



# Architecture concept and Roadmap for a Digital Twinning solution

The Digital Twin platform provides a unified operational representation of the installed base, enabling scalable lifecycle visibility, interoperability, and advanced analytics across heterogeneous medical devices.

# Problem framing:

Heterogeneous installed base across device generations

## Key architectural challenges:

Multiple device generations: legacy systems and modern connected devices

Multiple protocols and data formats, inconsistent semantics

Data fragmented across silos (device logs, service systems, hospital IT, engineering repositories / artifacts)

Highly regulated environment (security, auditability, and compliance requirements)

## Target architecture outcomes:

Unified asset identity and lifecycle state across all generations

Repeatable onboarding framework for legacy and new device families

Reliable end-to-end pipeline from device data to operational insights

Security-by-design across device, edge, and platform layers

# Legacy Device Integration Strategy

Integrating heterogeneous medical devices without modifying existing systems

## Challenge

Legacy medical devices expose heterogeneous and often proprietary interfaces that were not designed for modern cloud platforms.

### Key constraints:

- multiple device generations
- proprietary protocols and telemetry formats
- restricted hospital network environments
- long device lifecycles (10-20 years)

## Approach: Edge abstraction layer

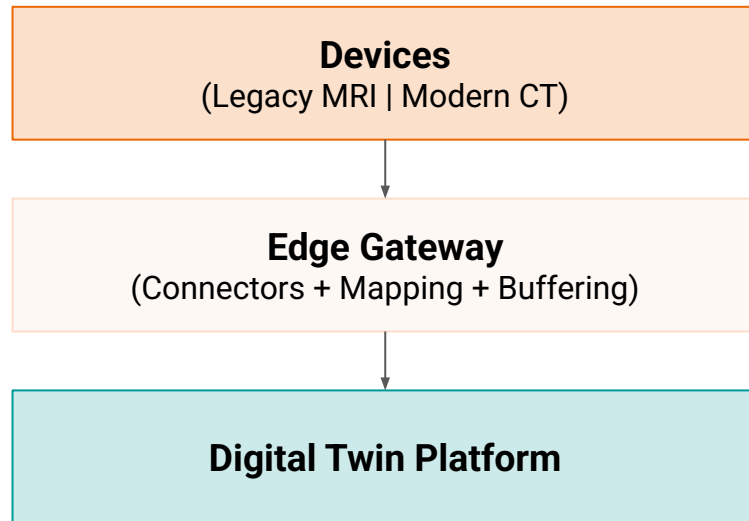
Edge gateways provide a controlled integration layer between devices and the digital twin platform.

### Capabilities:

- protocol adapters (DICOM, HL7, OPC-UA, proprietary interfaces)
- telemetry normalization
- secure outbound connectivity
- buffering and store-and-forward

## Outcome

Legacy and modern devices integrate through a stable Digital Twin layer, without requiring hardware modifications.



# Semantic Normalization for Device Generations

Decoupling applications from device-specific telemetry

## Challenge

Devices expose telemetry with different schemas, naming conventions, and capabilities.

To ensure consistent analytics and operations, **the platform introduces a canonical Digital Twin data model.**

## Canonical twin model

### Connector mapping layer

Device-specific connectors translate telemetry into the canonical model.

### Type Twin

Defines device family structure and telemetry schema.

### Instance Twin

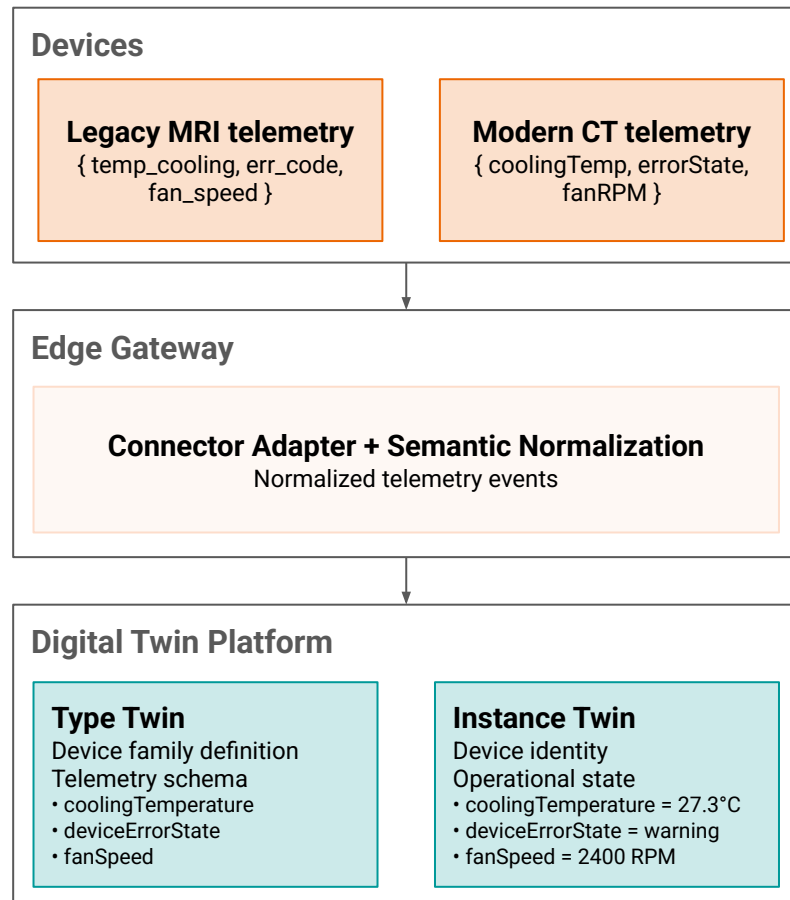
Represents a specific physical device and its current operational state.

### This allows:

- consistent telemetry semantics
- stable application APIs
- independent evolution of device firmware and applications

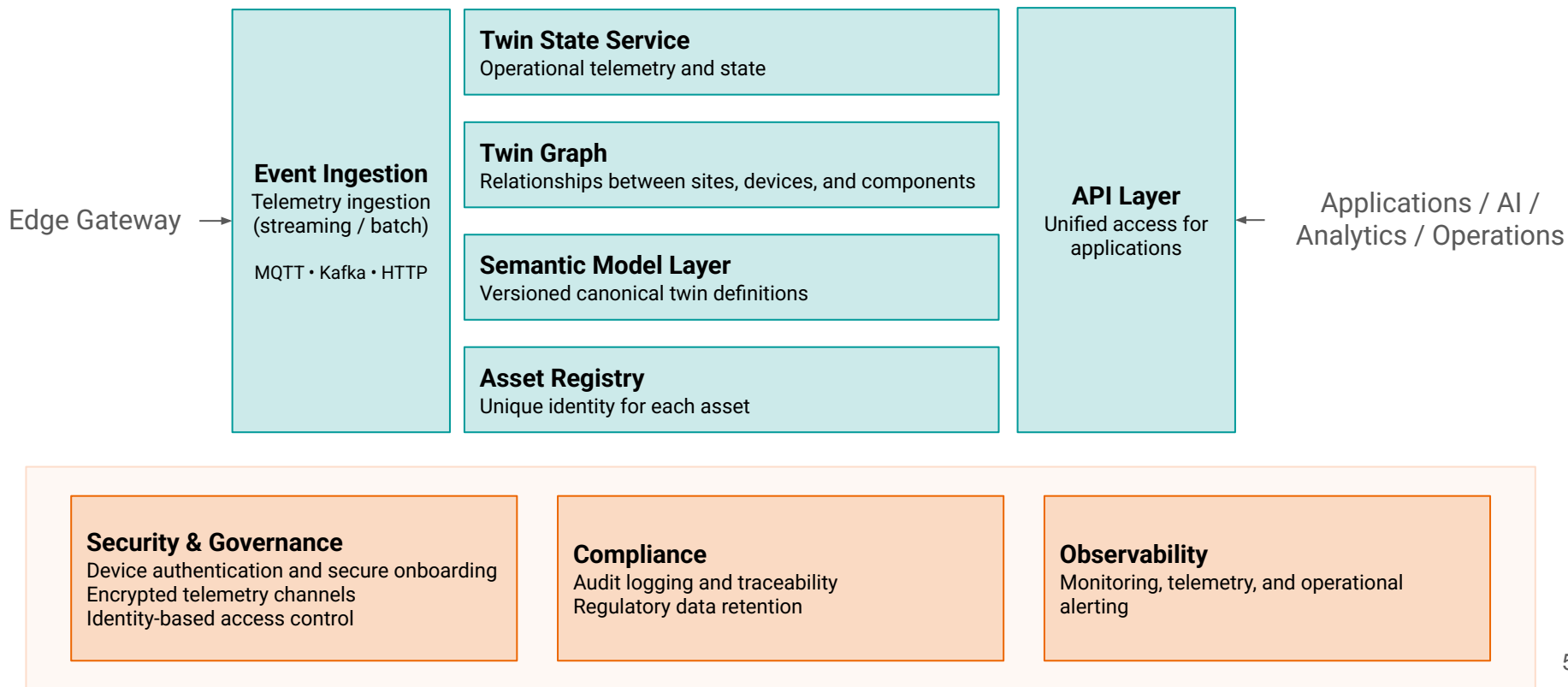
## Outcome

Applications interact with a stable Digital Twin layer, regardless of device generation.



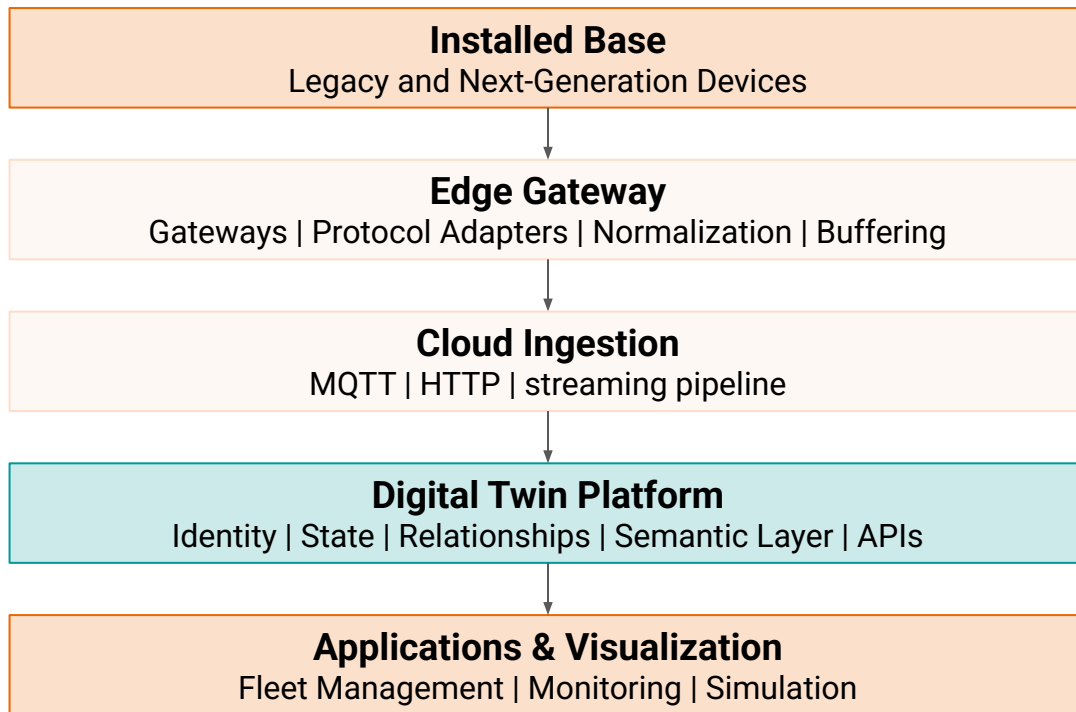
# Core Architecture of the Digital Twin Platform

The platform maintains a consistent representation of assets, their state, and their relationships across the lifecycle.



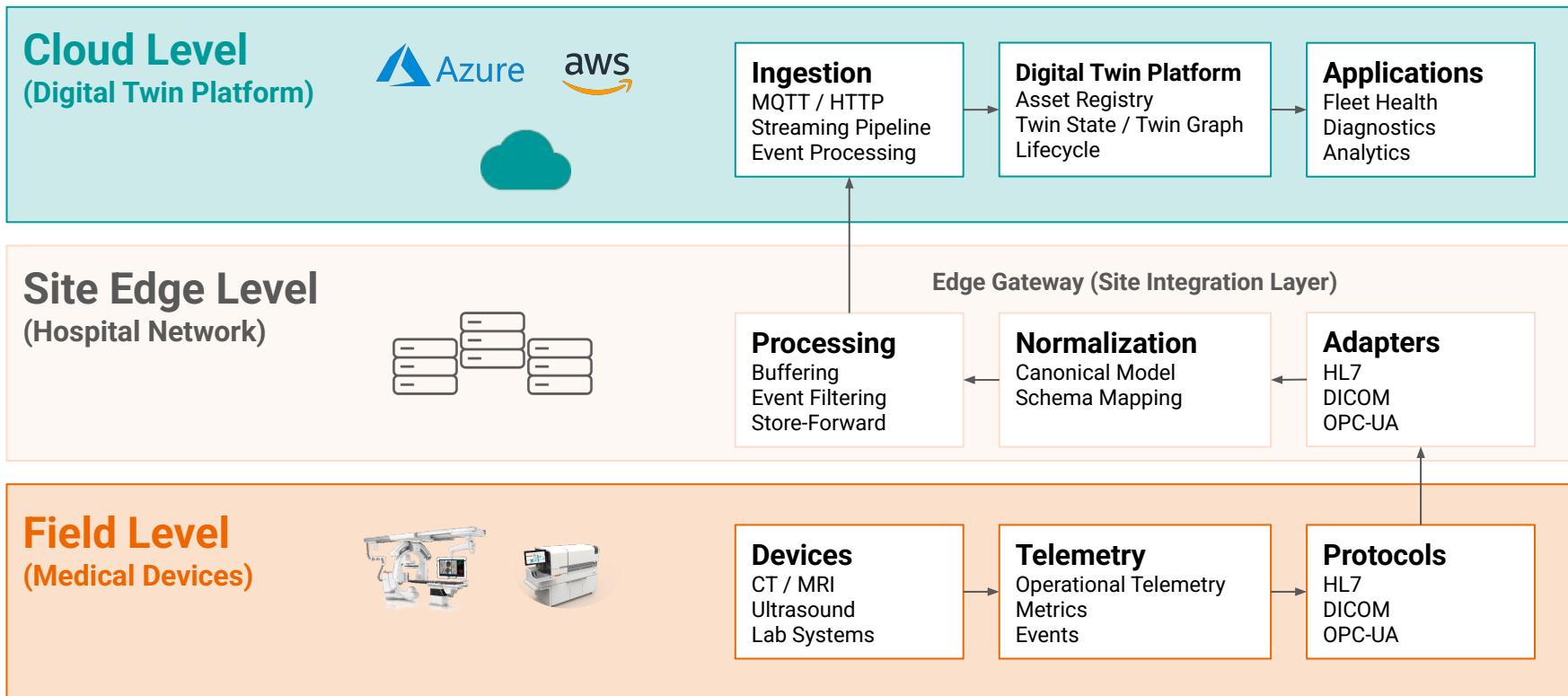
# End-to-End Digital Twin Architecture Overview

The Edge Gateway provides the semantic abstraction layer between heterogeneous devices and the Digital Twin Platform.



# Digital Twin Platform Deployment Architecture

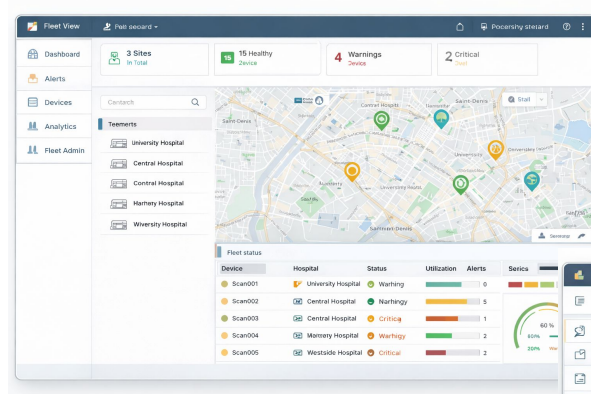
Operational data from medical devices is integrated at the site edge and synchronized with the cloud Digital Twin platform.



# Digital Twin Visualization & Applications

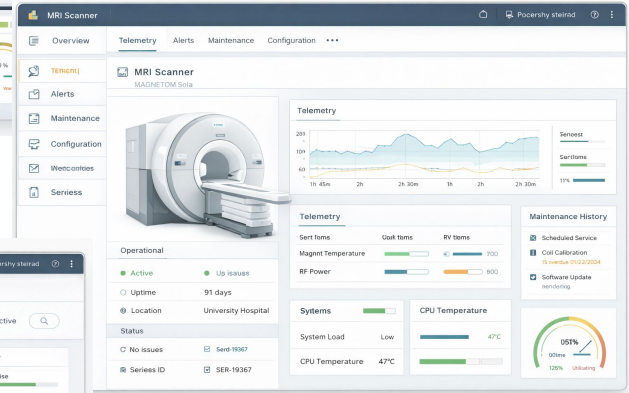
## Fleet View

- Fleet health dashboard
- Site status overview
- Device availability
- Alerts & anomalies



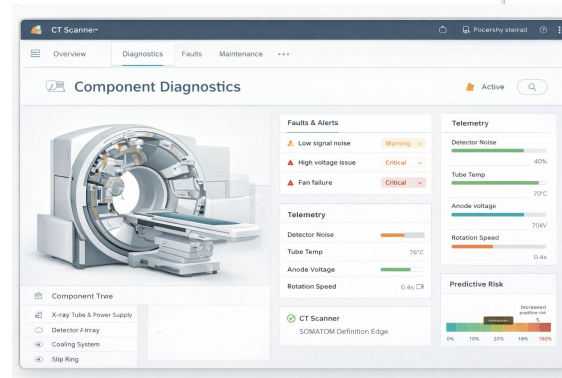
## Device Digital Twin

- Device operational state
- Telemetry streams
- Configuration
- Maintenance history



## Component Diagnostics

- Component level telemetry
- Fault diagnostics
- Predictive maintenance indicators



# Roadmap: From Concept to Scalable Digital Twin Platform

Incremental rollout enabling legacy integration and platform scalability



## 01 | Alignment (2-4 weeks)

Establish semantic and architectural foundations

Select 2-3 priority use cases

Define canonical asset model  
(Type and Instance twins)

Inventory legacy protocols and connectivity options

Approved reference architecture and MVP scope

## 02 | MVP (6-10 weeks)

Deliver first operational Digital Twin pipeline

Deploy asset registry and twin state services

Connect  
1 legacy device  
+ 1 modern device

Implement ingestion pipeline and APIs

Deliver first fleet health and utilization dashboard

Working end-to-end Digital Twin pipeline

# Roadmap: From Concept to Scalable Digital Twin Platform

Incremental rollout enabling legacy integration and platform scalability

## 03 | Pilot (3-4 months)

Validate platform in real hospital environment

Deploy in selected site

Implement asset relationships  
(Twin Graph)

Implement monitoring, governance, and security

Measure operational and service KPIs

Stable operations with measurable business value

## 04 | Scale out (6-12 months)

Large-scale onboarding across installed base

Build reusable connector framework

Standardize onboarding templates and processes

Integrate service and enterprise systems

Enable multi-site fleet visibility

Repeatable onboarding across device generations

## 05 | Advanced (12+ months)

Enable advanced Digital Twin and AI capabilities

Workflow and facility twins

Predictive maintenance

Simulation and optimization

AI-driven decision support

Full enterprise Digital Twin ecosystem

# From heterogeneous devices to a unified operational view

Unified Digital Twin workspace for fleet health monitoring, device telemetry, component diagnostics, and site-level operations.

[Open interactive Digital Twin concept](#)

