



Automatic Asset Onboarding

Using WoT and ChatGPT for Automatic Asset Onboarding in Industrial IoT Projects

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The Biggest Challenge: Vendor Lock-In

...happens when...

you are forced to use a closed-source **SDK** in your product.

you are forced to use a proprietary **interface** to communicate.

you are forced to use a proprietary **communication protocol**.

you are forced to use a vendor-specific **data model**.

you are forced to run your solution in a specific **software platform**.

you are forced to run your solution on specific **hardware**.

The Key to Reducing Costs: Interoperability

We need...

1. A common **Interface** (Analogy: A Book)
2. A common **Data Format** (Analogy: Latin Alphabet)
3. A common **Data Model** (Analogy: English)
4. Common **Semantics** (Analogy: "Moby Dick")

Only when all 4 things are present can we truly understand each other!

An Interoperability Example for OPC UA-enabled Assets

1. **Interface:** OPC UA Client/Server
2. **Data Format:** OPC UA Binary
3. **Data Model:** OPC UA Information Model
4. **Semantics:** OPC UA Robotics Companion Spec



An Interoperability Example for non-OPC UA-enabled Assets

1. **Interface:** Modbus (later mapped to OPC UA)

2. **Data Format:** JSON-LD

3. **Data Model:** Web of Things Thing Description

4. **Semantics:** Modbus Protocol Binding





IEC 62541 - The Industrial Interoperability Standard

Microsoft is a member of the OPC Foundation since 1996, >900 members

Microsoft supports OPC UA on Azure since 2016

Microsoft has contributed over 5M lines of open-source code to the OPC Foundation

Interoperability

Vendor, Protocol, Platform and OS Independent



Open Source on GitHub (>4.5M source lines contributed by Microsoft)

Scalable from sensor to Cloud, Services Oriented Architecture (SOA)

Owned by a Non-Profit (OPC Foundation)

>100M installed base and exponential growth

Data Modelling

Discoverable, supports complex data types

Graph support, preserves source context

Vendor extendable

Domain-specific Companion Specifications:

- Discrete: Robotics, Machine Vision, ..
- Process: FDI, FDT, PA-DIM, MDIS, NOA..
- Energy: IEC61850, ..

Security

Secure Design from group-up

Based on open security standards

Auditing, Authentication & Encryption

Evolves as security technologies evolve

Vendors can choose level of security

Acceptable by IT departments

Semantic Interoperability via Companion Specs

The VDMA has over 3200 member companies, over 600 are involved in building OPC UA Companion Specs

- » Agricultural Machinery
- » Air Conditioning & Ventilation
- » Air Pollution Control
- » Automated Guided Vehicles
- » Battery Production
- » Building Control and Management
- » Building Materials
- » Ceramic Machinery
- » Cleaning Systems
- » Compressors, Compressed Air and Vacuum Technology
- » Construction Equipment
- » Continuous Conveyors
- » Cranes
- » Die & Mould
- » Drying Technology
- » Electrical Automation
- » Electronics, Micro & Nano Technologies

- » Engines
- » Engines & Systems
- » Fire Fighting Equipment
- » Fluid Power
- » Food Processing and Packaging Machinery
- » Foundry Machinery
- » Glass Machinery
- » Hydro Power Plants
- » Industrial Trucks
- » Integrated Assembly Solutions
- » Intralogistic Systems
- » Length Measurement Technology
- » Lifts & Escalators
- » Machine Tools and Manufacturing Systems
- » Machine Vision
- » Metallurgical Plants and Rolling Mills

- » Micro Technologies
- » Mining
- » Photovoltaic Equipment
- » Plastics & Rubber Machinery
- » Power Transmission Engineering
- » Precision Tools
- » Printing & Paper Technology
- » Process Plant & Equipment
- » Productronic
- » Pumps & Systems
- » Refrigeration & Heat Pump Technology
- » Robotics
- » Security Systems
- » Software & Digitalization
- » Surface Technology
- » Testing Technology
- » Textile Care, Fabric and Leather Technology

- » Textile Machinery
- » Thermal Power Plants
- » Thermo Process Technology
- » Valves
- » Waste Treatment & Recycling
- » Weighing Technology
- » Welding & Pressure Gas Equipment
- » Wind Power Plants
- » Woodworking Machinery

- | |
|---|
| OPC UA CS Released |
| OPC UA CS Release Candidate |
| Joint Working Group with OPC Foundation |
| OPC UA CS in Progress |
| OPC UA CS in Planning |

Industrial Connectivity



Industrial IoT Edge Partnerships



Normalized, standardized,
open data model & telemetry
stream for all machines,
including security!

 Matrikon Data Broker By Honeywell System Integrators (SIs), engineers, and IT professionals, use Matrikon® Data Broker to easily setup, manage...	 ThingWorx Kepware Edge for Azure By PTC Inc. PTC's ThingWorx Kepware Edge is a Linux-based connectivity platform providing a single source of industrial...	 OPC Router – The Communication... By Inray Industriesoftware GmbH The central Industry 4.0 platform enables data exchange in your networked production processes to be automa...	 edgeConnector 840D By Softing Industrial Automation GmbH Run the IoT Edge Module and connect up to 20 Siemens SINUMERIK 840D SolutionLine and PowerLine Controllers....	 edgeConnector Siemens By Softing Industrial Automation GmbH Run the IoT Edge Module and connect up to 20 Siemens S7-300/400 or S7-1200/1500 PLCs. Acts as OPC UA server...	 edgeConnector Modbus By Softing Industrial Automation GmbH Softing edgeConnector Modbus is a containerized Modbus TCP connectivity module adding OPC UA Server and MQT...
Get it now	Get it now	Get it now	Get it now	Get it now	Get it now
 zenon on IoT Edge: Free Trial By COPA-DATA zenon on IoT Edge brings the data acquisition and processing power of the zenon Runtime to your IoT Edge de...	 edgeAggregator By Softing Industrial Automation GmbH Container-based flexible OT/IT integration solution built on OPC UA with MQTT connectivity to IoT solutions	 Kalki.io Edge (IoT Module) By Kalkitech.com Kalki.io Edge simplifies data acquisition at the edge from field devices such as Sensors, Controllers, PLC,...	 gamma Visual Logger for OPC IoT Edge Module By One-Way Automation Inc. Integration tool to collect, store and forward, visualize, analyze OPC UA data.	 IcoEdgeAgent By ICONICS IcoEdgeAgent for IoT Edge devices is a required module to be deployed as part of a complete ICONICS IoT WorX...	 edgeConnector FANUC CNC By Softing Industrial Automation GmbH Run the IoT Edge Module and connect up to 20 FANUC CNC Controllers. Acts as OPC UA server on Azure IoT Edge...
Get it now	Get it now	Get it now	Get it now	Get it now	Get it now

All products – Microsoft Azure Marketplace

Industrial Asset Data Model Kinds and how to Map to OPC UA (Estimated WW Numbers!)

1. Discoverable (~10%)
 - a) OPC UA-enabled (PLC) (~4%)
-> No ind. conn. software required!
 - b) Non-OPC UA-enabled (PLC) (~6%)
-> Automatic mapping by ind. conn. software
2. Non-Discoverable (~90%)
 - a) Fixed function/data model (~63%)
-> Automatic mapping based on WoT Thing Description sent to ind. conn. software
 - b) Programmable (PLC) (~27%)
-> Manual mapping via ind. conn. software

Web of Things Thing Description

Standardized machine and human readable device descriptions

```
1  {
2      "@context": "https://www.w3.org/2019/wot/td/v1",
3      "id": "urn:siemens:pac4200",
4      "base": "modbus://192.168.10.100:1502",
5      "title": "Siemens SENTRON PAC4200",
6      "description": "Multifunctional energy metering device",
7      "properties": {
8          "VoltageL1-N": {
9              "@type": "opcua_30141:AcVoltagePe_UL1N",
10             "type": "number", "readOnly": true,
11             "forms": [
12                 {"href": "/1?offset=3&length=4", "op": ["readproperty", "observeproperty"]}
13             ]
14         },
15         > "VoltageL2-N": { ...
16             }
17     },
18     "actions": {
19         "changeRate": {
20             "@type": "opcua_30141:metering_rate",
21             "input": {
22                 "type": "number", "enum": [0,1],
23                 "description": "0 for high rate, 1 for low rate"
24             },
25             "forms": [
26                 {"href": "/1?offset=60006&length=1", "op": "invokeaction"
27             ]
28         }
29     }
30 },
```



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/>

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Contributors:

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Repository:

[We are on GitHub](#)

[File a bug](#)

Please check the [errata](#) for any errors or issues reported since publication.

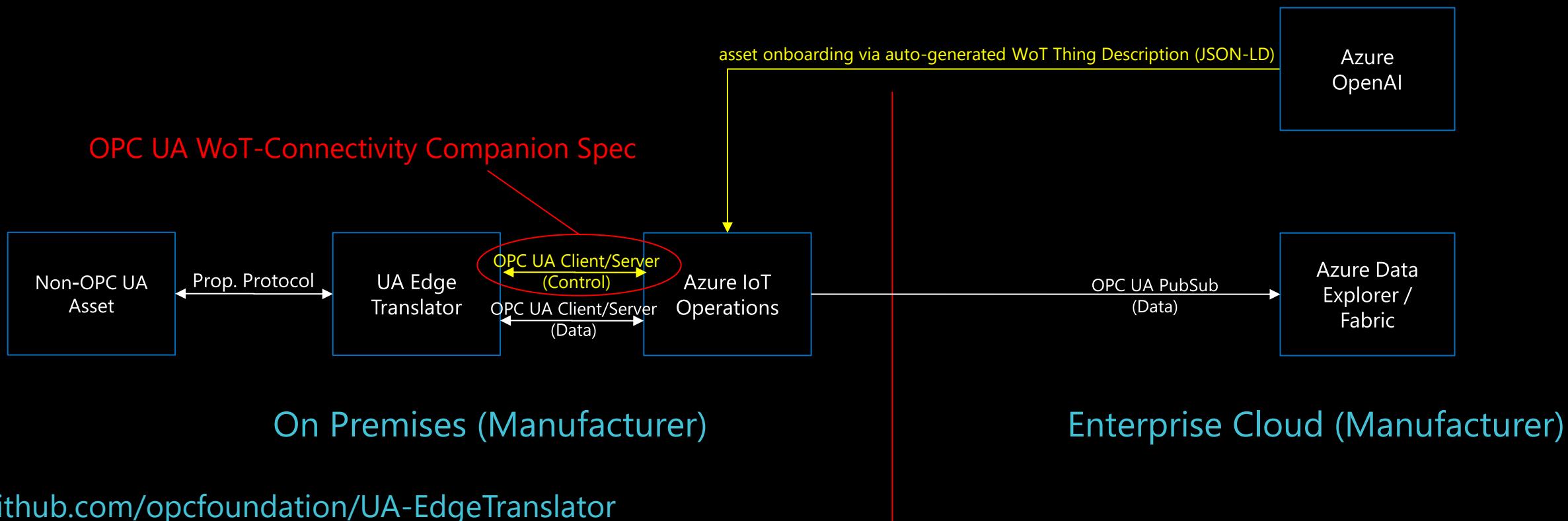
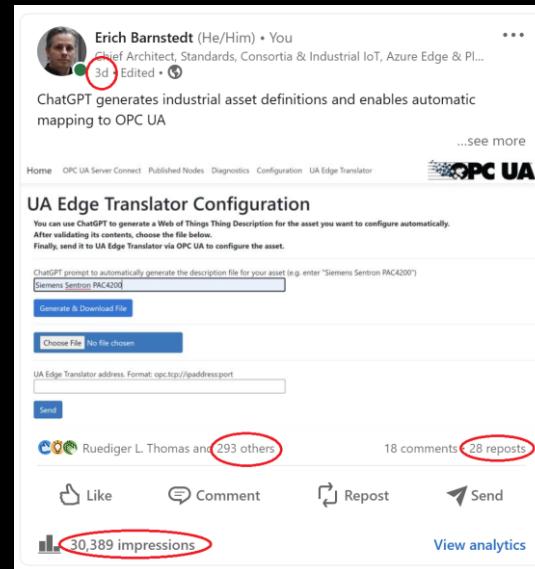
See also [translations](#).

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Abstract

SIEMENS

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



OPC 10100-1

**OPC UA for WOT Connectivity
Part 1: API Definition**

Release V1.01

1. User enters make and model of asset in Chat prompt

The screenshot shows the 'UA Edge Translator Configuration' page. At the top, there is a navigation bar with links: Home, OPC UA Server Connect, Published Nodes, Diagnostics, Configuration, and UA Edge Translator. To the right of the navigation bar is the OPC UA logo.

The main content area has a dark background with white text. It starts with a heading 'UA Edge Translator Configuration'. Below the heading, there is a paragraph about using the Azure OpenAI service to generate a Web of Things (WoT) Thing Description for the asset. It includes a link to an online editor for WoT files and instructions for validating the file and sending it to the UA Edge Translator.

Step 1 is highlighted with a red oval: '1. ChatGPT prompt to automatically generate the description file for your asset (e.g. enter "Siemens Sentron PAC4200")'. Below this, there is a text input field and a blue 'Generate & Download File' button.

Step 2 is labeled '2. Load the manually validated asset description file:' followed by a 'Choose File' button with the text 'No file chosen'.

Step 3 is labeled '3. Send the loaded asset description file to UA Edge Translator. UA Translator address format: opc.tcp://ipaddress:port'. Below this is another text input field and a blue 'Send' button.

At the bottom of the page, there is a copyright notice: '© 2022 - UA Cloud Publisher - [Privacy](#)'.

Asset Copilot - Azure OpenAI auto-generated WoT TD File Including support for OPC UA Companion Specifications



```
pac4200.jsonld ✘ X
Schema: https://json.schemastore.org/jsonld.json
1 { "@context": [
2   "https://www.w3.org/2019/wot/td/v1",
3   "https://si-ra.github.io/ontologies/td-context.jsonld",
4   "http://opcfoundation.org/UA/PNEM/"
5 ],
6 "id": "urn:pac4200",
7 "securityDefinitions": {
8   "nosec_sc": {
9     "scheme": "nosec"
10   }
11 },
12 "security": [
13   "nosec_sc"
14 ],
15 "@type": [
16   "Thing"
17 ],
18 "name": "modbus-pac4200-sn324",
19 "base": "modbus://192.168.10.100:502",
20 "title": "Siemens SENTRON PAC4200",
21 "properties": {
22   "VoltageL1-N": {
23     "type": "number",
24     "readOnly": true,
25     "observable": true,
26     "forms": [
27       {
28         "href": "/1?address=1&quantity=2",
29         "op": [
30           "readproperty",
31           "observeproperty"
32         ],
33         "opcua:type": "nsu=http://opcfoundation.org/UA/PNEM;;i=6098",
34         "modbus:type": "float",
35         "modbus:entity": "holdingregister",
36         "modbus:pollingTime": 2000
37       }
38     ]
39   },
40   "VoltageL2-N": {
41     "type": "number",
42     "readOnly": true
43 }
```

2. User edits auto-generated WoT Thing Description

The screenshot shows the edi(TD)or web application interface. On the left, the main panel displays the Thing Description for a Siemens SENTRONPAC4200. It includes sections for Properties (with items like VoltageL1-N, VoltageL2-N, and VoltageL3-N) and Actions. A red oval highlights the status bar at the top of the main panel, which shows "JSON Validation ✓" and "JSON Schema Validation ✓". On the right, a sidebar titled "SiemensSENTRONPAC4200" shows the JSON code for the Thing Description:

```
1  {
2    "@context": ["https://www.w3.org/2019/wot/td/v1"],
3    "title": "SiemensSENTRONPAC4200",
4    "id": "urn:pacPVDAS1",
5    "name": "Pac4200",
6    "mlfb": "7KM3220-1BA01-1EA0",
7    "base": "modbus://host:port",
8    "securityDefinitions": {
9      "nosec_sc": {
10        "scheme": "nosec"
11      }
12    }
13 }
```

A modal window titled "Ask Your AI Assistant" is open on the right, containing a message input field with the placeholder "Send a message and it will be forwarded to a GPT instance. It will assist you in writing your TDs" and a button labeled "Generate me a Thing Description for a Siemens Sentron PAC 4200". Below the message input, there is a text area showing the generated JSON code, and a button labeled "Copy last message to editor".

3. User sends edited WoT Thing Description to UA Edge Translator

The screenshot shows a dark-themed web interface for 'UA Edge Translator Configuration'. At the top, there's a navigation bar with links: Home, OPC UA Server Connect, Published Nodes, Diagnostics, Configuration, and UA Edge Translator. To the right of the navigation is the 'OPC UA' logo.

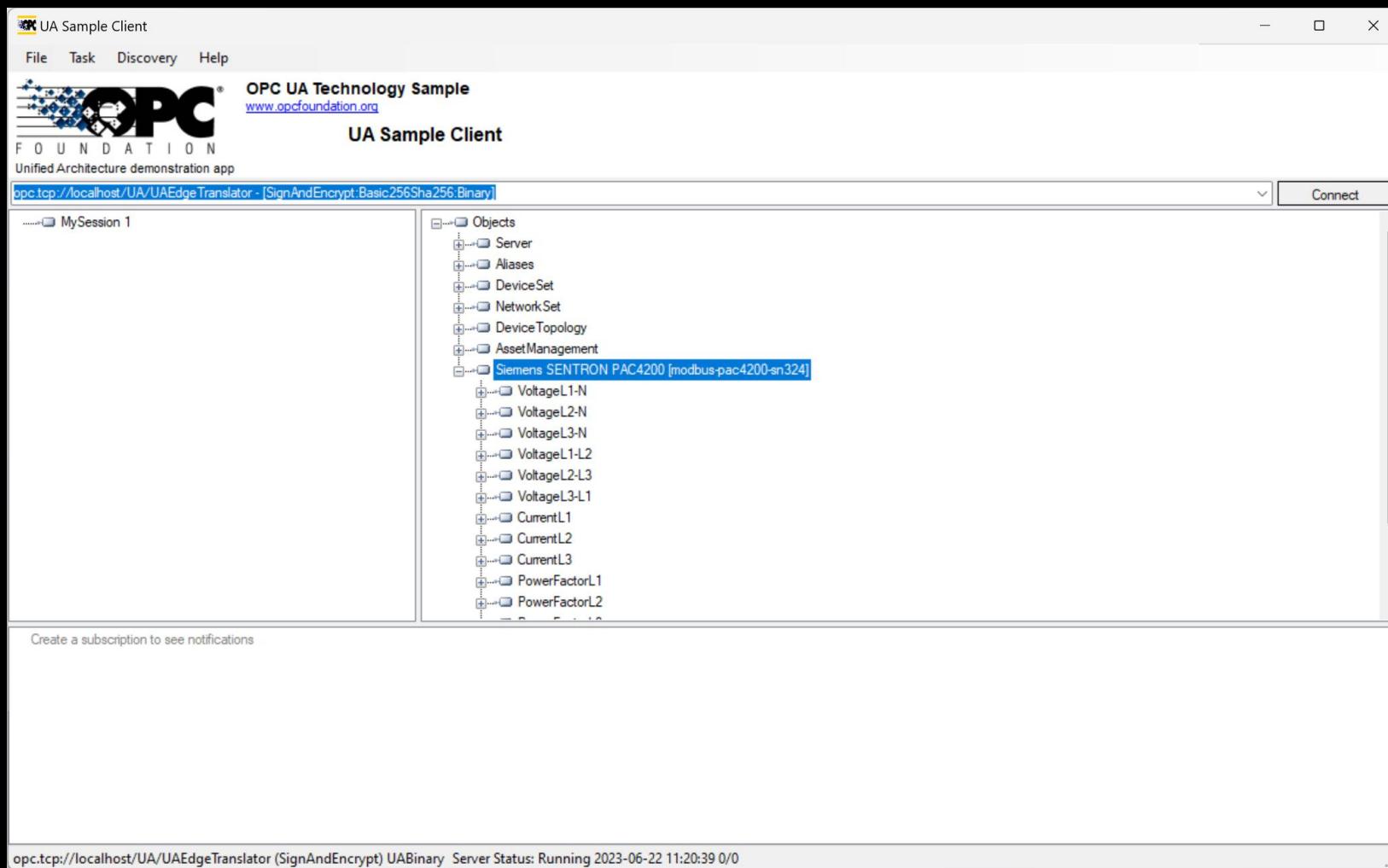
The main content area has a heading 'UA Edge Translator Configuration'. Below it, there's a paragraph about using the 'Azure OpenAI' service to generate a WoT Thing Description. It includes a link to an online editor and instructions for validating and sending the file via OPC UA.

Three numbered steps are listed:

1. ChatGPT prompt to automatically generate the description file for your asset (e.g. enter "Siemens Sentron PAC4200"): A text input field followed by a blue 'Generate & Download File' button.
2. Load the manually validated asset description file: A 'Choose File' button with the text 'No file chosen'.
3. Send the loaded asset description file to UA Edge Translator. UA Translator address format: opc.tcp://ipaddress:port: A text input field followed by a blue 'Send' button.

At the bottom of the page, there's a copyright notice: '© 2022 - UA Cloud Publisher - Privacy'.

UA Edge Translator Automatically Maps the Modbus I/F to OPC UA

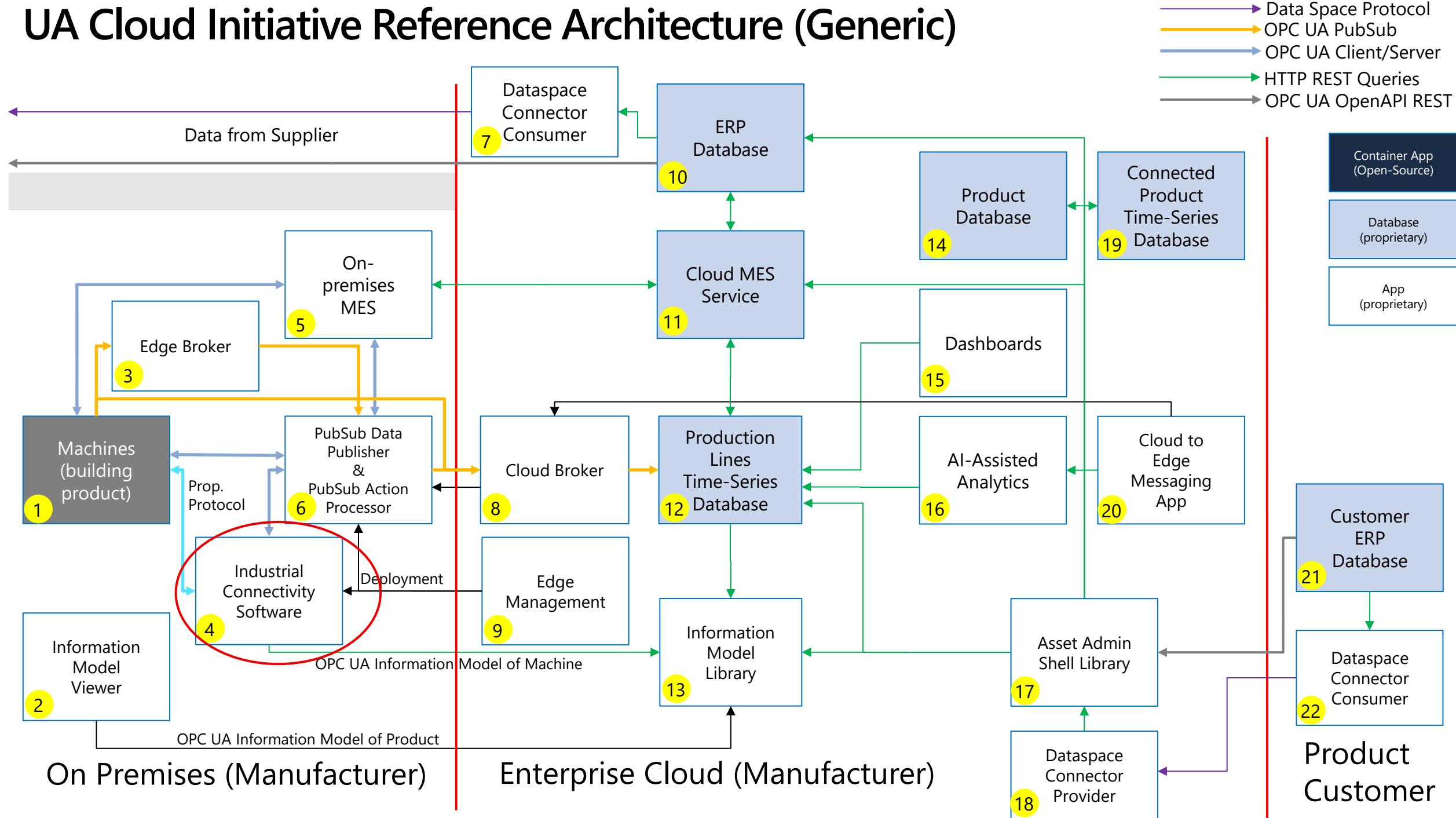


github.com/OPCFoundation/UA-EdgeTranslator

OPC Foundation Cloud Initiative: How

- ▶ Create a **pre-competitive environment** for collaboration.
- ▶ **Replicate best-practices** established in the OPC Foundation Field Level Communications Initiative, bringing cloud architects together with the technology experts from the OPC Foundation.
- ▶ **Harmonize existing cloud-related working groups** under the roof of a single steering committee.
 - **UA Cloud Library** – A query-able online store of OPC UA Information Models
 - **OPC UA over MQTT** – secure transport from edge to cloud and cloud to cloud.
 - **OPC UA REST Interface** – cloud-based OPC UA server access
 - **OPC UA WoT Connectivity** – standardized industrial connectivity software configuration
 - **OPC UA Industrial Metaverse** – reference architecture to combine the virtual and the physical world
 - **OPC UA AI** - Leveraging Large Language Models
- ▶ Bring **actionable manufacturer challenges** and opportunities for enhancement to cloud applications to the table.
- ▶ Initiate **new working groups** to develop OPC UA technology for cloud-centric applications.

UA Cloud Initiative Reference Architecture (Generic)



UA Cloud Initiative Reference Architecture (Open-Source)

