CONCERTO

The CONCERTO project: a open source methodology for designing, deploying, and operating reliable and safe CPS systems

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The CONCERTO Project

ARTEMIS JU project

Call 2012

Technical Coordinator

Intecs

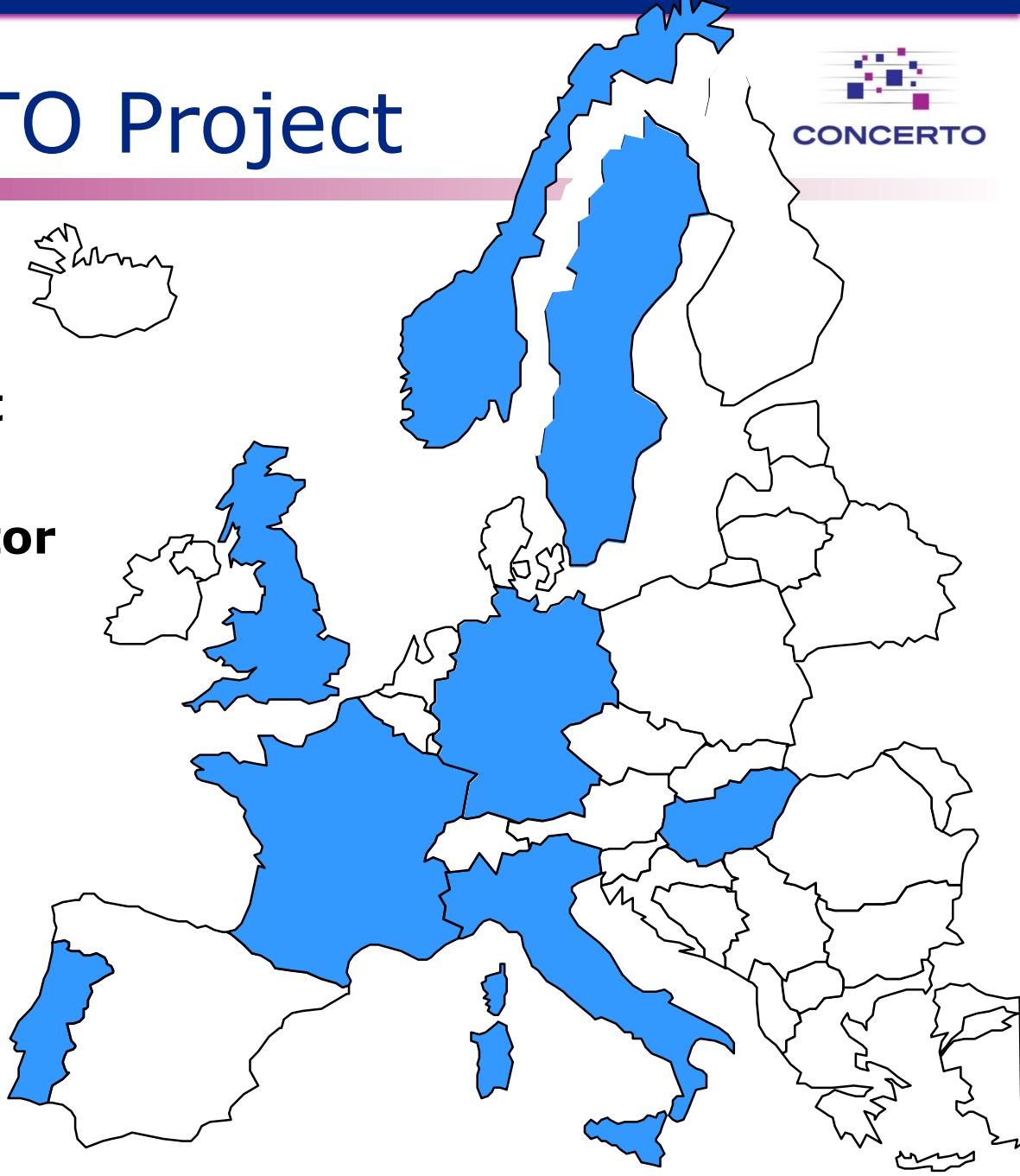
Partners 15

Countries 8

Start May 2013

End April 2016

Total cost 9,6 M €



CONCERTO Partners

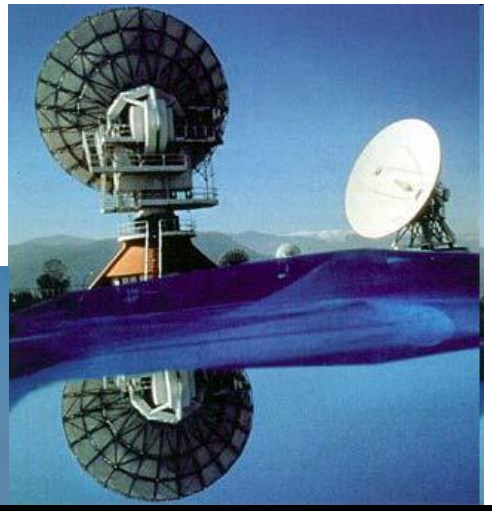
- Industrial Partners
  - Thales Communications & Security (F)
  - EADS (F)
  - Oilfield Technology Group (N)
  - Aensys Informatikai (BU)
  - Intecs (I)
  - X/Open Company Limited-The Open Group (UK)
  - ATEGO (F)
  - AICAS (D)
  - CSW (P)
- Research Centres
  - ISEP (P)
  - SINTEF (N)
- Universities
  - University of Padua (I)
  - Maelardalen University (SW)
  - University of Florence (I)
  - Budapest University of Technology and Economics (BU)

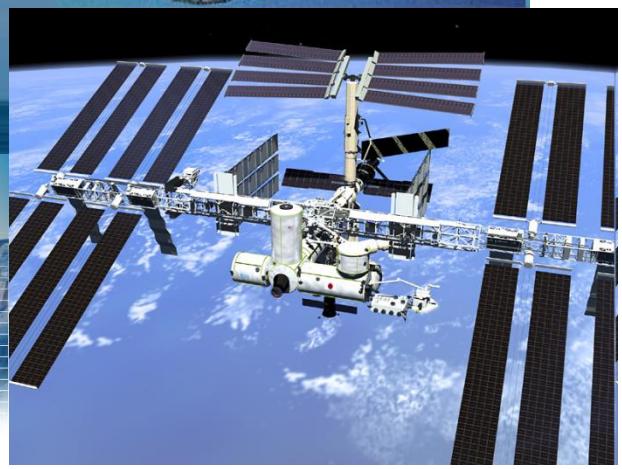
CONCERTO Objectives

- "Guaranteed Component Assembly with Round Trip Analysis for Energy Efficient High-integrity Multi-core Systems"- ARTEMIS JU Call 2012
  - Correctness-by-construction for multicore systems through model-driven engineering
  - Advanced hardware modelling capabilities
  - Enhanced hierarchical, multi-domain component model
  - Support for separation of concerns into the multi-domain, multicore environment
  - Wider coverage of industrial domains
- Building on the results of the CHESS project (ARTEMIS-2008-1-100022)

CONCERTO application areas

- Space
- Avionics
- Petroleum
- Medical
- Telecom
- Automotive



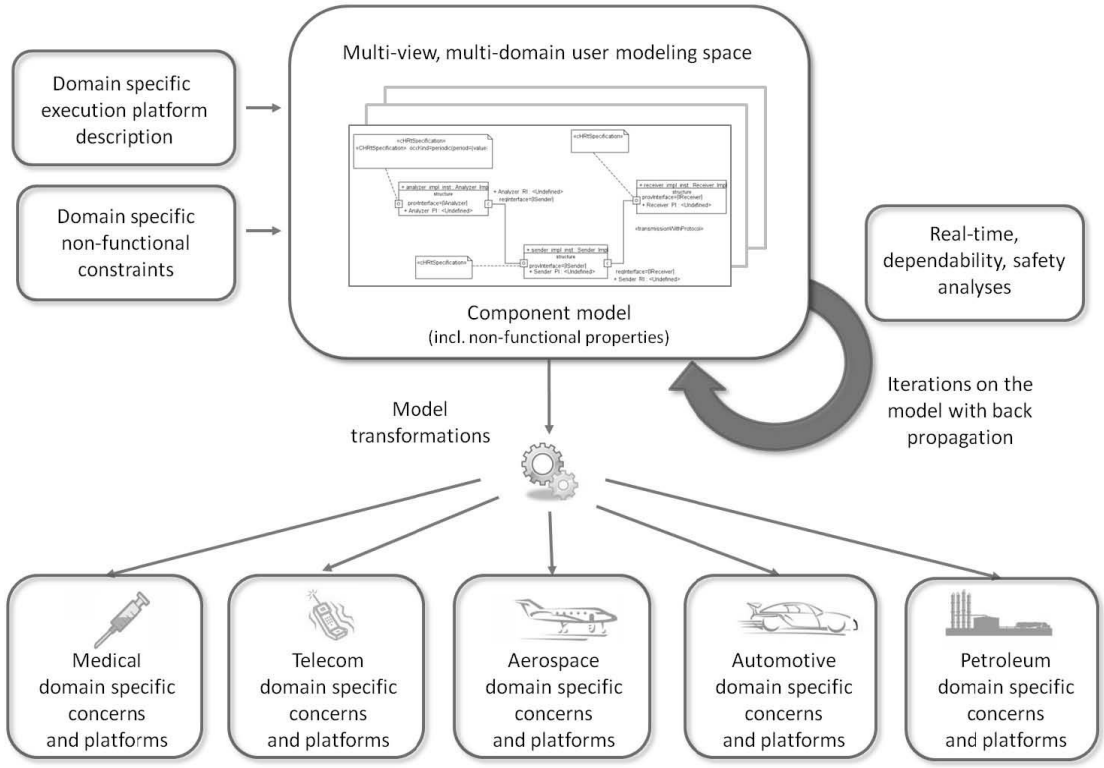


CONCERTO industrial use cases

- Medical by AENSys
- Petroleum by OTG
- Telecom by Intecs Telecom
- Automotive Multi-criticality Infotainment by Critical Software
- Automotive AUTOSAR conformance by Intecs
- Avionics by AIRBUS
- Space by Thales for Thales Alenia Space
- Space by AIRBUS for ASTRIUM SAT

Building on the CHESS technical approach

- A multi-view, hierarchical cross-domain design space for complex next generation platforms
- Correctness-by-construction, iterative and incremental development
- Hardware modelling facilities equipped for partitioned, mixed criticality and multicore platforms
- Early model-based analysis, with automated back propagation
- Automated code generation
- Run-time monitoring of non-functional properties

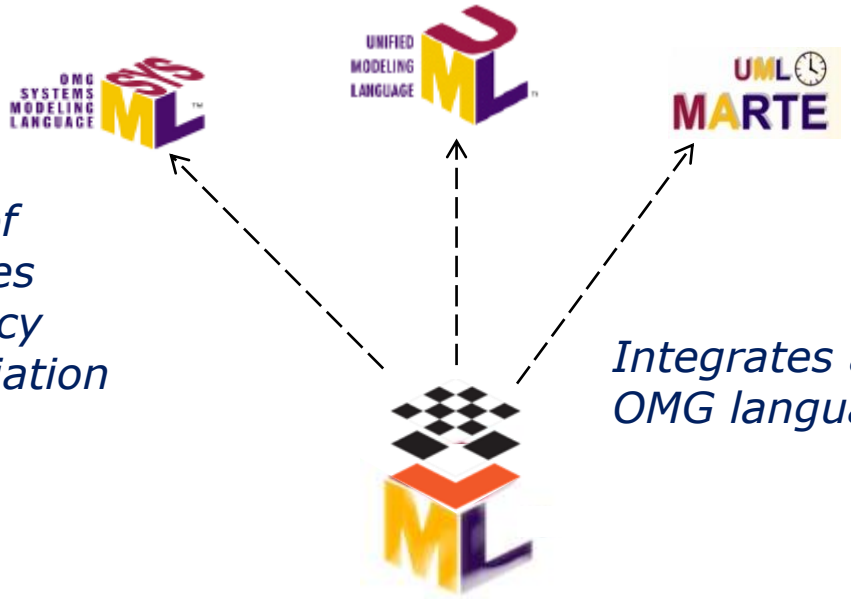


The Modeling Language

Standard profile for System (and Requirements) Modeling

Standard Unified Modeling Language

Standard profile for Modeling and Analysis of Real-Time and Embedded Systems



Imports subsets of standard languages
✓ avoid redundancy
✓fix semantic variation points

Integrates and extends standard OMG languages

Introduces a ***Dependability Profile***

The component model

Exposes a set of cohesive functional services

Reuse of components under different extra-functional concerns → increased reuse potential

enables

A component is a *pure functional unit*

Declares the functional services required from other components or the system to operate correctly

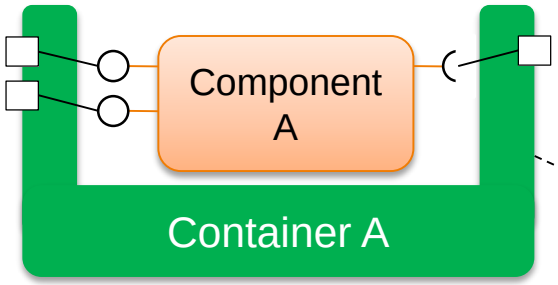
Declares the applicable extra-functional constraints and requirements in terms of *annotations* of its functional interface

The source code of components is pure sequential code.

Extra-functional concerns are realized (and warranted) by the component model infrastructure

CHESS container and connector

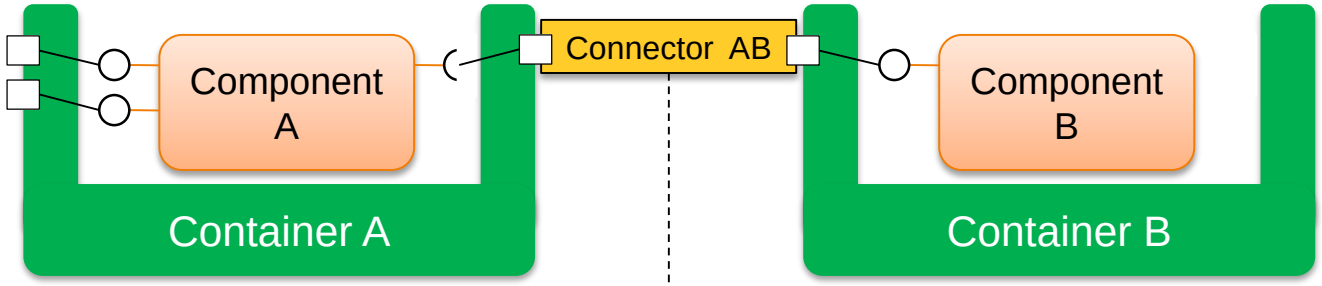
Container



-Wrapper responsible for the declared extra-functional attributes (e.g. the realization of tasking, timing behavior, fault containment and fault tolerance)

- Provides the component with a mediated connection with the execution platform and the system in general

Connector



- Addresses interaction concerns
- Decouples the component from the other end-point(s) of a communication
- Realizes connection properties (best-effort, at most once, exactly once)
- E.g. procedure/function call, remote message passing, I/O file operation, …

The CONCERTO process

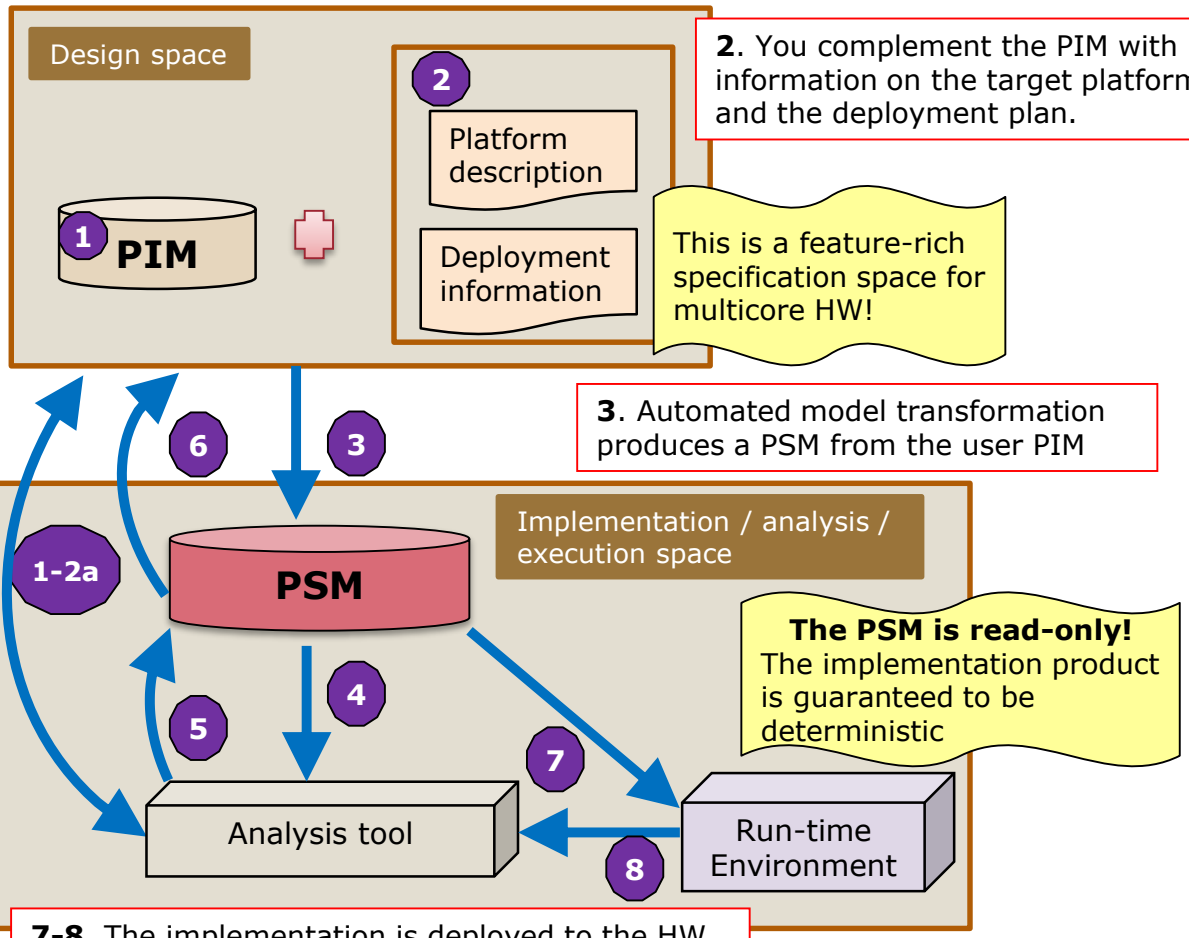
1. You construct a PIM to represent your solution to your problem, independent of any specific implementation.

1-2a. Dependability/safety analysis is performed at PIM system/SW and platform specification level, with back propagation of analysis results.

4. Real-time relevant analysis is performed on the PSM

5-6. The analysis results are back propagated to the PSM and to the PIM

The user iterates the 1-6 cycle as many times as needed



2. You complement the PIM with information on the target platform and the deployment plan.

3. Automated model transformation produces a PSM from the user PIM

7-8. The implementation is deployed to the HW, with run-time verification support if needed. Run-time monitoring is activated to grab live data for run-time monitoring analyses and back propagation of results, as in **5-6.**

Cross-domain Core Methodology

- Reaching the final version of the CONCERTO Methodology and Toolset
  - Consolidation of the CONCERTO Modelling Language and Multi-concern Component Methodology
    - Matlab/Simulink Synchronous Block Diagrams (SBDs) support
    - Inter-component interactions and end-to-end response time analysis
    - Multicore deployment
    - Timing analysis for multicore: scheduling and workload analysis
    - Dependability profile and analysis
    - Modeling criticality
    - Run-time monitoring, with back propagation
    - CONCERTO Failure Logic Analysis (FLA)
    - Extensions to State Based Analysis
- Migration to Polarsys/Maturation of the toolset
  - Most of the tools are delivered to Polarsys

Specialized and Domain-specific Features

- Petroleum domain
  - Modelling and analysis for monitoring of safety barriers of petroleum installations
- Telecare domain
  - Definition of a specific profile
  - Sirius integration in the CONCERTO framework
  - Dependability analysis
  - Code generation
- Automotive domain
  - AUTOSAR conformance
  - ASIL association
  - Mixed criticality for infotainment
- Avionics Domain
  - Conformance with the ARINC-653 IMA principles

MyCCM and ARTISAN

- Transfer of CONCERTO concepts to MyCCM
  - Extensions for modelling of component behaviour and execution environment
  - Enhanced MyCCM Generation Chain
- Extensions to PTC's Integrity Modeler
  - Support to the CONCERTO Methodology
  - Target to MyCCM

Future Extensions

- Within the AMASS Project
  - Extensions of the contract-based approach
  - Formalization of multi concern assurance properties of the architectural components
  - Integration with the AMASS assurance framework and toolchain
  - Improve reuse support

Questions?