ARTEMIS 2013 AIPP5

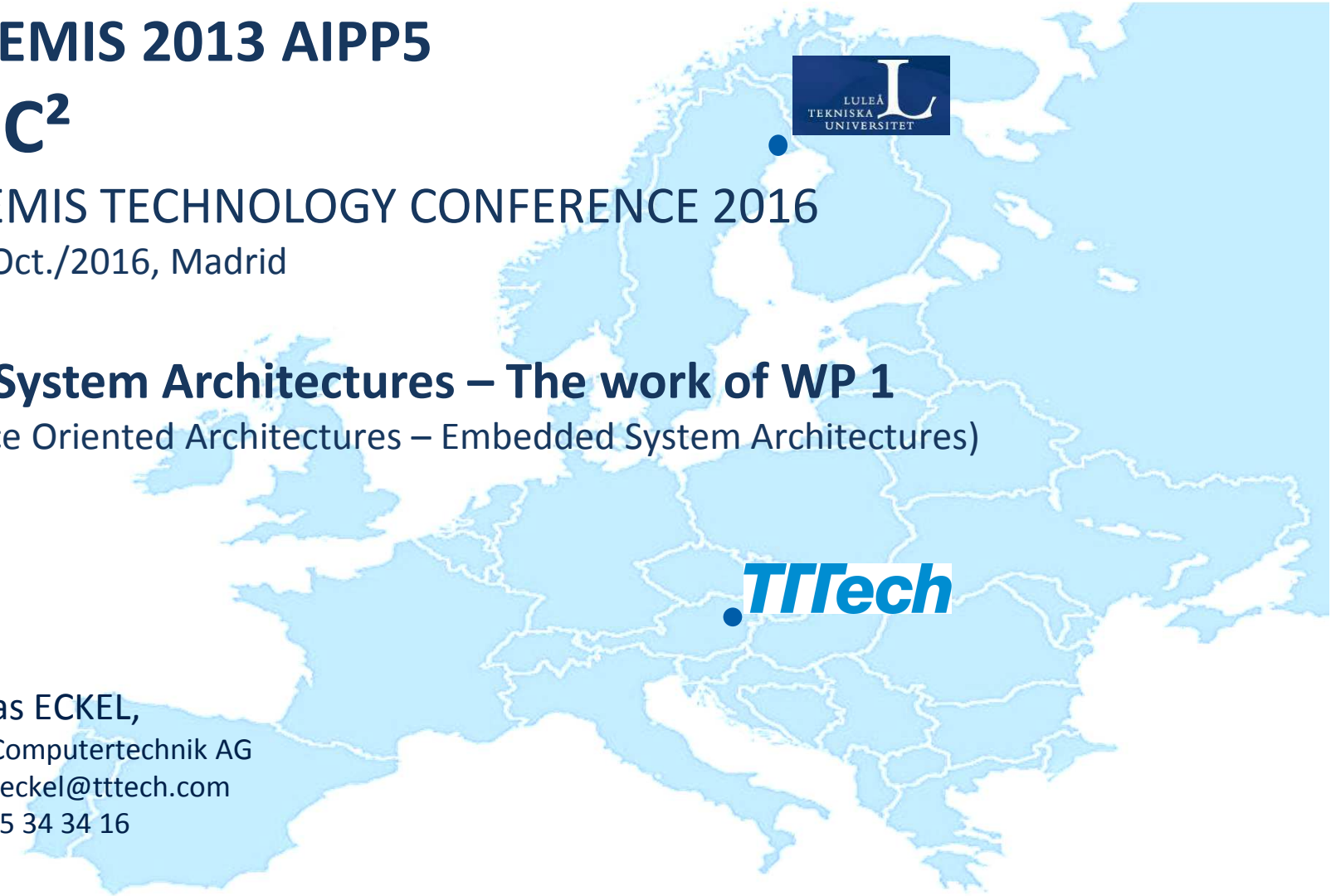
EMC²

ARTEMIS TECHNOLOGY CONFERENCE 2016

4 – 6/Oct./2016, Madrid

SoA System Architectures – The work of WP 1

(Service Oriented Architectures – Embedded System Architectures)



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AGENDA

- WP 1 Overview
- SoA Approaches in Previous EC Funded Projects
  - ARROWHEAD
    - Advances Beyond Predecessor Projects
    - Applications
  - GENESYS / INDEXYS / ACROSS
    - Advances Beyond Predecessor Projects
    - Applications
- Conclusions

WP 1 Overview (1/2)

WP 1: Service Oriented Architectures – Embedded System Architecture

- 37 Partners contributing, 381 MM
- Objectives:
  - Architecture enabling an open system of networked computation units based on requirements, constraints, goals/objectives, suitable for IoT & SoS
  - A particular set of functional & non functional services
    - Interoperability and integrability with service oriented frameworks
    - System validation, qualification and certification
    - Static, quasi-static and dynamic provision of computational resources to application services

WP 1 Overview (2/2)

WP 1: Service Oriented Architectures – Embedded System Architectures

- Application Services
  - System security
  - System functional safety, fault tolerance, dependability
  - System service criticality capabilities
  - Real time constraints
  - Energy efficiency and optimal computational performance
  - System robustness and fault tolerance
  - Performance predictability from application services centric point of view
  - Variability adaptability for changes in application services

- Take the results from previous projects towards supporting multicore support suited for IoT & SoS application

SoA Approaches in Previous EC Funded Projects

Arrowhead – IoT, Clouds & Collaborative Manufacturing

- Coordination: Lulea Technical University of Sweden
- Coordinator: Prof. Jerker DELSING
- ARTEMIS JU Call 2012
- Eligible Cost: 67,52 M€
- EU Funding: 11,29 M€

GENESYS/INDESYS/ACROSS – Partitioning in safety-critical Multicore Control Systems

- **GENESYS:**
  - FP7 Project
  - Lead: TU Vienna, Dr. Roman OBERMAISER
- **INDEXYS:**
  - ARTEMIS JU Call 2008
  - Lead: TTTech Computertechnik AG, Andreas ECKEL
- **ACROSS:**
  - ARTEMIS JU Call 2009
  - Lead: TU Vienna, Dr. Christian El Salloum

Arrowhead Overview (1/4)

SoA Key Properties:

- Loosely coupled
  - Autonomy
  - Distributed
  - Owner is responsible and owns the information and decide whom to share to
- Late binding
  - Possible to use information anytime by connect to the correct resource at a given time
- Lookup
  - Publish and register for notify others about endpoint (how to reach me)
  - Discover others that I comply to (expected/wanted Service Type)

Arrowhead
Overview (2/4)

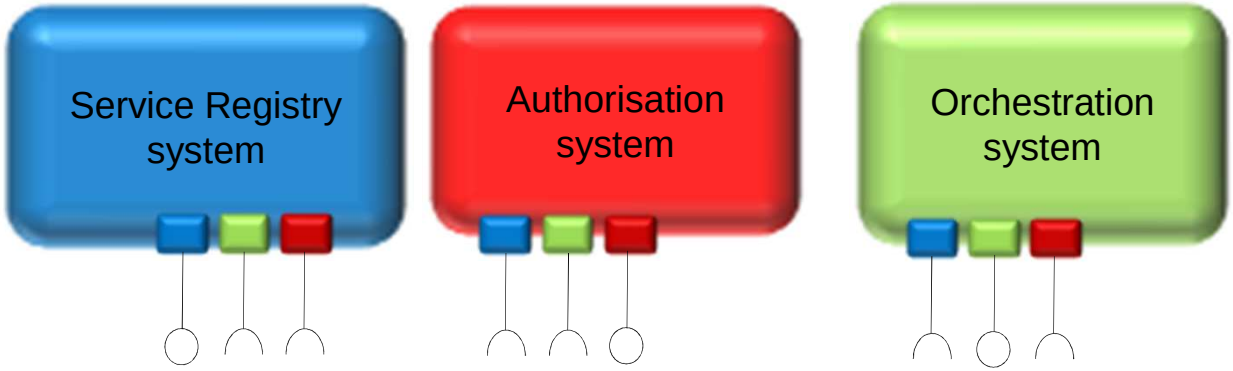
Fundamental Approaches in Arrowhead:

- Information centric
- Information assurance at service exchange level
- Publish subscribe approach
- Push approach - Pull possible
- Minimal set of mandatory services in a System of Systems

Arrowhead
Overview (3/4)

Principles, Properties and Fundamentals:

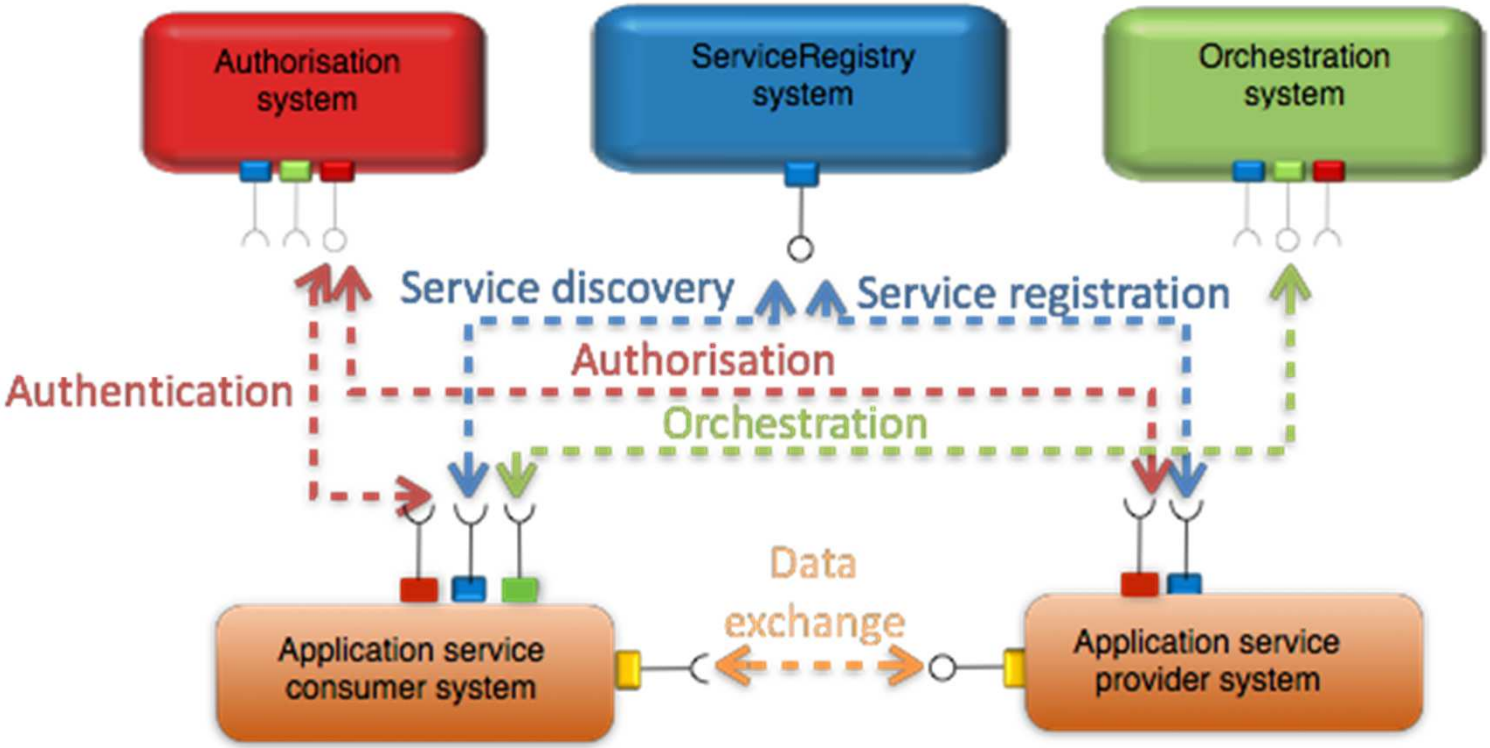
- Provided by:
  - A minimal set of mandatory services to create a System of Systems
  - A set of automation support services - facilitating design of application System of Systems



Arrowhead
Overview (4/4)

Local Clouds:

- Local cloud usage of mandatory core systems
  - Authentication and Authorization
  - Service registration and discovery
  - Service orchestration



Arrowhead – Connecting Local Clouds

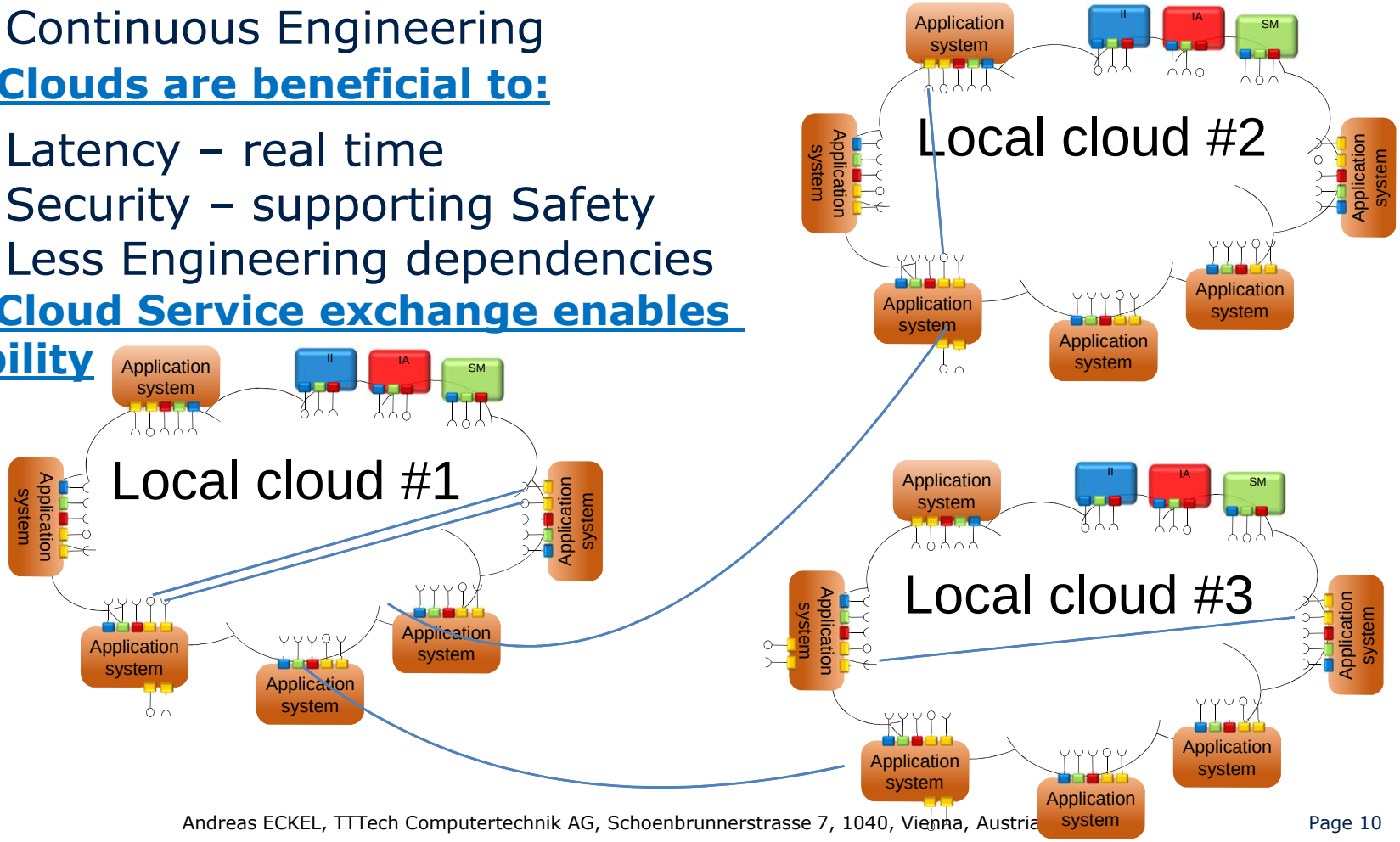
Automation is local - requirements on:

- Real Time
- Security & Safety
- Continuous Engineering

Local Clouds are beneficial to:

- Latency – real time
- Security – supporting Safety
- Less Engineering dependencies

Inter Cloud Service exchange enables scalability



Application Examples Arrowhead

Railway:

- Bearing wear monitoring

IoT:

- Recycling Application

Construction Machines:

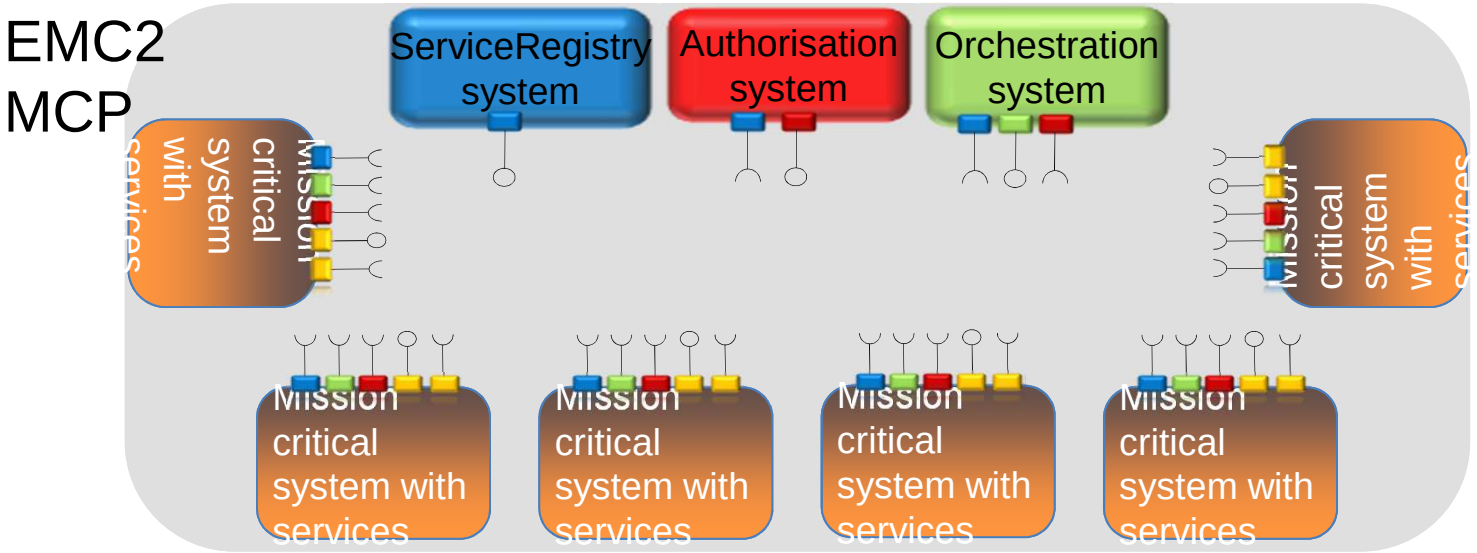
- Wheel Loader

… and multiple others

Advances Beyond Predecessor Projects (1/3)

Enhance Arrowhead towards Multicore support:

- Put the Arrowhead Elements on a multicore chip

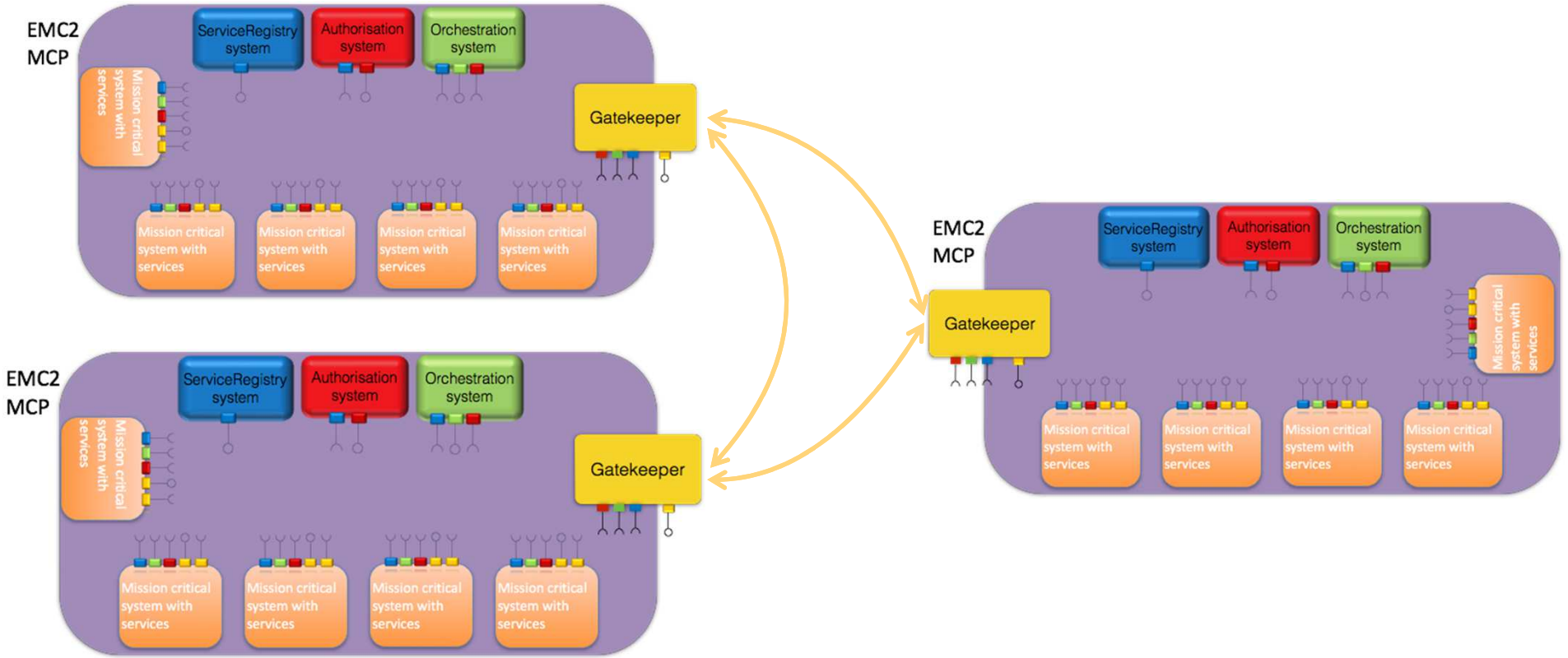


Support Collaborative Automation in the Cloud

Advances Beyond Predecessor Projects (2/3)

Enhance Arrowhead towards multiple MCPs:

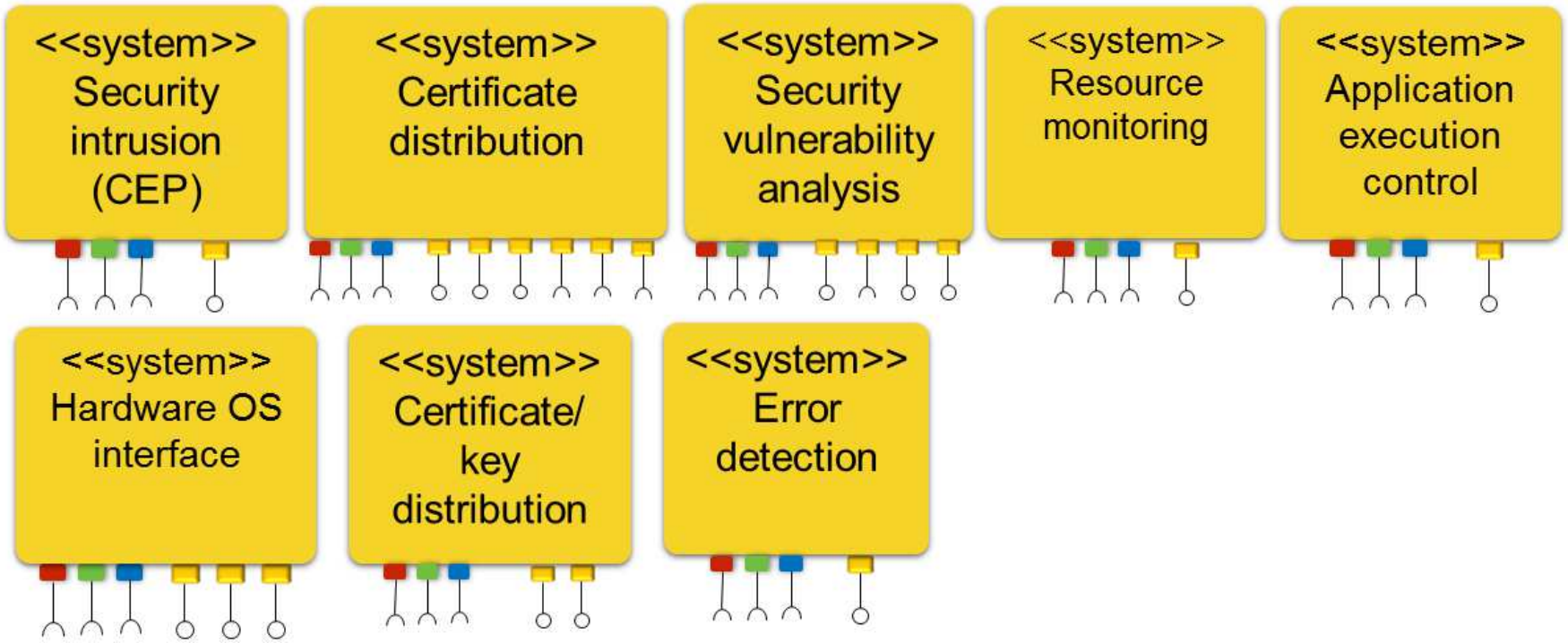
- Interconnecting MCP - Local cloud properties preserved



Advances Beyond Predecessor Projects (3/3)

Enhance Support Services:

- Based on EMC2 requirements
- To be defined in details during last year of EMC2
- To support connection of local clouds via IoT and still provide the services such as security etc.

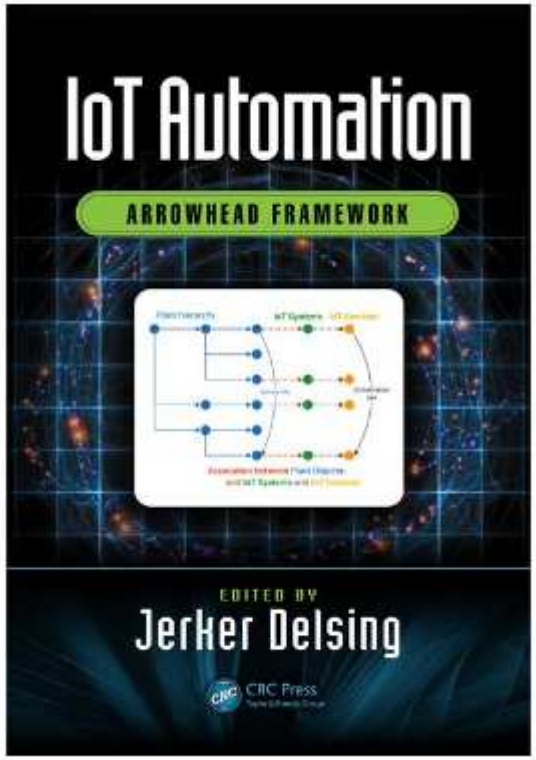


Arrowhead Book

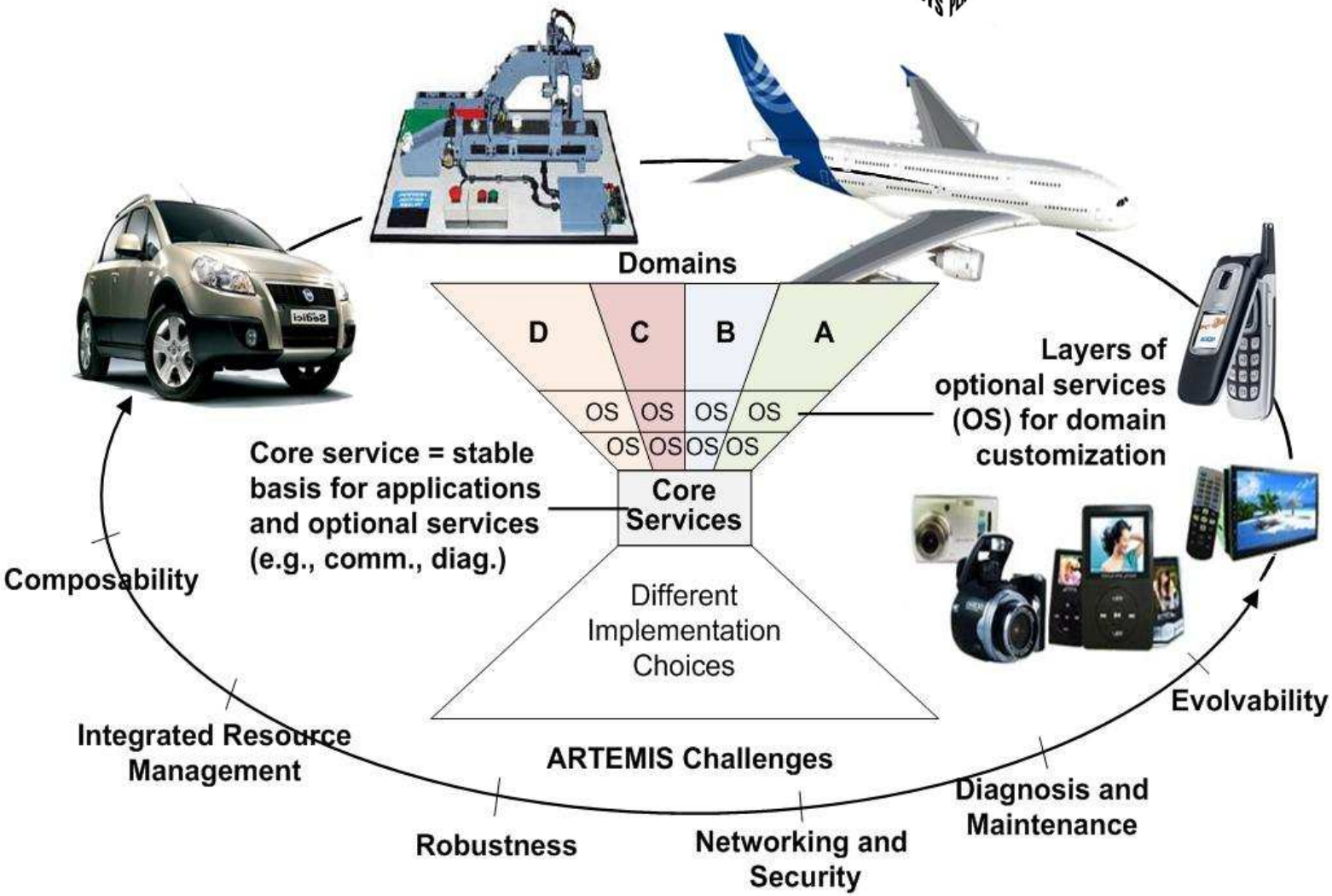
Arrowhead Book out: "IoT Automation: Arrowhead Framework",

Prof. Jerker DELSING, CRC Press Taylor & Francis Group

https://www.crcpress.com/Arrowhead-Framework-IoT-Automation-Devices-and-Maintenance/Delsing/p/book/9781498756754Real Time



GENESYS / INDEXYS / ACROSS Approach



GENESYS / INDEXYS / ACROSS Approach

Core Services:

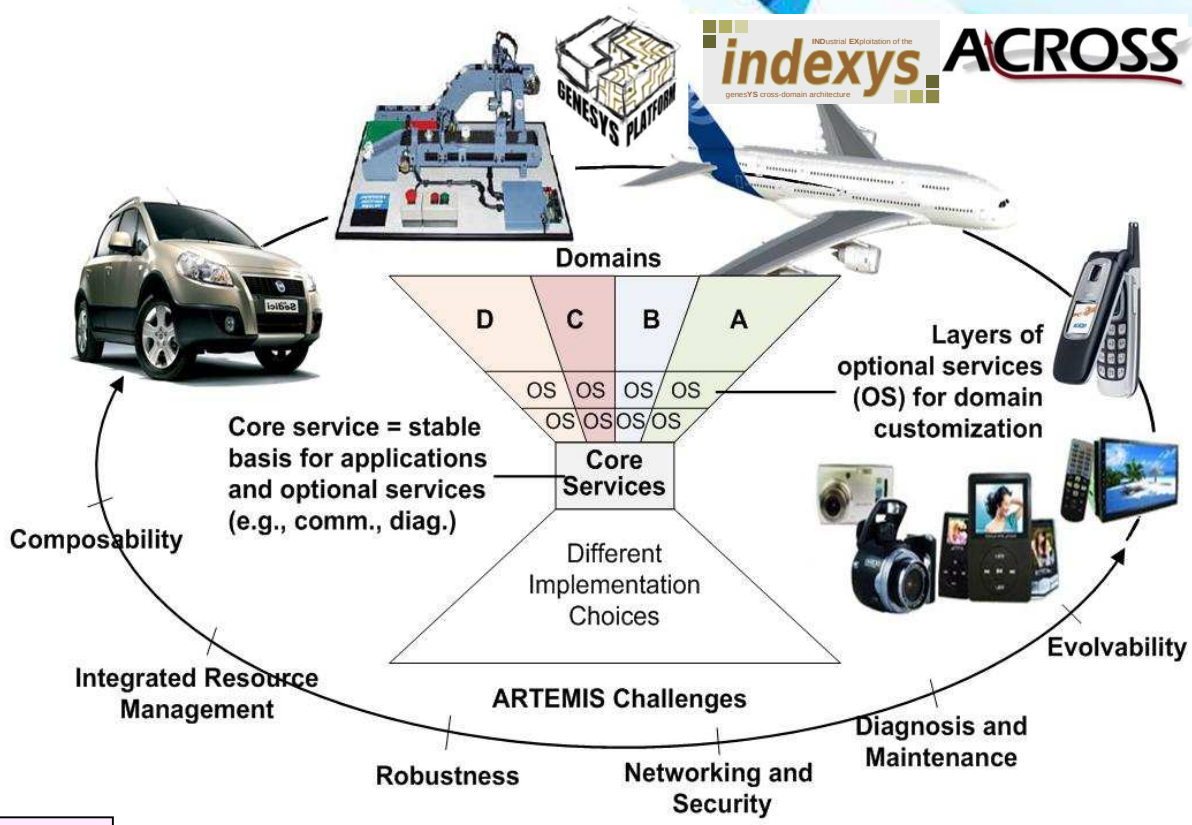
- Basic Configuration Services
- Basic Execution Control Services
- Basic Time Services
- Basic Communication Services

Optional Services:

- Diagnostic Services
- External Management Services
- Security Services
- Resource Management Services
- Gateway Services
- Mobility Services
- Generic Middleware Services

Domain Specific Services:

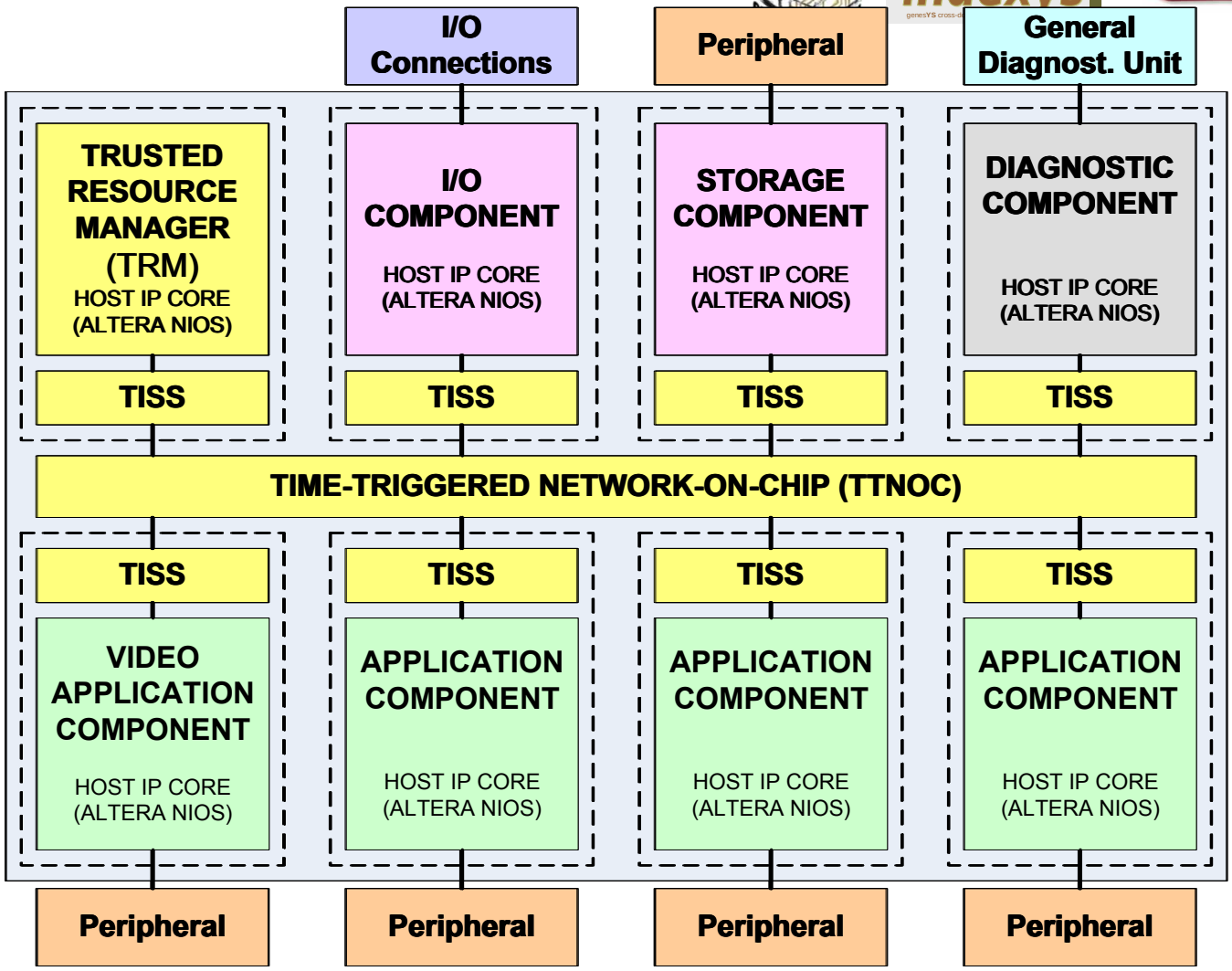
- Data Management Services
- Combined QoS & Resource Awareness
- Multimedia & Graphics
- Trust & Privacy
- Open Systems & Ambient Intelligence



GENESYS Book: „A Candidate for an ARTEMIS Cross-Domain Reference Architecture for Embedded Systems“
Publisher SVH. 208 pages, ISBN 3838110404. 2009.
R. Obermaisser, H. Kopetz (Eds.)

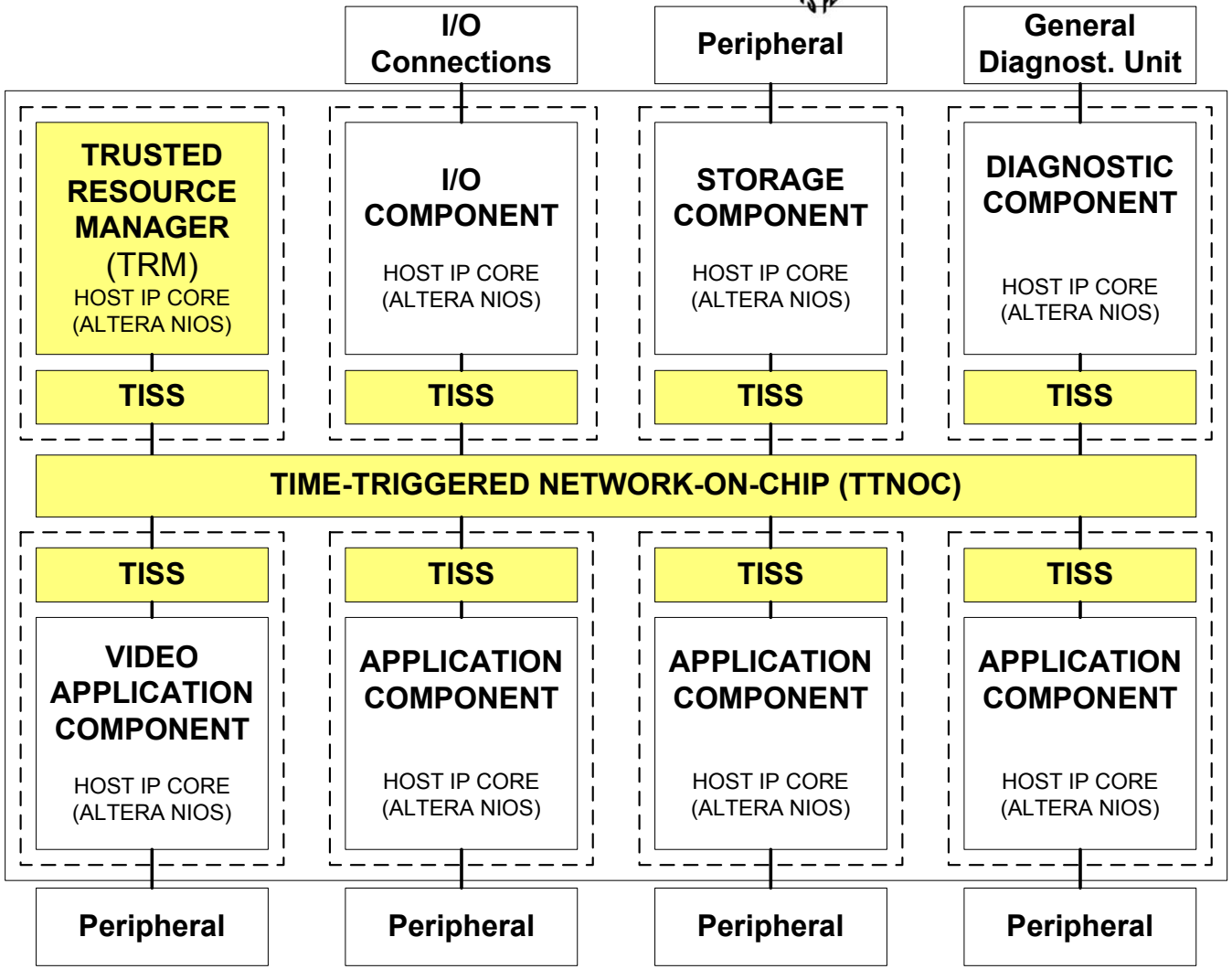
Also available for download at *www.genesys-platform.eu*

GENESYS / INDEXYS / ACROSS Approach



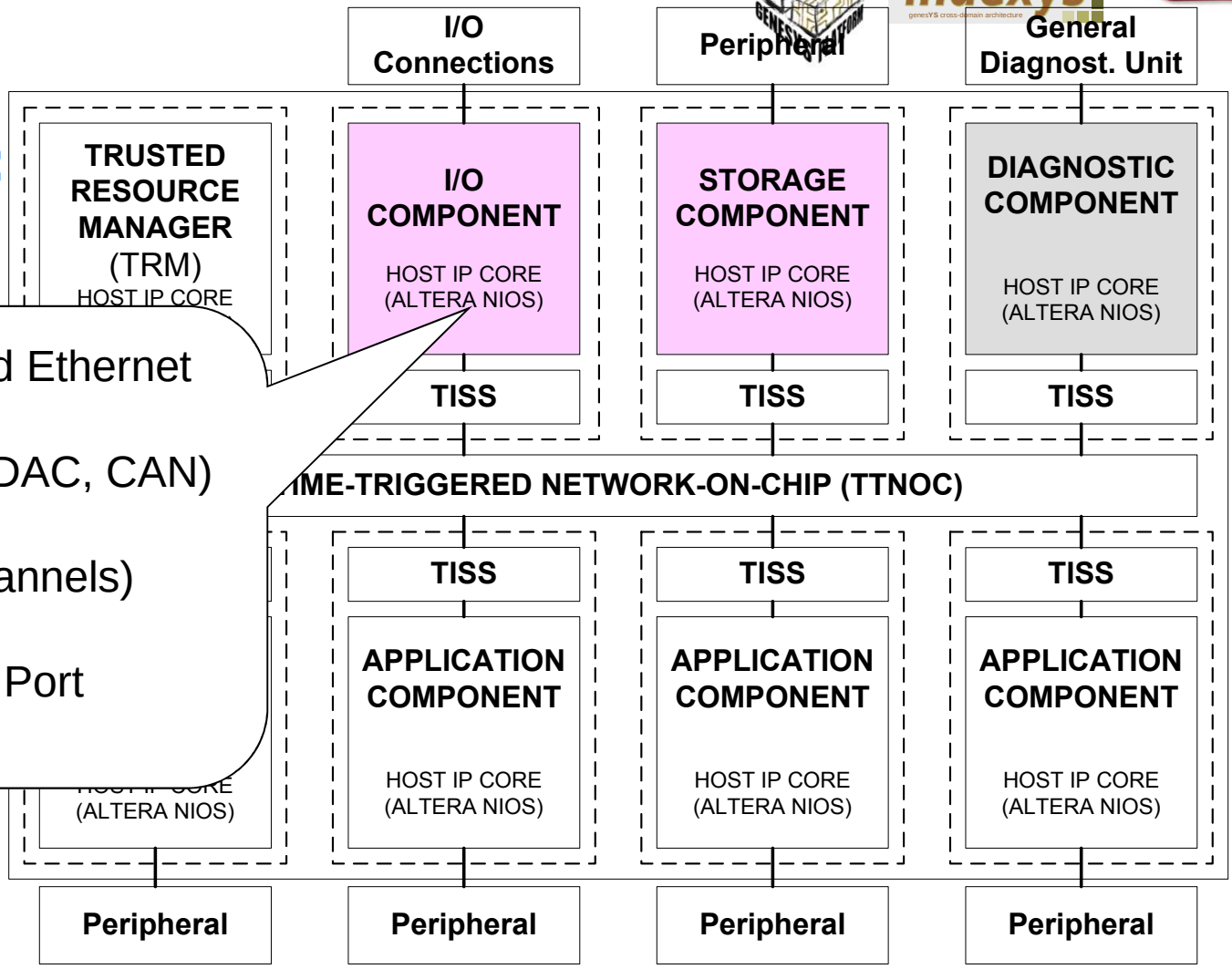
GENESYS / INDEXYS / ACROSS Approach

TTNOC:



GENESYS / INDEXYS / ACROSS Approach

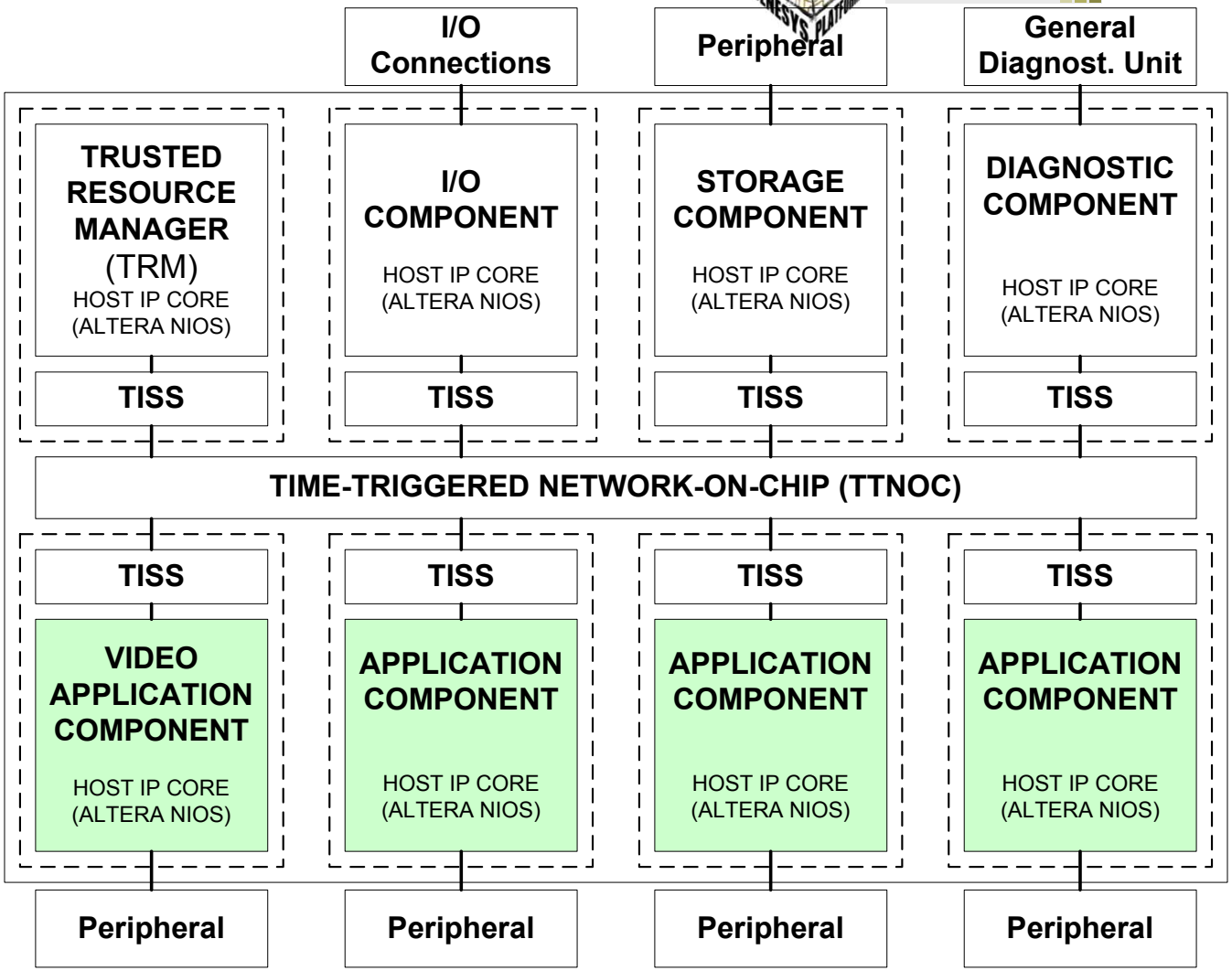
System & Diagnostic Components:



- 1x Time-Triggered Ethernet controller
- 3x M-Bus (CAD, DAC, CAN)
- 1x ANYBUS
- ARINC 429 (4 channels)
- 1x RS422 UART
- 1x Fault Injection Port
- 1x CAN Port

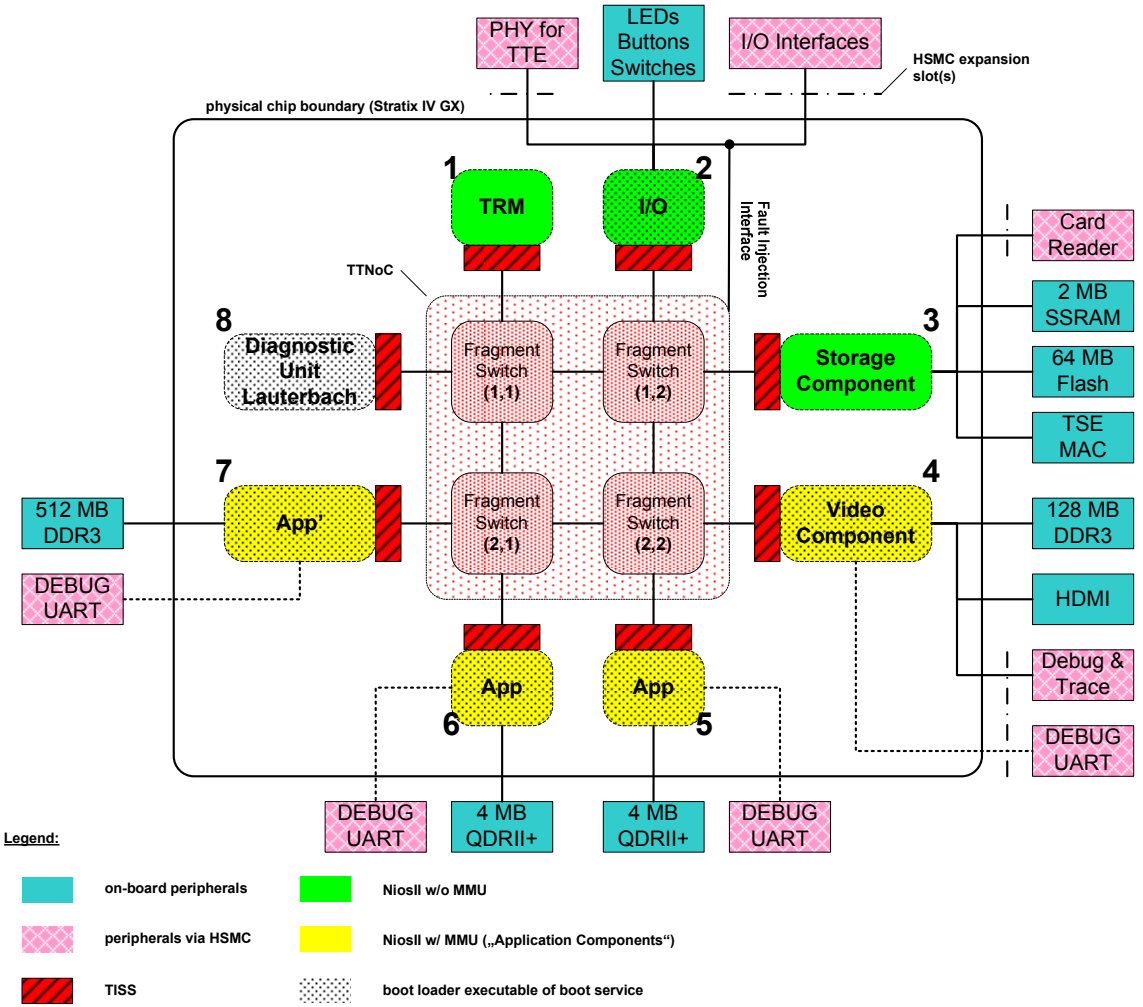
GENESYS / INDEXYS / ACROSS Approach

Application Components:



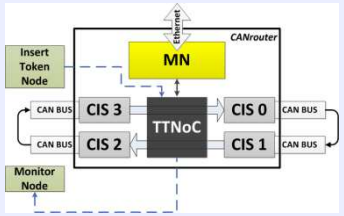
GENESYS / INDEXYS / ACROSS Approach

ALTERA VIRTEX IV FPG with 8 NIOS CORES:

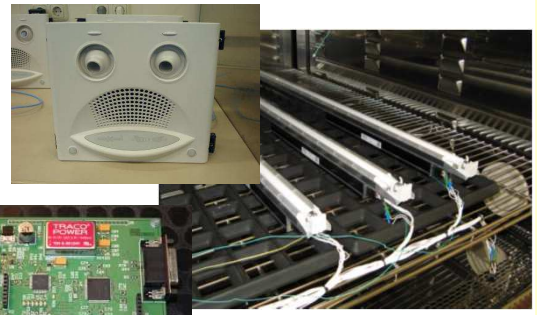


Applications/Demonstrators
GENESYS/INDEXYS/ACROSS

FlexRay Multirouter



CAN Router



Remote Data Concentrator

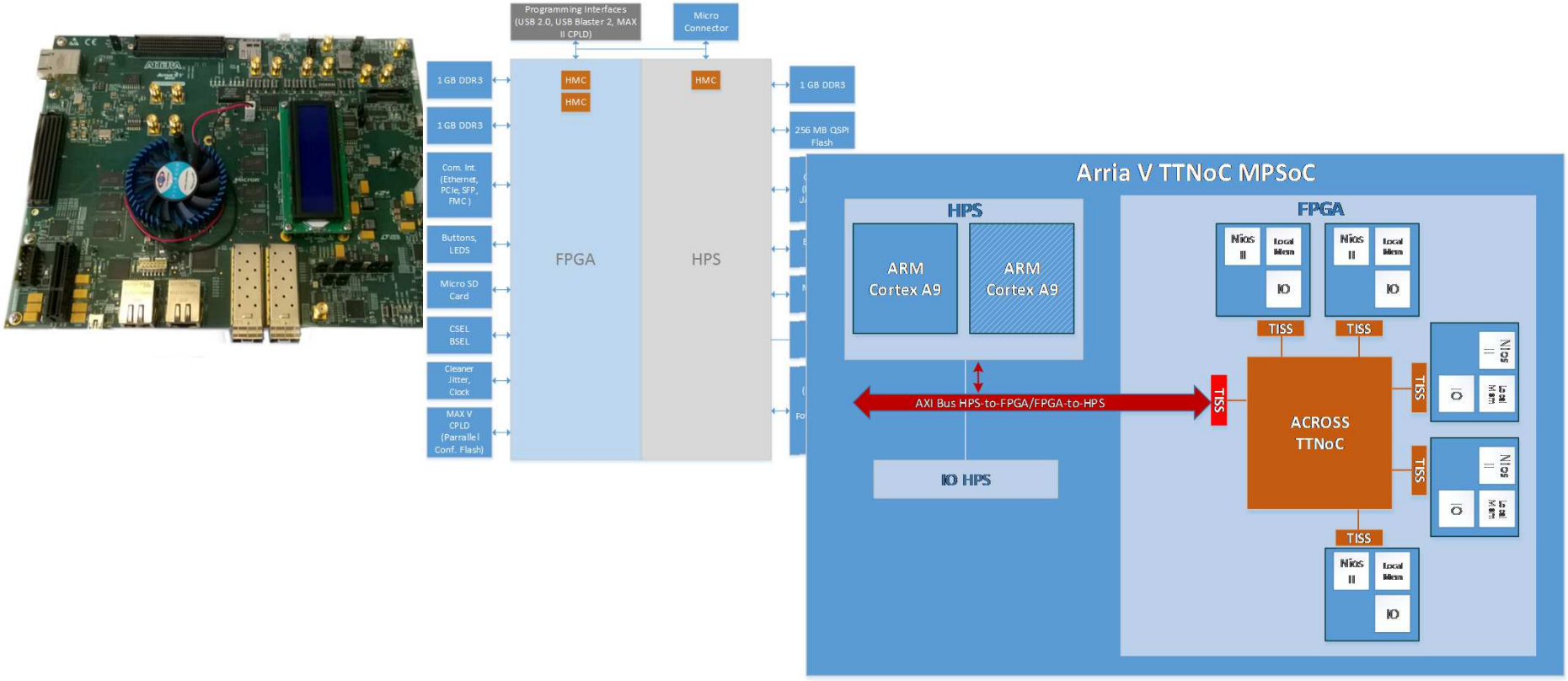
Railway Signaling

Advances Beyond Predecessor Projects

Portation To ALTERA ARRIA V Platform with dual ARM 9 CORE:

- Improve weak computing performance of NIOS CORES
- Improve weak performance of STRATIX IV Interconnect

Investigate Xilinx ZYNQ Platform



Applications

Piloted Driving
- Central Driving Computer

Space Applications
- ORION
- Ariane 6

Off- Highway Applications
- Hydraulics control

Hyperlink for video:

https://m.youtube.com/watch?v=eOYsI1cqUrw

Conclusions

The Major Messages:

- SoA used in systems design **can significantly reduce the engineering effort**. Both approaches INEPENDENTLY concluded from OEM and Customer Evaluation: there is a reduction of engineering time to be expected by 4 or 5!
- SoA are a major contribution towards offering means to standardize development approaches for IoT and ES
- SoA supports cooperation by multiple players in one and the same engineering effort for up to large scale safety relevant, security sensitive and highly automated systems
- SoA is not limited by the communication technology used
- SoA may supports hard real time needs.
- Critical automation trust requires:
  - Latency control and Security
  - Scalability
  - Ease of continuous engineering

Thank you for your attention!

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