

# MEET YOUR DIGITAL TWIN!

Microsoft Azure Digital Twins

Understand • Model • Predict

altius

# Who is Remco?

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- Work

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Evolution of IoT solutions

2

What is Azure Digital Twins?

3

Simple demo

4

Architecture, Messages and Scripting

5

More 'advanced' demo

6

Left overs

# EVOLUTION OF INTERNET OF THINGS

- We are seeing the beginning of a new trend in IoT solutions
- IoT is still evolving, customers want to model a physical environment first, and then keep the model up to date with IoT data
- Provides a much more natural approach for IoT solutions

# A SIMPLE VIEW OF AN IOT SOLUTION

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# A MORE REALISTIC VIEW...

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# A History of Digital Twins

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R&D & ENGINEERING

MANUFACTURING OPERATIONS, SERVICES

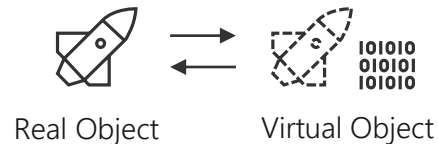
NEW SERVICES DRIVEN BUSINESS MODELS

## Information mirroring\* model

- Powerful modeling and analysis
- R&D and engineering focus

1985-2002  
(18 years)

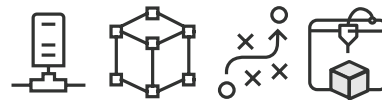
Digital Twin  
evolution



## Simulation and 3D printing

- Digital design, virtual assembly, and simulation
- 3D printing mainstream

2003-2014  
(12 years)



## Connected IoT assets

- Unified physical and virtual data
- Rapid feedback across design, manufacturing, and operations

2015-2017  
(3 years)



Remote Monitoring  
Predictive Maintenance

## Model any physical environment

- Humans and device collaboration
- Spatial awareness and intelligence
- Mixed Reality experience

2018 - ...  
(the future is now)



Enable any organization to create digital  
feedback loops for all aspects of their business

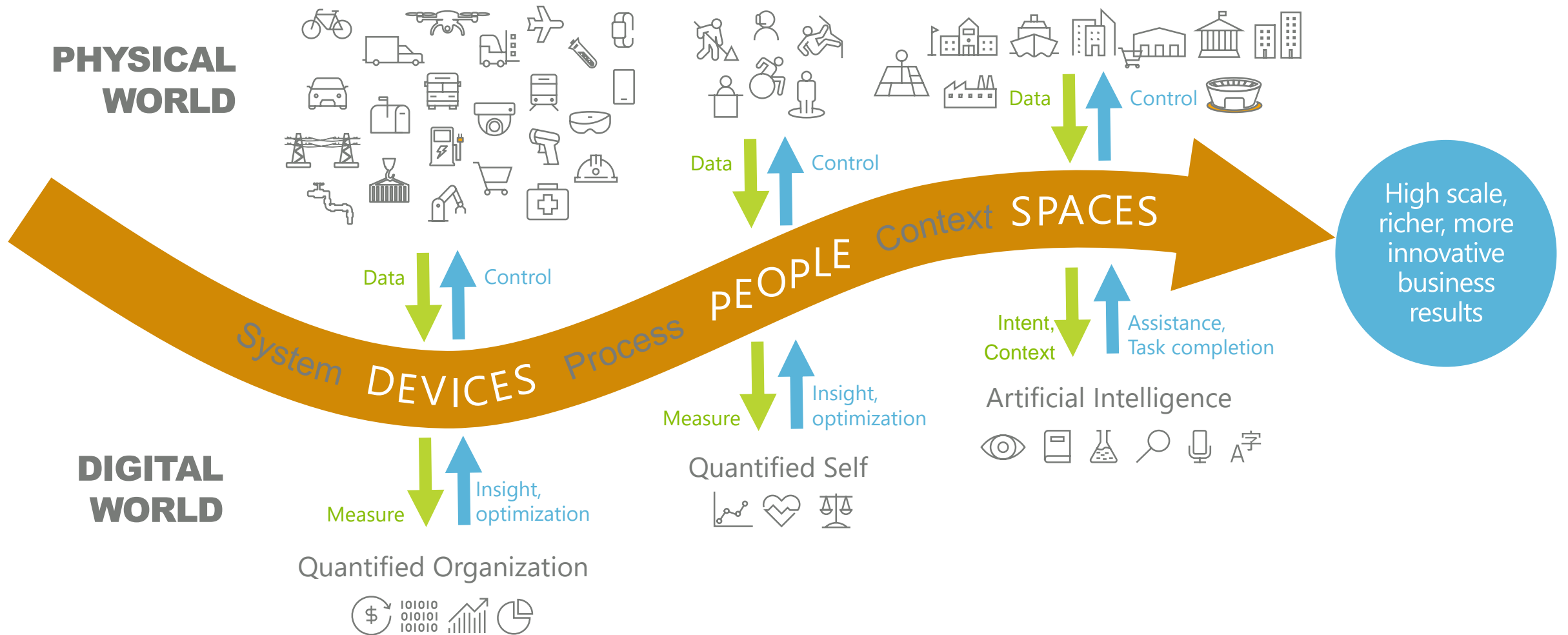
\*Dr. Michael Grieves and John Vickers – University of Michigan

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# FUSING DIGITAL WITH PHYSICAL

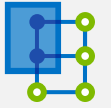
8





# WHAT IS AZURE DIGITAL TWINS?

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Enables customers and partners to create a comprehensive digital model of any physical environment, including the people, and places, things, and the relationships that bind them.

Virtually represent the physical world with a digital twin that models the relationships between people, places and devices.

Leverage predefined and extensible Twin Object Models to build contextually-aware solutions uniquely attuned to your industry domain.

Automate actions in a space with custom functions that send events and /or notifications to endpoints based on incoming telemetry.

Securely replicate solutions across multiple tenants through built-in multi- and nested-tenancy.



## Spatial Intelligence Graph

- Model relationships between People, Place, and Device Twins
- Blob storage attach to People, Place, and Device Twins (maps, pictures, manuals, etc.)
- Topology-based device provisioning & management
- Nested tenancy: data processing and storage separation by customer, region, facility, etc.

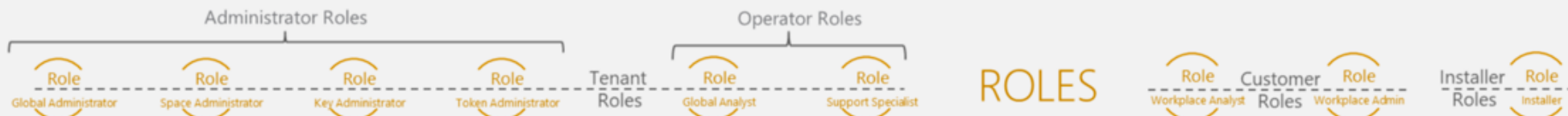
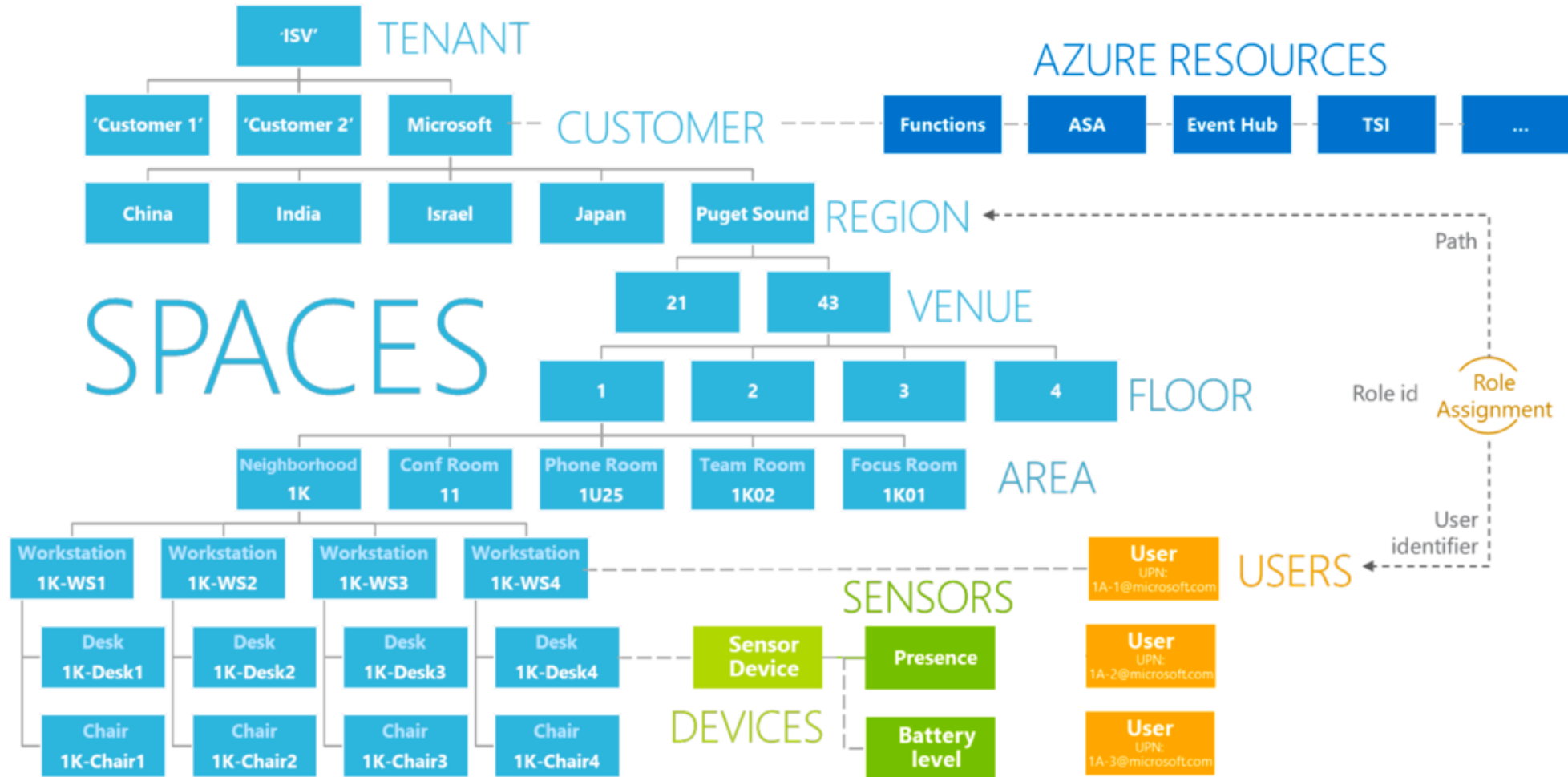
## Loadable Twin Object Models

- Ontology: Predefined domain-specific concept definitions, categories, and semantics
- Properties and the relations between them

## Advanced Processing and Control

- Role-based access and control (RBAC)
- Authentication / authorization via AAD
- Customizable sensor processing (Functions)
- Egress: notifications and routing (Service Bus, Event Hub, Event Grid)

# AN EXAMPLE GRAPH IN AZURE DIGITAL TWINS



## POSITION WITHIN MICROSOFT IOT ECOSYSTEM

12

Azure IoT Solution  
Accelerators

Azure IoT Central (SaaS)

Azure Digital Twins

People

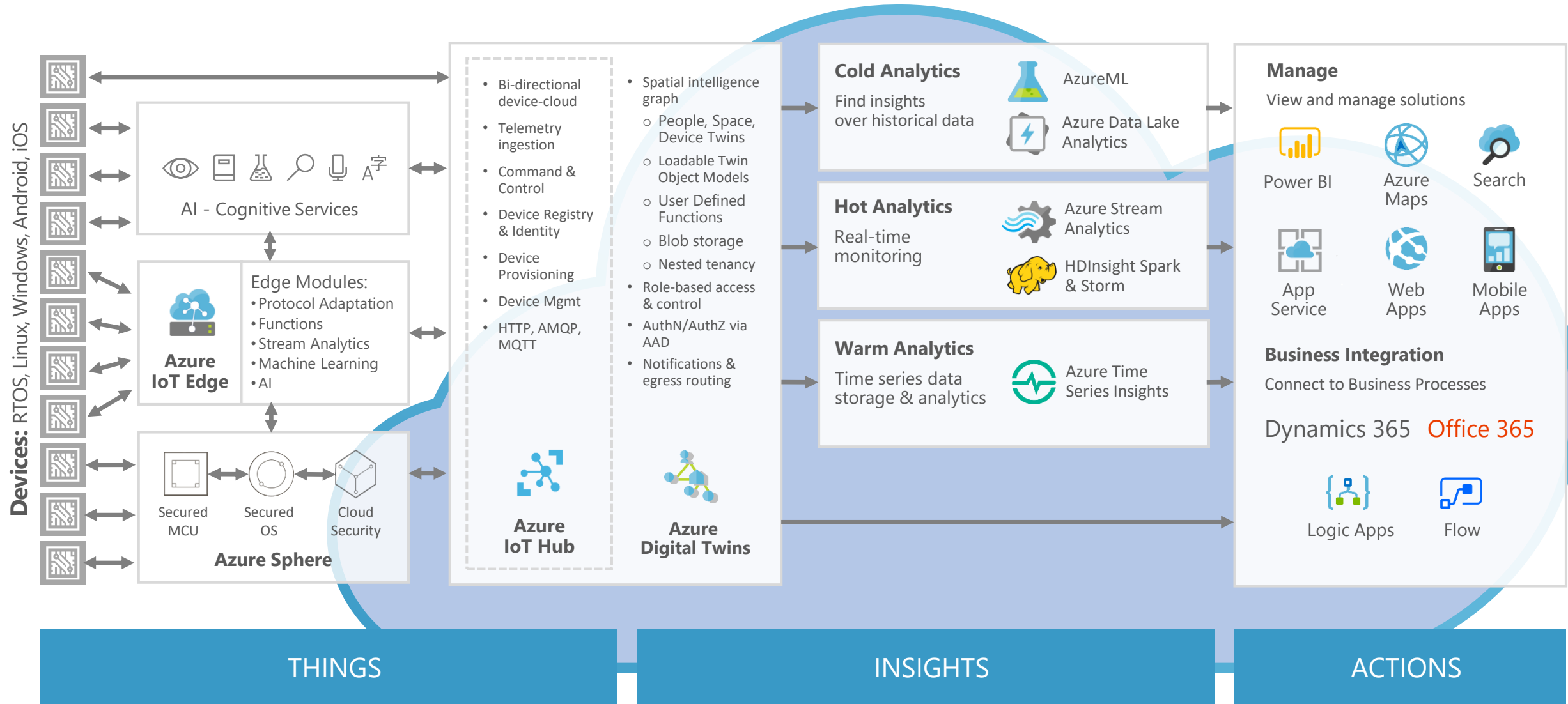
Azure IoT Hub

Devices

Places

# POSITION OF AZURE DIGITAL TWINS IN THE IOT/ AZURE LANDSCAPE

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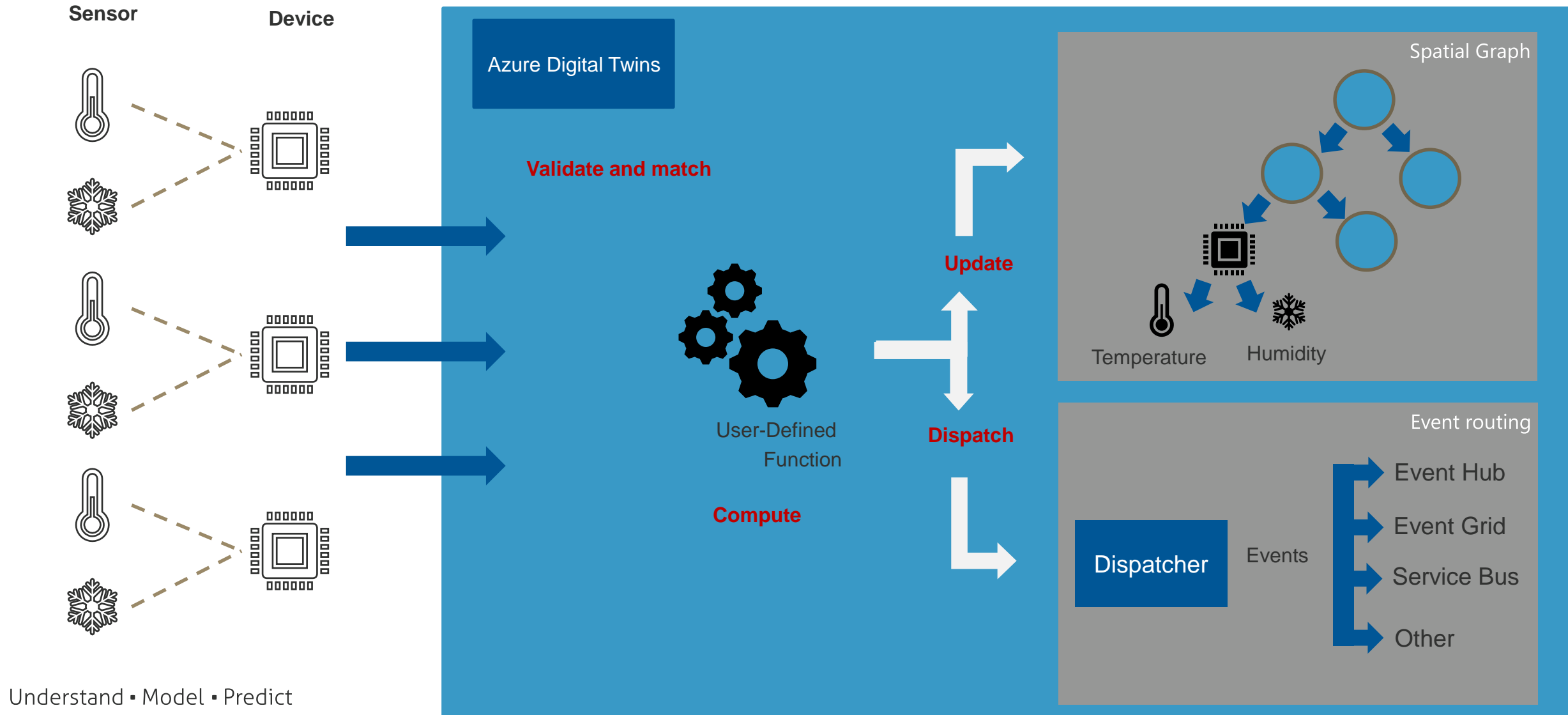




## Demo - Setup Microsoft Azure Digital twins for the first time and playing with the API's via Postman

# DATA PROCESSING IN AZURE DIGITAL TWINS

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- Extra properties are needed beside the value of the sensor
  - DigitalTwins-Telemetry “1.0”
  - DigitalTwinsSensorHardwareId “unique hardwareid of the sensor)
  - Optional: CreationTimeUTC “ISO 8601”
  - Optional: CorrelationId “UUID”
- Example:

Sending message: {"SensorValue":"870"} Properties: { 'DigitalTwins-Telemetry': '1.0','DigitalTwins-SensorHardwareId': 'ParticleSensorCO','CreationTimeUtc': '2019-05-31T08:40:50.3324194Z'}



- Define a set of conditions of incoming sensor telemetry
- Can include different matches
  - Sensor of datatype
  - Device that belongs to customer X
  - Belongs to venue
  - Has a 01 port
  - ....

```
{
  "SpaceId": "DE8F06CA-1138-4AD7-89F4-F782CC6F69FD",
  "Name": "My custom matcher",
  "Description": "All sensors of datatype temperature ",
  "Conditions": [
    {
      "target": "Sensor",
      "path": "$.dataType",
      "value": "\"Temperature\"",
      "comparison": "Equals"
    }
  ]
}
```

- An **isolated** custom function in Azure Digital Twins (JavaScript)
- Access to raw sensor telemetry
- Access to the spatial graph and dispatcher service
- Triggers on raw data with a matcher
- Examples:
  - Set sensor reading as value on a space in the graph
  - Perform an action based on sensor reading – CO2 too high set fan on
  - Create a notification based on certain conditions for incoming sensor reading
  - Add extra graph meta-data to the sensor reading before sending it to endpoints, like Event Grid

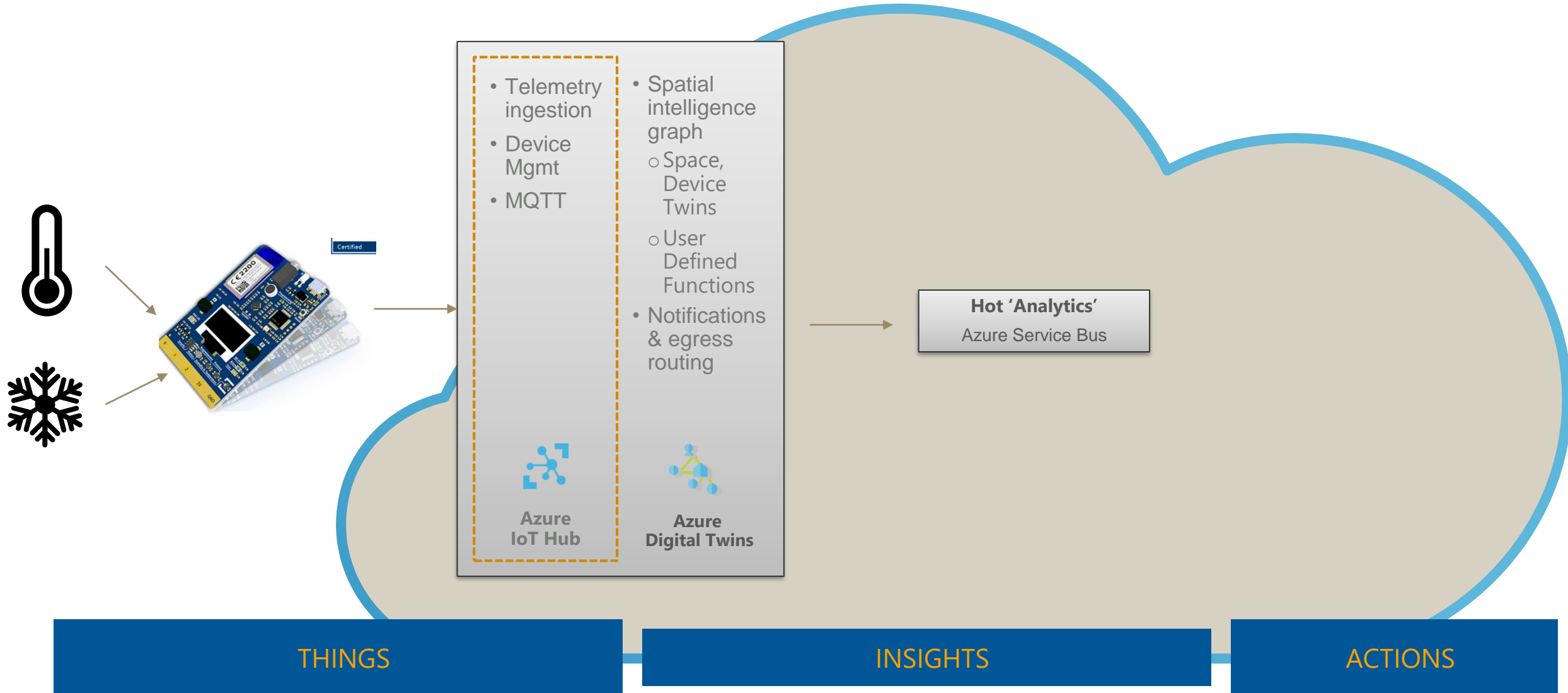
|            | DeviceMessages | TopologyOperation | SpaceChange | SensorChange | UdfCustom |
|------------|----------------|-------------------|-------------|--------------|-----------|
| EventHub   | X              | X                 | X           | X            | X         |
| ServiceBus |                | X                 | X           | X            | X         |
| EventGrid  |                | X                 | X           | X            | X         |

# Create Egress endpoint example – Service Bus

```
{ "type": "ServiceBus",  
  "eventTypes": [  
    "SensorChange",  
    "SpaceChange",  
    "TopologyOperation"  
  ],  
  "connectionString":  
    "Endpoint=sb://YOUR_NAMESPACE.servicebus.windows.net/;SharedAccessKeyName=RootManageSharedAccessKey;SharedAccessKey=YOUR_PRIMARY_KEY", "secondaryConnectionString":  
    "Endpoint=sb://YOUR_NAMESPACE.servicebus.windows.net/;SharedAccessKeyName=RootManageSharedAccessKey;SharedAccessKey=YOUR_SECONDARY_KEY", "path": "YOUR_TOPIC_NAME" }
```

# SOLUTIONS OVERVIEW OF THE DEMO

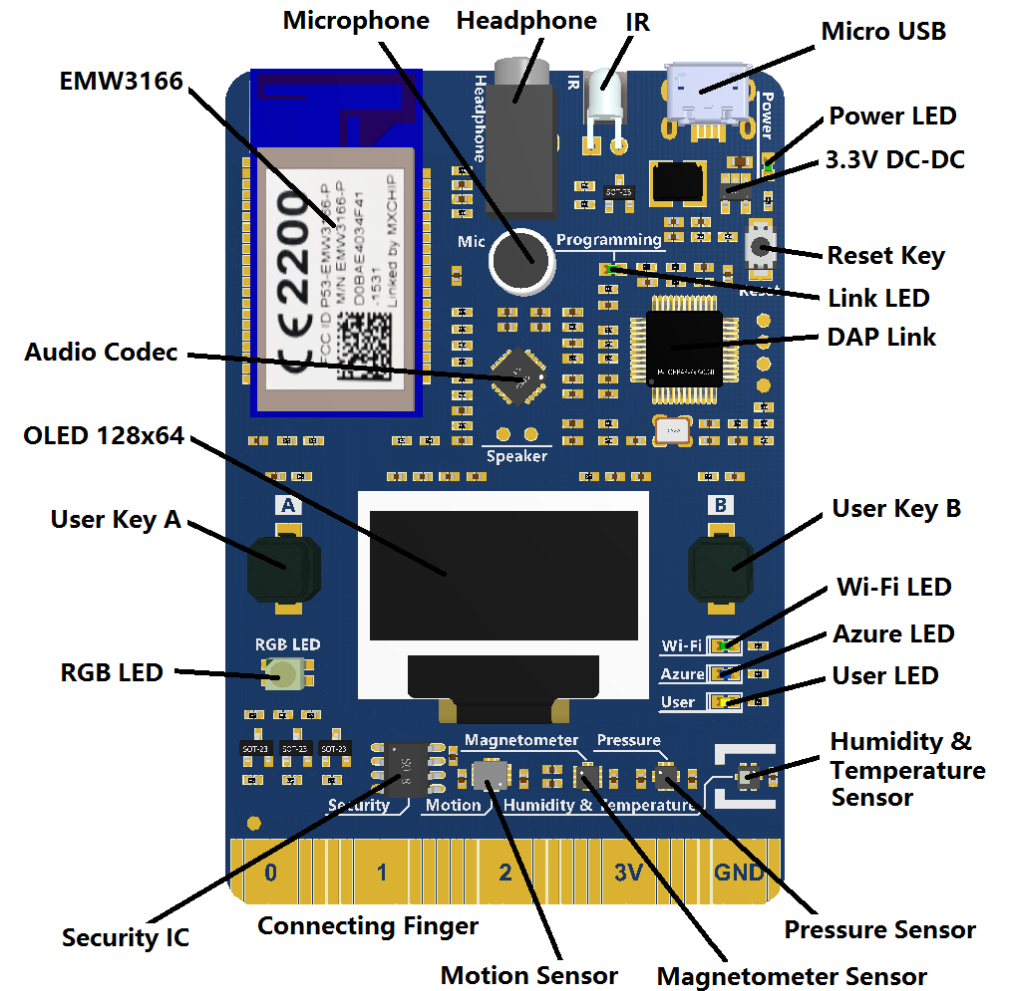
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# MXCHIP AZ3166 – 39 dollar

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“The MXChip IoT DevKit (a.k.a DevKit) is an all-in-one IoT Device Kit, you can use it to develop and prototype IoT (Internet of Things) solutions that take advantage of Microsoft Azure services. It includes an Arduino-compatible development board with rich peripherals and sensors, an open-source board package, and a growing projects catalog”



# ELSE YOU CAN USE THE WEB-BASED SIMULATOR

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MXChip IoT DevKit Simulator

Buy Help

Shake Shake

azureFunction

ShakeShake.ino

ShakeUI.h

ShakeUI.cpp

Configure

Deploy

connectionString

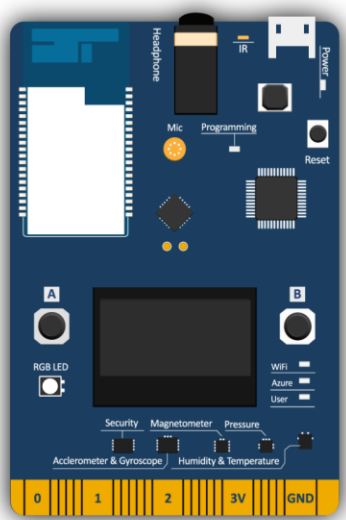
topic

song

```
1 // Copyright (c) Microsoft. All rights reserved.
2 // Licensed under the MIT license.
3 // To get started please visit https://microsoft.github.io
4 #include "AZ3166WiFi.h"
5 #include "AzureIoTHub.h"
6 #include "IoTHubMQTTClient.h"
7 #include "OledDisplay.h"
8 #include "Sensor.h"
9 #include "ShakeUI.h"
10 #include "SystemTickCounter.h"
11
12 #define RGB_LED_BRIGHTNESS 32
13 #define LOOP_DELAY 100
14
15 #define HEARTBEAT_INTERVAL 300000
16 #define PULL_TIMEOUT 15000
17
18 #define MSG_HEADER_SIZE 20
19 #define MSG_BODY_SIZE 200
20
21 #define SCROLL_OFFSET 16
22
23 static const char* iot_event = "{\"topic\":\"iot\"}"; //
24 static const char* iot_event_heartbeat = "{\"topic\":\"
25
26 // Application running status
27 // 0 - idle
28 // 1 - shaking
29 // 2 - do work
30 static int app_status;
31
32 // Peripherals
33 static DevI2C *ext_i2c;
34 static LSM6DSL *acc_gyro;
35 static RGB_LED rgbLed;
36
37 // Tweet message
38 static char msgHeader[MSG_HEADER_SIZE];
39 static char msgBody[MSG_BODY_SIZE];
40 static int msgStart = 0;
41
```

Run

Get a kit





## DEMO: Mxchip AZ3166 with Azure Digital Twins

sourcecode and guidance available on:

<https://github.com/rploeg/Azure-Digital-Twins-and-MXchip>



- Smart Building
  - Energy
  - Space utilization
  - Productivity
- Smart Houses
  - Zero Energy houses (ZNE)s
- Locks
  - Insights
  - Performance management
- Factory
  - Insights
  - Predictive maintenance

# CURRENT (JULY 2019) LIMITS IN PREVIEW

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- General

- Only one Azure Digital Twins Service per Azure subscription
- No support for Azure IoT Edge

- Per instance-limits

- Only one IoT Hub recourse is embedded
- Only one Eventhub Endpoint for device messages
- Up to three Eventhub, ServiceBus or Eventgrid endpoints

- API limits

- 100 request per seconds to the API
- Max 1.000 objects

- UDF rate limits

- 400 client library calls per second
- 100 SendNotification calls per sends

- Device Telemetry limits

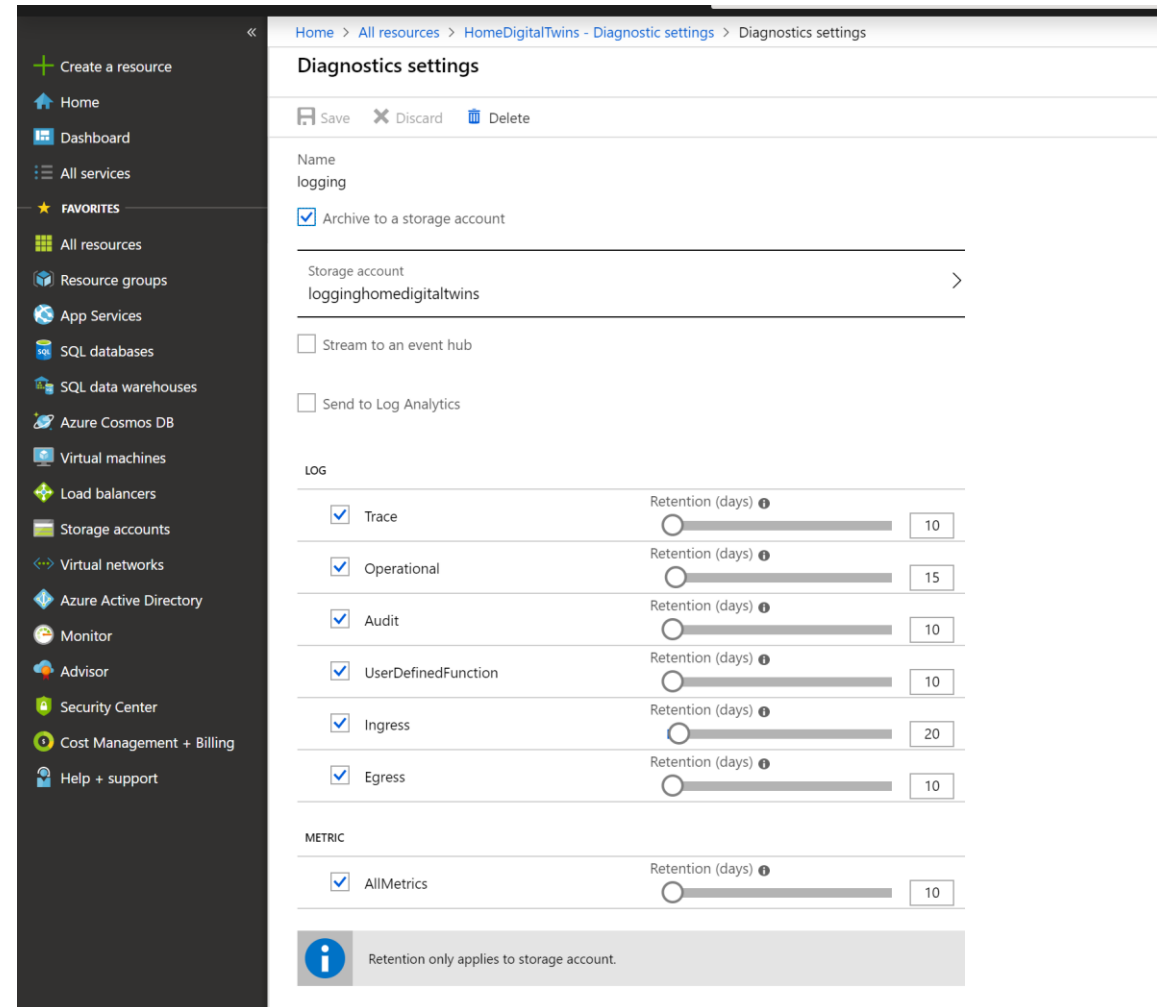
- 100 messages per second

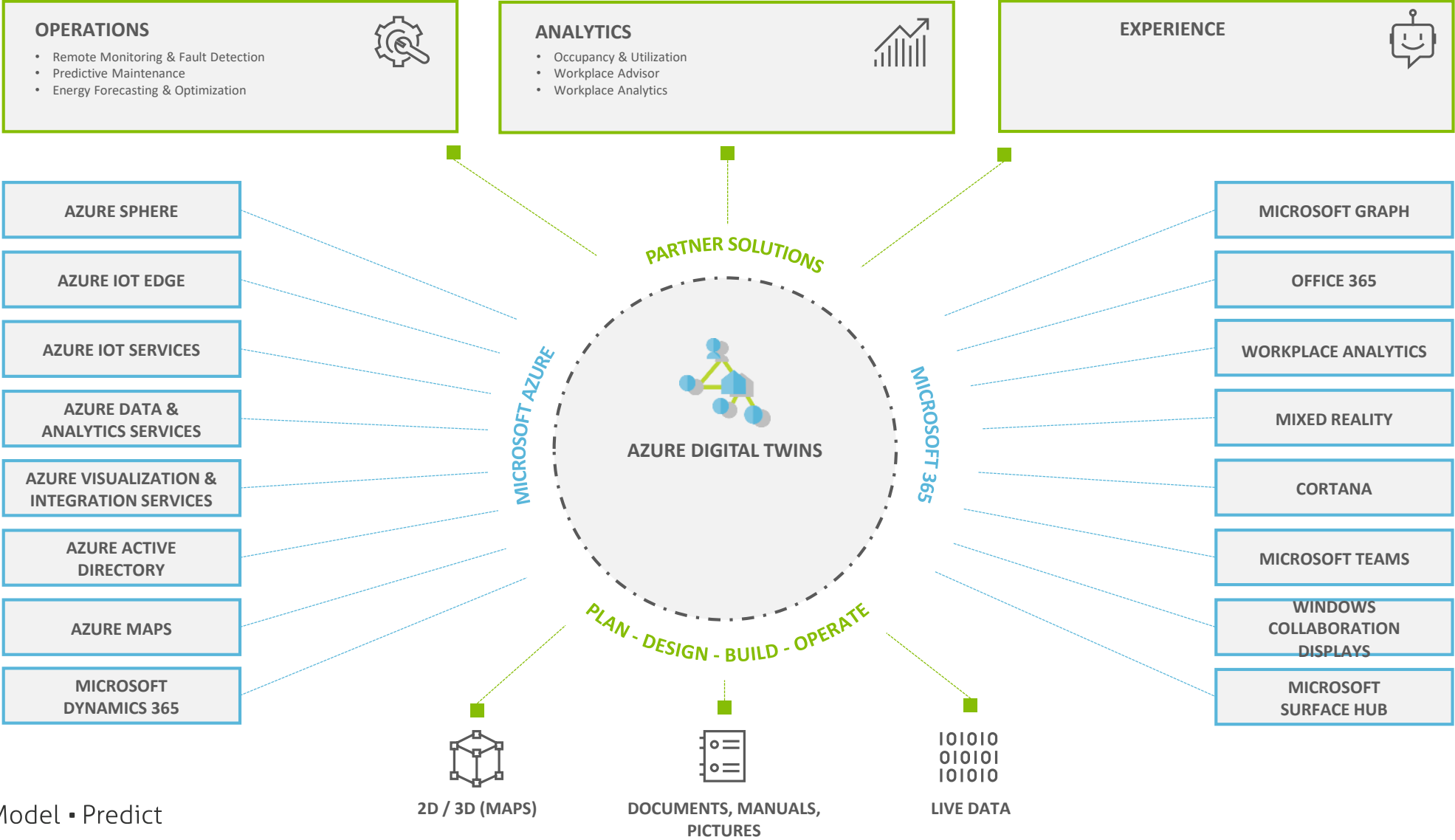
- Debugging.....

# DEBUGGING IS HARD

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- Enable 'simple' debugging in the service
- You cannot see the raw sensor messages that are **not** coming into the platform
- UDF – Use the Service Bus to check the debug messages....





- General information  
<https://azure.microsoft.com/en-us/services/digital-twins/>
- Start building: Monitor a building with Azure Digital Twins:  
<https://docs.microsoft.com/en-us/azure/digital-twins/tutorial-facilities-setup>
- Start building: Azure Digital Twins with the Microsoft Mxchip  
<https://github.com/rploeg/Azure-Digital-Twins-and-MXchip>
- MXChip
  - Buy: <https://www.seeedstudio.com/AZ3166-IOT-Developer-Kit.html>
  - Or use the web based simulator: <https://azure-samples.github.io/iot-devkit-web-simulator/>
- Any questions?  
[remco.ploeg@altius-europe.com](mailto:remco.ploeg@altius-europe.com)

The background image shows a hand holding a black pen, drawing a circular node in a network diagram on a transparent surface. The surface is covered with various data visualizations, including line graphs, bar charts, and network diagrams. Some text is visible on the surface, such as '+134:23:454:12' and '134:23:454:1'. The overall theme is data analysis and business strategy.

# Thank you

For more information, please contact

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