HIVEMQ

Smart Data to Smart Decisions:

The Power of Digital Twins

Speakers

Ravi Subramanyan
Director of Industry Solutions
Manufacturing - HiveMQ

Kelly Watt
Senior Digital Twin Consultant
- Digital Twin Consulting

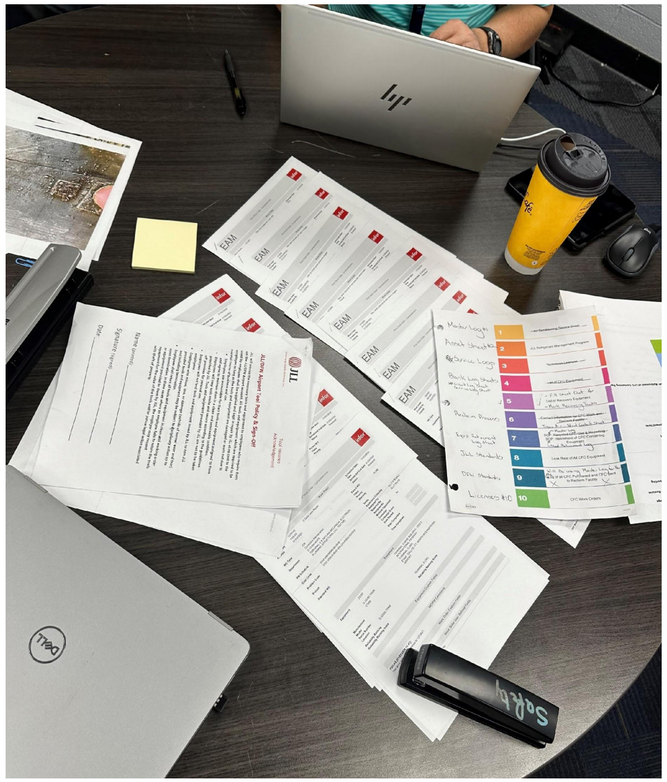
Agenda

- Digital Transformation and Industrial 4.0
- Digital Twin Interoperability
- Real-time Data and Unified Namespace
- Digital Twin Maturity
- Use Cases: Industrial Use cases
- Demo - Digital Twin application and MQTT data platform

Digital Factory

The term "**Digital Factory**" is a transformative shift in business process.

- **Beyond Paper:** At its core, the Digital Factory is about eliminating paper from the manufacturing process.
- **Smart Interactions:** Equipments communicates directly with other equipments, applications and processes.
- **Real-time Data:** Decisions are informed by live data, ensuring timely and accurate responses to ever-changing manufacturing needs.
- **Big Data, Bigger Insights:** By harnessing historical data and combining it with current metrics, the Digital Factory can predict future trends, preempt challenges, and optimize operations like never before.



Industry 4.0 - Enabling the Digital Factory

- Enables **real-time information** that could transform decision-making
- Powers **predictions** that could help plan more effectively and stay ahead of market trends
- Enables **autonomous** factory operations
- Use of data generated from Industry 4.0 data could create entirely **new revenue streams** for factory
- Help fully **integrate** systems/data change collaboration and decision-making
- Enables processes to be **radically transformed** with new technologies.

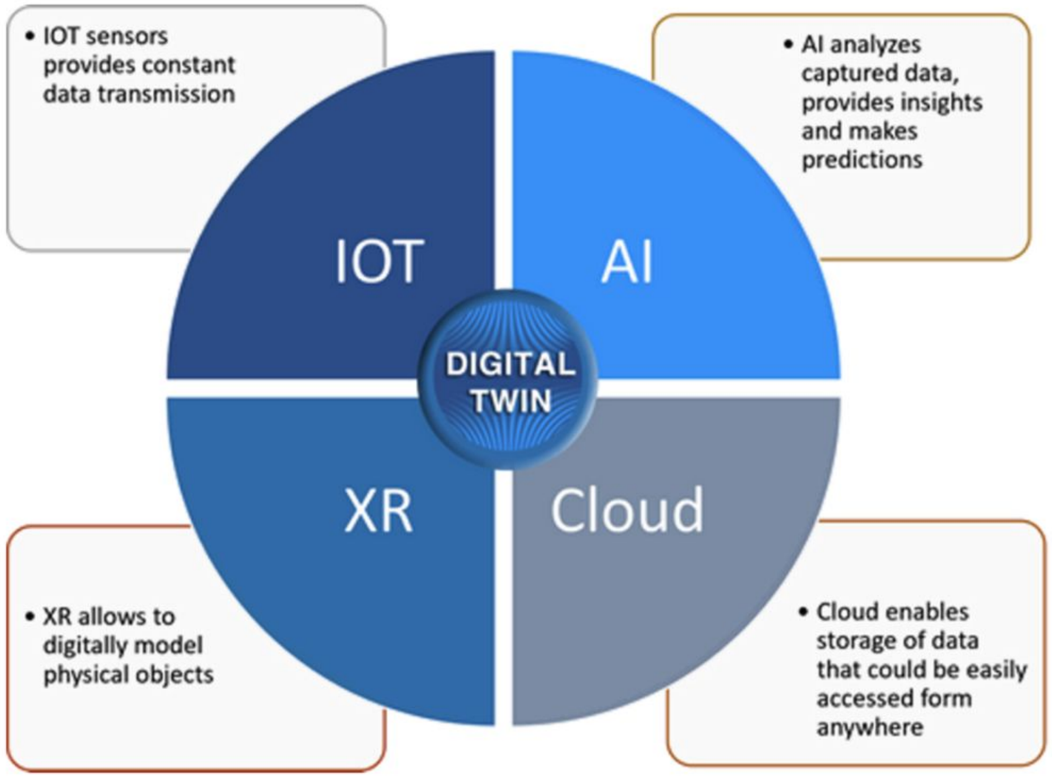
Industry 4.0 is a revolution, not just an evolution

How Industry 4.0 is Implemented

- **STEP 1:** Connecting, collecting, consolidating, normalizing, contextualizing and storing all data within the business.
- **STEP 2:** Analyzing and visualizing this data to turn it into actionable information.
- It's not just about automation; it's about making data-driven decisions that transform business processes.
- Use case: Overall Equipment Effectiveness (OEE), three crucial factors measured from 0%-100%.

What Components Comprise a Digital Twin ?

- It is a virtual model designed to accurately reflect a physical object (asset).
- The object being studied could include an operational system such as a product line, an HVAC system, Electrical System or Data Center.
- Sensors on the object collect different aspects of asset performance, energy output, and system health where downstream analytics monitor setpoints, schedules, sequences or models to identify issues.
- This data is then relayed to a processing system and applied to the digital copy.



The Digital Twin Ecosystem | **Image Source: sciencedirect.com**

Gartner estimates that by 2027, over 40 percent of large companies worldwide in the industrial sector will be using digital twins in their projects

Spatial Context is Critical To Digital Twin

A digital twin offers spatial context to the unified data, which helps with decision process.

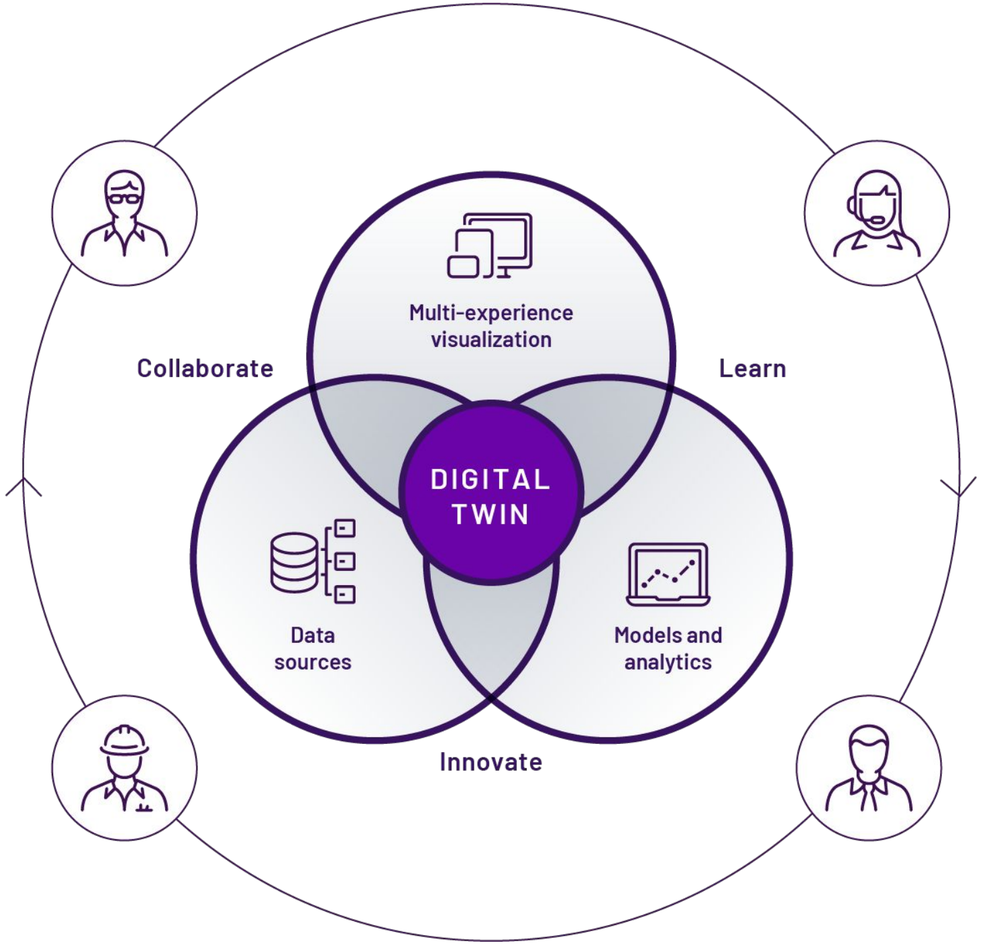
The spatial element also provides deeper context, and draws relationships to other elements.

Visualization Provides Context

Industrial Use Cases for Digital Twins

1. Monitoring and Analysis

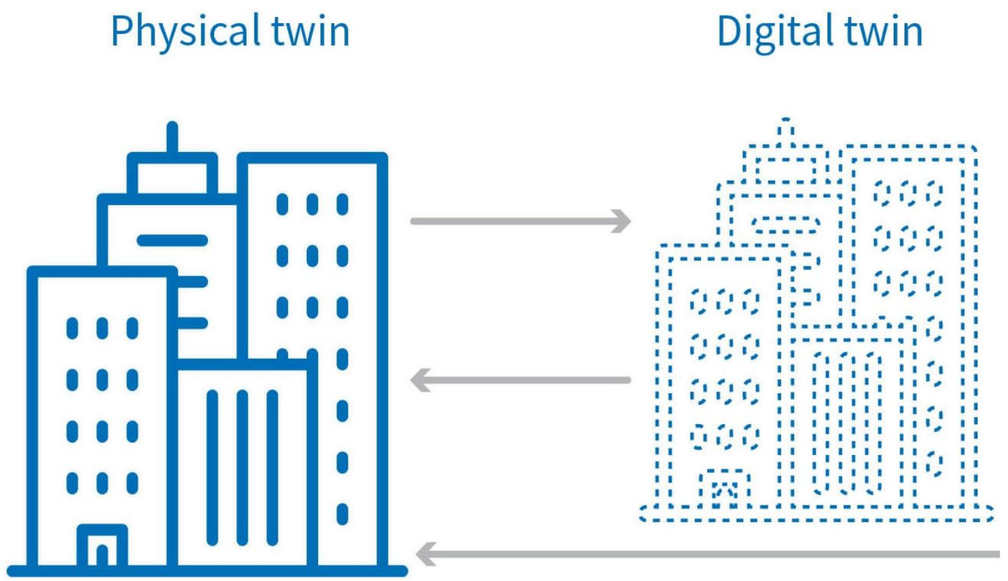
- The digital twin is **continuously updated** with new data from the physical asset, or business processes, which allows for real-time monitoring and analysis.
- Engineers, operators, and industrial decision-makers can use the digital twin to **gain insights i**nto the performance, health, and efficiency of the physical asset.
- For instance, **predictive maintenance** can be performed by analyzing historical data and making predictions about when maintenance is required.



Industrial Use Cases for Digital Twins

2. Remote Control and Optimization

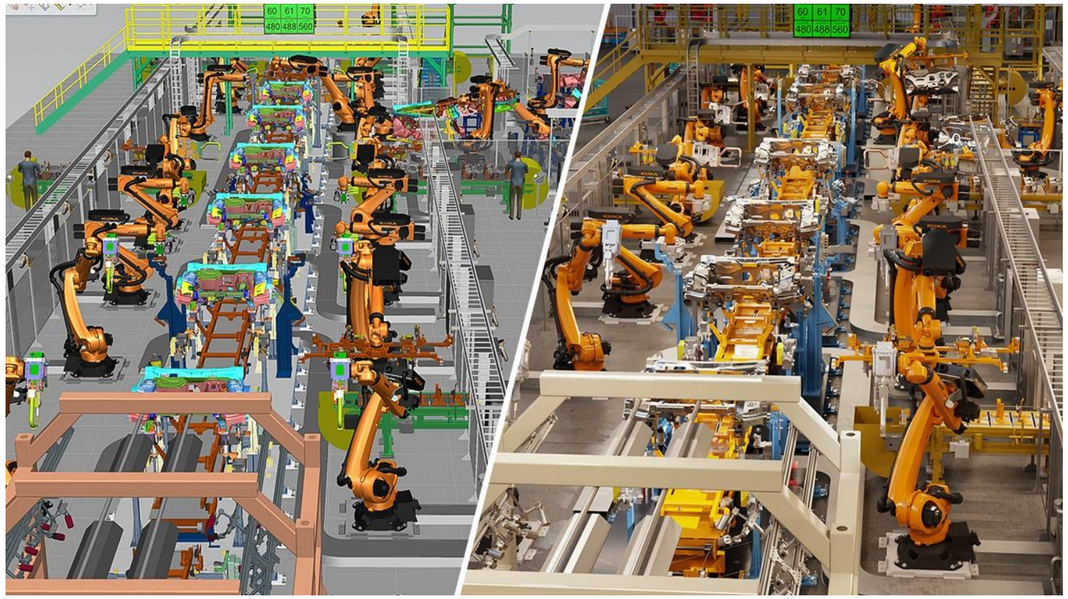
- With a digital twin in place, industrial operators can make changes and adjustments to the virtual model.
- These changes can then be tested before being applied to the physical asset.
- This capability enables remote control and optimization of industrial processes, leading to increased efficiency and reduced downtime.



Industrial Use Cases for Digital Twins

3. Simulation and Scenario Planning

- Digital twins also allow for simulations and scenario planning.
- Industrial operators can simulate various conditions or scenarios and assess how they would impact the physical asset or system.
- This is invaluable for decision-making and risk assessment.



Interoperable Digital Twins

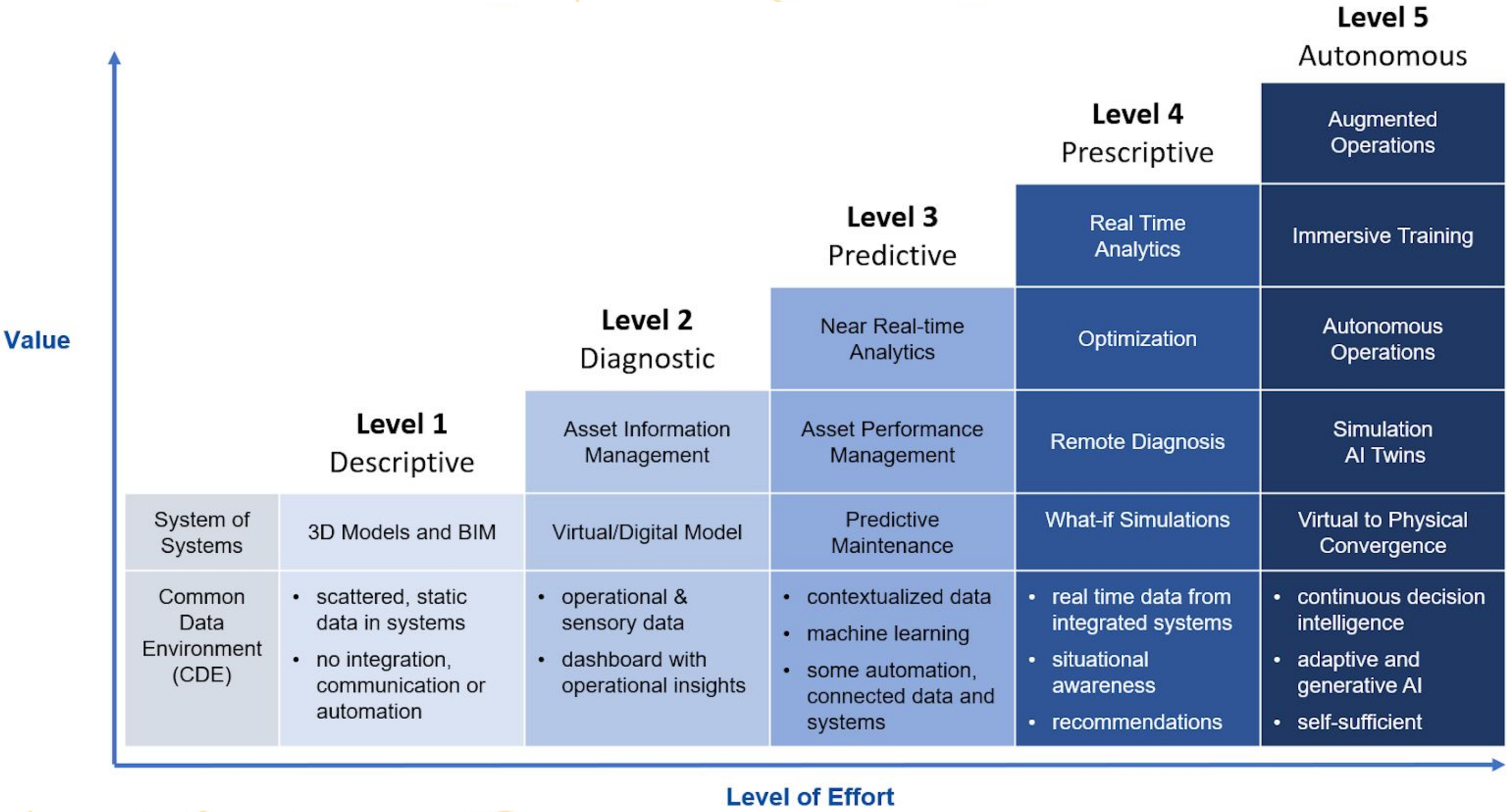
Common Data Information Model for Interoperability, Unified Namespace
Relating data in real-time with historical context drives good decision-making.

Contextualization and Intelligence Layers
Driving higher understanding of complex problems through relationships

Visualization Interface(s) & Contextual Consumption
Tailor data to stakeholders based on their unique needs. Oversight, analysis, relate, act
IOC, workstation, mobile

Data consumers have various needs
Surfacing the right data at the right time to provide an intelligent prepared response with detailed clear recommendations

Digital Twin Maturity Model



So why do so many digital initiatives fail to reach their potential?

Laying the Groundwork

Creativity
Extracting Knowledge

Sizing the Prize

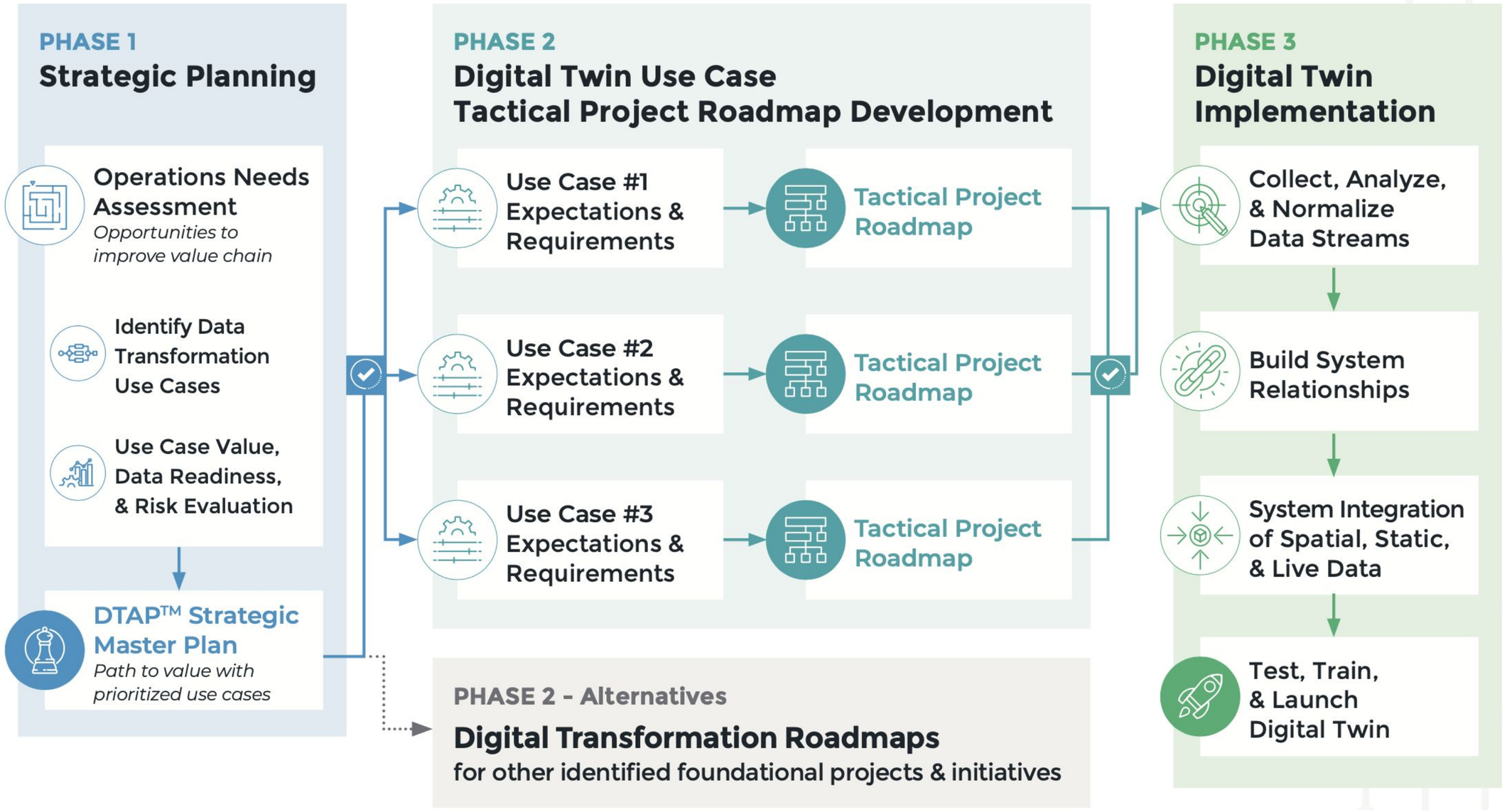
Infrastructure
Spatial Data
Data Engineering

Artificial Intelligence and Machine Learning *(AI/ML)*

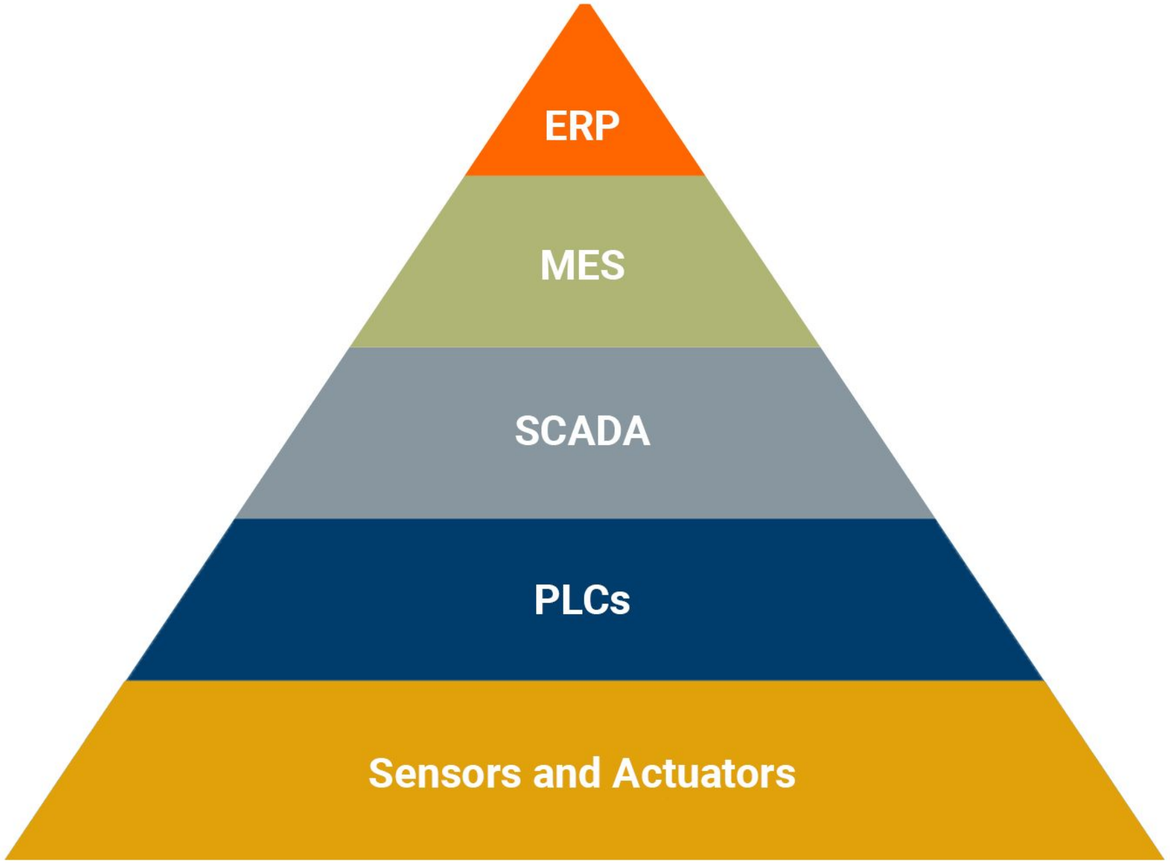
Validate and bake process changes into business systems

Human Factors
Mindshift
Behavior change
Data ownership

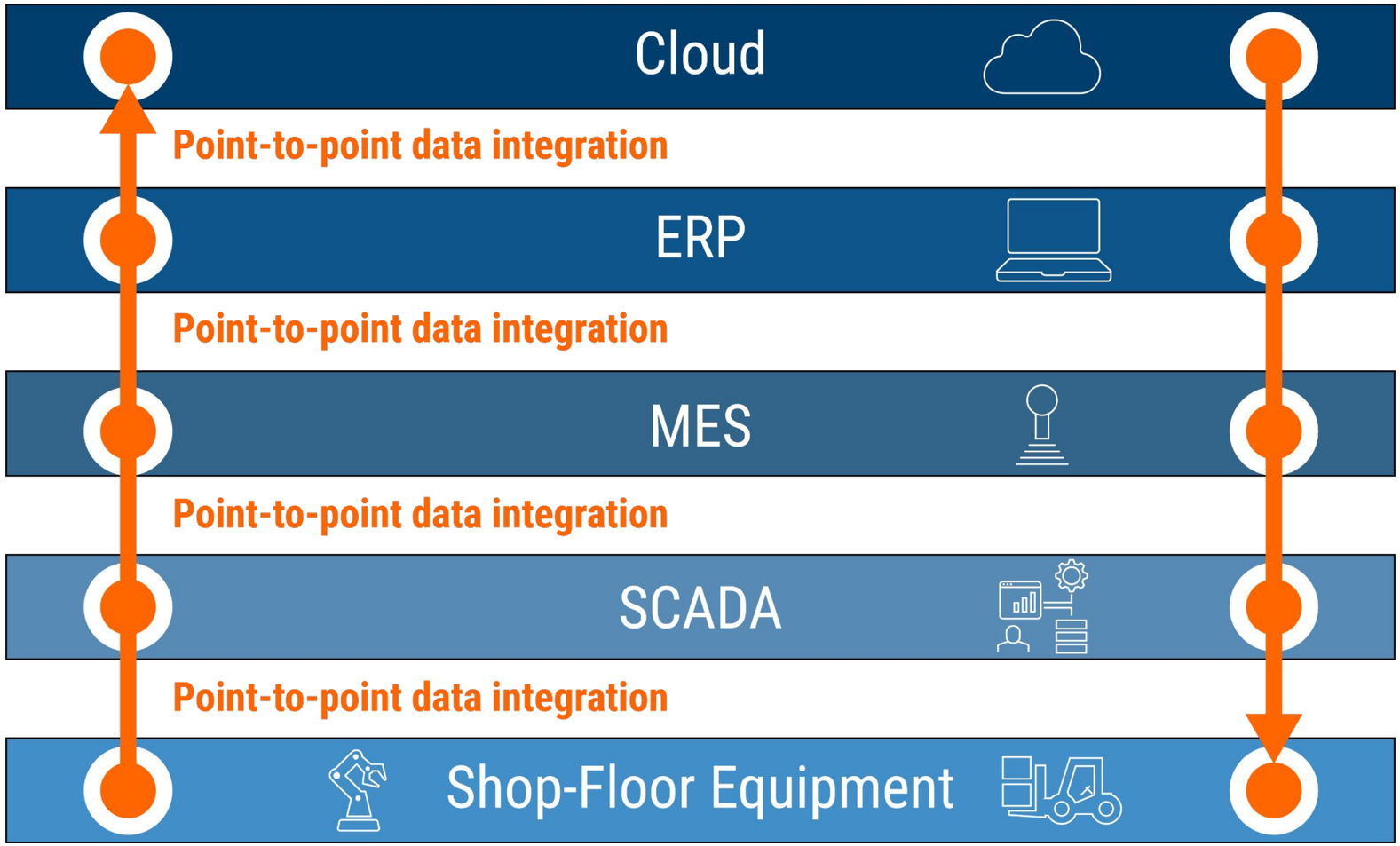
Digital Twin Assessment Process (DTAP™)



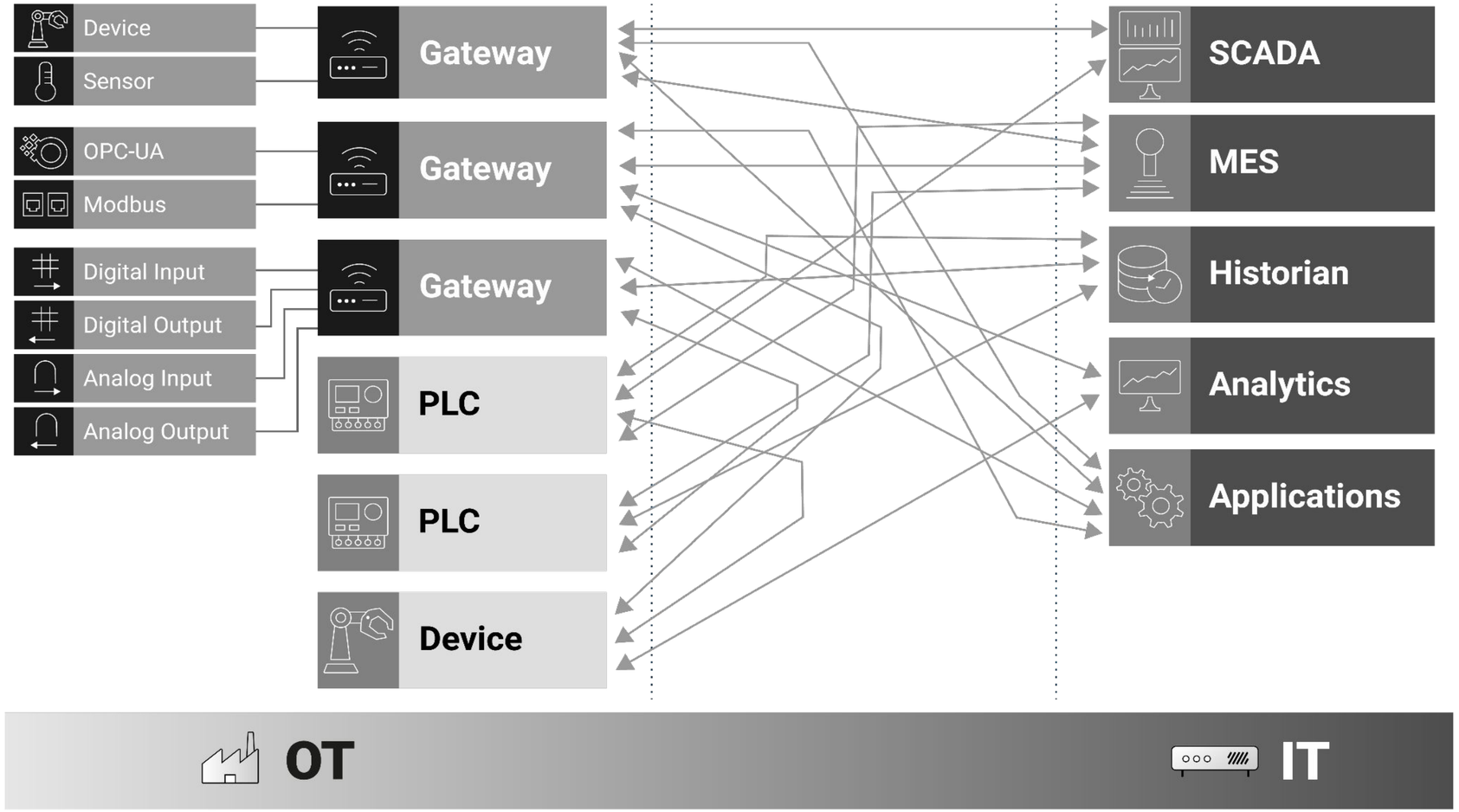
Computer Integrated Manufacturing (CIM) Pyramid



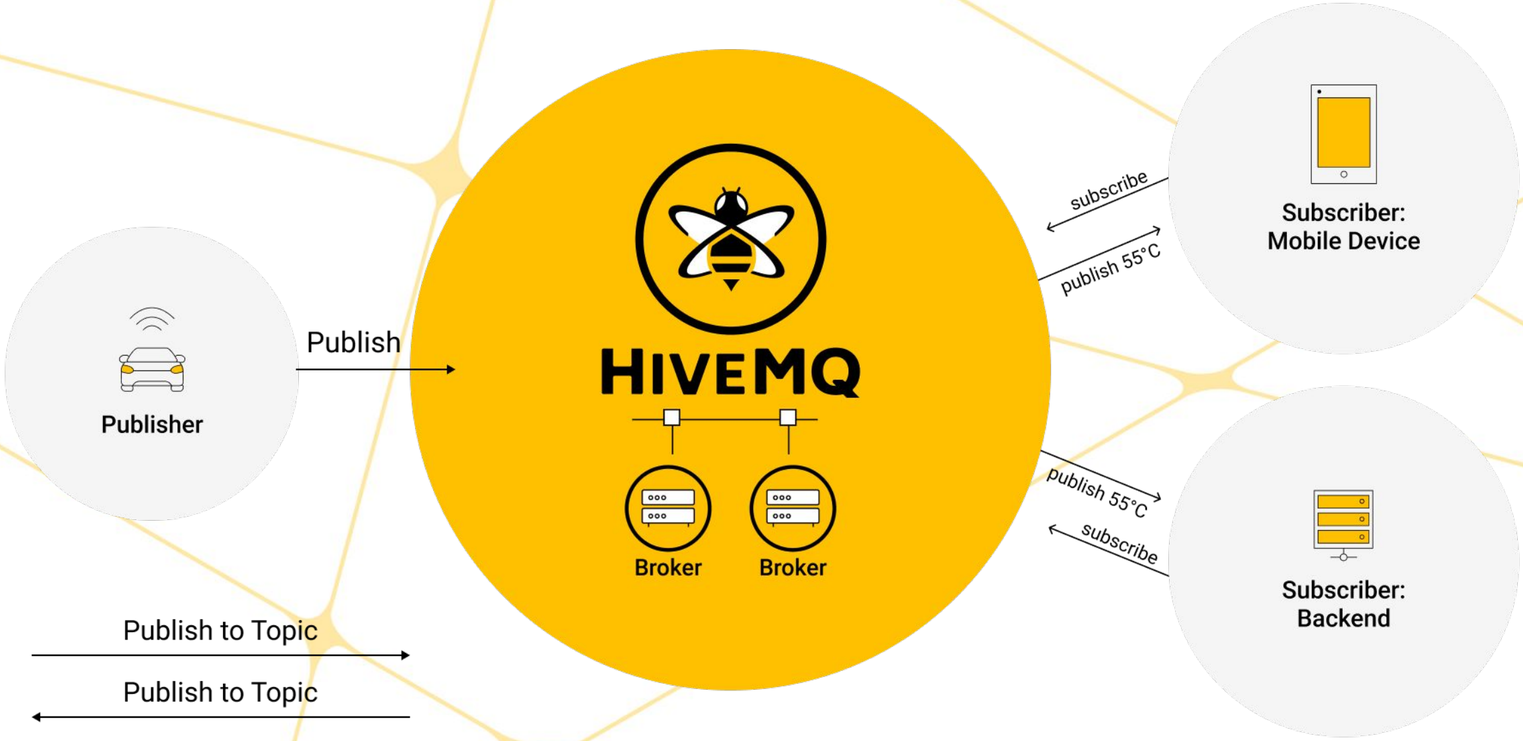
Traditional Industrial Data Integration



Traditional Industrial Data Integration



MQTT - the de facto IoT standard protocol

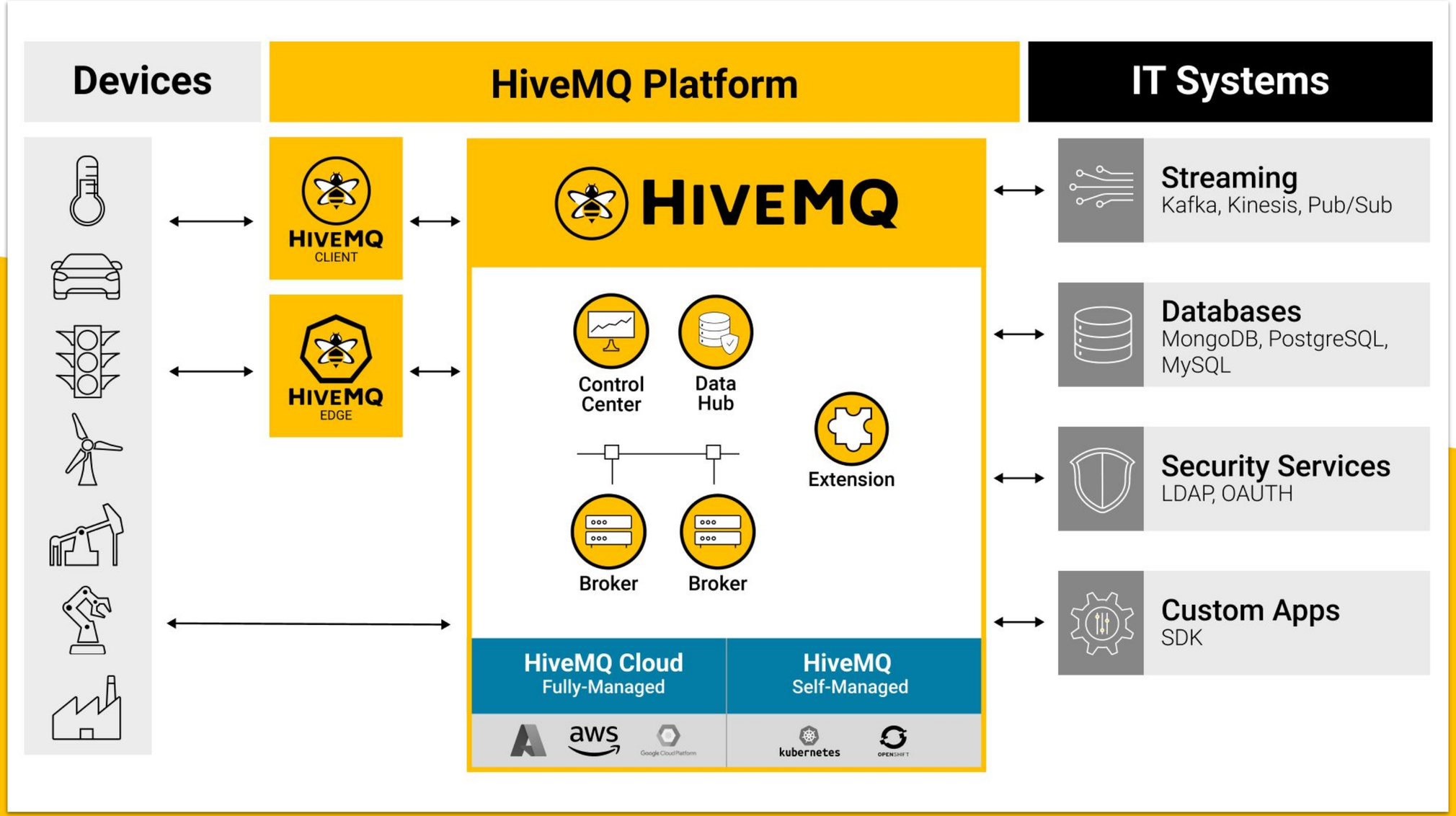


Lightweight and efficient publish and subscribe

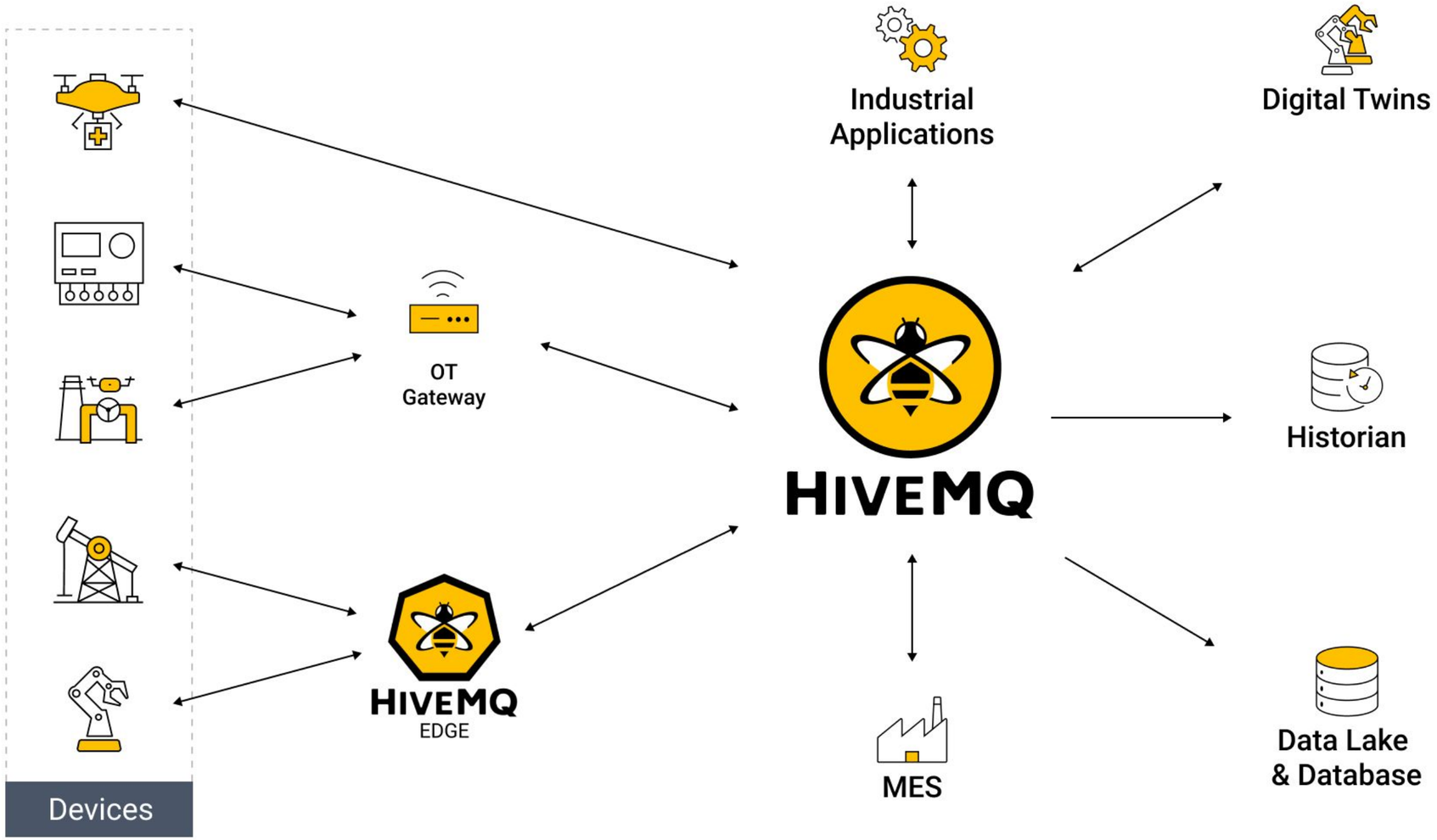
Reliable bi-directional data transport

Designed for devices with stateful context

The HiveMQ Platform



HIVEMQ | The Enterprise MQTT Platform

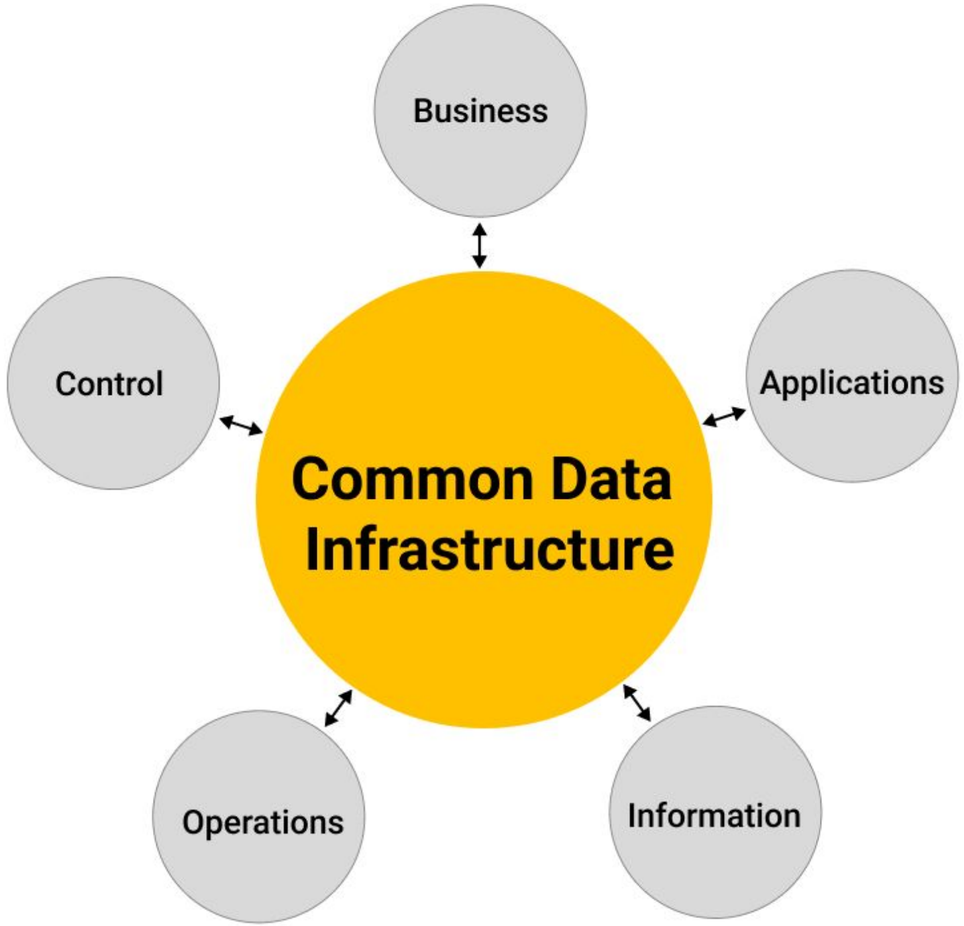


Key Industries

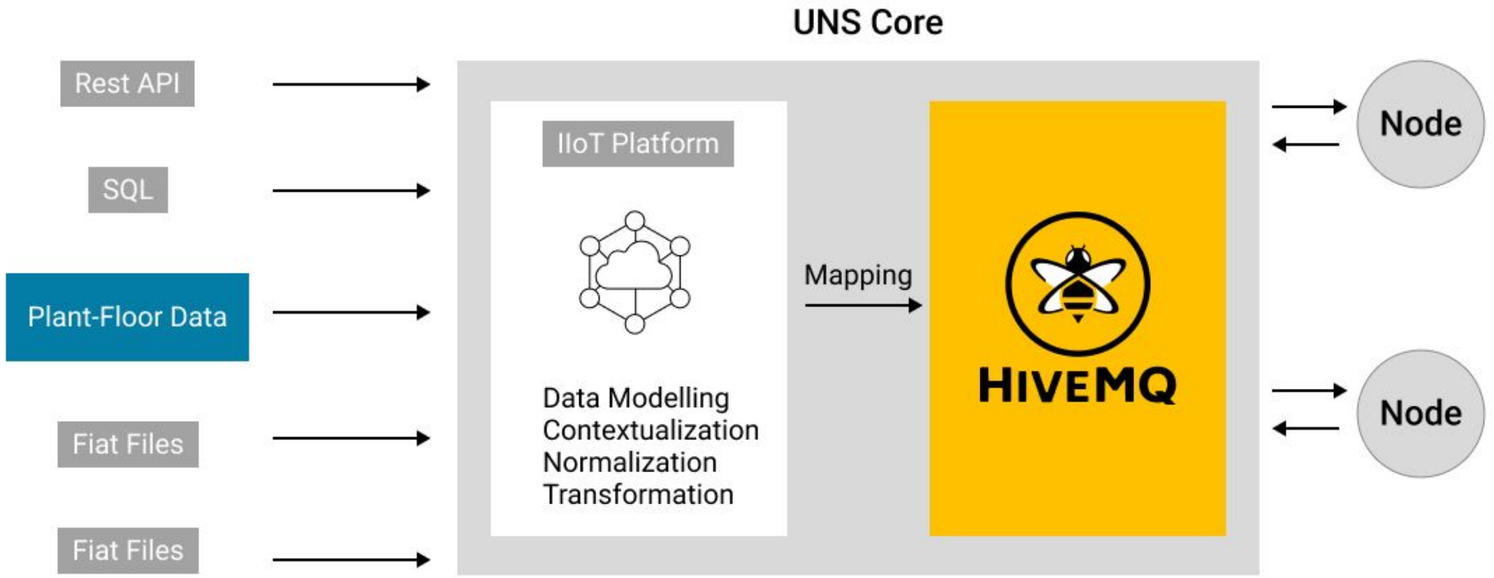
Unified Namespace

Foundations of Unified Namespace

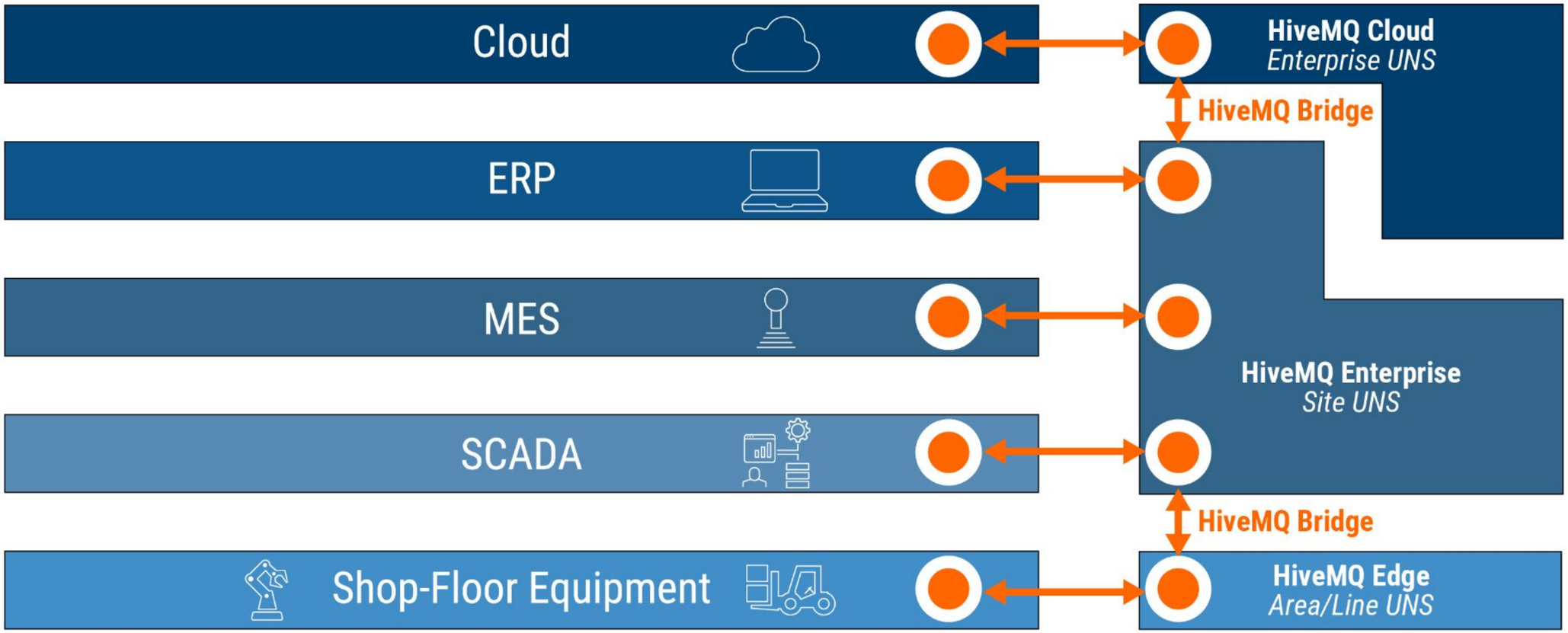
- Edge Driven
- Open Architecture
- Lightweight
- Report by Exception



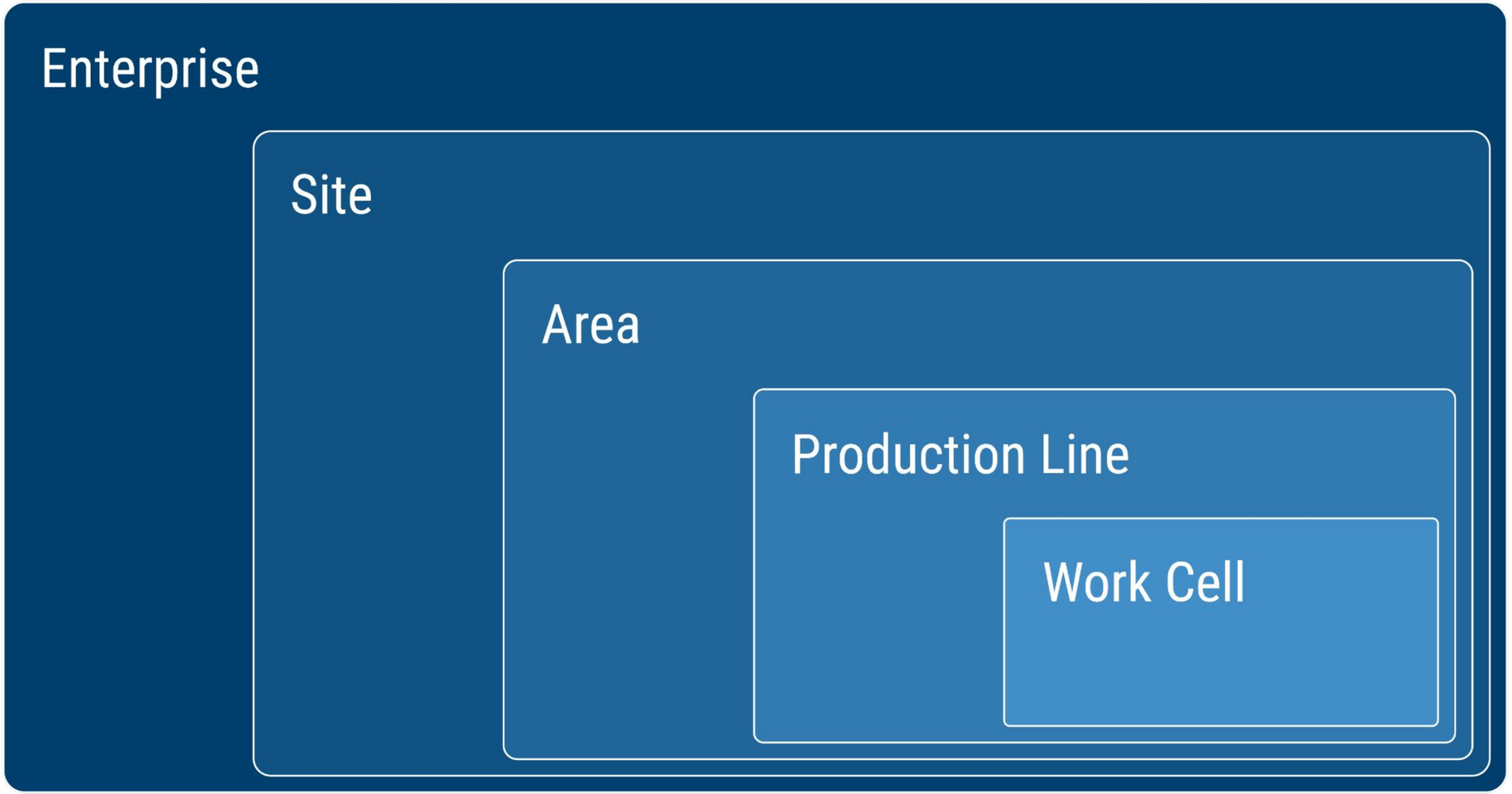
The Core of Unified Namespace



Reference Architecture Model

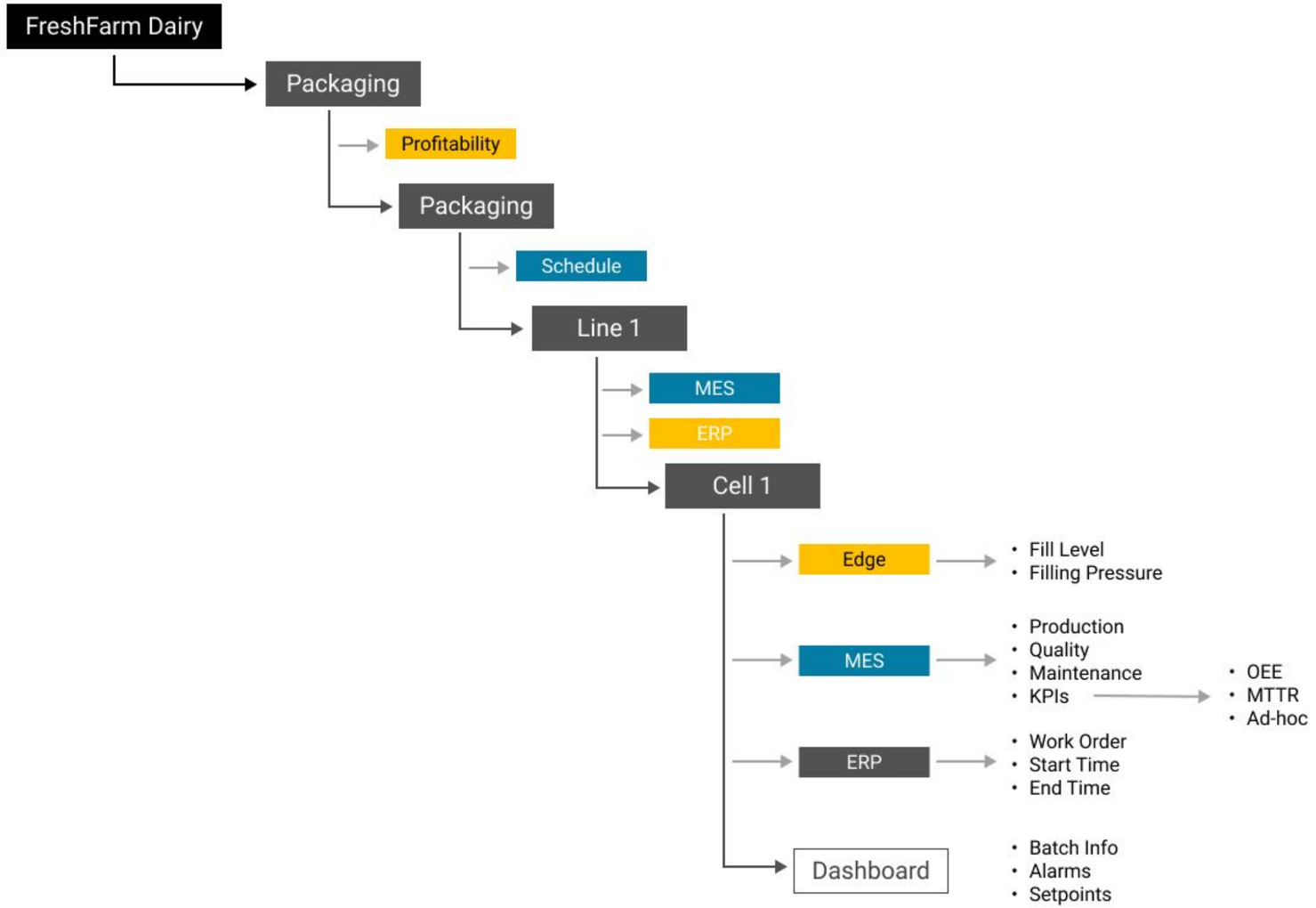


Best Practices for Structuring the UNS

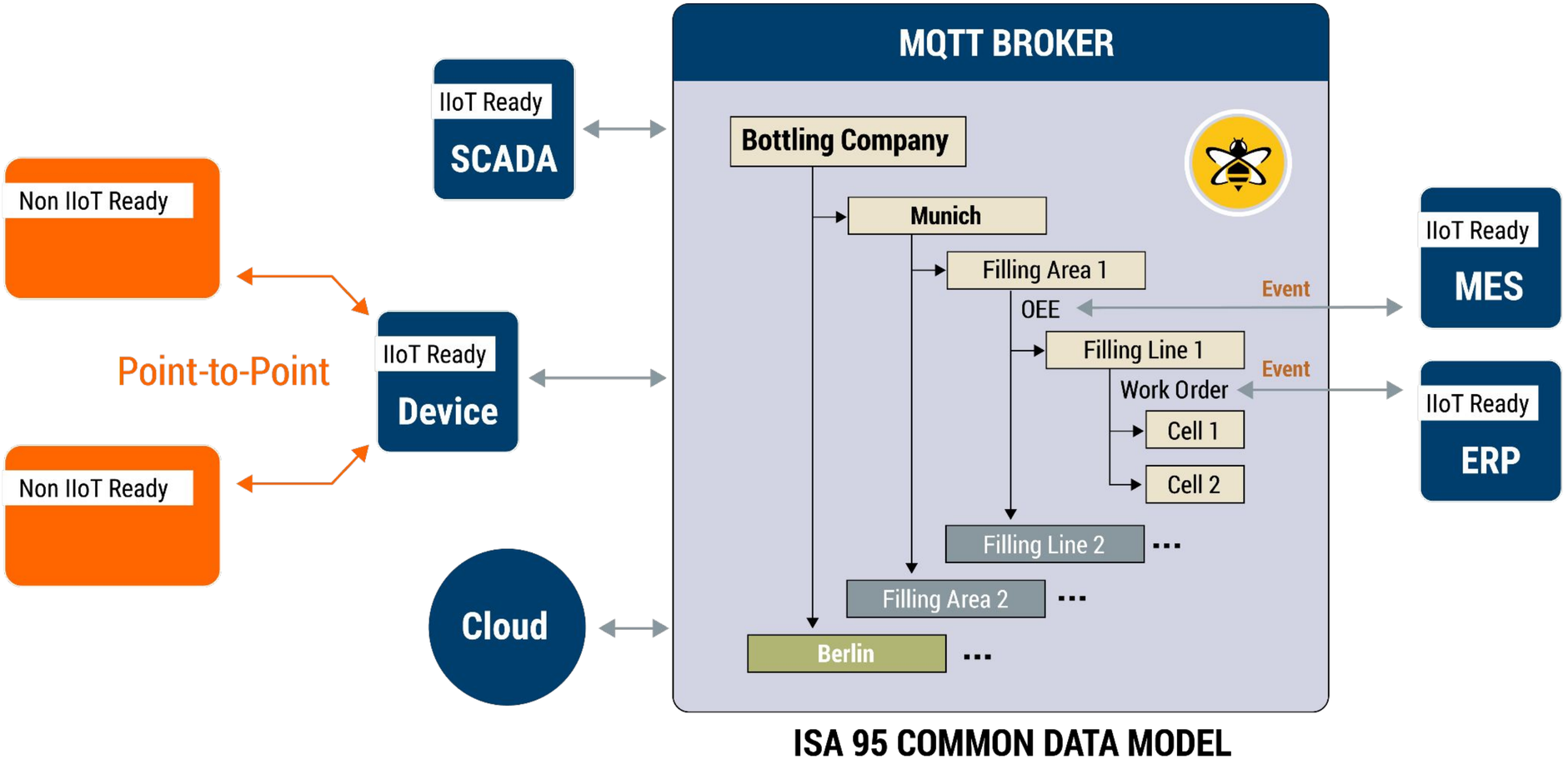


ISA 95 Common Data Model

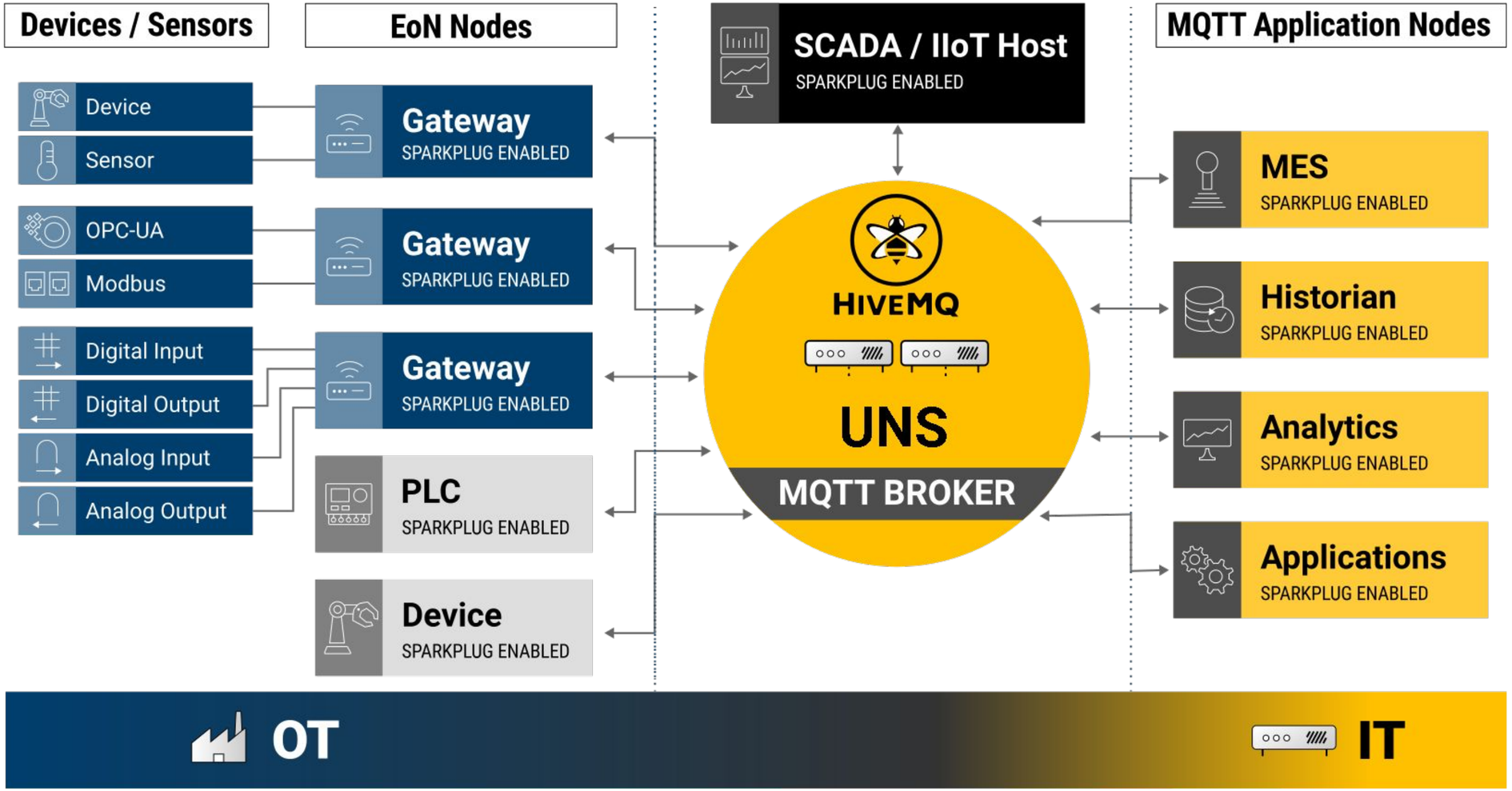
UNS Semantic Hierarchy



Example of a UNS Enterprise Structure

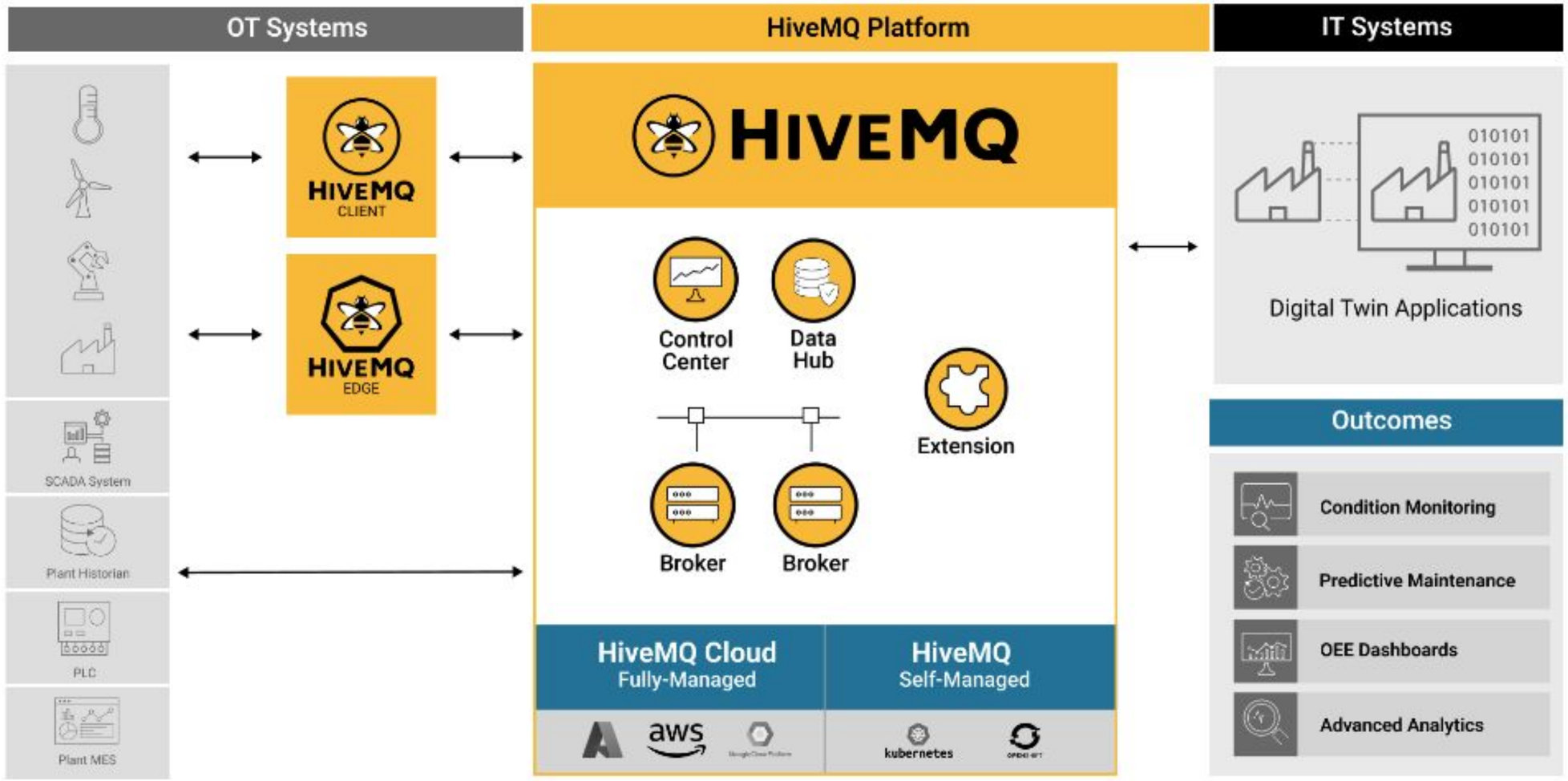


Where Does The Unified Namespace Live?



© HiveMQ GmbH

How HiveMQ Enables Digital Twin Use Cases



Enabling Water System IoT Data Streaming

Customer: DFW Airport

What they do: Second largest airport in the world. Smart City & Logistic needs.

Challenges: Reliable real-time communication with 5 different controls systems, legacy communication protocols, and need for remote end device communications

HiveMQ solution: Messages brokered through HiveMQ solution standardizing IoT with SparkPlugB, and stream data between the digital twin, remote devices and controls

Results: Real-time fault detection and diagnosis (FDD) to digital twin to reduce energy use by 20% and drive operational workforce efficiency by 25%. Meet sustainability goals

Results: District Water Metering reducing unaccounted water loss from 25%-10%, and flow/pressure/quality communication from 6 hrs to 15 min intervals and automated valves

Results: Integration of flight data with controls, fault detection, operational oversight for passenger bridge perfect turn, asset condition monitoring, reduction of jet-fuel burn goals

Demo

The Power of Digital Twins

Q&A

Do you have any questions for our speakers?

Resources

[Advancing Digital Twin Use Cases with IIoT and MQTT]

[Hands-on Guide to Using MQTT and Eclipse Ditto for Digital Twins]

[Building Industrial Digital Twins on AWS Using MQTT Sparkplug]

[DTAP - Proven Approach to Digital Twin Solutions]

[MQTT Essentials - All Core Concepts Explained]

[Unified Namespace (UNS) Essentials for IIoT]

[MQTT Sparkplug Essentials for IIoT | HiveMQ]

Contact Us

Kelly Watt

Senior Digital Twin Consultant

Digital Twin Consulting

Kelly@digitaltwinconsulting.com

www.digitaltwinconsulting.com

Ravi Subramanyan

Director of Industry Solutions

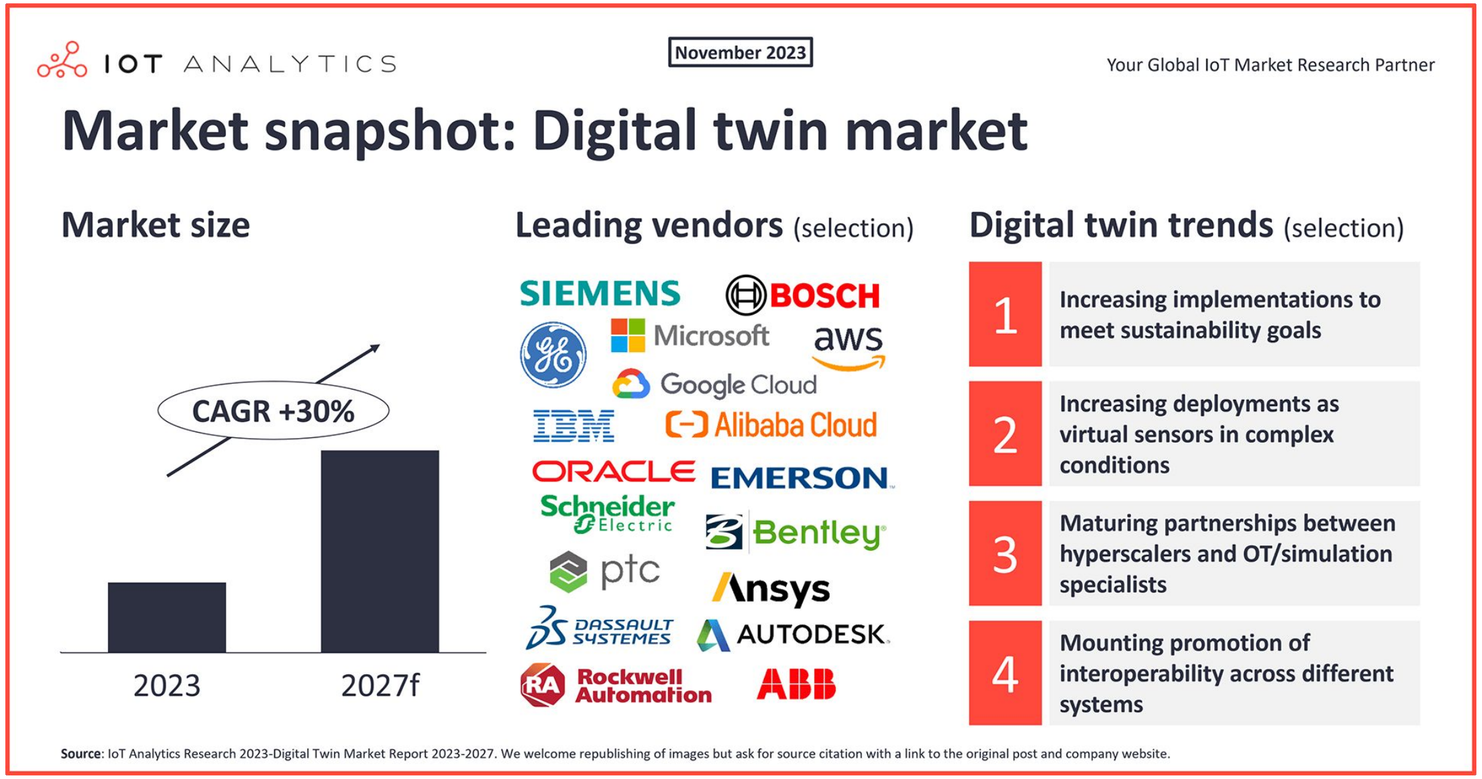
Manufacturing, HiveMQ

Ravi.Subramanyan@hivemq.com

linkedin.com/in/ravisubra/

Back up

Relevance of Digital Twins in Manufacturing



- According to IoT Analytics Digital Twin Market Report, the digital twin market is expanding, with a projected CAGR of 30% between 2023 and 2027.
- 29% of global manufacturing companies have either fully or partially implemented their digital twin strategies.