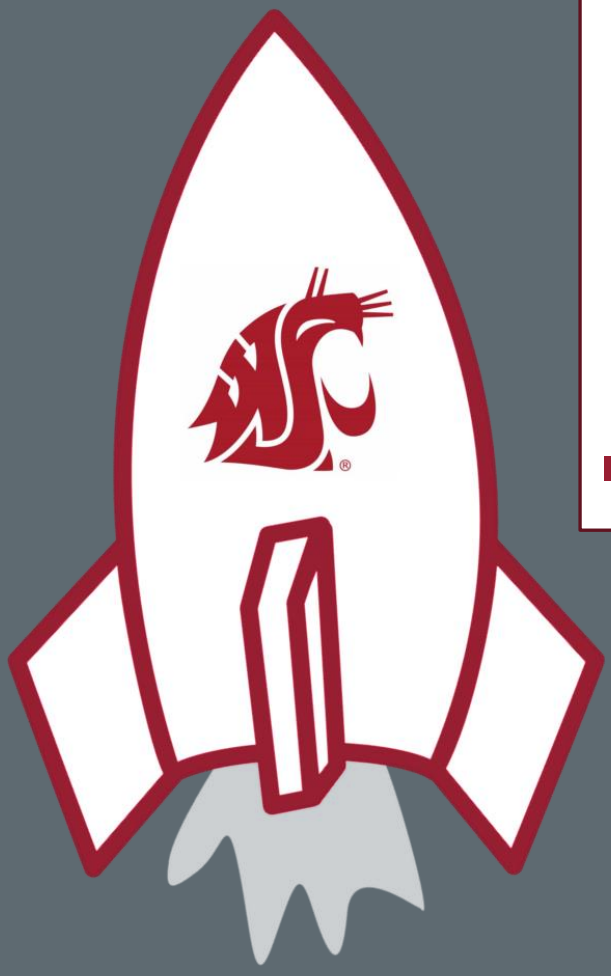
This document explains how the IFJR and the IHU are communication down to the byte by byte level.

IFJR Interface

Detailed Description of the IFJR and IHU Interface

Revision: 1.0.3



Elijah Craig

Table of Contents

1 Hardware Layer 2
2 Software Layer 3
2.1 Temperature Data Request 3
2.1.1 IHU to IFJR 3
2.1.2 IFJR to IHU 3
2.2 Storage Capacity Data Request 3
2.2.1 IHU to IFJR 3
2.2.2 IFJR to IHU 4
2.3 Reprogram Select Processor 4
2.3.1 IHU to IFJR 4
2.3.2 IFJR to IHU 4
2.4 Send Binary to IFJR 4
2.4.1 IHU to IFJR 5
2.4.2 IFJR to IHU 5
3 Example Communication 6
3.1 Data Request for Location 6
3.2 Repeated Data Request 6
3.3 Reprogramming Command 6

1 Hardware Layer

The hardware interface between the IFJR and the IHU is I^2C. It is a standard implementation of I^2C with a clock wire and a data wire. See Wikipedia's I^2C article for details on how it works.

2 Software Layer

The In-Flight JTAG Reprogramming system, located at $8b$ address `0x1F`, is a slave board to the IHU. The IFJR oversees the updating of select boards.

2.1 Temperature Data Request

The IFJR responds with an $8b$ signed integer with $1°C/LSB$.

2.1.1 IHU to IFJR

The first byte represents the command ID, `0x00`.

Byte Offset	0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x07
0x00	0x00							

2.1.2 IFJR to IHU

The IFJR responds with an array of two $8b$ signed integers

Byte Offset	0x00	0x01	0x02	0x03
0x00	ADCS (µController) Temperature	SD Card Temperature		

2.2 Storage Capacity Data Request

This command is used to determine the total capacity used for the IFJR specific SD card. The bytes used is represented by a $64b$ unsigned integer with $1B/LSB$.

2.2.1 IHU to IFJR

The first byte represents the command ID, `0x01`.

Byte Offset	0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x07
0x00	0x01							

2.2.2 IFJR to IHU

Byte Offset	0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x07
0x00	Bytes Used							

2.3 Reprogram Select Processor

This command assumes the processor binary has already been sent and exists in the IFJR's SD card.

2.3.1 IHU to IFJR

The first byte represents the command ID, 0x02. The second byte, represented by an unsigned $8b$ integer, is the target subsystem which will be reprogrammed. The remaining bytes are all unsigned $8b$ integers representing the major, minor, and patch version associated with the binary. This is in alignment with the communication protocol[1] reprograming definition, Section 3.2.2.

Byte Offset	0x00	0x01	0x02	0x03	0x04
0x00	0x02	0x00: ADCS 0x01: IFJR 0x02: IHU 0x03: PMIC 0x04: Comms 0x05: Payload 1 0x06: Payload 2 0x07: Payload 3	Major	Minor	Patch

2.3.2 IFJR to IHU

The ADCS replies with an error code defined in Code SOP 6.4.1[2].

2.4 Send Binary to IFJR

This command will send a fully packaged binary from the IHU to IFJR.

[1] https://github.com/CougsInSpace/CougSat1-Software/blob/master/CougSat1-IHU/docs/CommunicationProtocol.pdf
[2] https://github.com/CougsInSpace/Resources/blob/master/StandardOperatingProcedures/Code.pdf

2.4.1 IHU to IFJR

The first byte is the command ID, `0x03`. The next parameter is a $32b$ unsigned integer representing the size with $1B/LSB$. The following bytes contain the data of the binary.

Byte Offset	0x00	0x01	0x02	0x03	0x04	0x05	0x06	0x07
0x00	0x03	Size of Binary				Data…	Data…	Data….

2.4.2 IFJR to IHU

The IFJR replies with an error code defined in Code SOP 6.4.1[3].

[3]ibid

3 Example Communication

3.1 Data Request for Location

IHU: [0x1F] 0x00 [IFJR write] temperature request

IFJR reads temperature and stores data in its buffer

IHU: [0x20] [IFJR read]

IFJR: 0x5A $90°C$

3.2 Repeated Data Request

IHU: [0x1F] 0x01 [IFJR write] storage capacity used request

IFJR reads capacity and stores data in its buffer

IHU: [0x1F] 0x00 [IFJR write] IFJR Processor Temperature Request

IFJR collects the processors temperature

IHU: [0x20] [IFJR read]

IFJR: 0x5A $90°C$

3.3 Reprogramming Command

IHU: [0x1F] 0x0200010203 [IFJR write] begin process of reprogramming

IFJR checks with ADCS and begins flashing ADCS binary v1.2.3

IHU: [0x20] [IFJR read]

IFJR: 0x00 Success