DCP COMMAND LINK

DATA FRAME DESIGN

SPECIFICATIONS

V0.1

23 Oct 2009

22400 Davis Drive
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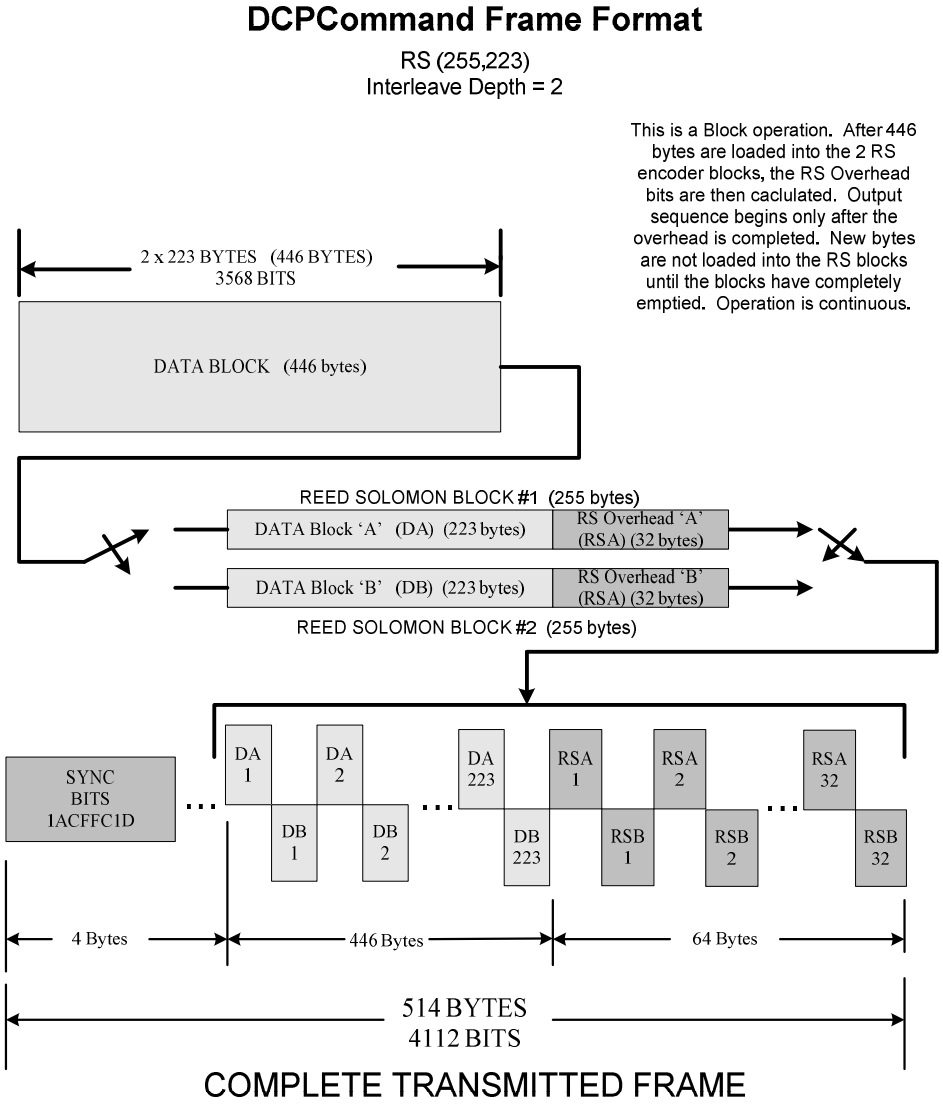
703-406-2800

DATA FRAME RECOMMENDED DESIGN

The GOES DCP COMMAND will utilize the recommended data format where possible specified by the Consultative Committee for Space Data Systems (CCSDS). The basic frame will consist of 2 standard Reed Solomon codeblocks each 255 bytes in length. These two codeblocks are then interleaved with each other to creating a larger block that is more resistant to burst errors. The CCSDS recommended Attached Sync Marker (ASM) is then attached to the already encoded data frame and correction bytes.

TOTAL FRAME (514 Bytes)

CCSDS Sync Word (4 bytes)	DATA (446 bytes)	RS Correction (64 bytes)



The bottom portion of the diagram explains how the interleaving of the data block(s) and RS overhead is accomplished. Note that the sync bits are NOT part of the interleaving process. In the above example, the RS calculations on Block 1 are calculated independently of Block 2.

DOWNLINK MESSAGE PACKET DEFINITION

OVERALL FRAME DETAIL SUMMARY:

	ITEM	LENGTH (Bytes)	LENGTH (Bits)	Comments
1	Overall Frame Length	514	4112	
2	Sync Word Length	4	32	
3	Data Block Length	446 (2x223)	3568	
	a. Header	8	64	
	b. Data	438	3504	
5	RS Overhead	64 (2x32)	512	

	ITEM		Seconds	
6	Transmit Data Rate	342.66667 Hz		with Overhead
7	Frame Transmit Rate	4112 / 342.66667	12.0000	5 Frames/Min

	ITEM			
8	Number of Short Commands per Frame	73		
9	Number of Short Commands per Hour	21,900		
10	Number of Short Commands per Day	525,600		

FRAME STRUCTURE:

Repeat the following block with no gaps between blocks.

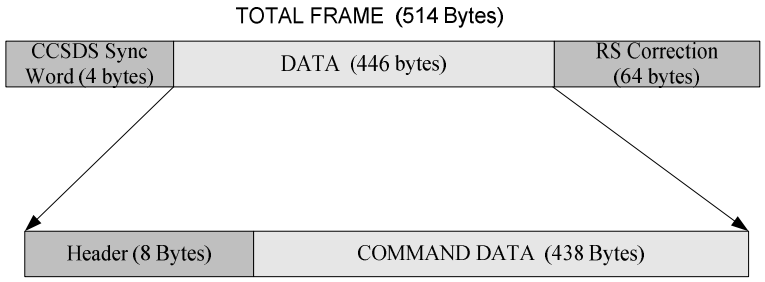
Name	Length (bytes)	Description
CCSDS Sync Marker (Attached Sync Marker)	4 bytes	Sync pattern identifying start of block
RS Block Data	446 bytes	Fixed length block of data 2 frames interleaved of 223 bytes each
RS Correction Bits	64 bytes	Reed/Solomon error correcting code 32 bytes each frame for total 64 bytes
TOTAL LENGTH	514 bytes (4112 bits)	2 RS blocks = 510 bytes + 4 byte Sync

CCSDS Sync Word (Attached Sync Marker or ASM) :

Name	Length (bytes)	Format	Description
Sync Word	4 bytes	4 byte CCSDS	1ACFFC1D (Hex)

Reference Figure 6-1 on page 6-2 in CCSDS 131.0-B-1

DATA FRAME DETAILS:



Header :

Offset (bit)	Name	Length (bits)	Format	Description
0	Time	16	3bit ID/13 bit data 000 / Year 001 / Day-Hour 010 / Min-Sec 011 / Milliseconds 100 / Future(TBD)	16 bit UTC Time Segment (examples for 13 bit data): ex. 7DA H = 2010 ex 3EA H (1002d) = Feb 10, 18 hours ex 8E2 H (2274d) = 37 min 54 seconds ex. 00 H = 000 ms = 00 H (see note 1,2)
16	AddLeap	1	0 = no leap 1 = leap	1=add a leap second at 00:00:00 UTC January 1st of the next year. (see note 3)
17	SubLeap	1	0 = no leap 1 = leap	1=subtract a leap second at 00:00:00 UTC January 1st of the next year. (see note 3)
18	Command Data Type (CDT)	6	binary	'00'H Commands '01'H No Commands (Fill only) '02'H Urgent Cmd '03'H - '3F'H TBD (Future)
24	Source	4	binary ..00 = Wallops ..01= Fairbanks ..10= etc	Uplink Data Source Generation
28	Satellite Longitude Subpoint	12	binary	Binary value representing the location of the Satellite representing Longitude in deg West.
40		24		Reserved (Future)
	TOTAL	64 (8 bytes)		

Command Block : (referred to as Command Block or 'CB')

Offset (bit)	Name	Length (bits)	Format	Description
0	Grp/Addr	1	binary	1=group 0=address
1	ID	21	binary	21 bit destination group or address
22	Command	8	binary	Predefined commands, see Command Document
30	Authentication	16	binary	Use ID and TIME and key to authenticate command
46	ReplyRqst (see fixed 6 byte reply block)	1	binary	0=no reply (no 6 byte extension) 1=reply. See Reply Channel Information below. (see note 5)
47	Command Extension	1	binary	0=no extension 1= See Extension following Reply Channel Information if requested.
	TOTAL	48 (6 Bytes)		Possibility of 73 (basic short) commands at 6 bytes each

Reply Channel Information: (optional)

0	[replyslot] Fixed 6 byte extension	48	see description	2 bits baud: '00'x=100 '01'x=300 '10'x=1200 '11'x=future use 11 bits channel: binary channel number 17 bits time: seconds into day? 8 bits reply length (256 seconds max) 10 spare (TBD)
	TOTAL	48 (6 Byte)		

Extended Command Specific Data Block (XCB): (optional)

0	[Cvalues]	16	Binary value ranging from 4 to 424 bytes	Defines <u>exact</u> amount of data sent (XCB) (not counting the 16 bits of this field). This data size does not have to be in a block size divisible by 48 bits (6 bytes). (See note 4)
16-3472		32 to 3456 bits (4 to 424 bytes)		Extended Command Specific Data. The system will round up to a 6 byte boundary with zeros (0's) stuffing.
	TOTAL	16 to 3472 (6 bytes to 426 bytes)		Increments of 6 bytes only**

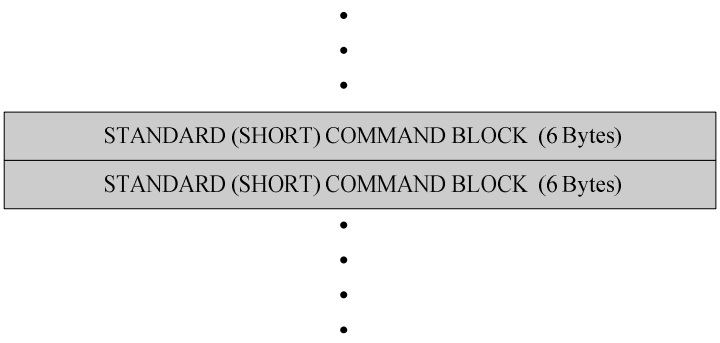
Notes:

1. The time value gives the UTC time at the start of the first bit of the CCSDS sync word. The time may be synchronized to the UTC so that the seconds are zero. However, because of leap seconds, the seconds value may take on other values such as 59 or 01 indicating that the frame is no longer synchronized to the UTC. This eliminates the need to stop and restart the data system when leap seconds occur. The millisecond value allows the exact time to be known even if the frame is not exactly synchronized to the UTC second. Note that intentions will be to synchronize the frames to the second such that the transmitted millisecond field will always be zero. In the event that the Wallops uplink is unable to maintain frame timing, this field will be available for fine adjustments. The Wallops uplink system will be responsible for the accuracy of the synchronization. This is analogous to how the GPS system maintains a 'UTC offset' and adjusts that value when a leap second occurs. The only difference is the UTC offset is included into the time value sent.
2. One 16 bit field will be sent each frame. The five fields above will be sent in sequential frames in the order defined above yielding a complete time arrangement every 1 minute. The frame will be synchronized to the precise value of the time transmitted at the end of the 5^{th} frame and before the start of the 1^{st} frame. Restated, the time included in the last 5 frames containing all 5 expected time fields will constitute the correct time at the start of the next frame.
3. The uplink system will give an advanced notice of a UTC shift allowing it to automatically adjust the time without receiving a new time value. This also will permit a leap second warning command to be sent to the Data Collection Platform to notify it in advance about the leap second such that the time adjustment may be accomplished exactly at the 00:00:00 time. This will prevent a DCP from transmitting in error while it would have to wait for a new time stamp in the new day.
4. The 16 bit value at the beginning of the XCB reflects exactly the amount of data to be transferred which may be any length that will fit into the frame. However, when the packet is transmitted, the Wallops uplink system will automatically transmit the data in a block size that is large enough to send the requested data that is divisible by 48 bits (6 bytes). For example, if a user wanted to send 79 bytes, the system would round the transmitted block up to 84 bytes and zero fill any unused bytes.
5. Command acknowledgement will be accomplished by setting a flag bit in the next scheduled transmission in the Data Collection Platform. This shall be a 'zero bandwidth' default requirement for normal commands that would not require a specific acknowledgement command. Any command justifying a reply transmission for acknowledgement or other purposes may be used although this is not recommended unless absolutely necessary to have a timely acknowledgement.

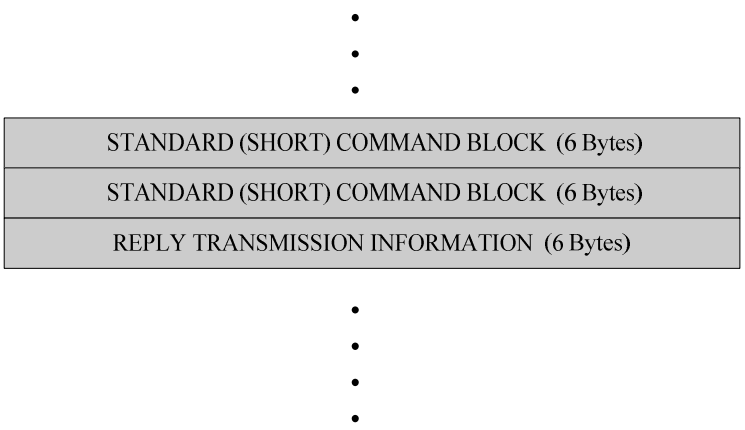
EXAMPLE FRAME SEGMENTS:

Below are 4 examples of how messages are compiled together. Short messages, long messages and messages that may have large blocks of data may follow these examples.

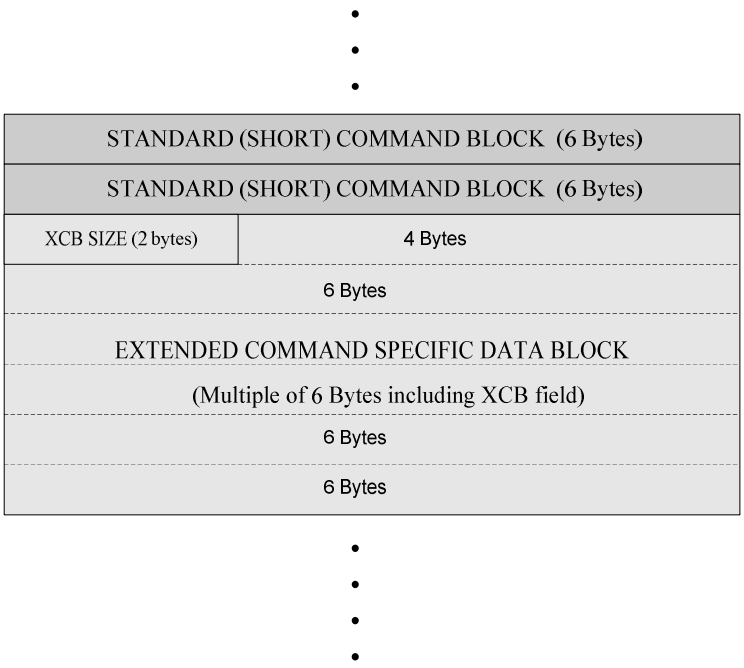
1) Typical string of 6 Byte commands.



2) Command with a Reply Slot Data shown:



3) Command with an Extended Command Specific Data Block:



4) Command with Reply and Extended Command Specific Data Block: