

Version History		
Code	Date	Description
a	11/13/1997	CDR version (see pp PJG-57 thru PJG-64
b	1/26/1998	Ground System / POC Working group
c	<i>1/14/1999</i>	<i>Update to support USN ICD</i>
d	<i>1/25/1999</i>	<i>interim correction to Table 2</i>

TIMED Telemetry and Command Data Structures

Paul Grunberger
The Johns Hopkins University
Applied Physics Laboratory
11100 Johns Hopkins Road
Laurel, MD 20723-6099

(240) 228-6405
grunberger@jhuapl.edu

General Notes

1) *Changes since Version "b" are in italics.*

Table 1. TIMED Telemetry Packet (TP) Structure

	net lengths (bits)	Portion of Total Length	Rollup Lengths (bits)	Rollup Lengths (Bytes)	Portion of Total Length
• Ground Receipt Header [see Table 3]					
> Packet Primary Header			48	6	2.3%
<i>Version Number</i>	3	0.1%			
Packet Identification Field:		0.0%			
Type Indicator	1	0.0%			
Packet Secondary Header Flag	1	0.0%			
Application Process Identifier	11	0.5%			
Packet Sequence Control Field:					
Grouping Flags	2	0.1%			
Source Sequence Count	14	0.7%			
Packet Data Length Field	16	0.8%			
> Packet Data Field			2048	256	97.7%
Packet Secondary Header					
Packet Secondary Header Time Code Field					
CCSDS Unsegmented Time Code [Note 2]					
coarse time (seconds)	32	1.5%			
fine time (sub-seconds) [Note 3]	16	0.8%			
Source Data	2000	95.4%			
Totals:	2096	100.0%	2096	262	100.0%

PJG, 1/23/98

- [1] A TIMED Telemetry Packet (TP) is a specialization of the Source Packet defined in CCSDS 102.0-B-4.
- [2] a.k.a. "Spacecraft Time." T-Field only (see CCSDS 301.0-B-2, ¶2.2.1). Epoch is 00:00 hrs, January 6, 1980 (the GPS Epoch).
- [3] Optional; add 2 Bytes to Source Data if not present. If present, the required resolution is 2^{-8} sec for one byte and 2^{-16} sec for two bytes.

Table 2. TIMED Telemetry Data Format

	Modes 3a, 3b [Note 4]	Mode 2	Modes 1a, 1b			
Approximate information rate(s)	4, 2 Mb/s	9 kb/s	4, 2 Mb/s			
Reed-Solomon coding?	no	yes	yes			
Convolutional coding?	yes	yes	no			

	Itemized lengths (bits)	Itemized lengths (bits)	Itemized lengths (bits)	Rollup 1 (bits)	Portion of total length	Rollup 2 (bits)
What goes to convolutional encoder [Note 2]:						
• Attached Sync Marker	32	32	32	32	0.3%	32
• Transmitted Codeblock:						
> Transfer Frame [Note 3]						8560
Transfer Frame Primary Header				48	0.5%	
Transfer Frame Version Number	2	2	2			
Transfer Frame identification Field						
Spacecraft ID	10	10	10			
Virtual channel ID	3	3	3			
Operational Control field	1	1	1			
Master channel frame count	8	8	8			
Virtual channel Frame count	8	8	8			
Transfer frame Data Field Status						
Transfer Frame Secondary Header Flag	1	1	1			
Synch. Flag	1	1	1			
Packet order Flag	1	1	1			
Segment Length ID	2	2	2			
First Header Pointer	11	11	11			
Transfer Frame Secondary Header [Note 5]				80	0.8%	
Transfer Frame Secondary Header ID:						
Transfer Frame Secondary Header Version No ("00")	2	2	2			
Transfer Frame Secondary Header length ("00 1001")	6	6	6			
spare bits	8	8	8			
Transfer Frame Secondary Header Data:						
CCSDS Unsegmented Time Code [Note 6]						
coarse time (seconds)	32	32	32			
spare bits	16	16	16			
Solid-State Recorder (SSR) playback error flags						
SSR Error Summary Flag [Note 7]	1	1	1			
diagnostic data (all "0" if Error Summary Flag = 0)	15	15	15			
Transfer Frame Data Field:				8384	84.9%	
Source Packet (1 of 4)	2096	2096	2096			
Source Packet (2 of 4)	2096	2096	2096			
Source Packet (3 of 4)	2096	2096	2096			
Source Packet (4 of 4)	2096	2096	2096			
Operational Control field	32	32	32	32	0.3%	
Frame Error Control Field [Note1]	16	16	16	16	0.2%	
> Reed-Solomon Check Symbols	none	1280	1280	1280	13.0%	1280
Totals:	8592	9872	9872	9872	100.0%	9872

PJG, 1/25/99

- [1] This field was added on 8-28-97 to permit the use of Modes 3a and 3b, which were subsequently dropped. Modes 3a and 3b had no Reed-Solomon coding. CCSDS considers this field optional when Reed-Solomon coding is present, but mandatory otherwise.
- [2] or, to Convolutional Encoder Bypass. In either case, the data shall be randomized per CCSDS 101.0-B-3, ¶6.
- [3] Transfer Frame length is 8560 b = 1070 B. A multiple of 5 B is preferred by formatter card designers for R-S interleave of 5, although it may be possible to remove this restriction with no penalty.
- [4] Modes 3a and 3b are available by design, but not now planned for use in TIMED
- [5] This is a new length, modified on 8-28-97 to maintain Transfer Frame length at an even multiple of 5 B. See note 3
- [6] a.k.a. "Spacecraft Time". T-Field only (see CCSDS 301.0-B-2, ¶2.2.1).
Epoch is 00:00 hrs, January 6, 1980 (the GPS Epoch).
- [7] 0 if all four source packets are free of SSR errors, "1" if there is a suspected SSR error in one or more packets

Table 3. TIMED Supplemented Telemetry Frame (STF) Structure

	net lengths (bits)	Net lengths (Bytes)	Portion of Total Length	Rollup 1 Lengths (Bytes)	Rollup 2 Lengths (Bytes)	Portion of Total Length
• Ground Receipt Header [see Table 3]					22	2.0%
> generic fields:				4.750		
<i>Size [of STP]</i>	16	2.000	0.2%			
Data Type	8	1.000	0.1%			
spare bits	8	1.000	0.1%			
GRH Version ID	6	0.750	0.1%			
> mission-specific fields:				17.250		
Spacecraft ID	10	1.250	0.1%			
Ground Receipt Time	32	4.000	0.4%			
Ground Receipt Time Vernier	32	4.000	0.4%			
Frame Source Type	4	0.500	0.0%			
Frame Source Index	4	0.500	0.0%			
Path	4	0.500	0.0%			
Front-end Identifier	4	0.500	0.0%			
Reed-Solomon Decode Flag	1	0.125	0.0%			
Reed-Solomon Error Status	1	0.125	0.0%			
Reed-Solomon Error Count	7	0.875	0.1%			
CRC Flag	1	0.125	0.0%			
CRC Error Flag	1	0.125	0.0%			
Master Channel Sequence Checked	1	0.125	0.0%			
Master Channel Sequence No. Error	1	0.125	0.0%			
Frame Sync Mode	2	0.250	0.0%			
Frame Quality Flag	1	0.125	0.0%			
Frame Sync Pattern Errors	4	0.500	0.0%			
Frame Sync Bit Slips	4	0.500	0.0%			
Archive flag	1	0.125	0.0%			
SSR Playback Error	1	0.125	0.0%			
spare bits	22	2.750	0.3%			
• Attached [Frame] Sync Marker	32	4.000	0.4%	4.000	4	0.4%
• Transfer Frame					1070	97.6%
> Transfer Frame Primary Header	48	6.000	0.5%	6.000		
> Transfer Frame Secondary Hdr [see Table 2]	80	10.000	0.9%	10.000		
> Transfer Frame Data Field [see Table 2]	8384	1048.000	95.6%	1048.000		
> Operational Control Field				4.000		
Command link Control Word [Note 1]						
Control Word Type (= "0")	1	0.125	0.0%			
CLCW Version Number (= "00")	2	0.250	0.0%			
Status Field	3	0.375	0.0%			
COP in Effect (= "01" for COP-1)	2	0.250	0.0%			
Virtual Channel ID	6	0.750	0.1%			
spare (= "00")	2	0.250	0.0%			
Flags						
No RF Available	1	0.125	0.0%			
No Bit Lock	1	0.125	0.0%			
Lockout	1	0.125	0.0%			
Wait	1	0.125	0.0%			
Retransmit	1	0.125	0.0%			
FARM B Counter [for Type B Frames]	2	0.250	0.0%			
spare (= "0")	1	0.125	0.0%			
Report Value [for Type AD frames]	8	1.000	0.1%			
> Frame Error Control Field	16	2.000	0.2%	2.000		
Totals:	8768	1096.000	100.0%	1096.000	1096	100.0%

PJG, 1/14/99

[1] as defined in CCSDS 202.0-B-2, ¶4.2.2

Table 4. TIMED Ground Receipt Header (GRH) Format

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Field	Offset (b)	Length (b)	Length (Bytes)	Description
Size	0	16	2.000	Size of this object including headers in bytes, unsigned integer in MSB first order (max = 65535)
Data Type	16	8	1.000	type of data object, 1 = STF, 2 = STP, 3 = PTP
spare bits	24	8	1.000	undefined
GRH Version ID	32	6	0.750	Version Identifier associated with this GRH format. (Decimal number, where this version = 2)
Spacecraft ID	38	10	1.250	CCSDS Spacecraft ID assigned to TIMED (= Binary 000111100011, Hex1E3)
Ground Receipt Time	48	32	4.000	Ground receipt time in elapsed seconds since 00:00:00 UTC January 6, 1980, in MSB first order
Gnd Rcpt Time Vernier	80	32	4.000	Microsecond offset from Ground Receipt Time, in MSB first order
Frame Source Type	112	4	0.500	0001 - Emulator/Mini-MOC 0010 - Simulator 0011 - Loop-Back 0100 - spacecraft 0101 - GSE 0110 - unused 0111 - unused 1000 - User-Defined 1001 thru 1111 - unused
Frame Source Index	116	4	0.500	for frame source type 0001 (Emulator/Mini-MOC): 0001 - GUVI Spacecraft Emulator 0010 - SABER Spacecraft Emulator 0011 - SEE Spacecraft Emulator 0100 - TIDI Spacecraft Emulator 0101 - GNS Mini-MOC 1 0110 - GNS Mini-MOC 2 0111 - G&C Mini-MOC 1 1000 - G&C Mini-MOC 2 1001 - IEM Mini-MOC 1 1010 - IEM Mini-MOC 2 for frame source type 0010 (Simulator): 0001 - TOPS 0010 - Software Simulation for frame source type 0011 (Loop-Back): 0001 - FE Hardware Simulation for frame source type 0100 (Spacecraft): 0001 - Spacecraft 0001 GSE 0010 MPCF sc1_rt instance 0011 MPCF sc2_rt instance 0100 MPCF dev instance 0101 MPCF tops instance 0110 MPCF iem_mm1_rt instance 0111 MPCF iem_mm2_rt instance (where MPCF=MOC/POC Command Filter: sc1_rt, sc2_rt, dev, tops, iem_mm1_rt, and iem_mm2_rt = EPOCH stream names) for frame source type 1000 (User-Defined): 0000 thru 1111 - User-Defined
Path	120	4	0.500	other path information (0000 for now)

(Continued on next page)

(Table 4, TIMED Ground Receipt Header, cont'd)

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Field	Offset (b)	Length (b)	Length (Bytes)	Description
Front-end Identifier	124	4	0.500	0001 - FE1 (bench-testing) 0010 - FE2 (I&T) 0011 - FE3 (primary ground station) 0100 - FE4 (spare) 0101 - G&C 0110 - GPS 0111 - MOC 1000-1101 - LEO-T or other off-site 1110-1111 - unused (Note that front end assignments will be finalized later.)
Reed-Solomon (R-S) Decode Flag	128	1	0.125	0 = disabled 1 = enabled
R-S Error Status [Ers]	129	1	0.125	0 = frame uncorrectable 1 = frame correct or corrected
R-S Error Count	130	7	0.875	0 = no error needed correction 1..80 count of corrected errors 81..127 unused
CRC Flag	137	1	0.125	0 = CRC disabled 1001 thru 1111 - unused
CRC Error Flag [Ecrc]	138	1	0.125	0 = CRC failed 1 = CRC passed
Master Channel Sequence Checked	139	1	0.125	0 = not checked/unknown 1 = sequence number checked
Master Channel Sequence Number Error	140	1	0.125	0 = sequence number increased by one 1 = sequence number increased by two or more
Frame Sync Mode	141	2	0.250	00 = search 01 = check 10 = lock 11 = flywheel
Frame Quality Flag [Ef = Ers or Ecrc or Essr]	143	1	0.125	0 = data is suspect 1 = data is correct (Used to determine if the frame quality is acceptable for output to client who requests only "good" data; "Good Data" = No RS Error & No CRC Error & No SSR Playback Error)
Frame Sync Pattern Errors	144	4	0.500	Number of errors detected in Frame Sync Marker
Frame Sync bit slips	148	4	0.500	0000 = no slip 1001 = 1 bit late 1010 = 2 bits late 1011 = 3 bits late 1101 = 1 bit early 1110 = 2 bits early 1111 = 3 bits early
Archive Flag	152	1	0.125	0 = do not archive 1 = archive
SSR Playback Error [Essr]	153	1	0.125	0 = no Spacecraft Solid State Recorder (SSR) playback error 1 = error
spares	152	22	2.750	undefined
Totals:		176	22.000	

Table 5. TIMED Supplemented Telemetry Packet (STP) Structure

	net lengths (bits)	Net Lengths (Bytes)	Portion of Total Length	rollup lengths (bits)	Rollup Lengths (Bytes)	Portion of Total Length
• Ground Receipt Header [see Table 3]	176	22.000	7.1%	176	22.000	7.1%
• Attached [Frame] Sync Marker	32	4.000	1.3%	32	4.000	1.3%
• Transfer Frame non-data-field excerpts:				176	22.000	7.1%
Transfer Frame Primary Header	48	6.000	1.9%			
Transfer Frame Secondary Header	80	10.000	3.2%			
Operational Control Field	32	4.000	1.3%			
Frame Error Control Field	16	2.000	0.6%			
• Transfer Frame Data Field excerpt:				2096	262.000	84.5%
> Source Packet (any one of 4)						
Packet Primary Header	48	6.000	1.9%			
Packet Data Field:						
Packet Secondary Header						
Pkt Sec Hdr Time Code Field [Note 1]						
CCSDS Unsegmented Time Code						
coarse time	32	4	1.3%			
fine time [Note 2]	16	2	0.6%			
Source Data	2000	250.000	80.6%			
Total :	2480	310.000	100.0%	2480	310.000	100.0%

PJG, 2/3/98

[1] See Table 1 for definitions

[2] Optional; add 2 Bytes to Source Data if not present.

Table 6. TIMED POC Telemetry Packet (PTP) Structure

	net lengths (bits)	Net Lengths (Bytes)	Portion of Total Length	rollup lengths (bits)	Rollup Lengths (Bytes)	Portion of Total Length
• Ground Receipt Header [see Table 3]	176	22.000	7.7%	176	22.000	7.7%
• Attached [Frame] Sync Marker				2096	262.000	92.3%
> Source Packet (any one of 4)						
Packet Primary Header	48	6.000	2.1%			
Packet Data Field:						
Packet Secondary Header						
Pkt Sec Hdr Time Code Field [Note 1]						
• Transfer Frame CCSDS Unsegmented Time Code						
coarse time	32	4.000	1.4%			
fine time [Note 2]	16	2.000	0.7%			
Source Data	2000	250.000	88.0%			
Totals:	2272	284.000	100.0%	2272	284.000	100.0%

PJG, 2/3/98

[1] See Table 1 for definitions

[2] Optional; add 2 Bytes to Source Data if not present.

Table 7. Command Packet (CP) Format

	length (bits)		Rollup Length (Bytes)	
	min	max	min	max
• Telecommand Packet [Note 1]:				
> Primary Header			6	6
Packet Identification:				
Version number	3	3		
Type	1	1		
Secondary header Flag	1	1		
Application process ID	11	11		
Packet Sequence Control:				
Sequence Flags	2	2		
Packet Name or Sequence Count	14	14		
Packet length	16	16		
> Application Data [Note 2]	8	32,000	1	4,000
Total:	56	32,048	7	4,006

PJG, 11/12/97

[1] A TIMED Command Packet (CP) is a specialization of the Telecommand Packet defined in CCSDS 203.0-B-1, ¶5.2.

[2] Any included Secondary Header is non-CCSDS defined; See CCSDS 203.0-B-1, ¶5.2. The maximum length here is limited by the TIMED program. A higher limit of 65,532 bytes is allowed by CCSDS 203.0-B-1, ¶5.2.1.3.

**Table 8. Command Frame (CF) for Software-Decoded Commands
(on Virtual Channels 2 and 3)**

	lengths (bits)		Lengths (Bytes)		Rollup Lengths (Bytes)	
	<i>min</i>	<i>max</i>	<i>min</i>	<i>max</i>	<i>min</i>	<i>max</i>
• Telecommand Frame [Note 1]:						
> [TC] Transfer Frame Header					5	5
Version Number	2	2	0.250	0.250		
Bypass Flag	1	1	0.125	0.125		
Control command Flag	1	1	0.125	0.125		
spare	2	2	0.250	0.250		
Spacecraft ID	10	10	1.250	1.250		
Virtual channel ID	6	6	0.750	0.750		
Frame Length	10	10	1.250	1.250		
Frame Sequence Number	8	8	1.000	1.000		
> Transfer Frame Data Field					2	1017
Telecommand Segment [Note 5]						
Segment Header						
Sequence Flags	2	2	0.250	0.250		
Multiplexer Access Point	6	6	0.750	0.750		
Segment Data Field [Notes 2, 3]	8	8128	1.000	1016.000		
> Transfer Frame Error Ctrl. Field [Note 4]	16	16	2.000	2.000	2	2
Totals:	72	8192	9.000	1024.000	9	1024

PJG, 1/14/99

- [1] A TIMED Command Frame (CF) is a specialization of the Telecommand (TC) Transfer Frame described in CCSDS 202.0-B-2, ¶4.2.1. Software-Decoded Command Frames are uplinked using Triple Error Detection
- [2] This can be a portion of one Command Packet (CP, Table 7), one CP, or multiple CPs
- [3] The indicated maximum of 1016 Bytes is the limit given by CCSDS 201.0-B-2. Table 10 shows that a maximum of 1014 Bytes makes more efficient use of uplink capacity.
- [4] This was included for use with Single-Error-Correction (SEC) as recommended in CCSDS 200.0-G-6, Annex I. SEC was abandoned in favor of TED, which does not need this field; however, it is to be retained.
- [5] This is a sub-type of "Telecommand Frame Data Unit" as defined in CCSDS 202.0-B-2, ¶3.3.1. During COP-1 operation, this field may occasionally be replaced by one of two **Control Commands**, as follows, per CCSDS 202.0-B-2, ¶4.2.1.2:
- UNLOCK:** Binary "00000000"
- Set V(R):** Binary "10000010 00000000 XXXXXXXX", where the last byte is the target value
- Control Commands support the Frame Acceptance and Reporting Mechanism (FARM) as described in CCSDS 202.1-B-1, ¶2.5.2.

Table 9. Command Frame (CF) for CCD Commands (for Critical Command Decoder, via Virtual Channels 0 and 1)

	Req'd Value [Note 2]	lengths (bits)		Lengths (Bytes)	
		itemized	rollup	itemized	rollup
• Telecommand Frame [Note 1]					
> [TC] Transfer Frame Header			40		5.000
Version Number	"00"	2		0.250	
Bypass Flag	"1"	1		0.125	
Control command Flag	"0"	1		0.125	
spare	"00"	2		0.250	
Spacecraft ID	"01 1110 0011"	10		1.250	
Virtual channel ID	"00 000x"	6		0.750	
Frame Length	"0000 0000"	10		1.250	
Frame Sequence Number	"0000 0000"	8		1.000	
> Transfer Frame Data Field			16		2.000
CCD Command [Note 3]		16		2.000	
Totals:		56	56	7.000	7.000

PJG, 1/14/99

- [1] A TIMED Command Frame (CF) is a specialization of the Telecommand (TC) Transfer Frame described in CCSDS 202.0-B-2, ¶4.2.1. CCD Commands are uplinked using Triple Error Detection (TED). No Transfer Frame Error Control Field is present.
- [2] MSB is transmitted first
- [3] CCSDS 202.0-B-2, ¶3.3.1 defines this as a "User Data Unit". (This is not a TC Packet.)

Table 10. Command Uplink with Long Frames

	length (bits)	length (Bytes)	Portion of Total	Rollup 1 (Bytes)	Rollup 2 (Bytes)	Rollup 3 (Bytes)
PJG, 1/26/98						
• Acquisition Sequence	500	62.5				
... followed by an indefinite number of the following sequence:						
• Command Link Transmission Unit (CLTU)						1178
> Start sequence	16	2	0.2%	2	2	
> Codeblocks [Note 2]					1168	
Original Frame Info [Notes 1, 6]				1022		
Frame Header	40	5	0.4%			
Frame Data Field:						
Segment Header	8	1	0.1%			
Segment Data Field	8112	1014	86.0%			
Transfer Frame Error Control [Note 5]	16	2	0.2%			
Error Control (for Codeblocks)	1168	146	12.4%	146		
CLTU Last-Codeblock Fill Bits [Note 3]		0	0.0%	0		
> Tail sequence	64	8	0.7%	8	8	
• Idle Sequence [Note 4]	8	1	0.1%	1		1
Totals for repeating sequence:	9432	1179	100.0%	1179		1179

- [1] For TIMED, each CLTU must contain exactly 1 Frame
- [2] 146 Codeblocks is assumed for maximum efficiency. Each codeblock is 64 bits long
- [3] Fill Bits are used only to make up integral Codeblocks/CLTU as defined in CCSDS 201.0-B-2, ¶3.3.3
The Segment Data Field length here chosen to avoid Fill Bits.
- [4] Next CLTU can follow immediately after idle sequence
- [5] This was included for use with Single-Error-Correction (SEC) as recommended in CCSDS 200.0-G-6, Annex D-5
SEC was abandoned in favor of TED, which does not need this field; however, it is to be retained.
- [6] as defined in Table 8. The original frame info shall be **randomized per CCSDS 201.0-B-2, ¶3.3.1,**
and **encoded** per CCSDS 201.0-B-2, ¶3.3.2

Table 11. Command Uplink with Medium-Length Frames

	length (bits)	length (Bytes)	Portion of Total	Rollup 1 (Bytes)	Rollup 2 (Bytes)	Rollup 3 (Bytes)
PJG, 1/26/98						
• Acquisition Sequence	500	62.5				
... followed by an indefinite number of the following sequence:						
• Command Link Transmission Unit (CLTU)						162
> Start sequence	16	2	1.2%	2	2	
> Codeblocks [Note 2]					152	
Original Frame Info [Notes 1, 5]:				133		
Frame Header	40	5	3.1%			
Frame Data Field:						
Segment Header	8	1	0.6%			
Segment Data Field	1000	125	76.7%			
Transfer Frame Error Control [Note 5]	16	2	1.2%			
Error Control (for Codeblocks)	152	19	11.7%	19		
CLTU Last-Codeblock Fill Bits [Note 3]		0	0.0%	0		
> Tail sequence	64	8	4.9%	8	8	
• Idle Sequence [Note 4]	8	1	0.6%	1		1
Totals for repeating sequence:	1304	163	100.0%	163		163

- [1] For TIMED, each CLTU must contain exactly 1 Frame
- [2] 19 Codeblocks is assumed for this case. Each codeblock is 64 bits long.
- [3] Fill Bits are used only to make up integral Codeblocks/CLTU as defined in CCSDS 201.0-B-2, ¶3.3.3
The Segment Data Field length here chosen to avoid Fill Bits.
- [4] Next CLTU can follow immediately after idle sequence
- [5] as defined in Table 8. The original frame info shall be **randomized per CCSDS 201.0-B-2, ¶3.3.1,**
and **encoded** per CCSDS 201.0-B-2, ¶3.3.2

Table 12. Command Uplink with CCD Frames

PJG, 1/26/98

	<i>length (bits)</i>		<i>Length (Bytes)</i>			<i>Transmit Time [5]</i> (sec)
	itemized	Rollup	itemized	Rollup 1	Rollup 2	
• Acquisition Sequence	500	500	62.5	62.5	62.5	0.25
... followed by an indefinite number of the following sequence [Note 7]:						
• CLTU with CCD Relay Command [Note 1]					18	0.072
> Start sequence	16	16	2	2		
> Codeblock		64		8		
Original Frame Info [Note 2]						
Frame Header	40		5			
Frame Data Field:						
Original CCD Command data	16		2			
CLTU Last-Codeblock Fill Bits [Note 3]	8		1			
> Tail sequence	64	64	8	8		
• Idle Sequence	8	8	1	1	1	0.004
• CLTU with No-Op CCD Command [Note 6]	144	144	18	18	18	0.072
• Idle Sequence [Note 4]	8	8	1	1	1	0.004
Totals for repeating sequence:	304	304	38	38	38	0.152

- [1] can be preceded by any number of software-decoded (VC2, 3) commands
- [2] as detailed in Table 9. The original frame info shall be **randomized** per CCSDS 201.0-B-2, ¶3.3.1, and **encoded** per CCSDS 201.0-B-2, ¶3.3.2
- [3] needed to make up integral Codeblocks/CLTU as defined in CCSDS 201.0-B-2, ¶3.3.3
- [4] Next CLTU can follow immediately after idle sequence
- [5] Transmit Times are based on an uplink clocking rate of 2,000 bits/sec
- [6] This can be a CCD internal command, but not a CCD relay command
- [7] Software-decoded commands may be resumed after any CCD command sequence

Table 13. Supplemented Command Frame (SCF) Structure

	Format	Required Value for TIMED	Lengths (Bytes)		Rollup Lengths (Bytes)	
			min	max	min	max
• Supplemented Command Frame (SCF) [Note 1]						
> Command Frame Delivery Header [Note 5]						
Message type [Note 3]		03 hex	1	1	24	24
spare		all 0	1	1		
Source identification [Note 4]		4D hex [Note 6]	1	1		
Destination identification (unused by LEO-T)		all 0	1	1		
spare		all 0	1	1		
Message generation time (unused by LEO-T)	PB-5 time code	all 0	7	7		
Spacecraft identification [Note 4]		01E3 hex	2	2		
Message sequence number (unused by LEO-T)	unsigned 16-bit binary integer	[Note 2]	2	2		
EDOS software version no. (unused by LEO-T)		all 0	2	2		
Length of frame (in bytes, including header)	unsigned 16-bit binary integer	actual value	2	2		
"spare" (set to zero)		all 0	4	4		
> Command Frame [See Table 8]:			9	1024	9	1024
Totals:			33	1048	33	1048

PJG, 1/14/99

- [1] The SCF is the TCP message content from the MOC to the Ground Station
- [2] Increment by one for each SCF, modulo 2¹⁶
- [3] where 03 hex indicates this is a "Command Data Block"
- [4] This is a validation parameter stored in the (LEO-T?) configuration database
- [5] Transcribed from the LEO-T Software interface Programmer's reference Manual
- [6] This is an arbitrary selection that works for APL front ends, but might need to change for USN or LEO-T