



# Factory-X

Manufacturing-X Technical Council  
February 18, 2025

PART OF



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# Agenda

## Topics and Presenters



Topic	Time	Presenter
Welcome, Moderation Introduction to Factory-X	15 min	Silke Huesmann Roland Rosen
Factory-X TP-4 “The Factory-X Kernel”		
• Short recap of MX TC on October 24, 2024	15 + 5 min	Per-Henrik Addicks
• Interface definition of FX-Port	15 + 10 min	Guido Stephan
• FX-Port and OPC UA	10 + 10 min	Thomas Dasbach
Discussion & Closing	10 min	All

*After each part of presentation we have time for questions*

# Factory-X

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The Digital Ecosystem for  
Factory Outfitters and Operators

# Factory-X is a Lighthouse Project for Manufacturing-X



- Building the **open** and **collaborative digital ecosystem** for Factory Outfitters and Operators upon Catena-X and concepts of Platform Industry 4.0
- Focus on **11 dedicated use cases** to extend the existing horizontal supply chain-oriented use cases and add vertical use cases to integrate the operation of shop floors
- Under the leadership of Siemens and SAP, **47 partners** are working together in this strong consortium, supplemented by **10 associated partners** (companies, associations and research institutions)
- **Manufacturing-X wide coordination** and establishment of an **international Manufacturing-X network**
- Project started on February 1<sup>st</sup>, 2024
- Completion of Project by June 2026

## Factory-X Partners

- |                                      |                                |  |
|--------------------------------------|--------------------------------|--|
| • August Wilhelm Scheer Institut     | • inovex                       | • Scheer GmbH                              |
| • BASF                               | • InstaWerk                    | • SCHUNK                                   |
| • Berger Holding                     | • ISW - Universität Stuttgart  | • SDFS Smarte Demonstrations-fabrik Siegen |
| • Catena-X e.V.                      | • Lenze                        | • SICK                                     |
| • Codewerk                           | • LNI e.V.                     | • Siemens                                  |
| • DMG MORI                           | • Matchory                     | • SmartFactory-KL e.V.                     |
| • Empolis                            | • MT Analytics                 | • soffico                                  |
| • EPLAN                              | • Open Industry 4.0 Alliance   | • Software AG                              |
| • Estainium                          | • Pakic                        | • TRUMPF                                   |
| • Eviden                             | • Phoenix Contact              | • T-Systems                                |
| • Festo                              | • prenode                      | • TÜV SÜD Chemie Service                   |
| • Fraunhofer                         | • proALPHA                     | • Uhlmann Group                            |
| • German Edge Cloud                  | • RIF Engineering & Consulting | • VDMA e.V.                                |
| • Hilscher                           | • Ruhr-Universität Bochum      | • WITTENSTEIN                              |
| • ifm diagnostic                     | • SAP                          | • ZVEI e.V. (FE)                           |
| • IFW - Leibniz Universität Hannover |                                |  |
| • igus                               |                                |  |

## Factory-X Associated Partners

- |                          |                      |             |
|--------------------------|----------------------|-------------|
| • ARENA2036 e.V.         | • Digital Data Chain | • VDE e.V.  |
| • Arvato Systems Digital | • IDTA e.V.          | • ZVEI e.V. |
| • Bayern Innovativ       | • Robert Bosch       |             |
| • Beckhoff Automation    | • Sharecat Solutions |             |

# Factory-X goes public

Registration over <https://factory-x.org/>



## Manufacturing-X Technical Council

### *What is the Manufacturing-X Technical Council?*

- Factory-X aims to create an IT/SW technical basis (the „Factory-X Kernel“) for software solutions in Manufacturing-X using results from Catena-X.
- In the M-X Technical Council, the approaches are presented – depending on the project progress – and feedback is invited.

### *Who is it for?*

- The Manufacturing-X Technical Council is aimed at anyone who is interested in the application of the IT/SW technical “Factory-X Kernel”, e.g., for the implementation of their own software solutions within the framework of Manufacturing-X.

***When? #3 Now!***

## Customer Sounding Board

### *What is the Customer Sounding Board?*

- In Factory-X, various so-called business applications (software solutions) are designed, developed as prototypes and validated for 11 use cases.
- In the Customer Sounding Board, these are presented – depending on the project progress – and feedback is invited.

### *Who is it for?*

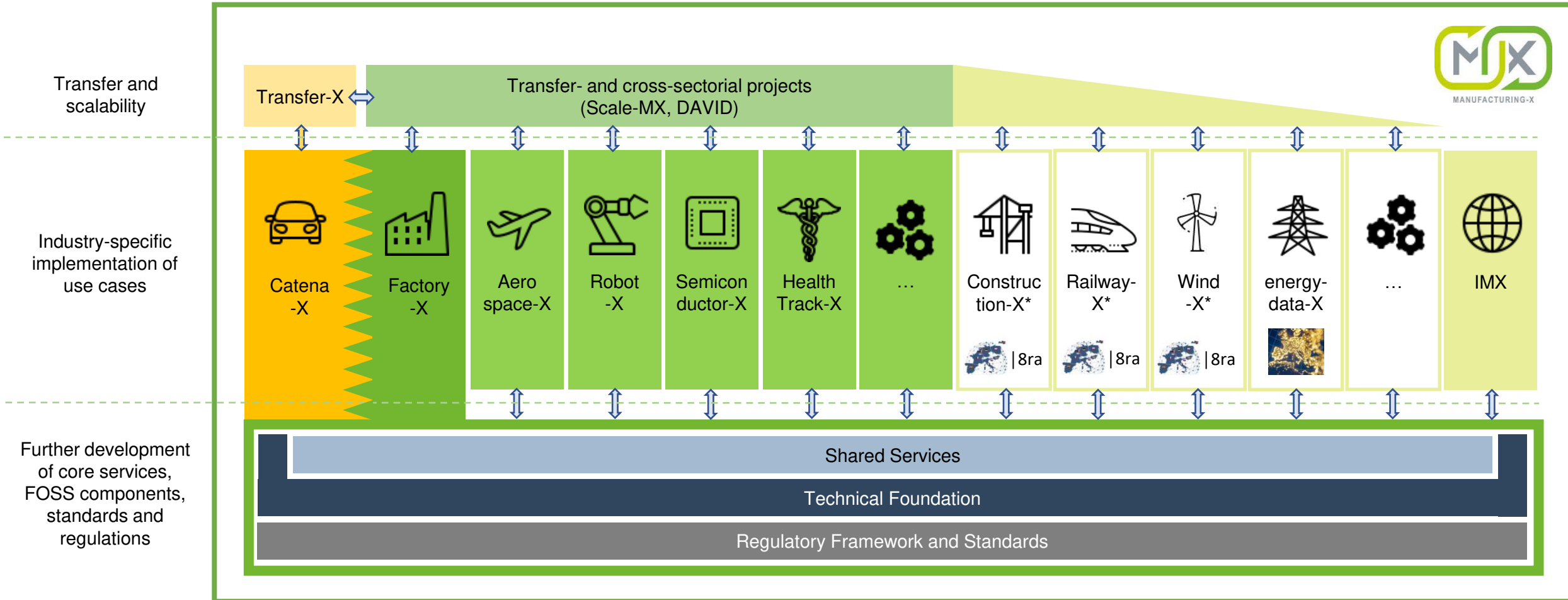
- The Customer Sounding Board is aimed at anyone who is interested in using, e.g. validation, the business applications of the use cases or who wants to create their own software applications that are interoperable with Factory-X.

***When? Sorry , #3 was on February 13, 2025***

## What's next?

**Further MX TC und CSB will follow and we aim for direct exchange! If necessary, via NDAs.**

# Germany Cooperation between the projects



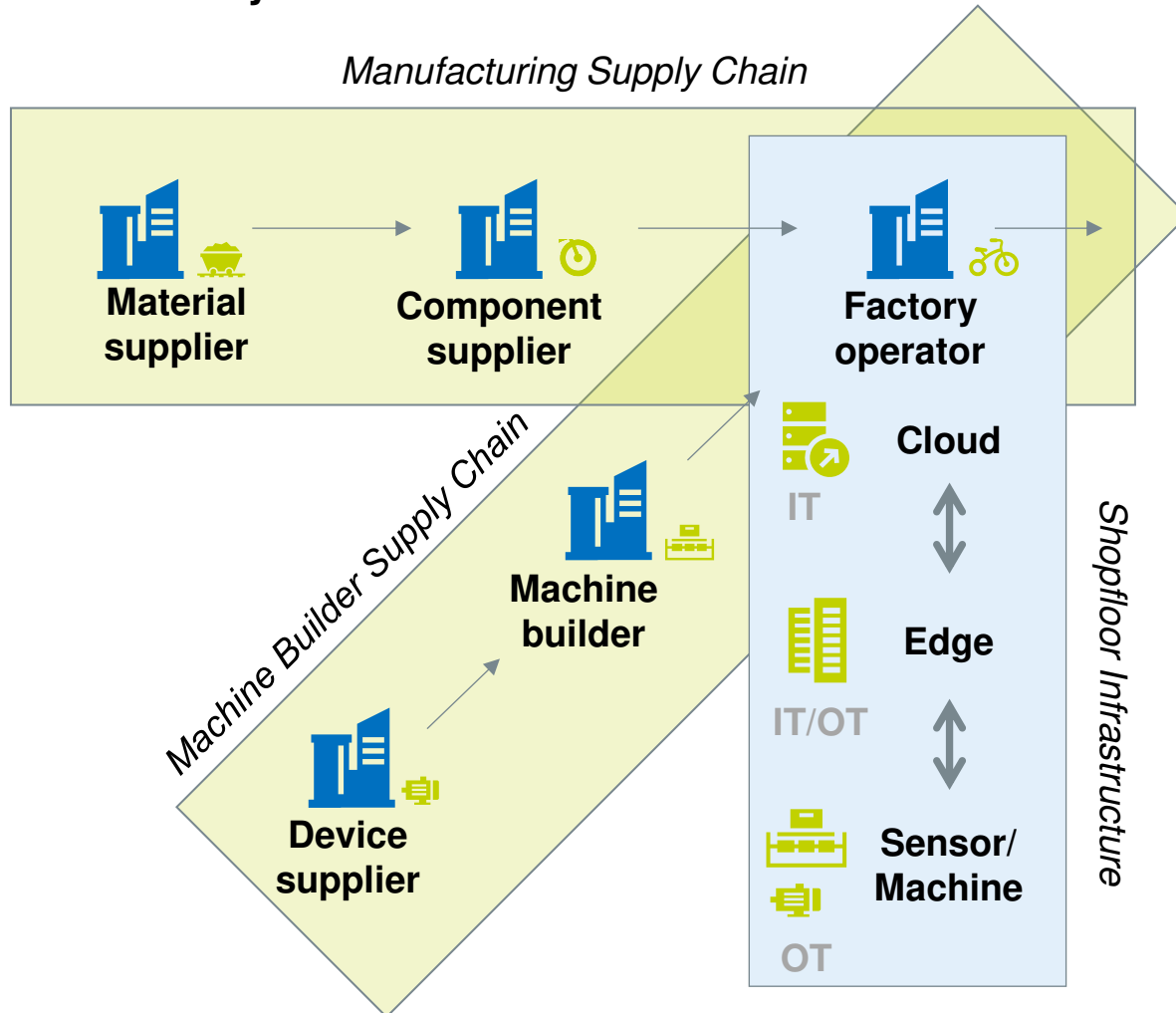
\*Project in preparation

All icons by icons8

# Strategic goals from the Factory-X project world



## The Factory-X Continuum



From the perspective of a manufacturing company, there are two different supply chains:

- Supply chain regarding the **product** of the manufacturing company
  - All deliveries from suppliers that are **integrated** into the manufacturing company's product
  - Application scope of Catena-X
- Supply chain regarding the **production system** of the manufacturing company
  - All deliveries from suppliers that are needed to **build** and **operate** the manufacturing company's production system
  - Expansion of application scope of Catena-X by Factory-X

# 11 Use Cases of Factory-X



<b>11 Use Cases for horizontal and vertical data transfer</b>	Integrated Toolchains and Collaborative Engineering 	Information Update and Change Service 	Collaborative Information Logistics 
Condition Monitoring led Services 	Modular Production 	Manufacturing as a Service - On Demand Manufacturing 	Autonomous Operation-as-a-Service 
Traceability 	Energy-Consumption and Load Management 	Carbon Footprint Management 	Circular Economy 

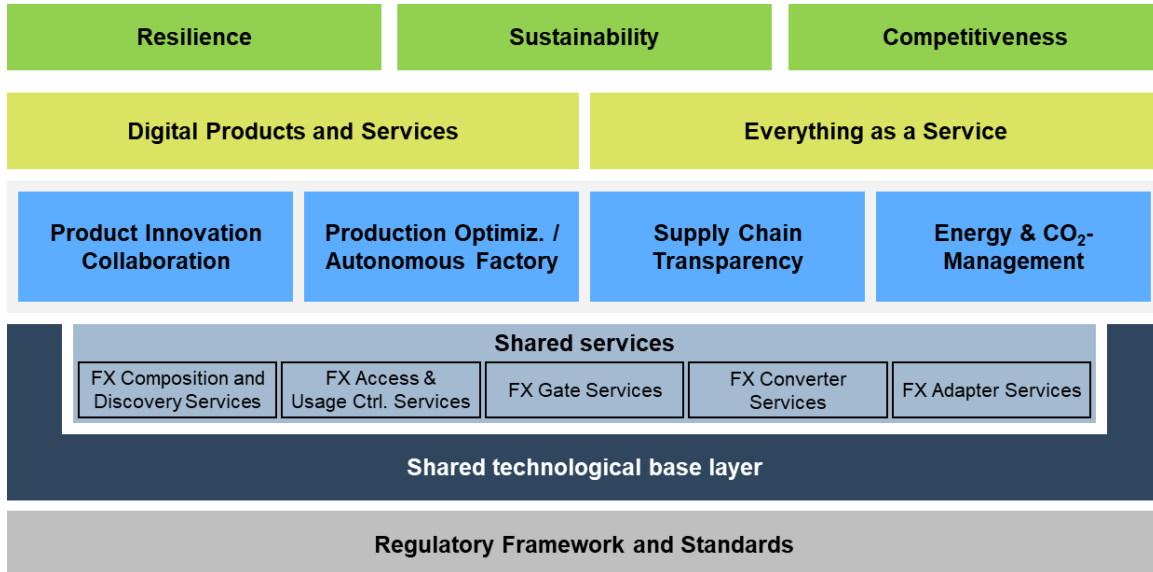
Factory-X Kernel & Basis Services



# Recap of MX TC on Oct. 24, 2024

# Shared Services of FX Port

## Standardized Common Base to integrate IT and OT



### Problem Statement

- Integration of IT and OT is technical possible but faces several hurdles.
- The standardized application of technology can solve this.

### Solution Approach

- Standardized vertical integration (intra-shopfloor) and horizontal integration (eg. IEC, Catena-X)

### Goals and Benefit

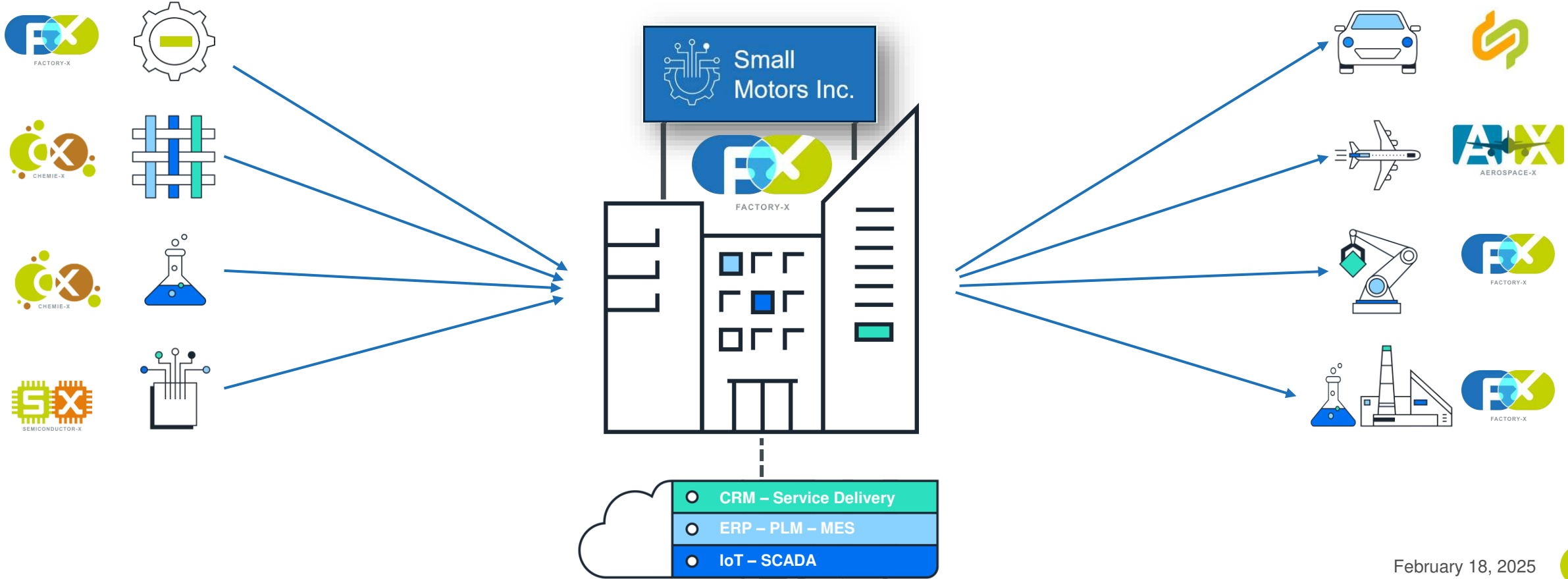
- Standardized Integration of IT and OT enhances technical capabilities and commercial offerings.
- Using the installed base unchanged protects investments and IP.

# Introducing: Small Motors Inc

A typical user of industrial data ecosystems



End to End Processes: PCF – Quality – Traceability – Availability



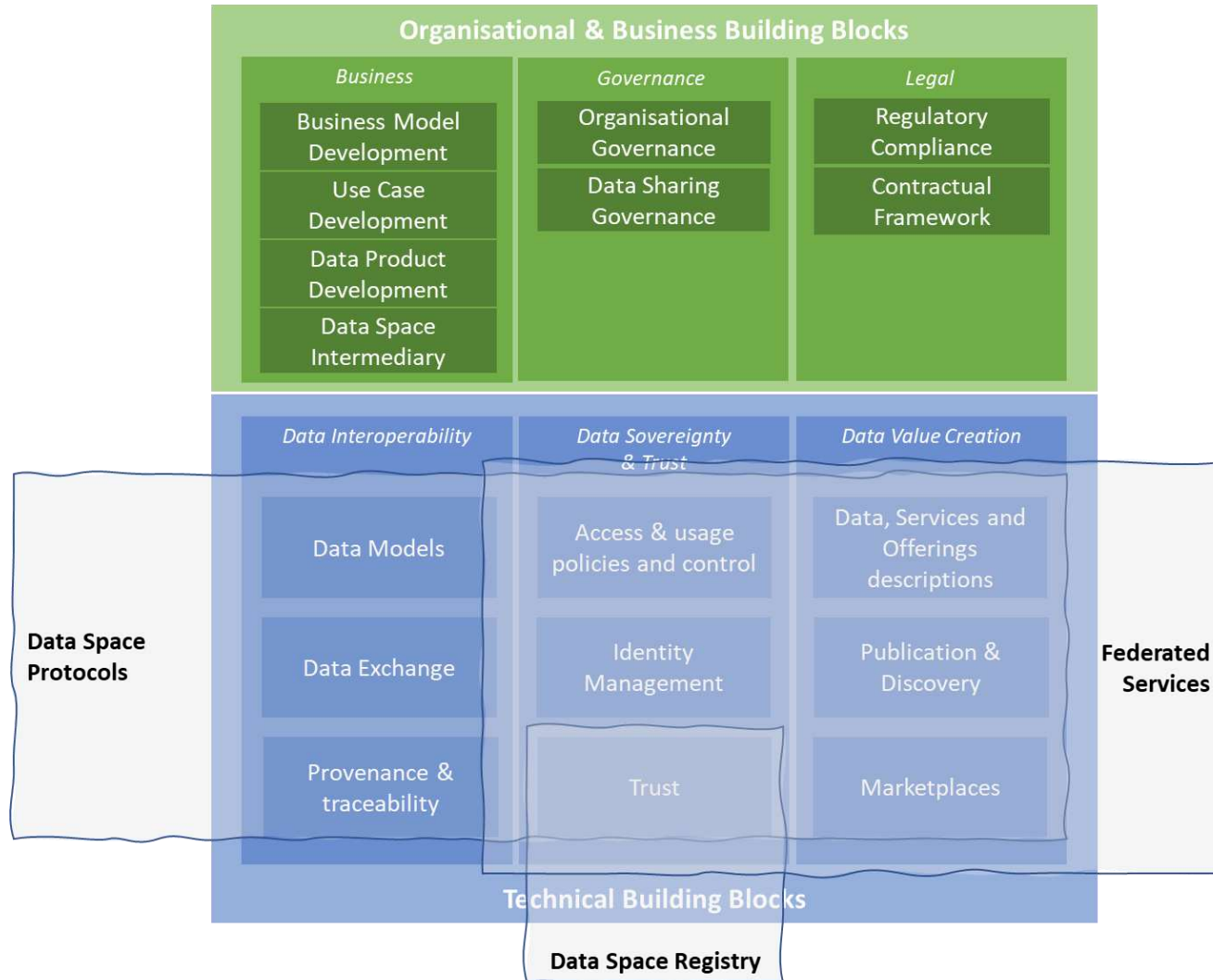
# Small Motors Inc

## What “it works” means for them



- 1. Connect Once and get access to all resources**
  - Register
  - Identify
  - Authenticate
- 2. Model data once to reach all stakeholders**
  - For similar use cases
- 3. Use one set of processes**
  - Use cases with similar goals are identical
- 4. Use one set of applications**
  - Built on the same protocols, connectors and standards
- 5. Use one infrastructure**
  - To connect to all data ecosystems

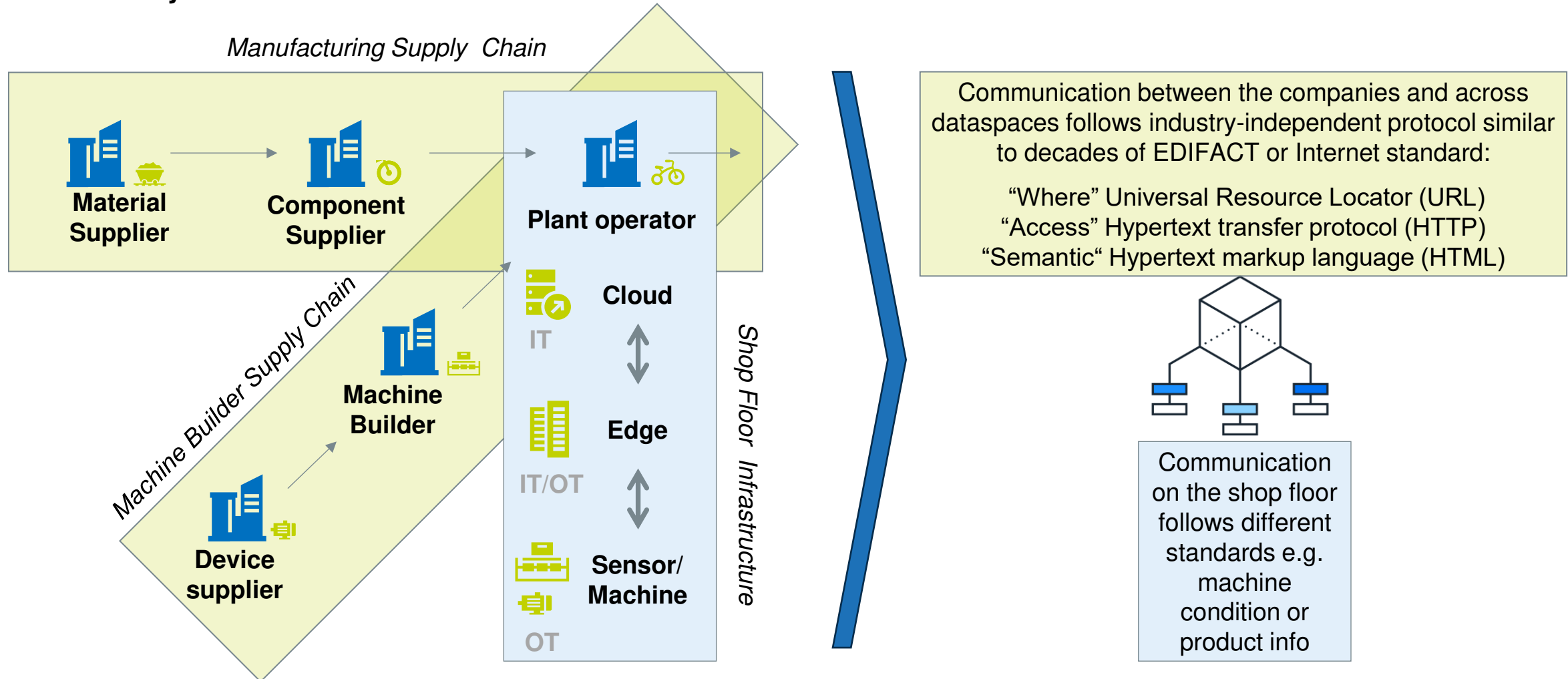
# A data space requires several capabilities on a technical level. They are structured according to three pillars:



1. **Data interoperability:** capabilities needed for the exchange of data: (semantic) models, data formats and interfaces (APIs). This also includes functionalities for provenance & traceability.
2. **Data sovereignty and trust:** capabilities needed for the identification of participants and assets in a data space, the establishment of trust and the possibility to define and enforce policies for access and usage control.
3. **Data value creation:** capabilities used to enable value-creation in a data space, e.g. by registering and discovering data offerings or services, providing marketplace functionality and enable monetisation of data sharing.

# Horizontal and vertical data exchange in an integration architecture / interface framework

## The Factory-X Continuum

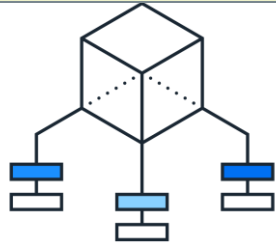


# Translate business and dataspace requirements into the modular FX port concept

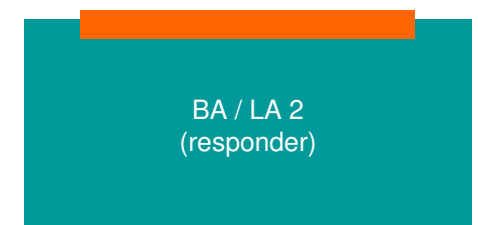
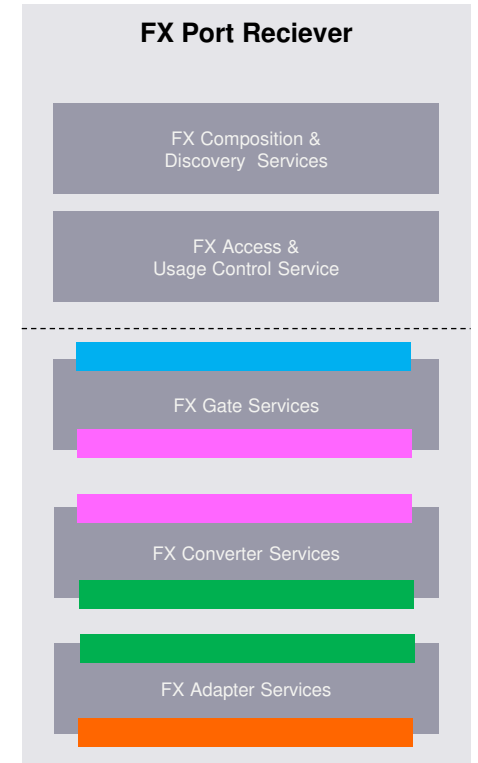
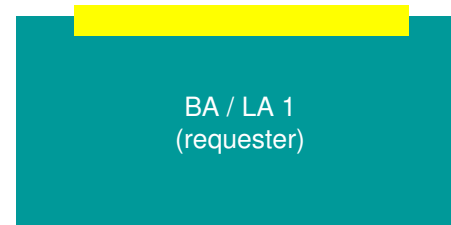
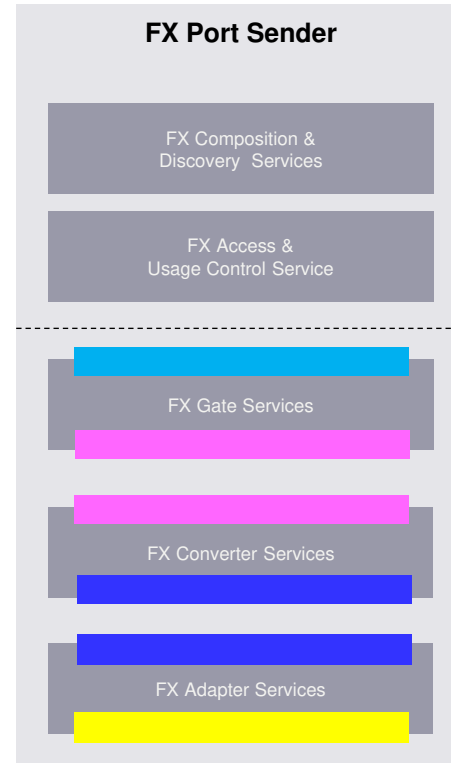


Communication between the companies and across dataspaces follows industry-independent protocol similar to decades of EDIFACT or Internet standard:

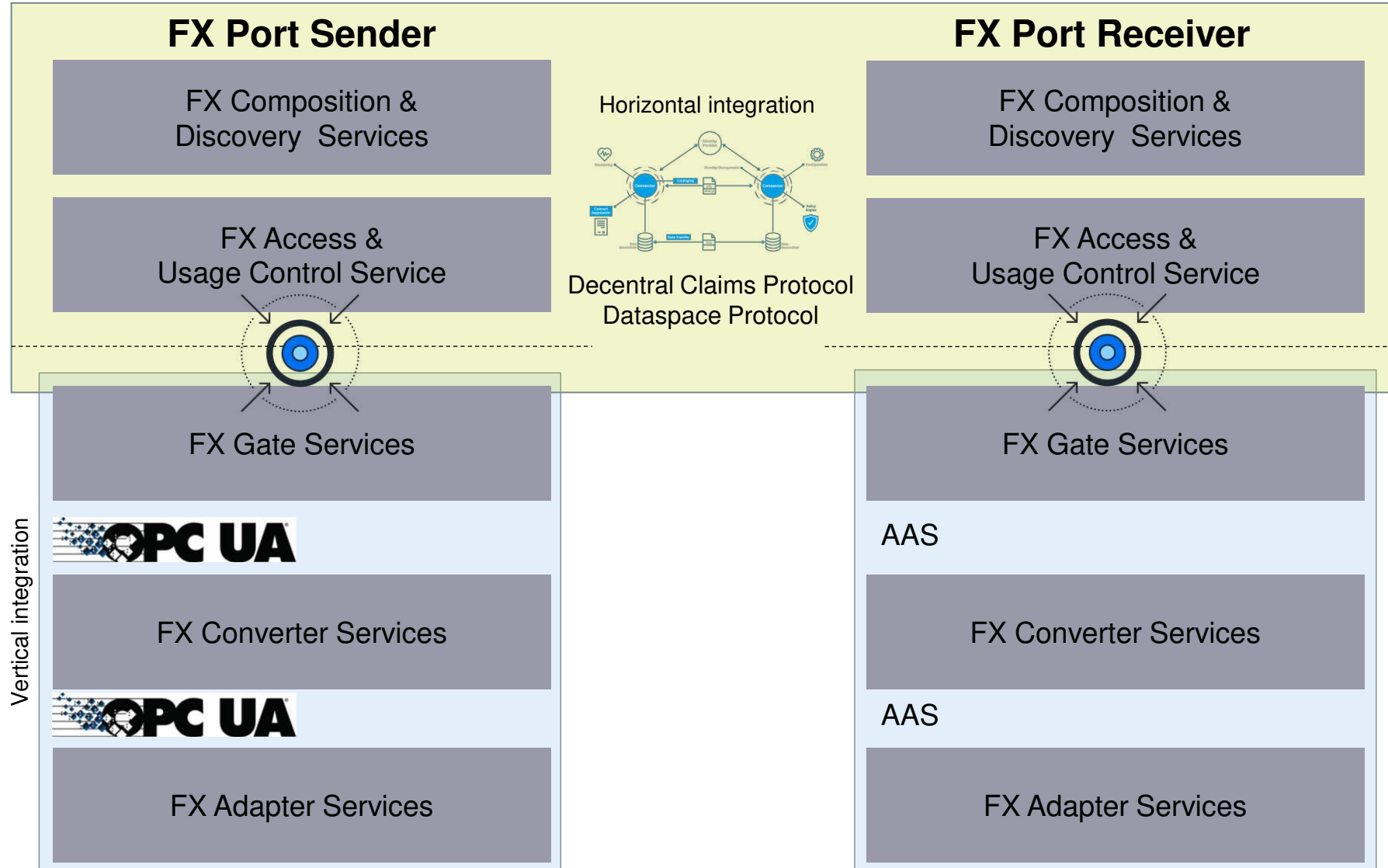
- “Where” Universal Resource Locator (URL)
- “Access” Hypertext transfer protocol (HTTP)
- “Semantic” Hypertext markup language (HTML)



Communication on the shop floor follows different standards e.g. machine condition or product info



# Assemble existing standards & protocols in the modular FX port concept or specify via a common framework



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# Interface definition of FX-Port

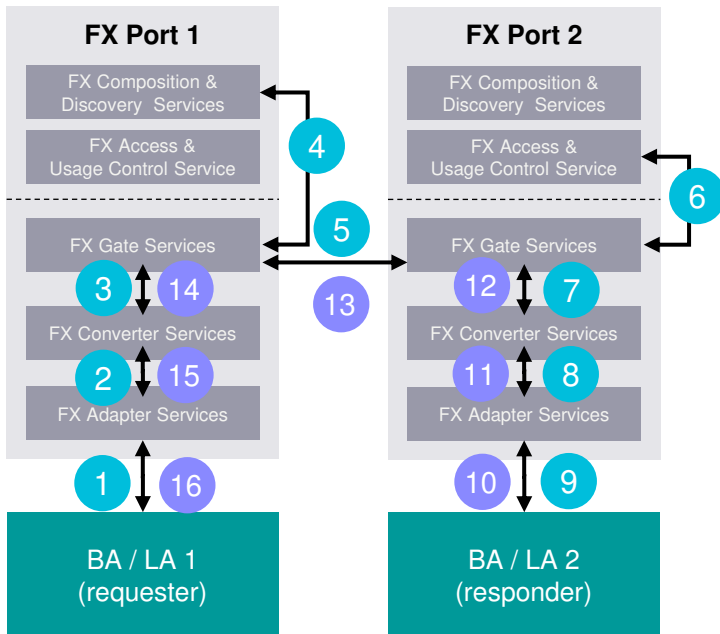
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# FX-Port concept

## Most generic interaction sequence



The sequence looks complex but this is what is done in one or the other way when integrating applications which have different information models and interfaces!



- x Request Sequence
- y Response Sequence

**Example operation :** BA / LA 1 requests generic operation kind X (e.g., read, write, execute, delete) from BA / LA 2

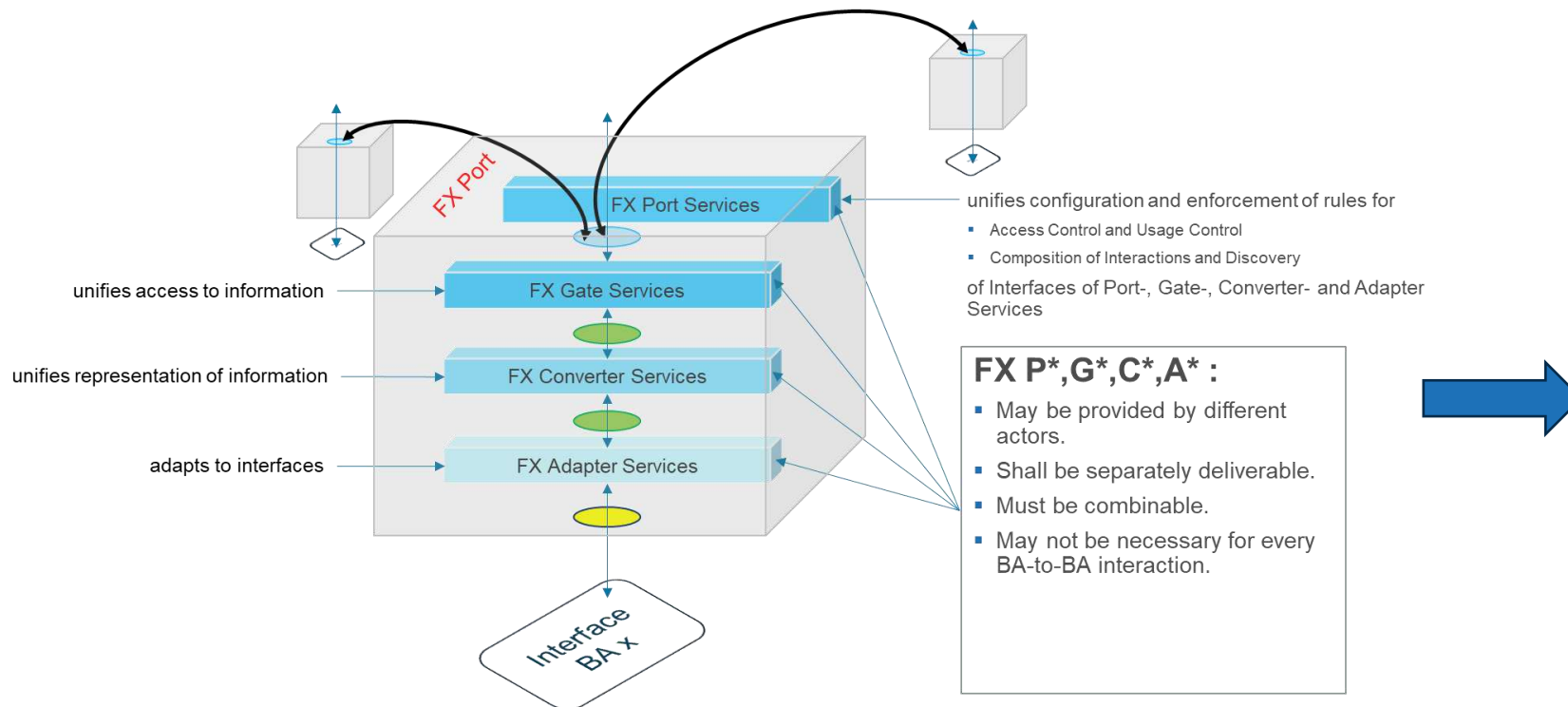
- 1 BA / LA 1 transfers information and requests operation X to Adapter 1. BA / LA 1 interface is used as specified
- 2 Adapter 1 transfers information of BA / LA 1 to interface of Converter 1 and invokes operation X to Converter 1
- 3 Converter 1 converts information of BA / LA 1 to information for exchange and invokes operation X' to Gate 1
- 4 Gate 1 requests destination of Gate 2 of BA / LA 2 (e.g., via EDC Discovery Service)
- 5 If 4 succeeds Gate 1 transfers information for exchange and invokes operation X' of Gate 2
- 6 Gate 2 enforces access & usage control of operation X',
- 7 If 6 succeeds Gate 2 transfers information for exchange via Ports and invokes operation X' of Converter 2
- 8 Converter 2 converts information for exchange to information model of BA / LA 2 and invokes operation X'' to Adapter 2
- 9 Adapter 2 transfers information and indicates operation X'' to BA / LA 2. Therefore BA / LA 2 interface is used as specified

**Information =** operation kind (e.g., read, write, execute, delete) and parameters

X, X', X'' = same kind but different information model of X

- 10 BA / LA 2 processes operation X'' and responds information to Adapter 2. BA / LA 2 interface is used as specified.
- 11 Adapter 2 transfers information of BA / LA 2 to Converter 2 and invokes operation X'' to Converter 2
- 12 Converter 2 converts information of BA / LA 2 to information for exchange and invokes operation X' to Gate 2
- 13 Gate 2 transfers information for exchange and invokes operation X' of Gate 1
- 14 Gate 1 transfers information for exchange and invokes operation X' of Converter 1
- 15 Converter 1 converts information for exchange to information model of BA / LA 1 and invokes operation X to Adapter 1
- 16 Adapter 1 transfers information and confirms operation X to BA / LA 1. Therefore BA / LA 1 interface is used as specified

# FX-Port interfaces - Design proposal 1: Use an asynchronous and event driven interaction scheme for FX-Port components deployable as microservices



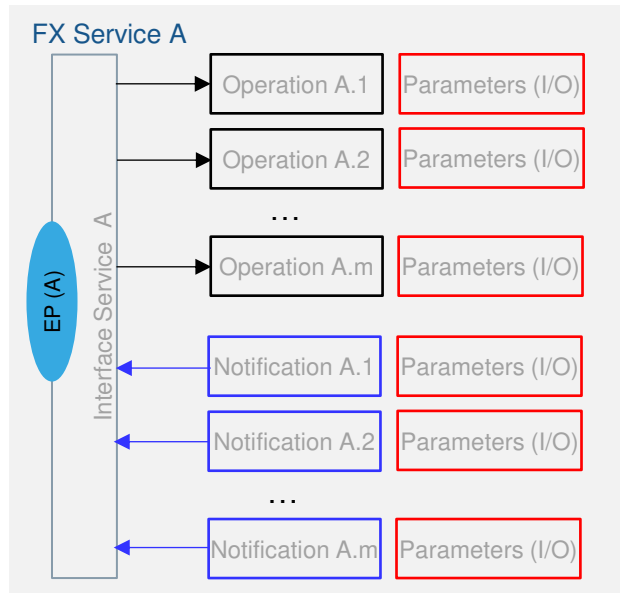
## Supported by

- Deployment of FX-Port components as microservices
- Standardized and combinable interfaces and APIs of FX-Port components
- Standardized interaction scheme between FX-Port components
- Message and therefore event driven interaction between FX-Port components
- Support of asynchronous interactions

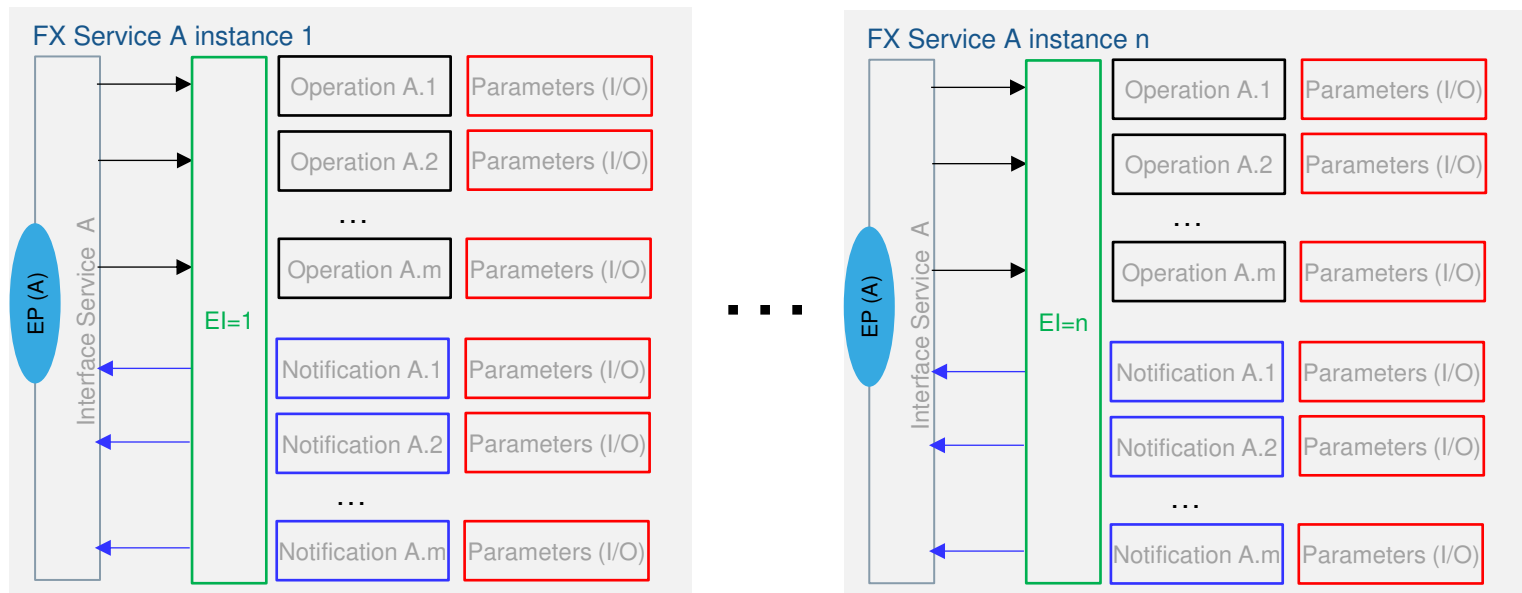
# FX-Port interfaces - Design proposal 2: Define Endpoint Identifiers to support multiple parallel asynchronous transactions (sessions) by instances of FX services



Service A



In parallel existing instances of Service A

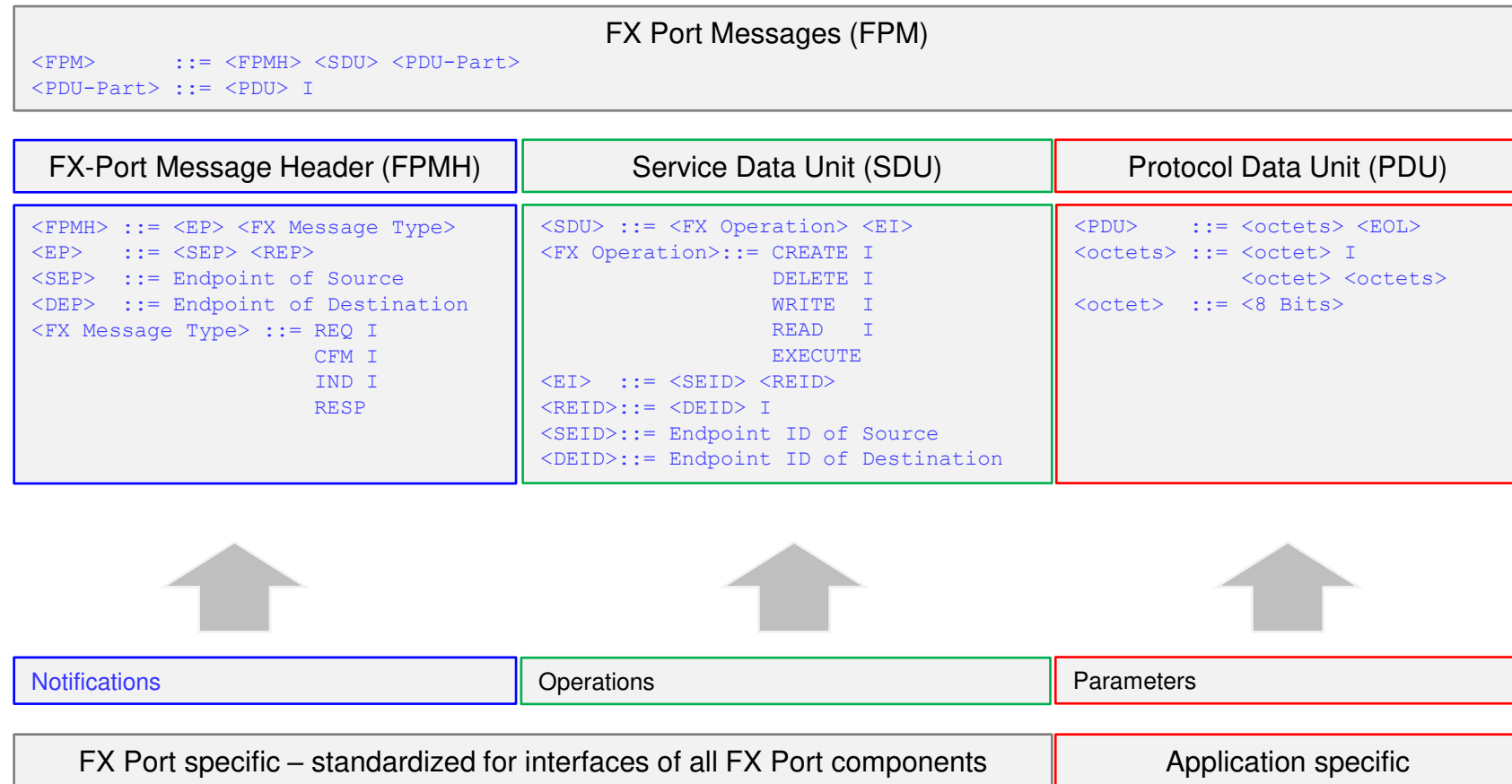
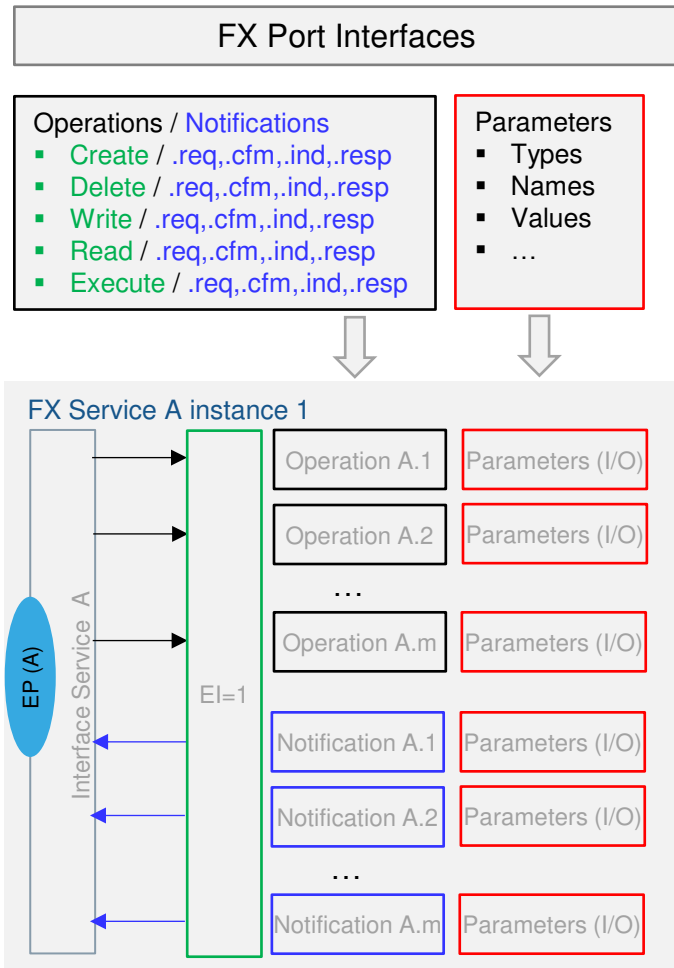


EP: Endpoint of interface (address where to find an interface of a service)  
 EI: Endpoint Identifier (Identifies the instance of one service, all instances of a service have the same EP)

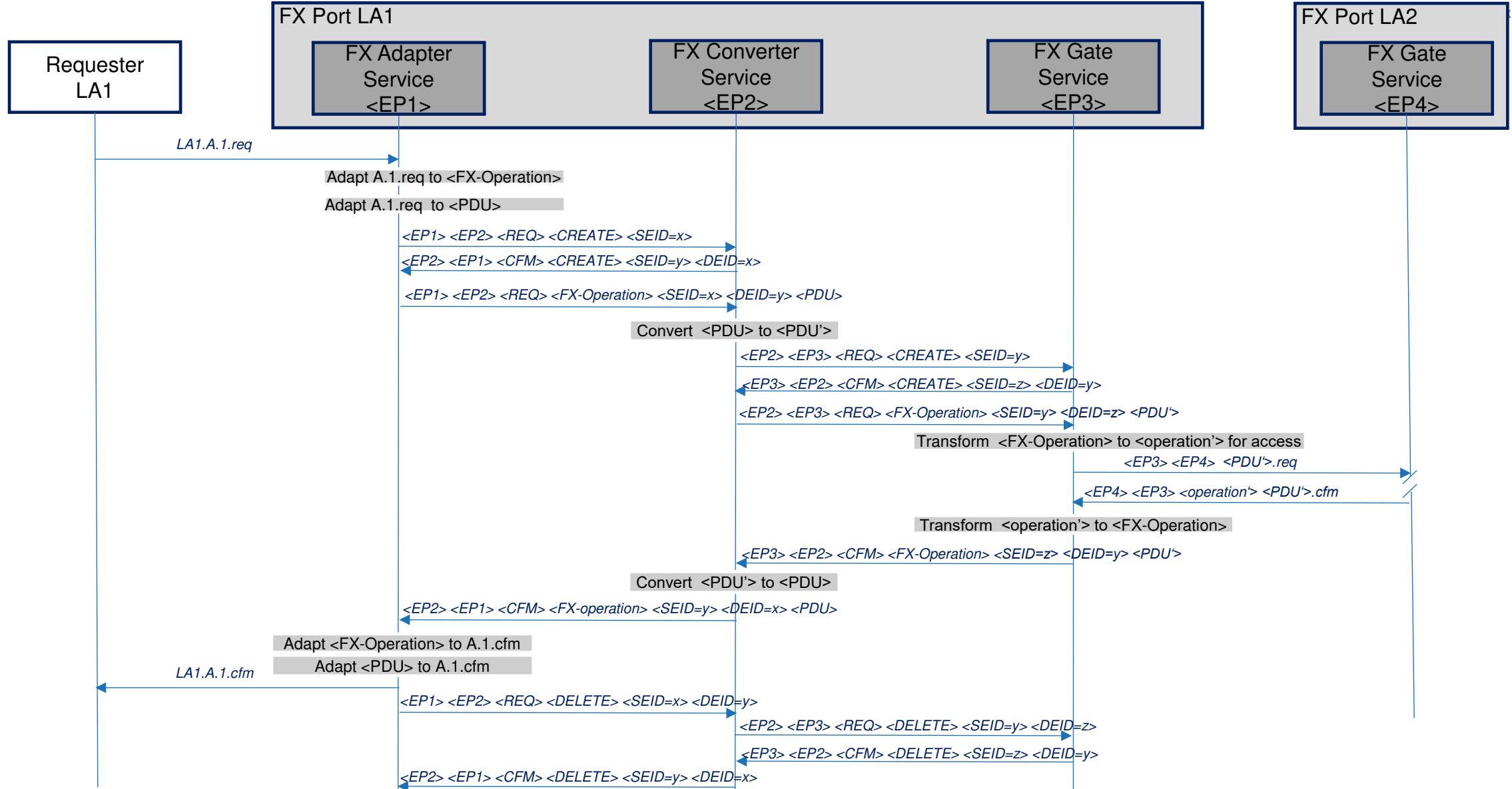
# FX-Port interfaces - Design proposal 3: Define FX Port Messages to support event driven interaction and standardized and flexible combination of FX-Port Interfaces and APIs as well as pre-integration of functions into one service



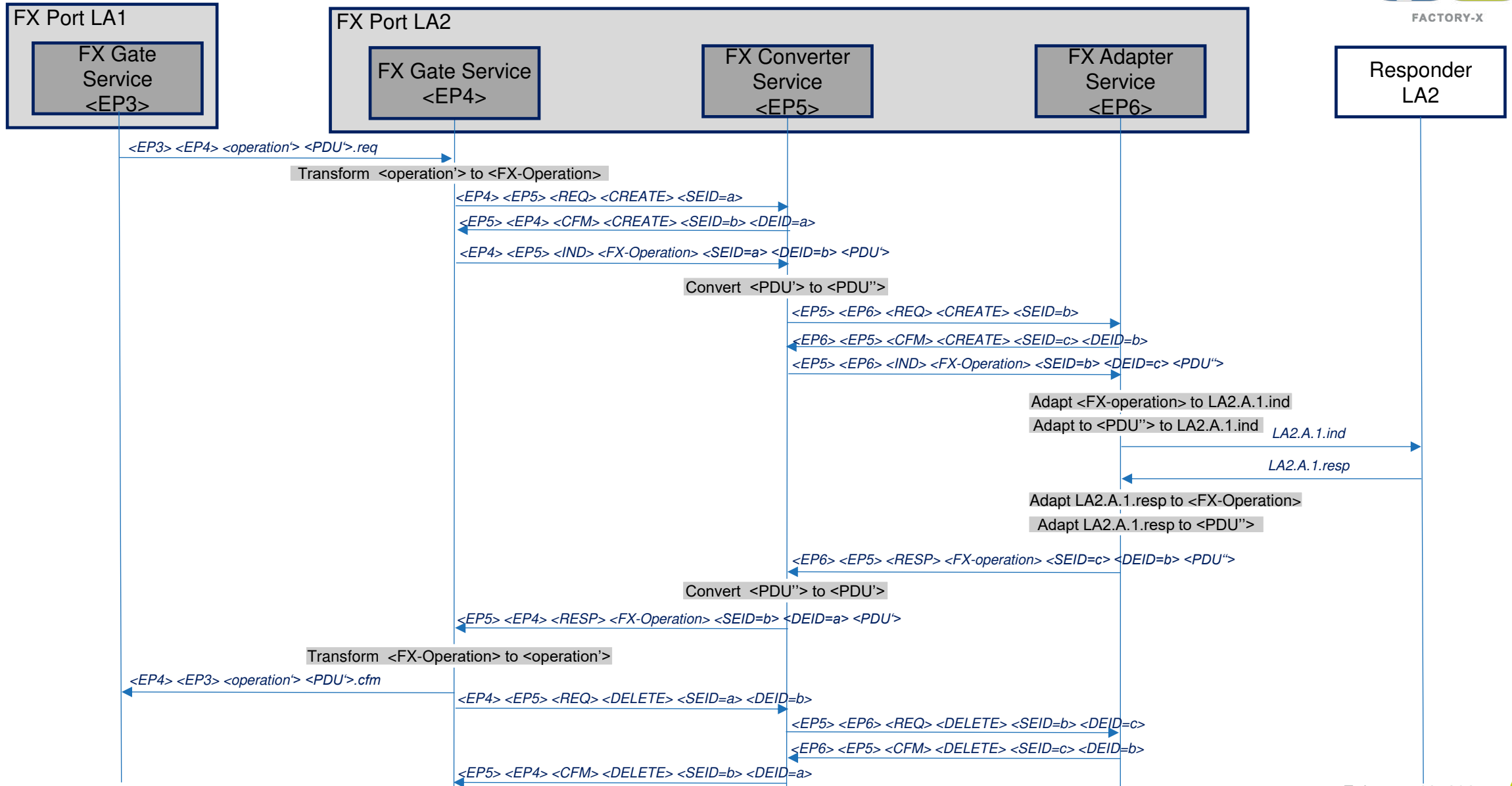
## Interfaces of FX Port components to support FX Port Messages



# FX Port Messages – Request Sequence



# FX Port Messages – Respond Sequence



# FX-Port and OPC UA

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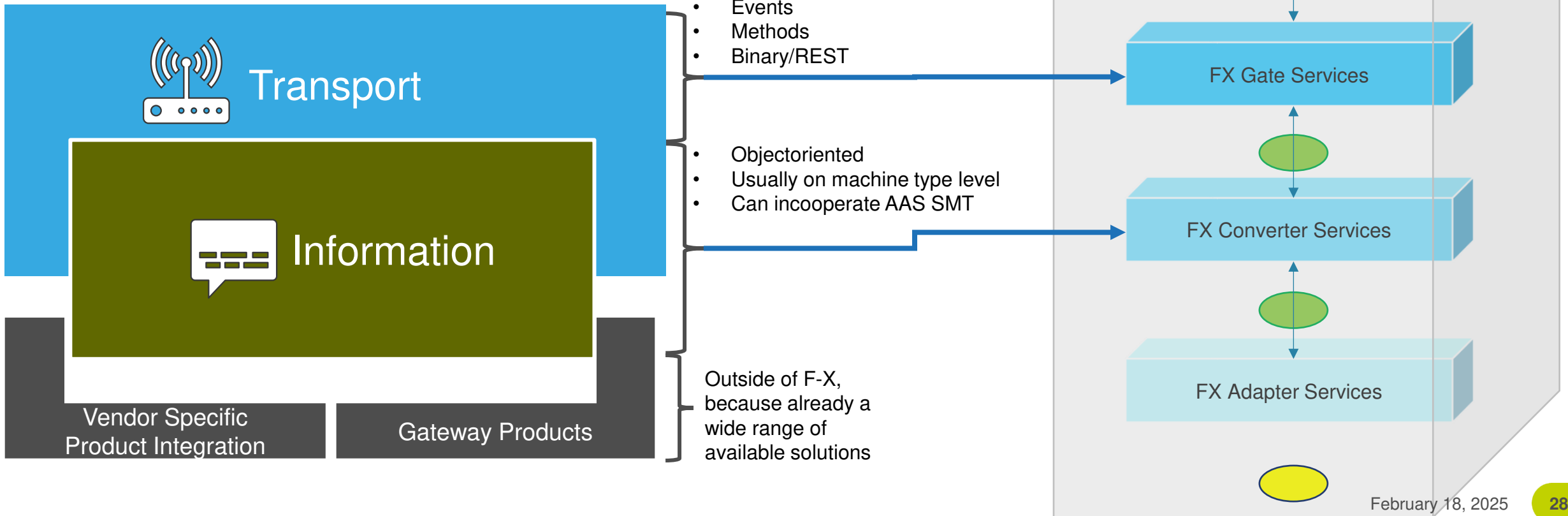


# FX-Port and OPC UA

## Current discussion



### Using OPC UA as Integration technology for FX Port

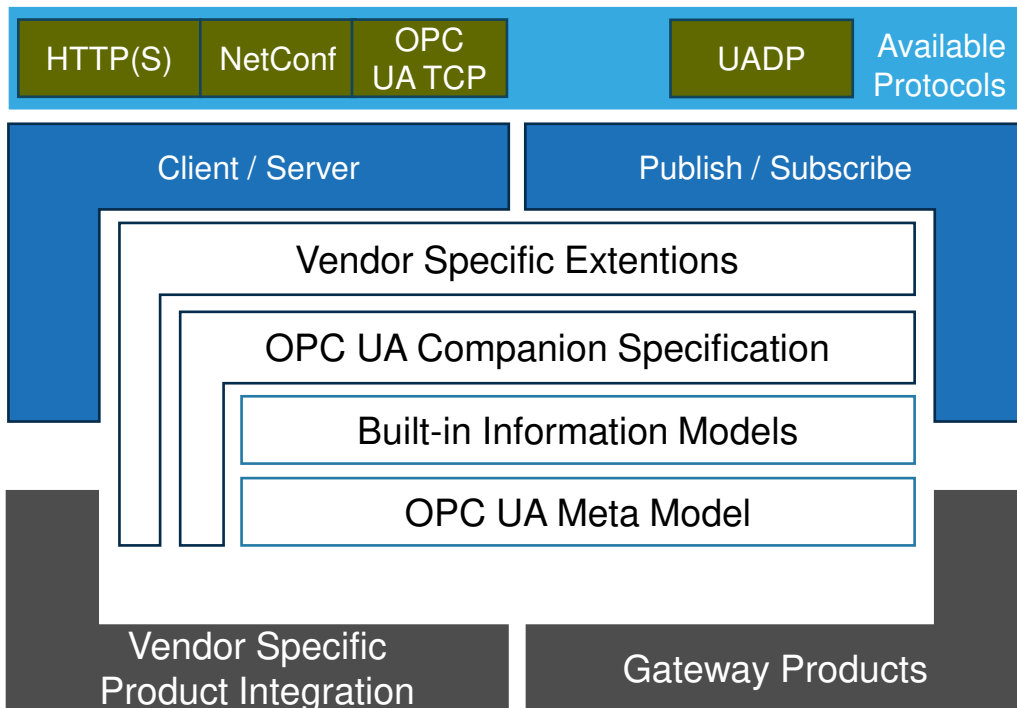


# FX-Port and OPC UA

## Current discussion



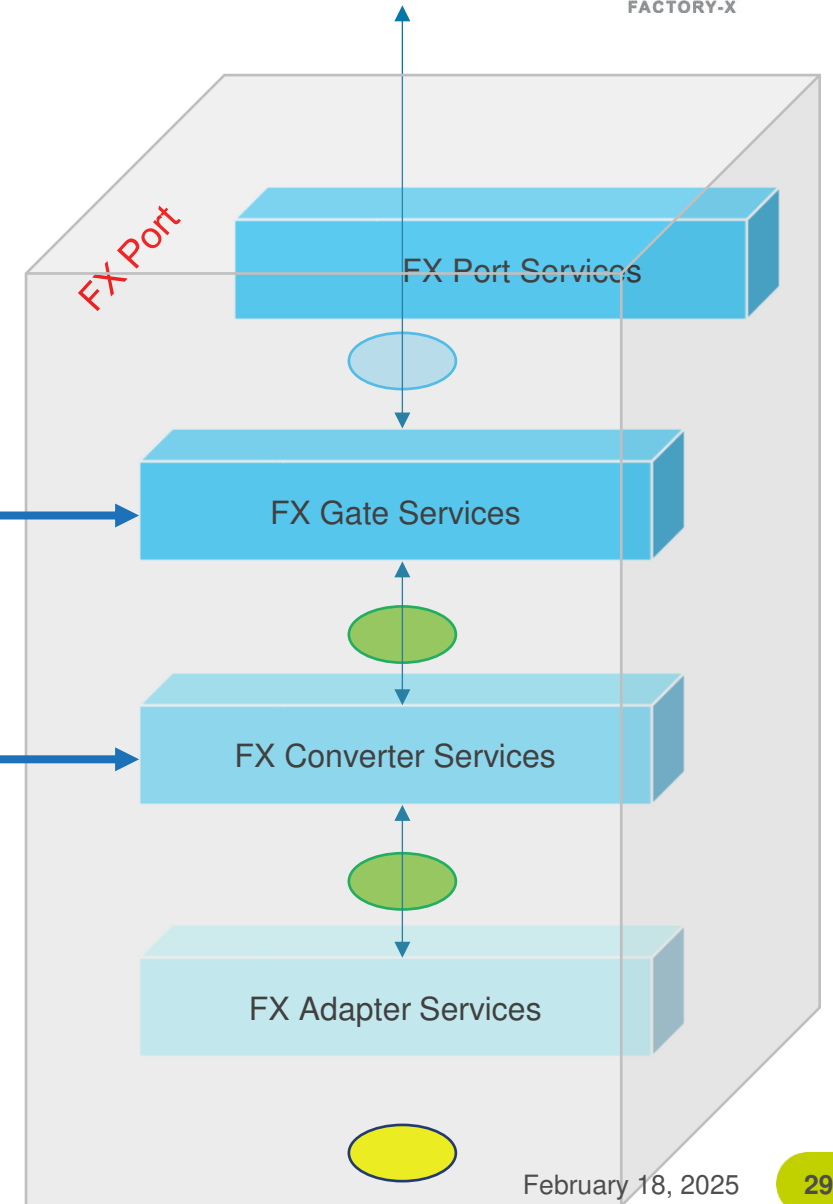
### Using OPC UA as Integration technology for FX Port



- Synchronous/Asynchronous
- Events
- Methods
- Binary/REST

- Objectoriented
- Usually on machine type level
- Can incooperate AAS SMT

Outside of F-X,  
because already a  
wide range of  
available solutions

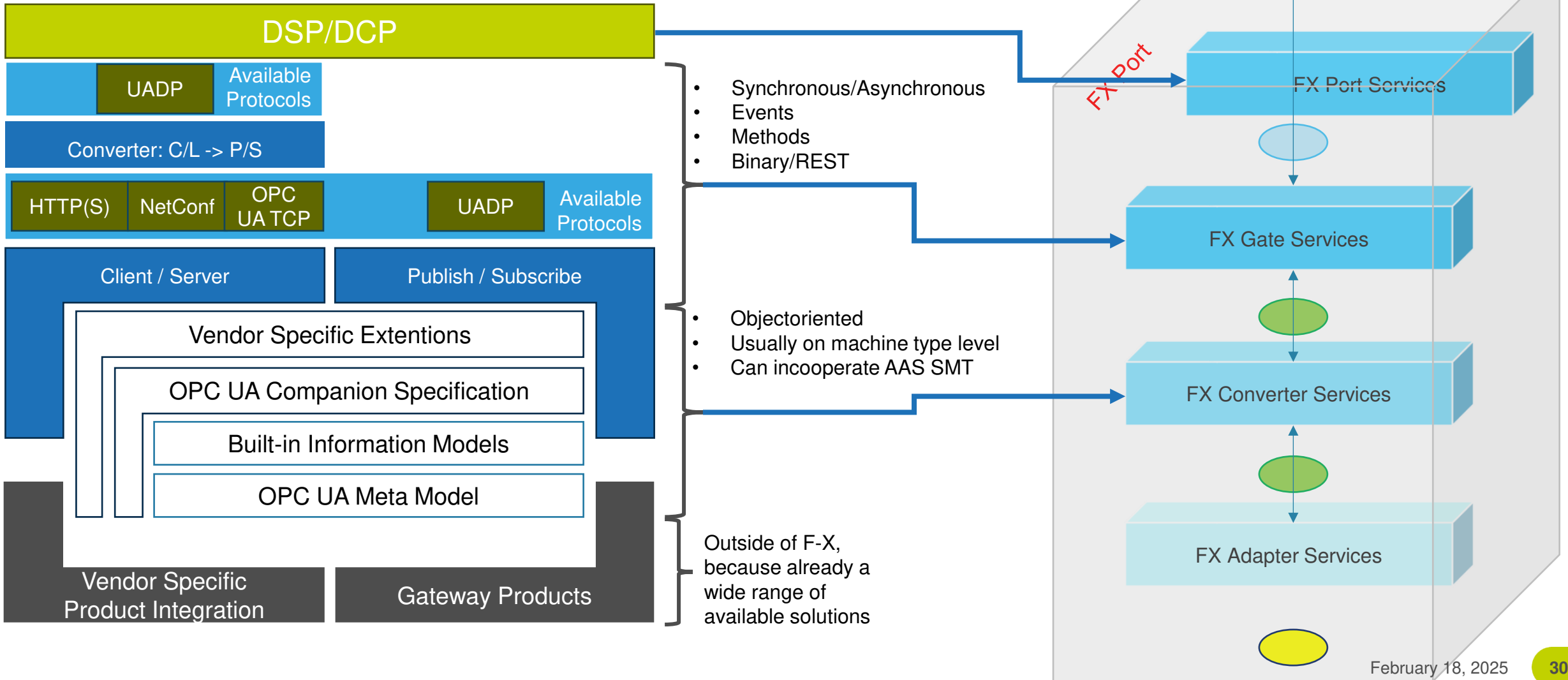


# FX-Port and OPC UA

## Current discussion



### Already PoC existing since HMI 2024



# Q & A

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# Thank you

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**Contact information:**

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[www.factory-x.org](http://www.factory-x.org)