OPC Day 2025

Erich Barnstedt
Chair OPC Foundation Cloud Initiative
Senior Director & Architect Industrial Standards Microsoft Corporation
erichb@microsoft.com

OPC Foundation Cloud Initiative: Major goals

- Accelerate **interoperability of IT and cloud applications** using OPC UA, targeting data analytics using AI, industrial data spaces, digital product passports, industrial metaverse as well as digital twin applications.

- Cover the use of **OPC UA Companion Specs** and other OPC UA information models within cloud services (e.g. through the UA Cloud Library).

- Create a **cloud reference architecture** to provide best practices, increase standardized data sharing and cloud-optimized profiles for the OPC UA standard, in line with global regulations such as the Data Act or the Cyber Resilience Act (CRA).

- Establish a new **Protected Identity** for OPC UA Cloud eXchange (UACX) – similar to OPC UA FX

- Establish a new **validation and certification program** for OPC UA Cloud interoperability as the leading cloud vendors Alibaba Cloud, AWS, Huawei, Microsoft and SAP already support OPC UA to some extent, but no rules govern this support in the cloud to date.

OPC Foundation Cloud Initiative Milestones

1. Bring the world’s leading cloud providers, automation providers and manufacturers together under one roof – **Done!**
2. Develop a reference architecture and map it to each provider’s product portfolio – **Done!**
3. Develop marketing material (a cloud landing page and brochure) and spread the word – **Done!**
4. Develop open-source reference implementations for edge and cloud applications – **Done!**
5. Develop a reference solution for the Digital Product Passport – **Done!**
6. Develop a reference solution for data sharing along manufacturing supply chains – **Done!**
7. Develop a list of interoperability tests providers can run against their product to be “OPC UA CX“ compliant – **In progress!**
8. Peace on earth and good will towards men – **Needs Improvement!**

An Industry-First: Supported by ALL major Cloud- and ALL major Automation-Providers!

Nr.	Generic Name	aws	Google Cloud	HUAWEI	Microsoft	SAP
1	Machines (building product)			Machines of the Manufacturer		
2	Information Model Viewer			UA Cloud Viewer		
3	Edge Broker	Shopfloor Connectivity running on AWS IoT Greengrass / Amazon EKS Hybrid Nodes Greengrass	Manufacturing Connect	UA Edge Translator	Azure IoT Operations on Azure Local	SAP APM Device Connectivity
4	Industrial Connectivity Software			UA Edge Translator		SAP Production Connector
5	On-premises MES			On-premises MES		
6	Gateway	Shopfloor Connectivity running on AWS IoT Greengrass / Amazon EKS Hybrid Nodes	Manufacturing Connect	IOT Edge	Azure IoT Operations on Azure Local	SAP APM Device Connectivity
7	Dataspace Connector Consumer	Eclipse Dataspace Connector Consumer	Eclipse Dataspace Connector Consumer	EDS	Eclipse Dataspace Connector Consumer	SAP Integration Suite Dataspace Connector
8	Cloud Broker	AWS IoT Core / Amazon Managed Streaming for Apache Kafka	Pub Sub & Data Flow	IIoT	Azure Event Grid/Hubs	SAP Integration Suite – Advanced Event Mesh
9	Edge Management	AWS IoT Device Management / Amazon EKS	Manufacturing Connect (Cloud)	IOT Edge	Azure Arc	SAP Edge Lifecycle Managment
10	ERP Database			ERP Database	Dynamics 365 ERP	SAP S/4HANA
11	Cloud MES Service			Model Based Manufacturing	Dynamics 365 MES	SAP Digital Manufacturing
12	Production Lines Time-Series Database	Amazon TimeStream / Amazon Simple Storage Service (S3)	Cloud Storage & Big Table	GeminiDB	Azure Data Explorer	SAP Business Data Cloud

Supporting end-users

Boehringer Ingelheim, Continental ContiTech, Danone, equinor, L'ORÉAL Operations, Miele, Mondelēz International, Renault Group, JTI, Tetra Pak, Volkswagen

Supporting automation providers

ABB, BECKHOFF, Honeywell, Mitsubishi Electric, Rockwell Automation, Schneider Electric, SIEMENS, YOKOGAWA

OPC Foundation Cloud Initiative Working Groups Progress

- OPC UA over MQTT & KAFKA
- OPC UA REST (OpenAPI REST compatible)
- Cloud Library V1.1
- AI
- Metaverse Demo Update
- WoT-Connectivity V1.1
- WoT-Binding V1.0
- I4AAS (nearing completion)

In addition:

- Dataspaces (European Cloud Accelerator project)
- Digital Product Passport/Battery Passport Demo
- Cloud Marketing activities

Data Spaces – powered by OPC UA

INTERNATIONAL DATA SPACES ASSOCIATION

- A **data space** is a trusted digital environment where multiple organizations share and exchange data securely.
- It ensures participants **keep control over their data (sovereignty)** while enabling interoperability.
- Common standards and governance rules define how data is accessed and used.
- Data spaces are key enablers for building collaborative ecosystems across industries.

INTERNATIONAL DATA SPACES ASSOCIATION

OPC FOUNDATION

OPC UA connects assets to International Data Spaces

OPC Foundation and International Data Spaces Association are collaborating to connect the largest ecosystem for industrial interoperability to international data spaces

Scottsdale, AZ – March 26th, 2025 - The OPC Foundation, a global organization committed to advancing the development and adoption of industrial communication standards, is pleased to announce an expanded collaboration with the International Data Space Association (IDSA) aiming to enhance interoperability and data governance in the automation industry. The OPC Foundation connects the largest ecosystem for semantic interoperability in the automation world through OPC UA including over 150 semantic domain standards. This extensive framework ensures seamless communication and integration across various automation systems, fostering a more connected and efficient industrial

OPC FOUNDATION

Collaboration Catena-X – powered by OPC UA

Catena-X
Your Automotive Network

Core areas of collaboration:

- **Semantic Integration:** Combine the OPC UA information modelling and Catena-X semantic templates – results in automated DPP generation from production data.
- **Open-Source Reference Implementations:** Jointly develop and provide open-source reference implementations for key dataspace and interoperability components, enabling straightforward integration of OPC UA-based systems into the Catena-X data ecosystem.
- **Reference Architecture Alignment:** Align the OPC Foundation's Cloud Initiative reference architecture with Catena-X's dataspace architecture to enable streamlined deployment from the shopfloor to the supply chain.
- **Industrial Ecosystem Enablement:** Empower companies to leverage their existing OPC UA tools and infrastructure to meet emerging regulatory requirements, particularly the DPP, while reducing integration costs and accelerating time-to-compliance.

Catena-X
Your Automotive Network

Catena-X and OPC Foundation Join Forces to Enable Seamless Industrial Data Exchange for the Digital Product Passport

The Partnership aligns OPC UA Standardization and Cross-Industry Data Interoperability to Comply with Regional Regulations like the EU Digital Product Passport

Scottsdale (AZ), USA / Berlin, Germany, August 19th, 2025 – The Catena-X Automotive Network e. V. and the OPC Foundation have announced a strategic collaboration to accelerate standardized, cross-

Link PR including whitepaper and joint webinar on Oct 14th, 2025

Digital product passports (DPP) as part of European broader regulatory

European Green Deal

EU Plan: climate-neutral by 2050, safeguard biodiversity, establish a circular economy and eliminate pollution, while boosting the competitiveness of the European industry

agreed

Ecodesign for Sustainable Product Regulation (ESPR)

- Proposed in Mar 2022, as central part to the Commission's strategy for eco-friendly and circular products
- Aims to promote environmental sustainability across a broader range of products

Requires **digital product passports based on harmonized European Standards (hEN)**

Entered into force

Battery Regulation

- Entered into force in Aug 2023 replacing the EU Battery Directive
- Provides a legal framework aiming to promote sustainability, circularity, safety and transparency

Mandates a **battery passport** for all EV, LMT, and industrial (>2kWh) batteries starting Feb 2027

Proposal

End-of-Life Vehicle Regulation

- Proposed in Jul 2023
- Will replace the End-of-life Vehicle Directive
- Governs the entire vehicle lifecycle, from design to end-of-life treatment

Mandates a **circularity vehicle passport**

DPP: An IEC standardized interface & data format / model / semantics

Interface: OpenAPI-compatible HTTP Interface from CEN/ELEC & IEC

Data Format: OPC UA Nodeset file (at rest) & CEN/ELEC JSON (in transit)

Data Model: OPC UA Modelling Language

Semantics: IEC Common Data Dictionary (CDD), EClass, VDMA OPC UA Companion Specs & IDTA/Catena-X Templates

OPC Foundation & CESMII Partner to Drive Interoperability

UA Cloud Library Joint Working Group (JWG)

- Collaboration to develop a repository of re-usable OPC UA information models
- Provides a library for ‘Types’ and ‘SubTypes’ – not a server for instance information (SM Profiles & Extensions)
- Affirms the concept of standardized data structures, drawing on input from Industry leaders
- Builds equity in an open and standardized implementation of the SM Profile Marketplace
- Will be implemented in the SM Platform, used as input for Industrie 4.0 efforts

UA Information Model Cloud Library

- Joint Working Group Charter -

PRESS

Purpose

The following organizations (“Parties”) cooperate in the joint working group (JWG) “**UA Information Model Cloud Library**”:

- Clean Energy and Smart Manufacturing Innovation Institute (CESMII) and
- OPC Foundation.

The JWG will develop a specification for an Internet-hosted database containing OPC UA information models. This database can be made publicly accessible through a RESTful interface. User access control will be handled through a separate identity provider. This cloud library can be made available to manufacturers who are looking to leverage industrial assets containing non-standardized information models for their SCADA or analytics systems. Non-standardized information models are meant to describe information models that are not defined through an OPC UA companion specification.

Scope

The output of the working group will be a specification which will, at a minimum, define the RESTful interface of the information model database. The query language to return results from the database will also be defined. Optionally, should this have merit, the way information models are stored in the database will additionally be defined.

OPC® FOUNDATION

CESMII THE SMART MANUFACTURING INSTITUTE

Joint Working Group Members

- ABB
- Ascolab
- Atlas Copco
- Bitctrl
- Bosch
- Capgemini
- Endress + Hauser
- Equinor
- Hilscher
- IBM
- idata
- Microsoft
- Prediktor
- Renault
- SAP
- Softing
- VDW (German Machine Tool Builders’ Association)
- Wago
- 4CE Industry

Enabling Interoperability for Smart Manufacturing

OPC UA Companion Specifications
- VDMA
- MTConnect
- Industry Associations

CESMII SM Profile Designer™
- Machine Builders
- System Integrators
- Any Domain Expert

CESMII Funded Translators
- OSI AssetFramework
- PTC ThingWorx Templates
- Savigent Class Definitions
- Others…

OPC FOUNDATION
CESMII THE SMART MANUFACTURING INSTITUTE

Cloud Library

- Open Specification
- Open Implementation
- Common, Searchable Repository
- Extensible

OPC UA Servers
Asset Administration Shell

CESMII SM Marketplace™
- SM Profiles™
- Apps that work against them

CESMII SM Innovation Platform™

Other "Smart" Cloud infrastructure and platforms

UA Cloud Library Instances

- uacloudlibrary.opcfoundation.org (free registration)
- cloudlib.cesmii.net (free registration)
- Many privately-hosted instances!

UA Cloud Library Open-Source Project

- github.com/OPCFoundation/UA-CloudLibrary
- Open-source console app & Client SDK
- Open-source UI-based upload tool: github.com/OPCFoundation/UA-CloudViewer
- Over 400 commits, frequency contributions
- Now updated to .Net9.0 (soon .Net10.0)

UA Cloud Library Benefits

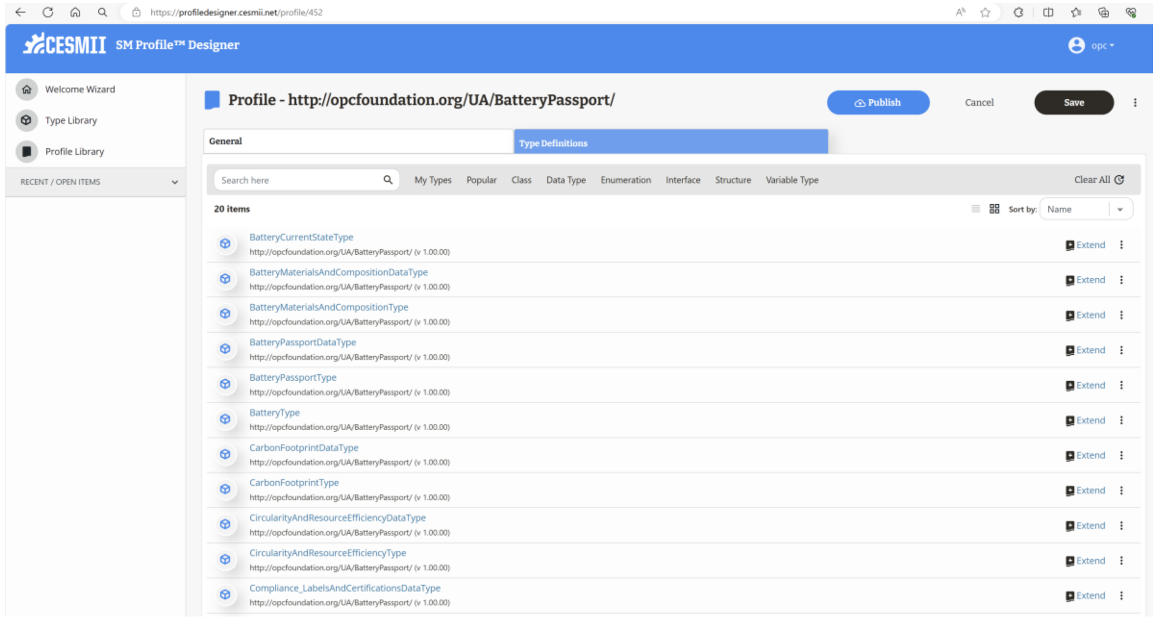
1. Setup an analytics pipeline or cloud dashboard before connecting to the plant for the first time.

2. Drive semantic interoperability through reuse of existing information models defined by domain experts.

3. Simulate and verify information models before the industrial asset is even built.

OPC FOUNDATION

EU Digital Product Passport PoC



profiledesigner.cesmii.net
(free online OPC UA editor)

UA Cloud Library

Hello erichb@microsoft.com! Logout

CarbonFootprintAAS

Loaded Nodesets

http://opcfoundation.org/UA/
http://industrialdigitaltwin.org/UA/CarbonFootprintAAS/

Required Nodesets Missing from UA Cloud Library

(none)

Nodeset Browser

- Root
  - Objects
    - Server
    - Aliases
    - Locations
    - **Asset Admin Shells**
    - **Submodels**
      - **CarbonFootprint**
        - **TransportCarbonFootprint**
        - **ProductCarbonFootprint**
    - **Concept Descriptions**
  - Types
  - Views

Selected Node Value Edit

(none)

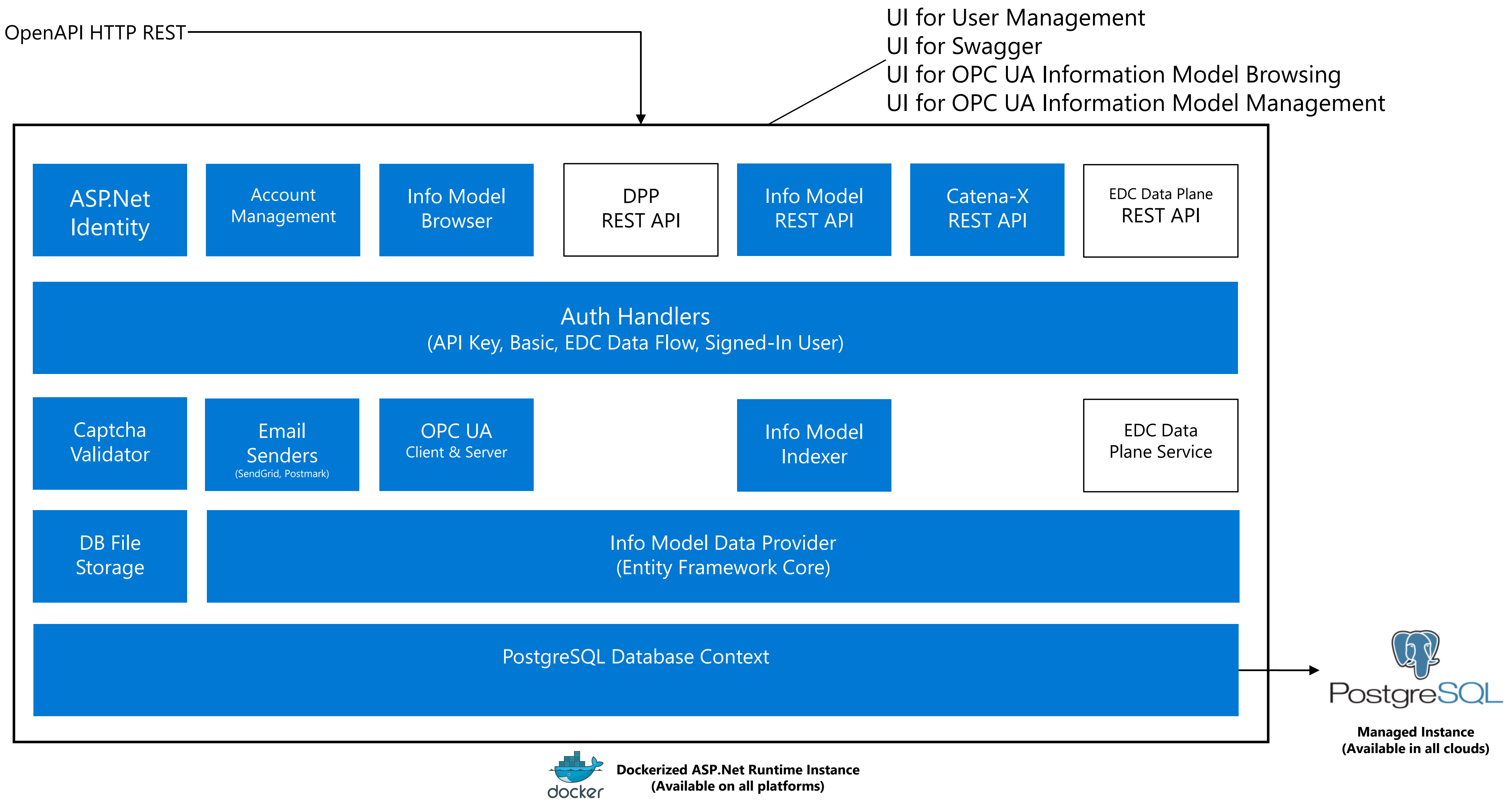
Nodeset File Copy

Download node values Download

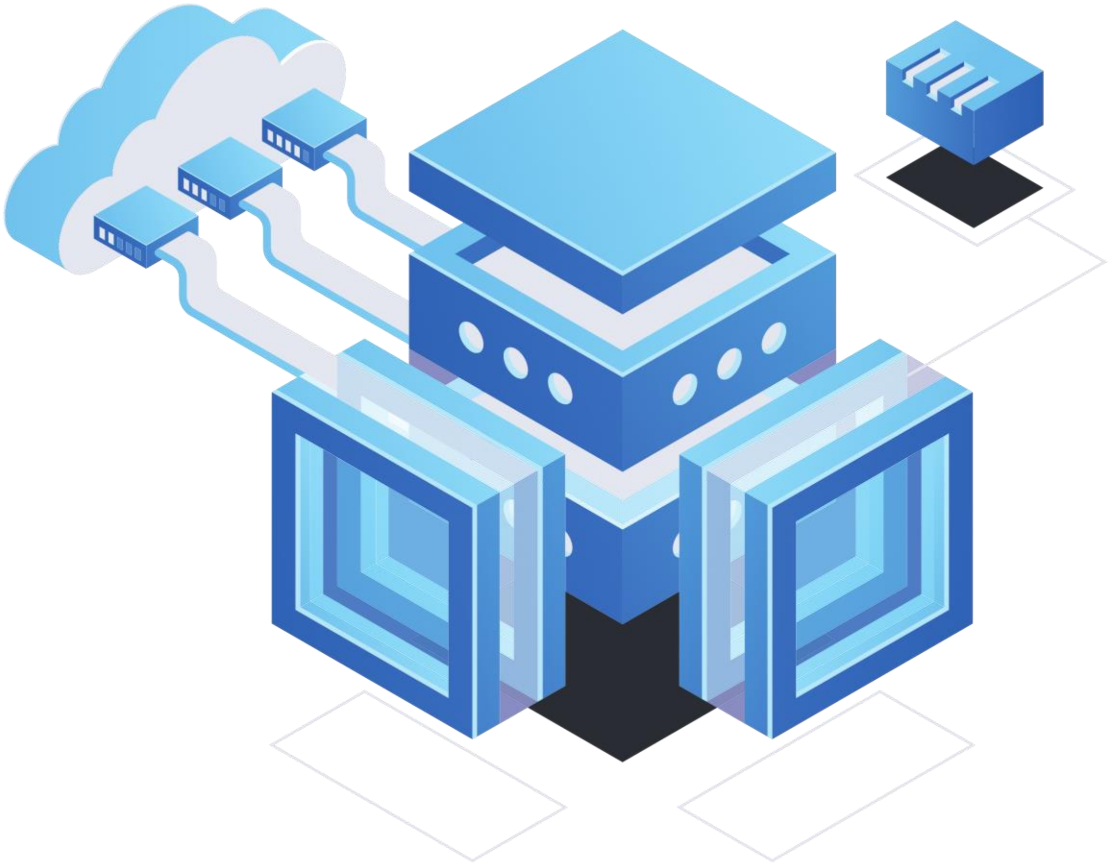
Save node values Save

F O U N D A T I O N

UA Cloud Library Multi-Tenant, Multi-Cloud Architecture



Dataspace Connectors



One example is the Eclipse Dataspace Connector, an **open-source framework** hosted by the Eclipse Foundation for building **secure, globally-scalable data-sharing services**. EDC provides highly customizable components for creating control planes, decentralized identity systems, and federated data catalogs. **Backed by leading companies and cloud providers**, EDC gives developers the tools they need to deliver innovative solutions for data exchange networks. Other projects are targeting dataspace connectivity issues, e.g. Data4Industry.

Next step: Integration and testing of Dataspace Connectors.

eclipse-edc.github.io

OPC FOUNDATION

Web of Things Thing Description

Standardized machine and human readable device descriptions

```
{
    "@context": "https://www.w3.org/2019/wot/td/v1",
    "id": "urn:siemens:pac4200",
    "base": "modbus://192.168.10.100:1502",
    "title": "Siemens SENTRON PAC4200",
    "description": "Multifunctional energy metering device",
    "properties": {
        "Voltagel1-N": {
            "@type": "opcua_30141:AcVoltagePe_UL1N",
            "type": "number", "readOnly": true,
            "forms": [{
                "href": "/1?offset=3&length=4","op": ["readproperty","observeproperty"]
            }]
        },
        "VoltageL2-N": {⋯
        }
    },
    "actions": {
        "changeRate": {
            "@type": "opcua_30141:metering_rate",
            "input": {
                "type": "number","enum":[0,1],
                "description":"0 for high rate, 1 for low rate"
            },
            "forms": [{
                "href": "/1?offset=60006&length=1","op": "invokeaction"
            }]
        }
    },
```

W3C Recommendation

Web of Things (WoT) Thing Description

W3C Recommendation 9 April 2020 (Link errors corrected 23 June 2020)

This version:
https://www.w3.org/TR/2020/REC-wot-thing-description-20200409/

Latest published version:
https://www.w3.org/TR/wot-thing-description/

Latest editor's draft:
https://w3c.github.io/wot-thing-description/

Implementation report:
https://w3c.github.io/wot-thing-description/testing/report.html

Previous version:
https://www.w3.org/TR/2020/PR-wot-thing-description-20200130/

Editors:
Sebastian Kaebisch (Siemens AG)
Takuki Kamiya (Fujitsu Laboratories of America)
Michael McCool (Intel)
Victor Charpenay (Siemens AG)
Matthias Kovatsch (Huawei)

Participate:
GitHub w3c/wot-thing-description
File a bug
Commit history
Pull requests

Contributors:
In the GitHub repository

Repository:
We are on GitHub
File a bug

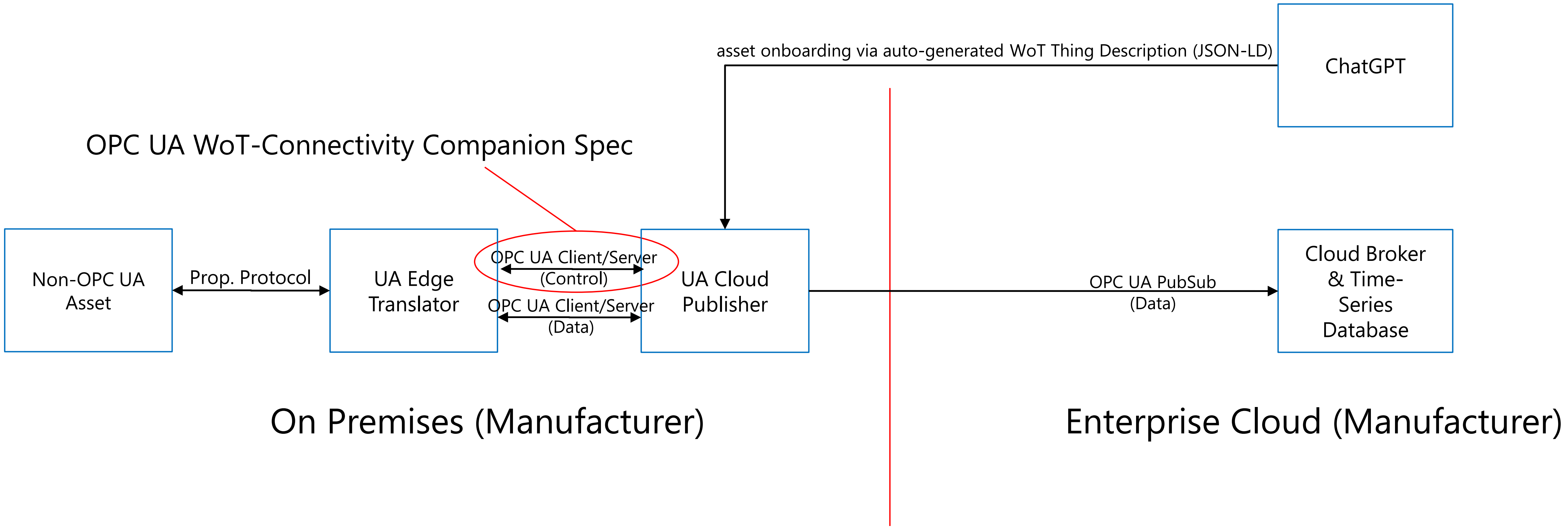
Please check the **errata** for any errors or issues reported since publication.

See also **translations**.

Abstract

FOUNDATION

UA Edge Translator
Standardized Industrial Connectivity Integration & OpenAI-Powered Automatic Asset Onboarding in 3 Steps!



In V1.0:

- CreateAsset()
- (WoT) File Upload()
- DeleteAsset()

In V1.1 (all optional):

- ConnectionTest()
- DiscoverAssets()
- CreateAssetForEndpoint()
- SupportedBindings
- Configuration (key-value pairs)
- License

In V1.2 (currently in review):

- Method calls (WoT Actions)

FOUNDATION

OPC 10100-1

OPC UA for WOT Connectivity

Part 1: API Definition

Release V1.02

OPC UA Companion-Specification

FOUNDATION

ChatGPT auto-generated WoT TD File
Including support for OPC UA Companion Specifications

pac4200.jsonld

Schema: https://json.schemastore.org/jsonld.json


```json
{
  "@context": [
    "https://www.w3.org/2019/wot/td/v1",
    "https://si-ra.github.io/ontologies/td-context.jsonld",
    "http://opcfoundation.org/UA/PNEM/"
  ],
  "id": "urn:pac4200",
  "securityDefinitions": {
    "nosec_sc": {
      "scheme": "nosec"
    }
  },
  "security": [
    "nosec_sc"
  ],
  "@type": [
    "Thing"
  ],
  "name": "modbus-pac4200-sn324",
  "base": "modbus://192.168.10.100:502",
  "title": "Siemens SENTRON PAC4200",
  "properties": {
    "VoltageL1-N": {
      "type": "number",
      "readOnly": true,
      "observable": true,
      "forms": [
        {
          "href": "/1?address=1&quantity=2",
          "op": [
            "readproperty",
            "observeproperty"
          ],
          "opcua:type": "nsu=http://opcfoundation.org/UA/PNEM/;i=6098",
          "modbus:type": "float",
          "modbus:entity": "holdingregister",
          "modbus:pollingTime": 2000
        }
      ]
    },
    "VoltageL2-N": {
      "type": "number",
      "readOnly": true,
```

PROSYS OPC Products Services Events & News Customer Cases About Us Blog

Prosys OPC UA Forge 1.4 Released

We're excited to announce the release of Prosys OPC UA Forge **1.4**, a major update shaped by user feedback from real-world production environments. This version introduces new features such as state-of-the-art Web of Things (WoT) connectivity and a highly anticipated HTTP client, further strengthening Forge's position in modern industrial systems.

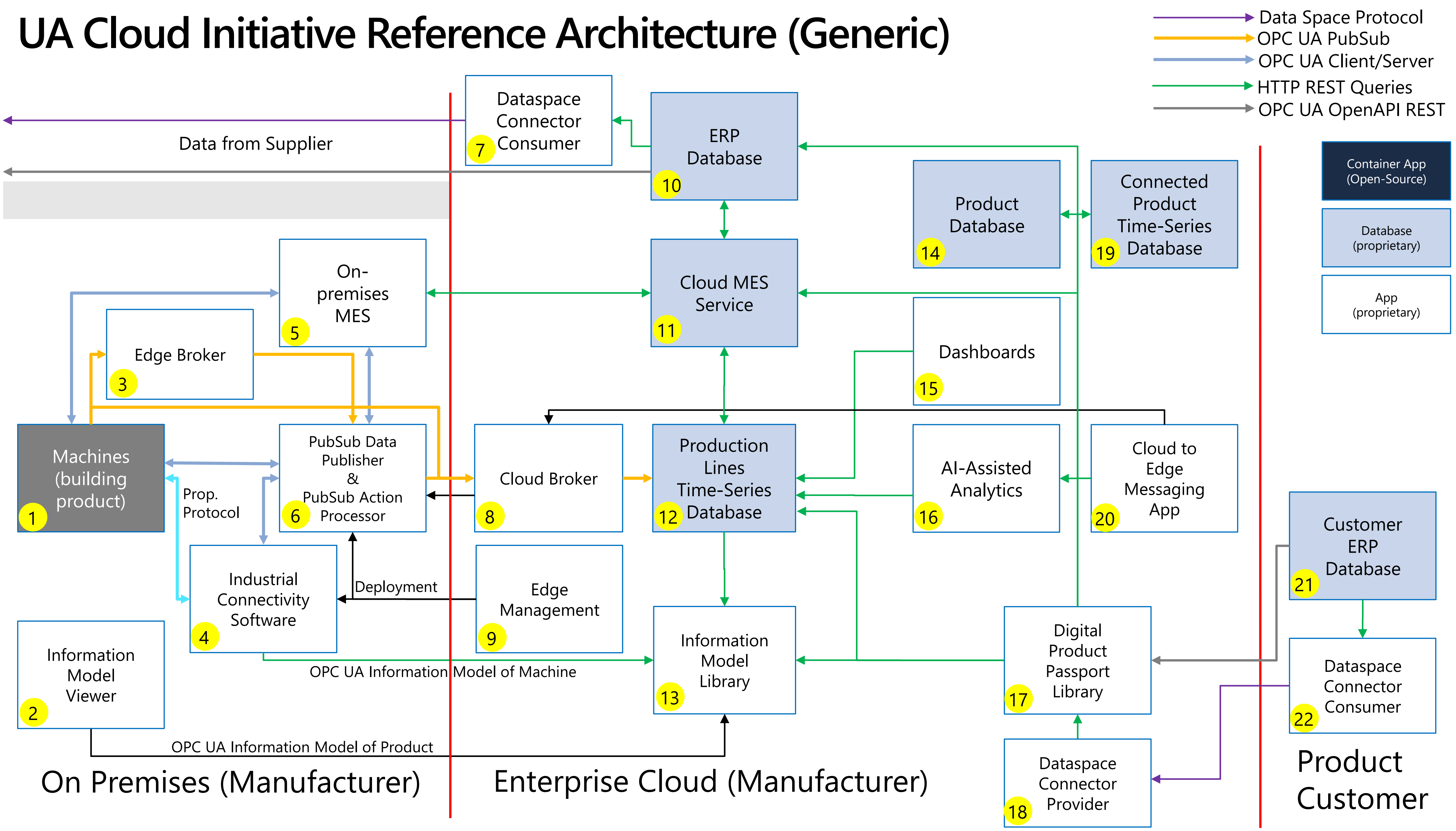
Based on direct input from Forge users, the update also brings numerous enhancements across existing modules—many of which were top-requested by the Forge users.

Key Highlights of Version 1.4:

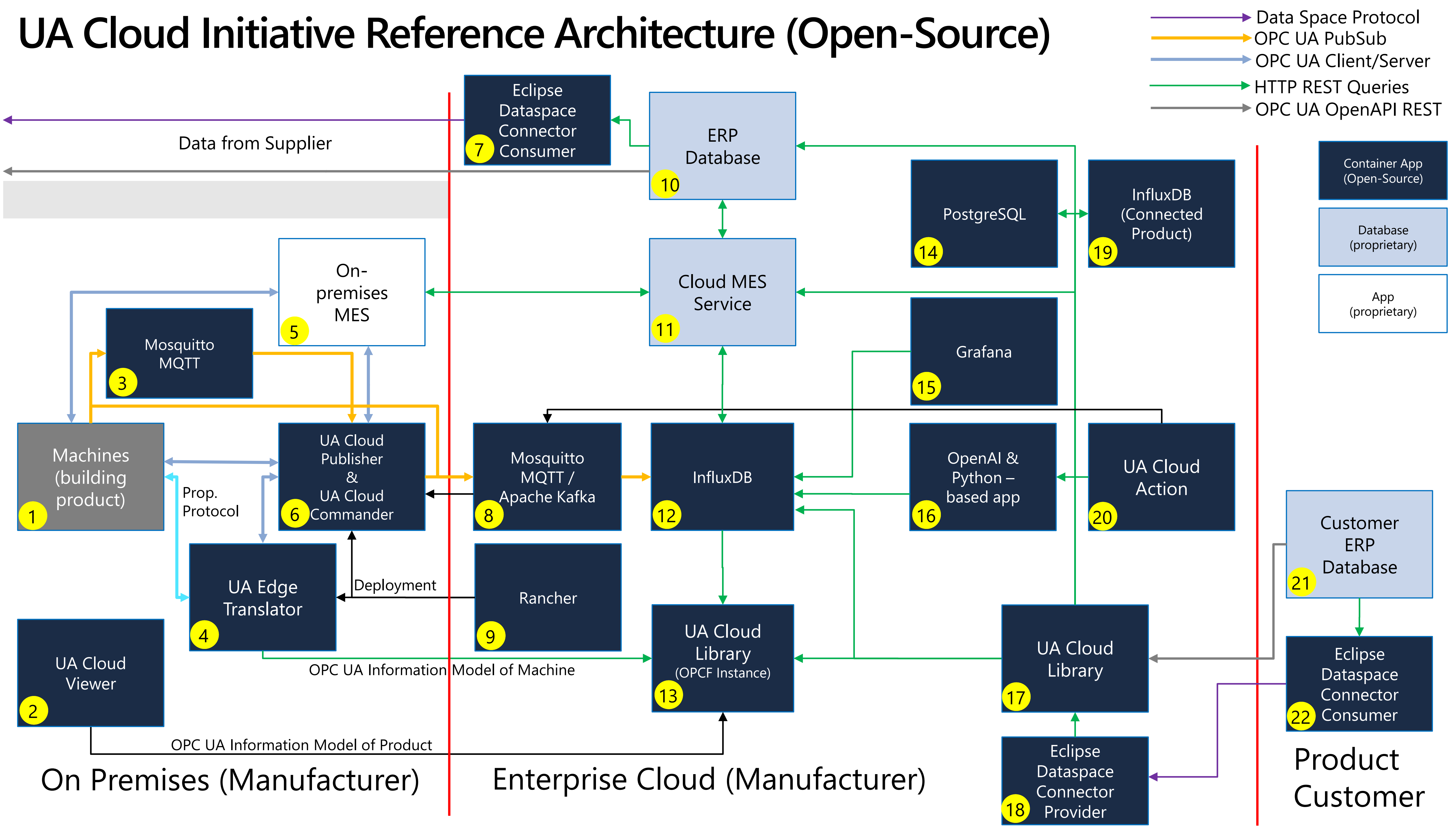
- **HTTP Module**: The new HTTP Client enables systems to retrieve data through a widely adopted HTTP interface, significantly enhancing Forge's data integration capabilities. It allows access to information provided by rest servers in JSON format (XML support coming soon). The HTTP module also introduces custom HTTP APIs, allowing you to adapt Forge APIs to match your needs.
- **Improved Data Logger:** The Data Logger is one of the most widely adopted features in Forge, and it has now been enhanced based on valuable user feedback. Key improvements include support for wide table logging, a trigger option to control when logging occurs, and an intuitive user interface for the existing Event Logger. These updates have allowed Forge to fully meet the evolving requirements outlined by our users.
- **WoT (Web of Things):** WoT is a state-of-the-art specification designed for the automatic onboarding of non-OPC UA devices. With this release, Forge now supports Modbus device onboarding via WoT, making it closer to meet the modern requirements of device onboarding.
- **Grafana Plugin for Forge Now Available:** We've received requests for data monitoring in Forge. Instead of building

OPC FOUNDATION

UA Cloud Initiative Reference Architecture (Generic)



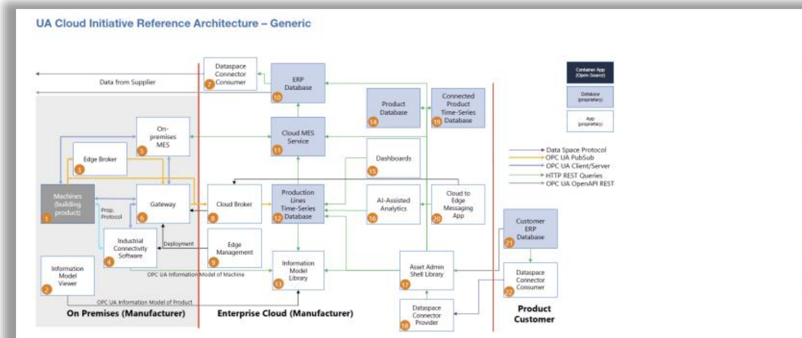
UA Cloud Initiative Reference Architecture (Open-Source)



Next Steps

- Release Interoperability Testing Strategy Document
  - Test cases for each component of the reference architecture
  - Cooperation with OPC Foudation test labs
- UA Nodeset Editor (formally CESMII Smart Manufacturing Profile Designer) performance improvements and implement feature requests (open-source on GitHub)
- UA Cloud Library implementation of CEN/CENELEC JTC24 DPP data model mapping and interface

OPC Foundation Cloud Initiative - Brochure



UA Cloud Initiative Reference Architecture – Generic

On Premises (Manufacturer)

Enterprise Cloud (Manufacturer)

Product Customer

1. Machines of the Manufacturer on-premises building the product.
2. An OPC UA Information Model viewer tool that can upload these models to the UA Cloud Library.
3. A message broker operated by the manufacturer on-premises, usually as part of an edge infrastructure and usually supporting the MQTT protocol.
4. An industrial connectivity software reference implementation providing an aggregating OPC UA server interface and supporting the OPC UA WoT-Connectivity Companion Specification.
5. The on-premises part of the Manufacturing Execution System (MES). It often supports an OPC UA server interface to read status information and manages the operation of the machines.
6. Gateways manage the bi-directional data exchange from assets the cloud services offering both, an OPC UA Client and a OPC UA PubSub supporting both the MQTT and Kafka protocol.
7. The Eclipse Dataspace Connector (EDC) consumer operated by the manufacturer which is used to establish trust between a supplier and the manufacturer by creating a digital contract. It also applies data sharing policies to the data received from the supplier.
8. The message broker operated by the manufacturer in the manufacturer's enterprise cloud. This can support either the MQTT or the Kafka protocol.
9. The industrial edge management software operated by the manufacturer in the manufacturer's enterprise cloud. It is responsible for deploying and managing edge applications on-premises.
10. The Enterprise Resource Planning (ERP) software operated by the manufacturer. It reads raw material and purchased components data from the supply chain.
11. The enterprise cloud part of the Manufacturing Execution System (MES). It often communicates directly with the ERP system and receives and processes production orders.
12. The time-series database receiving telemetry data from the production line via the cloud broker. It can also read order information from the MES system and OPC UA Information Model metadata from the UA Cloud Library.
13. The online store of OPC UA Information Models. This can either be the public instance operated by the OPC Foundation (mainly containing OPC UA Companion Specifications), or it can be a private instance operated by the manufacturer (containing OPC UA Information Models for the produced products), or both.
14. The database containing produced product information like specifications or user manuals.
15. Visual dashboards used to monitor the operation of the production.
16. AI-assisted analytics software used to calculate equipment effectiveness, make production forecasts and make predictions about required machine maintenance.
17. The Asset Administration Shell Repository reference implementation from the Digital Twin Consortium. It supports loading Asset Admin Shells modelled with OPC UA and provides the OPC UA OpenAPI REST interface. It provides product data to the customers of the manufacturer.
18. The Eclipse Dataspace Connector (EDC) provider operated by the manufacturer which is used to establish trust between a customer and the manufacturer by creating a digital contract. It also applies data sharing policies to the product data provided by the manufacturer.
19. The time-series database receiving telemetry data from product usage in the field.
20. An online reference application taking the outcomes of the production data analysis and making live modifications to the production via UA Cloud Commander (completing the digital feedback loop).
21. The Enterprise Resource Planning (ERP) software operated by the customer of the manufacturer. It reads product data from the manufacturer.
22. The Eclipse Dataspace Connector (EDC) consumer operated by the customer of the manufacturer which is used to establish trust between the customer and the manufacturer by creating a digital contract. It also applies data sharing policies to the data received from the manufacturer.

Download brochure here

OPCF-Cloud-Initiative-Brochure.pdf

OPC FOUNDATION