Sensor System

System Design Description

Abstract
This document describes the detailed design and implementation of the **Telemetry Sensor System**, which produces and manages real-time turbine telemetry data for Arrowhead-compliant environments. The implementation follows the corresponding System Description (SysD) and Service Description (SD) documents for the *turbineTelemetryService* and *sysMonitor* services.

Contents

1 Overview

This document describes the design and implementation of the **Sensor System**, which is responsible for collecting, processing, and exposing turbine sensor data as Arrowhead services. It implements the functionality described in the corresponding System Description (SysD) document, and provides telemetry information through the *turbineTelemetry* service, while also offering internal system status information via the *sysMonitor* service.

The implementation follows Arrowhead framework principles for secure, interoperable, and service-oriented automation systems.

2 Implementation

This implementation is based on the System Description (SysD) and Service Description (SD) documents for the Telemetry Sensor System and the *turbineTelemetry* service.

2.1 Implementation Language and Tools

- **Programming language:** Python 3.11
- **Frameworks:** Flask for REST API exposure, Paho MQTT for optional telemetry streaming
- **Development tools:** Visual Studio Code, Git, Docker for containerized deployment
- **Libraries:**
  - `requests` – for consuming Arrowhead core services
  - `cryptography` – for X.509 certificate handling
  - `sqlite3` – for local telemetry storage
- **Implementation mode:** Stateless RESTful design, with optional local caching for performance

2.2 Functional Properties Implementation

- **Function operations:**
  - Collect and store telemetry from turbine sensors
  - Serve telemetry via REST (and optionally MQTT)
  - Support registration and discovery through Arrowhead Service Registry
- **Data handled:**
  - Telemetry data (temperature, vibration, RPM, power output)
  - Metadata (timestamps, sensor IDs, status)
- **Database:** Lightweight SQLite database, schema includes tables for sensors, telemetry data, and health logs
- **Result:** Structured JSON payloads containing real-time or historical telemetry values

2.3 Non-functional Properties Implementation

2.3.1 Security

The system operates in Arrowhead secure mode using HTTPS/TLS and Arrowhead-compliant X.509 certificates. Mutual authentication is performed for all inter-service communication. Authorization is enforced via the Authorization core system.

2.3.2 Power Management

Low-power mode is supported through configurable telemetry intervals and adaptive sensor polling.

2.3.3 Internal Monitoring

The *sysMonitor* service provides system-level metrics such as CPU load, uptime, and error counts.

2.3.4 Configuration

- Configuration is loaded from a JSON file or environment variables.
- Configurable parameters: service URIs, certificate paths, telemetry frequency, database path.
- Hot reconfiguration supported via REST endpoint or local command interface.

3 Services

The implementation is based on the following Service and Interface Design Description documents:

- SD: `turbineTelemetry-SD`
- IDD: `turbineTelemetry-IDD`
- SD: `sysMonitor-SD`
- IDD: `sysMonitor-IDD`

Table 1: References to documentation for services produced and consumed.

Services Produced	**SysD Ref**	**SD Ref**	**IDD Ref**
turbineTelemetryService	SysD SensorTurbine	SD turbineTelemetryService	IDD turbineTelemetryService
sysMonitor	SysD SensorTurbine	SD sysMonitor	IDD sysMonitor
Services Consumed	**SysD Ref**	**SD Ref**	**IDD Ref**
serviceDiscovery	SysD CoreSystem	SD serviceDiscovery	IDD serviceDiscovery
deviceDiscovery	SysD CoreSystem	SD deviceDiscovery	IDD deviceDiscovery
getPublicKey	SysD CoreSystem	SD getPublicKey	IDD getPublicKey
serviceOrchestration	SysD CoreSystem	SD serviceOrchestration	IDD serviceOrchestration
consumerAuthentication	SysD CoreSystem	SD consumerAuthentication	IDD consumerAuthentication

4 References

5 Revision History

5.1 Amendments

No.	Date	Version	Subject of Amendments	Author
1	2025-10-16	4.4.1	Initial release of Telemetry Sensor System SysDD	[Your Name]

5.2 Quality Assurance

No.	Date	Version	Approved by
1	2025-10-16	4.4.1	[Supervisor/Reviewer Name]