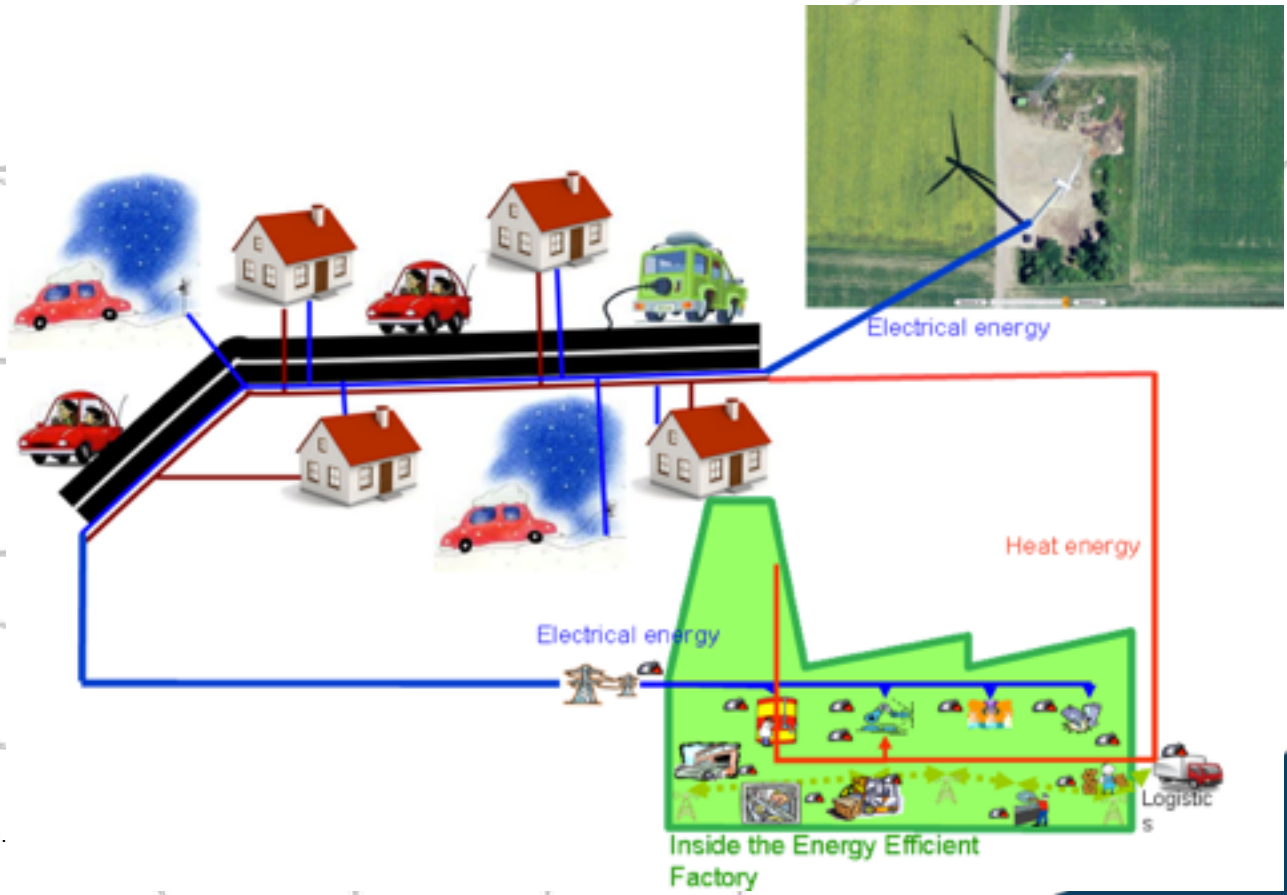


The Arrowhead direction - Building automation systems based on IoT

Prof. Jerker Delsing

How to build very large complex automationssystem?



Heathrow terminal 5

5 million connected points!!

Heathrow terminal 5

5 million connected points!!

Many parallel systems - to many!!

What about London railway then?

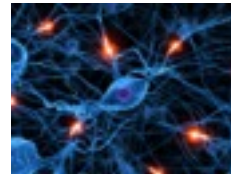
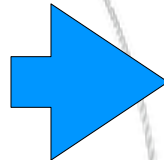
X.XXX.XXX number of bearings

- Connected bearings will support
 - Bearing condition monitoring
 - Railway wagon condition monitoring



The society nervous system - the automation challenge

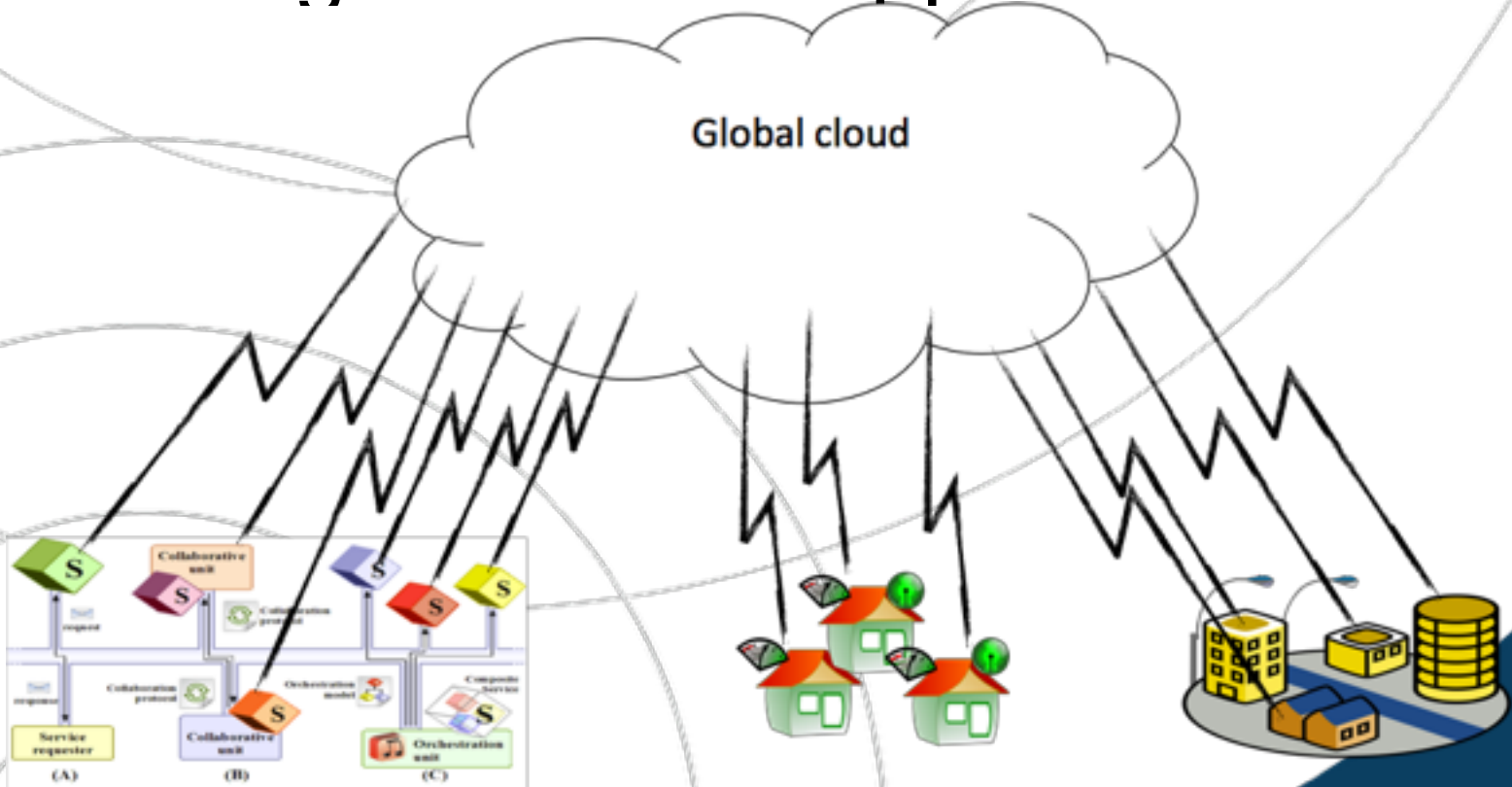
- Annual growths more than 10% and over 40 billion connected devices are expected worldwide by 2020. - Artemis SRA 2011
- Massive automation systems not possible with current technologies
 - Not enough many engineers on the globe to do the job with current technology
- Arrowhead automation service framework based on
 - Internet of Things and Service Oriented Architecture enabling
 - Collaborative automation involving almost any device and
 - Machine supported system integration



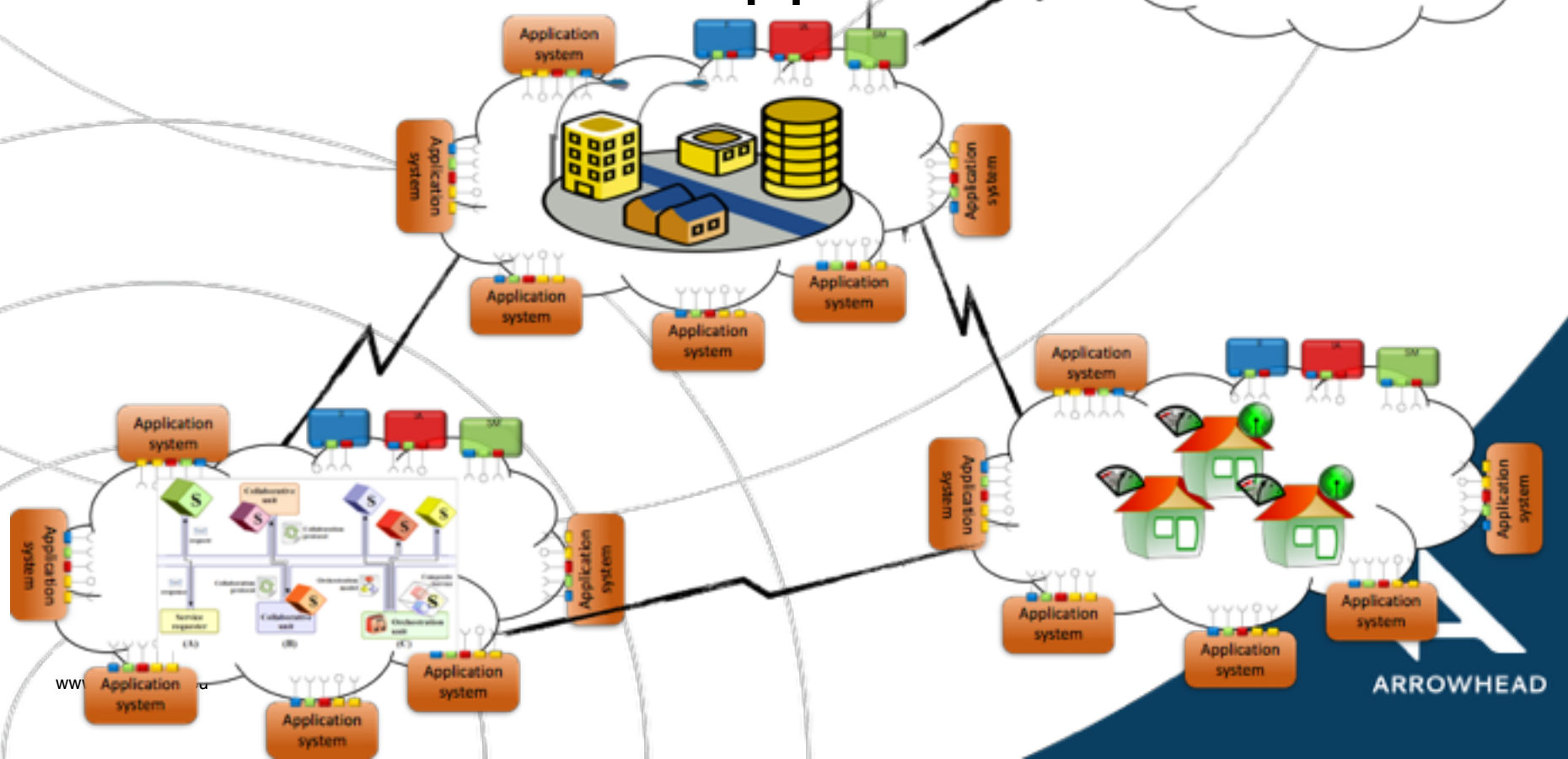
Benefits to the production industry

- Better optimization and coordination of single processes or process chains and of complete plants and sites,
- Significantly improved resource efficiency.
- Better coordinated control loops in one process step and improved collaboration of control systems of different processes along a process chain give higher process yields which results in better material efficiency, waste reduction, less energy use and reduction of pollution.
- Improved product quality through better process control and smart quality control
- Higher utilization of equipment
- New collaborative solutions with integrated information management offer new possibilities for supply chain management including price-based coordination or optimised market mechanisms
- Safer operation of plants due to improved control and shut-down procedures.
- Possibilities to integrate multiple processes.

The global cloud approach



The local cloud approach



Necessary technology

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

Experiments made

Boliden 2011

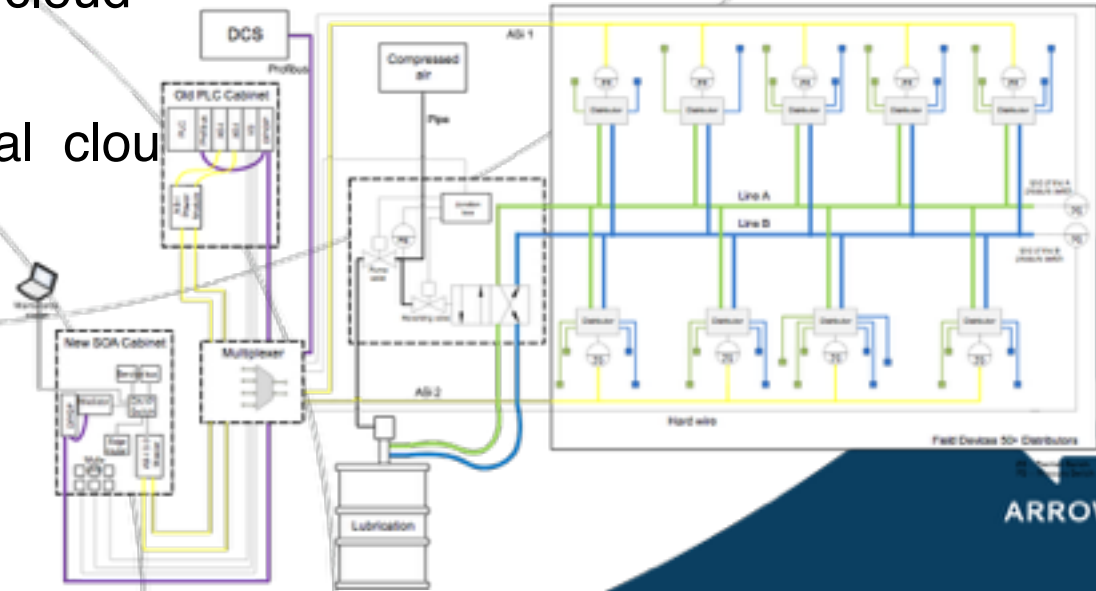
Control over wireless link

Hydraulic control at dam in Tampere 2013

PLC in a global cloud

LKAB 2013

SCADA in a local cloud



Whats in the works

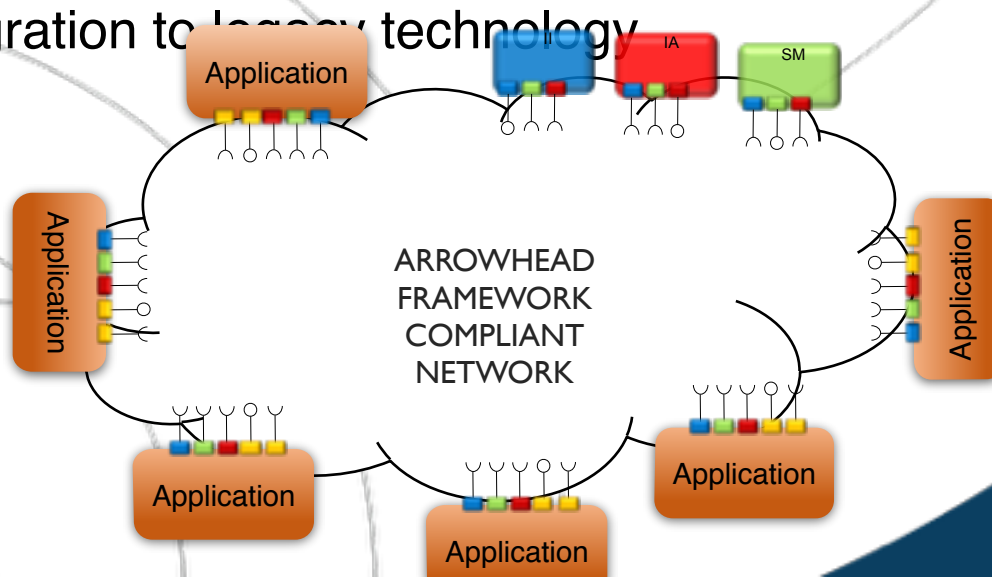
Arrowhead

- Automation cloud integration technology - SOA based
 - Interoperability at service level across suppliers and technologies
 - Technology translation
 - Integration to legacy technology
 - Development support, documentation, training
 - Development tools
 - Test tools
 - Open source working examples
 - Commercial actors offering products

Whats in the works

Arrowhead

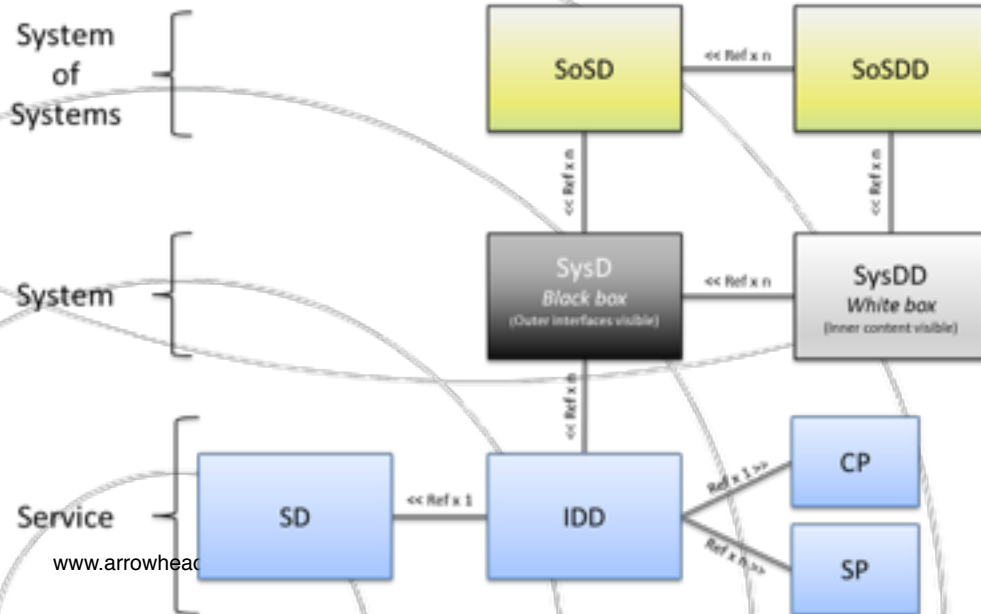
- Automation cloud integration technology - SOA based
- Interoperability at service level across suppliers and technologies
- Technology translation
- Integration to legacy technology



Whats in the works

Arrowhead

Engineering tools for cloud automation systems
Development support, documentation.



SoSD: System-of-Systems Description
SoSDD: System of Systems Design Description
SysD: System Description
SysDD: System Design Description
SD: Service Description
IDD: Interface Design Description
CP: Communication Profile
SP: Semantic Profile

Whats in the works

Arrowhead

- Development tools
- Management tool

Logged in as user:admin Logout

ServiceRegistry | **Orchestration** | Authorisation | Logs | Certificates

CA certificate: thawtpremiumserverca

Alias name: thawtpremiumserverca
Creation date: Dec 2, 2009
Entry type: trustedCertEntry

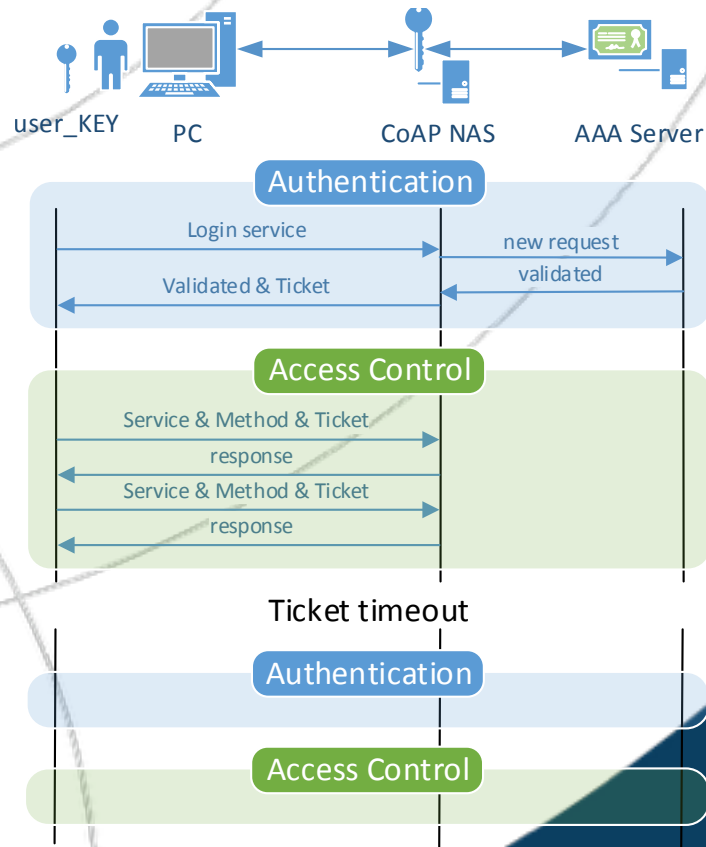
Owner: EMAILADDRESS=premium-server@thawte.com, CN=Thawte Premium Server CA, OU=Certification Services Division, O=Thawte Cons
Issuer: EMAILADDRESS=premium-server@thawte.com, CN=Thawte Premium Server CA, OU=Certification Services Division, O=Thawte Cons
Serial number: 36122296c5e338a520a1d25f4cd70954
Valid from: Thu Aug 01 02:00:00 CEST 1996 until: Sat Jan 02 00:59:59 CET 2021
Certificate fingerprints:
MD5: A6:6B:60:90:23:9B:3F:2D:BB:98:6F:D6:A7:19:0D:46
SHA1: E0:AB:05:94:20:72:54:93:05:60:62:02:36:70:F7:CD:2E:FC:66:66
SHA256: 3F:9F:27:D5:83:20:4B:9E:09:C8:A3:D2:06:6C:4B:57:D3:A2:47:9C:36:93:65:08:80:50:56:98:10:5D:BC:E9
Signature algorithm name: SHA1withRSA
Version: 3

Extensions:

Whats in the works

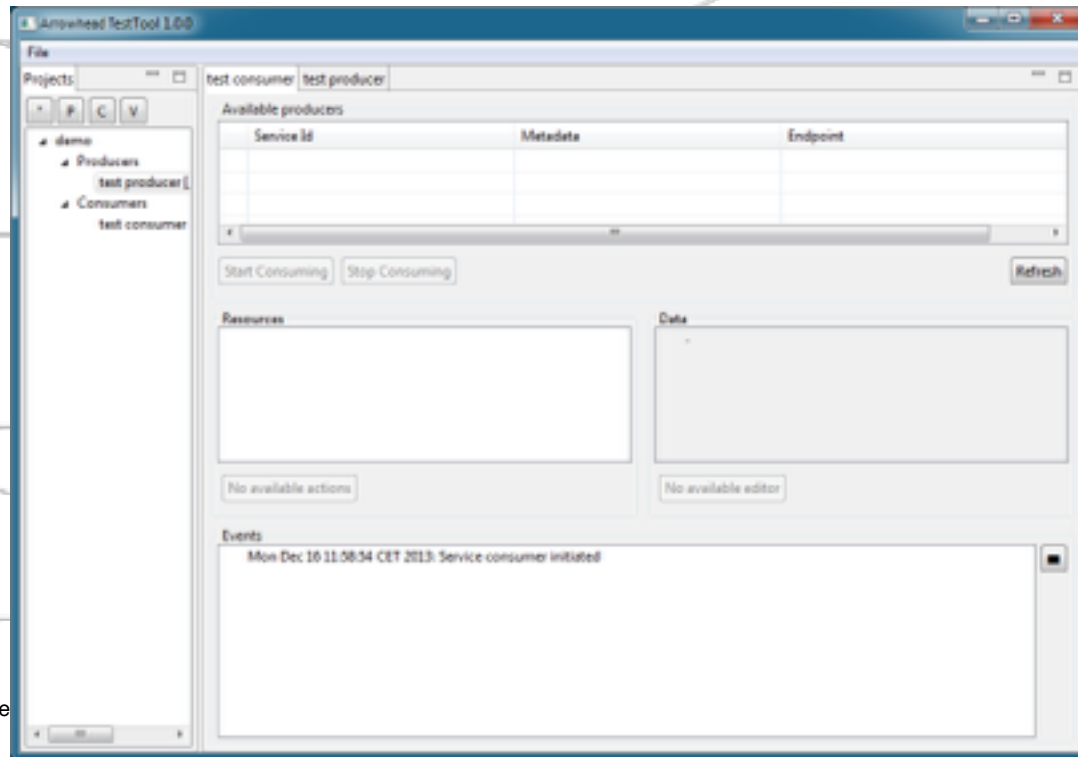
Arrowhead

- Security support
 - Security at service level
 - Data encryption



Whats in the works Arrowhead

- Test tools for cloud automation.



Whats in the works

Arrowhead

- Automation cloud integration technology - SOA based
 - Open source working examples
 - Commercial actors offering products

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.

➔ Some products on the market

➔ Demonstrated in industrial env.

➔ First products on the market

➔ Demonstrated in industrial env.

➔ First products on the market

Thanks for listening