**CAN Communication Interface**

**Introduction to CAN**

The **Controller Area Network (CAN)** is a robust, differential serial communication protocol originally developed for automotive applications and now widely used in aerospace and industrial systems. It enables multiple microcontrollers and devices to communicate over a shared two-wire bus (CANH and CANL) without the need for a central host computer.

Key advantages of CAN in the BBM include:

* **Noise immunity** – Differential signalling significantly reduces susceptibility to electromagnetic interference, which is critical in environments with high-current switching components such as the H-bridge and relays.
* **Error detection and recovery** – CAN implements automatic retransmission and error checking, improving communication reliability.
* **Multi-node capability** – Multiple subsystems can be connected to the same bus without additional point-to-point wiring.
* **Deterministic timing** – The arbitration system ensures predictable message prioritisation, which is essential for time-critical control and telemetry.

**Implementation in the BBM**

In the BBM, the CAN bus serves as the **primary communication backbone**, interconnecting all microcontroller-based subsystems — including the **Electrical Power System (EPS)**, **On-Board Computer (OBC)**, **Attitude Determination and Control System (ADCS)**, and the **payload** — for telemetry, command, and coordination.

Each subsystem uses the internal CAN controller of the Teensy microcontroller, interfaced to the physical bus via a **Texas Instruments SN65HVD232** CAN transceiver. This transceiver was selected for its 3.3 V logic compatibility, robust noise performance, and suitability for short to medium internal wiring lengths.

The basic wiring per node is as follows:

* **Teensy TX (CANx\_TX)** → **TXD** (transceiver)
* **Teensy RX (CANx\_RX)** ← **RXD** (transceiver)
* **3.3 V** → **VCC**, **GND** → **GND**
* **CANH** and **CANL** connected between nodes using a twisted pair

**Bus Topology and Electrical Design**

The CAN bus follows a **linear topology**, with all subsystems connected to a common twisted pair. Proper impedance matching is achieved by placing a **single 120 Ω resistor** directly between CANH and CANL at each physical end of the bus.

Design considerations include:

* Twisted-pair wiring for CANH and CANL to improve noise immunity
* Short stub lengths (< 10 cm) to minimise signal reflections
* Careful routing to avoid coupling noise from high-current switching components

The initial bitrate is configured at **500 kbps** using the **FlexCAN\_T4** library for Teensy, balancing throughput and noise tolerance. If testing confirms stable operation, the bitrate may be increased to 1 Mbps.

**Role in Payload / Camera Operation**

In the BBM, the CAN bus enables the OBC to send control commands to the payload’s embedded controller, request image captures, and download image data in segmented packets. All communication, including boot signalling, status requests, and payload configuration, is performed over the shared CAN backbone, ensuring unified subsystem integration.