# Asset Maintenance using Azure Digital Twin

Digital Twin Microsoft Azure

# Solution Overview and Major Features

Digital Twin is a logical extension of Predictive Asset Maintenance (PAM) solutions. With a twin, it is possible to build a virtual version of an asset where data and predictive insights can be overlaid on the asset to provide meaningful and rich insight to the maintenance staff. This Solution is a combination of a fan and CPU. As soon as heat increases beyond a certain threshold, the fan will start automatically and vice versa. This solution in real-time is connected to actual hardware as well as the simulated version of the assets to demonstrate the features. This solution has used Azure's out-of-the-box services like Azure IOT Hub, Device Twin, Azure functions, etc. integrated with Custom Model designed and developed by Wipro's Data Science Team.

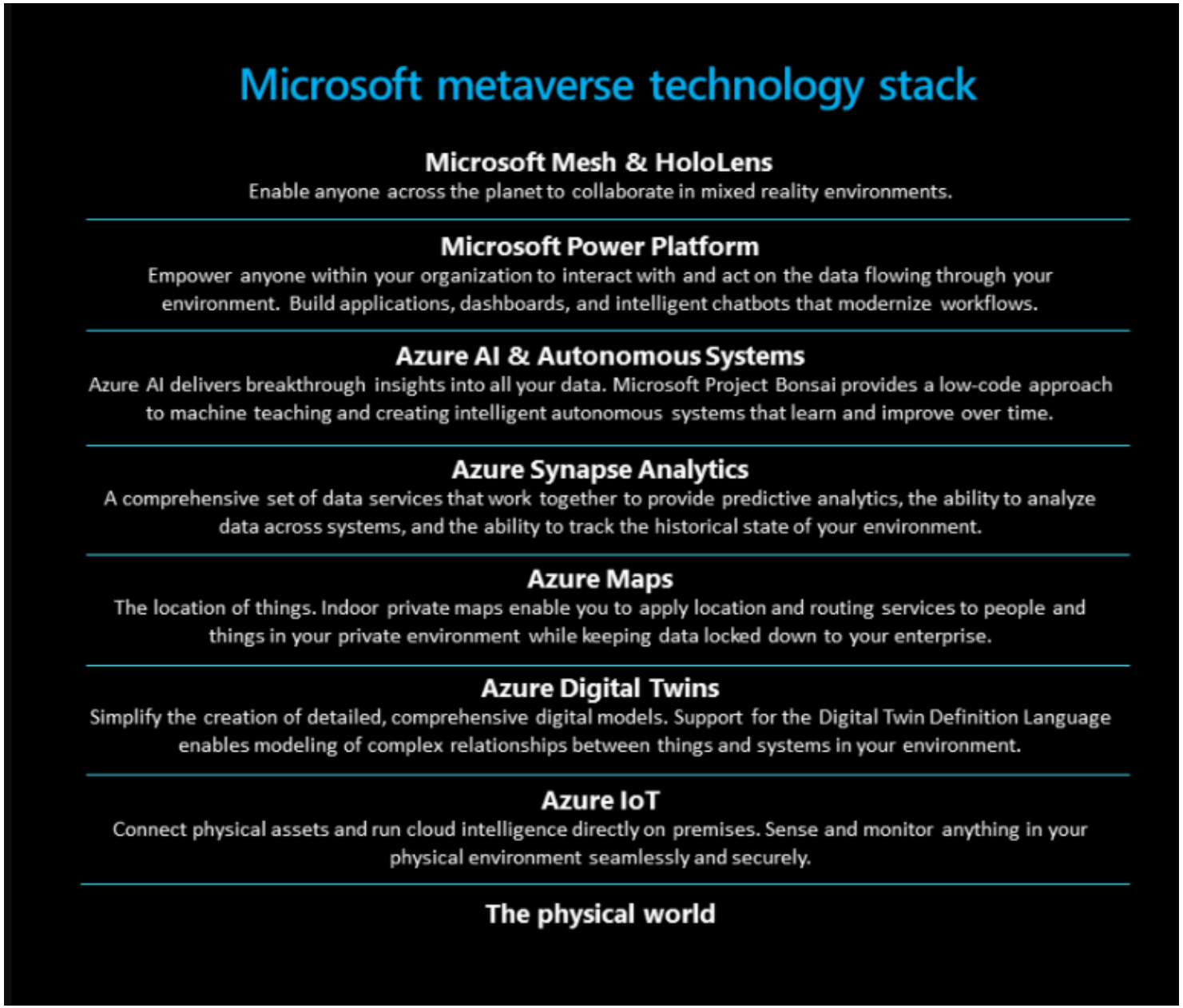
**End to End connection and control**: All hardware temperature censures are connected and controlled by the solution with 3D Visualisation containing 360 Degree Rotation.

**Real-time Simulation**: Simulation of temperature can be done to observe fan behaviour.

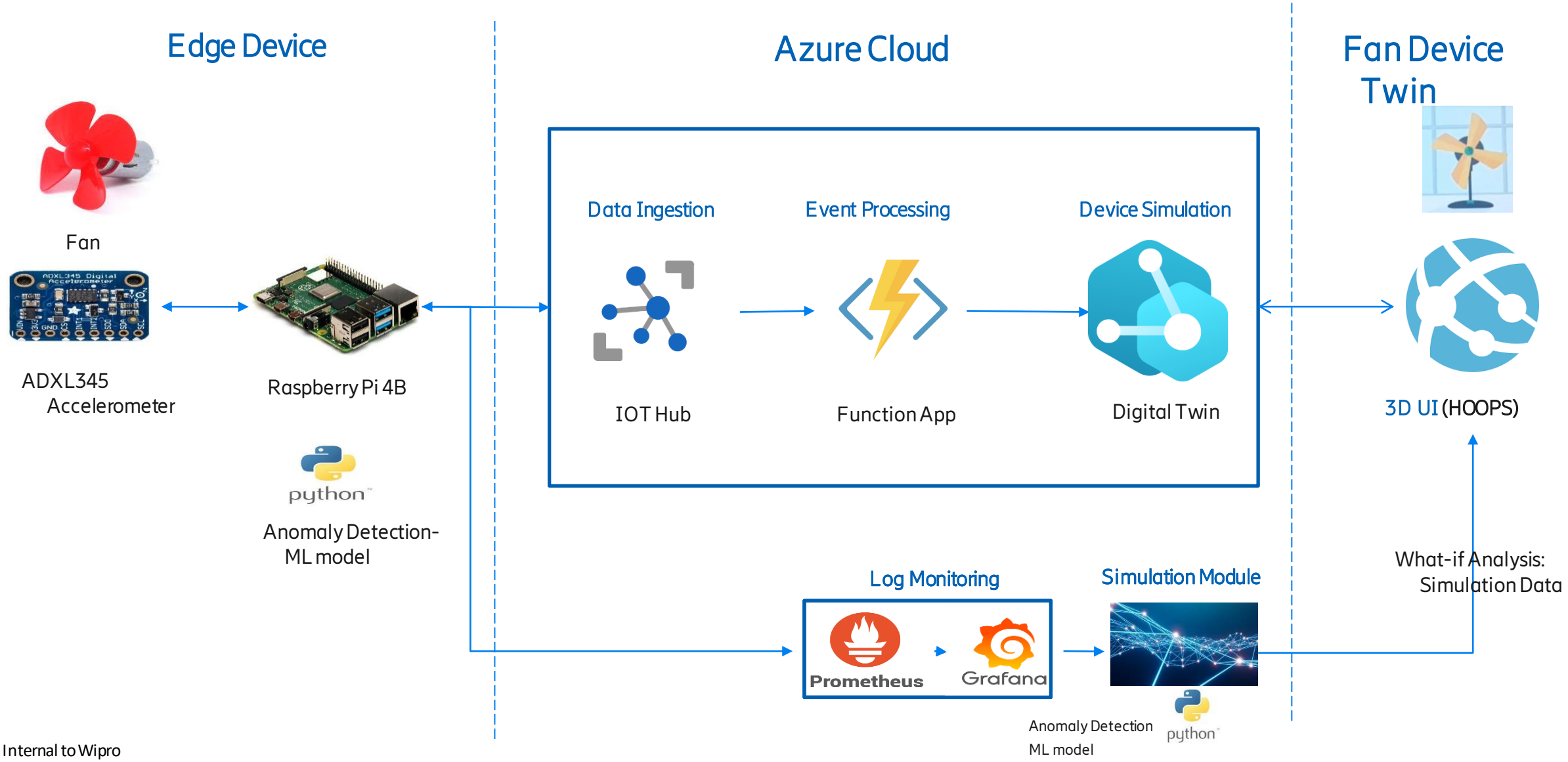
**If Else Condition:** User can provide own value and check the behaviour.

**Dashboard**: Dashboard provides a complete view and report of the process

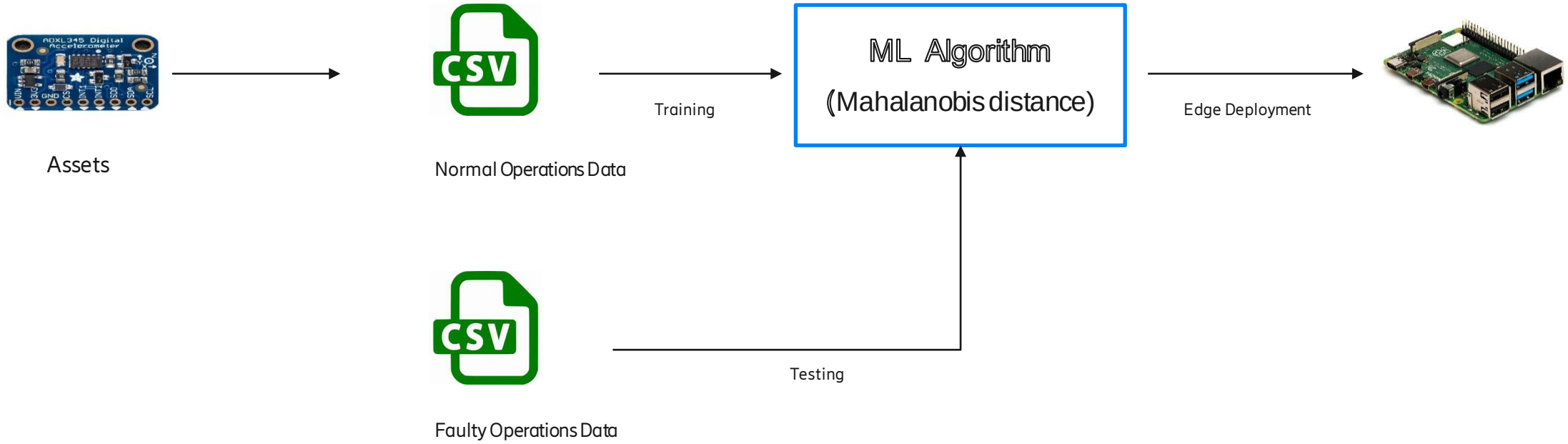
# Solution Architecture – Azure Metaverse



# Current Solution Architecture – High Level View



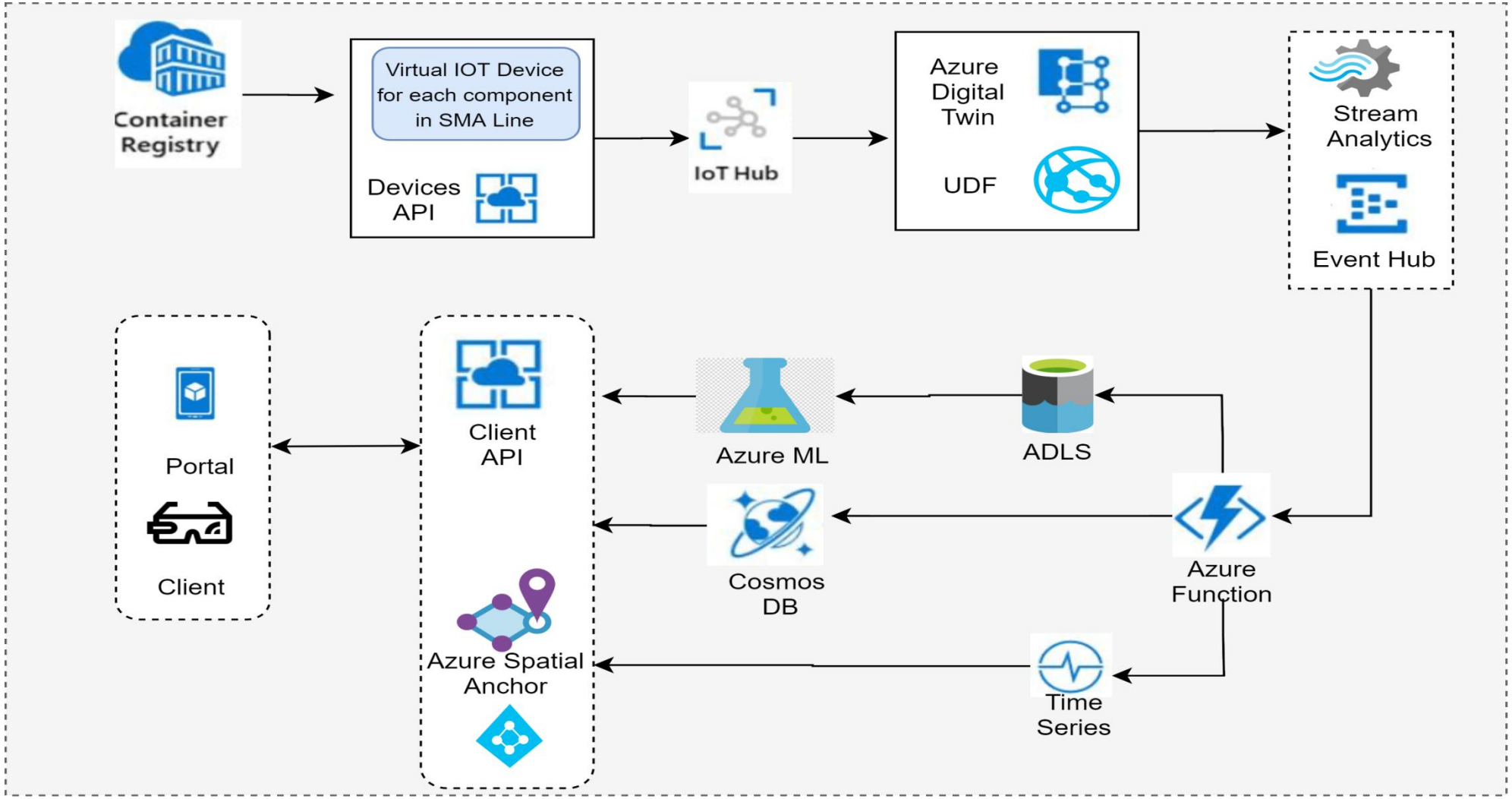
# Machine Learning Model




## Key highlights

- Model trained on accelerometer data for Normal operations.
- Testing was done on accelerometer data for faulty operations (anomalies were introduced by attaching a tape to the fan blade).
- Model could classify around 80% observations as faulty
- Model was deployed on the edge device (Raspberry Pi)

# Futuristic Enhanced Architecture Diagram



# Solution

Back

What If

**Temperature Telemetry**

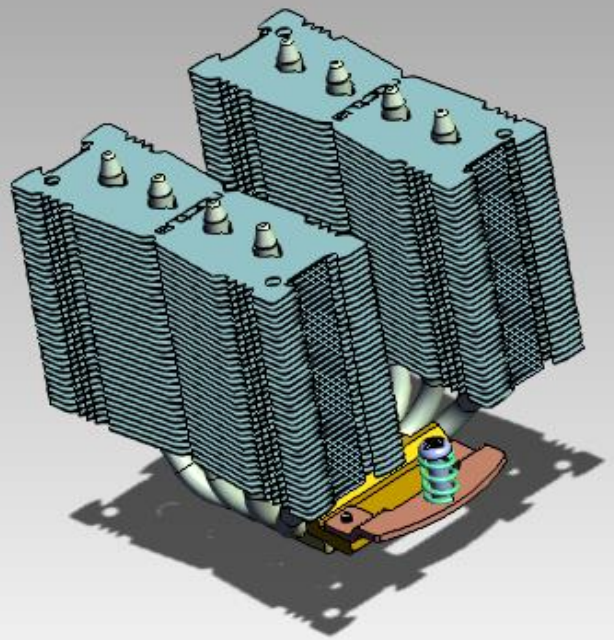
Temperature: **30**

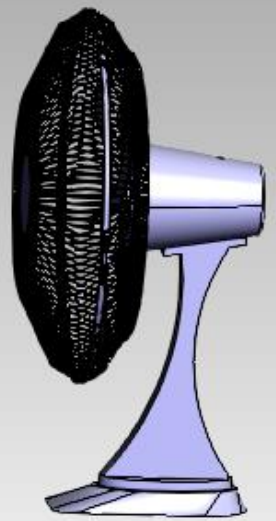
Last Updated: **3/25/2022, 11:00:37 AM**

**Device Telemetry**

AccelerationX: **0.4707192**
AccelerationY: **-10.0420096**
AccelerationZ: **-1.6082906**
Status: **Stopped**
Operation: **Stopped**
RPM: **0**

Last Updated: **3/25/2022, 11:00:37 AM**

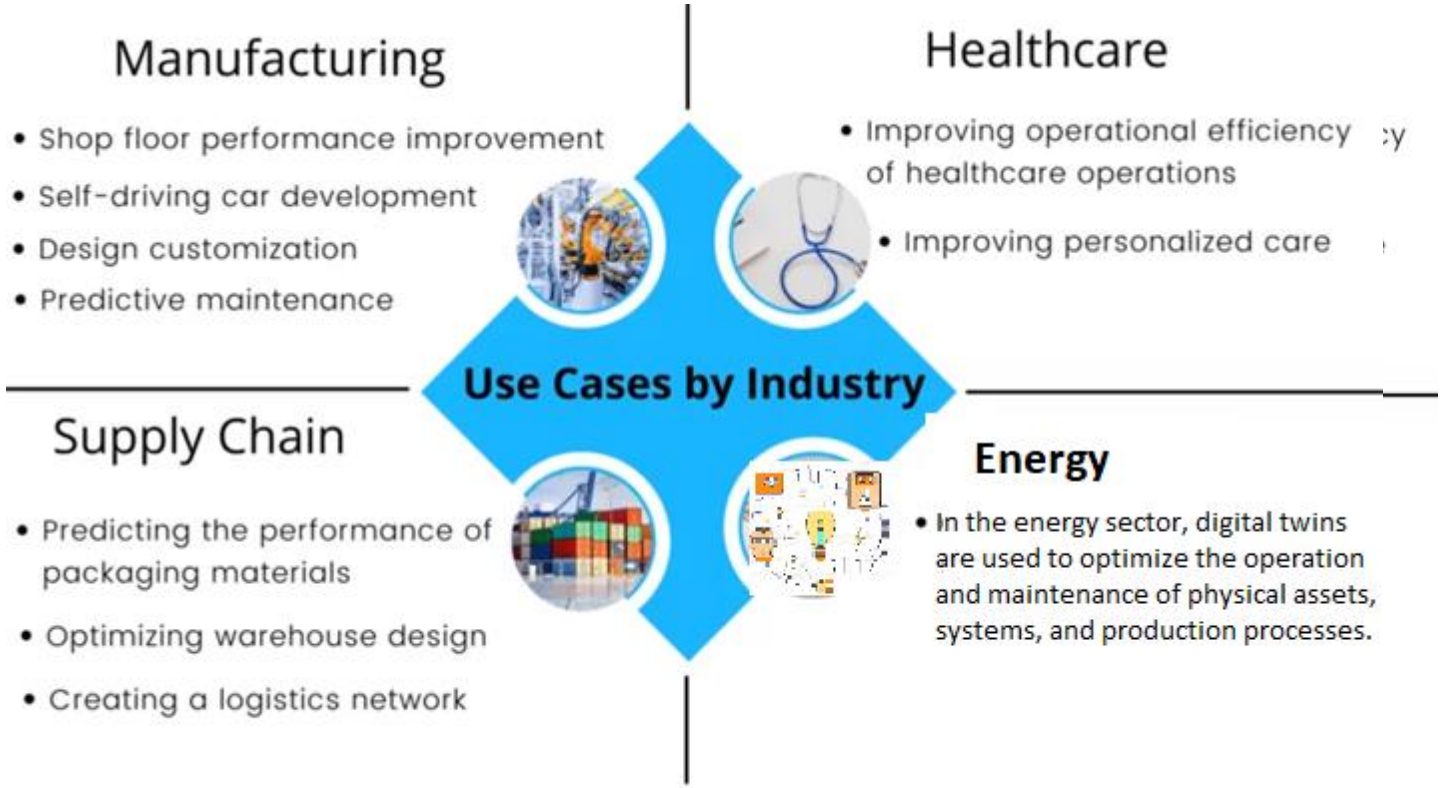




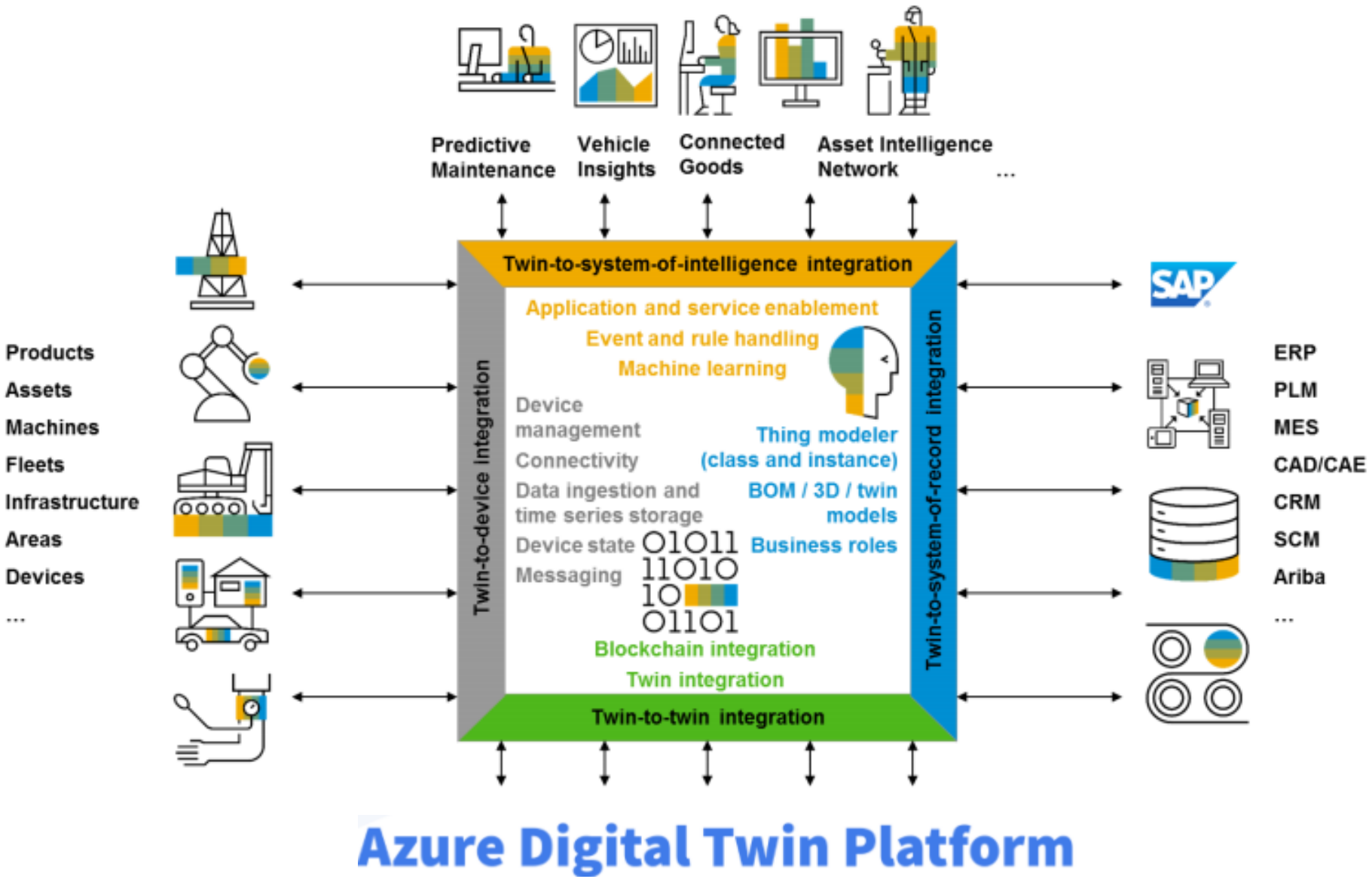
**Simulate**

# Cross-Industry Solution

Multi-Domain Approach



# Digital Twin – Conceptual View



# Sample RealTime Requirements

## Example User Stories

Meet Ullar, a production manager at the Smart Factory plant

**Feature 1:**

- **When (situation)**... I need to check and predict the performance of the Factory's SMA line
- **I want to (motivation)**... have a Digital Twin with Trained ML Model is running
- **So I can (expected outcome)**... know the accurate current and historical data from anywhere along with fault (Anomaly) detection

**Feature 2:**

- **When (situation)**... I want to plan for increased production/performance
- **I want to (motivation)**... model parameter changes on the Digital Twin to predict when and where the bottlenecks occur using own developed Machine learning Model
- **So I can (expected outcome)**... anticipate and avoid bottlenecks

**Feature 3:**

- **When (situation)**... Make production changes to a machine on the SMA line
- **I want to (motivation)**... have a Digital Twin emulation model
- **So I can (expected outcome)**... assess the changes, find integration problems areas, model expected performance, and resolve problems before implementing in the Factory

## User journey

Ullar wants to model a production change request

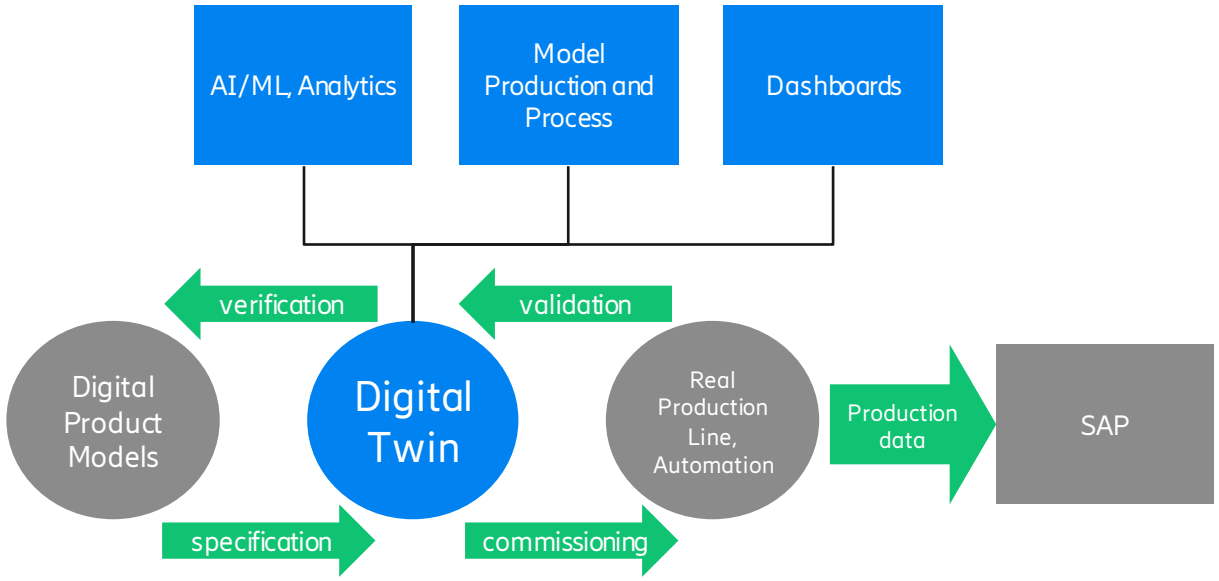
Ullar uses the Digital Twin to test the change

Ullar drills down into modeled data, backed by Digital Twin's simulation/emulation

Ullar sees the bottlenecks and makes decisions to solve bottleneck or adjusts production to avoid bottleneck

# Digital Twin Approach

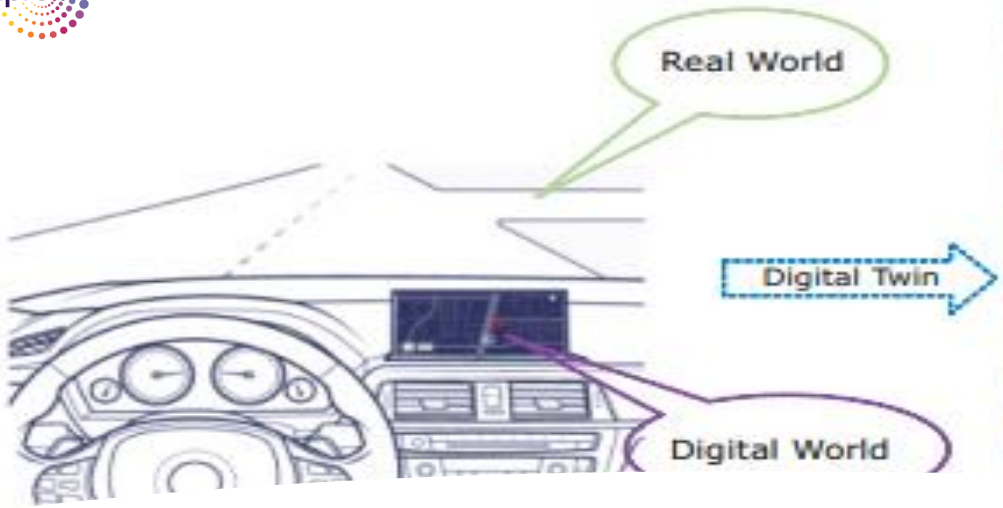
- Trial Digital Twin solutions for modeling:
  - Model production line forecasts
  - Model process efficiency
- Implement AI/ML for:
  - Predictive maintenance
  - Detect variances
- Dashboards for interacting with Digital Twin



# About Digital Twin

"A digital twin is a digital representation of a physical object in real time. By representing the critical physical characteristics and the business context of an object, from the idea through design, development, manufacturing, maintenance and service to the end of its use, the digital twin delivers real-time information about its configuration, its constitution and status, but also historical data that can be accessed from various sources."

- Data is a “new oil” and **Industry 4.0** is gaining momentum. New growth opportunities will emanate form Industry 4.0.
- A key enabler of data-driven manufacturing is the concept of **digital twin**.
- It represents a pairing of virtual and physical worlds underpinned by emerging technologies such as IoT, 3D simulation tools, and predictive analytics.
- The result: enhanced ability to analyze data and monitor systems to solve the problems even before they occur.





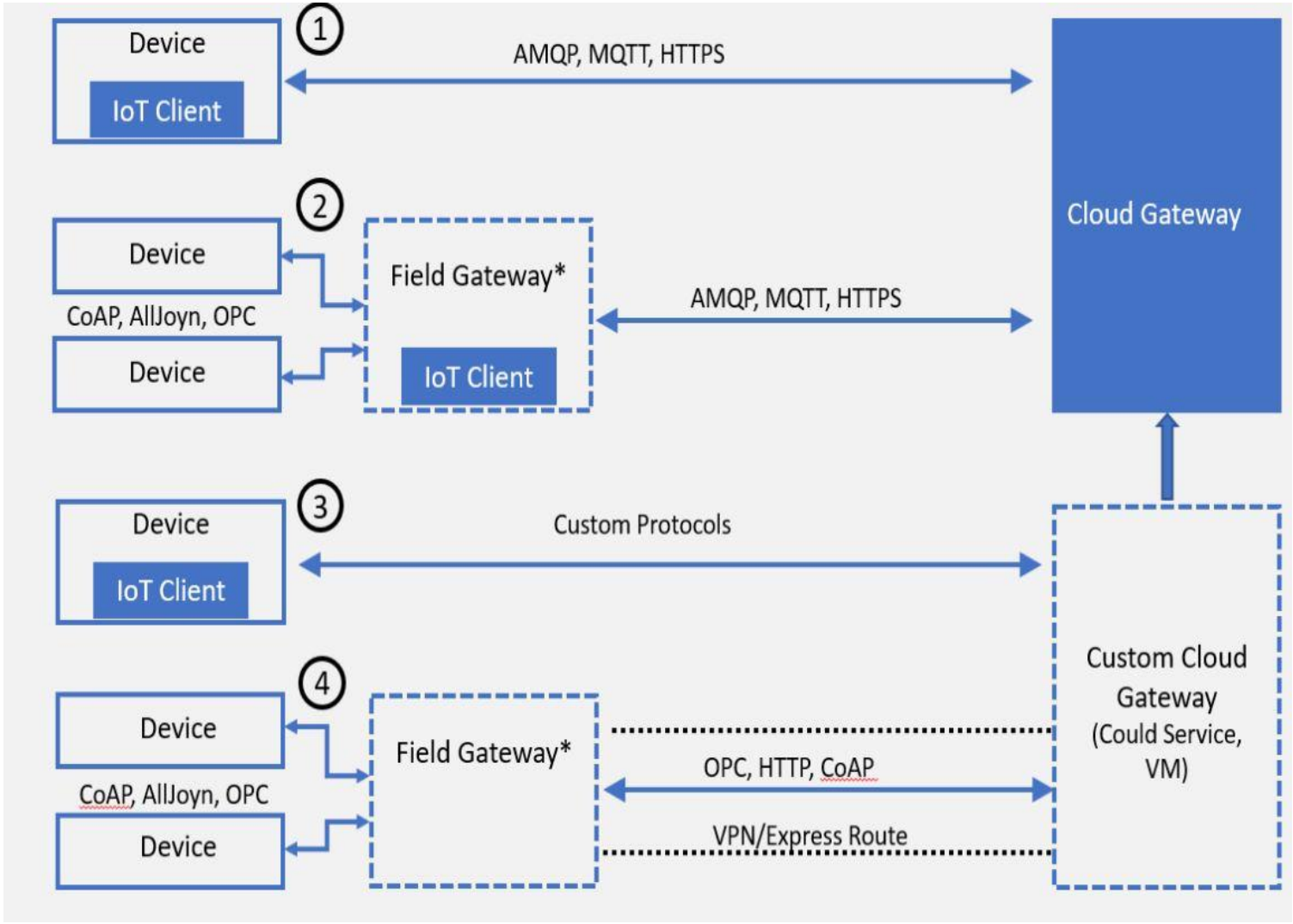
# Digital Twin – Example

- The digital twin is composed of three components - the physical entities in the real world, their virtual models, and the connected data/view that ties the two worlds together.
- The left half of the figure shown below represents the physical road ahead and its virtual image on the satellite navigator. In this scenario, the driver needs to do three things: view the satellite navigator for direction, view the actual road, overlay the SatNav direction mentally into the actual road to take the right turn. **This requires mental effort, some degree of driving experience, and a sense of timing**.
- In the right half of the figure, the vehicle uses Augmented Reality (AR) capability, giving the driver a converged view of digital and physical worlds to seamlessly navigate the turns on the road. **This minimizes mental effort, distraction, and chances of human error by allowing the driver to focus on the road.**
- This concept can be extended across the value chain for any industry or sector to perform operations efficiently by leveraging different technology capabilities underpinned by IoT, Big Data analytics, and simulation techniques.

# Market Study – Digital Twin

- Digital twin technology is becoming more widespread.
- According to Deloitte study, the global market for digital twins is expected to grow with
- 38%CAGR to reach $16 billion by 2023, and the proliferation of IoT technology accelerating
- this growth.

# Device connectivity with IOT Hub – Communication Protocols




# Thank You