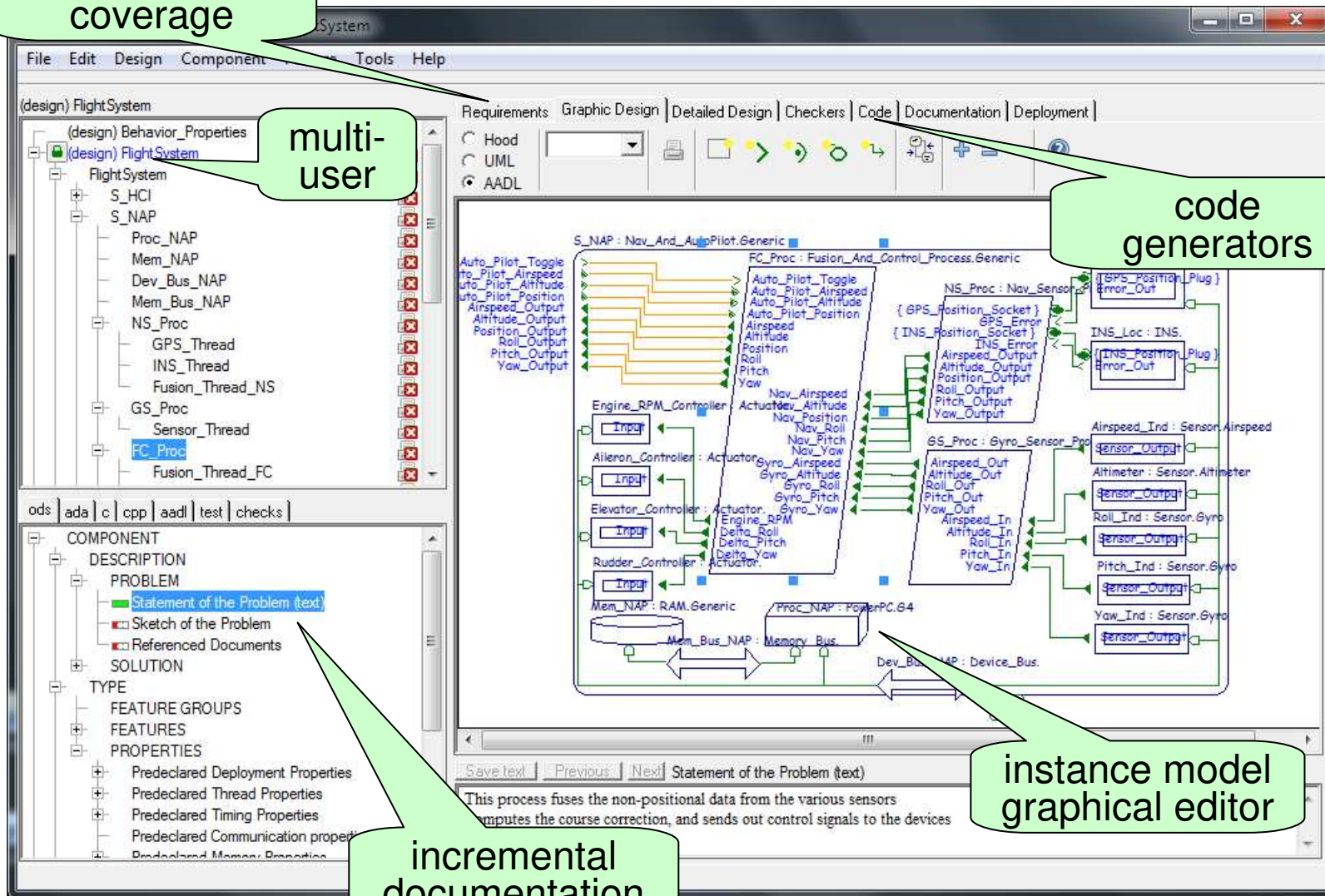
- Supported languages: AADL, Ada, C, XM* (XML, XMI, ECore)
- Implementation: parsers + prolog engine and libraries

Stood for AADL

requirements
coverage

multi-
user

code
generators



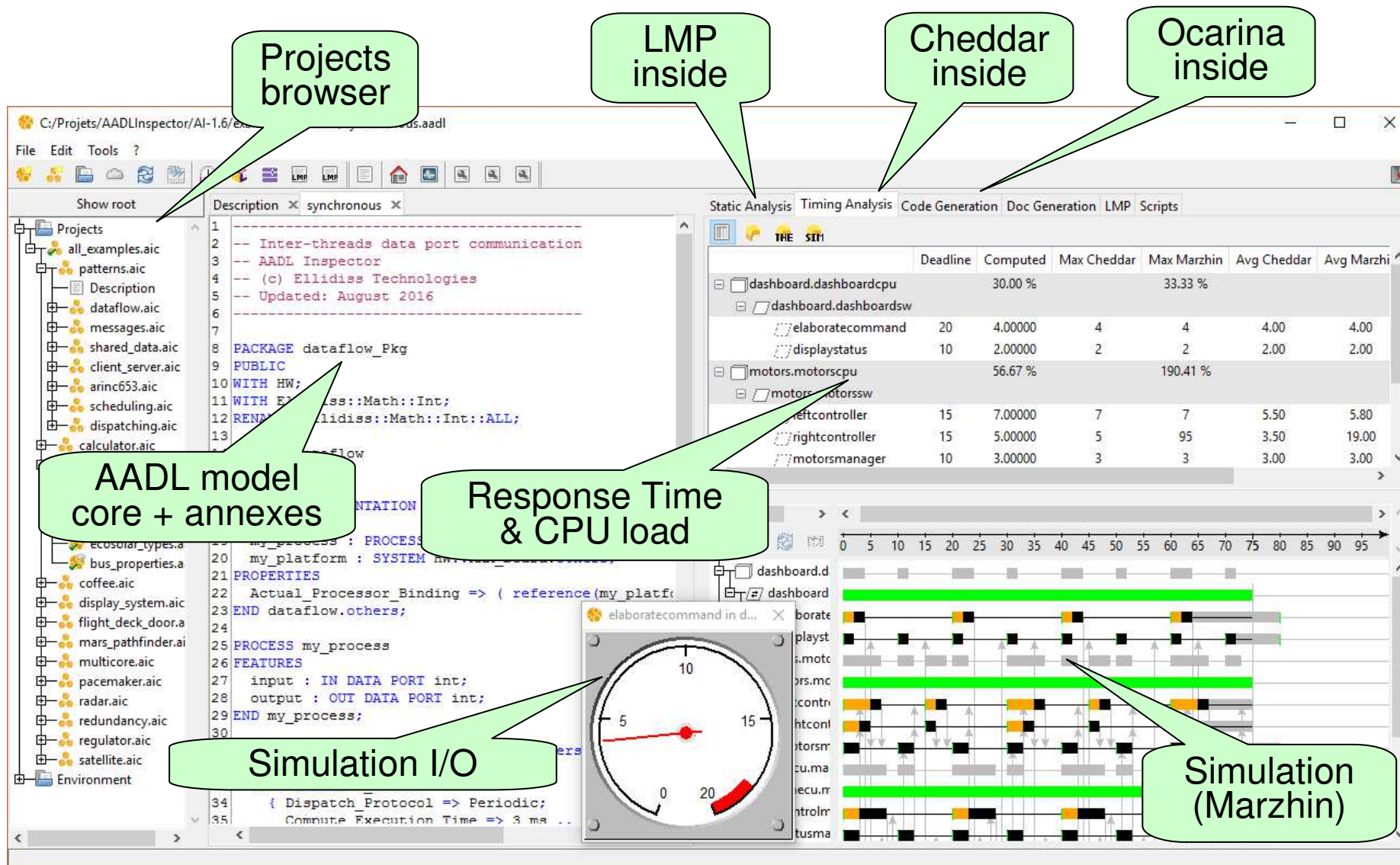
incremental
documentation

instance model
graphical editor

Top-Down modeling process for AADL

- Offers an industry proven practical modeling process to AADL designers
- Hierarchical Object Oriented Design (HOOD)
 - Inherits 20 years usage for the biggest European avionics projects (Airbus, Eurofighter)
 - Architectural Design (diagrams):
 - hierarchy of components with rigorous visibility rules:
 - enable safe subcontracting (sub-trees)
 - ease testing, integration and maintenance
 - prevent from producing "spaghettiware"
 - Detailed Design (structured text):
 - keep track of design decisions
 - requirements coverage
 - supporting framework for design documentation, coding and testing
- Benefits for the AADL user (cf. Stood for AADL)
 - Graphical editor of the AADL Instance Model (what you design is what you get)
 - Data Hiding enforcement (visibility rules, no provides data access)
 - AADL Declarative Model generator (textual AADL) for early verification activities
 - Complement AADL design activities with detailed design (documentation and coding)

AADL Inspector



The screenshot shows the AADL Inspector interface with the following components and callouts:

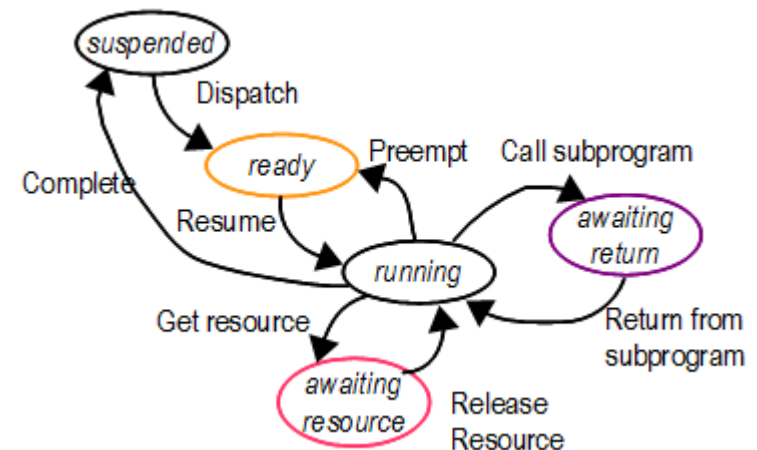
- Projects browser:** A tree view on the left showing a hierarchy of projects and components, including 'all_examples.aic', 'patterns.aic', 'dataflow.aic', 'messages.aic', 'shared_data.aic', 'client_server.aic', 'arinc653.aic', 'scheduling.aic', 'dispatching.aic', 'calculator.aic', 'ecosolar_types.aic', 'bus_properties.aic', 'coffee.aic', 'display_system.aic', 'flight_deck_door.aic', 'mars_pathfinder.aic', 'multicore.aic', 'pacemaker.aic', 'radar.aic', 'redundancy.aic', 'regulator.aic', and 'satellite.aic'.
- AADL model core + annexes:** A callout pointing to the 'Description' tab, which displays AADL code for a 'synchronous' package. The code includes package declarations, properties, and features for a dataflow package.
- Response Time & CPU load:** A callout pointing to the 'Static Analysis' tab, which displays a table of analysis results. The table includes columns for Deadline, Computed, Max Cheddar, Max Marzhin, Avg Cheddar, and Avg Marzhin. The data is organized by component, showing values for 'dashboard.dashboardcpu', 'dashboard.dashboardsw', 'motors.motorscpu', and 'motors.motorssw'.
- Simulation I/O:** A callout pointing to a circular gauge in the bottom center, which displays a numerical value (approximately 10) and a red needle.
- Simulation (Marzhin):** A callout pointing to a Gantt chart in the bottom right, which displays a timeline of events and resource usage for various components.
- LMP inside:** A callout pointing to the 'LMP' tab in the top menu bar.
- Cheddar inside:** A callout pointing to the 'Code Generation' tab in the top menu bar.
- Ocarina inside:** A callout pointing to the 'Scripts' tab in the top menu bar.

Component	Deadline	Computed	Max Cheddar	Max Marzhin	Avg Cheddar	Avg Marzhin
dashboard.dashboardcpu		30.00 %		33.33 %		
dashboard.dashboardsw						
elaboratecommand	20	4.00000	4	4	4.00	4.00
displaystatus	10	2.00000	2	2	2.00	2.00
motors.motorscpu		56.67 %		190.41 %		
motors.motorssw						
leftcontroller	15	7.00000	7	7	5.50	5.80
rightcontroller	15	5.00000	5	95	3.50	19.00
motorsmanager	10	3.00000	3	3	3.00	3.00

Marzhin

Executable AADL

- Multi-agent real-time simulator:
 - Based on a pre-existing multi-agent kernel
 - Specialized agents to represent real-time software constructs:
 - Processor and scheduler
 - Process and partition
 - Thread and shared data
 - Ports and connections
 - Bus and bus messages
 - The agents interact together and exhibit a global behavior
- Implementation of the AADL run-time
 - Standard run-time semantic
 - Details with the Behavior Annex (subset of)
 - Supports TSP & multicore (AMP,SMP,BMP)
 - Generates system state changes events
- Accepts user interaction
 - Can be controlled by scenarios or dialogs
 - Used to display simulation traces
 - Used to animate 2D/3D graphics

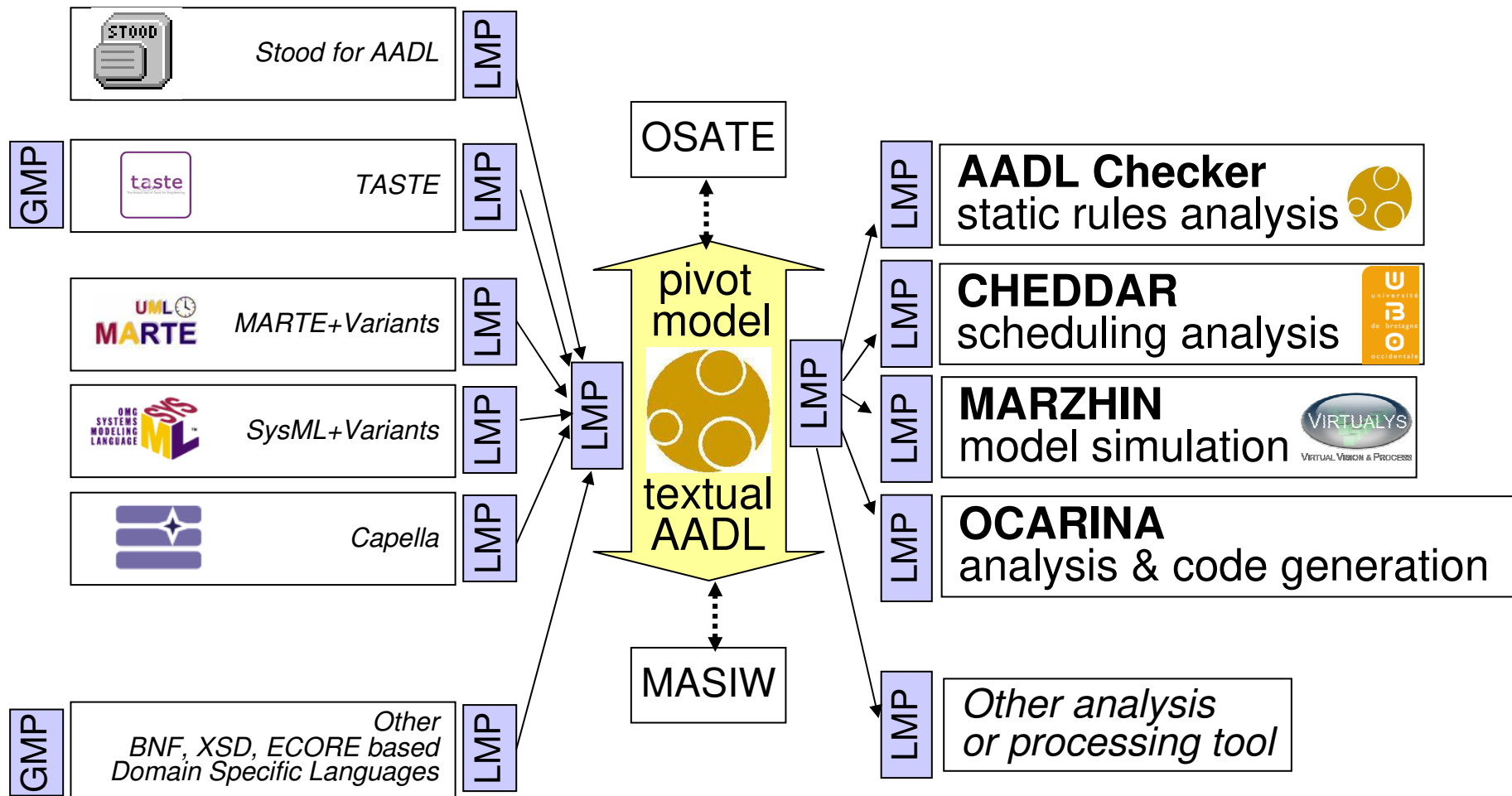


AI 1.6 Features

- AADL projects manager
 - core 2.2 + annex sub-languages EMV1, EMV2, BA 2.0
 - interface with other AADL editors (Osate, Stood, ...) and github access
 - hierarchical project structure:
 - AADL environment (libraries, property sets)
 - sharable sub-projects
 - simulation scenarios
 - documentation sections (text, pictures)
- Imports XML/XMI models
 - generic transformation process for ECore based models using LMP
 - existing prototypes for UML/MARTE, SysML, Capella, ...
 - require precise mapping rules to be formalized (project dependent)
- AADL model processing
 - turnkey embedded tools:
 - Cheddar (scheduling analysis)
 - Marzhin (event based simulation)
 - Ocarina (AADL compliancy analysis, code generation)
 - customizable plugins using the LMP toolbox:
 - AADL and XML parsers
 - prolog engine
 - AADL processing libraries (instance model, legality rules, ...)



AADL based tool-chains



AADL related projects

- Cheddar
 - collaboration with the University of Brest (F. Singhoff & all)
 - multicore scheduling analysis (SMP, BMP)
 - cache aware scheduling (priority assignment, scheduling simulation)
 - network on ship scheduling analysis (NoC)
 - partitioning methods, multi objective optimization
- European Robotic Goal-Oriented Autonomous Controller (ERGO)
 - EC funded collaborative project: www.h2020-ergo.eu
 - reuse/improvement of the TASTE tool chain (AADL based)
 - part of a bigger project about Space Robotics: PERASPERA
- Other topics of interest (but not funded yet...)
 - Safety Analysis support in AADL Inspector
 - interfacing with existing tools (i.e. COMPASS)
 - possible use case: ship Dynamic Positioning system
 - Security Modeling & Analysis
 - possible collaboration with Telecom Bretagne/French Navy (PhD student)
 - contribution to the AADL security annex ?
 - FMI/FMU support in AADL Inspector (Marzhin)
 - AADL subsets (needed for tool set specification)

Conclusion

- **COTS tools**
 - Stood for HOOD: software design and coding (Ada, C)
 - Stood for AADL: instance model graphical editor for AADL
 - AADL Inspector: analysis and simulation
 - AADL Builder (future product)
 - LMP Designer (future product)
- **Technology**
 - LMP: model processing toolbox (prolog)
 - GMP: DSL graphical editor framework
- **Services**
 - Tools support
 - AADL consulting
 - Graphical front ends development
 - Model processing tools (rules checkers, generators)
 - Model transformations
 - Heterogeneous tools integration
 - R&D partnerships