Assignment 1 - System Categorization
Data Flow Diagrams
CSE 4380

Group Thorin

February 28th, 2025

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1 Data Flow Analysis

This section provides an in-depth analysis of the AeroTech X9 Drone System's data flow, including how data is processed, stored, and transmitted within and outside the system. The AeroTech X9 is an advanced UAV designed for real-time reconnaissance, environmental monitoring, and secure data transmission.

1.1 Data Identification

The AeroTech X9 Drone System processes multiple categories of data essential for autonomous operation, mission execution, and communication. Below is a breakdown of data types managed by the system.

1.1.1 Types of Data Processed

The system processes the following key data types:

- **Flight Telemetry:** GPS coordinates, altitude, speed, heading, battery status, and environmental data.
- **Navigation Data:** GNSS signals, AI-assisted route optimization, obstacle detection.
- **Mission Data:** Captured 4K imagery, thermal imaging, LiDAR scans, real-time object tracking.
- **Command and Control Signals:** Remote operator commands, autonomous navigation directives, emergency override signals.
- **System Health Logs:** Battery diagnostics, motor status, CPU load, AI inference logs.
- **Encrypted Communications:** Secure telemetry uplinks, data-at-rest encryption for stored mission files.

1.1.2 Data Classification

Data is classified based on sensitivity and impact level according to **FIPS 199** and **NIST SP 800-60** standards:

- **Low Sensitivity:** General flight status, non-classified mission logs.
- **Moderate Sensitivity:** AI-processed imagery, encrypted telemetry data.
- **High Sensitivity:** Secure command and control transmissions, surveillance recordings, real-time intelligence data.

1.2 Data Flow Diagrams (DFDs)

To illustrate data movement within the system, Level 0 and Level 1 Data Flow Diagrams (DFDs) are provided. These diagrams detail interactions between onboard subsystems, external control entities, and data repositories.

1.2.1 Level 0 Context Diagram

Figure 1 defines the AeroTech X9 Drone as the system boundary, with external inputs (GCS, GNSS, RF Commands, Sensors) and outputs (Telemetry, Mission Data, Encrypted Logs).

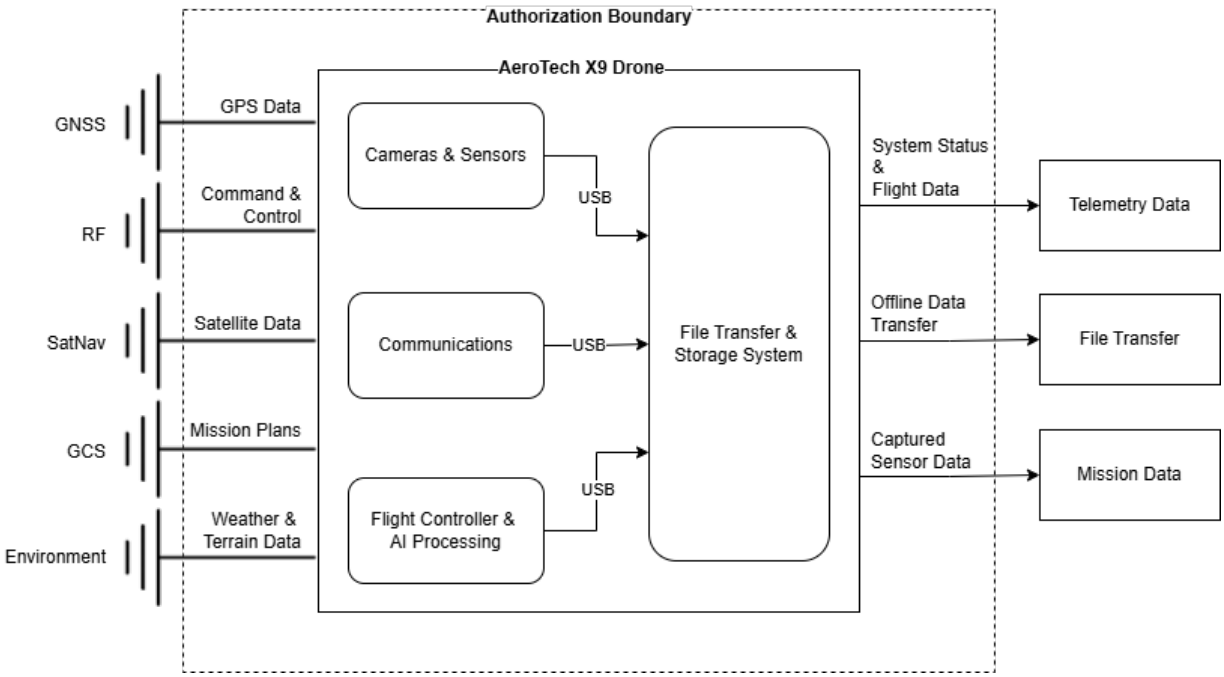

Figure 1: Level 0 Context Diagram

1.2.2 Level 1 Data Flow Diagram

Figure 2 expands internal data flow, detailing communication between Flight Controller, AI Processing Unit, Power Management, and Communication Systems.

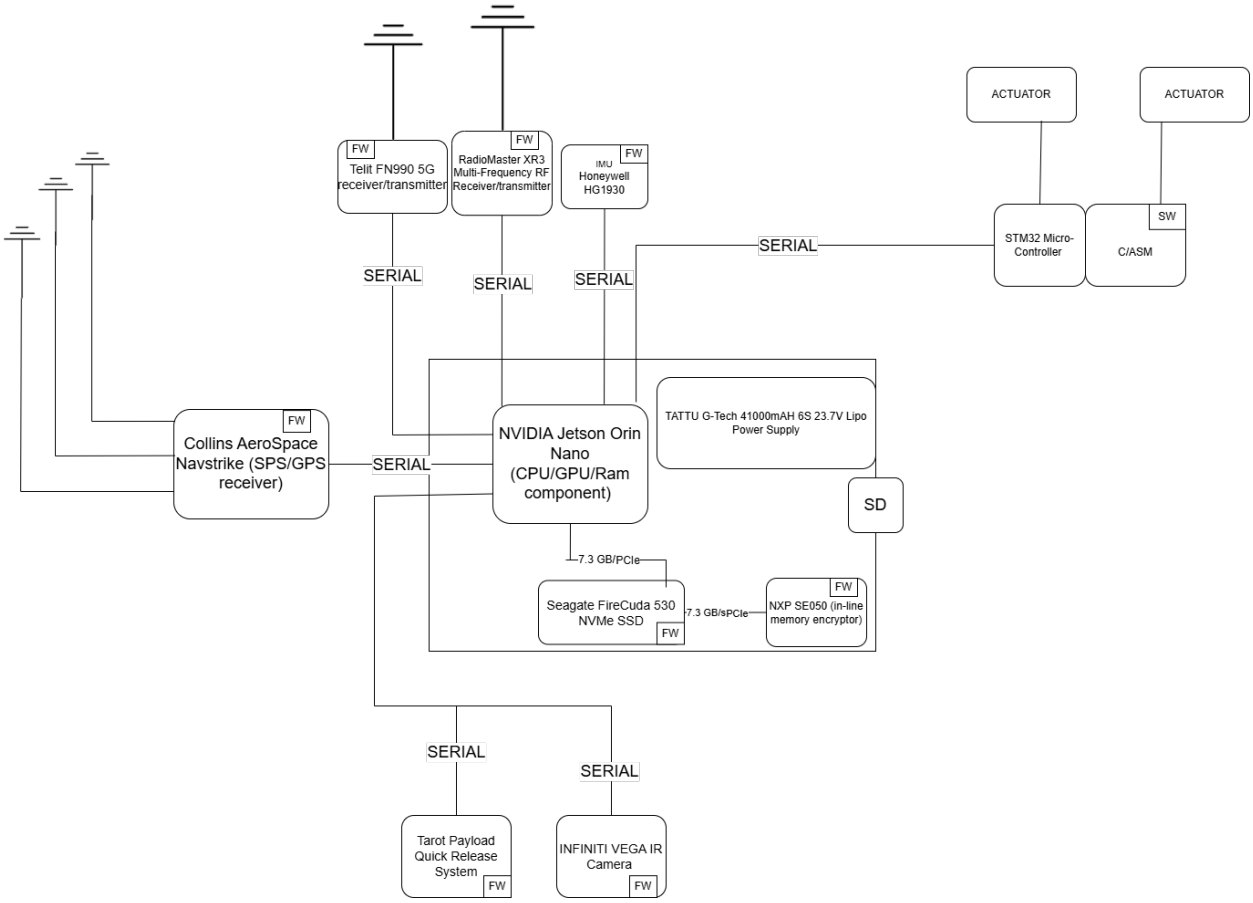

Figure 2: Level 1 Data Flow Diagram

1.3 Interfaces

The AeroTech X9 Drone System interacts with multiple external entities through wired and wireless interfaces, ensuring seamless data transmission and control.

1.3.1 Types of Interfaces

- **Wired Interfaces:**
  - **USB 3.1**: Used for manual file transfers and firmware updates.
  - **Ethernet**: High-speed data extraction at maintenance stations.
- **Wireless Interfaces:**
  - **RF Communication**: Short-range, low-latency telemetry link (up to 20 km).
  - **4G/5G Connectivity**: Extended-range communication with mission servers.
  - **Satellite Link (Iridium-based)**: Beyond-line-of-sight (BLOS) operations.
  - **ADS-B Transceiver**: Airspace awareness and regulatory compliance.
- **Cloud-Based Interfaces:**
  - **Secure Mission Storage**: Encrypted cloud repository for AI-enhanced analysis.

1.3.2 Protocols & Security Features

The AeroTech X9 ensures secure communication and data integrity through industry-standard encryption and security measures:

- **AES-256 Encryption:** Ensures confidentiality of command signals and mission data.
- **TLS/SSL Secure Transmission:** Used for encrypted telemetry over cellular and satellite networks.
- **Frequency Hopping Spread Spectrum (FHSS):** Protects against jamming in RF communications.
- **Multi-Factor Authentication (MFA):** Required for accessing control interfaces remotely.
- **Intrusion Detection System (IDS):** Monitors network traffic for unauthorized access attempts.