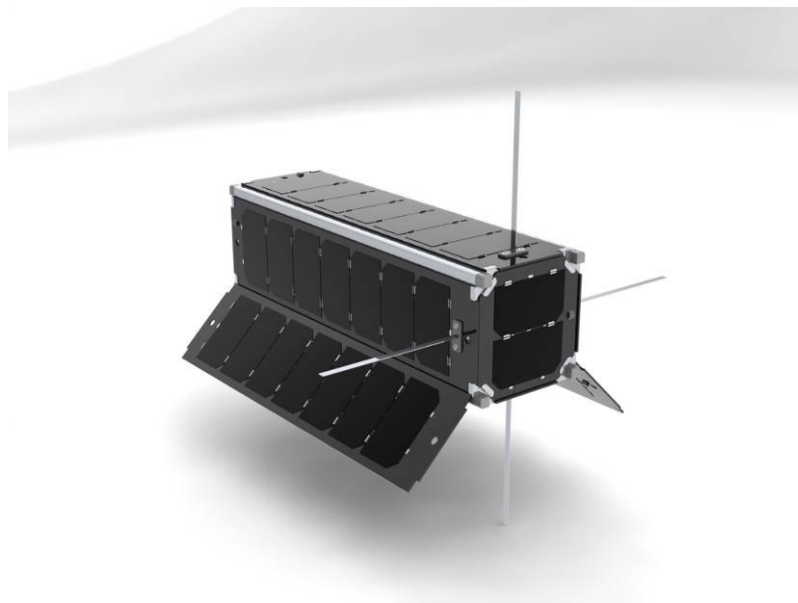


UKube-1 Program

Payload Protocol & Packet Definition

Technical Note 009 / Issue C

Public



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1 OVERVIEW

All Commands and Responses between the Primary Payload and Platform shall be routed through a single Payload Controller, implemented within the payload by the Payload Provider. Two data bus lines are available to the Payload Controller: Payload I2C and Comms SPI. The former is a required interface, and the latter an optional interface.

All commands shall follow a common standard packet format as defined in Figure 1.

The Payload Controller shall be compatible with nine Commands received via the Payload I2C data bus, and if implemented respond to data requests via the Comms SPI. Additional Commands may be defined for specific payloads, subject to confirmation by the Platform Provider. All commands shall be responded to.

Payload data successfully received shall be acknowledged by the Platform I2C so the Payload may retain / discard as appropriate.

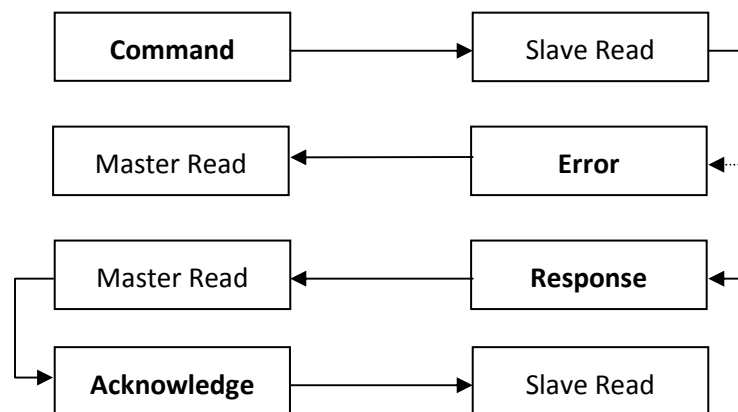


Figure 1; UKube-1 Standard Packets

The Payload shall always be a slave on the Payload I2C and Comms SPI data buses and therefore only issue Responses. The first two bytes of any packet constitute the header and are mandatory for both commands and responses.

1.1 Payload Packet Concept

The UKube-1 standard packet is intended for basic communications with low overhead, but with future compatibility for more complex packet framing. For the Payload, only basic functionality is required.

With regard the packet format, the first byte defines the Command Code, and the second part is reserved for further definition of the packet. The Body is mandatory with the exception of when an Error code is returned by a payload, or when an Acknowledge CRC is returned by the master. Acknowledges indicate that a data packet is received and successfully passed checks.

CRC shall be included in all the commands and responses received by payloads. The acknowledge shall not contain a CRC check. The flag within the header should be set, although there is no check.

Error codes shall be defined as required by the Payload Provider.

All packet lengths are determinate. Payload Data packets contain 256 Bytes of data. The maximum length of any data packets is 264 Bytes, **although the maximum length for payloads is 260 Bytes**. The maximum length of data packet received by the Payload shall be 32 Bytes.

Backwards compatibility with existing Clyde Space and ISIS command formats is maintained by evaluation of the initial command byte (this is not apparent to Payloads). Forwards compatibility will be implemented within the additional reserved byte to extend commands and potential formats.

1.2 Payload Command Concept

The Payload Controller shall respond to the following commands on the Payload I2C data bus.

1. Payload Operation Initialise; to initialise the Payload Controller into a specific operating mode and set operational parameters following switch-on of the payload power lines.
2. Payload Operation Status; to poll the Payload Controller for current status at a frequency of 1-60 s whilst the payload is active.
3. Payload Operation Update; to reinitialise or update the Payload Controller into a specific operation mode, or to update operational parameters.
4. Payload Parameter Write; to set a specific parameter value within the Payload Controller.
5. Payload Parameter Read; to get a specific parameter value from the Payload Controller.
6. Payload Priority Data Receive; to receive priority data from the Payload Controller and transfer to mass memory for downlink.
7. Payload Data Receive; to receive any data from the Payload Controller and transfer to mass memory for downlink.
8. Payload SPI Data Transfer; to prepare the Payload Controller for transferring data via the Comms SPI.
9. Payload Shutdown; to warn the Payload Controller of imminent (+30 s) shutdown of the payload power lines.

1.3 SPI Implementation

The packet format shall simply be sent as data over SPI links, with the Slave Select line held in an active position for the full duration of the packet. Data received by a slave which is shorter than expected shall be discarded and an appropriate error condition returned within the next Slave to Master command. Similarly if data is received with an incorrect CRC check, then the data shall also be discarded and an appropriate error condition returned within the next Slave to Master command.

1.4 I2C Implementation

The packet format shall be sent as data over I2C links. As per the I2C standard, the data shall be preceded by the slave device address (7-bits) and a single read/ write bit (1-bit). Data received by a slave which is shorter than expected shall be discarded and an appropriate error condition returned within the next

Slave to Master command. Similarly if data is received with an incorrect CRC check, then the data shall also be discarded and an appropriate error condition returned within the next Slave to Master command.

If a CRC is received by the Master then the command may be repeated. In the event of payload data, the Master confirms receipt with an acknowledge.

1.5 Definition

0x00	Indicates hexadecimal values
0b00000000	Indicates binary values
[003 – 004]	Corresponds to bytes 3 to 4 within the packet.

Due to the presence of headers in every packet, the parameter fields always start at byte 002.

0x9001 Payload Operations Initialise

COMMAND : [Payload Operation Initialise](#)
HEADER : [0x9000](#)

DESCRIPTION : [Initialisation command for payload to enter](#)

Command Parameters	Length	Var	Format	Range	Resolution	Description
[002 - 002] Payload Operation Mode	1		unsigned char	0x00-0xFF		Payload Provider defined value, describing the operation mode for the payload. 0x00 is always the wake-up mode.
[003 - 004] Payload Operation Flag	2		16-bit flag	16-bit flag		Payload Provider defined flags, for use with the operation mode for configuring the payload
[005 - 008] Onboard Time	4		time	0-4.2E6 s 0-999 ms	1 ms	Onboard time with second synchronised to the synchronisation pulse
[009 - 010] Payload Priority Data Limit	2		unsigned int	0-16 MB	256 B	Data limit for current operations that will be accepted as Priority Data in units of 256 B
[011 - 012] Payload Priority Data Remaining	2		unsigned int	0-16 MB	256 B	Remaining data for current operations that will be accepted as Priority Data in units of 256 B
[013 - 016] Payload Mass Memory Limit	4		unsigned long	0-4096 MB	256 B	Mass memory limit in platform available for use by the Payload
[017 - 020] Payload Mass Memory Remaining	4		unsigned long	0-4096 MB	256 B	Remaining mass memory in platform available for use by the Payload
[021 - 022] Payload Poll Frequency	2		unsigned short	1-60000 ms	1 ms	Frequency at which Platform will issue Payload Status command

Response Parameters

[none](#)

0x9101 Payload Operation Status

COMMAND : **Payload Operation Status**
 HEADER : **0x9100**

DESCRIPTION : **Poll Payload for current status**

Command Parameters	Length	Var	Format	Range	Resolution	Description		
none								
Response Parameters								
[002 - 002]			Payload Operation Mode	1	unsigned char	0x00-0xFF	Payload Provider defined value, describing the operation mode for the payload. 0x00 is always the wake-up mode.	
[003 - 004]			Payload Operation Flag	2	16-bit flag	16-bit flag	Payload Provider defined flags, for use with the operation mode for configuring the payload	
[005 - 006]			Payload Priority Data Waiting	2	unsigned int	0-16 MB	256 B	Priority Data in Payload waiting for transfer in units of 256 B
[007 - 010]			Payload Data Waiting	4	unsigned long	0-16 MB	256 B	Total data in Payload waiting for transfer
[011 - 011]			Payload Request	1	8-bit flag	8-bit flag		Payload request flags (from MSB: 0 = Payload Update; 1 = Next Mode; 2 = Disable Compression; 3 = Stream Ready; 6 = Reset Payload; 7 = Shutdown)
[012 - 012]			Payload Parameter ID	1	unsigned char	0x00-0xFF		Parameter ID for associated parameter value
[013 - 013]			Payload Parameter ID	1	unsigned char	0x00-0xFF		Parameter ID for associated parameter value
[014 - 014]			Payload Parameter ID	1	unsigned char	0x00-0xFF		Parameter ID for associated parameter value
[015 - 015]			Payload Parameter ID	1	unsigned char	0x00-0xFF		Parameter ID for associated parameter value
[016 - 016]			Payload Parameter ID	1	unsigned char	0x00-0xFF		Parameter ID for associated parameter value
[017 - 017]			Payload Parameter ID	1	unsigned char	0x00-0xFF		Parameter ID for associated parameter value
[018 - 018]			Payload Parameter ID	1	unsigned char	0x00-0xFF		Parameter ID for associated parameter value
[019 - 019]			Payload Parameter ID	1	unsigned char	0x00-0xFF		Parameter ID for associated parameter value

0x9201 Payload Operation Update

COMMAND : **Payload Operation Update**
 HEADER : **0x9200**

DESCRIPTION : **Update Payload into operational mode**

Command Parameters	Length	Var	Format	Range	Resolution	Description
[002 - 002] Payload Operation Mode	1		unsigned char	0x00-0xFF		Payload Provider defined value, describing the operation mode for the payload. 0x00 is always the wake-up mode.
[003 - 004] Payload Operation Flag	2		16-bit flag	16-bit flag		Payload Provider defined flags, for use with the operation mode for configuring the payload
[005 - 008] Onboard Time	4		time	0-4.2E6 s 0-999 ms	1 ms	Onboard time with second synchronised to the synchronisation pulse
[009 - 010] Payload Priority Data Limit	2		unsigned int	0-16 MB	256 B	Data limit for current operations that will be accepted as Priority Data in units of 256 B
[011 - 012] Payload Priority Data Remaining	2		unsigned int	0-16 MB	256 B	Remaining data for current operations that will be accepted as Priority Data in units of 256 B
[013 - 016] Payload Mass Memory Limit	4		unsigned long	0-4096 MB	256 B	Mass memory limit in platform available for use by the Payload
[017 - 020] Payload Mass Memory Remaining	4		unsigned long	0-4096 MB	256 B	Remaining mass memory in platform available for use by the Payload
[021 - 022] Payload Poll Frequency	2		unsigned short	1-60000 ms	1 ms	Frequency at which Platform will issue Payload Status command
Response Parameters						
none						

0x9301 Payload Parameter Write

COMMAND : Payload Parameter Write
 HEADER : 0x9300

DESCRIPTION : Provide parameter to the Payload

Command Parameters	Length	Var	Format	Range	Resolution	Description	
[002 - 002]			Payload Parameter ID	1	unsigned char	0x00-0xFF	Parameter ID for associated parameter value
[003 - 004]			Payload Parameter Value	2	unsigned short	0x0000-0xFFFF	16 bit parameter value passed to the Payload
Response Parameters			none				

0x9401 Payload Parameter Read

COMMAND : Payload Parameter Read
 HEADER : 0x9400

DESCRIPTION : Provide parameter to the Payload

Command Parameters	Length	Var	Format	Range	Resolution	Description
[002 - 002] Payload Parameter ID	1		unsigned char	0x00-0xFF		Parameter ID for associated parameter value
Response Parameters	Length	Var	Format	Range	Resolution	Description
[002 - 003] Payload Parameter Value	2		unsigned short	0x0000-0xFFFF		16 bit parameter value passed to the Payload

0x9501 Payload Priority Data Transfer

COMMAND : Payload Priority Data Transfer

HEADER : 0x9500

DESCRIPTION : Transfer of priority data to mass memory

Command Parameters	Length	Var	Format	Range	Resolution	Description	
none							
Response Parameters							
[002 - 257]			Payload Data	256	user defined	256 * (0x00-0xFF)	User defined Payload Data packet
Acknowledge Parameters							
[000 - 001]			CRC Return	2	unsigned int	0x00-0xFF	

0x9601 Payload Data Transfer

COMMAND : **Payload Data Transfer**

HEADER : **0x9600**

DESCRIPTION : **Transfer of any data to mass memory**

Command Parameters	Length	Var	Format	Range	Resolution	Description	
none							
Response Parameters							
[002 - 257]			Payload Data	256	user defined	256 * (0x00-0xFF)	User defined Payload Data packet
Acknowledge Parameters							
[000 - 001]			CRC Return	2	unsigned int	0x00-0xFF	

0x9701 Payload SPI Data Transfer

COMMAND : Payload SPI Data Transfer
HEADER : 0x9700

DESCRIPTION : Prepare Payload for Data Transfer via SPI

Command Parameters	Length	Var	Format	Range	Resolution	Description	
[002 - 002]			SPI Transfer Settings	1	unsigned char	0x00-0xFF	Specifies the settings and expected response by the slave next time the slave select is enabled. 0x00 indicates data only, in units of 256 B at 1 Mbps.
Response Parameters RESPONSE VIA SPI none							
Acknowledge Parameters							
[000 - 001]			CRC Return	2	unsigned int	0x00-0xFF	

0x9F01 Payload Shutdown

COMMAND : Payload Shutdown
HEADER : 0x9F00

DESCRIPTION : Update Payload into operational mode

Command Parameters	Length	Var	Format	Range	Resolution	Description
none						
Response Parameters						
none						