Have a clear understanding of Azure IoT hub

Features of IoT hub

Provision IoT hub and device provisioning service

Integrate to Azure services

Perform message routing (at a basic level)

Knowledge of IoT edge

EXPECTATION/GOAL SETTING

AGENDA

Introduction to Azure IoT Hub

Device Provisioning and Management

Data Ingestion and Processing

Development Tools
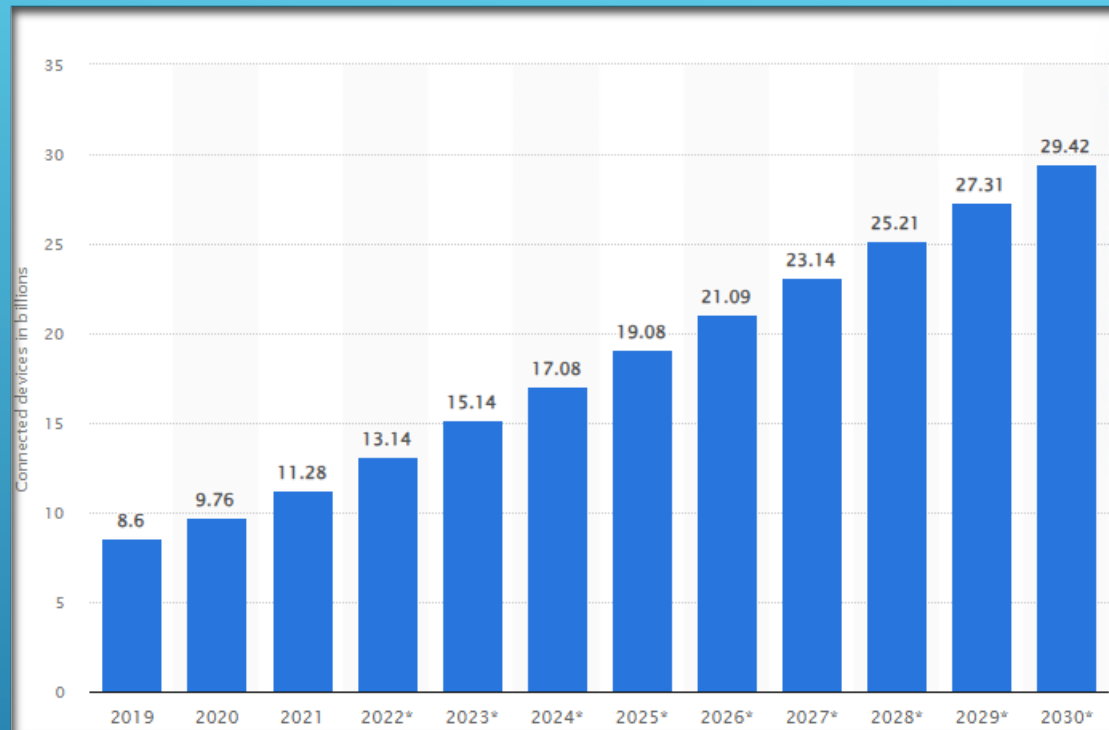
Message Routing and Event Processing

Azure IoT Hub Security

Azure IoT Edge Integration

Monitoring and Diagnostics

Demos (along the way)

Best Practices

What is IoT

- Network of physical devices, that can exchange data with each other and centralized systems

Why it is pervasive

- Availability of affordable sensors, advancements in connectivity and the rise of cloud computing

Why is it important for digital transformation

- Enables organizations to optimize processes, automate tasks, gain valuable insights, and make data-driven decisions
- Enables businesses transform their operations, improve productivity, enhance customer engagement, and drive innovation

ABOUT IOT

Connectivity

Security and privacy

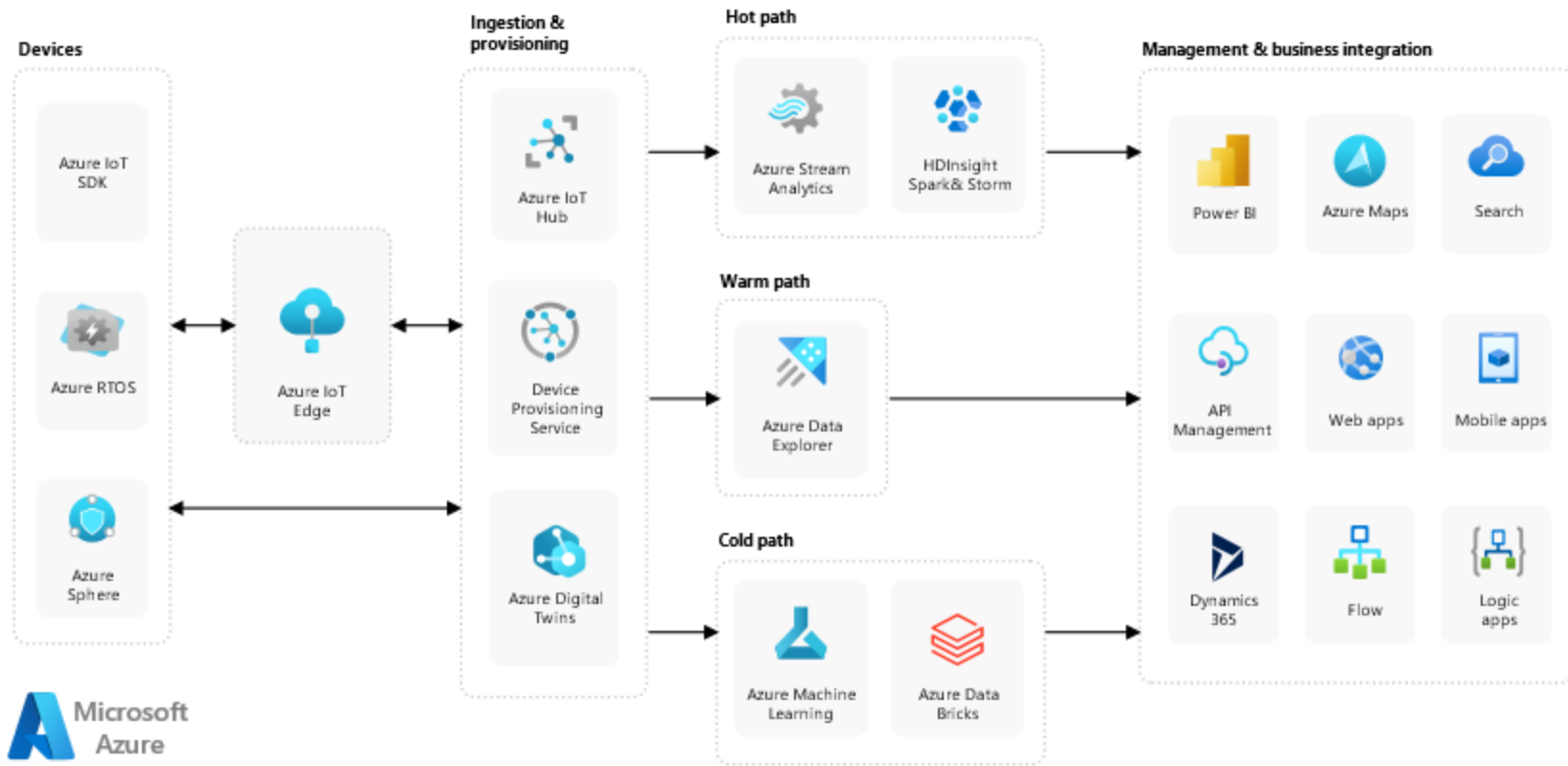Interoperability

Scalability and complexity

CHALLENGES

Data management

Standards and regulations

- Azure IoT Hub is a cloud-based service provided by Microsoft Azure that serves as a central hub for managing, connecting, and securing Internet of Things (IoT) devices.

- It acts as a communication bridge between IoT devices and the cloud, enabling bidirectional messaging, device provisioning, and device management at scale.

AZURE IOT HUB

Device Connectivity

Connectivity, Interoperability

Device Management and Device Twins

Complexity

Integration with Azure Services

Data management

Message Routing

Complexity

Security and Authentication

Security

Edge Computing

Complexity

Scalability and Performance

Scalability

Monitoring and Diagnostics

Complexity

AZURE IOT HUB FEATURES

Capability of Azure IoT hub to securely connect IoT devices to the cloud, enabling bidirectional communication between the devices and the cloud-based services thereby simplifying the process of connecting and managing IoT devices at scale. It allows organizations to securely collect data from devices, control and manage them remotely, and leverage cloud-based services for advanced analytics and insights.

Key Features of device connectivity

| Protocols: MQTT, AMQP, and HTTP(S) for D2C and C2D communication. | Connection Security | Device-to-Cloud Communication | Allows Cloud-to-Device Communication | Edge Connectivity |

DEVICE CONNECTIVITY

Capability of Azure IoT hub that enables organization to effectively manage their IoT device fleets, streamline operations, maintain device configurations, monitor device health, and remotely control and update devices. These capabilities enable efficient device management at scale, ensuring the reliability and performance

Key Features of device management

Device Provisioning	Device Twins	Device Monitoring	Device Commands	Lifecycle Management
	• Device Configuration and Updates • Device Bulk Management			

DEVICE MANAGEMENT AND DEVICE TWINS

Azure Iot hub seamlessly integrates with a multitude of Azure service. The azure services can be divided as 3 major categories

Data Ingestion

Azure Stream Analytics: Real-time data processing and analytics.

Azure Event Hubs: High-scale event ingestion and stream processing.

Data Processing

Azure Functions: Trigger serverless functions based on IoT events.

Azure Machine Learning: Train ML models using device data.

Azure Logic Apps: Workflow automation and integration.

Data storage

Azure Storage: Store device-to-cloud messages for historical analysis.

Azure Time Series Insights: Analytics and visualization for time series data.

INTEGRATION TO AZURE SERVICES

- Azure IoT Device Provisioning Service (DPS) is a fully managed service provided by Azure IoT Hub that simplifies the process of securely provisioning and registering large numbers of IoT devices at scale. It helps automate and streamline the enrollment of devices into an Azure IoT solution

- It provides ways for
  - Scalable and secure device enrollment
  - Flexible attestation
  - Automatic device registrations
  - Integrated to IoT Hub
  - Device provisioning service SDK's

DEVICE PROVISIONING SERVICE

Software development kit

- Azure IoT Hub Device SDKs for multiple programming languages.

- Azure IoT Hub Device Provisioning Service SDK for simplified device provisioning.

- Azure IoT Explorer, a web-based tool for device management, message monitoring, and integration with Azure IoT services.

- Azure IoT Central, a fully managed low-code platform for building and deploying IoT applications.

- Visual studio code based tools

  - Azure IoT Hub Toolkit for Visual Studio Code, providing tools for device management, message handling, and monitoring.

  - Azure IoT Device Workbench for an end-to-end development experience within Visual Studio Code.

DEVELOPMENT TOOLS

Provision	Provision Azure IoT hub
Provision	Provision Azure device provisioning service
Configure	Configure device provisioning service to use the IoT hub created
Configure	Configure device simulator with values •Device provisioning •D2C messaging

DEMO

Message

- The data payload sent from an IoT device to the cloud. It typically contains telemetry data, device status information, or any other relevant data generated by the device

Message composition

- Message Body
- Message metadata
- Custom properties

MESSAGE

- Message Routing
  - For device to cloud messages
  - Enhances scalability, enables efficient distribution and streamlining
  - Routing definition – SQL like query expressions
  - Routing criteria – Dynamic and flexible routing based on message content, context, device properties, message priority, or device geolocation
  - Supports telemetry data, device twin changes, device lifecycle events, digital twin change events, and device connection state events with ordering
  - Endpoints - Azure Storage, Azure Event Hubs(built in), Azure Service Bus, or custom endpoints

MESSAGE ROUTING

CREATE STORAGE ENDPOINT

CREATE ROUTE

CREATE QUERY

DEMO

Azure IoT Hub empowers organizations to build event-driven architectures and implement reactive workflows thereby enabling to perform real-time actions, trigger notifications, automate processes, and integrate IoT events with other business systems.It consists of 3 major actions

| Event trigger | Event subscription | Event processing and actions |

For processing IoT hub integerates with Azure Functions,Azure logic apps and Azure Machine learning. This allows organizations to

| Perform real time action based on events | Run workflows, orchestrate actions | Train Ai models | And More.. |

EVENT PROCESSING

CREATE HUB TRIGGER SUBSCRIPTION FUNCTION

CONSUME MESSAGES AS THEY ARRIVE

DEMO

Ensures secure communication and protects IoT devices and data. By incorporating the below security and authentication features, Azure IoT Hub enables organizations to establish a secure and trusted environment for IoT deployments. It ensures the confidentiality, integrity, and availability of IoT device data, protects against unauthorized access, and helps organizations meet their security and compliance objectives.

Key Features of security and authentication are

| Device Identity and Authentication | Secure Device-to-Cloud Communication | Access Control and Authorization | Device Twin Security | Firewall and Network Security | Threat Detection and Monitoring | Compliance and Certifications |

SECURITY AND AUTHENTICATION

Azure IoT Edge is an extension of Azure IoT Hub that brings cloud capabilities and intelligence to the edge devices, enabling local processing, analytics, and decision-making empowering organizations to extend cloud capabilities to edge devices, enabling local processing, analytics, and decision-making by leveraging cloud-based analytics, machine learning, and services to the edge.
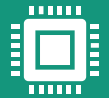
It provides a scalable and flexible architecture for managing and deploying modules on edge devices, facilitating real-time insights, reduced latency, and improved resilience enhancing the capabilities of IoT solutions and enabling intelligent edge computing scenarios
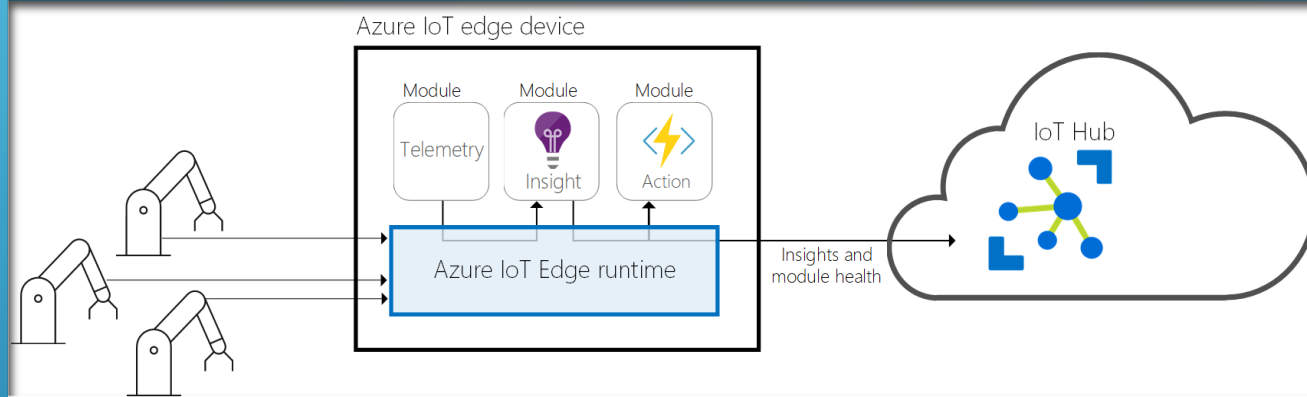
Azure IoT Edge is made up of 3 major components

IoT Edge modules

IoT Edge Runtime

IoT Edge cloud interface

• Centralized management through Azure IoT Hub interface

AZURE IOT EDGE INTEGRATION

- IoT Edge Modules
  - Units of execution, implemented as Docker-compatible containers, that run your business logic at the edge. Multiple modules can be configured to communicate with each other, creating a pipeline of data processing
    - Offline and Resilient Operations using Azure services or custom code
    - AI at the edge
- IoT Edge Runtime
  - Enables custom and cloud logic on IoT Edge devices. The runtime sits on the IoT Edge device, and performs management and communication operation
    - Edge Device Provisioning and Management
    - Communication between
      - Downstream devices and an IoT Edge device,
      - Modules on an IoT Edge device,
      - IoT Edge device and the cloud.
    - Secure Deployment and Updates

IOT EDGE MODULE AND RUNTIME

Enables organizations to gain visibility into the health, performance, and status of their IoT devices and deployments. It enables proactive monitoring, detection of anomalies or issues, real-time insights, and timely actions to ensure the reliability and optimal performance of IoT solutions

The aspects of monitoring and diagnostics include

| Device Monitoring	Message Monitoring	Metrics and Telemetry	Alerts and Notifications	Diagnostics Logging	Integration with Azure Monitor

MONITORING AND DIAGNOSTICS

- Best practices for some real world use cases are below
  - Security
    - Implement strong device authentication mechanisms, such as using X.509 certificates or Azure Active Directory
  - Device provisioning
    - Device Auto Provisioning
  - Symmetry or asymmetry of C2D and D2C messages
    - Cloud to device async method – When D2C is much greater than C2D
    - Direct method – When C2D is equal or greater than D2C
  - Message Optimization
  - Error Handling and Retry Policies
  - Monitoring and Analytics
  - Data Governance and compliance

BEST PRACTICES

Q & A
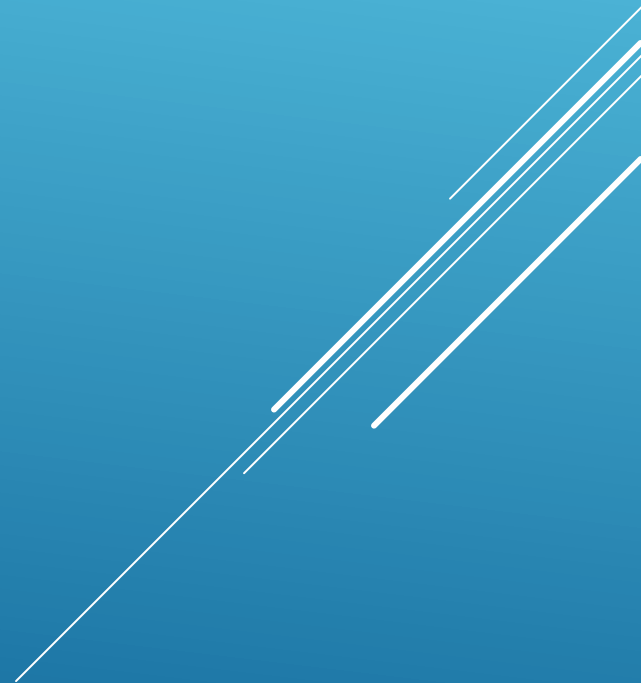
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THANK YOU