

Arrowhead Framework

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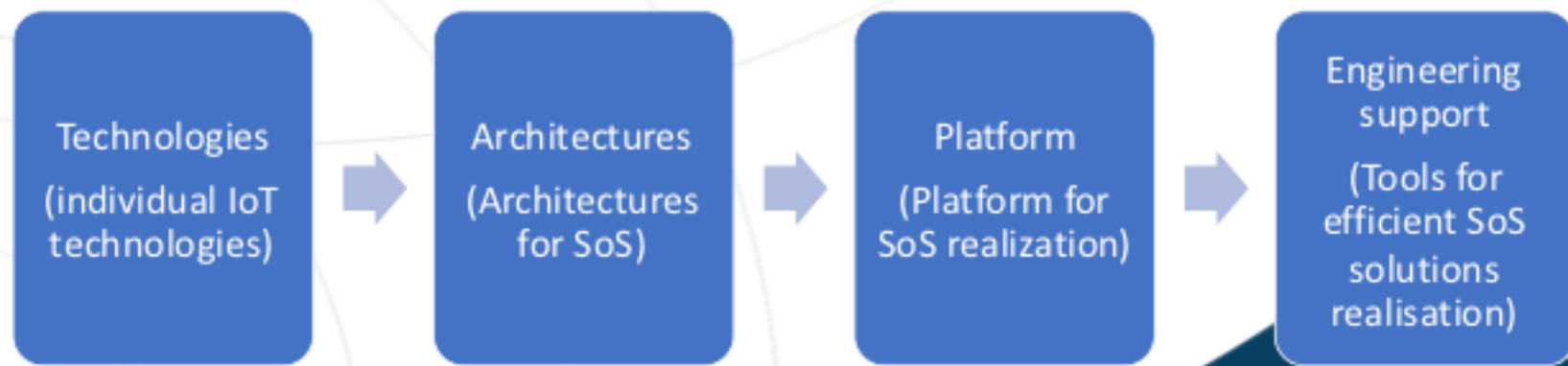
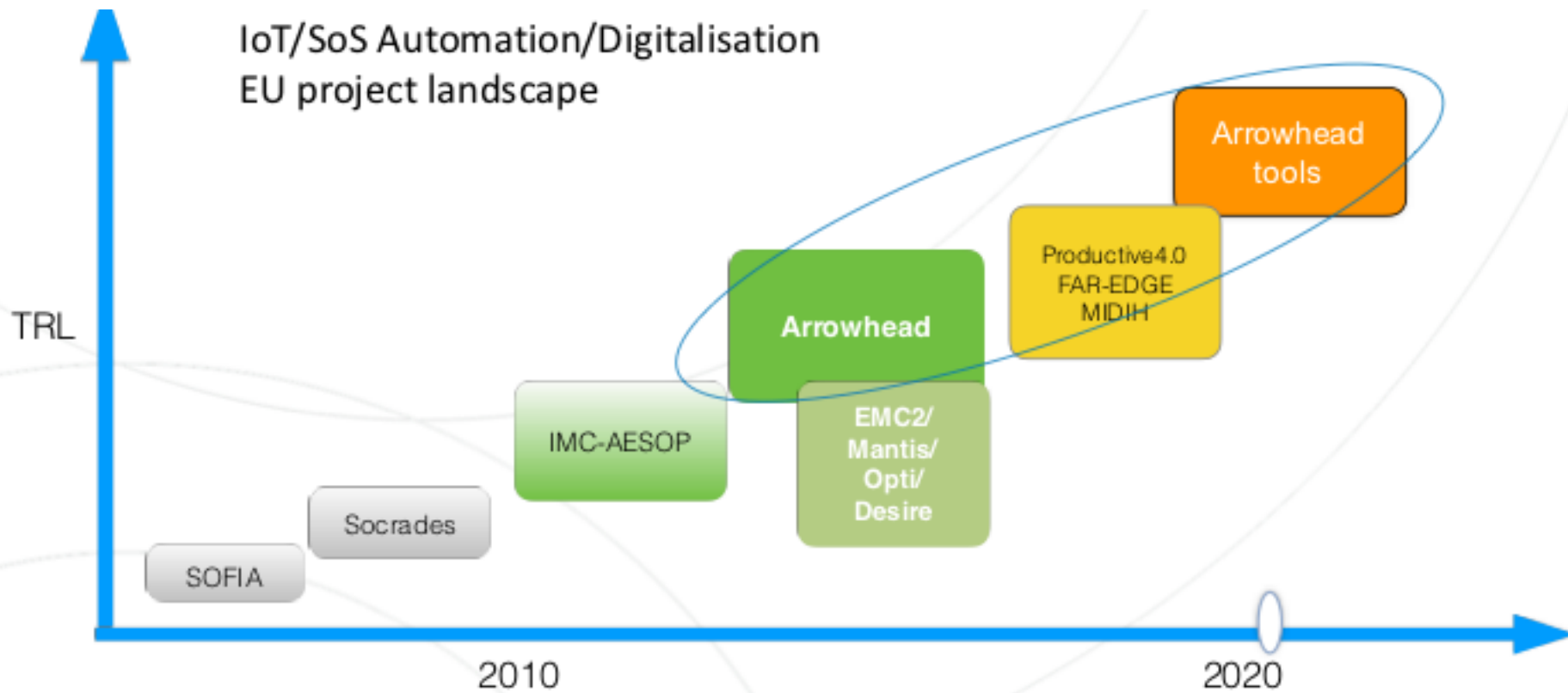
Eclipse Arrowhead

Jerker Delsing

Primary focus

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

IoT/SoS Automation/Digitalisation EU project landscape



ARROWHEAD
TOOLS

Automation & Digitalisation requirements

AUTOMATION & DIGITALISATION REQUIREMENTS

- ◆ Seamless interoperability between IoT systems
- ◆ **Real time performance**
- ◆ Security
- ◆ Scalability
- ◆ Engineering simplicity, process and tool chains
- ◆ Evolvable System of Systems
- ◆ **Flexible automation**
 - ◆ Run-time management
- ◆ Integration along value chain
- ◆ Integration along product life cycle
- ◆ Integration to across stakeholders

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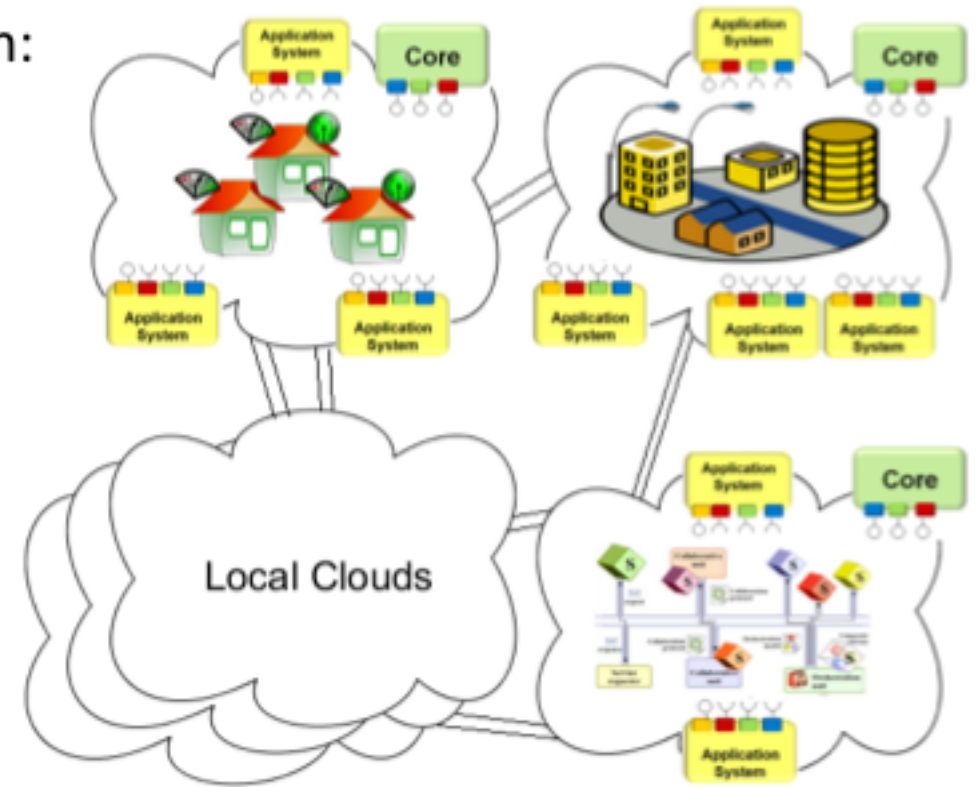
Collaborative automation in the cloud

◆ Automation is local - requirements on:

- ◆ Real time
- ◆ Security and safety
- ◆ Continuous engineering
- ◆ Scalability

◆ Autonomous local clouds provides:

- ◆ Protective fence enabling
 - ◆ Latency - real time
 - ◆ Security - supporting safety
 - ◆ Less engineering dependencies
- ◆ Scalability through inter cloud service exchange



J. Delsing, et.al., Enabling IoT automation using local clouds,
Proc. IEEE WorldForum on IoT 2016, Reston, USA

Arrowhead technology approach

- ◆ Service oriented architecture SOA
- ◆ Autonomy
- ◆ Pull and push behaviour
- ◆ Translation to bridge service contract mismatches

- ◆ Integration platform
- ◆ Engineering process
- ◆ Engineering tool chains
- ◆ Engineering tools

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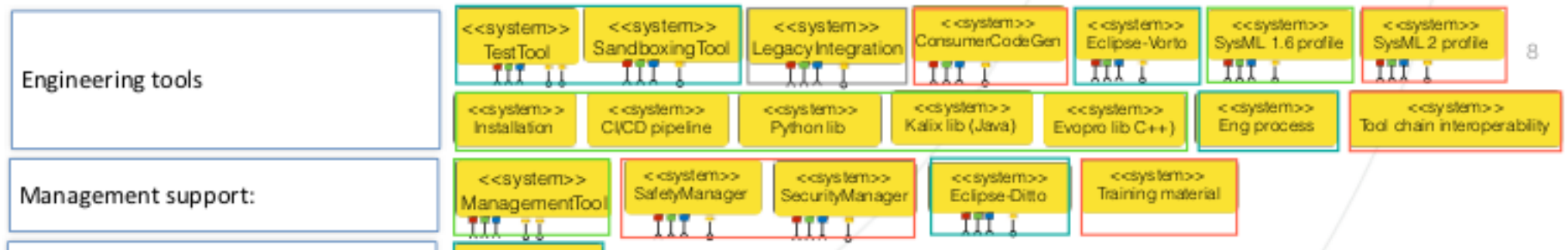


Security

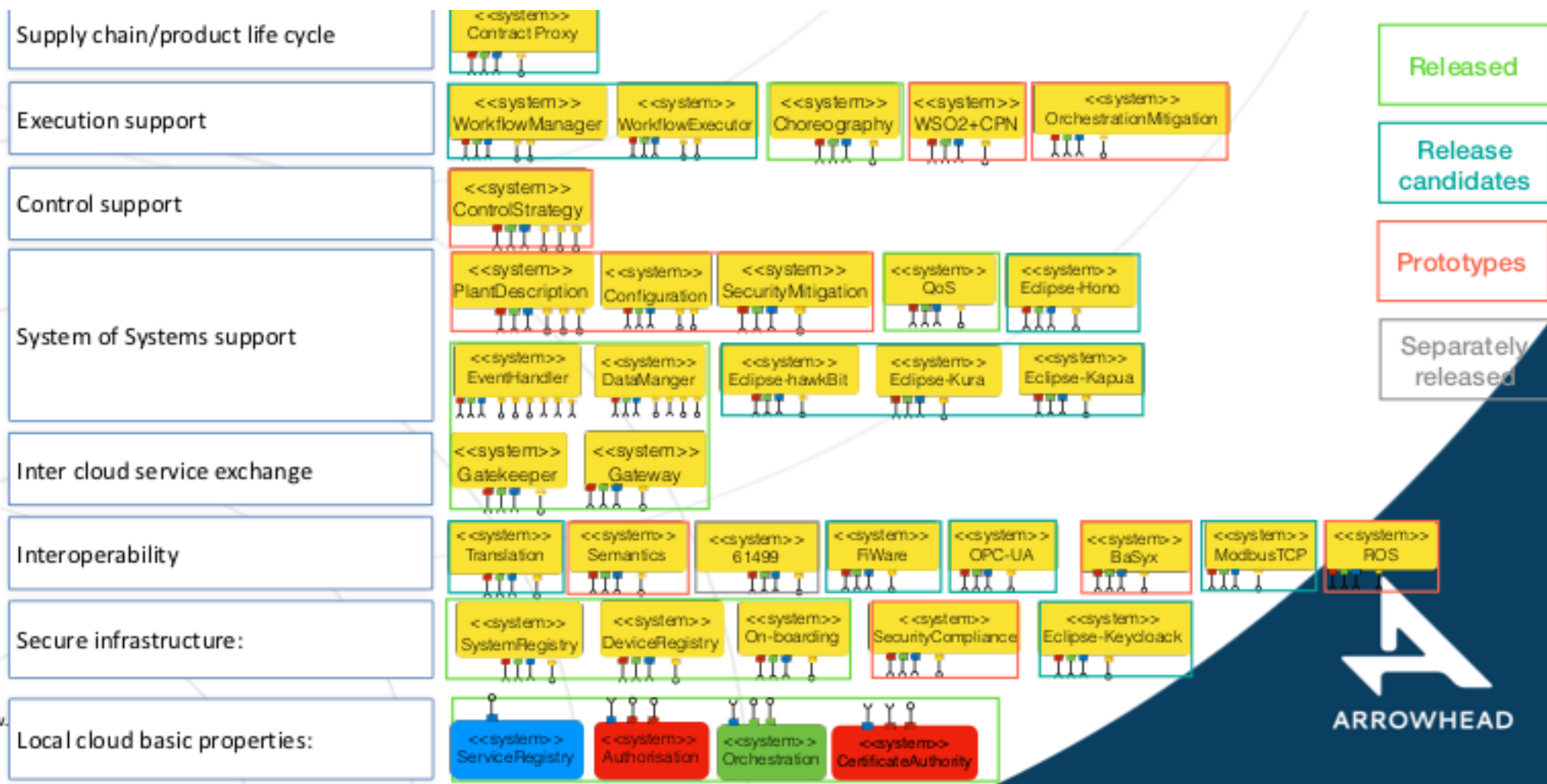
Security

- ◆ Pay load encryption
- ◆ Who is allowed to consume certain data
 - ◆ Authentication schema based on Certificates X.509
- ◆ Authorisation for a specific service consumption
 - ◆ X.509 certificates
- ◆ Audit of data consumption
- ◆ Security management
 - ◆ Arrowhead Management Tool

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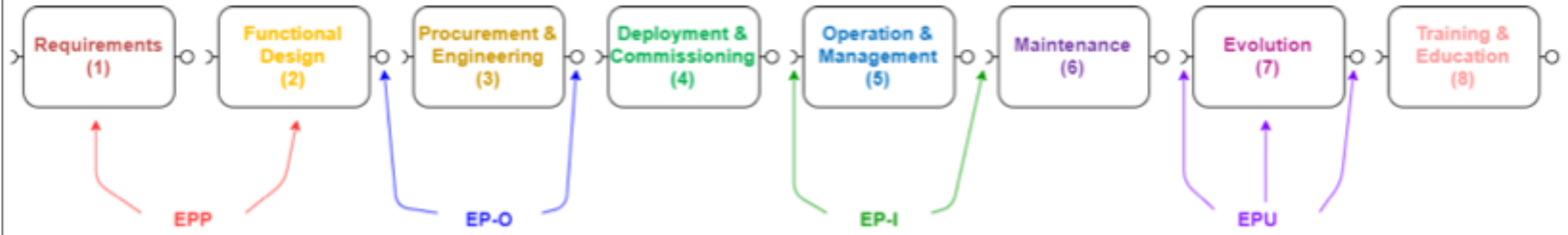
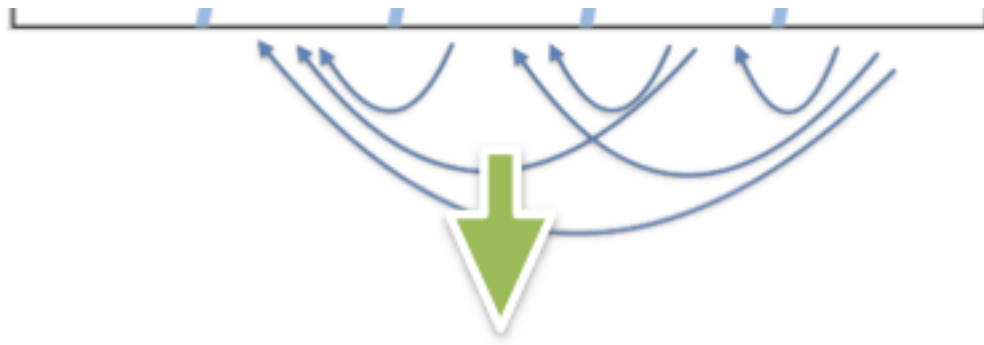
Arrowhead v4.1.3



Automating the engineering process

IEC81346

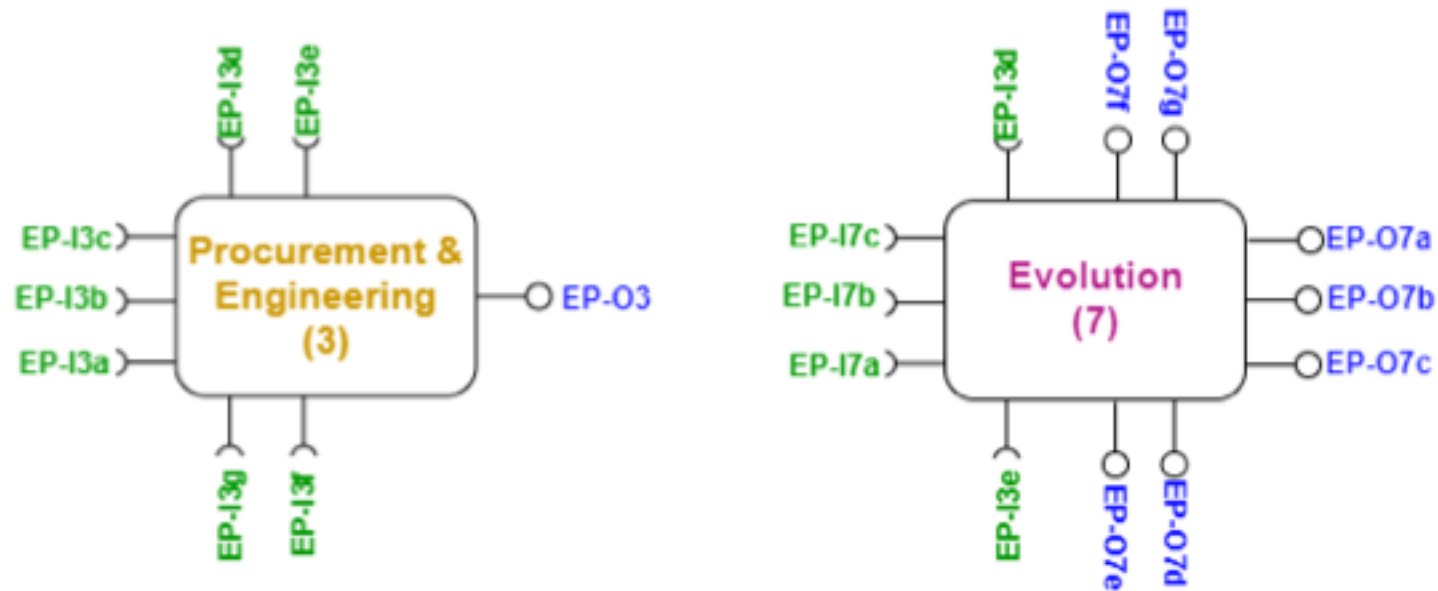




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Engineering process and tools integration based on SOA



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

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Efficient engineering Tools chains

Vertex - building CAD tool
Speaks BIM XML

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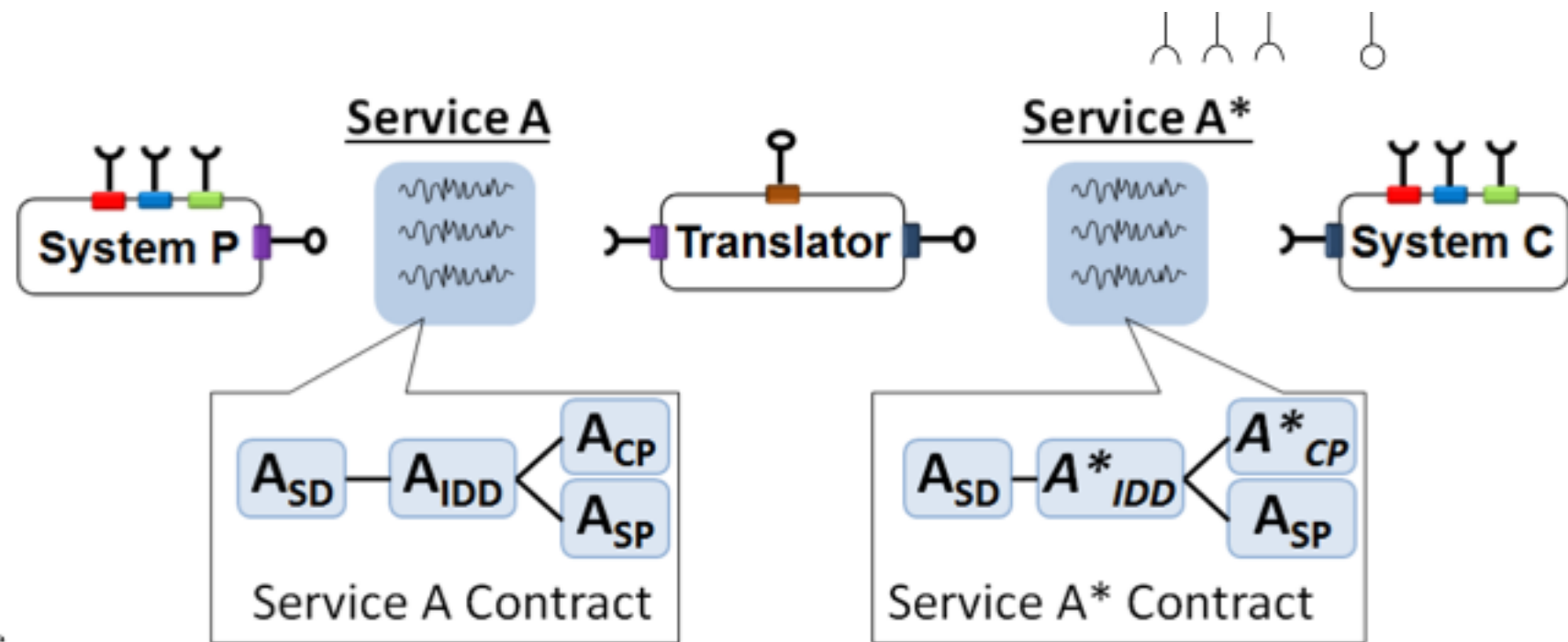
Tool interoperability based on SOA

Translation between different protocols

e.g. HTTP, CoAP, MQTT, OPC-UA, ...

<<system>>
Translation





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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"}
]

```

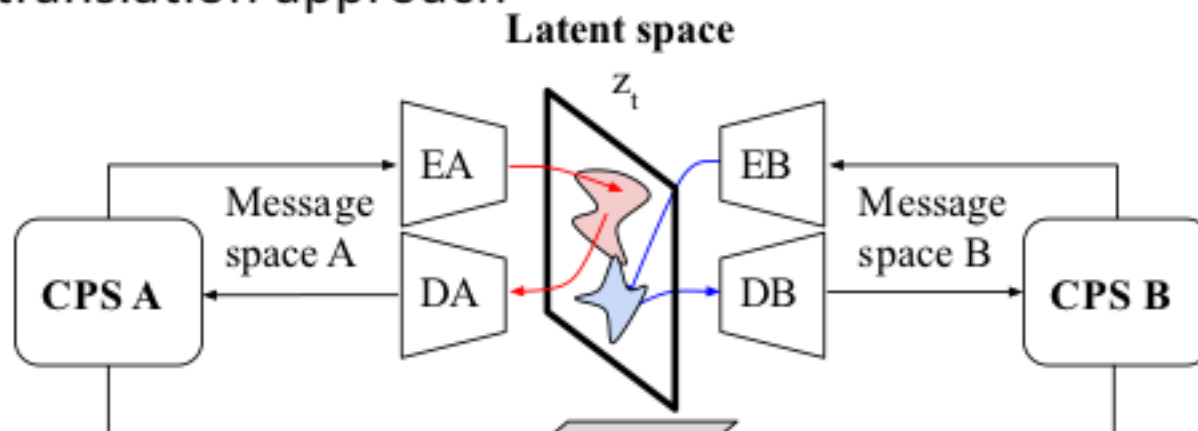
Same ontology
Same data
Do not look the same!!

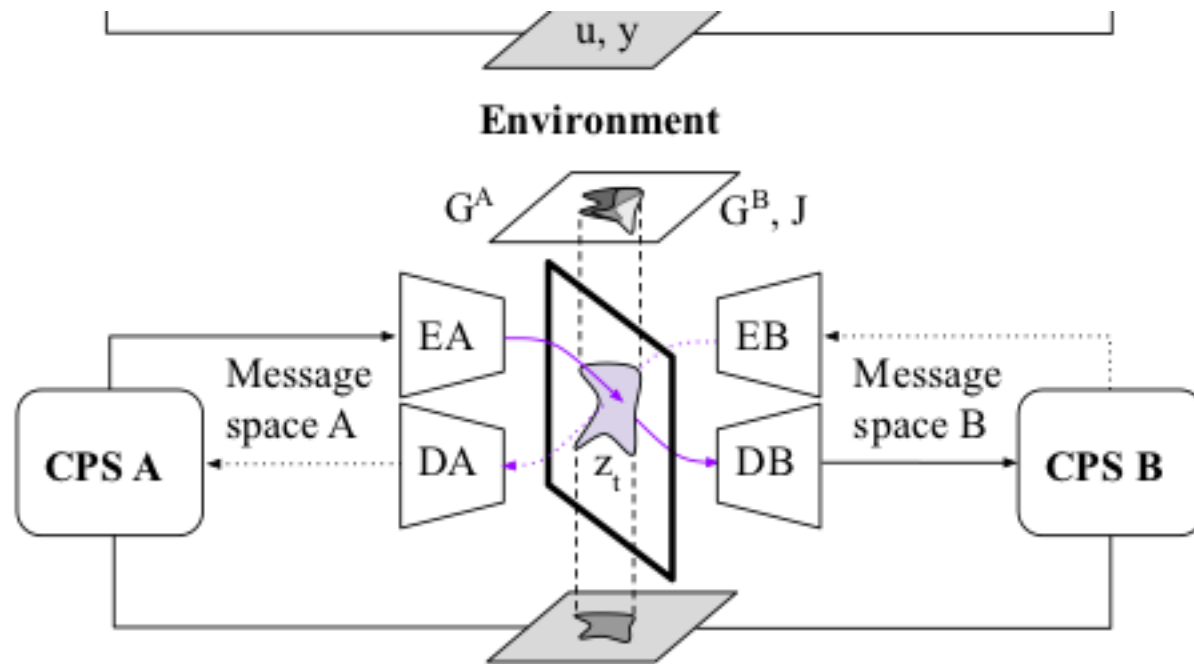
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Tool data semantics interoperability

Semantics translation approach





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SysML modelling and engineering

- SysML 1.6 profile and library (in progress)
 - Arrowhead Framework core systems

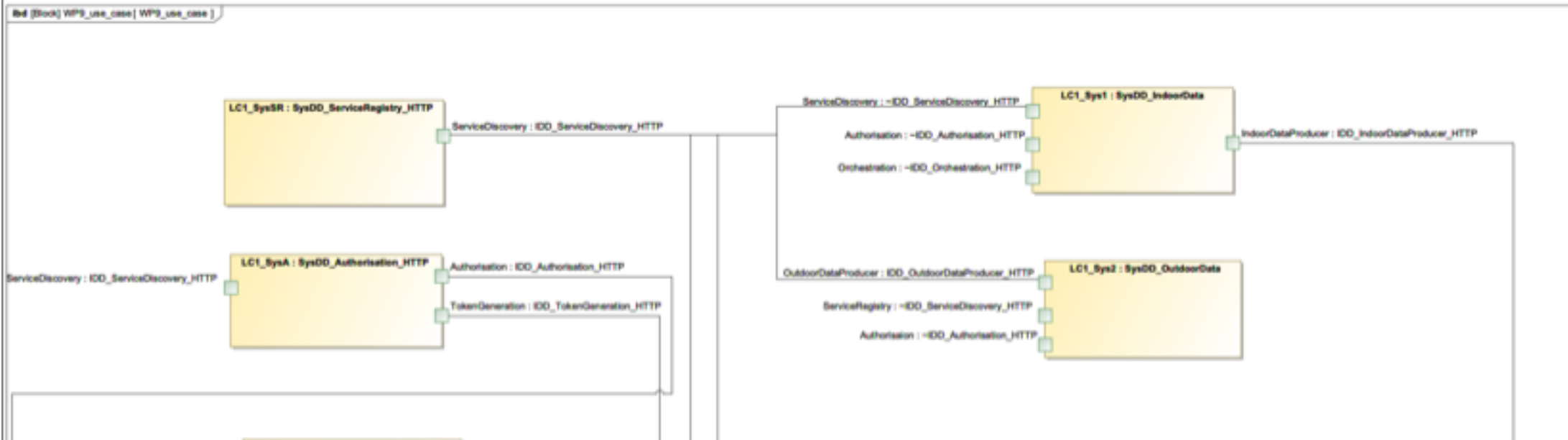
- SysML 2 library (in progress)

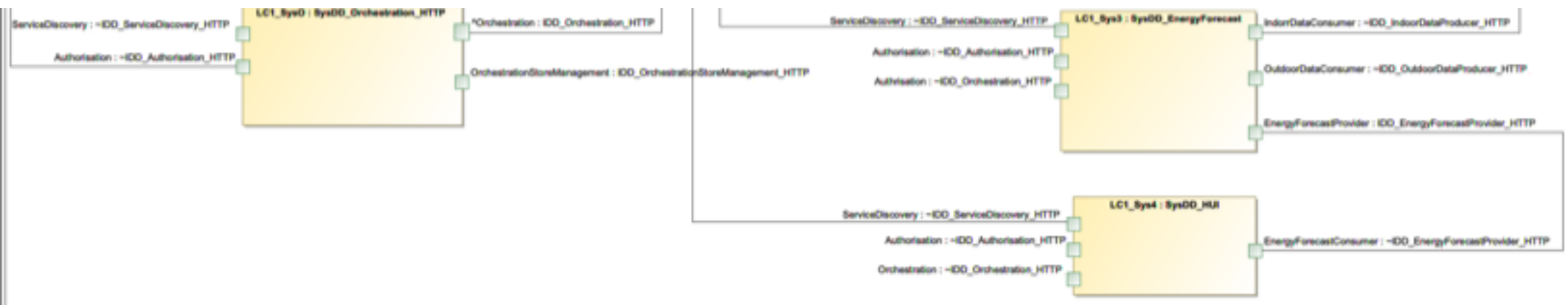
- Arrowhead is the SOA validation case for the upcoming SysML 2 standard

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System and SoS Modeling - SysML





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 and Jerker Delsing, Engineering of Service-oriented IoT Automation Systems, IEEE System journal 2017, ISSN 1932-8184, E-ISSN 1937-9234



Resources

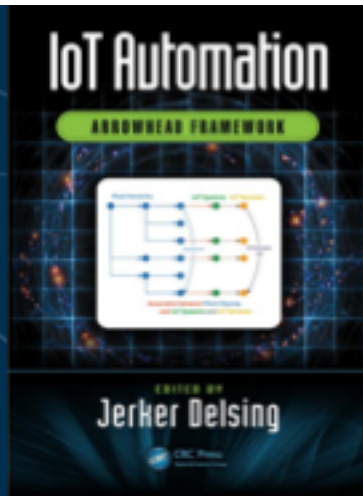
Web

www.arrowhead.eu/arrowheadframework

Github

www.github.com/arrowhead-f

Book



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Glad to become part of
the Eclipse project family

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www.arrowhead.eu

