Building Production Automation Systems from IoT
Arrowhead Framework: concepts and basic architecture

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IoT Product Segments

Conveyor (Tier2) Components and Parts (Tier3)

- Drive Heads
- LTU & Winches
- Belt Structure
- Belting
- Pulleys
- Feeder Breakers
- Components (a.u. idlers, motors, etc.)

Suppliers of these Products are:

- Potential partners, and;
- Future Service Providers

One customer, KGHM, one component

- 120 km conveyers
- 720,000 idler bearings
The automation challenge

- Annual growths more than 10% and over 500 billion connected devices are expected worldwide by 2025. - Cisco 2013

- Massive automation systems not possible with current technologies

- Not enough many engineers on the globe to do the job with current technology
ISA-95 systems in to the cloud?
Arrowhead approaches

- TCP/IP everywhere, middleware nowhere.
  - Internet of Things - IoT
  - System of systems - SoS

The Integrating approach
- Service Oriented Architectures - SOA
Classical automation system characteristics

- Centralised controllers, DCS, SCADA, PLC,
- Pull based - time slotted streaming of all data
- Hard real time
- Design time bindings

Seams to have an upper bound of $X \times 10^5$ I/O’s
Cloud based automation systems

- Choice of centralised or distributed control and data to information computations
- Push on event or pull
- Late binding - runtime binding

- Hard real time?
The global cloud approach
Collaborative automation in the cloud

- Automation is local - requirements on:
  - Real time
  - Security and safety
  - Continuous engineering

- Local clouds are beneficial to:
  - Latency - real time
  - Security - supporting safety
  - Less engineering dependencies

- Inter cloud actions are necessary and possibly secure!

www.arrowhead.eu
Arrowhead Framework - support for: System of systems in a local cloud

- Mandatory core systems:
  - Information infrastructure
  - System management
  - Information assurance
Arrowhead core systems

- Factory description system
- Deployment system
- Configuration system
- Event handler system
- Historian system
- Meta service registry system
- User registry system
- Quality of Service system
Real time local cloud automation & inter cloud automation

Real time
Local cloud #1

Real time
Local cloud #2

Real time
Local cloud #3
Necessary technology for large automation systems in the cloud

Robust communication, wired or wireless

IoT sensors, actuators, PLC:s, etc.

DCS and SCADA functionality’

MES and ERP functionality

Cloud integration technology

Engineering tools for cloud automation systems

Test tools and simulators for debugging

Migration of cloud automation into legacy production system

Suitable security
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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Arrowhead Framework

- Public by fall 2015

- Wiki at forge.soa4d.org/projects/arrowhead-f
  - Documentation
  - Cookbook
  - Mandatory core systems: images and code
  - Tools
    - System management
    - Test tool
  - Sample simple service - code
  - Sample automation services - code

Selected/interested people to be invited for pre-usage!
Automation implementations

- 18 production automation demos is prepared for
  - ECS fair, Stockholm Nov 3-4 2015.

- Arrowhead Framework reduces engineering time
  - From 5-6 days -> 6-8 hours (Abelko)
  - From 4-5 weeks -> 1 week (BnearIT)
Conclusions - Critical platform properties

Security
- Scalable and flexible security solutions

Latency
- How provide "clouds" with latency "guarantees"

Dynamics/Continuous
- Engineering, configuration and deployment

Scalability
- For massive numbers of resource constrained IoT and CPS devices
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