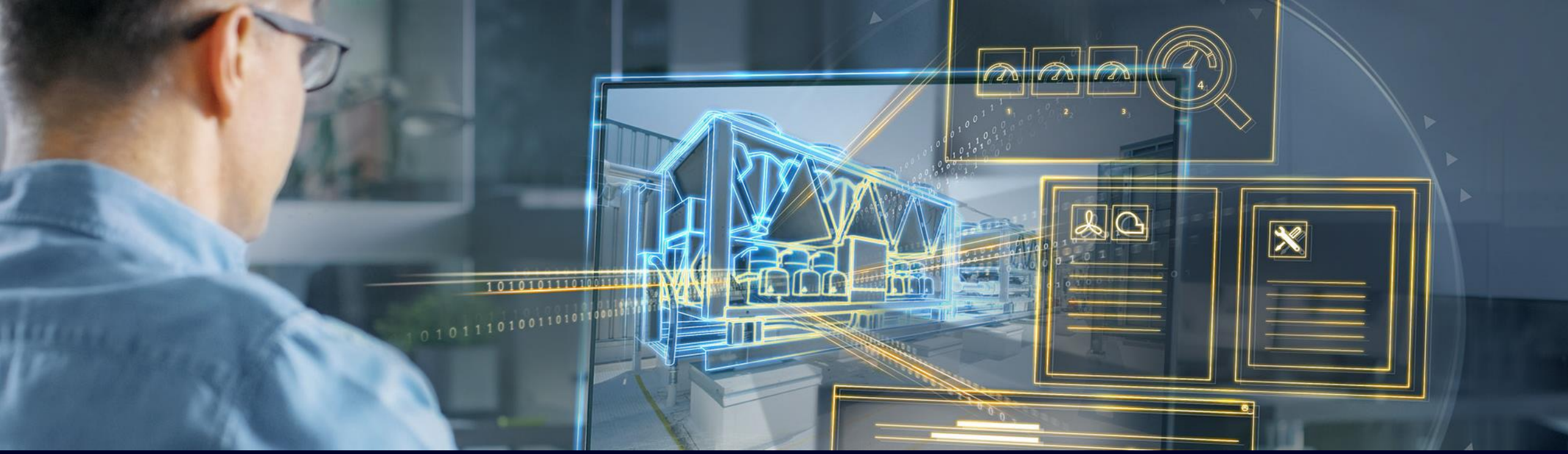

W3C Web of Things

Automated Industrial Asset Onboarding Using Open Standards

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Your Hosts today

Pedram Hadjian

Software Architect

SI Chief Technology Office

Erich Barnstedt

Chief Architect

Microsoft

Felix Paulini

Product Owner

evosoft GmbH

Sebastian Kaebisch

Senior Key Expert

Siemens Technology

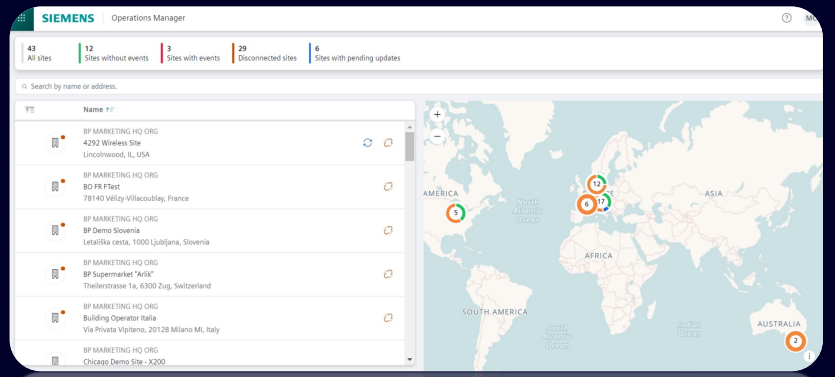
SIEMENS

IoT Solutions have huge Potential...

Transparency

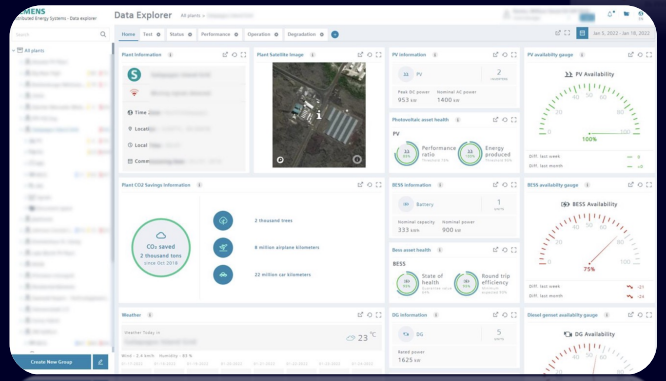
Flexibility

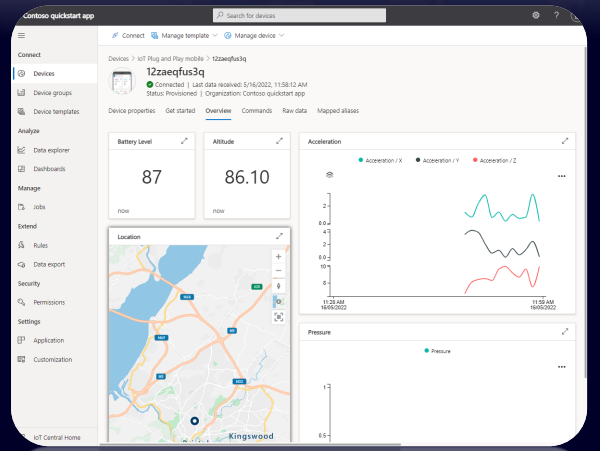
Sustainability



Predictability

New Business Models





Adaptability

Interoperability

Scalability

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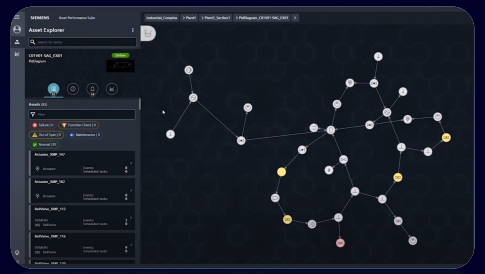
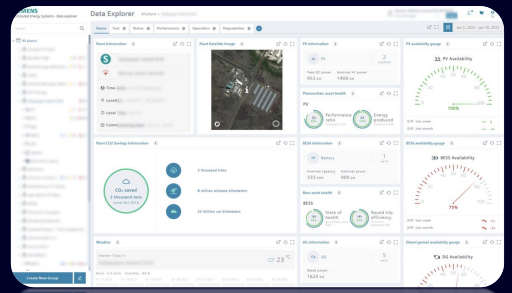
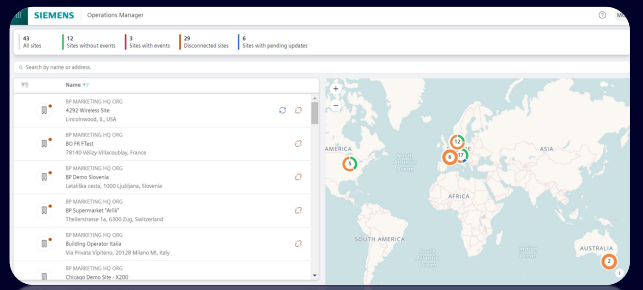
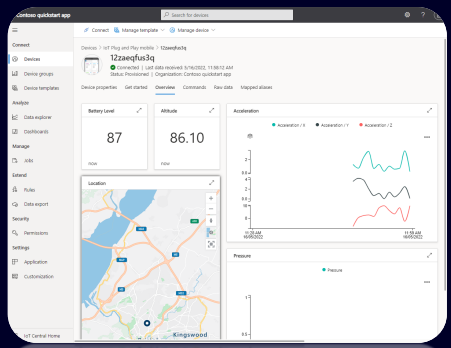
But connecting devices to them is a Bottelneck









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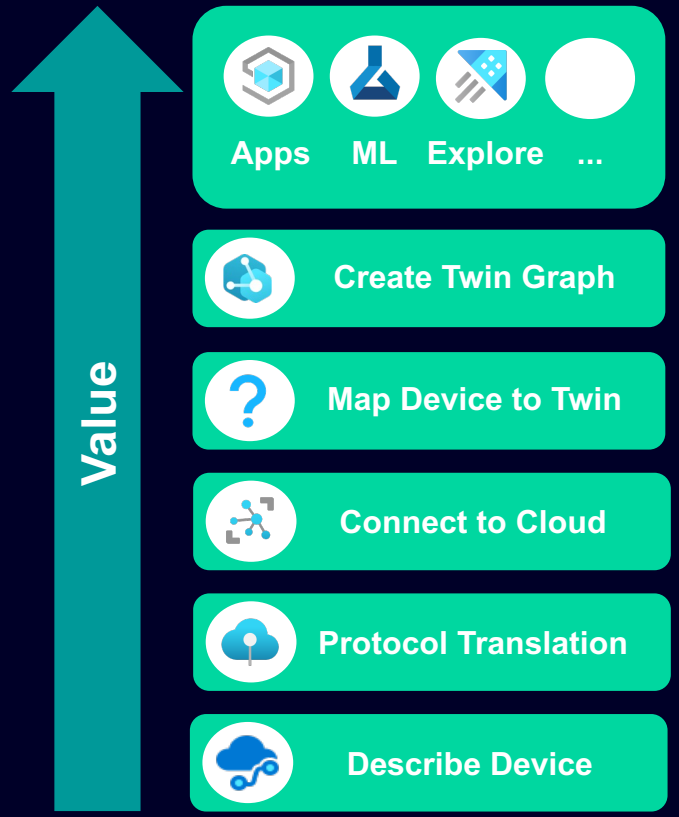
Example: Azure IoT



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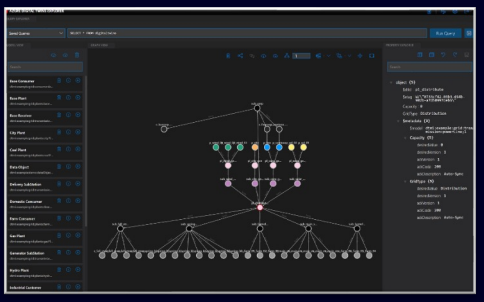
Example: Azure IoT
Efforts in Detail (Manufacturing Domain)

Coils (in Multiples of 8)	
Output Coils	32
Input Coils	32
Registers	
Internal Registers	32
Holding Registers	32
Blocks	
Block Read Strings	Disable


```
[
    {
        "NodeId": "1001",
        "TwinId": "simulation",
        "Property": "Counter",
        "ModelId": "dtmi:com:micr
    },
    ...
]
```



Describe Device | **Protocol Translation** | **Connect to Cloud** | **Map Device to Twin** | **Create Twin Graph**

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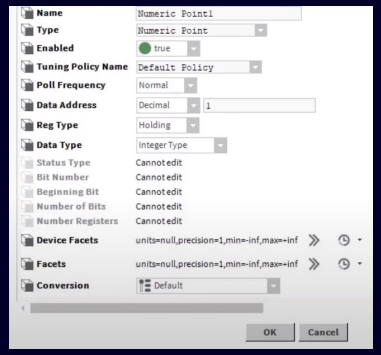
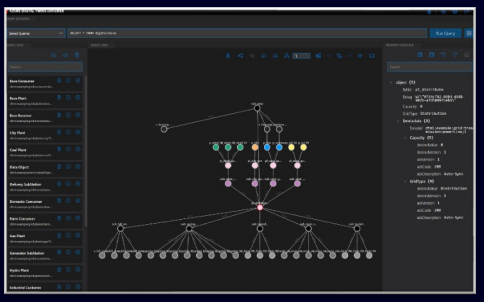
Example: Azure IoT
Efforts in Detail (Building Domain)




```
[
    {
        "NodeId": "1001",
        "TwinId": "simulation",
        "Property": "Counter",
        "ModelId": "dtmi:com:micr
    },
    ...
]
```



Describe Device

Protocol Translation

Connect to Cloud

Map Device to Twin

Create Twin Graph

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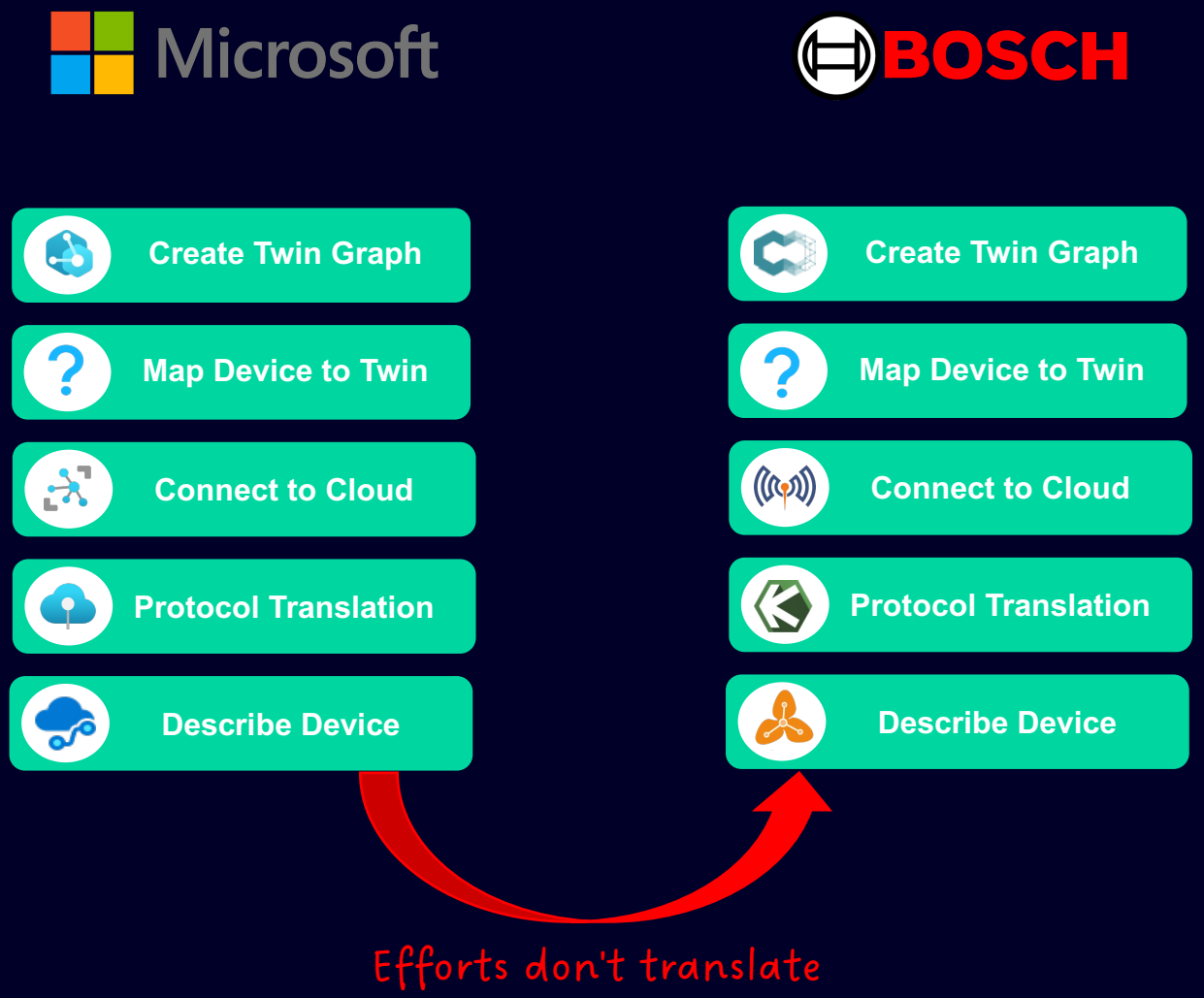
Example: Azure IoT
Decrease Effort



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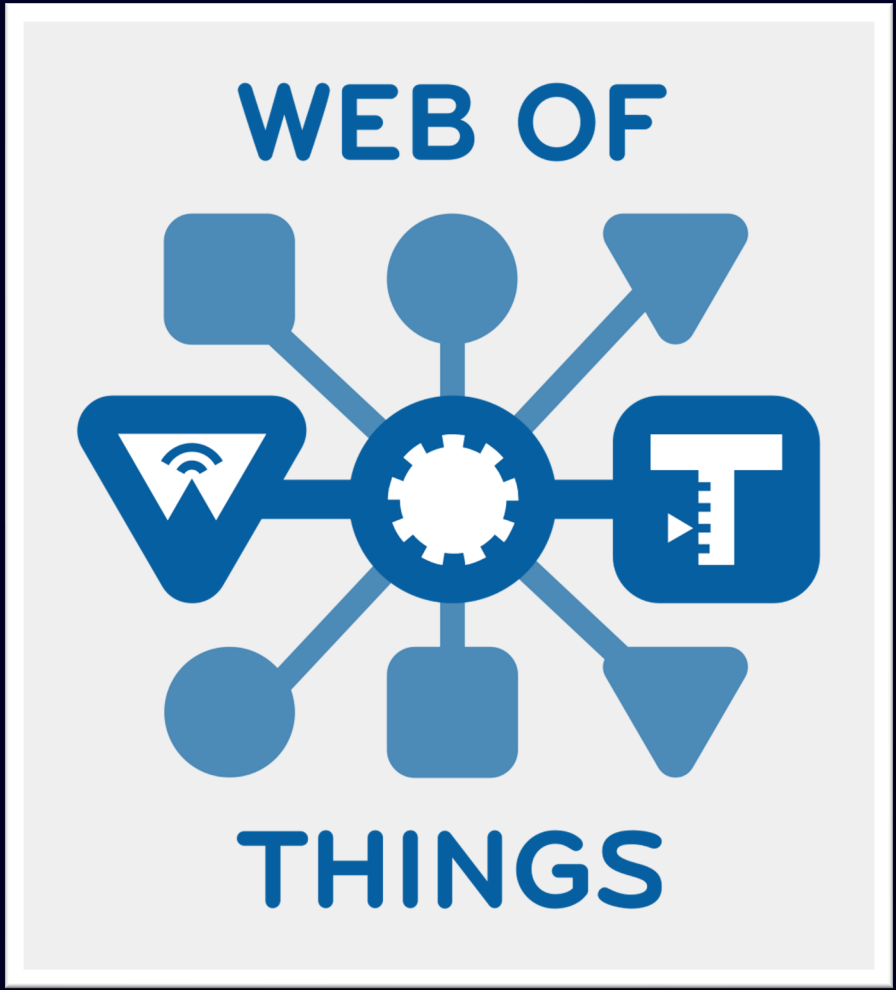
Enter the Web of Things



- Standardized Device Description Language
- IT-Friendly Technologies
- Protocol Agnostic
- Language Extensions for Protocols
- Supported by Bosch, Siemens, Intel …
- Governance on "Common Ground" at W3C

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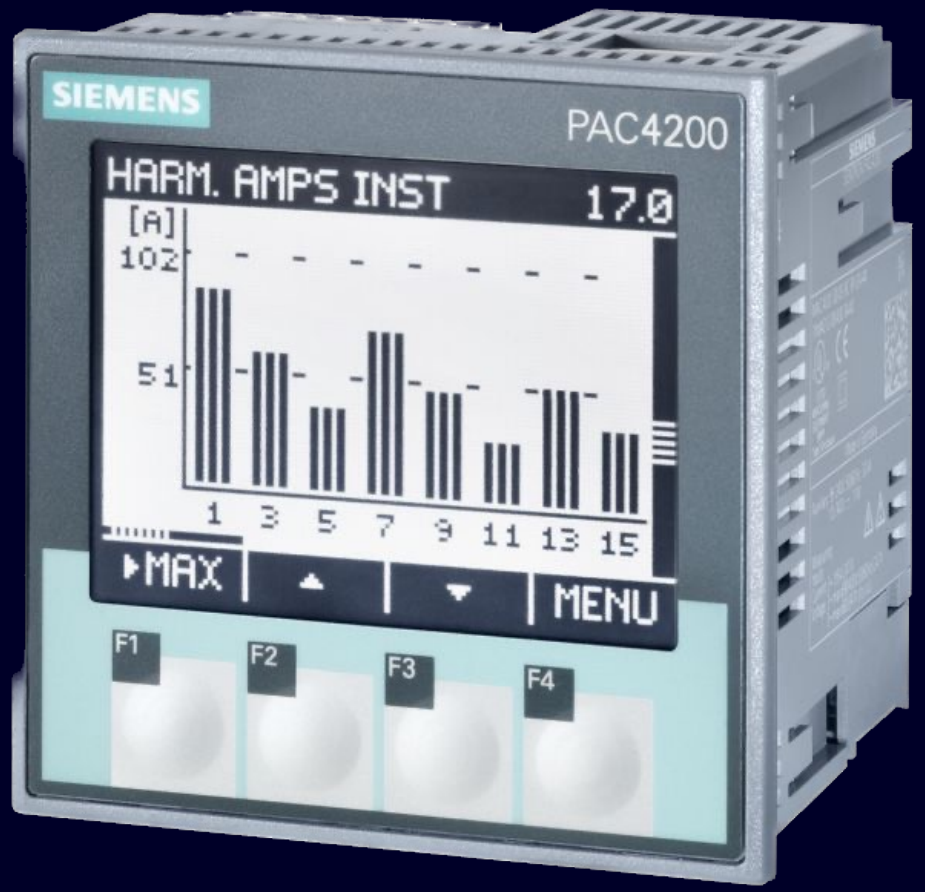
Let’s integrate a Device



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WoT Thing Description

Describe Device

```
{
  "@context": [
    "https://www.w3.org/2019/wot/td/v1"
  ],
  "id": "urn:pac4200",
  "@type": [
    "soris:Thing",
    "Thing"
  ],
  "name": "modbus-pac4200-sn324",
  "base": "modbus://192.168.10.100:1502",
  "title": "Siemens SENTRON PAC4200",
  "mlfb": "7KM4212-0BA00-2AA0",
  "properties": {
    "VoltageL1-N": {
      "@type": "opcua_30141:AcVoltagePe_UL1N",
      "type": "number",
      "readOnly": true
    },
    "VoltageL2-N": {
      "@type": "opcua_30141:AcVoltagePe_UL2N",
      "type": "number",
      "readOnly": true,
      "observable": true
    }
  },
  "actions": {

  },
  "events": {

  }
}
```

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

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WoT Protocol Bindings

Describe Device

```
{
  "@context": [
    "https://www.w3.org/2019/wot/td/v1"
  ],
  "id": "urn:pac4200",
  "@type": [
    "soris:Thing",
    "Thing"
  ],
  "name": "modbus-pac4200-sn324",
  "base": "modbus://192.168.10.100:1502",
  "title": "Siemens SENTRON PAC4200",
  "mlfb": "7KM4212-0BA00-2AA0",
  "properties": {
    "VoltageL1-N": {
      "type": "number",
      "readOnly": true,
      "forms": [
        {
          "href": "/1?offset=1&length=4",
          "op": [
            "readproperty",
            "observeproperty"
          ],
          "modbus:type": "float",
          "modbus:entity": "holdingregister",
          "modbus:pollingTime": 2000
        }
      ]
    },
    "VoltageL2-N": {
      "type": "number",
      "readOnly": true,
      "observable": true,
      "forms": [
        {
          "href": "/1?offset=3&length=4",
          "op": [
            "readproperty",
            "observeproperty"
          ],
          "modbus:type": "float",
          "modbus:entity": "holdingregister",
          "modbus:pollingTime": 2000
        }
      ]
    },
```

TD

Web of Things (WoT) Modbus Binding Template

W3C Editor's Draft 12 October 2022

▼ **More details about this document**

This version:
https://w3c.github.io/wot-binding-templates/bindings/protocols/modbus/

Latest published version:
https://www.w3.org/TR/wot-modbus-binding/

Latest editor's draft:
https://w3c.github.io/wot-binding-templates/bindings/protocols/modbus/

History:
Commit history

Editor:
Cristiano Aguzzi (Invited Expert)

Feedback:
GitHub w3c/wot-binding-templates (pull requests, new issue, open issues)

Abstract

In the context of the Web of Things (WoT), a Binding Template is a blueprint that gives guidance on how to implement a specific IoT protocol, data format or IoT platform. This document gives implementation guidelines regarding the Modbus protocol. Modbus protocol is a well-known cost-effective IoT protocol for communication between industrial control and automation devices.

The following defines a set of standard terms and rules with relevant examples that can be used inside a Thing Description document to describe a WoT operation using the Modbus protocol over the network.

§ 1. Introduction

The Modbus is a data communication protocol originally developed by Modicon which is now a part of Schneider Electric. The protocol was specifically designed for the remote management of the hardware devices in the industrial environment. For this reason, it has low level of abstraction and it has built in bit handling capabilities oriented to the direct control of the relays and generic contact statuses. The physical layer it is mainly an RS485 differential bus which has less susceptibility to the EMC interference. This Limit the usability of the protocol in short distance networks, typically within a kilometer. Due to its age the protocol does not implement any safety system, so usually when wide internet access is needed it is encapsulated in a TCP/IP protocol and with Ethernet as a physical layer. Thanks to this encapsulation strategy, the Modbus protocol can reach remote nodes

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WoT Device Description

Describe Device

```
{
  "@context": [
    "https://www.w3.org/2019/wot/td/v1"
  ],
  "id": "urn:pac4200",
  "@type": [
    "soris:Thing",
    "Thing"
  ],
  "name": "modbus-pac4200-sn324",
  "base": "modbus://192.168.10.100:1502",
  "title": "Siemens SENTRON PAC4200",
  "mlfb": "7KM4212-0BA00-2AA0",
  "properties": {
    "VoltageL1-N": {
      "type": "number",
      "readOnly": true,
      "forms": [
        {
          "href": "/1?offset=1&length=4",
          "op": [
            "readproperty",
            "observeproperty"
          ],
          "modbus:type": "float",
          "modbus:entity": "holdingregister",
          "modbus:pollingTime": 2000
        }
      ]
    },
    "VoltageL2-N": {
      "type": "number",
      "readOnly": true,
      "observable": true,
      "forms": [
        {
          "href": "/1?offset=3&length=4",
          "op": [
            "readproperty",
            "observeproperty"
          ],
          "modbus:type": "float",
          "modbus:entity": "holdingregister",
          "modbus:pollingTime": 2000
        }
      ]
    },
```

TD

kepware — S7 PN MB …

niagara4 — DL BN MB …

IN Stack — DL BN MB …

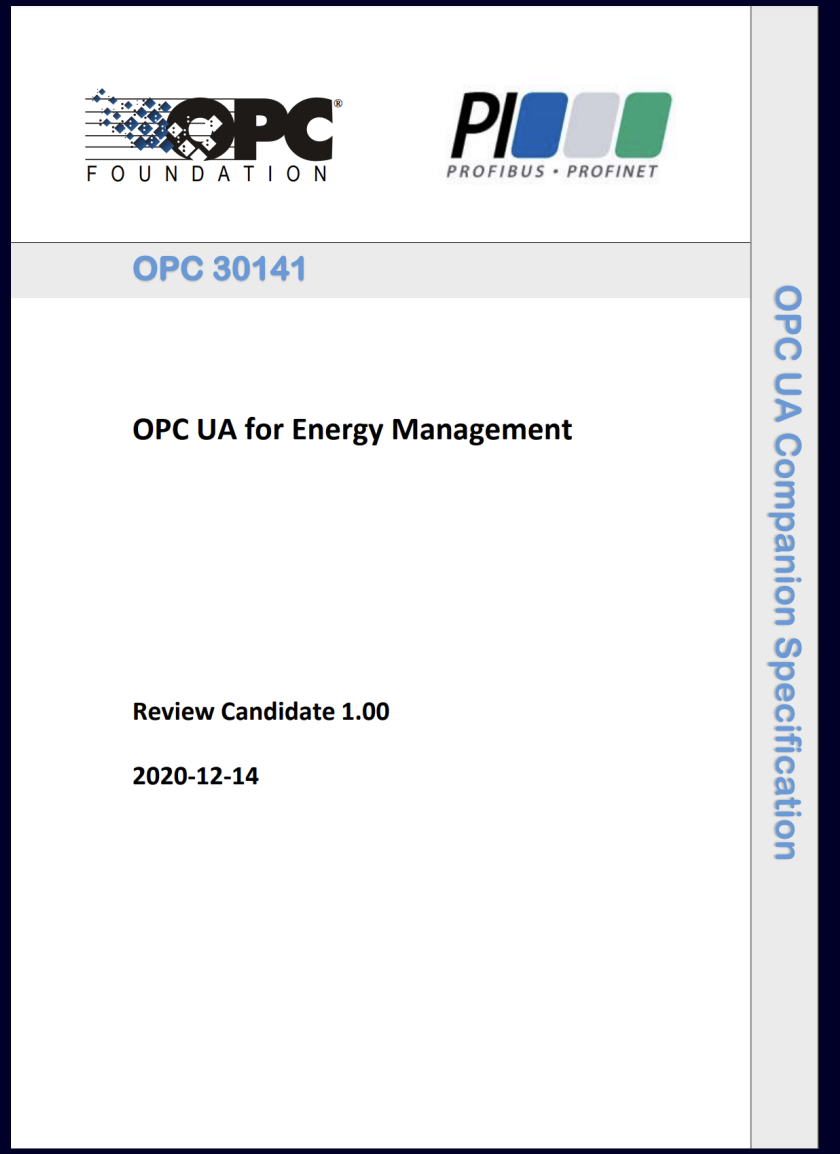
optimize! softing — S7 PN MB …

SIEMENS

WoT Context Extension

Map Device to Model

```jsonc
{
  "@context": [
    "https://www.w3.org/2019/wot/td/v1",
    { "opcua_30141": "https://ontology.siemens.com/standards/opcua/opcua_30141" }
  ],
  "id": "urn:pac4200",
  "@type": [
    "soris:Thing",
    "Thing"
  ],
  "name": "modbus-pac4200-sn324",
  "base": "modbus://192.168.10.100:1502",
  "title": "Siemens SENTRON PAC4200",
  "mlfb": "7KM4212-0BA00-2AA0",
  "properties": {
    "VoltageL1-N": {
      "@type": "opcua_30141:AcVoltagePe_UL1N",
      "type": "number",
      "readOnly": true,
      "forms": [
        {
          "href": "/1?offset=1&length=4",
          "op": [
            "readproperty",
            "observeproperty"
          ],
          "modbus:type": "float",
          "modbus:entity": "holdingregister",
          "modbus:pollingTime": 2000
        }
      ]
    },
    "VoltageL2-N": {
      "@type": "opcua_30141:AcVoltagePe_UL2N",
      "type": "number",
      "readOnly": true,
      "observable": true,
      "forms": [
        {
          "href": "/1?offset=3&length=4",
          "op": [
            "readproperty",
            "observeproperty"
          ],
          "modbus:type": "float",
          "modbus:entity": "holdingregister",
          "modbus:pollingTime": 2000
        }
      ]
    },
```

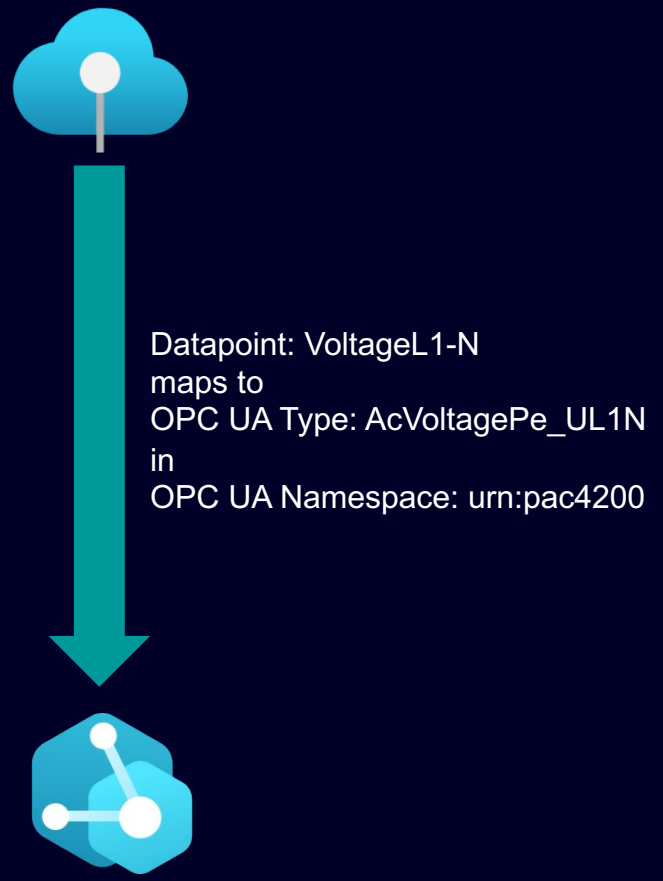


SIEMENS

WoT Context Extension

Map Device to Model

```jsonc
{
  "@context": [
    "https://www.w3.org/2019/wot/td/v1",
    { "opcua_30141": "https://ontology.siemens.com/standards/opcua/opcua_30141" }
  ],
  "id": "urn:pac4200",
  "@type": [
    "soris:Thing",
    "Thing"
  ],
  "name": "modbus-pac4200-sn324",
  "base": "modbus://192.168.10.100:1502",
  "title": "Siemens SENTRON PAC4200",
  "mlfb": "7KM4212-0BA00-2AA0",
  "properties": {
    "VoltageL1-N": {
      "@type": "opcua_30141:AcVoltagePe_UL1N",
      "type": "number",
      "readOnly": true,
      "forms": [
        {
          "href": "/1?offset=1&length=4",
          "op": [
            "readproperty",
            "observeproperty"
          ],
          "modbus:type": "float",
          "modbus:entity": "holdingregister",
          "modbus:pollingTime": 2000
        }
      ]
    },
    "VoltageL2-N": {
      "@type": "opcua_30141:AcVoltagePe_UL2N",
      "type": "number",
      "readOnly": true,
      "observable": true,
      "forms": [
        {
          "href": "/1?offset=3&length=4",
          "op": [
            "readproperty",
            "observeproperty"
          ],
          "modbus:type": "float",
          "modbus:entity": "holdingregister",
          "modbus:pollingTime": 2000
        }
      ]
    },
```



Datapoint: VoltageL1-N
maps to
OPC UA Type: AcVoltagePe_UL1N
in
OPC UA Namespace: urn:pac4200

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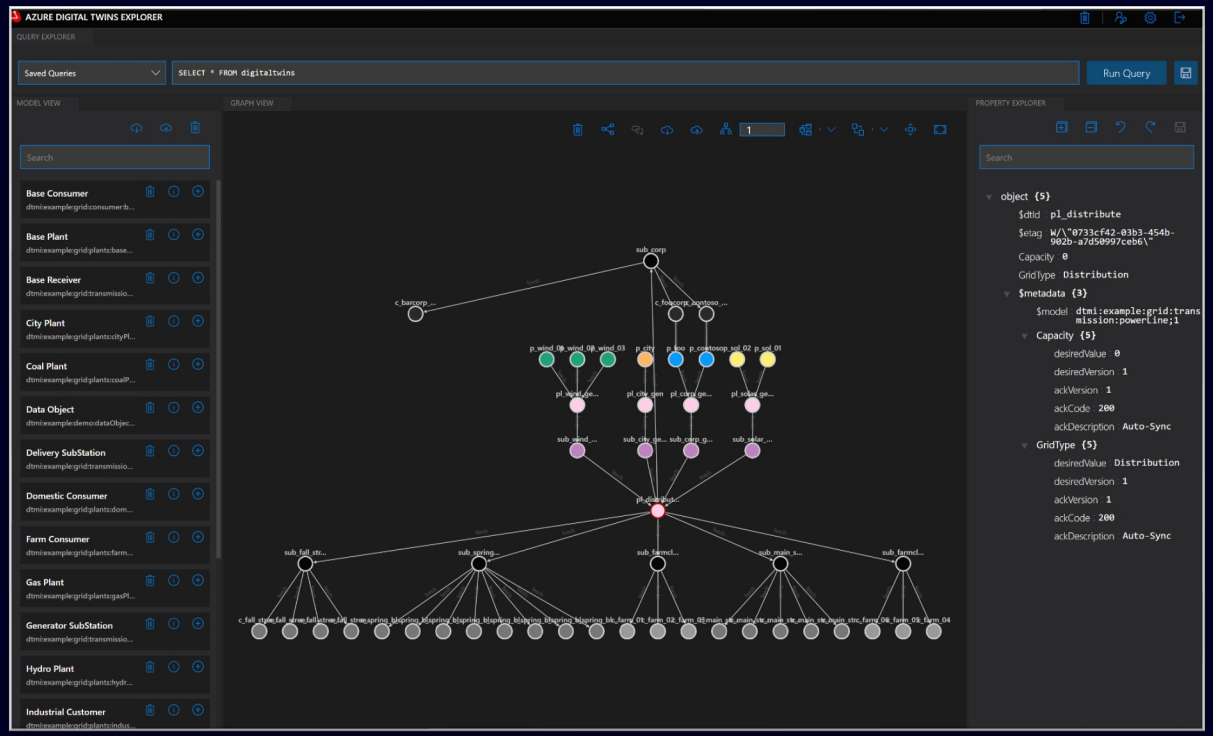
WoT Links

Create Twin Graph

```
15    "title": "Siemens SENTRON PAC4200",
16    "mlfb": "7KM4212-0BA00-2AA0",
17    "properties": {
18      "VoltageL1-N": {
19        "@type": "opcua_30141:AcVoltagePe_UL1N",
20        "type": "number",
21        "readOnly": true,
22        "forms": [
23          {
24            "href": "/1?offset=1&length=4",
25            "op": [
26              "readproperty",
27              "observeproperty"
28            ],
29            "modbus:type": "float",
30            "modbus:entity": "holdingregister",
31            "modbus:pollingTime": 2000
32          }
33        ]
34      },
35      "VoltageL2-N": {
36        "@type": "opcua_30141:AcVoltagePe_UL2N",
37        "type": "number",
38        "readOnly": true,
39        "observable": true,
40        "forms": [
41          {
42            "href": "/1?offset=3&length=4",
43            "op": [
44              "readproperty",
45              "observeproperty"
46            ],
47            "modbus:type": "float",
48            "modbus:entity": "holdingregister",
49            "modbus:pollingTime": 2000
50          }
51        ]
52      }
53    },
54    "links": [
55      {
56        "href": "dtmi:com:siemens:aggregate_meter;1",
57        "rel": "SubMeterOf",
58        "type": "application/td+json"
59      },
60      {
61        "href": "dtdmi:com:siemens:room;101",
62        "rel": "atRoom",
63        "type": "application/td+json"
64      }
65    ]
66  }
```



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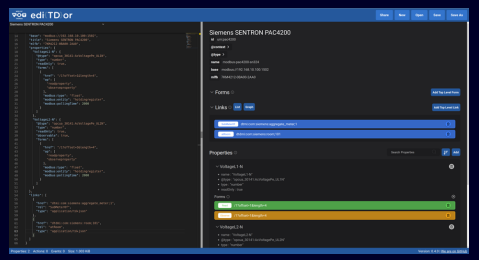
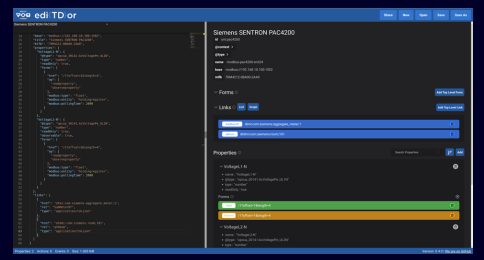
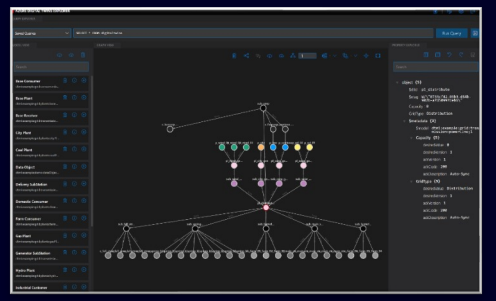
Let's Revisit the Authoring Flow







Describe Device

- Reusable across Stacks
- Trivial to read-in TDs
- Already OSS Tools out
- Bosch + Siemens

Protocol Translation

- 3rd party protocol adapters
- PnP SDK for Devices

Connect to Cloud

- Still custom Development
- But one-off

Map Device to Twin

- Reusable across Stacks

Create Twin Graph

- Import / Export TDs
- Reusable across Stacks
- Azure Digital Twins and others

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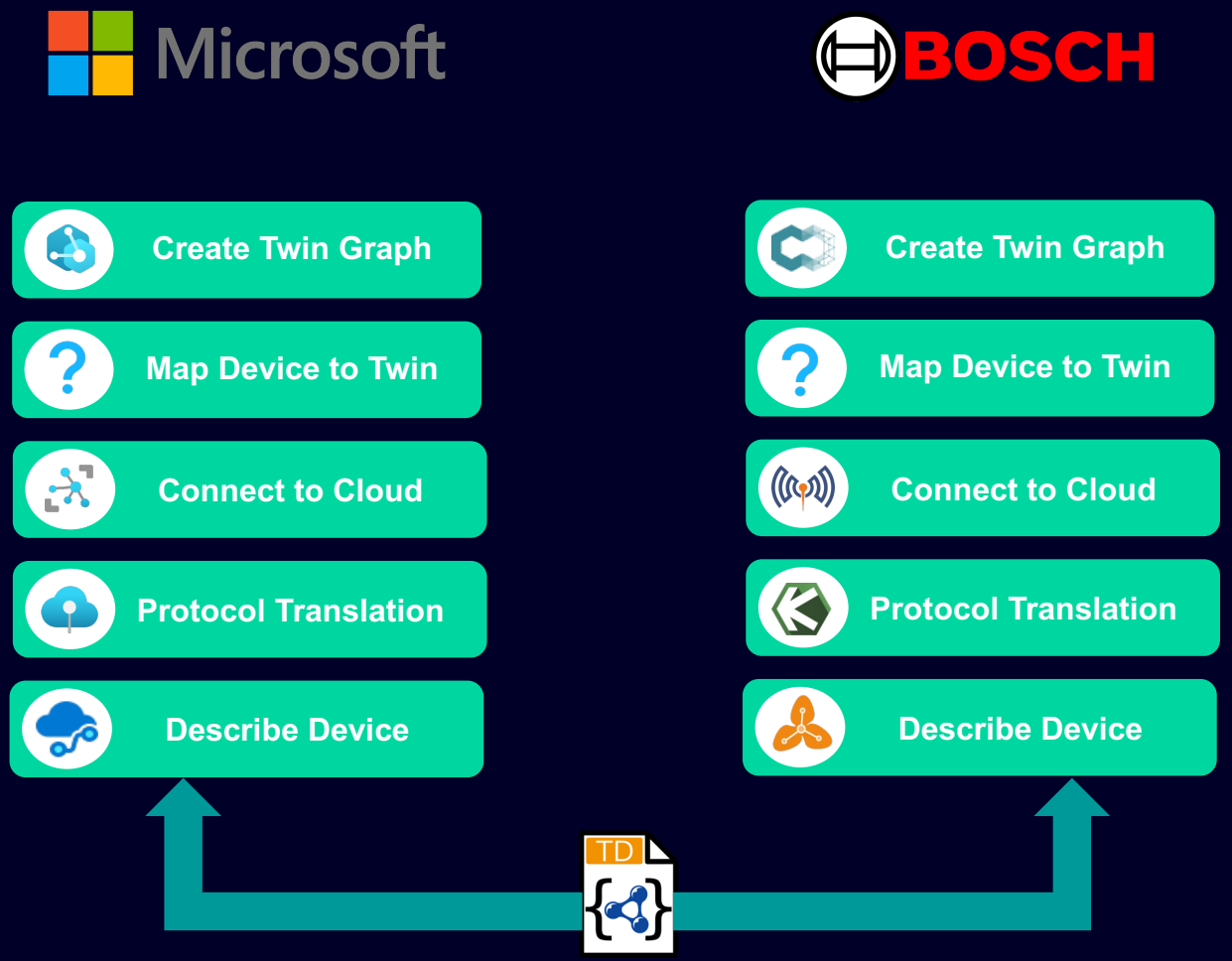
Reusable Device Integration Efforts



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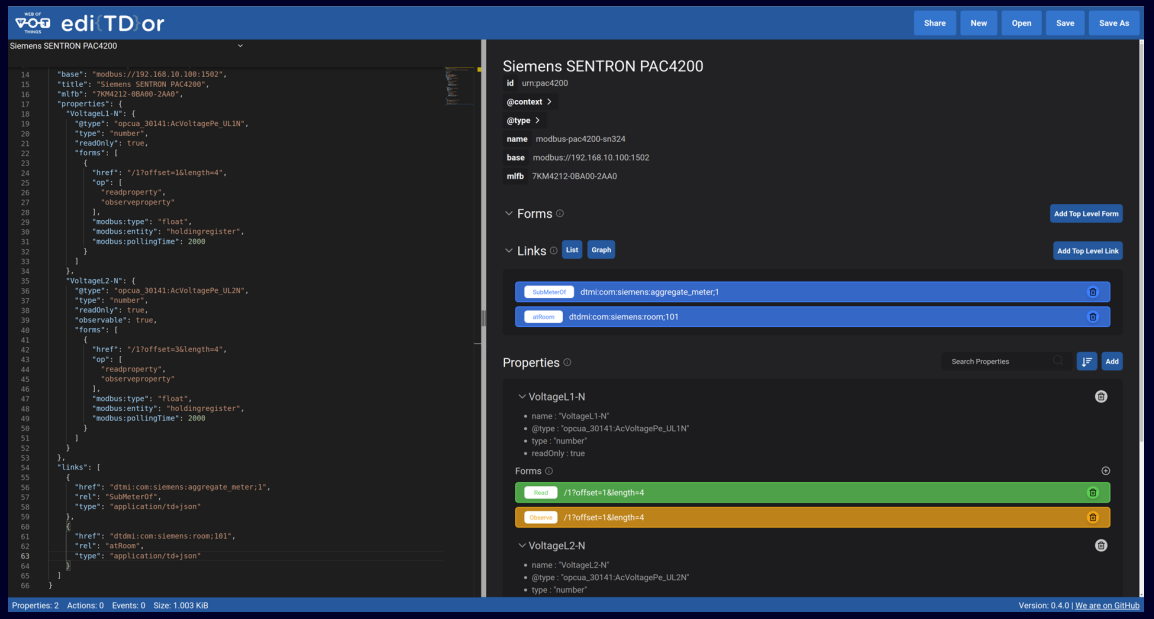
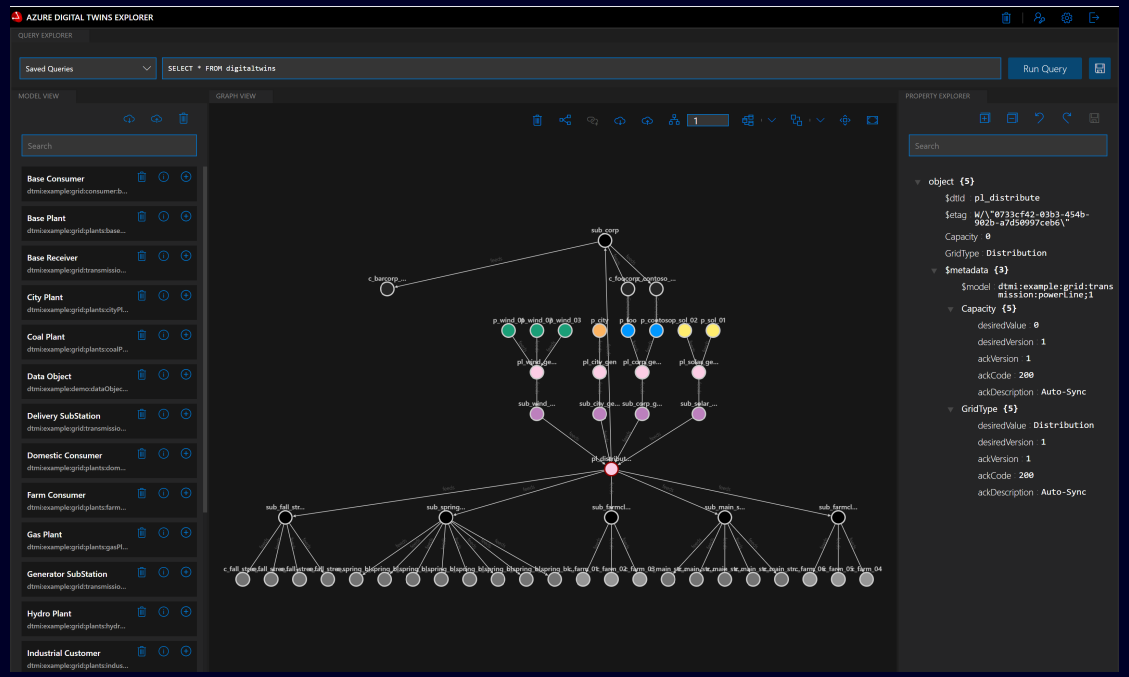
Collaborate on Common Tools
Which work on every Stack





SIEMENS Microsoft

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Demos

Questions?