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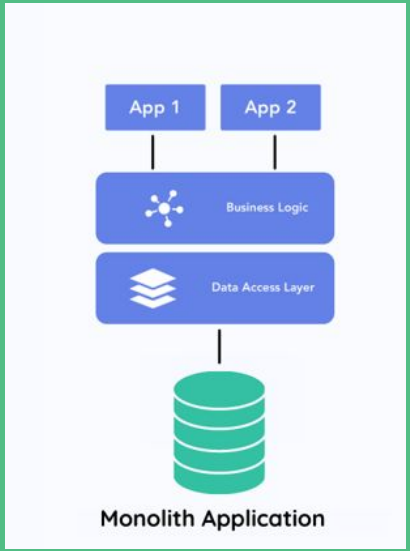
Kubernetes for Industrial IOT Ecosystems

Software Architectures for Industrial Ecosystems
Type 1 - Monolithic Architecture

Monolithic

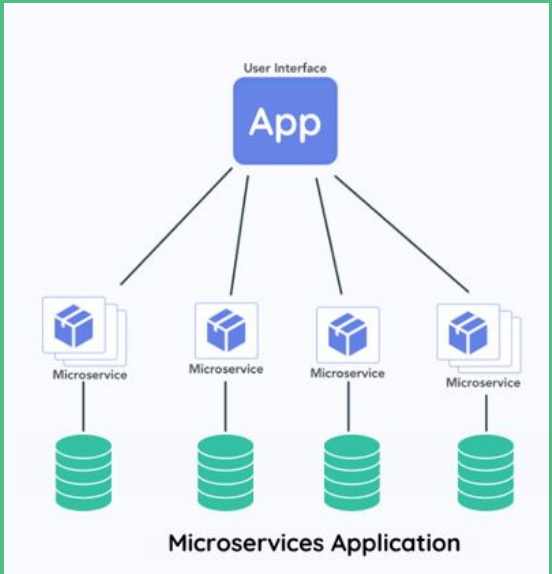


All layers are packed into single deployable unit

1. Layer 1 - Device Layer (Edge & Sensors)
2. Layer 2 - Data Ingestion & Processing
3. Layer 3 - Business Logic Layer
4. Layer 4 - API & UI

Software Architectures for Industrial Ecosystems
Type 2 - Microservices Architecture

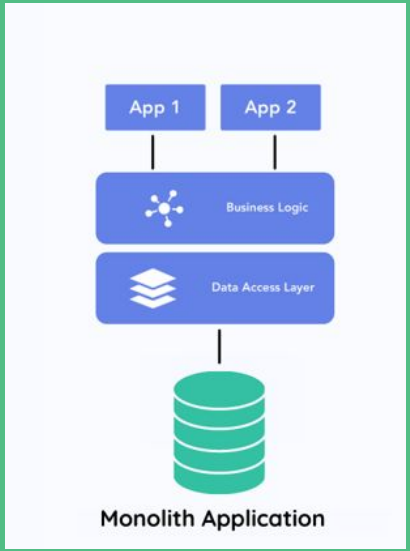
Microservices



1. Independently Deployable Services
2. Single Responsibility Principle
3. Loosely Coupled
4. Polyglot Tech Stack
5. Scalability & Resilience
6. Fault Isolation
7. DevOps & CI/CD Friendly

Why Monolithic Architecture fail for Industrial Ecosystems?

Monolithic



1. Single Point of failure
2. Scalability bottlenecks
3. Slow Innovation
4. Difficult to integrate with modern solutions
5. Suitable for small scale operations but for large industrial ecosystem, it is not profitable
6. Latency is critical for Industrial ecosystems

Different Microservice Architectures

Kubernetes (K8s)

Features:

- Automated orchestration
- Automated scaling
- Self healing

When to use:

- Large Scale
- Cloud native applications
- Needs high observability
- Needs high resilience

Serveless

Features:

- Event driven
- Fully managed
- Scales automatically

When to use:

- Lightweight
- No need of long running services
- Event driven workloads

Traditional VMs

Features:

- Direct deployment on VMs

Cons:

- Need full control on hardware
- Legacy constraints
- Security constraints

Why K8s powered Microservice is best for Industrial IoT Ecosystems?

kubernetes

1. Scalability & Resilience
2. Hybrid & Edge Deployment for IIoT
3. Security & Compliance for Industrial Systems
4. Observability & Real-Time Monitoring
5. DevOps & Automation for Large Industrial Workloads

Why K8s powered Microservice is best for Industrial IoT Ecosystems?

kubernetes

1️⃣ Scalability & Resilience

✅ **Auto-scaling**: Supports **Horizontal & Vertical Pod Autoscaling** to adjust workloads dynamically.

✅ **Self-healing**: Automatically restarts failed services, ensuring **zero downtime** for critical industrial systems.

✅ **Multi-node failover**: Ensures redundancy across **edge devices, on-prem clusters, and cloud regions**.

Why K8s powered Microservice is best for Industrial IoT Ecosystems?

kubernetes

2 Hybrid & Edge Deployment for IIoT

✅ **Runs on Edge, Cloud, and On-Prem**: Industrial systems often need a **hybrid cloud-edge** model (e.g., factory sensors sending data to cloud AI models).

✅ **Lightweight Kubernetes (K3s, MicroK8s)**: Can run on **low-power industrial gateways** and IoT devices.

✅ **Multi-cloud Support**: Works across AWS, Azure, GCP, or on-prem industrial data centers.

Why K8s powered Microservice is best for Industrial IoT Ecosystems?

kubernetes

3️⃣ Security & Compliance for Industrial Systems

✅ **RBAC (Role-Based Access Control)** ensures restricted access to mission-critical services.

✅ **Network Policies & Service Mesh (Istio, Linkerd)** enable **zero-trust security** and **encrypted communications (mTLS)**.

✅ **Audit Logging & Monitoring** ensures regulatory compliance (e.g., GDPR, NIST, ISO 27001).

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kubernetes

4 Observability & Real-Time Monitoring

✅ **Industrial ecosystems need real-time monitoring** for predictive maintenance and anomaly detection.

✅ Kubernetes integrates **Prometheus, Grafana, ELK Stack** for advanced logging, metrics, and alerting.

Why K8s powered Microservice is best for Industrial IoT Ecosystems?

kubernetes

5️⃣ DevOps & Automation for Large Industrial Workloads

✅ Supports **CI/CD pipelines** with tools like **ArgoCD, Flux, and Helm** for rapid deployment.

✅ Manages **rolling updates & blue-green deployments** to prevent downtime during updates.

Benefits of K8s Powered Microservices for Industrial IoT Ecosystems

kubernetes

1. 40% Faster Deployment Cycles
2. 99.9% System Uptime
3. 30% reduction in operational costs
4. 3x Improvement in fault isolation

Benefits of K8s Powered Microservices for Industrial IoT Ecosystems

kubernetes

1️⃣ 40% Faster Deployment Cycles

✅ K8s enables continuous delivery and rolling updates enabling new features and security patches to be deployed seamlessly

✅ No downtime

✅ Isolates changes to specific components thereby speeds the development cycles

Benefits of K8s Powered Microservices for Industrial IoT Ecosystems

kubernetes

2️⃣ 99.9% System Uptime

✅K8s' Self-healing capabilities and auto-scaling ensures workloads are balanced across multiple nodes

✅ When one node goes down, other node takes over the control healing at a quicker rate with almost no downtime

✅ K8s automatically reschedules workloads based on node availability ensuring minimal impact

Benefits of K8s Powered Microservices for Industrial IoT Ecosystems

kubernetes

3️⃣ 30% reduction in operational costs

✅K8s optimizes resources through horizontal scaling and resource quotas

✅ K8s thereby makes efficient allocation of CPU and memory across nodes

✅Edge and Cloud environments can dynamically scale and reduce waste & save cost

Benefits of K8s Powered Microservices for Industrial IoT Ecosystems

kubernetes

4 3x Improvement in fault isolation

✅K8s decouples individual services ensuring fault isolation

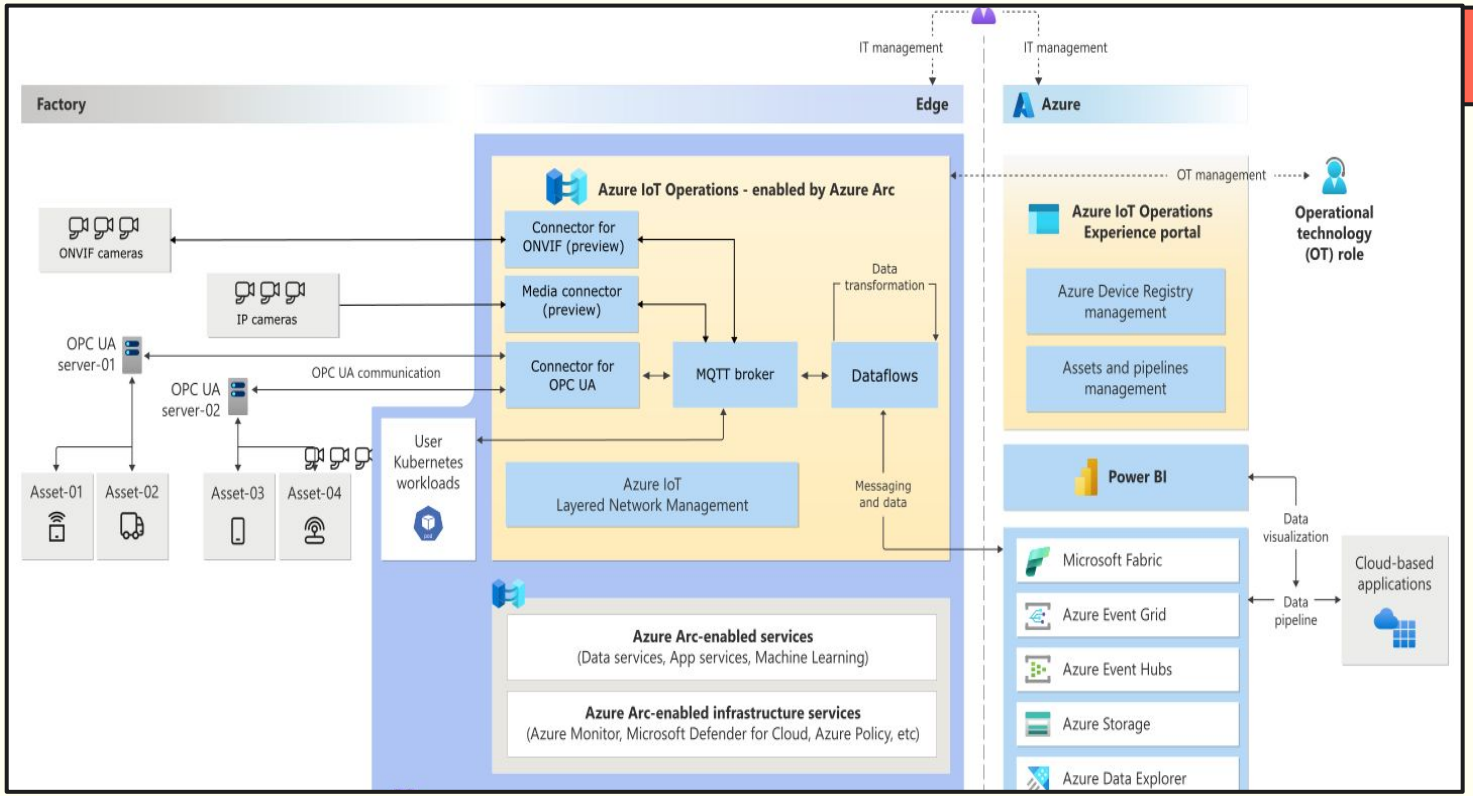
✅Doesn't impact the entire system

✅K8s has namespace and pod isolation ensuring services are isolated and managed individually.

✅Overall overs 3x improvement in performance in fault isolation

Azure IoT Operations Case Study

Azure IoT operations Architecture



Features of Azure IoT operations

- ☑️Is built from ground up by using Kubernetes native applications.
- ☑️Is highly extensible, scalable, resilient, and secure.
- ☑️Lets you manage edge services and resources from the cloud by using Azure Arc.
- ☑️Can integrate customer workloads into the platform to create a unified solution.
- ☑️Supports GitOps configuration as code for deployment and updates.
- ☑️Natively integrates with Azure Event Hubs, Azure Event Grid's MQTT broker, and Microsoft Fabric in the cloud.
- ☑️Includes an industrial-grade, edge-native MQTT broker that powers event-driven architectures.

Reach out in LinkedIn!

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Questions?
Thank You