ARTEMIS Arrowhead

interoperability solutions
motivated by the industrial automation domain

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Challenge for **Internet of Things** regarding closed groups (e.g. Automation Systems)

**Major Problem**
Systems that should cooperate as System-of-Systems have diverse needs and diverse communication features (interfaces, protocols)

**Answer:** Arrowhead Framework,
(i) setting an **interoperability and integrability philosophy**
(ii) providing **design principles** together with **documentation guidelines** that enables system designers to understand other - Arrowhead compliant - systems' capabilities and features
(iii) providing **Core functionalities** within the framework to ease the building and deployment of System-of-Systems
How to build an automation cloud?
- Requirements -

• Interoperability between devices and systems to be utilized
• Scalability
• Real time performance
• Security
• Engineering simplicity
Interoperability: Global and Local cloud approaches
Collaborative automation in the cloud

Automation is local - requirements on:

Real time
Security and safety
Continuous engineering
Scalability

Local clouds are beneficial to:

Latency - real time
Security - supporting safety
Less engineering dependencies
Inter cloud service exchange enables scalability
Collaboration and interoperability of systems
Service Oriented Architecture and the Arrowhead Framework

- to ensure interoperability and integrability

Core Systems and Services

Included in the Arrowhead Framework

Authorisation System

Service Registry

Orchestration System

Service providing system

Service consuming system
Arrowhead-compliant System of Systems – a generic example
Inter-Cloud Servicing

- **Aim:** General interoperability
- **Use cases:**
  - No local service providers matching
  - Temporarily no local resources
  - Usage of local service providers are not optimal
Issues to solve

• Global Service Discovery
• Security issues
  - Authentication
  - Authorisation
  - Accounting
• Semantic Interoperability
• Quality of Service
• Orchestration
Service Interactions through Gatekeepers

- Global Service Discovery
- Inter-cloud Negotiations
Automation engineering time

Automation is a service, based on products.
Simplicity of automation service engineering is market key.

Arrowhead Framework reduces engineering time:
From 5-6 days -> 6-8 hours (Abelko)
From 4-5 weeks to 1 week (BnearIT)
# Why & How

- Objectives
- Strategy

## Core systems & services

- Mandatory core systems and services
- Support core systems and services
- Core system prototypes
- Online deployed clouds
- Local deployment guidance

## Technical architecture

- Authorisation System
- Service Registry
- Orchestration System
- Information Exchange

## How to implement

- Java library API for Core services usage
- Application system example - Using the Core system via the Java library and example application services
- Application system examples
- Design documentation and code

## Application services

- Service specifications

## Technical documentation model

- SoSD
- SoSDD
- Compliance criteria
- Test tool
- Interoperability matrix
Can we build Arrowhead automation systems today?

Robust communication
IoT sensors, actuators, PLC:s, etc.
DCS and SCADA functionality
MES and ERP functionality
Cloud integration technology
Engineering tools cloud automation
Test tools and simulators
Migration to cloud automation
Suitable security

⇒ Products on the market
⇒ Some products on the market
⇒ First products on the market
⇒ Demonstrated in industrial env.
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Conclusions

• **Aim:**
  - Provide a generic interoperability framework for design, development, and deployment of IoT systems

• **Arrowhead Framework**
  - Service Oriented Architecture
  - Core Systems for Local Clouds

• *Inter-Cloud collaboration*
• Arrowhead reduces engineering time
• Products using Arrowhead technology
  – have already appeared; and continue to do so 😊