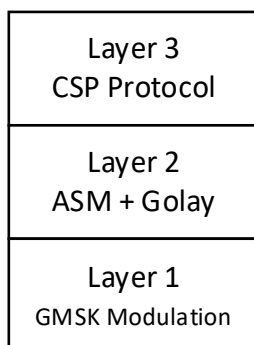


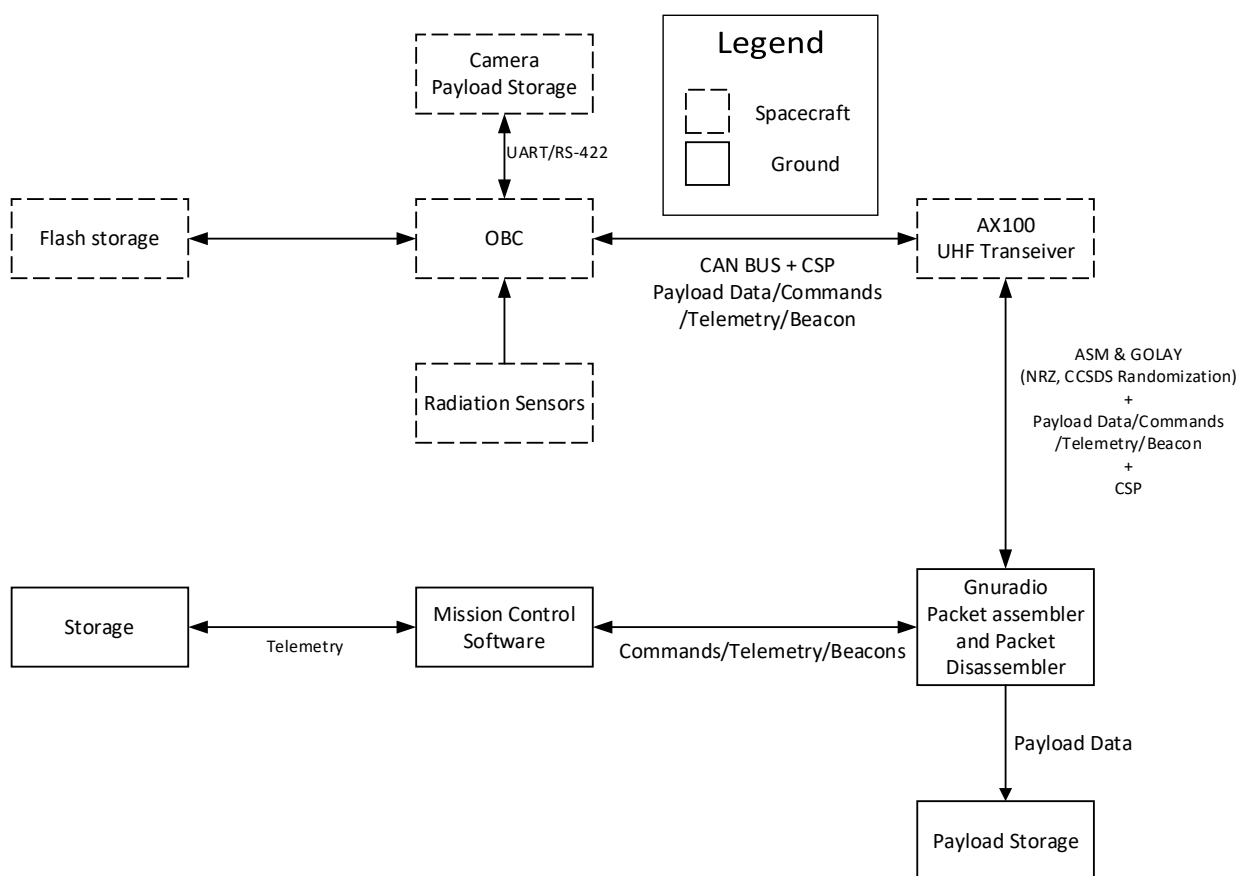


## Uplink/Downlink Protocols



**Figure 1 - The Communication model use for SC-ODIN for uplink and downlinking.**

Figure 1 shows the protocols that will be used on the SC-ODIN CubeSat and on the ground station for data to be sent between them. The three layers were chosen for better effective transmission of the packets, as the added layer 3 will make it easier to communicate between ground and the CubeSat as the ground station, transceiver and OBC will be acting as node. The layer 2 and layer 1, are the needed layer to even establish a connection and receive data.



**Figure 2 - The Uplink and downlink protocol path for SC-ODIN and the ground station.**

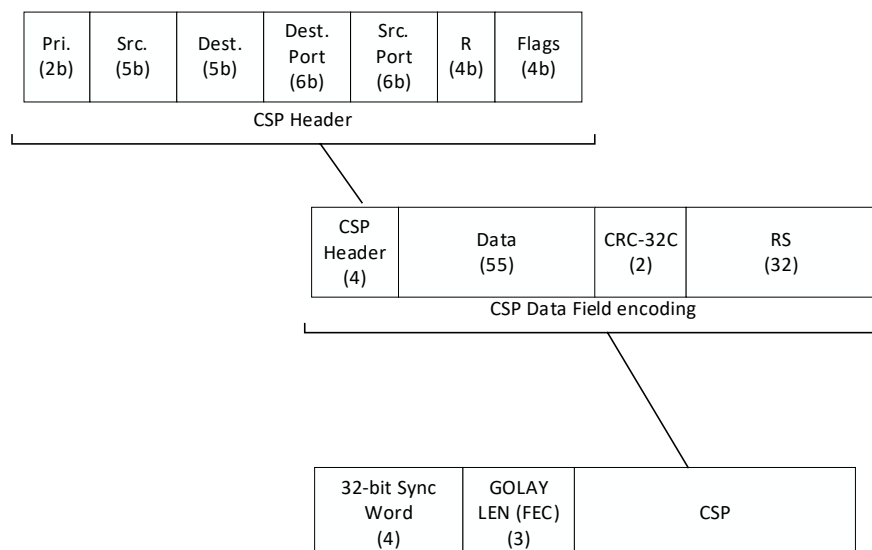


Figure 2 shows all the protocols that will be used on both the ground station and the CubeSat for the data to flow from one side to the other. From the diagram it shows the main point of communication to the transceiver from the OBC is the CAN bus, but the UART protocol (as seen from **Error! Reference source not found.**) is not shown in the diagram as it will be setup as a backup connection. The CAN bus protocol is used as it is known to be robust.

OBC will be able to communicate with its own storage system, and the two payloads, which are the camera and the radiation sensors. The OBC will be able to divide the data into packet format and integrated in a CSP protocol, which will add the address of the transceiver. Once it is formatted it will be sent on the CAN BUS and directed to the transceiver and will be able to transmit the data to the ground station, from there the ground station will decode it and will know what to do with the received data. If commands need to be sent from the GS the same process is made, but this time it will be done by a computer on the ground station. The GS will know the CSP nodes of the CubeSat and transceiver will be able to guide the packets on the CubeSat, which means every data sent and received will always go to the right destination, if the packet is not lost due to major errors.

When the data transmitted from either GS or the transceiver it will be using the ASM & GOLAY format, this will be able to add error correction from the packets being sent from the CubeSat transceiver. The main reason for ASM & Golay is the high fidelity it contains to for packets to be received safely on both the CubeSat and the GS.

All packets will be decoded and encoded from the ground station using GNU radio, the data for each packet will be sent to either to the payload storage or mission control software to decode the telemetry, beacon, or commands.



**Figure 3 - The Packet format for SC-ODIN.**

Figure 3 shows the CSP and ASM&GOLAY format that will be used for communication between the CubeSat and the Ground Station. The CSP packet will be made from the OBC to send Payload/telemetry/Beacon, while the GS will make the CSP packet when sending Commands from there the Packet will then use ASM&GOLAY to transmit the packet between CubeSat and Ground station. Important to note the commands will have authentication and encryption.