



# QOE AI INSIGHTS : QOE IOT SIM AGENT

## Functional Specification

### Abstract

QoE AI Insights delivers a unified, privacy-first platform for measuring and improving real-world mobile experience. It combines lightweight device data, intelligent enrichment, and secure partner delivery with a robust control plane for licensing, governance, and analytics. Built on Microsoft Fabric, it enables operators and regulators to access high-resolution QoE intelligence and actionable insights through powerful dashboards.

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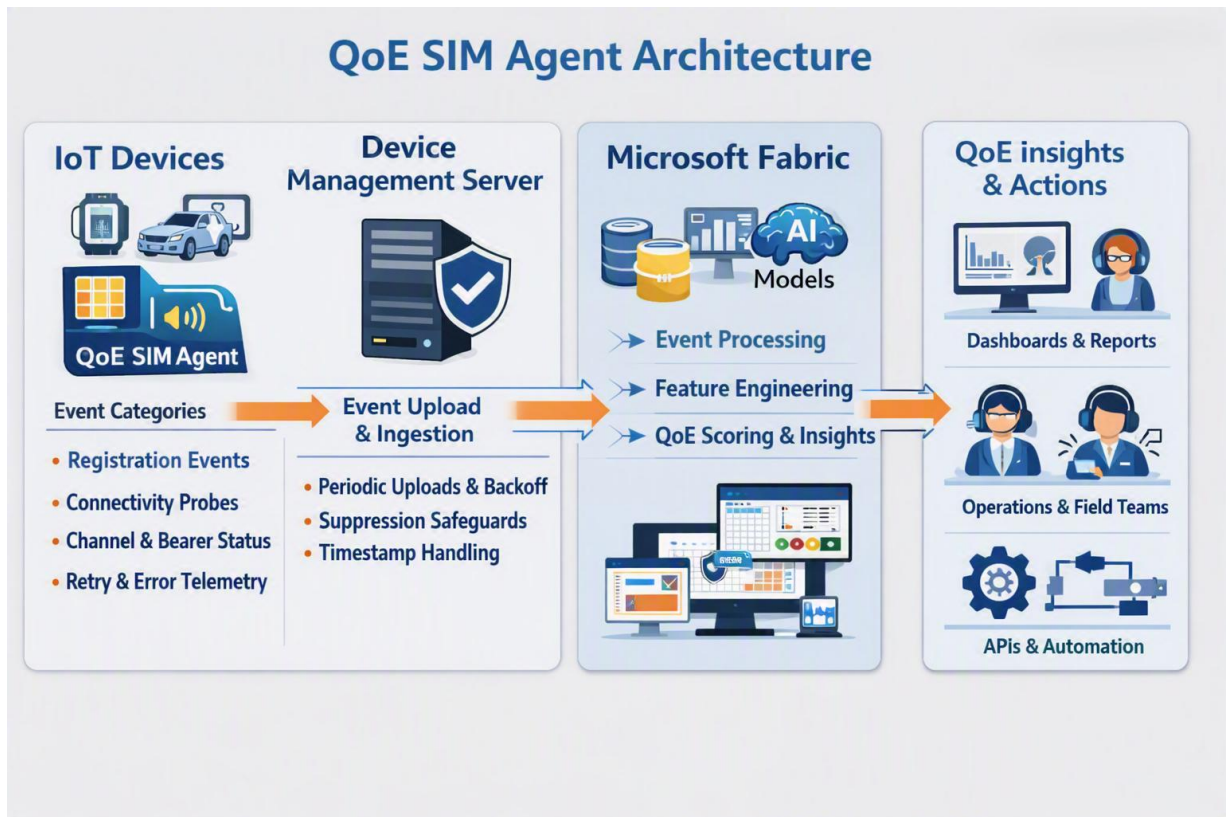
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# 1 Overview

The QoE SIM Agent provides a modern, event-driven approach to measuring and improving connectivity performance across IoT deployments. Combined with Microsoft Fabric, it delivers a complete telemetry-to-insight pipeline that enhances operational visibility, accelerates incident response, and strengthens SLA assurance.



This document describes the full end-to-end solution: **from SIM-level telemetry → device management server → Microsoft Fabric → AI-driven QoE insights.**

## 2 QoE IoT SIM Agent

### 2.1 Event-Driven QoE Telemetry

The QoE SIM Agent continuously monitors network and service behaviour and emits structured, deterministic events. These events provide deep visibility into real-world connectivity conditions without requiring application changes or device firmware updates.

#### 2.1.1 Captured Event Categories

- **Registration & Access Technology Changes** Tracks transitions across RATs (2G/3G/4G/5G/NB-IoT/LTE-M) and PLMN behaviour.
- **Connectivity Probe Outcomes** Measures reachability, latency, and failure patterns.

- **Channel & Bearer Status Signals** Observes throughput, packet loss, and bearer stability.
- **Search & Termination Behaviour** Identifies mobility-related triggers, detach causes, and termination flows.
- **Retry, Suppression & Error Telemetry** Provides insight into degraded conditions, backoff behaviour, and workflow resilience.

These events form the foundation for downstream analytics and AI-driven QoE scoring.

## 2.2 Deterministic Event Schema

All telemetry follows a **fixed-width, machine-friendly schema** designed for:

- predictable parsing
- low-friction backend ingestion
- long-term analytics stability
- consistent AI feature engineering

This ensures that operators, integrators, and analytics teams can rely on stable structures across versions and deployments.

## 2.3 Intelligent Upload Behaviour

The agent is engineered to operate reliably across diverse IoT environments, including constrained or intermittent connectivity.

### Upload Features

- **Periodic upload windows** for predictable batching
- **Bounded exponential backoff** during failures
- **Suppression safeguards** to avoid excessive signalling during outages
- **Resilient transport logic** to ensure telemetry eventually reaches the backend

This behaviour reduces noise, protects radio resources, and ensures high-quality data delivery.

## 2.4 Resilient Timestamp Strategy

To maintain ordering and auditability, the agent uses a dual-timestamp model:

- **Primary:** handset-provided envelope timestamps
- **Fallback:** deterministic server-side timestamps when device time is unavailable

This guarantees consistent sequencing and reliable historical analysis, even in low-capability devices.

## 2.5 Controlled Diagnostics Access

Operational teams can securely export:

- event buffers
- agent status snapshots
- upload window metadata

These exports support validation, triage, compliance audits, and field engineering workflows—without exposing sensitive SIM or network credentials.

## 3 End-to-End Architecture with Microsoft Fabric

### 3.1 Device Management Server → Microsoft Fabric

The device management server collects QoE SIM Agent events and uploads them to Microsoft Fabric using streaming or batch ingestion.

### 3.2 Fabric Processing & AI Insights

Within Fabric:

1. **Event ingestion** into Eventstream/Eventhouse
2. **Feature engineering** across connectivity, mobility, and retry patterns
3. **AI inference** to produce QoE scores, anomaly detection, and root-cause hints
4. **Insight generation** for devices, SIMs, sites, and fleets
5. **Activation** via dashboards, APIs, alerts, and automation workflows

### 3.3 Delivered Outcomes

- Faster **mean time to detect (MTTD)**
- Faster **root-cause isolation**
- Higher confidence during **rollouts, migrations, and roaming**
- Improved **SLA reporting** with verifiable event evidence
- Reduced **truck rolls** through remote diagnostics and proactive insights

### 3.4 Deployment Model

The QoE SIM Agent is designed for controlled deployment through standard smart-card lifecycle tooling. It integrates seamlessly into existing provisioning, operations, and fleet-management runbooks.

## 3.5 Standards Alignment

The QoE SIM Agent aligns with widely adopted UICC and mobile standards, ensuring compatibility across operator environments.

### 3.5.1 Referenced Standards

- **3GPP TS 31.111** – USIM Application Toolkit (USAT)
- **3GPP TS 31.102** – USIM application characteristics
- **ETSI TS 102 221** – UICC-terminal interface
- **ETSI TS 102 223** – Card Application Toolkit command set
- **ISO/IEC 7816 series** – APDU and ICC conventions
- **GlobalPlatform Card Specifications** – secure channel and lifecycle management

**Note:** USAT/UICC specifications are the primary behavioural baseline; legacy GSM/SAT references are included only for compatibility.

## 4 Summary

The QoE SIM Agent and Microsoft Fabric together deliver a robust, standards-aligned, AI-powered QoE intelligence platform for IoT connectivity. This end-to-end solution provides operators and enterprises with:

- richer visibility
- faster detection
- stronger SLA assurance
- lower operational overhead

All while maintaining deterministic behaviour, secure diagnostics, and seamless integration into existing IoT ecosystems.