

Arrowhead Tools

Jerker Delsing



Primary focus

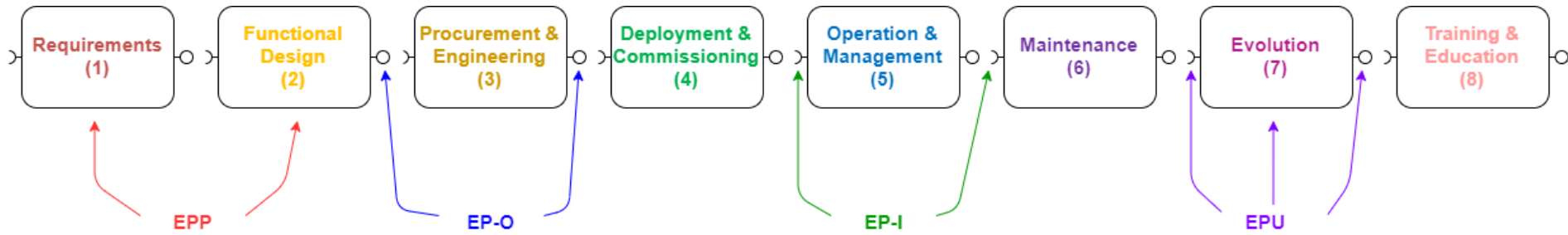
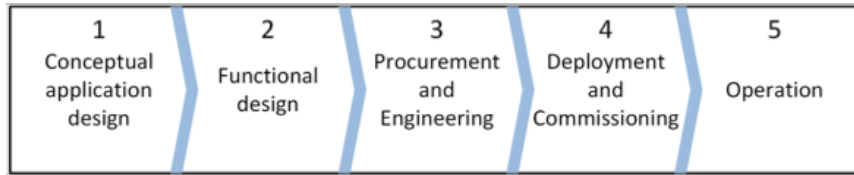
- Automation and digitalisation for:
 - Production of goods and services

Key areas addressed

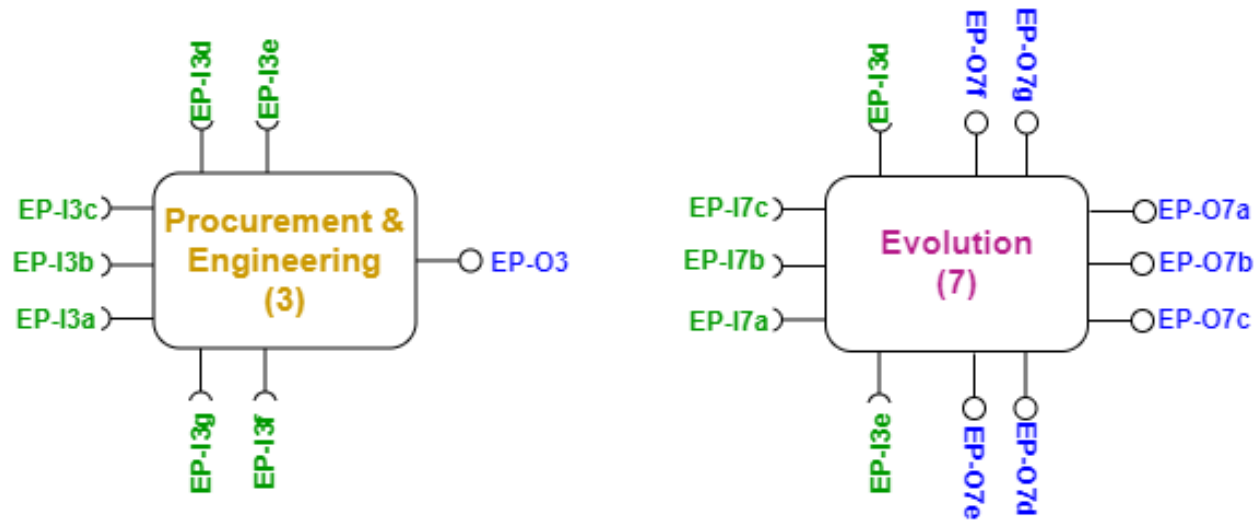
- Engineering process for production automation/digitalisation
- Tool chain integration
- Engineering tools
- Integration platform

Automating the engineering process

IEC81346

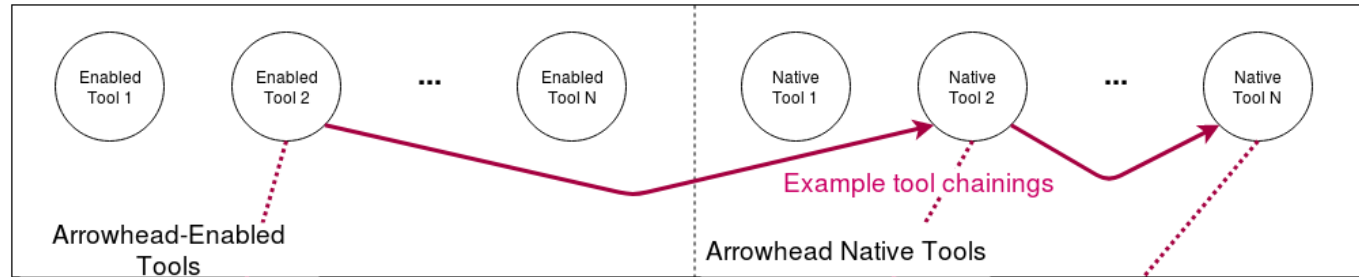


Process integration based on SOA

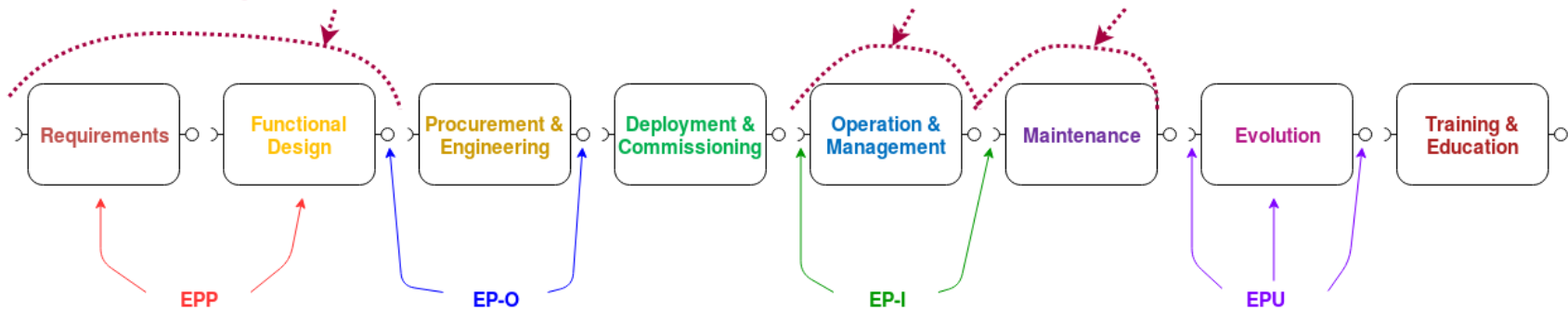


Tool mapping to engineering process

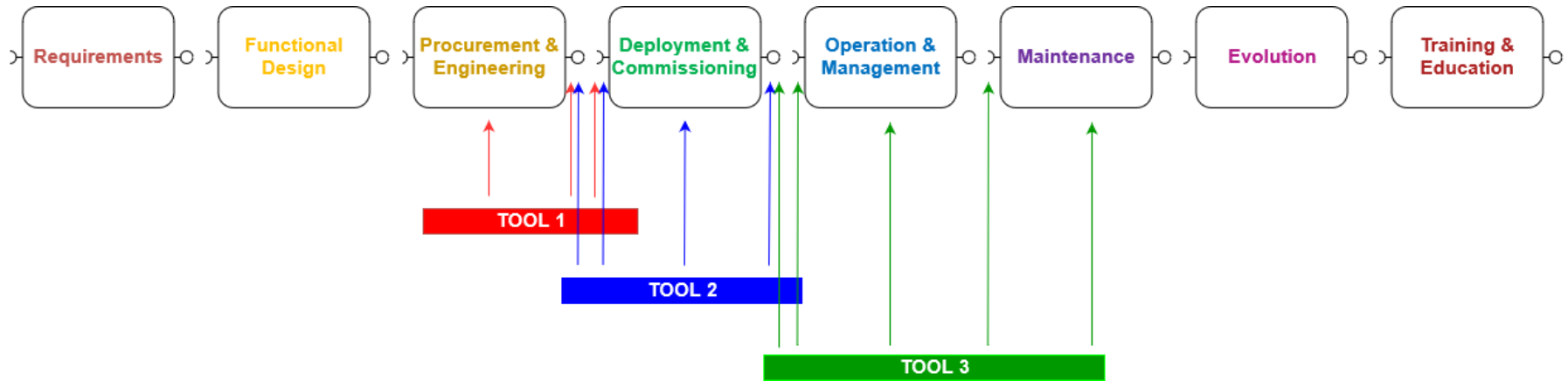
Arrowhead Bag of Tools



Example Toolchain with EPM: EPP1-2 > EP-O2 > EP-I5 > EPP5 > EP-O5 > EP-I6 > EP6



Tool chain integration to the process



Efficient engineering Tools chains

How to move data efficient and securely from one tool to another

- Example
- LindbäcksBygg
 - Vertex - building CAD tool
 - Speaks BIM XML
- ABB Robot Studio
 - Speaks proprietary protocol
- Arrowhead Tools wrapper around each tool
 - Provides protocol, security, encoding translation
 - Provides UC specific semantics translation

Efficient engineering Tools chains

Vertex - building CAD tool

Speaks BIM XML

ABB Robot Studio

Speaks proprietary protocol

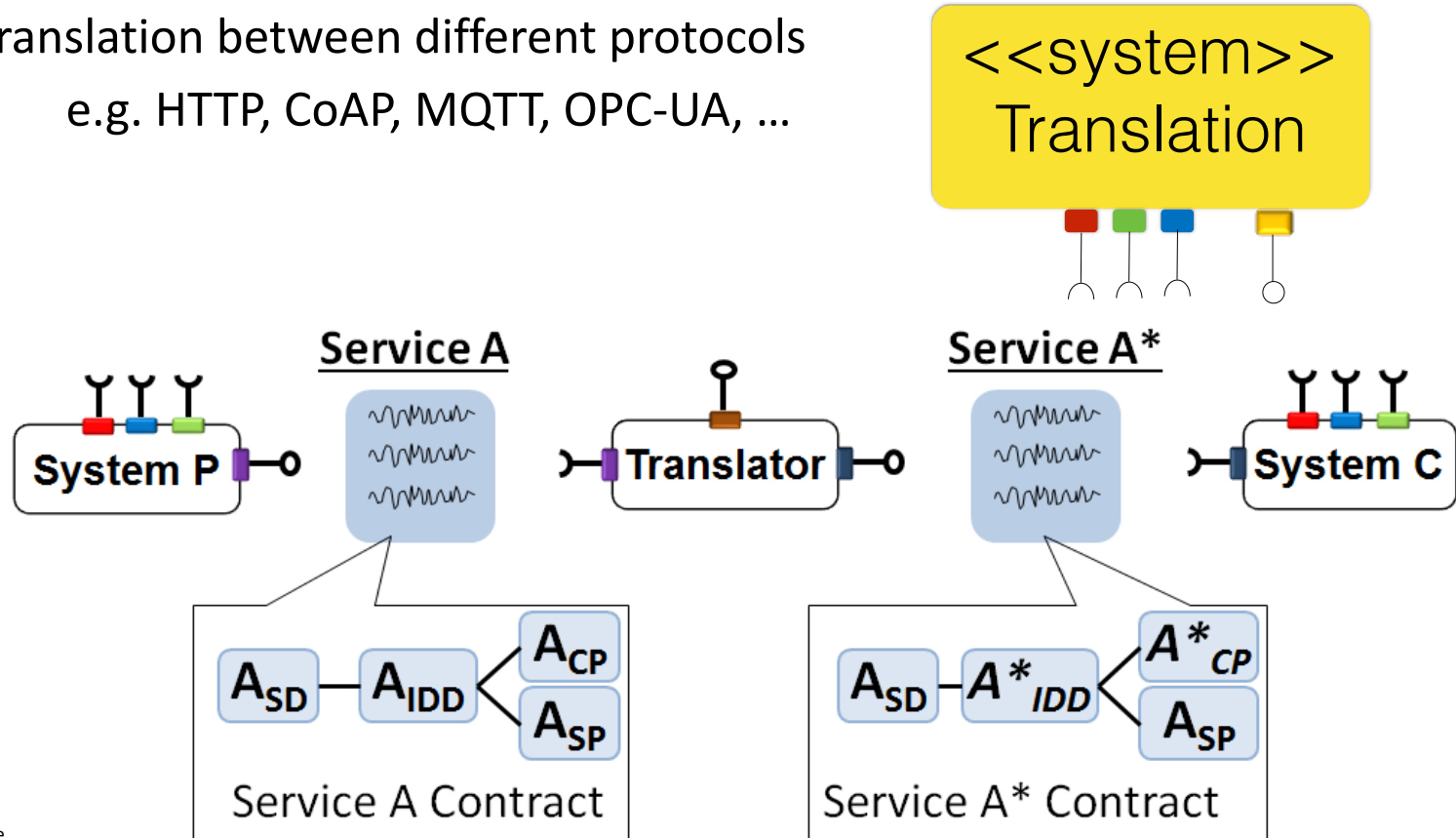
Arrowhead Tools wrapper around each tool

Provides protocol, security, encoding translation

Provides UC specific semantics translation

Tool interoperability based on SOA

Translation between different protocols
e.g. HTTP, CoAP, MQTT, OPC-UA, ...



Tool data semantics interoperability

Semantics translation problem

CPS A message:

```
[  
  {"n": "00_temp_sensor",  
   "t": 318350,  
   "u": "K",  
   "v": 263.4948599934143}  
]
```

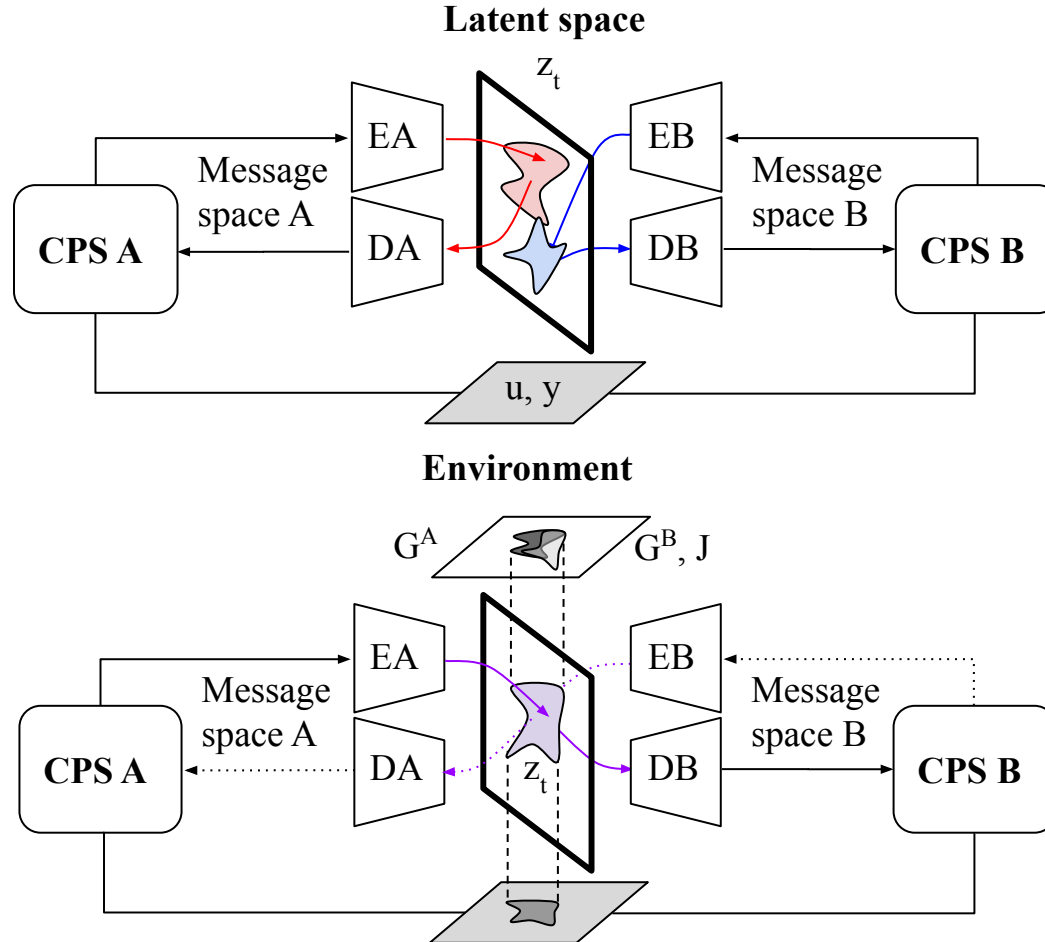
CPS B message:

```
[  
  {"bn": "temp_sensor", "bt": 321680},  
  {"u": "Cel", "v": 20.970178532724503},  
  {"u": "Lon", "v": "1"},  
  {"u": "Lat", "v": "-1"}  
]
```

Same ontology
Same data
Do not look the same!!

Tool data semantics interoperability

Semantics translation approach



Tool data semantics interoperability

Semantics translation results

TABLE I: Tested models and their results.

Model	Kind	Strategy	Size	Accuracy		Error	
				Max	Mean	Min	Mean
0	non-shared	2	1-layer	0.70	0.44	0.57	4.0
1	non-shared	2	2-layer	0.73	0.38	0.50	4.9
2	non-shared	1	1-layer	0.66	0.39	0.48	6.7
3	non-shared	1	2-layer	0.74	0.34	0.71	12.0
4	shared	2	2-layer	0.70	0.34	0.54	15.0
5	shared	3	2-layer	0.75	0.41	0.43	2.7
6	shared	1	2-layer	0.69	0.33	0.53	12.0
7	supervised	–	1-layer	1.0	1.0	0.16	0.17
8	supervised	–	2-layer	1.0	0.99	0.16	0.19

Standards currently being addressed

Engineering tools and platform

Arrowhead Framework

Arrowhead Framework Technology

Arrowhead Framework and integrated
engineering tool chains



Technology Properties

Implementation of Automation and Digitalisation solutions

In production

In product

Real time capabilities

Run time flexibility

Run-time engineering

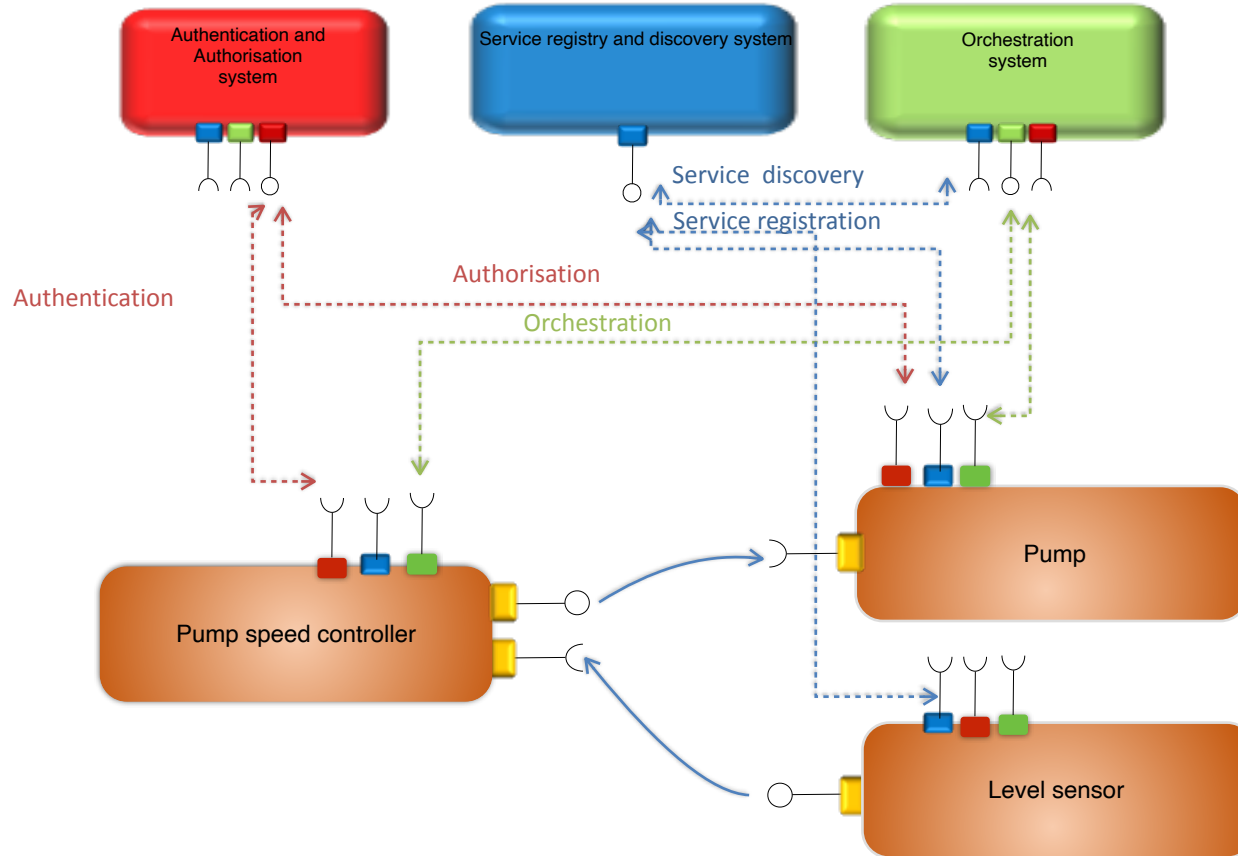
Security

Multi level security

Evolvable solutions

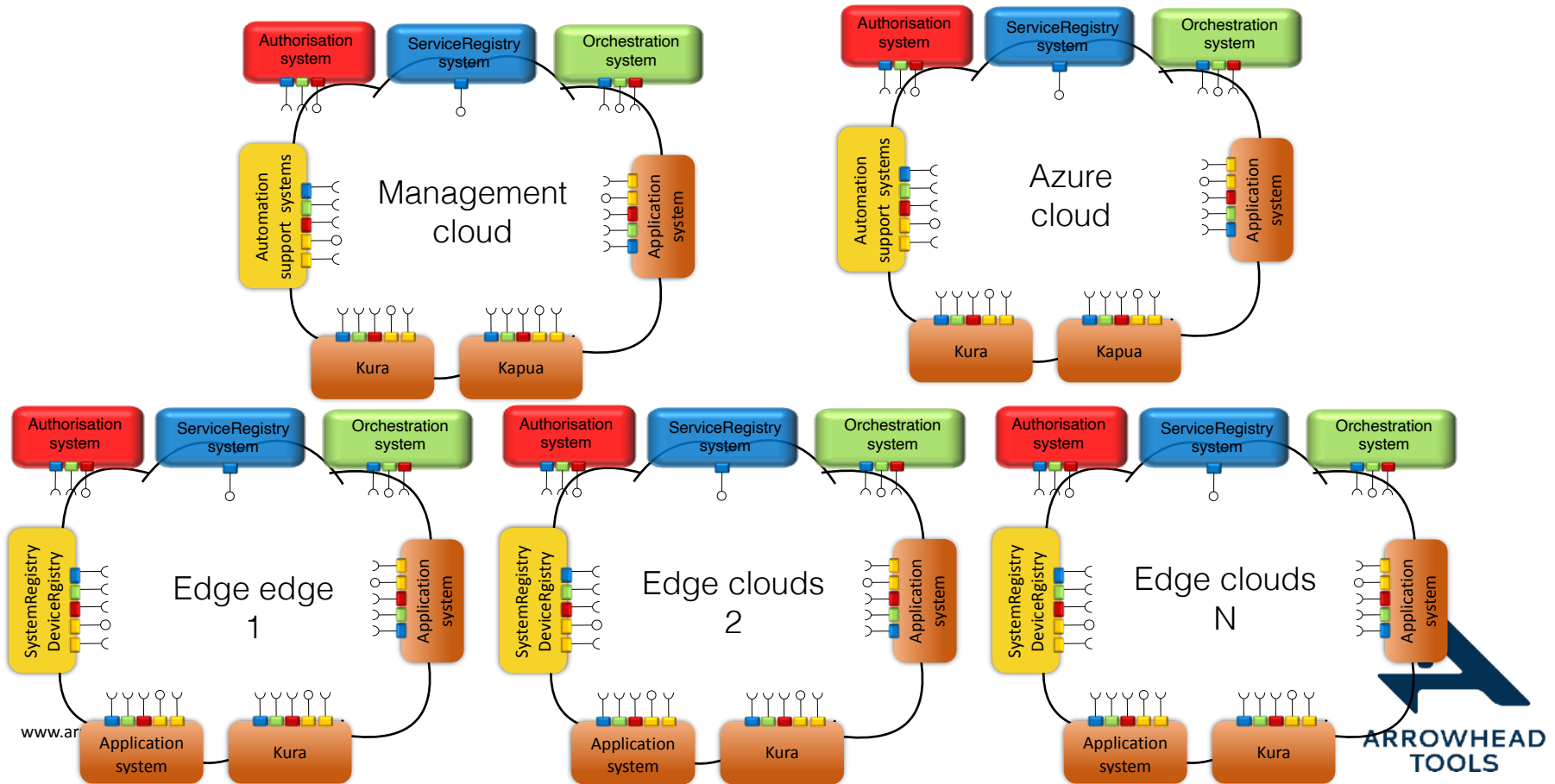
On-site validation and verification

SOA approach

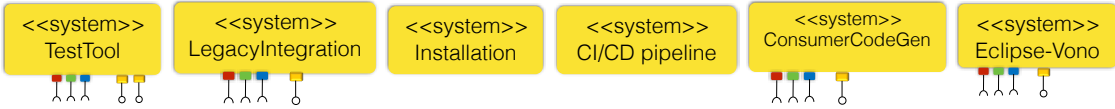


Complex system & System of systems

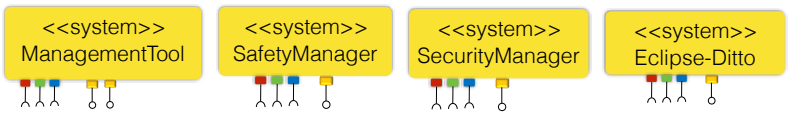
A micro service approach



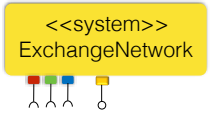
Engineering tools



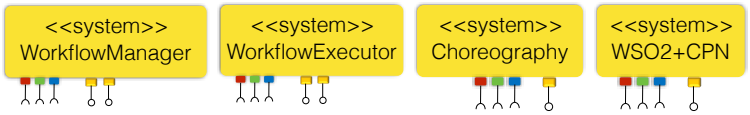
Management support:



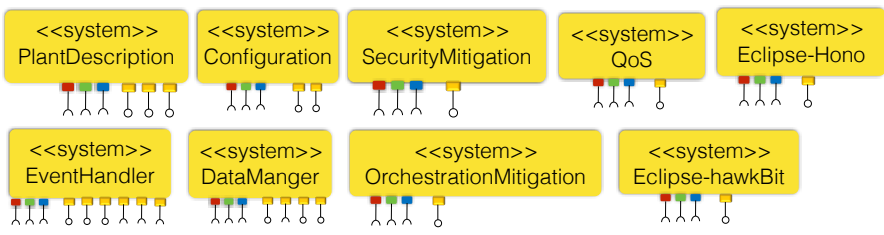
Supply chain/product life cycle



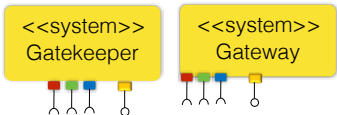
Execution support



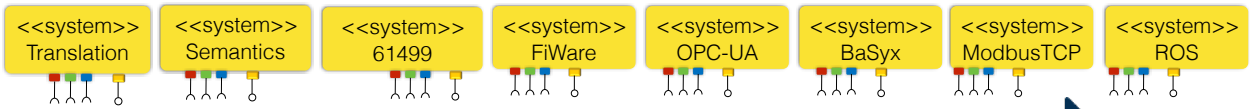
System of Systems support



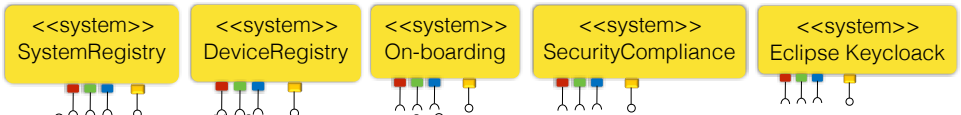
Inter cloud service exchange



Interoperability



Secure on-boarding and infrastructure:



Local cloud basic properties:

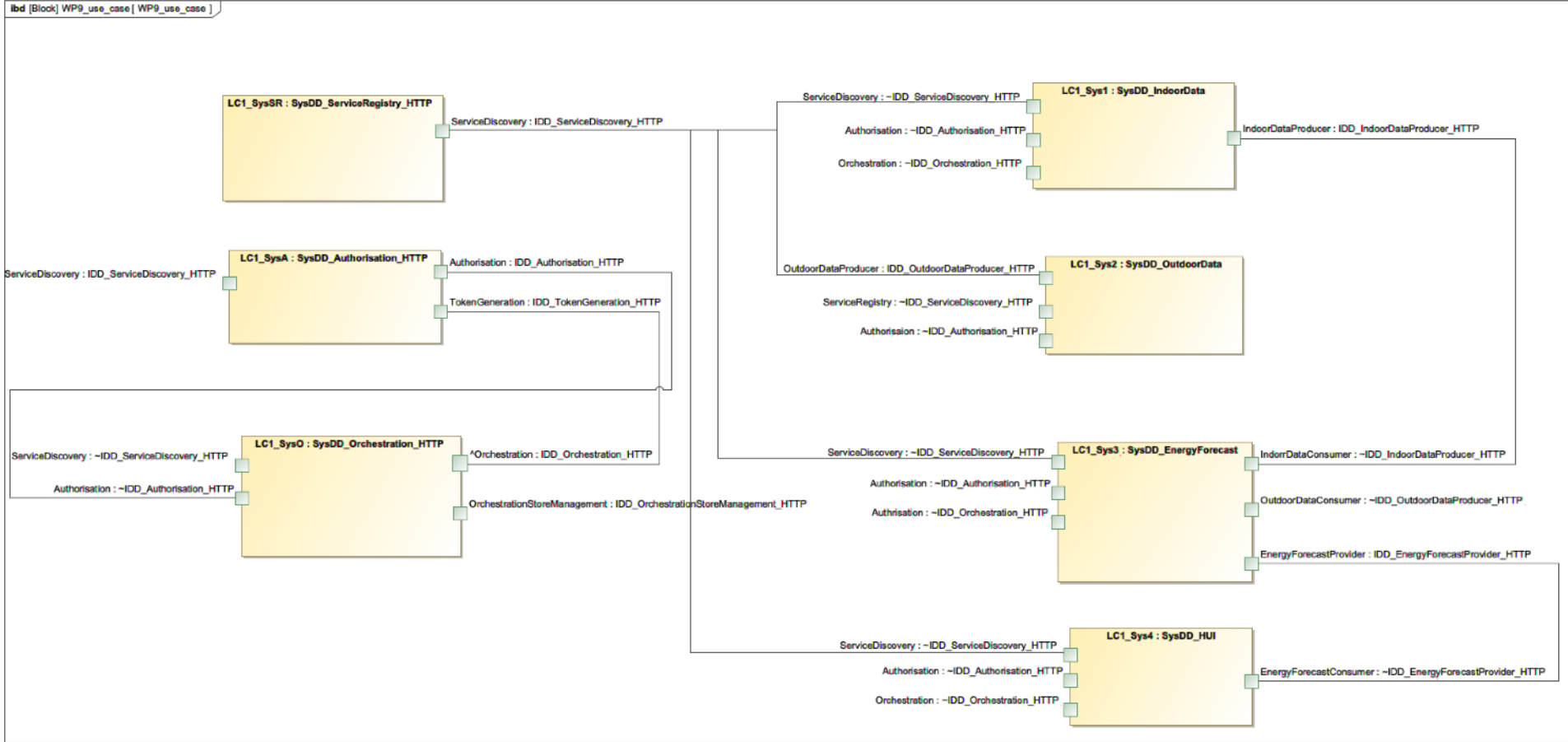


SysML modelling and engineering

SysML 1.6 profile and library

Arrowhead Framework core systems

System and SoS Modeling - SysML



SysML -> code

- Autogeneration of code for SoS integration (in progress)
- SysML extraction of ontology based naming (in progress)
ISO 10303 in cooperation with e.g. Jotne
- Transfer of SysML plant data to Arrowhead PlantDescription (in progress)
- Semiconductor fab semantics web model
RDF graf
integration planed for Productive Intelligence project.

Security

Pay load encryption

Who is allowed to consume certain data

Authentication schema based on Certificates X509

Authorisation for a specific data transfer

X.509 certificates

Audit of data consumption

Security management

Arrowhead Management Tool

Security

Self contained local clouds

Private networks

Authentication, Authorisation, Audit, Payload encryption,

Cloud to cloud communication over open internet

GateKeeper - Gateway solution

Accepted for Engine test data transfer from test chamber to OEM

Automation engineering time

Application	Local cloud [h]	Legacy [h]	Gain
Building energy automation	6-8	40-48	1 : 5
Airport information automation	40	160-200	1 : 4.5
Recycling logistics	80	240-300	1 : 3.5

Data provided by

- Abelko Innovation AB
- BnearIT AB
- Supported by qualitative analysis comparing ISA95 and Arrowhead local cloud engineering
 - Oscar Carlsson, Jerker Delsing, Engineering of Service-oriented IoT Automation Systems, Submitted to IEEE System journal

Question?

jerker.delsing@ltu.se



ArrowHead contribution

ISO20922 + HW security as enabler for secure inter-cloud communication

