AzureDAY 2018 Ukraine

Device Twins, Digital Twins and Device Shadow

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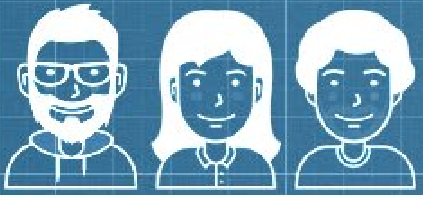

About Speaker

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Agenda

- Device Twins
- Azure vs. AWS
- Resume
- New in Azure
- Back to the Future

Topic
Protocols
SDK
Security
Authentication
Communication
Pricing

1 - Device Twins

Device Twins

JSON documents

-> store device state information

including metadata, configurations, and conditions.

What for?

- Store device-specific metadata in the cloud
- Report current state information such as available capabilities and conditions from your device app
- Synchronize the state of long-running workflows between device app and back-end app
- Query your device metadata, configuration, or state

2 – Azure vs. AWS

Focus

- Azure IoT Hub
- AWS Device Shadows

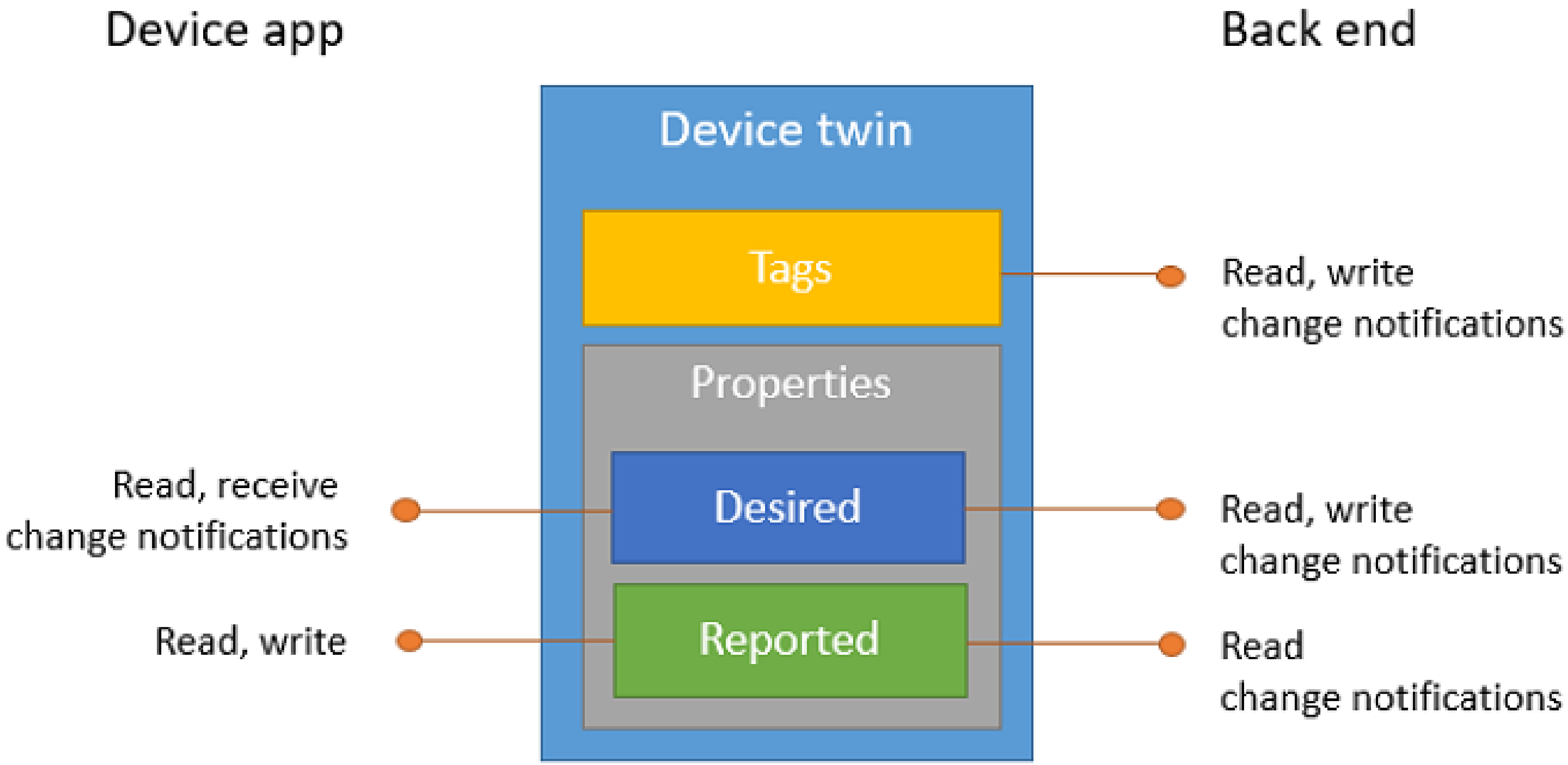
Structure of the Device

- High Level Concept
- Device Description
- Device Model
- Properties
- Actions
- Events
- Serialization format

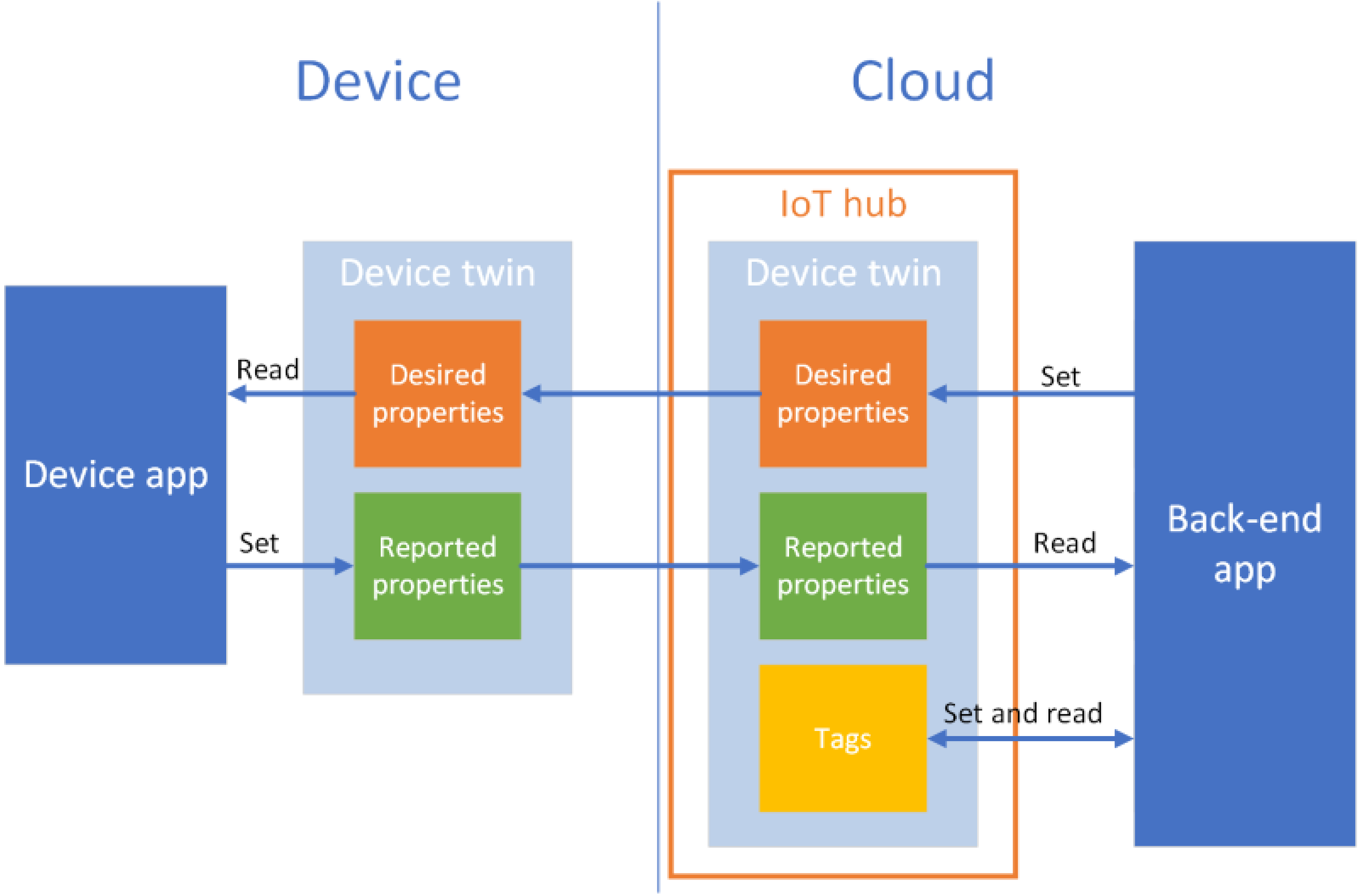
Microsoft Azure IoT Hub – Device Twins

- Microsoft’ Device Twin is an abstraction of a device state using properties and a set of tags, containing metadata values
- Actions and events are not of the model, but are handled by application code
- Messages are rather lightweight and the content can be selected by the application down to property level
- /!\ The format of the messages is defined by applications only
- The Device Twin model does not define a ‘template’ or a mechanism to aggregate multiple devices into a combined device model

Microsoft Azure IoT Hub – Cloud



Microsost Azure IoT Hub – Edge/Cloud



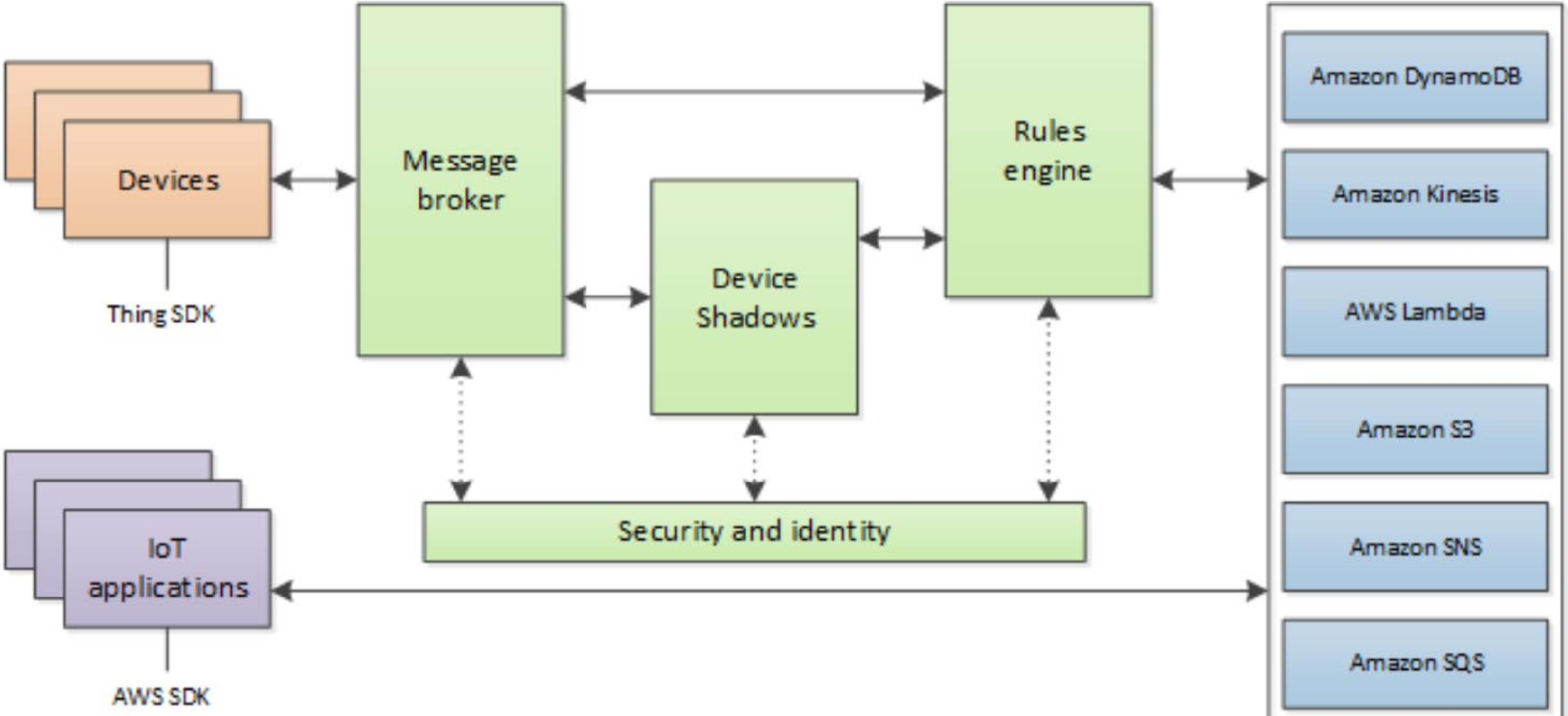
AWS IoT Device Shadows

- Enable Internet-connected devices to connect to the AWS Cloud and let application in the cloud interact with internet-connected devices

- Devices report their state by publishing messages in JSON format on MQTT topics

- /!\ Each MQTT topic has a hierarchical name that identifies the device whose state is being updated

AWS IoT Device Shadows – Cloud



Microsoft’s Device Twin = JSON file

- Tags: a section where the solution back-end has access to
- Properties: Used to synchronize device configuration or conditions
- All property values can be of the following JSON type: Boolean, number, string, object
- /!\ Arrays are not allowed in Azure but there are in AWS

3 kinds of properties

- Desired properties: can be set by the solution back-end and read by the device app

- Reported properties: The device app can set reported properties and the solution back-end can read and query them

- Device identity properties: The root of the Device Twin JSON file contains the read-only properties from the corresponding device identity stored in the identity registry

The AWS Thing is a Device Model

- AWS IoT provides a registry to manage **Things**

- A Thing is a **representation of a specific device or logical entity**

```
{
     "version": 3,
    "thingName": "MyLightBulb",
    "defaultClientId": "MyLightBulb",
    "thingTypeName": "LightBulb",
    "attributes": {
        "model": "123",
        "wattage": "75"
    }
}
```

AWS Thing types

- Thing types: store description and configuration information that is common for all things associated with the same thing type

- Thing groups: allow to manage several things at once

- /!\ Groups can also contain groups

Actions (Microsoft & AWS)

Actions do not correspond
to a formal description in the JSON file, but are modelled
via posting of a payload to a ‘method’ endpoint

Events

There is no dedicated event mechanism.

Serialization formats Comparison

```
{
   "deviceId": "devA",
   "moduleId": "moduleA",
   "etag": "AAAAAAAAAAc=",
   "status": "enabled",
   "statusReason": "provisioned",
   "statusUpdateTime": "0001-01-
01T00:00:00",
   "connectionState": "connected",
   "lastActivityTime": "2015-02-
30T16:24:48.789Z",
   "cloudToDeviceMessageCount": 0,
   "authenticationType": "sas",
   "x509Thumbprint": {
      "primaryThumbprint": null,
      "secondaryThumbprint": null
   },
   "version": 2,
   "tags": {
      "$etag": "123",
      "deploymentLocation": {
         "building": "43",
         "floor": "1"
      }
   },
   "properties": {
      "desired": {
         "telemetryConfig": {
            "sendFrequency": "5m"
         },
         "$metadata" : {...},
         "$version": 1
      },
      "reported": {
         "telemetryConfig": {
            "sendFrequency": "5m",
            "status": "success"
         }
         "batteryLevel": 55,
         "$metadata" : {...},
         "$version": 4
      }
   }
}
```

```
{
    "version": 3,
   "thingName": "MyLightBulb",
   "defaultClientId": "MyLightBulb",
   "thingTypeName": "LightBulb",
   "attributes": {
      "model": "123",
      "wattage": "75"
   }
}
```

```
{
   "state": {
      "desired": {
         "attribute1": integer2,
         "attribute2": "string2",
         ...
         "attributeN": boolean2
      },
      "reported": {
         "attribute1": integer1,
         "attribute2": "string1",
         ...
         "attributeN": boolean1
      }
   }
   "clientToken": "token",
   "version": version
}
```

SDKs

Azure

- IoT device SDKs (.NET, C, Java, NodeJS, Python, iOS)
- IoT service SDKs (.NET, C, Java, NodeJS, Python, iOS)
- Device provisioning SDKs (C, C#, Java, NodeJS, Python)

-> GitHub

AWS

- AWS Mobile SDK for Android
- Arduino Yún SDK
- AWS IoT Device SDK for Embedded C
- AWS IoT C++ Device SDK
- AWS Mobile SDK for iOS
- AWS IoT Device SDK for Java
- AWS IoT Device SDK for JavaScript
- AWS IoT Device SDK for Python

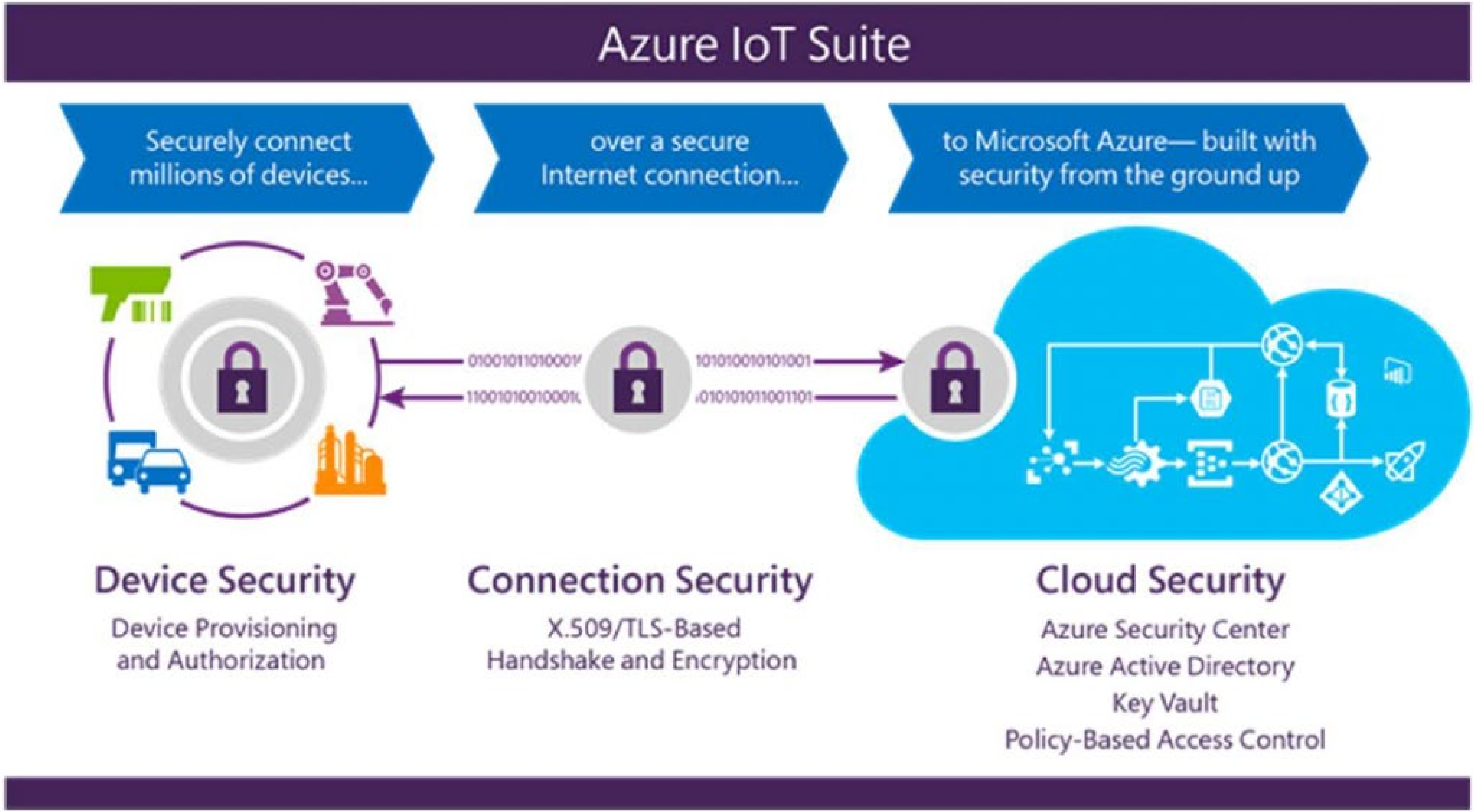
Protocols in Azure

- **AMQP 1.0** is already the official supported protocol for all Azure services
- **MQTT 3.1.1** but provides a simple programming model for building protocol adapters for other protocols
- **HTTPS**
- additional protocols using the Azure IoT Protocol Gateway framework
- Look at the Microsoft partnerships
  (PTC for useful connectors for example)

Protocols in AWS

- **MQTT 3.1.1** is the official supported protocol
- /!\ The broker doesn’t support retained messages, persistent sessions and QoS level 2
- **HTTP** protocol is supported but it’s limited to publish messages using a REST API (POST method only)

Security in Azure



Azure IoT Suite

Securely connect millions of devices...

over a secure Internet connection...

to Microsoft Azure— built with security from the ground up

Device Security

Device Provisioning and Authorization

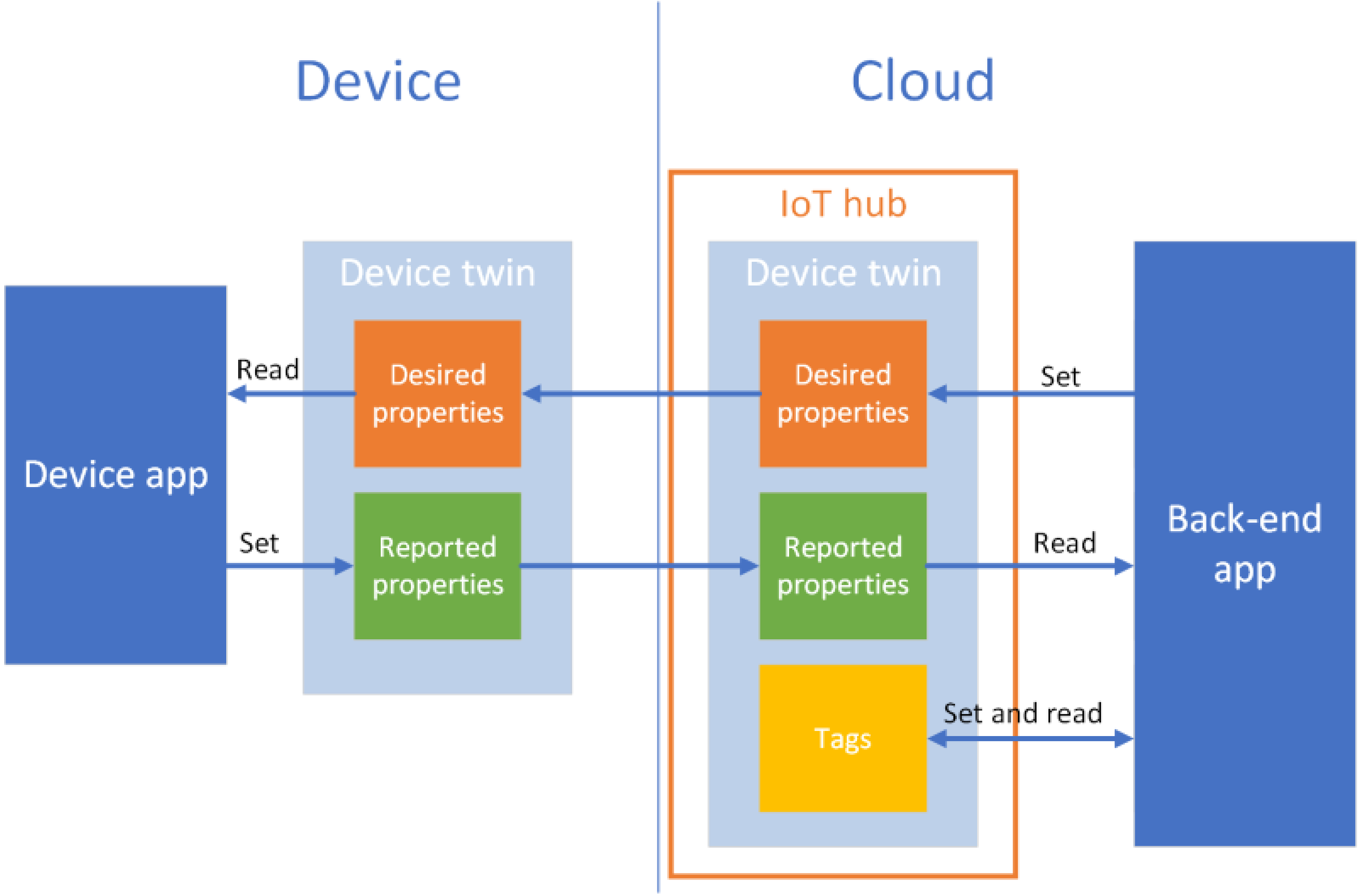
Connection Security

X.509/TLS-Based Handshake and Encryption

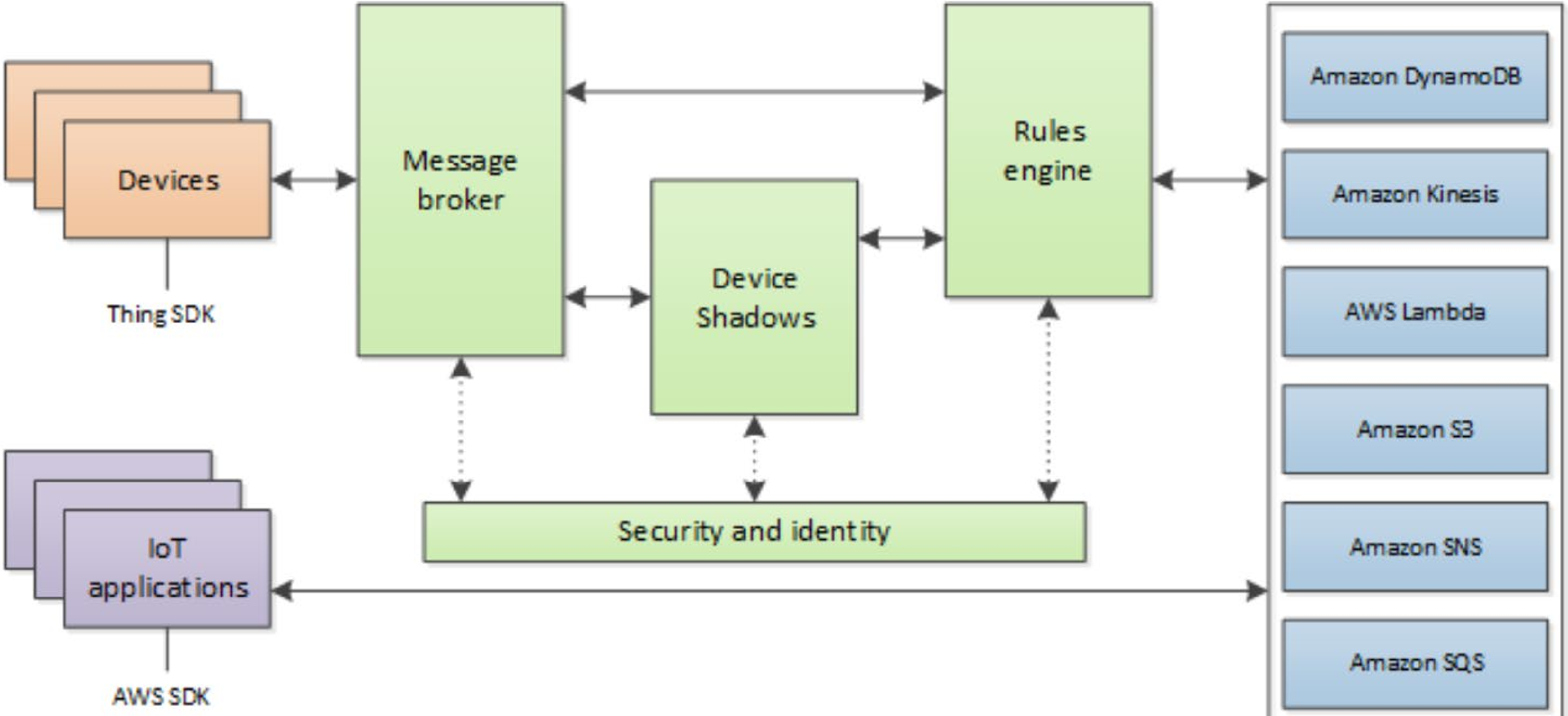
Cloud Security

Azure Security Center
Azure Active Directory
Key Vault
Policy-Based Access Control

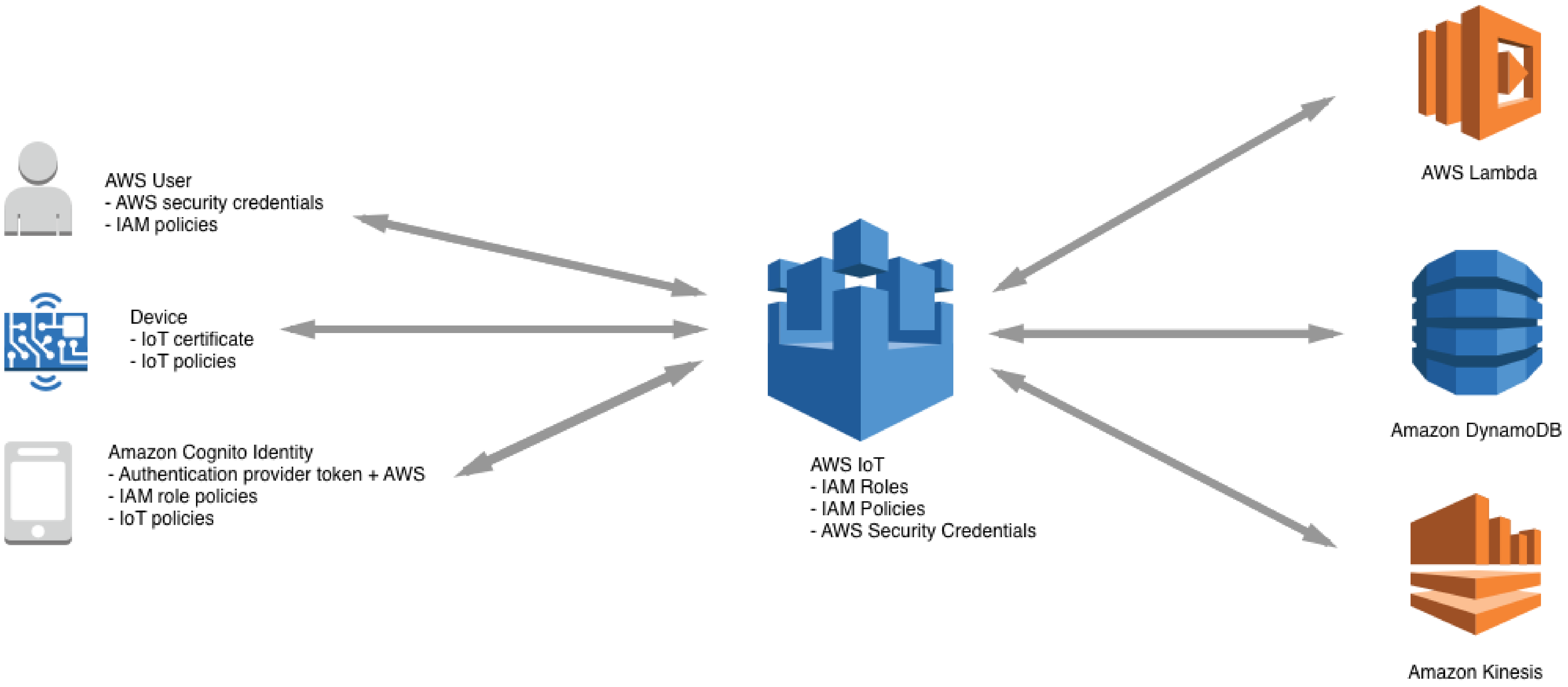
Microsost Azure IoT Hub – Edge/Cloud



AWS IoT Device Shadows – Cloud



Security in AWS



3 – Summary

Summary

- AWS and Azure only define a data model, no actions and events
- None of the serialization formats are uniformized
- None of the formats defines a protocol binding
- A device manufacturer, who wants to address these platforms, has to create code for both diferrent environments

A **unified device model** will simplify the integration tasks across different platforms and **will accelerate IoT market adoption.**

Summary

Topic	Azure IoT Hub	Amazon AWS IoT
Protocols	HTTPS, AMQP, MQTT, custom ones (using protocol gateway)	HTTP, HTTPS, MQTT
SDKs	.NET, UWP, Java, C, C#, NodeJS, Python, iOS (CocoaPod)	C, NodeJS, Java, Python, iOS
Security	TLS (Server authentication only)	TLS (Mutual authentication)
Authentication	Token bas (SAS) per device, X.509 device certificate	X.509 client authentication, IAM service, Cognito Service
Communication	Command based, telemetry	Command based (state), telemetry
Pricing	Per IoT Hub unit combined with number of devices and messages per day	Per number of messages (traffic) to/from device

4 – New in Azure

Azure Digital Twins

- Twin object models
- Spatial intelligence graph
- Advanced compute capabilities
- Data isolation via multi- and nested-tenancy capabilities
- Security through access control and Azure AD
- Integration with Microsoft services

Digital Twins object models

- Spaces
- Devices
- Sensors
- Users

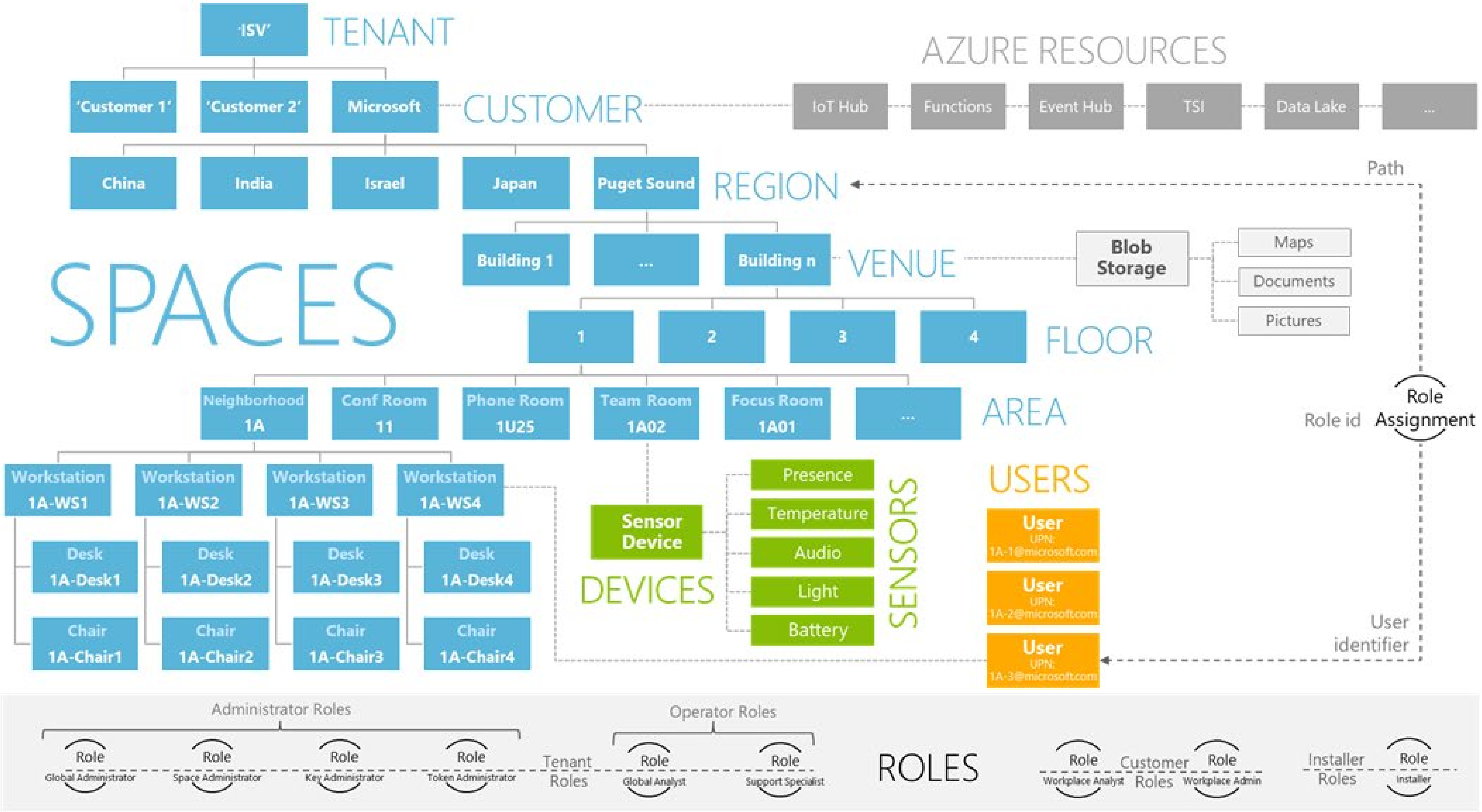
Other categories:

Resources, Extended Types, Ontologies, Property Keys and Values, Roles/Roles Assignments, Security Key Stores, UDFs, Matchers, Endpoints

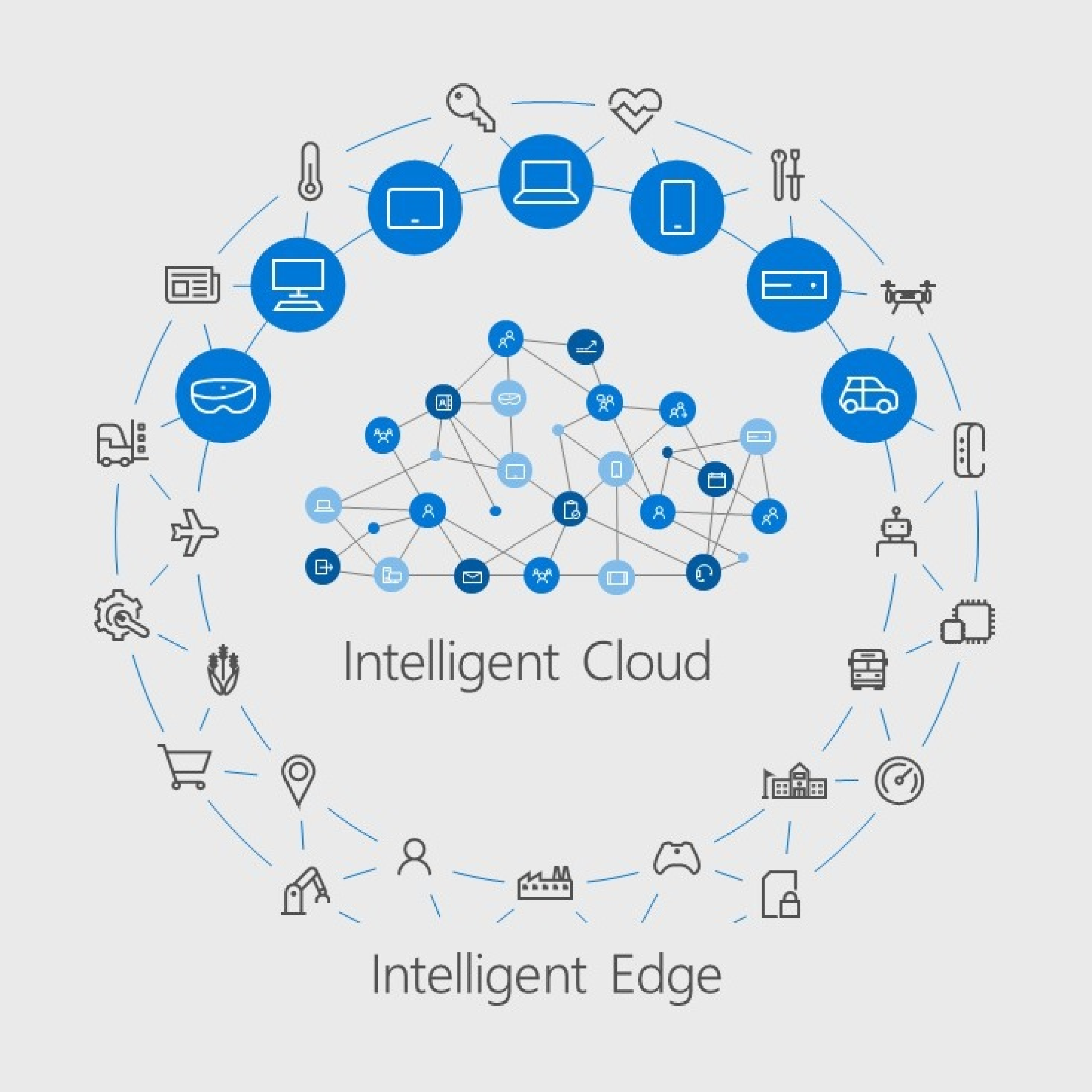
Spatial intelligence graph

- Managed with a collection of REST APIs
- Devices are provisioned with the Device API
- https://github.com/Azure-Samples/digital-twins-samples-csharp

Digital Twins



5 – Back to the Future


Intelligent Cloud
Intelligent Edge

Find ressources

Azure IoT

- https://code.visualstudio.com/download
- https://azure.microsoft.com/en-us/services/iot-hub/
- https://azure-samples.github.io/iot-devkit-web-simulator/
- https://azure-samples.github.io/raspberry-pi-web-simulator/#Getstarted
- https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-devguide-device-twins
- https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-node-node-twin-getstarted
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- https://docs.microsoft.com/en-us/azure/iot-hub/iot-hub-node-node-device-management-get-started
- https://github.com/MicrosoftDocs/azure-docs/blob/master/articles/iot-hub/iot-hub-devguide-device-twins.md
- https://docs.microsoft.com/en-us/azure/digital-twins/concepts-objectmodel-spatialgraph
- https://docs.westcentralus.azuresmartspaces.net/management/swagger/ui/index

Where are the instructions?
https://aka.ms/ms-docs

- docs.microsoft.com is new the platform hosting Microsoft technical documentation

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AWS IoT

- https://docs.aws.amazon.com/iot/latest/developerguide/what-is-aws-iot.html
- https://hub.packtpub.com/build-an-iot-application-with-aws-iot-tutorial/

- https://docs.aws.amazon.com/iot/latest/developerguide/iot-device-shadows.html
- https://docs.sumerian.amazonaws.com/tutorials/create/intermediate/iot-thing-shadow-script/

Thank you for your time