SEA-99-0073
ICR01CFX
13 December 1999

TO: Distribution

FROM: P. J. Grunberger

SUBJECT: TIMED Telemetry and Command Data Structures

ATTACHMENT: TIMED Telemetry and Command Data Structures, Rev. j

REFERENCE: SEA-99-0009, PJGrunberger, *"TIMED Telemetry And Command Data Structures,"* January 21, 1999, (with Rev. c of the above document attached)

Attached is a new revised and expanded version of the subject document. This document collects the structural details of command and telemetry messages that flow between elements of the TIMED End-to-End Data System. It is intended for your convenience. Nothing in it is intended to be in conflict with specifications now under configuration control.

The last paper release of this document was Rev. c, issued under the referenced cover memo. There are no actual design changes from Rev. c, only corrections and additions. In particular, I have included further defined fields in the Ground Receipt Header, and a listing of Application Process Identifiers. What follows here is an introduction to the contents.

Included Tables

The following tables are included in the Attachment:

Table 1. **TIMED Telemetry Packet (TP) Structure**, as originated by a spacecraft instrument, spacecraft subsystem, or ground-based telemetry source.

Table 2. **TIMED Telemetry Data Format**, just prior to the last (convolutional) stage of encoding (if any) for the downlink.

Table 3. **TIMED Supplemented Telemetry Frame (STF) Structure**, for delivery of Telemetry Frames from ground station to MOC and POC.

Table 4a. **TIMED Ground Receipt Header (GRH) Format**, detailing the common header field used for the STF and STP.

Table 4b. **TIMED GRH Telemetry Source Identification**, summarizing the numeric values to be used when ordering a stream service.

Pictorial Guide to Structures

The telemetry and command structures used by TIMED are variations on CCSDS-defined packages, as shown in ***Figure 1***. In this and all following figures, the shaded fields are the carriers of the primary data.

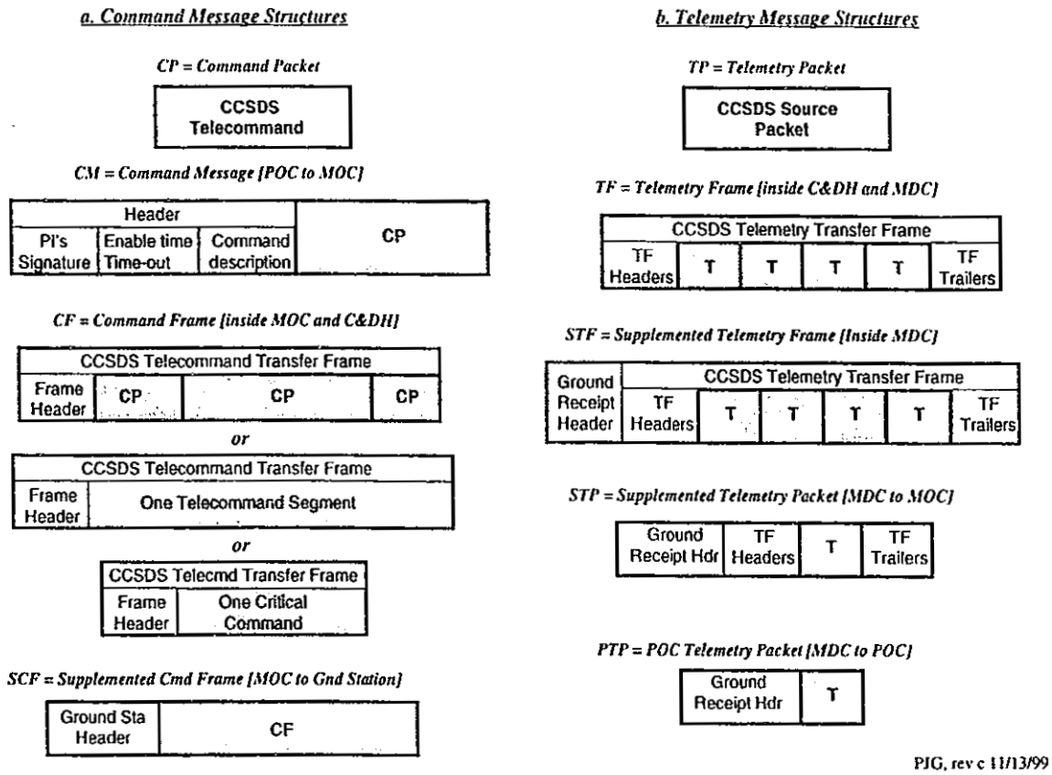

Figure 1. Telemetry and Command Packaging

The principal data-carrying structure for telemetry is the Telemetry Packet (TP). ***Figure 2*** shows how TPs are transformed and re-packaged during each step of their excursion from the source instrument to the end user. Spacecraft subsystems also use TPs. However, TPs originating in the C&DH and GNS subsystems bypass the 1553 bus transport process.

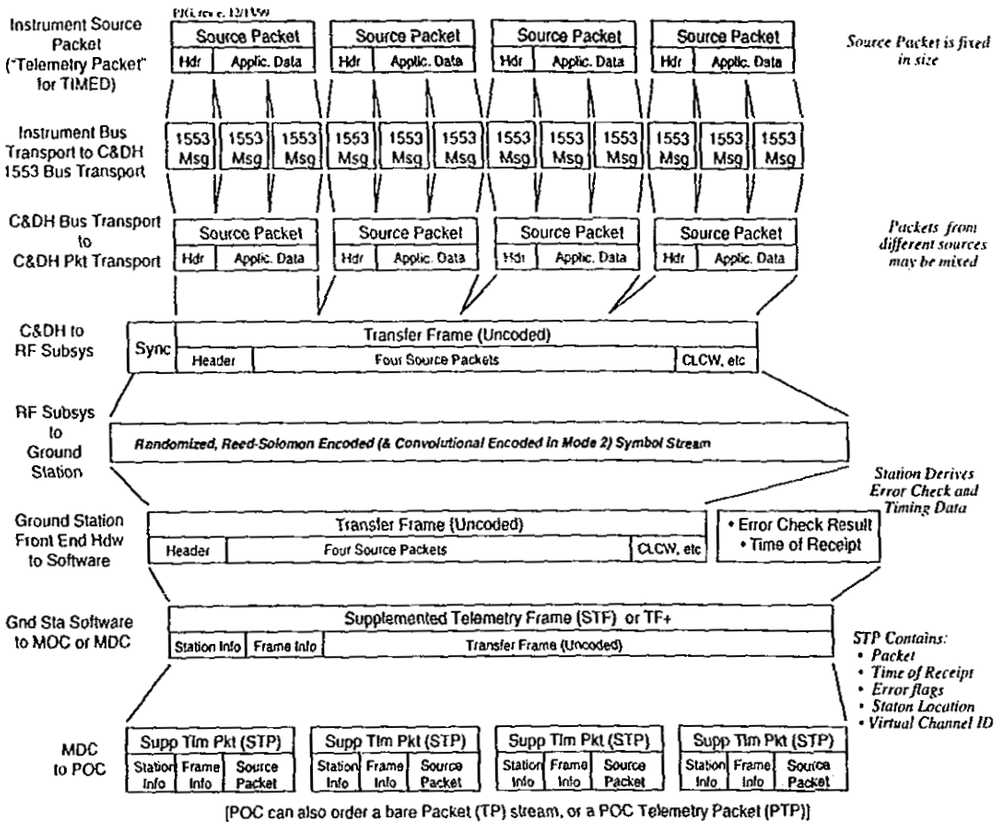

Figure 2. Structure Transformations for Telemetry Packet Delivery

The principle data-carrying structure for commands is the Command Packet (CP), which is just the TIMED name for a CCSDS Telecommand Packet. ***Figure 3*** shows how CPs are conveyed from a Payload Operations Center (POC) to an instrument. Commands traveling from the Mission Operations Center (MOC) to spacecraft subsystems go through transformations similar to those in Figure 3, except that they start with a bare CP in the MOC. (That is, the "Command Message" delivery step shown at the top of the figure is not used.) Also, there is a special "packet-less" Command Frame for the hardware-decoded commands that go to the spacecraft's Critical Command Decoder. This structure is shown in Figure 1 and detailed in Table 12 of the Attachment.

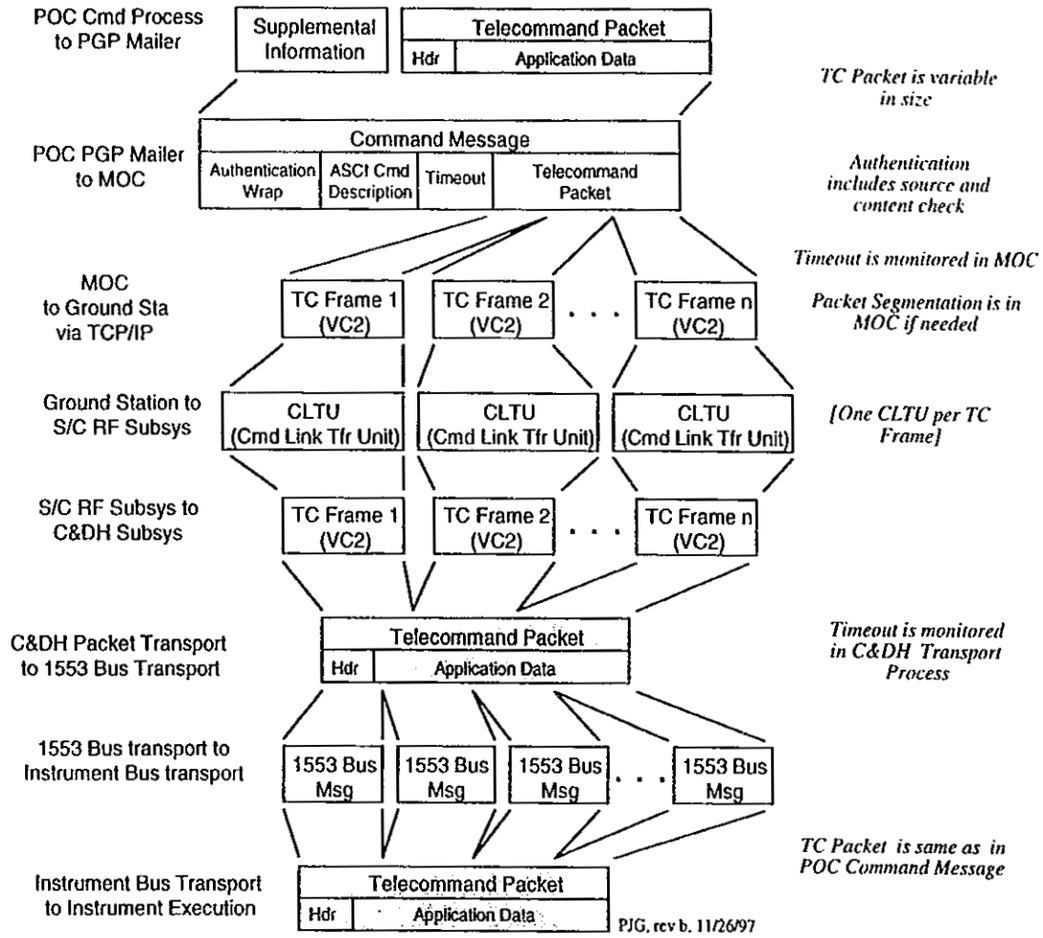

Figure 3. Structure Transformations for Command Packet Delivery

Follow-up

TIMED telemetry and command structures continue to evolve, and we continue to find errors in the structures document from time to time. I will immediately notify the full distribution via e-mail of any errors or significant new definitions that come to my attention.

Paul Grunberger

P. J. Grunberger
TIMED Ground System Engineer

Distribution:

PNBoie	MD6-104
GECameron	4-352
AAChacos	MD1-110
MIChu	4-158
PJClark	4-320
WSDevereux	MD1-116
WCDove	23-326
SEGemeny	36-103
JGoldman	4-326
DGGrant	4-356
PJGrunberger (4)	MD1-102
RJHarvey	23-324
KJHeffernan	4-238
RJHeins	MD1-108
MMHopkins (2)	4-167
WPKnopf (3)	MD6-106
SFKozuch	23-318
DYKusnierkiewicz	MD1-114
KMLyons (2)	4-174
DSMehoke	23-396
WLMitnick (2)	23-314
RDNordeen	MD6-108
SJOffenbacher	4-154
BSOgorzalek	4-204
MJPackard	MD6-102
JEPenn	4-328
EFProzeller	23-308
WERadford	23-368
RJRedman	23-379
EHRodberg (2)	23-332
JAStock	4-120
EPTheus	23-334
DRTracey	4-302
SPWilliams	23-362
DSWilson	4-152
JYee	7-312
SEA Files (3)	MD1-118
Archives	5-30

Version History		
Code	Date	Description
a	11/13/97	CDR version (see pp PJG-57 thru PJG-64
b	1/26/98	Ground System / POC Working group
c	1/14/99	Update to support USN ICD
d	1/25/99	Correction to Table 2 (Transmitted codeblock)
e	2/9/99	Correction to Table 6 (Tfr Frame Data Field Excerpt)
f	4/2/99	Corrections to Table 2 (spare bits location) & Table 4 (GSE frame source type)
g	5/3/99	Added a column in Table 2. Restored row 13 in all tables to reverse their omission in Version f
h	*11/28/99*	*In Table 2, coding note added. In Table 4, additional front end and path definitions, GRH version 2 redefined, and GRH version 3 introduced. Table 14 (with Virtual Channel Assignments) added. Tables 15 and 16 (with AppID assignments) are added.*
j	*12/13/99*	*In Table 4, GRH version 3 is rescinded and a "TDRSS WDISC" front-end identifier is added. In Table 16, USN AppIDs are added. Several typographical errors are corrected.*

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 "g" are in italics.

Table 1. TIMED Telemetry Packet (TP) Structure

	Offset from Start of TP (Bytes + bits)	net lengths (bits)	Portion of Total Length	Rollup Lengths (bits)	Rollup Lengths (Bytes)	Portion of Total Length
• ***Source Packet*** *[Note 1]*						
> Packet Primary Header				**48**	**6**	**2.3%**
Version Number	*0 + 0*	3	0.1%			
Packet Identification Field:			0.0%			
Type Indicator	*0 + 3*	1	0.0%			
Packet Secondary Header Flag	*0 + 4*	1	0.0%			
Application Process Identifier	*0 + 5*	11	0.5%			
Packet Sequence Control Field:						
Grouping Flags	*2 + 0*	2	0.1%			
Source Sequence Count	*2 + 2*	14	0.7%			
Packet Data Length Field	*4 + 0*	16	0.8%			
> Packet Data Field				**2048**	**256**	**97.7%**
Packet Secondary Header	*6 + 0*					
Packet Secondary Header Time Code Field	*6 + 0*					
CCSDS Unsegmented Time Code [Note 2]						
coarse time (seconds)	*6 + 0*	32	1.5%			
fine time (sub-seconds) [Note 3]	*10 + 0*	16	0.8%			
Source Data [note 4]	*12 + 0*	2000	95.4%			
PJG, 12/13/99 **Totals:**		2096	100.0%	2096	262	100.0%

[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.

[4] If fine time is not present Starts at position "10 + 0, and length is 2016 bits

Table 2. TIMED Telemetry Data Format

	Mode 3a, Mode 3b [Note 4]	Mode 2	Modes 1a, 1b
Approximate information rate(s)	4 Mb/s, 2 Mb/s	*9 kb/s, 4.5 kb/s*	4 Mb/s, 2 Mb/s
Reed-Solomon coding?	no	yes	yes
Convolutional coding?	yes	yes	no

	Item lengths (bits)	Item lengths (bits)	Item lengths (bits)	Rollup 1 (bits)	Rollup 1 (Bytes)	Portion of total length	Rollup 2 (bits)	Rollup 2 (Bytes)
What goes to convolutional encoder [Note 2]:								
• Attached Sync Marker	32	32	32	32	4	0.3%	32	4
• Transmitted Codeblock:								
>Transfer Frame [Note 3]							8560	1070
Transfer Frame Primary Header				48	6	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 *[modulo 256 for combined VCs]*	8	8	8					
Virtual channel Frame count *[modulo 256 per VC]*	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	10	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					
Transfer Frame Secondary Header Data:								
spare bits	8	8	8					
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	1048	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	4	0.3%		
Frame Error Control Field [Note1]	16	16	16	16	2	0.2%		
>Reed-Solomon Check Symbols *[Note 8]*	none	1280	1280	1280	160	13.0%	1280	160
PJG, 12/13/99 **Totals:**	8592	9872	9872	9872	1234	100.0%	9872	1234

[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

[8] Coding is per CCSDS 101.0-B-3, ¶4. An interleaving depth of I = 5 is selected for TIMED

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 4a]*					22	2.0%
> **generic fields:**				4.750		
Size [of STP]	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		
PJG, 12/13/99 **Totals:**	8768	1096.000	100.0%	1096.000	1096	100.0%

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

Table 4a. TIMED Ground Receipt Header (GRH) Format

PJG 12/13/99

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 (current version is 2)* *1 = Version 1* *2 = Version 2 [Note 4]*
Spacecraft ID	38	10	1.250	CCSDS Spacecraft ID assigned to TIMED (= Binary 000111100011, Hex 1E3)
Ground Receipt Time (GRT)	48	32	4.000	Ground receipt time in elapsed seconds since 00:00:00 UTC January 6, 1980, in MSB first order
Gnd Receipt Time Vernier	80	32	4.000	Microsecond offset from GRT, in MSB first order
Frame Source Type [Note 1]	112	4	0.500	*Concatenated with Frame Source Index into 8-bit value as "Source" selection criterion for stream service; unsigned binary integer as follows:* *1 = Emulator/Mini-MOC* *2 = Simulated Spacecraft Data* *3 = Loop-Back through Front End* 4 = Spacecraft 5 = GSE 6 = unused 7 = unused 8 = user-defined 9-15 = unused
Frame Source Index [Note 1]	116	4	0.500	*Qualifier for "Frame Source Type" (see above); unsigned binary integer as follows:* For frame source type 1 (Emulator/Mini-MOC): 1 = GUVI Spacecraft Emulator 2 = SABER Spacecraft Emulator 3 = SEE Spacecraft Emulator 4 = TIDI Spacecraft Emulator 5 = GNS Mini-MOC 1 6 = GNS Mini-MOC 2 7 = G&C Mini-MOC 1 8 = G&C Mini-MOC 2 9 = IEM Mini-MOC 1 10 = IEM Mini-MOC 2 For frame source type 2 (Simulated Spacecraft Data): 1 = TOPS 2 = Software Simulation For frame source type 3 (Loop-Back): 1 = FE Hardware Simulation For frame source type 4 (Spacecraft): 1 = Spacecraft For frame source type 5 (GSE) 1 = GSE 2 = MPCF sc1_rt instance 3 = MPCF sc2_rt instance

Field	Offset (b)	Length (b)	Length (Bytes)	Description
				4 = MPCF dev instance 5 = MPCF tops instance 6 = MPCF iem_mm1_rt instance 7 = 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 8 (User-Defined): 0 - 15 = user defined
Path	120	4	0.500	Unsigned binary integers as follows: 0 = APL usage 1-6 = USN usage: 1 = FEP1 (Front End Processor 1) 2 = FEP2 3 = FEP3 4 = FEP4 5-6 = Reserved for future USN use 7-15 = Future APL use
Front-end Identifier	124	4	0.500	*"Front End" selection criterion for telemetry stream service; unsigned binary integer:* 1 = FE1 (w/ IEM Eng'g Model) 2 = FE2 (p/o I&T GSE; then SCF backup) 3 = FE3 (Primary Ground Station at APL/SCF) 4 = FE4 (w/ IEM breadboard) 5 = G&C Bench-Test Emulator 6 = GPS Bench-Test Emulator *7 = MOC (Ground Sys Tlm into Bld Tlm, except Front End Tlm is identified w/Front End)* *8-13 = Universal Space Network (USN):* *8 = NMC (Network Mgmt. Ctr. in PA or CA, for test use)* *9 = USAK01 (North Pole, Alaska Remote Gnd Sta (RGS)* *10 = AUWAO1 (Perth, Australia RGS)* *11 = USH101 (South Point, Hawaii RGS)* *12 = SEK101 (Kiruna, Sweden CRGS)* *13 = USN other (for temporary use)* *14 = WDISC "PTP" front end for TDRSS LEOP support at WSGT &/or STGT* *15 = 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	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 1 = CRC is active
CRC Error Flag [Note 3]	138	1	0.125	*0 = CRC failed* *1 = CRC passed*
Master Channel Sequence	139	1	0.125	0 = not checked/unknown

Field	Offset (b)	Length (b)	Length (Bytes)	Description
Checked				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	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 [Note 2]	152	1	0.125	0 = do not archive 1 = archive
SSR Playback Error [Note 2]	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	

[1] See Table 4b for Ground System (i.e., GSE) telemetry assignments

[2] Not present in Version 1

[3] Sense was incorrectly inverted for all APL front-end generated data prior to about 11/15/99

[4] Version 1 changed to Version 2 when the SSR Playback Error flag and Archive Flag were added (on abolut 7/1/98). Version 2 was improperly labeled as "1" until 12/99, except for ground System telemetry generated by the MOC "Bld Tlm" module.

Table 4b. TIMED GRH Telemetry Source Identification

PJG, 12/4/99

Source	Frame Source Type (decimal)	Frame Source Index (decimal)	Source "SRCE" (decimal)	Note
GPS Simulator PC 1	1	5	21	part of GNS Emulator/MiniMOC
TASTIE 1	1	7	23	
TASTIE 2	1	8	24	
Protocol Analysis & Sim. Sys. 1 (PASS 1)	1	9	25	1553 bus monitor for IEM-Breadboard
IEM Test Bed 1	1	9	25	
IEM Test Bed 2	1	10	26	
Protocol Analysis & Sim. Sys. 2 (PASS 2)	1	10	26	1553 bus monitor for spacecraft
TASTIE - TOPS [Note 1]	2	1	33	
60 ft Antenna Controller	5	1	81	
Blockhouse Control Unit	5	1	81	
Front End 1 Gnd Tlm	5	1	81	
Front End 2 Gnd Tlm	5	1	81	
Front End 3 Gnd Tlm	*5*	*1*	*81*	
Front End 4 Gnd Tlm	*5*	*1*	*81*	
GPS Simulator PC 2	5	1	81	with Spacecraft
RFGSE	5	1	81	
Solar Array Simulator (SAS)	5	1	81	
TASTIE - TINTS	5	1	81	
USN Ground Tlm	5	1	81	

[1] assignments shown required new release of TASTIE software, as of 11/9/99

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	7.1%
• Attached [Frame] Sync Marker	32	4.000	1.3%	32	4	1.3%
• Transfer Frame non-data-field excerpts:				176	22	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:						
> Source Packet (any one of 4)				2096	262	84.5%
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%			
PJG, 5/3/99 **Total :**	2480	310.000	100.0%	2480	310	100.0%

[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%
• **Transfer Frame Data Field excerpt:**						
> **Source Packet (any one of 4)**				2096	262.000	92.3%
Packet Primary Header	48	6.000	2.1%			
Packet Data Field:						
Packet Secondary Header						
Pkt Sec Hdr Time Code Field [Note 1]						
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%			
PJG, 5/3/99 **Totals:**	2272	284.000	100.0%	2272	284.000	100.0%

[1] See Table 1 for definitions
[2] Optional; add 2 Bytes to Source Data if not present.

Table 7. TIMED 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
PJG, 5/3/99 **Total:**	56	32,048	7	4,006

[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, ¶5.2.2 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)	
	min	max	min	max	min	max
• **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
PJG, 5/3/99 **Totals:**	72	8192	9.000	1024.000	9	1024

[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 (TED).

[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 D-5
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	lengths (bits)		Lengths (Bytes)	
	[Note 2]	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	
PJG, 5/3/99 **Totals:**		56	56	7.000	7.000

[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 (VC2 and VC3 only)

PJG, 12/1/99	length (bits)	length (Bytes)	Portion of Total	Rollup 1 (Bytes)	Rollup 2 (Bytes)	Rollup 3 (Bytes)
• 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*	1
Totals for repeating sequence:	9432	1179	100.0%	1179	*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 (VC2 and VC3 only)

PJG, 12/13/99	length (bits)	length (Bytes)	Portion of Total	Rollup 1 (Bytes)	Rollup 2 (Bytes)	Rollup 3 (Bytes)
• 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*	1
Totals for repeating sequence:	1304	163	100.0%	163	*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, 5/3/99	length (bits)		Length (Bytes)			Transmit Time [Note 5] (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]					24	24
Message type [Note 3]		03 hex	1	1		
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
PJG, 5/3/99		**Totals:**	33	1048	33	1048

[1] The SCF is the TCP message content from the MOC to the Ground Station
[2] Increment by one for each SCF, modulo 2^16
[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

Table 14. TIMED Virtual Channel Assignments

Command Function	Side #1	Side #2	Comments
Hardwired Commands (Critical, Power Subsystem)	VC0	VC1	Intercepted by Uplink Interface of RF Subystem
Direct-Delivery Commands (to Instruments, C&DH, GPS Subsys, G&C susys)	VC2	VC3	Direct delivery to instruments and subsystems; sequence of delivery is allowed to differ from order of receipt by s/c

Telemetry Function	Side #1	Side #2	Comments
Downlink Board Fill	VC0	VC0	Different channels not needed; only one side has active telemetry
Dump Telemetry (Instruments, C&DH and Subsystems)	VC6	VC6	Different channels not needed; only one side has active telemetry
Real-Time Telemetry (Instruments, C&DH, and Subsystems)	VC7	VC7	Different channels not needed; only one side has active telemetry

PJG, 11/4/97

Table 15. TIMED Application Identifier Ranges

Subsystem	Number of Identifiers (Decimal)	Range of Identifiers (Decimal)				(Hex 11-bit integer)		
C&DH #1	128	0 thru 2^7-1	0	thru	127	000	thru	07F
C&DH #2	128	2^7 thru 2×2^7-1	128	thru	255	080	thru	0FF
G&C #1	128	2×2^7 thru 3×2^7-1	256	thru	383	100	thru	17F
G&C #2	128	3×2^7 thru 4×2^7-1	384	thru	511	180	thru	1FF
Active G&C	128	4×2^7 thru 5×2^7-1	512	thru	639	200	thru	27F
Inactive G&C	128	5×2^7 thru 6×2^7-1	640	thru	767	280	thru	2FF
GNS #1	128	6×2^7 thru 7×2^7-1	768	thru	895	300	thru	37F
GNS #2	128	7×2^7 thru 8×2^7-1	896	thru	1023	380	thru	3FF
Ground System [2]	128	8×2^7 thru 9×2^7-1	1024	thru	1151	400	thru	47F
GUVI	128	9×2^7 thru 10×2^7-1	1152	thru	1279	480	thru	4FF
TIDI	128	10×2^7 thru 11×2^7-1	1280	thru	1407	500	thru	57F
SABER	128	11×2^7 thru 12×2^7-1	1408	thru	1535	580	thru	5FF
SEE	128	12×2^7 thru 13×2^7-1	1536	thru	1663	600	thru	67F
Power #1	128	13×2^7 thru 14×2^7-1	1664	thru	1791	680	thru	6FF
Power #2	128	14×2^7 thru 15×2^7-1	1792	thru	1919	700	thru	77F
spare	127	15×2^7 thru 16×2^7-2	1920	thru	2046	780	thru	7FE
Idle Packets [1]	1	16×2^7-1	2047			7FF		

PJG 11/5/99

[1] as contained in VC0 Telemetry Frames
[2] as received from, or sent to, controlled equipment in the ground system

Table 16. TIMED Application Identifier Assignments

APID (hex)	APID (dec)	Subsystem	Side	Description
000	0	C&DH	1	Boot Code Telemetry
001	1	C&DH	1	Physical Memory Dump
002	2	C&DH	1	Structure Memory Dump
004	4	C&DH	1	High Pr. Houskeeping
005	5	C&DH	1	[Note 1]
006	6	C&DH	1	Low Pr. Housekeeping #1
007	7	C&DH	1	Low Pr. Housekeeping #2
008	8	C&DH	1	C&DH Housekeeping
009	9	C&DH	1	Autonomy Housekeeping
00A	10	C&DH	1	[Note 1]
080	128	C&DH	2	Boot Code Telemetry
081	129	C&DH	2	Physical Memory Dump
082	130	C&DH	2	Structure Memory Dump
083	131	C&DH	2	[Note 1]
084	132	C&DH	2	High Pr. Houskeeping
086	134	C&DH	2	Low Pr. Housekeeping #1
087	135	C&DH	2	Low Pr. Housekeeping #2
088	136	C&DH	2	C&DH Housekeeping
089	137	C&DH	2	Autonomy Housekeeping
08A	138	C&DH	2	[Note 1]
100	256	AIU	1	Boot Code Telemetry
101	257	AIU	1	Boot Code Memory Dump
102	258	AIU	1	Anomaly History Buffer
103	259	AIU	1	Bus Status and Hardware Values
104	260	AIU	1	Command History Queue
105	261	AIU	1	Health Monitor
106	262	AIU	1	IRU Auxiliary Packet
107	263	AIU	1	Parameter Block Dump
108	264	AIU	1	RTW Parameter Block Dump
109	265	AIU	1	RTW Telemetry
141	321	AIU	1-D	Diagnostic Channel Memory Dump
142	322	AIU	1-D	Diagnostic Channel Anomaly History Buffer
143	323	AIU	1-D	Values
144	324	AIU	1-D	Diagnostic Channel Command History Queue
145	325	AIU	1-D	Diagnostic Channel Health Monitor
146	326	AIU	1-D	Diagnostic Channel IRU Auxiliary Packet
147	327	AIU	1-D	Diagnostic Channel Parameter Block Dump
148	328	AIU	1-D	Diagnostic Channel RTW Parameter Block Dump
149	329	AIU	1-D	Diagnostic Channel RTW Telemetry
17F	383	IEM Testbed	1	AIU Dummy Packet
180	384	AIU	2	Boot Code Telemetry
181	385	AIU	2	Boot Code Memory Dump
182	386	AIU	2	Anomaly History Buffer
183	387	AIU	2	Bus Status and Hardware Values
184	388	AIU	2	Command History Queue
185	389	AIU	2	Health Monitor
186	390	AIU	2	IRU Auxiliary Packet
187	391	AIU	2	Parameter Block Dump

APID (hex)	APID (dec)	Subsystem	Side	Description
188	392	AIU	2	RTW Parameter Block Dump
189	393	AIU	2	RTW Telemetry
1C1	449	AIU	2-D	Diagnostic Channel Memory Dump
1C2	450	AIU	2-D	Diagnostic Channel Anomaly History Buffer
1C3	451	AIU	2-D	Values
1C4	452	AIU	2-D	Diagnostic Channel Command History Queue
1C5	453	AIU	2-D	Diagnostic Channel Health Monitor
1C6	454	AIU	2-D	Diagnostic Channel IRU Auxiliary Packet
1C7	455	AIU	2-D	Diagnostic Channel Parameter Block Dump
1C8	456	AIU	2-D	Diagnostic Channel RTW Parameter Block Dump
1C9	457	AIU	2-D	Diagnostic Channel RTW Telemetry
1FF	511	IEM Testbed	2	AIU Dummy Packet
200	512	AFC	1	Boot Telemetry
201	513	AFC	1	Memory Dump
202	514	AFC	1	Dump Summit RAM
204	516	AFC	1	Dump Flash RAM
208	520	AFC	1	Dump Data Block
20C	524	AFC	1	Dump Parameter Block
20D	525	AFC	1	Dump RTW Parameter Block
210	528	AFC	1	Control Law
211	529	AFC	1	Attitude Estimation
212	530	AFC	1	Wheel Status
213	531	AFC	1	Covariance Matrix
214	532	AFC	1	Counter Status
215	533	AFC	1	Interface Messages
220	544	AFC	1	Command Bookkeeping
221	545	AFC	1	Dump Command Bookkeeping
222	546	AFC	1	Anomaly
223	547	AFC	1	Task Performance
224	548	AFC	1	Task Statistics
225	549	AFC	1	Task Internals
226	550	AFC	1	Internal Queue
227	551	AFC	1	Dynamic Telemetry
228	552	AFC	1	AST Telemetry
22A	554	AFC	1	Application RAM Dump
22C	556	AFC	1	AST1 A
22D	557	AFC	1	AST1 B
22E	558	AFC	1	Application Block Dataword Dump #2
230	560	AFC	1	AST2 A
231	561	AFC	1	AST2 B
241	577	AFC	1-D	Diagnostic Channel Memory Dump
242	578	AFC	1-D	Diagnostic Channel Dump Summit RAM
244	580	AFC	1-D	Diagnostic Channel Dump Flash RAM
248	584	AFC	1-D	Diagnostic Channel Dump Data Block
24C	588	AFC	1-D	Diagnostic Channel Dump Parameter Block
24D	589	AFC	1-D	Diagnostic Channel Dump RTW Parameter Block
250	592	AFC	1-D	Diagnostic Channel Control Law
251	593	AFC	1-D	Diagnostic Channel Attitude Estimation
252	594	AFC	1-D	Diagnostic Channel Wheel Status
253	595	AFC	1-D	Diagnostic Channel Covariance Matrix
254	596	AFC	1-D	Diagnostic Channel Counter Status

APID (hex)	APID (dec)	Subsystem	Side	Description
255	597	AFC	1-D	Diagnostic Channel Interface Messages
260	608	AFC	1-D	Diagnostic Channel Command Bookkeeping
261	609	AFC	1-D	Diagnostic Channel Dump Command Bookkeeping
262	610	AFC	1-D	Diagnostic Channel Anomaly
263	611	AFC	1-D	Diagnostic Channel Task Performance
264	612	AFC	1-D	Diagnostic Channel Task Statistics
265	613	AFC	1-D	Diagnostic Channel Task Internals
266	614	AFC	1-D	Diagnostic Channel Internal Queue
267	615	AFC	1-D	Diagnostic Channel Dynamic Telemetry
268	616	AFC	1-D	Diagnostic Channel AST Telemetry
26A	618	AFC	1-D	Diagnostic Channel Application RAM Dump
26C	620	AFC	1-D	Diagnostic Channel AST1 A
26D	621	AFC	1-D	Diagnostic Channel AST1 B
26E	622	AFC	1-D	Dump #2
270	624	AFC	1-D	Diagnostic Channel AST2 A
271	625	AFC	1-D	Diagnostic Channel AST2 B
272	626	AFC	1	Application Test 272
280	640	AFC	2	Boot Telemetry
281	641	AFC	2	Memory Dump
282	642	AFC	2	Dump Summit RAM
284	644	AFC	2	Dump Flash RAM
288	648	AFC	2	Dump Data Block
28C	652	AFC	2	Dump Parameter Block
28D	653	AFC	2	Dump RTW Parameter Block
290	656	AFC	2	Control Law
291	657	AFC	2	Attitude Estimation
292	658	AFC	2	Wheel Status
293	659	AFC	2	Covariance Matrix
294	660	AFC	2	Counter Status
295	661	AFC	2	Interface Messages
2A0	672	AFC	2	Command Bookkeeping
2A1	673	AFC	2	Dump Command Bookkeeping
2A2	674	AFC	2	Anomaly
2A3	675	AFC	2	Task Performance
2A4	676	AFC	2	Task Statistics
2A5	677	AFC	2	Task Internals
2A6	678	AFC	2	Internal Queue
2A7	679	AFC	2	Dynamic Telemetry
2A8	680	AFC	2	AST Telemetry
2AA	682	AFC	2	Application RAM Dump
2AC	684	AFC	2	AST1 A
2AD	685	AFC	2	AST1 B
2AE	686	AFC	2	Application Block Dataword Dump #2
2B0	688	AFC	2	AST2 A
2B1	689	AFC	2	AST2 B
2C1	705	AFC	2-D	Diagnostic Channel Memory Dump
2C2	706	AFC	2-D	Diagnostic Channel Dump Summit RAM
2C4	708	AFC	2-D	Diagnostic Channel Dump Flash RAM
2C8	712	AFC	2-D	Diagnostic Channel Dump Data Block
2CC	716	AFC	2-D	Diagnostic Channel Dump Parameter Block
2CD	717	AFC	2-D	Diagnostic Channel Dump RTW Parameter Block

APID (hex)	APID (dec)	Subsystem	Side	Description
2D0	720	AFC	2-D	Diagnostic Channel Control Law
2D1	721	AFC	2-D	Diagnostic Channel Attitude Estimation
2D2	722	AFC	2-D	Diagnostic Channel Wheel Status
2D3	723	AFC	2-D	Diagnostic Channel Covariance Matrix
2D4	724	AFC	2-D	Diagnostic Channel Counter Status
2D5	725	AFC	2-D	Diagnostic Channel Interface Messages
2E0	736	AFC	2-D	Diagnostic Channel Command Bookkeeping
2E1	737	AFC	2-D	Diagnostic Channel Dump Command Bookkeeping
2E2	738	AFC	2-D	Diagnostic Channel Anomaly
2E3	739	AFC	2-D	Diagnostic Channel Task Performance
2E4	740	AFC	2-D	Diagnostic Channel Task Statistics
2E5	741	AFC	2-D	Diagnostic Channel Task Internals
2E6	742	AFC	2-D	Diagnostic Channel Internal Queue
2E7	743	AFC	2-D	Diagnostic Channel Dynamic Telemetry
2E8	744	AFC	2-D	Diagnostic Channel AST Telemetry
2EA	746	AFC	2-D	Diagnostic Channel Application RAM Dump
2EC	748	AFC	2-D	Diagnostic Channel AST1 A
2ED	749	AFC	2-D	Diagnostic Channel AST1 B
2EE	750	AFC	2-D	Dump #2
2F0	752	AFC	2-D	Diagnostic Channel AST2 A
2F1	753	AFC	2-D	Diagnostic Channel AST2 B
300	768	GNS	1	Boot Code Telemetry
301	769	GNS	1	Boot Code Memory Dump
302	770	GNS	1	Navigation Processor Physical Memory Dump
303	771	GNS	1	Navigation Processor Logical Memory Dump
304	772	GNS	1	Navigation Processor Memory Read
305	773	GNS	1	Tracking Processor Physical Memory Dump
306	774	GNS	1	Tracking Processor Logical Memory Dump
307	775	GNS	1	Tracking Processor Memory Read
308	776	GNS	1	Long-term Propagation State
309	777	GNS	1	Event Prediction Table
30A	778	GNS	1	Orbital Element Set Table
30B	779	GNS	1	Integrity Flags & Error Data
30C	780	GNS	1	Command Data Buffer
30D	781	GNS	1	Configuration and Status
30E	782	GNS	1	Constants Data
30F	783	GNS	1	GNS Data State
310	784	GNS	1	Raw Tracking Data
311	785	GNS	1	Tracking Health & Status
312	786	GNS	1	Pseudorange Table
313	787	GNS	1	State Vector / Covariance Matrix #1
314	788	GNS	1	State Vector / Covariance Matrix #2
315	789	GNS	1	Kalman Filter Quality
316	790	GNS	1	Acquisition Aids
317	791	GNS	1	GTA MIC Register Values
380	896	GNS	2	Boot Code Telemetry
381	897	GNS	2	Boot Code Memory Dump
382	898	GNS	2	Navigation Processor Physical Memory Dump
383	899	GNS	2	Navigation Processor Logical Memory Dump
384	900	GNS	2	Navigation Processor Memory Read
385	901	GNS	2	Tracking Processor Physical Memory Dump

APID (hex)	APID (dec)	Subsystem	Side	Description
386	902	GNS	2	Tracking Processor Logical Memory Dump
387	903	GNS	2	Tracking Processor Memory Read
388	904	GNS	2	Long-term Propagation State
389	905	GNS	2	Event Prediction Table
38A	906	GNS	2	Orbital Element Set Table
38B	907	GNS	2	Integrity Flags & Error Data
38C	908	GNS	2	Command Data Buffer
38D	909	GNS	2	Configuration and Status
38E	910	GNS	2	Constants Data
38F	911	GNS	2	GNS Data State
390	912	GNS	2	Raw Tracking Data
391	913	GNS	2	Tracking Health & Status
392	914	GNS	2	Pseudorange Table
393	915	GNS	2	State Vector / Covariance Matrix #1
394	916	GNS	2	State Vector / Covariance Matrix #2
395	917	GNS	2	Kalman Filter Quality
396	918	GNS	2	Acquisition Aids
397	919	GNS	2	GTA MIC Register Values
400	1024	Mission_Ops		[Note 1]
401	1025	FE		Status Telemetry - High Rate Software Chain
402	1026	FE		Status Telemetry - Low Rate Software Chain
403	1027	FE		Status Telemetry
404	1028	FE		Status Telemetry
405	1029	FE		Status Telemetry
406	1030	FE		Status Telemetry
40A	1034	USN Gnd Sta		USN Gnd Station Status Telemetry, Part A
40B	1035	USN Gnd Sta		USN Gnd Station Status Telemetry, Part B
40C	1036	USN Gnd Sta		USN Gnd Station Gap Message
40D	1037	USN Gnd Sta		USN Gnd Station End of Real-Time Telemetry
40E	1038	USN Gnd Sta		USN Gnd Station Command Status
411	1041	TASTIE		TASTIE Forwarding of AIU HSK Message
418	1048	MDC		Status Telemetry - ArchiveServer
419	1049	MDC		Status Telemetry - TS2 Router
41A	1050	MDC		Status Telemetry - TS1 Router
41B	1051	MDC		Status Telemetry - TS3 Router
420	1056	GNS Test	1	[Note 1]
42F	1071	GS		GPS Simulator
430	1072	TASTIE		Status Message
431	1073	TASTIE		TASTIE Forwarding of AIU Attitude Message
432	1074	TASTIE		TASTIE Forwarding of GNS Message
433	1075	TASTIE		RTW Telemetry
434	1076	TASTIE		RTW Telemetry
435	1077	TASTIE		RTW Telemetry
436	1078	TASTIE		RTW Telemetry
437	1079	TASTIE		RTW Telemetry
440	1088	IEM Testbed		[Note 1]
441	1089	IEM Testbed		[Note 1]
442	1090	IEM Testbed		[Note 1]
443	1091	IEM Testbed		[Note 1]
444	1092	IEM Testbed		[Note 1]
445	1093	IEM Testbed		[Note 1]
446	1094	IEM Testbed		[Note 1]

APID (hex)	APID (dec)	Subsystem	Side	Description
447	1095	IEM Testbed		[Note 1]
448	1096	IEM Testbed		[Note 1]
449	1097	IEM Testbed		[Note 1]
44A	1098	IEM Testbed		[Note 1]
44B	1099	IEM Testbed		[Note 1]
44C	1100	IEM Testbed		[Note 1]
44D	1101	IEM Testbed		[Note 1]
44E	1102	IEM Testbed		[Note 1]
44F	1103	IEM Testbed		[Note 1]
450	1104	IEM Testbed		[Note 1]
451	1105	IEM Testbed		[Note 1]
452	1106	IEM Testbed		[Note 1]
453	1107	IEM Testbed		[Note 1]
454	1108	Mission_Ops		Derived Telemetry
457	1111	Mission_Ops		[Note 1]
459	1113	PASS		[Note 1]
45D	1117	GS		MPCF
45E	1118	MDC		Status Telemetry
45F	1119	Mission_Ops		Raw Packet Dump
467	1127	GS		SAS
470	1136	GS		RF
477	1143	GS		BCU
480	1152	GUVI		[Note 1]
499	1177	TASTIE		[Note 1]
49A	1178	TASTIE		[Note 1]
49B	1179	TASTIE		[Note 1]
500	1280	TIDI		[Note 1]
580	1408	SABER		[Note 1]
600	1536	SEE		[Note 1]
7FF	2047	Idle Packet		VC0 Idle Packet

WPKnopf / PJG 12/13/99

[1] No assignment information received.

Distribution:

PNBoie	MD6-104
GECameron	4-352
AAChacos	MD1-110
MIChu	4-158
PJClark	4-320
WSDevereux	MD1-116
WCDove	23-326
SEGemeny	36-103
JGoldman	4-326
DGGrant	4-356
PJGrunberger (4)	MD1-102
RJHarvey	23-324
KJHeffernan	4-238
RJHeins	MD1-108
MMHopkins (2)	4-167
WPKnopf (3)	MD6-106
SFKozuch	23-318
DYKusnierkiewicz	MD1-114
KMLyons (2)	4-174
DSMehoke	23-396
WLMitnick (2)	23-314
RDNordeen	MD6-108
SJOffenbacher	4-154
BSOgorzalek	4-204
MJPackard	MD6-102
JEPenn	4-328
EFProzeller	23-308
WERadford	23-368
RJRedman	23-379
EHRodberg (2)	23-332
JAStock	4-120
EPTheus	23-334
DRTracey	4-302
SPWilliams	23-362
DSWilson	4-152
JYee	7-312
SEA Files (3)	MD1-118
Archives	5-30