HERSCHEL / PLANCK

Packet Structure Interface Control Document (PSICD)

SCI-PT-ICD-07527

Product Code : 000 000

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ENREGISTREMENT DES EVOLUTIONS / CHANGE RECORD

Date	Issue No.	Rev. No.	Pages Affected	Description/Authority	CR No.
1-9-2000	1	0	All	New Issue	---
12-7-2001	2	0	All	Update after review (instruments, ESA, industry) at start of phase B, and CCB decision, 4-7-2001.	
12-11-2002	3	Draft 2	Various	Update after PDR, in line with fax SCI-PT-14776, Fax SCI-PT-15976, SCI-PT–15977. **Introduction of requirement-identfiers**	
2-04-2003	3	0	Para. 1.4	RD 4, RD 5 and RD 6 added	
			Table 2-1 :	Applicability and optional services for RTs and ACMS explicitly indicated	
			Para.3.1.1.2.2 :	Source Identifier definition extended	
			Para.3.1.1.3 :	MTL-Telecommands : encapsulated TC-packet useable maximum size is 228 octets. (removal of TBC)	
			Para 4.1 :	**TM-packets undergo a standard-check before their data are used**	
			Para. 5.1.2.1	Error codes and parameters, layout of parameter-field : minimum of 4 octets Deleted limitation to 64 octets	
			Para. 5.1.2.4 :	Parameters allowed for TC(1,7)	
			Para. 5.1.2.6 :	Generation of Telecommand Contents Reports is mandatory for CDMU, ACC.	
			Para. 5.3.1.1 :	**Definition of HK/Diagnostic-Packet Report (3,1) and (3,2) : two fields, Segment ID and Number of parameters added**	
			Para. 5.5	An Event-Sequence-Counter introduced. Deleted : limitation to 64 octets	

Date	Issue No.	Rev. No.	Pages Affected	Description/Authority	CR No.
			Para. 5.6 :	Padding in case of SAU = octet. Clarification on CRC for TC(6,2).	
			Para. 5.8.	Clarifications for execution of 'Start' and 'Activity'. Stop Function (8,2) must be executable.	
			Para. 5.11	a) Concept of Permanent/ Transient Subschedules. b) Subschedule ID added to TC(11,5) c) Statement about error-reporting while inserting/ deleting : deleted. d) TM(1,7)-report in case of successful deletion. e) Definition for Time-Tag-1, and -2 refined f) Summary Schedule Request TC(11,12) and Report TM(11,13) re-introduced. g) MTL status reporting introduced, TC(11,18) and TM(11,19)	
			Para. 5.12	Number of repetitions and Event-ID-1 and -2 introduced for TC(12,5).	
			Para. 5.14	Packet-ID in TC(14,1/2) specified in detail for different Services.	
			Para. 5.15	Percentage Filled/ Downlinked deleted, No. of Packets replaced by No. of Octets in TM(15,13)	
			Para. 5.18 :	a) Two new fields : Segment ID and number of octets within segments added to TC(18,1). b) New :OBCP Dump Request TC(18,14) and OBCP Dump Report TM(18,15). c) TC-packets as part of the OBCP-code carry a Sequence Count and a CRC-field, which must be modified at execution time.	

Date	Issue No.	Rev. No.	Pages Affected	Description/Authority	CR No.
			Para. 5.19	a) Event-Action-List marked as requirement 6380-EVNT. b) TC-packets as part of an Action carry a Sequence Count and a CRC-field, which must be modified at execution time.	
			Para. 5.22	Context Saving : service deleted	
			Appendix 3	Essential HK-packets shall get Base-APID + 0 and highest priority, normal HK-packets retain their 'Base-APID + 2'	
			Appendix 5.2	Private TC defined.	
			Appendix 6	a) Changed : PTC and PFC 8bits instead of 4 b) Added : Enumerated, 32 bits c) Change (PTC,PFC)=(5,2) to (5,3), (5,2) : unused d) Added : Variable Bitstring, Variable Octet String	
			Appendix 8	Sequence Counter : always 0000hex	
			Appendix 9	Para. 1.3 : RD 5, RD 6, RD 7 added Requ. 3242-DLL for more clarity on SA-use for non-intelligent RTs Requ. 4080-TFL : deleted, obsolete. Requ. 4170-TFL with more details on timing. Clarified requirement 4345-TFL : The RT shall copy the Time Message to SA 8T Para. 4.5.1 : Clarifications on TC-handshake : word-count=00000b means : 32 words	

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			Appendix 9	Para's 4.5.2 and 4.6.2 : a) not applicable for instruments. b) Change of names : "High-Priority TM/TC-Messages" Para. 4.6.1.1 : Clarification : 'Flow Control'-bits to be changed according to status. 4610-TFL modified to reflect one retry Para. 4.6.1.3 : Several clarifications for Normal Data Bus Mode : one retry if the BC detects a transmission error, etc.	
			Appendix 9	Para. 4.6.1.3 : Several clarifications for Burst DB Mode : TM-transfer may happen each subsequent Subframe, no retry, a RT can send interleaved other packets, details on timing. Para 4.7 Transfer Layer FDIR : BC required to generate error reports to higher protocol layers, etc. Details to be included in specific reference documents	
25-07-2003	4	Draft 0		This issue is the first one after hand-over of document to Alcatel Space. For this issue the modification have been restricted to those defined in the frame of BSW consolidation plan.	
			Para. 5.3	Clarification added for re-definition of an Housekeeping / Diagnostic TM packet : Packet generation disabled during re-definition, APID not modified.	

Date	Issue No.	Rev. No.	Pages Affected	Description/Authority	CR No.
			Para. 5.3.1.1	<5200-PERP> ; <5210-PERP> modif. Segment Identifiers for TC(3,1) TC(3,2) shall be consecutive. 0xFF Segment Identifier required also for single TC re-definition.	
				<5200-PERP> ; <5210-PERP> modif. Definition of Application Data Field for periodic reporting of RAM cells content.	
				<5230-PERP> modif. Time-out suppressed for re-definition of an Housekeeping / Diagnostic TM packet	
			Para. 5.3.1.2	<5261-PERP> added TC(3,3) and TC(3,4) disable Packet generation.	
			Para. 5.3.2.1	<5300-PERP> ; <5310-PERP> modif. Definition of Application Data Field for periodic reporting of RAM cells content.	
			Para. 5.3	Combination of Memory ID and Start Address allowed for definition of a memory location.	
			Para. 5.6.1.6 Added	<5455-MM> added TC(6,5) added to abort current memory dump.	
			Para. 5.14	Scope of service 14 to CDMS extended to control the Real Time down-linking and/or SSMM storage : TC(14,5).	
				Packet generation disabled during re-definition,	
				<5911-PTXC> ; <5310-PTXC> added Autonomous use Real Time down-linking and/or SSMM storage control capability.	

Date	Issue No.	Rev. No.	Pages Affected	Description/Authority	CR No.
			Para. 5.14.1.2	<5941-PTXC> added Scope of TC(14,3) to CDMS extended to require Real Time down-linking and/or SSMM storage status.	
			Para. 5.14.1.3 Added	<5945-PTXC> ; <5946-PTXC> ; <5947-PTXC> added TC(14,5) to CDMS added for Real Time down-linking and/or SSMM storage controlling.	
			Para. 5.14.2.1	<5950-PTXC> modified <5951-PTXC> added Common TM(14,4) format TBC.	
			Appendix 2	TC(6,11) and TC(14,5) added.	
			Appendix 9 Para. 3.1.1	3010-DLL modified Repetition of message authorised.	
			Appendix 9 Para. 4.2 Para. 4.4	Not part of BSW consolidation plan 4270-TFL, Figure4.4-1 modified Subframe Count (and Reserved bits) field length modified for "Broadcast Mode Command Synchronize with Data Word".	
			Appendix 9 Para. 4.5.2	4440-TFL ; 4445-TFL ; 4450-TFL ; 4455-TFL ; 4460-TFL ; 4465-TFL ; 4470-TFL ; 4475-TFL- T deleted High-Priority TC Messages Not used	
			Appendix 9 Para. 4.6.2	4800-TFL ; 4805-TFL ; 4810-TFL ; 4815-TFL ; 4820-TFL ; 4830-TFL ; 4835-TFL ; 4840-TFL ; 4845-TFL ; 4850-TFL ; 4855-TFL ; 4860-TFL ; 4865-TFLdeleted High-Priority TM Messages Not used	

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04-11-2003	4	Draft 1		This issue reflects the updates defined during several teleconferences involving the European Space Agency, Alcatel Space and Alenia Spazio, held following the 11/09/03 PS-ICD review (see H-P-ASP-MN-3627). Agreement about update included in the present issue have been collected in dedicated file : "PSICD4d0_comments-fs11.doc"	
			Para. 1.1	Modification of scope to reflect that in addition to a requirement document PS-ICD becomes the document defining the actual building block for spacecraft operation. <1000-GEN> modified All TM/TC –Packet Type/ Subtype introduced in PS-ICD.	
			Para. 1.4	Introduction of SVM Interface Specification as reference document.	
			Para. 2	<2000-PACK> clarified Table 2-1 modified to clarify Packet Services supported by Herschel/Planck on-board subsystems and instruments.	
			Para. 3.1.1.1.3 Para. 3.1.1.2.2	<3000-TC> clarified Clarification of Data Field Header flag for "Standard Distribute CPDU command". Source part value confirmed for TC from ACC FDIR, CDMU Routine, ACC Routine.	
			Para. 3.1.2.1	<3010-TC> modified Bit 3 of Ack field not mandatory. Spare field for 16-bit alignment.	
			Para. 4.1.2.1	<4010-TM> modified Spare field for 16-bit alignment.	

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			Para. 5.1.2.1	<5070-TCV> modified Parameter field submitted to ESA/ASP approval.	
			Para. 5.2.1.1	<5130-DCV> modified N field not optional. Maximal number of pulse command set to 8.	
			Para. 5.2.1.2	<5140-DCV> modified N field not optional. Data field length defined. Maximal number of register load command set to 8.	
			Para. 5.2.1.3	<5150-DCV> modified Duration field split. Duration unit defined to 13 ms. Para. 5.2.1.3.1 added for Standard Distribute CPDU command. Para. 5.2.1.3.2 added for Mission specific Distribute CPDU command. <5155-DCV> added Maximal number of CPDU command set to 8 for Mission specific Distribute CPDU command.	
			Para. 5.3	<5160-PERP> modified Rectification of RD for Essential HK rule definition.	
			Para. 5.3.1.1	<5210-PERP> modified Definition of HK/DGN packet with one single TC(3,1) or TC(3,2).	
			Para. 5.3.2.1	<5310-PERP> modified Reporting of HK/DGN packet definition with one single TC(3,10) or TC(3,12). Segment 255 to flag HK/DGN packet definition report completion.	

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			Para. 5.5.2	Addition of comment for limitation of normal progress reporting. Addition of comment for limitation of Event parameter B field length.	
			Para. 5.5.2	Addition of design goal for definition of packet layout without reference to SID.	
			Para. 5.6.1.2	Addition of comment for clarification of checksum area (unpadded one) in TC(6,2).	
			Para. 6.6.1.6	<5455-MM> clarified ST, SST added for Abort current memory dump TC(6,11).	
			Para. 5.8.1.1	Addition of design goal for definition of packet layout without reference to SID.	
			Para. 5.8.1.4	Addition of design goal for definition of packet layout without reference to SID.	
			Para. 5.8.2.1	Addition of design goal for definition of packet layout without reference to SID.	
			Para. 5.9.1.6	Addition of comment for clarification of re-synchronisation procedure (rare operation).	
			Para. 5.11	<5575-OBTM> ; <5577-OBTM> modified Limitation of subschedule number to 4095.	
			Para. 5.11.1.1	<5590-MTL> modified Modification of TC(11,1) and TC(11,2) for independent setting of APID/subschedule release status.	
			Para. 5.11.1.4.1	<5640-MTL> ; <5650-MTL> modified Introduction of Time-tag in TC(11,5) data field. Clarification about TC sequence to be deleted.	

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			Para. 5.11.1.5.1	<5675-MTL> modified ; <5677-MTL> added ; Modification of TC(11,9) for specification of subschedules for which status shall be reported.	
			Para. 5.11.1.5.1 ; 5.11.1.6.1 ; 5.11.1.6.2 ; 5.11.1.7.	<5680-MTL> ; <5690-MTL> ; <5700-MTL> ; <5702-MTL> clarified Specified APID/subschedule shall be reported.	
			Para. 5.11.2.1	<5725-MTL> added Addition of requirement for ordering of MTL contents reporting.	
			Para. 5.11.2.2	<5730-MTL> modified Introduction of Time-tag in TM(11,13) data field.	
			Para. 5.11.2.2	<5731-MTL> added Addition of requirement for ordering of MTL contents reporting.	
			Para. 5.11.2.3	<5732-MTL> modified Modification of TM(11,19) for independent reporting of APID/subschedule release status. Comment added for clarification.	
			Para. 5.12	<5780-OBMF> modified Contents of monitoring events defined.	
			Para. 5.12.1.1	<5830-OBMF> rectified Recovery TC defined in by Event/Action Service. Condition for TC(12,1) ; TC(12,2) rejection.	

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			Para. 5.12.1.3	<5850-OBMF> modified Recovery TC defined in by Event/Action Service. Addition of Check-Mask in TC(12,5). Addition of Checking-IDs. Clarification of IN_RANGE / OUT_OF_RANGE checking status.	
			Para. 5.12.1.3	<5856-OBMF> added Addition of range for Event-IDs.	
			Para. 5.12.1.4	<5860-OBMF> rectified Monitoring-ID to be removed. Recovery TC defined in by Event/Action Service. Condition for TC(12,6) rejection.	
			Para. 5.12.3	Para 5.12.3 added. <5886-OBMF> ; <5887-OBMF> ; <5888-OBMF> added Contents of monitoring events defined.	
			Para. 5.14.1.2	<5941-PTXC> deleted Specific TM(14,7) defined for Real Time down-linking and SSMM storage status reporting.	
			Para. 5.14.1.3	<5945-PTXC> modified Raw value defined for Real Time down-linking and SSMM storage status.	
			Para. 5.14.1.3	<5946-PTXC> deleted Detailed handling of TC(14,5) definition left at lower level.	
			Para. 5.14.1.4	Para 5.14.1.4 added. <5948-PTXC> added Specific TC(14,6) defined for Real Time down-linking and SSMM storage status reporting request.	

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			Para. 5.14.2.1	<5951-PTXC> deleted Specific TM(14,7) defined for Real Time down-linking and SSMM storage status reporting.	
			Para. 5.14.2.2	Para 5.14.2.2 added. <5948-PTXC> added Specific TM(14,7) defined for Real Time down-linking and SSMM storage status reporting.	
			Para. 5.15	Addition of a comment stating that VC and Store type are defined at packet Store allocation time.	
			Para. 5.15	<5965-OBSR> rectified TM packet not available if specifically disabled.	
			Para. 5.15.1.1	<5980-OBSR> modified Store type replaced by spare field in TC(15,1) and TC(15,2).	
			Para. 5.15.1.2	<6000-OBSR> modified Store type replaced by spare field in TC(15,3) and TC(15,4).	
			Para. 5.15.2.1	<6080-OBSR> modified Store type and Virtual Channel reported in TM(15,6). Addition of a comment stating that VC and Store type are defined at packet Store allocation time.	
			Para. 5.17.2	<6120-FTS> deleted Requirement about TC Verification Failure reporting replaced by a comment.	
			Para. 5.18	<6135-CPM> rectified OBCP Sequence Count incremented at TC release time. TC reporting requirement replaced by a comment.	

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			Para. 5.18.1.1	<6150-CPM> modified Segment-ID incremented one by one from 1 to K.	
			Para. 5.18.1.3	<6170-CPM> modified Parameter-ID replaced by OBCP-PID. TC(18,3) data field split into 32-bit and 64-bit long parameter areas.	
			Para. 5.18.1.7	<6230-CPM> modified Parameter-ID replaced by OBCP-PID. TC(18,7) data field split into 32-bit and 64-bit long parameter areas.	
			Para. 5.18.2.3	<6300-CPM> modified Parameter-ID replaced by OBCP-PID. TM(18,13) parameter field become optional.	
			Para. 5.18.2.4	<6310-CPM> modified Sequence-ID replaced by Segment-ID. Segment 255 to flag OBCP code reporting completion.	
			Para. 5.19	<6410-EVNT> rectified MTL Sequence Count incremented at TC release time. TC reporting requirement replaced by a comment.	
			Para. 5.19	<6415-EVNT> added MTL TC sequence count reporting identical to the loaded one.	
			Para. 5.19.1.1	<6420-EVNT> modified Indication about maximal size of Action-TC in TC(19,1).	
			Para. 5.20	<6500-INFO> ; <6510-INFO> ; <6515-INFO> ; <6520-INFO> ; <6530-INFO> ; <6540-INFO> deleted Service 20 not used.	

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			Appendix 2	<1100-A2> deleted Table A-2.1 expanded to include packets Type and Subtype and to reflect OBSW implementation.	
			Appendix 2 Table A-2.1	TC(2,3) split into Standard and Mission specific Distribute CPDU command lines. TC(3,25) split into Essential and Non-essential HK parameter report lines. Addition of TM(8,7) ; TM(8,8) and TM(8,9) Mission specific packets. Addition of TC(14,6) and TM(14,7) Mission specific packets.	
			Appendix 3 Table A-3.1	<1140-A3> modified Table split into TC and TM packet columns. APID removed for OBCP ; System ; EPS ; TCS ; TT&C end users. APID+2 allocation clarified for Diagnostic and Non-essential HK parameter reports.	
			Appendix 3 Table A-3.3	<1180-A3> modified Table expanded to include all TM packets Type and Subtype and Virtual Channel allocation.	
			Appendix 6 Para. A6.2 Para. A6.3.9	Para. A6.3.9 added. Addition of PTC=11 : Deduced parameter type.	
			Appendix 9 Para. 1.3	RD7 modified CDMU FDIR spec replaced by SOFDIR.	
			Appendix 9 Para. 3.1.4	3085-DLL-R,T modified TBC removed for No response Time out duration.	

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			Appendix 9 Para. 3.2.3	3140-DLL-D modified Table 3.2.3-1 modified. High-Priority message SA not used. TBC removed for Internal Time on SA8T.	
			Appendix 9 Para. 3.2.3.3	3160-DLL-T ; 3161-DLL-T ; 3165-DLL-T ; 3170-DLL-T deleted High-Priority message not used.	
			Appendix 9 Para. 3.5.1	3285-DLL- defined TBD removed : Reference to SOFDIR and IID-A for DLL FDIR.	
			Appendix 9 Para. 3.5.2.1	Reference to SOFDIR and IID-A for MIL FDIR.	
			Appendix 9 Para. 3.5.2.4	3375-DLL-T ; 3380-DLL-T modified Reference to SOFDIR and IID-A for bus FDIR.	
			Appendix 9 Para. 3.5.2.5	3395-DLL-R,T modified Reference to SOFDIR and IID-A for bus FDIR.	
			Appendix 9 Para. 4.1.3.1	4165-TFL-R,T modified Rectification of regulation slot duration, High-Priority message not used.	
			Appendix 9 Para. 4.1.4.1	4225-TFL-T deleted Event message SA not used.	
			Appendix 9 Para. 4.2	4275-TFL-T clarified RTA included in SA11T to SA26T used for TM data sent.	
			Appendix 9 Para. 4.4	4365-TFL-T clarified SA1R available for low level commanding.	
			Appendix 9 Para. 4.4	Figure 4.4-1 modified 4375-TFL-T modified ; 4392-TFL-R,T ; 4393-TFL-R,T ; 4394-TFL-R,T added Specification of SA1T 3rd and 4th data words according to SOFDIR.	

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			Appendix 9 Para. 4.5.1	4435-TFL-N modified Reference to SOFDIR and IID-A for bus FDIR.	
			Appendix 9 Para. 4.6.1.1	Table 4.6.1.1-1 modified 4525-TFL-T ; 4530-TFL-T ; 4535-TFL-T ; 4540-TFL-T deleted Event message not used.	
			Appendix 9 Para. 4.6.1.2	4670-TFL-D deleted High-Priority message not used.	
			Appendix 9 Para. 4.6.1.2	4675-TFL-N modified Reference to SOFDIR and IID-A for bus FDIR.	
			Appendix 9 Para. 4.6.2.	Figure 4.6.2-1 deleted Event message not used.	

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4.0	07-Nov-2003	Formal release generated by DOORS 5.2 / TREK 3. No modification in the text since issue 4 draft1. Only styles are modified. Legendes of tables and figures are systematically put below table or figure. Exceptions: Requirement <5261-PERP> : Typo correction TC(14,2) replaces TC(14,1). Requirement <5180-PERP> : Remove of "No additional use of Service 14 (Packet Transmission Control) shall be necessary for this purpose, nor shall it be necessary to re-define Housekeeping Packets under foreseeable mission conditions". Actually in case of spacecraft mode transition (eg to Survival mode) it is foreseen to use (as defined during BSW consolidation plan) service 14 autonomously for disabling the down-linking of some packets. Change bars removed. The requirements deleted in this issue or before will not be displayed in the core of the next issues. They are therefore listed hereafter and displayed in the core of this issue.	F.Sauvage I.Bénilan

List of requirements deleted in issue 4.0 or before

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§5.8.1.1	[5510-FNM]	Deleted in	4.0 or before		

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§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§5.14.1.2	[5941-PTXC]	New in, Deleted in	- >3D4 - 4.0 or before		
§5.14.1.3	[5946-PTXC]	New in, Deleted in	- >3D4 - 4.0 or before		
§5.14.2.1	[5951-PTXC]	New in, Deleted in	- >3D4 - 4.0 or before		
§5.17.2	[6120-FTS]	Deleted in	4.0 or before		
§5.20.1.1	[6500-INFO]	Deleted in	4.0 or before		
§5.20.1.1	[6510-INFO]	Deleted in	4.0 or before		
§5.20.1.1	[6515-INFO]	Deleted in	4.0 or before		
§5.20.1.2	[6520-INFO]	Deleted in	4.0 or before		
§5.20.1.3	[6530-INFO]	Deleted in	4.0 or before		
§5.20.2	[6540-INFO]	Deleted in	4.0 or before		
§7	[1100-A2]	Deleted in	4.0 or before		

Issue	Date	Change Record	Author
5.0	20-Jul-2004	Formal release generated by DOORS 5.2 / TREK 3. Open points of PS-ICD issue 4.0 have been discussed between ESA and ASP during dedicated teleconferences and meeting. Summary of these discussions and the concluded updates of PS-ICD are reported in H-P-ASP-MN-5160 (dated : 15/07/2004). In addition to requirements update individually listed below, the following changes are included in the present PS-ICD issue 5.0. - Introduction of upper traceability references. Links to requirements from higher level document (mainly OIRD : AD3) is introduced for each PS-ICD requirement. Dedicated paragraph of section 1.1 gives the used format for upper level traceability. - Harmonisation of titles giving a packet structure. When a PS-ICD section gives the structure of a packet, the packet Type and Subtype has been added in the section title. - Reference to table A-2.1 for time synchronisation procedure. A comment referring to PS-ICD table A-2.1 has been added after requirement 5500-OBTM a for clarification of the time synchronisation procedure for each end user. - Comment for TC(11,5) execution failure. A comment has been added after requirement 5655-MTL. It clarifies that TC(11,5) execution causing the deletion of a number of MTL TC lower than the specified number is not considered as an execution failure. - Optional spare octet for TC(15,3) ; TC(15,4) ; TC(15,7) ; TM(15,6). A comment has been added after requirements 6000-OBSR ; 6040-OBSR ; 6080-OBSR a. It clarifies that a spare octet may added to thes packet to fulfil the packet 16-bit alignment requirement. - TC packet reporting in TM(19,7). A comment has been added after requirements 6490-EVNT a. It clarifies that one TC packet is to be reported in each TM(19,7). - Table A-2.1 completed. This table indicates, for each end user, the implemented packets. - Section A6-3.5. This section has been updated to include the 64-bit double precision format. - Section A6-3.7. This section has been updated to indicate that Octet String parameter are not editable by spacecraft operators. Requirements modified, new or deleted in this issue: see list below. The requirements deleted in issue 4.0 or before are not displayed in the core of the document.	F.Sauvage

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List of requirements modified, new or deleted in issue 5.0

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§1.4	[RD-8]	New in	5.0	SOFDIR added as reference document.	H-P-ASP-MN-5160
§5.1	[5020-TCV a]	Modified in	5.0	Clarification of APID for TC Verification Reports.	H-P-ASP-MN-5160
§5.1.2.1	[5050-TCV]	Modified in	5.0	Clarification for Telecommand Acceptance Report - Success TM(1,1) issuing condition.	H-P-ASP-MN-5160
§5.1.2.1	[5070-TCV]	Modified in	5.0	Extension of allowed range for Failure-Code.	H-P-ASP-MN-5160
§5.1.2.6	[5120-TCV]	Modified in	5.0	Clarification of Variable Octet String used for TC packet reporting.	H-P-ASP-MN-5160
§5.3.1.1	[5210-PERP a]	Modified in	5.0	Separation of TC(3,1)/TC(3,2) used for USD-ID from those used for "regular" Parameter-ID.	H-P-ASP-MN-5160
§5.3.2.1	[5310-PERP a]	Modified in	5.0	Separation of TM(3,10)/TM(3,12) used for USD-ID from those used for "regular" Parameter-ID.	H-P-ASP-MN-5160
§5.3.2.2	[5340-PERP]	Modified in	5.0	Explicit indication for optional spare octet at the end of odd octets length TM(3,25)/TM(3,26).	H-P-ASP-MN-5160
§5.6	[5390-MM]	Modified in	5.0	Addition of 8-bit SAU, Removal of 24-bit SAU.	H-P-ASP-MN-5160
§5.6	[5395-MM]	Modified in	5.0	Length replaced by "N" : number of SAUs.	H-P-ASP-MN-5160
§5.6.1.2	[5410-MM a]	Modified in	5.0	Length replaced by "N" : number of SAUs. Explicit indication for optional spare octet at the end of odd octets length data in TC(6,2). Separation of types for the various SAUs lengfh.	H-P-ASP-MN-5160
§5.6.1.4	[5430-MM a]	Modified in	5.0	Length replaced by "N" : number of SAUs. Clarification of requested dump size depending on SAU length.	H-P-ASP-MN-5160
§5.6.1.5	[5450-MM a]	Modified in	5.0	Length replaced by "N" : number of SAUs.	H-P-ASP-MN-5160

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§5.6.2	[5460-MM a]	Modified in	5.0	Length replaced by "N" : number of SAUs. Explicit indication for optional spare octet at the end of odd octets length data in TM(6,6). Separation of types for the various SAUs lengfh.	H-P-ASP-MN-5160
§5.6.2	[5470-MM a]	Modified in	5.0	Length replaced by "N" : number of SAUs.	H-P-ASP-MN-5160
§5.9.1.1	[5500-OBTM a]	Modified in	5.0	Clarification TC(9,3) handling.	H-P-ASP-MN-5160
§5.11	[5577-OBTM a]	Modified in	5.0	Number of permanent subschedules defined through HPSDB.	H-P-ASP-MN-5160
§5.11.1.3	[5620-MTL]	Modified in	5.0	Clarification of Variable Octet String used for TC packet reporting.	H-P-ASP-MN-5160
§5.11.2.1	[5720-MTL]	Modified in	5.0	Clarification of Variable Octet String used for TC packet reporting.	H-P-ASP-MN-5160
§5.11.2.1	[5725-MTL a]	Modified in	5.0	Addition of requirement for an event at completion of command schedule reporting.	H-P-ASP-MN-5160
§5.11.2.2	[5731-MTL a]	Modified in	5.0	Addition of requirement for an event at completion of command schedule reporting.	H-P-ASP-MN-5160
§5.11.2.3	[5735-MTL]	New in	5.0	Addition of requirement for an event at completion of command schedule reporting.	H-P-ASP-MN-5160
§5.12.1.3	[5850-OBMF a]	Modified in	5.0	Extension of maximal monitoring interval (255 to 65535). Addition of spare octet. Rectification of Type for "Check-value" and "Check-Mask".	H-P-ASP-MN-5160
§5.12.2.1	[5885-OBMF a]	Modified in	5.0	Addition of requirement for an event at completion of monitoring list reporting.	H-P-ASP-MN-5160
§5.12.3	[5888-OBMF a]	Modified in	5.0	Addition of "Check-Value" in Monotoring event packets.	H-P-ASP-MN-5160
§5.14.1.1	[5930-PTXC]	Modified in	5.0	Replacement of "all packet" identifier (0 replaced by 65535).	H-P-ASP-MN-5160
§5.15.2.1	[6080-OBSR a]	Modified in	5.0	Addition of "Storage status" in TM(15,6).	H-P-ASP-MN-5160

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§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§5.18	[6135-CPM a]	Modified in	5.0	Comment about value of Sequence Count in reported TC packet, converted into requirement.	H-P-ASP-MN-5160
§5.18	[6145-CPM]	New in	5.0	Addition of requirement for "all OBCP" identifier applying to TC(18,4).	H-P-ASP-MN-5160
§5.18.1.1	[6150-CPM a]	Modified in	5.0	Length replaced by "N" : number of loaded octets. OBCP code as a repetition of "fixed Length Octet String" instead of "Variable Octet String". Explicit indication for optional spare octet at the end of odd octets length OBCP code.	H-P-ASP-MN-5160
§5.18.1.1	[6155-CPM a]	Modified in	5.0	Updated for rejection of TC(18,1) requiring the loading of an already existing OBCP-ID.	H-P-ASP-MN-5160
§5.18.1.3	[6170-CPM]	Modified in	5.0	Clarification about type used for OBCP parameters.	H-P-ASP-MN-5160
§5.18.1.7	[6230-CPM]	Modified in	5.0	Clarification about type used for OBCP parameters.	H-P-ASP-MN-5160
§5.18.2.4	[6310-CPM a]	Modified in	5.0	Length replaced by "N" : number of dumped octets. OBCP code as a repetition of "fixed Length Octet String" instead of "Variable Octet String". Explicit indication for optional spare octet at the end of odd octets length OBCP code.	H-P-ASP-MN-5160
§5.19	[6400-EVNT]	Modified in	5.0	Aligned to implementation. Detection list can include Event-ID of Error/Alarm Report TM(5,4).	H-P-ASP-MN-5160
§5.19	[6415-EVNT a]	Modified in	5.0	Comment about value of Sequence Count in reported TC packet, converted into requirement.	H-P-ASP-MN-5160
§5.19.1.1	[6420-EVNT a]	Modified in	5.0	Detection list can include Event-ID of Error/Alarm Report TM(5,4). Clarification of Variable Octet String used for TC packet reporting.	H-P-ASP-MN-5160
§5.19.1.2	[6440-EVNT a]	Modified in	5.0	Updated to allow repetition of APID, Event-ID in TC(19,2).	H-P-ASP-MN-5160

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§5.19.1.4	[6460-EVNT a]	Modified in	5.0	Updated to allow repetition of APID, Event-ID in TC(19,4).	H-P-ASP-MN-5160
§5.19.1.4	[6470-EVNT a]	Modified in	5.0	Updated to allow repetition of APID, Event-ID in TC(19,5).	H-P-ASP-MN-5160
§5.19.2.1	[6490-EVNT a]	Modified in	5.0	Updated to include "Parameter passing status", "AFO-Status" and "AFS-Status" in TM(19,7). Reporting of one only TC packet per TM(19,7). Clarification of Variable Octet String used for TC packet reporting.	H-P-ASP-MN-5160
§5.19.2.1	[6495-EVNT]	New in	5.0	Added requirement for an event at completion of Event Detection List reporting.	H-P-ASP-MN-5160
§8	[1140-A3 a]	Modified in	5.0	Odd APID used for TM packet from instrument redundant side.	H-P-ASP-MN-5160
§8	[1180-A3 a]	Modified in	5.0	APID and Virtual Channel added for Time Packet and Idle Packet.	H-P-ASP-MN-5160
§11.1	[1200-A6]	Modified in	5.0	Addition of 64-bit double precision PTC, PFC = 5,2	H-P-ASP-MN-5160
§12	[1300-A7 a]	Modified in	5.0	Modification of TIme packet issuing period.	H-P-ASP-MN-5160

THALES

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6.draftA	17 Dec. 2007	Draft release for review (Appendix 9 not distributed). - Typo correction. Correction of reference for Time Packets and Idle Packets layout description. Title of section 5.3.2.1 : TM(3,11) rectified to TM(3,12). [5430-MM a] : missing "of" added. Section 5.19.2.1 : Undue line removed in "AFS-Status" paragraph. Section A6-3.8 : acronym corrected to CTR (for Central Time Reference). - Clarification for periods involved in Service 3. Section 5.3 : Packet generation period is a power of two of the "basic sampling period". Super-commutated parameters (if any) appears a power of two times consecutively at the end of an HK or DIAG Parameter Report. - Clarification for definition or re-definition of an HK or DIAG Parameters Report. Section 5.3 : When defining or re-defining an HK or DIAG Parameter Report nor APID nor VC for Real-Time down-linking are modified. - Clarification for alignment of 8-bit parameters in HK or DIAG Parameters Reports. Section 5.3.2.2 : Spare octet can be inserted between 8-bit parameters. - Clarification for Packet Data Field Structure of TM(6,6) Section 5.6.2 : Addition of data definition for the particular case of STR dump - Clarification for On-board Scheduling service (Type 11). Section 5.11 : Wild-Card SubscheduleID = 0 does not apply to "Insert MTL-Telecommands in Command Schedule" TC(11,4). Section 5.11.1.4.1 : Multiple deletion criteria not allowed for "Delete a set of Telecommands from the MTL" TC(11,5). Section 5.11.1.4.1 : In case of deletion of incomplete MTL command set, deleted MTL commands are not restored. - Clarification for periods involved in Service 12. Section 5.12 : Basic monitoring period is a negative power of two of the "basic sampling period". - Addition of Unit-ID and Unit-Status in TM(12,9). Section 5.12.2.1 : Modification of TM(12,9) Source Data Field. - Clarification for On-board Storage and Retrieval service (Type 15). Section 5.15 : minor wording clarifications. Section 5.15.1.1 : Clarification of allocation of Packet Store characteristics. Section 5.15.1.2 : Rectification of N1 repetition, optional spare octet addition. Section 5.15.1.4 : Rectification of N1 repetition, optional spare octet addition. Section 5.15.1.6 : Rectification of Store ID length, repeated spare octet addition. Section 5.15.1.7 : Removal of repetition counter for packet store catalogue report request. Section 5.15.2.1 : Rectification of N1 repetition, optional spare octet addition. Section 5.15.2.2 : Removal of repetition counter for packet store catalogue report. Replacement of time (48-bit) and size information by coarse time, and pointers information.	F.Sauvage R.Sghedoni

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		- Clarification for On-board Control Procedures service (Type 18) Section 5.18.1.1 : value 0 for N in termination segment (Segment ID = FFhex) not checked on-board. Immediately suspension of OBCP if Step ID = 0 in TC(18,5). Section 5.18.2.3 : Modification of TM(18,13) source data for reporting of Procedure Status and separation of the 32-bit reported parameters from the 64-bit ones. - Appendix 3 upgrade. Upgrade of introduction section and of requirements 1140-A3a and 1180-A3a according to Data Management Working Group#23 (H-P-ASP-6276) outcomes. - Appendix 6 upgrade. Section A6-2 'encoding formats of parameter types' : PTC 8 Character-string parameter allowed on-board stored identifier of software version. Section A6-10 'Character-string parameter' description added. - Appendix 7 & 8 upgrade. Clarification for Data Field Header Flag for Time and Idle packets. Requirements modified, new or deleted in this issue : see list below. The requirements deleted in issue 4.0 or before are not displayed in the core of the document.	

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List of requirements modified, new or deleted in issue 6.draftA

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§4.1	[4000-TM]	Modified in	6.draftA	Correction of reference for Time Packets and Idle Packets layout description.	
§4.2.2	[4030-TM]	Modified in	6.draftA	Addition of VC4 for transmission of TM packets that cannot be identified.	
§5.1.2.1	[5070-TCV]	Modified in	6.draftA	Rectification of minimal length for TM(1,2) and TM(1,8) optional "parameters" field.	ESA-AAS-SSF mail exchange (2004-11-11)
§5.3	[5170-PERP]	Modified in	6.draftA	Reworded after clarification for periods involved in Service 3.	
§5.3.1.1	[5210-PERP a]	Modified in	6.draftA	Reworded after clarification for periods involved in Service 3.	
§5.3.2.1	[5310-PERP a]	Modified in	6.draftA	Reworded after clarification for periods involved in Service 3.	
§5.3.2.2	[5340-PERP]	Modified in	6.draftA	Reworded after clarification for periods involved in Service 3.	
§5.5.2	[5350-EVRP]	Modified in	6.draftA	Clarification regarding purpose of (TM layout) figure.	
§5.5.2	[5360-EVRP]	Modified in	6.draftA	Clarification regarding purpose of (TM layout) figure.	
§5.5.2	[5370-EVRP]	Modified in	6.draftA	Clarification regarding purpose of (TM layout) figure.	
§5.6.1.2	[5400-MM]	Modified in	6.draftA	Removal of part requiring loaded data discard.	AI#4 from MoM : H-P-MI-AI-1088.
§5.6.2	[5460-MM a]	Modified in	6.draftA	Addition of data definition for the particular case of STR dump.	SCI-PT-33930 (15-Feb-2005)
§5.8	[5480-a-FNM]	Modified in	6.draftA	Rename of [5480-FNM] already existing in §5.8.2.1.	
§5.8.1.4	[5460-FNM]	Modified in	6.draftA	Removal of undue line : value 0 for SID allowed if parameter(s) are present.	
§5.8.1.5	[5475-FNM]	Modified in	6.draftA	Clarification of the requirement : TM(8,6) issued in response to TC(8,5).	
§5.9.5.1	[5540-OBTM]	Modified in	6.draftA	Clarification of requirement.	

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§5.11	[5575-OBTM]	Modified in	6.draftA	Clarification about the specific case of TC (11,4). Wild-Card SubscheduleID = 0 does not apply to "Insert MTL-Telecommands in Command Schedule" TC(11,4).	
§5.11.1.1	[5590-MTL]	Modified in	6.draftA	Addition of case N = 1 and subschedule = 0.	
§5.11.1.1	[5595-MTL]	Modified in	6.draftA	Clarification of the requirement : any of the N subschedules ; any of the M APID added.	
§5.11.1.3	[5610-MTL]	Modified in	6.draftA	Clarification of the requirement : 216 octets for the application data field.	
§5.11.1.4.1	[5640-MTL]	Modified in	6.draftA	Multiple deletion criteria not allowed in TC(11,5). Clarification of Packet Sequence Control in TC(11,5).	
§5.11.1.4.1	[5655-MTL]	Modified in	6.draftA	Modification of the error case : in case of deletion of incomplete MTL command set, deleted MTL commands are not restored.	
§5.11.2.2	[5730-MTL]	Modified in	6.draftA	Clarification of Packet Sequence Control in TM(11,13).	
§5.11.2.3	[5732-MTL]	Modified in	6.draftA	Addition of an optional spare octet in TM(11,19).	
§5.12	[5810-OBMF]	Modified in	6.draftA	Reworded after clarification for periods involved in Service 3 : basic monitoring period is a negative power of two of the "basic sampling period".	
§5.12.1.1	[5830-OBMF]	Modified in	6.draftA	Clarification of the requirement : Checking status set to IN_RANGE when monitoring is enabled.	
§5.12.1.3	[5850-OBMFa]	Modified in	6.draftA	Reworded after clarification for periods involved in Service 3.	
§5.12.2.1.	[5880-OBMF]	Modified in	6.draftA	Addition of Unit-ID and Unit-Status in TM(12,9) monitoring list contents report.	
§5.12.2.1.	[5885-OBMFa]	Modified in	6.draftA	Reference to modified TM(12,9) source data field added.	
§5.15.1.1	[5980-OBSR]	Modified in	6.draftA	Reworded for clarification of allocation of Packet Store characteristics.	

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§5.15.1.2	[6000-OBSR]	Modified in	6.draftA	Rectification of repetition defined by N1. Addition of an optional spare octet.		
§5.15.1.4	[6040-OBSR]	Modified in	6.draftA	Rectification of repetition defined by N1. Addition of an optional spare octet.		
§5.15.1.6	[6060-OBSR]	Modified in	6.draftA	Rectification of Store ID length. Addition of a repeated spare octet.		
§5.15.1.7	[6070-OBSR]	Modified in	6.draftA	Removal of repetition counter for packet store catalogue report request.	H-P-MI-AI-0601	
§5.15.2.1	[6080-OBSR]	Modified in	6.draftA	Rectification of repetition defined by N1. Addition of an optional spare octet.		
§5.15.2.2	[6090-OBSR]	Modified in	6.draftA	Removal of repetition counter for packet store catalogue report. Replacement of time (48-bit) and size information by coarse time, and pointers information.	H-P-MI-AI-0601 and SCI-PT-30522	
§5.18.1.1	[6150-CPMa]	Modified in	6.draftA	Removal of undue line : value 0 for N in termination segment (Segment ID = FFhex) not checked on-board.		
§5.18.1.5	[6190-CPM]	Modified in	6.draftA	Addition of requirement to immediately suspend the procedure if Step ID = 0 in TC(18,5).		
§5.18.1.10	[6265-CPM]	Modified in	6.draftA	Clarification of requirement : TM(18,13) used to report OBCP status and parameters.		
§5.18.1.11	[6275-CPM]	Modified in	6.draftA	Reworded for clarification of the requirement.		
§5.18.2.3	[6300-CPM]	Modified in	6.draftA	Modification of TM(18,13) source data (OBCP status report) : reporting of Procedure Status and separation of the 32-bit reported parameters from the 64-bit ones		

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§5.19.1.1	[6430-EVNT]	Modified in	6.draftA	Clarification of the requirement : 220 octets for the application data field.	
§5.19.2.1	[6490-EVNTa]	Modified in	6.draftA	Removal of undue line.	
Appendix 3	[1140-A3 b]	Modified in	6.draft1	Rectification of instrument used APIDs according to DMWG#23 outcomes.	H-P-ASP-MN-6276
Appendix 3	[1140-A3 c]	Modified in	6.draftA	Modification of PACS used APIDs according to NCR 3746 outcomes : APID 1154/1155 for "Diagnostic Parameter Report" ; APID 1158/1159 for "Diagnostic Science Data Report".	
Appendix 3	[1180-A3 b]	Modified in	6.draft1	Rectification of instrument used APIDs according to DMWG#23 outcomes.	H-P-ASP-MN-6276
Appendix 3	[1180-A3 c]	Modified in	6.draftA	Modification of PACS used APIDs according to NCR 3746 outcomes : APID 1154/1155 for "Diagnostic Parameter Report" ; APID 1158/1159 for "Diagnostic Science Data Report".	
Appendix 6	Section A6-3.10	New in	6.draftA	PTC = 8 : On-board use is restricted to the PROM stored identifier of software version.	
Appendix 7	[1300-A7 a]	Modified in	6.draftA	Clarification of Data Field Header Flag for Time Packet.	
Appendix 8	[1400-A8]	Modified in	6.draftA	Clarification of Data Field Header Flag for Idle Packet.	

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6.0	25 Jan. 2008	Formal release for application. - Clarification for On-board Scheduling service (Type 11). Section 5.11.1.1 : N = 0 in TC(11,1) and TC(11,2) "Enable/Disable Release of Telecommands" shall not change Subschedules release status. Wild-Card SubscheduleID = 0 shall be used to affect the release status of all Command Schedule (i.e. : all Subschedules). Section 5.11.2.3 : Removal of misleading note regarding the non-reporting of release status for non-used subschedules. Requirements modified, new or deleted in this issue : see list below. The requirements deleted in issue 4.0 or before are not displayed in the core of the document.	F.Sauvage R.Sghedoni

List of requirements modified, new or deleted in issue 6.0

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§1.4	[RD-8]	Modified in	6.0	Update of RD-8 (SOFDIR) issue.	
§5.11.1.1	[5590-MTL]	Modified in	6.0	Requirement expanded for clarification of cases where - N = 0 ; - N = 1 and Subsch-ID = 0 ; - N > 0 and Subsch-ID <> 0 ;. - M = 0 ; - M > 0 and APID <> 0.	
Appendix 6	Section A6-3.5 and A6-3.5.2	Modified in	6.0	Removal of real format PTC,PFC = 5,3 : 32-bit single format according to MIL-STD-1750-A	

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LIST OF FIGURES AND TABLES

1. INTRODUCTION AND SCOPE

1.1 Scope

The ESA Packet Telemetry and Telecommand Standards ([AD-1] and [AD-2]) address the transport of telemetry and telecommand data between user applications on the ground and user applications on-board of a satellite, and the intermediate transfer of these data through the different elements of the ground and space segments.

The Packet Structure Interface Control Document (PS-ICD) serves to complement and extend the Packet Telemetry and Telecommand Standards by defining all the mission specific details of the data transfer between ground and on-board applications (i.e. on-board units, subsystems, and instruments, and their counterparts on ground).

For the Application Layer Interface this document describes procedures and the data structures for Telemetry and Telecommand Packets to be implemented for support of the operational requirements defined in the Herschel / Planck Operations Interface Requirements Document [AD-3]. Being tailored especially for Herschel / Planck, this document supersedes the Packet Utilisation Standard (PUS) [RD-1].

Additionally to defining functionality and generic operational details of TM/TC Packet Services and the associated layout of Packet Data Fields, the PS-ICD defines the applicability for all on-board users. It also specifies, which parts of Packet Data Fields are generic, and which parts can be defined in a user-specific way. In its function as ICD, the document allocates certain fixed values, like Application Identifiers (APID), to specific users. It also defines certain unique Packet Data Fields, together with their allocated Packet Type/ Subtype value to specific users.

In addition, for treceability purpose, parent requirements are indicated as follows :
[P:<Parent_Specification_Reference>#<Parent_Paragraph_Number>-<Parent_Requirement_Identifier>

- Example : [P:SCI-PT-RS-07360#3.1-PACK-14.
  This example indicates that the requirement PACK-14 in §3.1 of the specification SCI-PT-RS-07360 (OIRD) is a parent of the current requirement.

Protocol layers below the Application Layer, which serve for transferring TC- and TM-Packets on a physical medium between on-board units, also have to be defined in order to be compliant with general and mission-specific requirements. Therefore, this document specifies in Appendix 9 a Satellite Data Bus Protocol, which provides the necessary definitions for controlling the on-board data transfer within the Physical, Data Link Layer and Transfer Layer.

#	Reference	1000-GEN

The Herschel / Planck space and ground segment shall support all and only the data structures and services defined in this document. All TM/TC -Packet Type/ Subtype –combinations shall only be used, together with the associated structure of the Packet Data Field, as specified in this document.

The document is to be agreed between the ESA Herschel / Planck Project Manager, the appointed ESOC representative and the Prime Contractor. Upon approval, the document will be controlled by the Prime Contractor, to whom any updates or changes to any parameters contained in it shall be submitted.

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1.2 Operations Scenario

1.2.1 Nominal Mission Operations

The mission operations of the Herschel / Planck spacecraft and their payloads will be conducted under control of the Mission Operations Centre (MOC, ground) at the European Space Operations Centre (ESOC). Throughout the complete mission duration (from launch up to the end of mission, when ground contact to the spacecraft/payload is terminated), facilities and services will be provided to the Science Centre for planning and execution of astronomical observations, and provision of the necessary data sets.

Interaction with the spacecraft will be by monitoring and analysis of telemetered data and by the uplink of commands to effect the necessary operations. Most Telecommands will be stored on board for later execution at a defined time, via the On-board Operation Scheduling Service, others may be intended for immediate execution. In both cases, it may be necessary to control subsystem and experiment equipment via on-board applications, which may interact with physical interfaces and/or serve for internal data processing.

Function Management Services or On-Board Control Procedures (OBCPs) may be used for these purposes. The OBCPs can constitute autonomous on-board control loops, which make use of the exchange of TM/TC Packets, can affect more than one unit, and may be active for a considerable period of time. They shall be kept simple and reduced to the essential minimum.

Telemetry and Telecommand services are provided in support of nominal management functions, including :

– sampling and processing of periodic housekeeping data,

– direct commanding of hardware interfaces,

– control of, and communication with, on-board functions and on-board control procedures,

– control of the on-board mission time line,

– recording to and retrieving data from an on-board mass memory,

– monitoring of and reacting on asynchronous on-board events.

Reference 1010-GEN

[P:SCI-PT-RS-07360#3.1-PACK-14.

All Telecommands must be appropriately verified by Telemetry Reports at acceptance. Whereas acknowledge of acceptance shall always be done via an TC Verification TM- Packet, Telecommand execution progress and completion can be reported by (a combination of) TM-Packets and/or periodic housekeeping data, depending on the exact nature of the executed function.

*

Telemetry data will be required in order to verify the execution of all mission operations, and will also be required for :

– routine on-ground status and health monitoring of the subsystems and the experiments ;

– reporting to the ground any anomalous events detected on-board and any actions taken autonomously by the on-board systems ;

– performance evaluation on the ground for the purposes of long-term trend analysis and feedback into the mission planning cycle.

The Mission Timeline (MTL) is defined as a linear sequence of Telecommands, which will be sent to their on-board destinations by the Scheduling Service, when their execution time has arrived. The autonomous

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operation of Herschel and Planck will be based on these TC packets, which are uplinked to the MTL during each daily communication period.

The autonomous execution of Telecommands requires that preconditions and execution status of each Telecommand are checked, as part of Flight Procedures that are executed automatically on-board (as opposed to ground control). The Scheduling Service is not specified to check the execution status of Telecommands. However, OBCPs can have capabilities in support of these control functions, like activating a part of the MLT, or skipping (parts of) the MTI up to a point in time, and releasing specific Telecommands for pre-planned recovery activities.

1.2.2 Contingency Operations

In the event of unforeseen on-board events, on-ground actions will be necessary to investigate and correct anomalies utilising the available telemetry and command functionality.

Several TM / TC packet services in support of unit-specific data structures are implemented in support of contingency operations :

– activation or modification of test or diagnostic operational modes and associated TM packet structures,

– modification of the on-board operations schedule,

– modification of on-board control procedures,

– In exceptional cases, it may be necessary to modify on-board parameters or software in order to compensate for on-board failures or anomalous performance. This may be done by dumping, checking, and loading of on-board memories.

1.2.3 Packet Distribution

The following Telemetry and Telecommand Packet categories exist :

– those generated on the ground and up-linked to the spacecraft for immediate distribution or intermediate storage,

– those generated by on-board applications and down-linked to the ground,

– those generated on-board and routed to other on-board applications (and to the ground in all cases).

These packet categories are to be routed to or from on-board end-users which are capable of handling the services associated with TM / TC Packet data structures (so-called packet end users). The routing of packet data takes place under control of the Command and Data Management System (CDMS) of the satellite, which is in charge of initialisation, timing, and prioritising of any on-board packet data transfer.

The CDMS is also acting as the controlling subsystem for the on-board serial data bus, which serves for physically connecting units and routing data from or to instruments, other spacecraft units, or subsystems. The protocol, which serves for transferring packet data and other data (e.g. control information), does not impose restrictions on packet data structures, and the associated service acts independently from packet services. Details of this protocol are specified in Appendix 9 of this document.

The management of the serial data bus incorporates certain Failure Detection, Isolation, and Recovery (FDIR) functions, which provide for a reliable transfer of packet data. They are also defined in Appendix 9. These FDIR functions are executed and reported by the CDMS ; all other packet end-users are required to generate the appropriate event packets in case problems with the exchange of data can be detected.

1.3 APPLICABLE DOCUMENTS

Reference AD-1
Packet Telemetry Standard, PSS-04-106, Issue 1, January 1988
*

Reference AD-2
Packet Telecommand Standard, PSS-04-107, Issue 2, April 1992
*

Reference AD-3
Herschel / Planck Operations Interface Requirements Document (H/P-OIRD), SCI-PT-RS-07360
*

1.4 REFERENCE DOCUMENTS

Reference RD-1
Packet Utilisation Standard (PUS), ECSS-E-70-41A, Issue 1, 6 November 2002
*

Reference RD-2
CCSDS Packet Telemetry, CCSDS 102.0-B-4, November 1995
*

Reference RD-3
MIL-Std.-1553 B, Digital Internal Time Division Command/Response Multiplex Data Bus, Issue Notice 2, 8 September 1986
*

Reference RD-4
SVM Requirements Specification, H-P-4-ASPI-SP-0019
*

Reference RD-5
Herschel / Planck Instrument Interface Document Part A, SCI-PT-IIDA-04624
*

Reference RD-6
CDMU Application SW Requirements Specification, H-P-SP-AI-0031

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Reference   RD-7

SVM Interface Specification, H-P-4-ASPI-IS-0042

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Reference   RD-8

System Operations & FDIR Requirements (SOFDIR), H-P-1-ASPI-SP-0209, issue 4.4

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2. PACKET SERVICES

#	Reference	2000-PACK

[P:SCI-PT-RS-07360#3.18-SCI-1. a

[P:SCI-PT-RS-07360#3.14-FTS-3.

[P:SCI-PT-RS-07360#3.10-OBMF-2.

[P:SCI-PT-RS-07360#3.16-EVNT-3.

[P:SCI-PT-RS-07360#3.14-FTS-1.

[P:SCI-PT-RS-07360#3.10-OBMF-1.

[P:SCI-PT-RS-07360#3.8-OBTM-4.

[P:SCI-PT-RS-07360#3.12-OBSR-1.

The Packet Services listed in Table 2-1 below are available on Herschel/Planck for users and are specified in detail within the following chapters. This Table 2-1 summarises the Packet Services supported by Herschel/Planck on-board subsystems (the CDMS and the ACMS) and instruments to the extent specified in this document.

For implementation of these Services, only a subset of packets specified in this document may, agreement with the Herschel / Planck project, be used by an on-board subsystems and instruments. This specificity is reflected in their respective User Manual and summarised in Table A-2.1 in Appendix 2 of this document. TM/TC-Packet Services other than specified in this document are not foreseen for the Herschel and Planck mission.

Service Type	Service Name	Services supported by		
		CDMS	ACMS	Instruments
1	Telecommand Verification	Yes	Yes	Yes
2	Device Command Distribution Service	Yes	Yes	No
3	Housekeeping and Diagnostic Data Reporting	Yes	Yes	Yes
4	Not Used	No	No	No
5	Event Reporting	Yes	Yes	Yes
6	Memory Management	Yes	Yes	Yes
7	Not Used	No	No	No
8	Function Management	Yes	Yes	Opt.
9	Time Management Service	Yes	Yes	Yes
10	Not Used	No	No	No
11	On-board Operations Scheduling Service	Yes	No	No
12	On-board Monitoring Service	Yes	Opt.	Opt.
13	Not Used	No	No	No
14	Packet Transmission Control Service	Yes	Yes	Yes
15	On-board Storage and Retrieval Service	Yes	No	No
16	On-board Traffic Management	Yes	No	No
17	Test Service	Yes	Yes	Yes
18	On-board Control Procedure Service	Yes	No	Opt.
19	Event/Action Service	Yes	Opt.	No
20	Not Used	No	No	No
21	Science Data Transfer Service	No	No	Yes
22	Not Used	No	No	No

Table 2-1 : Packet Services specified within this document

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3. TELECOMMAND STRUCTURE

3.1 Telecommand Source Packets

Reference 3000-TC

[P:SCI-PT-RS-07360#3.2-TCV-0.

[P:SCI-PT-RS-07360#2.1.2-TC-4.

All Telecommand source packets must conform to the structure defined in [AD-2] and shown in Figure 3.1-1 below.

PACKET HEADER (48 bits)						PACKET DATA FIELD (VARIABLE)		
PACKET ID				PACKET SEQUENCE CONTROL		PACKET LENGTH	DATA FIELD HEADER	APPLIC-ATION DATA	PACKET ERROR CONTROL
Version Number	Type	Data Field Header Flag	APID	Sequence Flags	Sequence Count				
3	1	1	11	2	14				
16 bits				16 bits		16 bits	32 bits	N x 16 bits	16 bits

Figure 3.1-1: Telecommand Packet Fields

– Packet Header

• Packet ID

Ø Version Number :

The Version Number must be set to '000'$_{BIN}$ for all commands.

Ø Type :

This bit distinguishes between Telecommand packets and telemetry source packets. For Telecommand packets, the type = 1.

Ø Data Field Header Flag :

This indicates the presence of the Data Field Header when set to 1.

All commands except the «Standard Distribute CPDU command» TC Packet Type/Subtype (2,3), shall have a data field header. Note that the TC packet data field header contains the packet Type and Subtype. As a consequence Packet Type/Subtype (2,3) will not be indicated in the «Standard Distribute CPDU command» TC Packet.

Ø Application Process ID :

The Application Process ID (APID) defines the application or unit which the Telecommand is addressed to.

The choice of Application Process ID values across the spacecraft subsystems and experiments are given in Appendix 3.

• Packet Sequence Control

Ø Sequence Flags :

These 2 bits shall be set to «11», all Telecommands shall be «stand-alone» packets.

Ø Sequence Count : (14 bits) :

This field is provided to identify a particular Telecommand packet so that it can be traced within the end-to-end Telecommand system. The field is divided into two parts as follows :

§ Source part (3 most significant bits) identifies the generator or source of a certain command as follows :

000 = Ground, highest priority, all sources (maintained by ground)

001 = Failure Detection, Isolation, and Recovery Telecommands (CDMU on-board)

010 = Mission Time Line (maintained by ground, executed by CDMU)

011 = On-board Control Procedures (executed by CDMU)

100 = Ground, low priority, all sources (maintained by ground)

101 = Failure Detection, Isolation, and Recovery Telecommands (ACC on-board)

110 = CDMU, other sources on-board

111 = ACMS, other sources on-board

§ Sequence part (11 bits) shall be used to represent the actual Sequence Count. The Sequence Count is maintained by the Telecommand source for each Application Process ID. The sequence count shall be incremented by 1 whenever a command is generated with that Application Process ID. The counter wraps around from «full-scale» to zero.

When an acknowledgement of a TC-packet is required (see «Ack» field in the data field header below), it is mandatory that the full Sequence Control field is included in the telemetry acknowledge packet as the identifier of the Telecommand packet being acknowledged.

No check is to be performed by the addressed application regarding the monotony of the sequence counter, the application shall accept commands regardless of the sequence counter.

• Packet Length

The Packet Length field specifies the number of octets contained within the Packet Data Field. The number is an unsigned integer «C» where :

C = (Number of octets in Packet Data Field) – 1

The maximum length of a Telecommand Packet Data Field is 242 octets (i.e. C <= 241). The overall TC Packet including the Packet Header is 6 octets longer, therefore the maximum TC Packet length is 248 octets.

The Packet Length shall be an integer number of 16 bit words, as a result C will always be a odd number (of octets).

Note : As almost all Telecommands will be stored and then executed from the on-board Mission Timeline (nominal case) the actual usable TC packet length is shorter than 248 octets. TC packets have to be encapsulated into MTL Telecommands in order to be loaded to the MTL. They are carried as Variable Octet String, for which the actual length is provided within their own Packet Header, leaving an actual overall length of 228 octets.

#	Reference	3010-TC

[P:SCI-PT-RS-07360#2.1.2-TC-4.

[P:SCI-PT-RS-07360#3.2-TCV-0.

[P:SCI-PT-RS-07360#3.2-TCV-5.

– Packet Data Field

• Data Field Header

The data field header shall be preceded by the packet header and followed by application data and error control in the Telecommand packet, refer to figure 3.1-1. The data field header is defined as follows :

CCSDS Secondary Header Flag	TC Packet PUS Version Number	Ack	Packet Type	Packet Subtype	Spare
Boolean (1 bit)	Enumerated (3 bits)	Enumerated (4 bits)	Enumerated (8 bits)	Enumerated (8 bits)	(8 bits)

Ø CCSDS Secondary Header Flag :

This bit shall be set to zero to indicate that the PUS Data Field Header is a «non-CCSDS defined Secondary Header».

Ø TC Packet PUS Version Number :

ONLY ONE PUS VERSION NUMBER IS PERMITTED : VERSION 0 (VALUE = 0).

Ø Ack :

This field is used to indicate which acknowledgements, in the form of Telecommand verification packets, are required to notify acceptance and to verify execution of this Telecommand packet. This relates only to acknowledgement of successful acceptance and execution, since failure reports shall be generated by default.

The bit settings shall be as follows :

§ ---1 (bit 3 of the Ack field set) :, acknowledge acceptance of the packet by the Application Process

§ --1- (bit 2 of the Ack field set) : acknowledge start of execution

§ -1-- (bit 1 of the Ack field set) : acknowledge progress of execution

§ 1--- (bit 0 of the Ack field set) : acknowledge completion of execution.

In nominal cases, the bit 3 of the Ack field (acknowledge acceptance) is always set by ground users. However in specific cases TC packet can be sent with this bit set to 0. In such a case, the on-board software shall perform the acceptance but, in case of successful TC acceptance, shall not issue the Telecommand Acceptance Report - Success TM(1,1) packet.

Ø Packet Type :

This indicates the Service to which this packet relates.

Ø Packet Subtype :

Together with the Packet Type, the Subtype uniquely identifies the nature of the Service Request constituted by this Telecommand packet.

The definition of Packet Type and Subtype is unique across all Application Processes.

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Ø Spare :

Spare bits are introduced in order to make up an integral number of 16-bit words. These spare bits shall be set to zero.

- Application Data

The Telecommand application data constitute the data element of the Telecommand to be used by the application.

- Packet Error Control (PEC) (16 bits)

The purpose of the mandatory Packet Error Control field is to transport an error detection code that shall be used by the receiving Application Process to verify the integrity of the complete Telecommand Packet. The type of the PEC is fixed for the complete mission for all Application Processes, and is defined in Appendix 4.

*

4. TELEMETRY STRUCTURE

4.1 Telemetry Source Packet

#	Reference	4000-TM

[P:SCI-PT-RS-07360#3.1-PACK-10.

[P:SCI-PT-RS-07360#3.1-PACK-12. a

[P:SCI-PT-RS-07360#2.1.3-TM-17.

All Telemetry Source Packets must conform to the structure defined in [AD-1] and shown in Figure 4.1-1 below.

SOURCE PACKET HEADER (48 bits)						PACKET DATA FIELD (VARIABLE)		
PACKET ID				PACKET SEQUENCE CONTROL		PACKET LENGTH	DATA FIELD HEADER	SOURCE DATA	PACKET ERROR CONTROL
Version Number	Type	Data Field Header Flag	Application Process ID	Segmentation Flags	Source Sequence Count				
3	1	1	11	2	14				
16 bits				16 bits		16 bits	80 bits	N x 16 bits	16 bits

Figure 4.1-1: Telemetry Source Packet Fields

– Source Packet Header

• Packet ID

Ø Version Number :

The Version Number must be set to '000'$_{BIN}$ (The specification in this document is consistent with [RD-2] and supersedes [AD-1]) for all telemetry issued on-board. The ground segment shall reject with an alarm any packet received with a version number other than zero.

Ø Type :

For Telemetry Source Packets, the type must be set to zero.

Ø Data Field Header Flag :

This indicates the presence or absence of a Data Field Header and must be set to 1 except for Time Packets and for Idle Packets where it is set to 0 (see Appendix 7 and Appendix 8).

Ø Application Process ID (APID) :

The Application Process ID uniquely identifies the on-board source of the packet.

For Telemetry Packets the APIDs have an internal structure that allows an allocation of each TM-Packet to one of three major service categories. The choice of Application Process ID values across the spacecraft subsystems and experiments are given in Appendix 3.

Two Application Process ID's have been reserved for special purposes, namely the Standard Spacecraft Time Source Packet and the Idle Packet. Their use and data structure are

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provided in Appendices 7 and 8 respectively. Additionally, a range of APIDs is allocated exclusively for EGSE-related messages. These APIDs shall not be used for any on-board TM/TC-Packets.

- Packet Sequence Control

  Ø Segmentation [Grouping] Flags :

  These two bits shall be set to '11'$_{BIN,}$ indicating «no segmentation».

  An exception to the above rule is made for Science Data packets TM(21,*x*). These packets may use the segmentation flags to implement packet grouping as defined below.

  § segmentation flags = 01 : first source packet of a group

  § segmentation flags = 00 : continuation source packet of a group

  § segmentation flags = 10 : last source packet of a group

  § segmentation flags = 11 : a self standing source packet not belonging to a group.

  The packet order within a group is given by the source sequence count field.

  Note that the onboard data management system and the ESA ground data system does not provide any special support for the grouping of source packets. All packets belonging to a group are treated as self standing data units. It shall be the responsibility of the user to support the packet grouping in the onboard instrument and in the ground data processing equipment.

  Ø Source Sequence Count :

  A separate source sequence count shall be maintained for each Application Process ID and shall be incremented by 1 whenever the source (APID) releases a packet. Therefore the counter corresponds to the order of release of packets by the source and enables the ground to detect missing packets.

- Packet Length

  The Packet Length field specifies the number of octets contained within the Packet Data Field, including the Data Field Header. The number is an unsigned integer «C» where

  C = (Number of octets in Packet Data Field) – 1

  For Herschel / Planck the maximum length of a Telemetry Source Packet Data Field is 1018 octets, i.e. the maximum value for C is 1017.

  It should be noted that the actual length of the entire Telemetry Source Packet, including the Source Packet Header, is 6 octets longer. Therefore the maximum TM Packet length is 1024 octets.

  The Packet Length shall be an integer number of 16 bit words, as a result C will always be a odd number (of octets).

*

Reference 4010-TM

[P:SCI-PT-RS-07360#3.1-PACK-10.

[P:SCI-PT-RS-07360#3.1-PACK-12. a

[P:SCI-PT-RS-07360#2.1.3-TM-17.

– TM Packet Data Field

  • Data Field Header

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The content of the Data Field Header depends on the nature of the Telemetry Reports defined in the remainder of this document, however all data field headers shall have the same basic structure, as follows :

Spare	TM Source Packet PUS Version Number	Spare	Packet Type	Packet Subtype	Spare	Time
Bitstring (1 bit)	Enumerated (3 bits)	Bitsring (4 bits)	Enumerated (8 bits)	Enumerated (8 bits)	Bitsring (8 bits)	(48 bits)

Ø   Spare :

To maintain symmetry with the Telecommand packet Data Field Header, this bit is reserved and shall be set to zero

Ø   TM Source Packet PUS Version Number :

ONLY ONE PUS VERSION NUMBER IS PERMITTED : VERSION 0 (VALUE = 0).

Ø   Spare :

Spare bits are placed in order to make up an integral number of 16-bit words. These spare bits shall be set to zero.

Ø   Packet Type :

This indicates the Service to which this telemetry source packet relates.

Ø   Packet Subtype :

Together with the Packet Type, the Subtype uniquely identifies the nature of the Service constituted by this telemetry source packet.

The definition of Packet Type and Subtype is unique across all Application Processes

Ø   Spare :

Spare bits are introduced in order to make up an integral number of 16-bit words. These spare bits shall be set to zero.

Ø   Time :

This field represents the local on-board reference time of the packet, expressed in CUC-format. Details of the time field are given in appendix 6.

The relationship of the time information to packet data generation or packet completion shall be fixed and defined per packet type/subtype of each application.

• Source Data (Variable)

The telemetry source data constitutes the data element of the TM Packet

• Packet Error Control (PEC) (16 bits)

The Packet Error Control field shall transport an error detection code that can be used by the ground to verify the integrity of the complete telemetry source packet. The presence of the PEC and its type is fixed for the complete mission for all Applications, and defined in Appendix 4.

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4.2 Telemetry Packet Verification

4.2.1 TM-Packet Errors

Certain TM-packets generated by Applications running in the CDMU or ACC, or from other RTs, are evaluated and used on-board by the CDMU (and ACC) in conjunction with various services (like Event/Action, Data Pool, etc…). Therefore it must be guaranteed that these TM-packets are complete and free of errors, before further processing of their data is started.

\#   Reference   4020-TM

These TM-packets shall therefore be subjected to a consistency check, which verifies correctness of at least :

- –   Packet Error Control (Failure Code = 2)
- –   Packet Length (Failure Code = 1)
- –   Legal APID (Failure Code = 0)
- –   Legal TM-packet Type (Failure Code = 3)
- –   Legal TM-packet Subtype (Failure Code = 4)

TM-Packets of Service 21 (Science-Packets) do not fall under this obligation.

\#   *

4.2.2 TM-Packet Error Reporting

\#   Reference   4030-TM

If the TM-packet verification fails, an Event Report, Type 5,x shall be generated, at least with failure codes as defined above and a minimum of 4 octets containing a copy of the erroneous part of the TM-packet. Transmission of this TM-packet to ground shall take place as foreseen for that packet, according to Virtual Channel assignment defined in table A-3.2. If APID, ST or SST cannot be identified in corrupted TM packet, this packet shall be transmitted to ground on VC4.

The data of the failed TM-packet shall not be passed on to any other on-board processing.

\#   *

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5. PACKET DATA FIELD STRUCTURES

5.1 Service Type 1 : Telecommand Verification Service

#	Reference	5010-TCV

[P:SCI-PT-RS-07360#3.2-TCV-7.

Telecommand Verification Report Packets shall be generated by on-board applications after reception and optionally during, and at the end of, execution of a Telecommand.

*

#	Reference	5020-TCV a

The APID in the Packet Header of the TC Verification Report shall be the APID of the Application Process which generates the report for the Telecommand packet being acknowledged.

*

During longer periods of autonomous operation of Herschel and Planck, Telecommands may be generated or released from several (sometimes independent) sources. An instrument for example may potentially receive commands from the Mission Timeline, On-board Control Procedures, or Failure Detection, Isolation and Recovery. It may additionally be the case, that the actual values of parameters, which are handed over to an Application, cannot be unambiguously determined on ground.

#	Reference	5030-TCV

As only all Telemetry packets are recorded on-board and downlinked, the actual sequence of on-board generated Telecommands, and their contents, shall be copied into special TM packets, TM(1,9), which will be added to a Packet Store of the SSMM, and later-on downlinked (on request).

*

5.1.1 Telecommand Packet Data Field Structure :

not applicable

5.1.2 Telemetry Packet Data Field Structure :

5.1.2.1 TM(1,1) TM(1,2) : Telecommand Acceptance

#	Reference	5050-TCV

[P:SCI-PT-RS-07360#3.2-TCV-2.

[P:SCI-PT-RS-07360#3.2-TCV-1.

For all Telecommands with bit 3 of Ack field set to 1, which pass the acceptance checks when received by the executing unit or application, a TC-Acceptance Report Packet shall be generated immediately, i.e. in less than 2 seconds after reception.
If bit 3 of Ack field is set to 0, no Telecommand Acceptance Report - Success TM(1,1) shall be generated.

*

Reference 5060-TCV

[P:SCI-PT-RS-07360#3.2-TCV-6.

[P:SCI-PT-RS-07360#3.2-TCV-1.

[P:SCI-PT-RS-07360#2.1.3-TM-4.

The reports of acceptance of a Telecommand Packet are as follows :

– Telecommand Acceptance Report - Success (1,1)

  Telemetry Source Packet, Source Data :

Telecommand Packet ID	Packet Sequence Control
Enumerated, 2 octets	Enumerated, 2 octets

- Telecommand Packet ID :

  This is a copy of the corresponding field from the packet header of the Telecommand to which this verification packet relates i.e. the APID (and the most significant 5 bits of this field).

- Packet Sequence Control :

  This is a copy of the corresponding fields from the packet header of the Telecommand to which this verification packet relates.

– Telecommand Acceptance Report - Failure (1,2)

*

Reference 5070-TCV

[P:SCI-PT-RS-07360#3.2-TCV-6.

[P:SCI-PT-RS-07360#3.2-TCV-2.

[P:SCI-PT-RS-07360#2.1.3-TM-4.

In case of rejection of any Telecommand by a unit or application an event-packet with the data field below shall be generated :

– Telemetry Source Packet, Source Data :

Telecommand Packet ID	Packet Sequence Control	Failure-Code	Parameters
2 octets	2 octets	Enumerated, 2 octets	Any

<---- Optional ---->

- Telecommand Packet ID :

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This is a copy of the corresponding field from the packet header of the Telecommand to which this verification packet relates i.e. the APID (and the most significant 5 bits of this field).

- Packet Sequence Control :

This is a copy of the corresponding fields from the packet header of the Telecommand to which this verification packet relates.

- Failure-Code :

The following standard reasons for failure of acceptance of a Telecommand shall be reported :

- Ø   0 = illegal APID ;
- Ø   1 = incomplete or invalid length packet ;
- Ø   2 = incorrect checksum ;
- Ø   3 = illegal packet Type ;
- Ø   4 = illegal packet Subtype ;
- Ø   5 = illegal or inconsistent Application Data ;

16 to 65535 = application-specific failure of acceptance, to be defined in the User Manual of the unit or subsystem involved, subject to approval by ESA and Prime Contractor.

The Failure-Code determines the structure and contents of the Parameters field that follows.

- Parameters :

For the standard reasons above the illegal or incorrect parameter shall be reported. The parameter-field shall be multiple of 16-bit-words, with a minimum of 4 octets. At least the parameter causing the rejection shall be reported in its original position in a certain word. In case of header-error the complete header, in case of CRC the complete CRC shall be reported.

For application-specific command rejections the parameter field is to be defined by users and provides complementary information relating to the particular value of the Failure-Code field. For telemetry bandwidth saving, the length of this field shall be kept as short as possible and is subject to approval by ESA and Prime Contractor.

In all cases the code field plus the parameter field shall have a length corresponding to one or several 16-bit words.

*

5.1.2.2 TM(1,3) : Telecommand Execution Started :

The nominal case for Telecommands shall be that they are executed immediately after reception. The timing of Telecommand execution is controlled by the Mission Timeline on-board or directly from ground.

For Telecommands, which cannot fulfil this criterion, a TC Execution Started Report may be generated, if the (start of) execution is not reported by periodic housekeeping. The data fields for reports of start of execution of a Telecommand packet are as follows :

Reference   5080-TCV

[P:SCI-PT-RS-07360#2.1.3-TM-4.

[P:SCI-PT-RS-07360#3.2-TCV-6.

[P:SCI-PT-RS-07360#3.4.3-EVRP-8.

−   Telecommand Execution Report - Started (1,3)

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Telemetry Source Packet, Source Data :

Same as for Type/Subtype (1,1)

*

5.1.2.3 TM(1,5) : Telecommand Execution Progress :

Only in case the execution of a Telecommand consists of a significant number of sub-steps and the overall execution takes several tens of seconds or more, it may be appropriate to report the successful completion of these steps by a Execution Report of type (1,5).

The data field for reports of progress of execution of a Telecommand packet are as follows :

Reference   5090-TCV

[P:SCI-PT-RS-07360#3.4.3-EVRP-8.

[P:SCI-PT-RS-07360#2.1.3-TM-4.

[P:SCI-PT-RS-07360#3.2-TCV-6.

– Telecommand Execution Report - Progress (1,5)

Telemetry Source Packet, Source Data :

Telecommand Packet ID	Packet Sequence Control	Step Number
2 octets	2 octets	Enumerated, 2 octets

- Telecommand Packet ID :

  This is a copy of the corresponding field from the packet header of the Telecommand to which this verification packet relates, i.e. the APID (and the most significant 5 bits of this field).

- Packet Sequence Control :

  This is a copy of the corresponding fields from the packet header of the Telecommand to which this verification packet relates.

- Step Number :

  This indicates the intermediate step number of the Telecommand execution profile whose execution has been completed. The values it can take are Telecommand specific.

*

5.1.2.4 TM(1,7) : Telecommand Execution Completed

If the successful overall completion of execution of a Telecommand can be detected by an application, and if the completed execution is not reported satisfactorily by other means (e.g. periodic housekeeping data), a Telecommand Execution Report - Success, type (1,7), shall be generated.

The reports of completion of execution of a Telecommand packet are as follows :

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#	Reference	5100-TCV

[P:SCI-PT-RS-07360#3.2-TCV-6.

[P:SCI-PT-RS-07360#3.2-TCV-3.

[P:SCI-PT-RS-07360#2.1.3-TM-4.

[P:SCI-PT-RS-07360#3.4.3-EVRP-8.

– Telecommand Execution Report - Completed (1,7)

Telemetry Source Packet, Source Data :

Same as for Type/Subtype (1,1)

*

5.1.2.5 TM(1,8) : Telecommand Execution Failure

For all other cases, i.e. for not started, unsuccessfully executed, or otherwise aborted TC executions an event-message of type (1,8) can be generated, if the unit or application involved is capable of doing this.

#	Reference	5110-TCV

[P:SCI-PT-RS-07360#3.2-TCV-6.

[P:SCI-PT-RS-07360#3.2-TCV-4.

[P:SCI-PT-RS-07360#2.1.3-TM-4.

– Telecommand Execution Report - Failure (1,8)

Telemetry Source Packet, Source Data :

Same as for Type/Subtype (1,2).

Execution- Failure Codes and Parameters : application–specific, to be defined in the User Manual of the unit or subsystem involved.

*

5.1.2.6 TM(1,9) : Telecommand Contents Report

For all Telecommands, which are released from an on-board source like an OBCP, etc., a Telecommand Contents Report (1,9) shall be generated by the source, which contains a complete copy of the actually executed Telecommand. The TM(1,9)-packets are normally stored in the SSMM, and downlinked according to needs. The generation of Telecommand Contents Reports is a mandatory service for CDMU and ACC. It is considered optional for commands generated or formatted and handled within instruments.

#	Reference	5120-TCV

[P:SCI-PT-RS-07360#2.1.3-TM-4.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

[P:SCI-PT-RS-07360#3.2-TCV-6.

[P:SCI-PT-RS-07360#2.1.2-TC-11.

– Telecommand Contents Report (1,9)

Telemetry Source Packet, Source Data :

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Same as the Telecommand to be reported. Type of reported telecommand packet is the «Variable Octet String» type specifically defined for TC packet in Appendix A.6.

*

5.2 Service Type 2 : Device Command Distribution

The Telecommands of service type 2 are foreseen for the control of units which are equipped with hardware interfaces for immediate execution of these commands. Completion of execution for these functions can only be indicated by periodic housekeeping in several cases.

5.2.1 Telecommand Packet Data Field Structure :

5.2.1.1 TC(2,1) : Distributing Pulse Commands

The request for the distribution of pulse command(s) by means of a Telecommand packet is :

Reference   5130-DVC

[P:SCI-PT-RS-07360#3.3-DVC-4.

[P:SCI-PT-RS-07360#3.3-DVC-2.

[P:SCI-PT-RS-07360#3.3-DVC-1.

– Distribute Pulse Commands (2,1)

Telecommand Packet, Application Data :

N	Address
Unsigned Integer (16-bit)	Enumerated (16-bit)

<---- Repeated N times ---->

- N :

The number of Pulse Commands which follow ($N > 0$, N_max. = 8).

- Address :

This gives the hardware address/channel to which the Pulse Command is to be routed.

*

5.2.1.2 TC(2,2) : Distributing Register Load Commands

Reference   5140-DVC

[P:SCI-PT-RS-07360#3.3-DVC-4.

[P:SCI-PT-RS-07360#3.3-DVC-2.

[P:SCI-PT-RS-07360#3.3-DVC-1.

The request for the distribution of Register Load Command(s) by means of a Telecommand packet is :

– Distribute Register Load Commands (2,2)

Telecommand Packet, Application Data :

N	Register Address	Register Data
Unsigned Integer	Enumerated	Unsigned Integer
(16-bit)	(16-bit)	(16-bit)

<--------------------- Repeated N times ------------------->

- N :

  The number of register load commands which follow (N > 0, N_max = 8).

- Register Address :

  This gives the hardware address of the register.

- Register Data :

  The register data consist of a set of parameters whose structure is known implicitly from the foregoing register address.

*

5.2.1.3 TC(2,3) : Distributing CPDU commands

This Telecommand serves for executing high-priority commands via Command Pulse Distribution Unit. The request for the generation of Command Pulses on the output lines of a CPDU is :

Reference 5150-DVC

[P:SCI-PT-RS-07360#3.3-DVC-1.

[P:SCI-PT-RS-07360#3.3-DVC-2.

[P:SCI-PT-RS-07360#3.3-DVC-3.

– Distribute CPDU Commands (2,3)

CPDU Telecommand Packet, Application Data :

Output Line-ID	Spare	Duration		Output Line-ID	Spare	Duration	
Enumerated	(5-bit)	(3-bit)		Enumerated	(5-bit)	(3-bit)	
(8-bit)	Unsigned Integer (8-bit)			(8-bit)	Unsigned Integer (8-bit)		
1st Command Pulse Instruction				Nth Command Pulse Instruction			

- Output Line ID :

  This identifies the CPDU output line on which the Command Pulse is issued.

- Spare :

Spare bits make up an integral octet and are ignored on-board. These spare bits shall be set to zero.

- Duration :

A value between 0 and 7 which determines the duration of the Command Pulse as follows :

Command Pulse duration = <CPDU_DURATION_UNIT> * 2 ^{Duration}

where <CPDU_DURATION_UNIT> is defined to 13 ms for the CPDU.

For Duration = 0, the Command Pulse duration is 13 ms ;

for Duration = 7, the Command Pulse duration is 1664 ms.

*

5.2.1.3.1 Standard Distribute CPDU Command

This Telecommand serves for executing high-priority commands (i.e. : Command Pulses on the output lines of a CPDU) directly from the CDMS TC decoder (Standard Distribute CPDU Command is not delivered to CDMS Processor Module).

For handling of the Standard Distribute CPDU Command, by CDMS TC decoder the relevant field of TC segment must be set to appropriate value (see AD2).

The number of Command pulse instruction in the «Standard Distribute CPDU Command» TC packet is variable from 1 to 120 (120 corresponds to the maximal length TC packet).

5.2.1.3.2 Mission specific Distribute CPDU Command

This Telecommand serves for executing high-priority commands (i.e. : Command Pulses on the output lines of a CPDU) through the Herschel / Planck on-board software. For this TC packet, the Data Field Header Flag must be set to 1 to indicate presence of Data Field Header.

Reference 5155-DVC

[P:SCI-PT-RS-07360#3.3-DVC-2.

It shall be possible to define any number, from 1 to 8, of Command pulse instruction in one «Mission specific Distribute CPDU Command» TC packet.

*

5.2.2 Telemetry Packet Data Field Structure :

not applicable

5.3 Service Type 3 : Housekeeping & Diagnostic Data Reporting

Periodic Housekeeping TM Packets (HK Packets) shall be used to report the status and health of each unit or subsystem on-board. In nominal conditions only one nominal HK Packet per unit / subsystem / instrument should be generated with a fixed, default sampling period.

Reference 5160-PERP

[P:SCI-PT-RS-07360#3.4.1-PERP-1.

However, in order to ensure that a basic set of status information from each on-board user can be transmitted to ground even under adverse link conditions, each on-board Packet-Terminal shall generate so-called Essential HK-Packets with an average data rate compatible with these minimum link conditions. These Essential HK-Packets shall be distinguished from nominal ones by their APID, as specified in Appendix 3. Details on data rates allocated to users are specified in the SVM Interface Specification (RD-7), and in the IID-A (RD-5), respectively.

*

The periods (or frequencies) involved in the "Housekeeping & Diagnostic Data Reporting service" are all power (negative, null or positive) of two multiples of the basic sampling period (or frequency) that is defined for each end user that supports the Housekeeping & Diagnostic Data Reporting service.

– "Housekeeping & Diagnostic Parameter Report" packets (i.e. : TM(3,25) & TM(3,26) are generated by an end user at a period that is a power (null or positive) of two multiple of its basic sampling period. This power of two factor (packet generation period / basic sampling period) appears as the "Sampling Interval" field in the "Define New Housekeeping & Diagnostic Parameter Report" command packets (i.e. : TC(3,1) & TC(3,2)).

– In a given "Housekeeping & Diagnostic Parameter Report" packet, some parameters may be repeated a power (positive) of two times. Such repeated parameters are said super-commutated in this TM packet.

Super-commutated parameters are periodically sampled on-board, for insertion into the HK or DIAG parameter report, at a period that is a power (negative) sub-multiple of the packet generation period. This allows to define for super-commutated parameters a reporting period faster than the basic sampling period.

The number of repetition of a super-commutated parameter is the number repetition of the Parameter-ID that identifies it in "Define New Housekeeping & Diagnostic Parameter Report" command packets (i.e. : TC(3,1) & TC(3,2)). In such cases, the value of Parameter-ID appears repeated a power of two times consecutively at the end of TC(3,1) or TC(3,2).

The parameters reported in a given HK or DIAG parameter report appear in the same order in the "Define New Housekeeping & Diagnostic Parameter Report" command packets (i.e. : TC(3,1) & TC(3,2)) that defines it, in the "Housekeeping & Diagnostic Parameter Report Definitions Report" (i.e. : TM(3,10) & TM(3,12)) and into the "Housekeeping & Diagnostic Parameter Report" packet itself (i.e. : TM(3,25) & TM(3,25)).

Reference 5170-PERP

[P:SCI-PT-RS-07360#3.1-PACK-7.

Super-commutated parameters shall be sampled at frequencies corresponding to 2, 4, 8, etc….times the basic sampling frequency, as needed for a certain parameter. The number of entries of a parameter in (an array of) the packet is equal to its sampling frequency factor.

*

If a number of user-parameters need to be reported with a sampling interval significantly longer or shorter than the nominal period, or if certain HK parameters are only relevant in specific operational modes or configurations of a unit / subsystem / instrument, additional Housekeeping TM Packets may be implemented by allocating adequate Structure Identifiers together with Data Field definitions. The Structure Identifier defines implicitly all sampling/timing relationships for the associated packet, as well as the structure and nature of all parameters.

Reference 5180-PERP

The generation and transmission of these nominal HK Packets shall start or stop automatically together with the corresponding mode or configuration change of a unit / application.

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Diagnostic TM Packets are equivalent to HK Packets in purpose, structure, and sampling approach. They may be utilised for data logging during specific modes or configurations related to calibration, engineering, or diagnostic phases (of limited duration). For easy extraction of these data on ground a special packet type is available for these data.

If certain diagnostic (or housekeeping) data need to be sampled only once (or over a short period of time) the default generation / transmission status for the involved Housekeeping / Diagnostic Packets can be «disabled», and Service 14 may be used to activate / deactivate these packets.

A (small) number of Housekeeping and Diagnostic TM packets may be defined or re-defined by assigning a new definition of sequence of Parameter Identifiers to an existing packet (identified by its HK Packet ID), together with a new Structure Identifier. The rules for construction of the data field and for the timing are the same as for static HK packets. During re-definition of an Housekeeping / Diagnostic TM packet, generation / transmission status for the involved Housekeeping / Diagnostic Packets shall be «disabled» and «cleared».

When for a given HK Packet ID, the parameter definition report is defined or re-defined, the Application Process ID (APID) of the Housekeeping / Diagnostic TM packet and the Virtual channel on which it is down-linked in Real-Time (which can take the values 'Base-APID + 0' : down-linked on VC0, or 'Base-APID + 2' : down-linked on VC4, as specified in Appendix 3) are not modified. This supposes that an HK packet ID value implicitly indicates the APID and the VC for Real-Time down-linking for the HK or DIAG packet it identifies.

5.3.1 Telecommand Packet Data Field Structure :

5.3.1.1 TC(3,1) TC(3,2) : Defining new housekeeping or diagnostic parameter reports

The TC requests, which allow to define new housekeeping or diagnostic parameter reports are :

\#   Reference   5200-PERP

[P:SCI-PT-RS-07360#3.1-PACK-3.

[P:SCI-PT-RS-07360#3.1-PACK-6.

[P:SCI-PT-RS-07360#3.1-PACK-10.

[P:SCI-PT-RS-07360#3.4.1-PERP-3.

    –   Define New Housekeeping Parameter Report (3,1)

       Telecommand Packet, Application Data : see Figure below.

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*

\#   Reference   5210-PERP a

[P:SCI-PT-RS-07360#3.4.1-PERP-5.

[P:SCI-PT-RS-07360#3.4.1-PERP-4.

[P:SCI-PT-RS-07360#3.1-PACK-10.

    –   Define New Diagnostic Parameter Report (3,2)

       Telecommand Packet, Application Data : see Figure below.

HK Packet ID	SID	Sampling Interval	Segment-ID	N	Parameter ID
Enumerated (16-bit)	Enumerated (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (8-bit)	Unsigned Integer (8-bit)	Enumerated (16-bit)
					USD alternative (64-bit) see below

<--- Repeated N times -->

- HK Packet ID :

  The HK Packet ID allows to identify uniquely a Housekeeping or Diagnostics TM packet definition.

- SID :

  The Structure Identifier defines the structure of the parameter field.

- Sampling Interval :

  The Sampling Interval defines, for this Housekeeping or Diagnostic Parameter Report, its generation period expressed as a power (null or positive) of two multiple of the basic sampling period of the addressed Application/ Unit. Allowed values : 1, 2, 4, 8…. (HK/ Diagnostic TM packets can be generated at the basic sampling period, or at a smaller rate/ frequency).

- Segment-Identifier :

  As a new Packet may contain more parameters than can be loaded with a single TC-packet, they have to be loaded by a sequence of TC-packets, each of them identified by a unique Segment-Identifier and carrying a segment of the overall parameter field.

  The Segment-ID shall always start with 1, and be incremented one by one up to K for the last segment (allowed range : 1 to 254). After transmission of K Telecommands a TC(3,1) or TC(3,2) shall be sent with Segment _ID set to FFhex, and N set to zero.

  If a new packet definition is loaded with a single TC-packet only, the Segment-ID shall be set to zero.

- N :

  N defines the number of parameters in the data field of the definition. With each TC(3,1) or (3,2) a maximum of 114 Parameter-Identifiers (or 28 if USD alternative is used) can be loaded for the definition of a new HK/Diagnostics Packet. As the actual length of the field needed for certain parameters depend on their type, the maximum number of segments, or parameters, of a HK/Diagnostics Packet is user-specific.

- Parameter ID :

  The Parameter ID identifies uniquely the parameter to be sampled. If a certain parameter shall be sampled and reported more than once (i.e. : super-commutated) in a certain HK packet, its Parameter ID shall be repeated the corresponding number of times (a power of two) consecutively at the end of the data field.

  USD alternative :

  For some subsystem (CDMS and ACMS) a dedicated value : USD-ID allows the periodic reporting of an User Selectable Data (USD) in RAM area. When Parameter ID takes this dedicated value, 3 additional 16-bit words (following the USD-ID) are defined as follows to indicate the RAM area to be periodically reported.

USD-ID	RAM start address (in logical) MSB	RAM start address (in logical) LSB	Length
Enumerated (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (16-bit)

Ø USD-ID :

Dedicated value (this value shall be different of any regular Parameter ID), indicating that the following three 16-bit words shall be interpreted as follows.

Ø RAM start address (in logical) MSB / RAM start address (in logical) LSB :

Defines the address of the first byte to be retrieved from RAM.

TC(3,1) / TC(3,2) shall be rejected when {RAM start address MSB / RAM start address LSB Length} combination defines memory location out of RAM area.

Ø Length :

Defines the number of bytes to be retrieved from RAM (consecutive address).

*

Reference 5220-PERP

[P:SCI-PT-RS-07360#3.4.1-PERP-5.

The definition of new HK/ Diagnostic TM packets shall only be possible if the associated on-board memory areas or tables have been cleared earlier.

*

Reference 5230-PERP

After a completed (Re-)Definition a TC Execution Report-Completed, TM(1,7), shall be generated, or a Failure Report, TM(1,8), in case of a failure.

*

5.3.1.2 TC(3,3) TC(3,4) : Clearing housekeeping or diagnostic parameter report definitions

The requests to clear one or more Housekeeping or Diagnostic TM packet definitions are :

Reference 5240-PERP

– Clear Housekeeping Parameter Report Definitions (3,3)

Telecommand Packet, Application Data : see Figure below

*

Reference 5250-PERP

[P:SCI-PT-RS-07360#3.4.1-PERP-5.

– Clear Diagnostic Parameter Report Definitions (3,4)

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Telecommand Packet, Application Data : see Figure below

N	HK Packet ID
Unsigned Integer	Enumerated
16 bits	16 bit

<---- Repeated N times --->

- N :

  N defines the number of HK Packets that shall be deleted.

- HK Packet ID :

  The HK Packet ID allows to identify uniquely a Housekeeping or Diagnostics TM packet definition in memory, which shall be cleared.

*

Reference 5260-PERP

When this request is received, the entries for the indicated Housekeeping or Diagnostic Packet definitions and the corresponding parameter sampling mode are cleared (released).

*

Reference 5261-PERP

[P:SCI-PT-RS-07360#3.4.1-PERP-5.

When this request is received, the indicated Housekeeping or Diagnostic Packet generation shall be disabled as per use of TC(14,2).

*

5.3.1.3 TC(3,9) TC(3,11) : Reporting housekeeping or diagnostic parameter report definitions

The requests for a report of one or more housekeeping or diagnostic parameter report definitions are :

Reference 5270-PERP

[P:SCI-PT-RS-07360#3.4.1-PERP-8.

[P:SCI-PT-RS-07360#3.11-PTXC-2.

- Report Housekeeping Packet Definitions (3,9)

  Telecommand Packet, Application Data : see Figure below

*

Reference 5280-PERP

[P:SCI-PT-RS-07360#3.4.1-PERP-8.

[P:SCI-PT-RS-07360#3.11-PTXC-2.

- Report Diagnostic Packet Definitions (3,11)

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Telecommand Packet, Application Data : see Figure below

N	HK Packet ID
Unsigned Integer	Enumerated
16 bits	16 bits

<---- Repeated N times --->

- N :

  N defines the number of HK Packets that shall be reported.

- HK Packet ID :

  The HK Packet ID allows to identify uniquely a Housekeeping or Diagnostics TM packet definition in memory, which shall be reported.

*

5.3.2 Telemetry Packet Data Field Structure :

5.3.2.1 TM(3,10) TM(3,12) : Reporting of Housekeeping or Diagnostic TM Packet Definitions

Reference 5290-PERP

[P:SCI-PT-RS-07360#3.4.1-PERP-8.

[P:SCI-PT-RS-07360#3.11-PTXC-2.

After reception of a TC(3,9) or TC(3,11) the Application/ unit shall generate one or several TM packets with a copy of the structure definition of the requested HK or Diagnostic Packets.

*

Reference 5300-PERP

[P:SCI-PT-RS-07360#3.4.1-PERP-8.

[P:SCI-PT-RS-07360#3.11-PTXC-2.

- Housekeeping Parameter Report Definitions Report (3,10)

  Telemetry Source Packet, Source Data : see Figure below

*

Reference 5310-PERP a

[P:SCI-PT-RS-07360#3.4.1-PERP-8.

[P:SCI-PT-RS-07360#3.11-PTXC-2.

- Diagnostic Parameter Report Definitions Report (3,12)

  Telemetry Source Packet, Source Data : see Figure below

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HK Packet ID	SID	Sampling Interval	Segment-ID	N	Parameter ID
Enumerated (16 bit)	Enumerated (16 bit)	Unsigned Integer (16 bit)	Unsigned Integer (8 bit)	Unsigned Integer (8 bit)	Enumerated (16 bit)
					USD alternative (64-bit) see below

<---- Repeated N times ---->

- HK Packet ID :

  The HK Packet ID allows to identify uniquely a Housekeeping or Diagnostics TM packet definition.

- SID :

  The Structure Identifier defines the structure of the parameter field.

- Sampling Interval :

  The Sampling Interval indicates, for this Housekeeping or Diagnostic Parameter Report, its generation period expressed as a multiple of the basic sampling period of the addressed Application/ Unit. (HK/ Diagnostic TM packets can be generated at the basic sampling period, or at a smaller rate/ frequency).

- Segment-Identifier :

  If parameters contained in a HK or Diagnostic-Packet allow its reporting with a single TM-packet (3,10) or (3,12), the Segment-Identifier shall be set to zero.

  If parameters contained in a HK- or Diagnostic-Packet requires, for its reporting, a sequence of TM-packets, each of them shall be identified by a unique Segment-Identifier and shall carry a segment of the overall parameter field.

  The Segment-ID shall always start with 1, and be incremented up to K for the last segment (allowed range : 1 to 254).

  After transmission of K TM-packets a TM(3,10) or TM(3,12) shall be sent with Segment _ID set to FFhex, and N set to zero.

- N :

  N defines the number of parameters in the data field of the definition.

- Parameter ID :

  The Parameter ID identifies uniquely the parameter to be sampled.

  USD alternative :

  For some subsystem (CDMS and ACMS) a dedicated value : USD-ID allows the periodic reporting of an User Selectable Data (USD) in RAM area. When Parameter ID takes this dedicated value, 3 additional 16-bit words (following the USD-ID) indicates the periodically reported RAM area. Definition of these 16-bit words is identical to the one used for TC(3,1) / TC(3,2).

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5.3.2.2 TM(3,25) TM(3,26) : Reporting Housekeeping or Diagnostic Data

---

\# Reference 5330-PERP

[P:SCI-PT-RS-07360#3.1-PACK-3.

[P:SCI-PT-RS-07360#3.1-PACK-10.

The periodic reports of the values of a set of housekeeping or diagnostic parameters shall be :

– Housekeeping Parameter Report (3,25)

Telemetry Source Packet, Source Data : see Figure below

\# *

\# Reference 5340-PERP

[P:SCI-PT-RS-07360#3.1-PACK-10.

– Diagnostic Parameter Report (3,26)

Telemetry Source Packet, Source Data : see Figure below

SID	Parameters	Spare
Enumerated (16-bit)	Any	(8-bit)

<-- Optional -->

- SID :

  The SID defines the structure of the parameter field.

- Parameters :

  This field consists of a sequence of values of housekeeping or diagnostic parameters that are sampled nominally once per packet generation interval. It may contain at the end of the field several (a power of two) samples of housekeeping or diagnostic parameters (super-commutated parameters). Each super-commutated parameter shall be sampled periodically at multiples of the Parameter Report generation frequency.

  The only authorised parameter types are those described in Appendix 6.

- Spare :

  8 bits, set to zero.

  This spare octet will be inserted, to fulfil the packet 16-bit alignment requirement, when the length of reported parameter is an odd number of octets.

\# *

In line with below requirement 1020-A1 (bullet 3) 8-bit length parameters are right adjusted on 16-bit word boundary. However, in a sequence of 8-bit parameters they are grouped by pairs on a 16-bit word. As a consequence a spare octet will be present before the last 8-bit parameter of an odd sequence.

5.4 Service Type 4 :   not used

5.5 Service Type 5 : Event Reporting

5.5.1 Telecommand Packet Data Field Structure :

not applicable

5.5.2 TM(5,1) TM(5,2) TM(5,4) : Telemetry Packet Data Field Structure :

Three different sub-types of user-initiated event reports are defined for Herschel / Planck, to facilitate routing, on-board processing, and/or ground processing. All reports have the same structure, as follows :

\# Reference 5350-EVRP

[P:SCI-PT-RS-07360#3.4.3-EVRP-6.

[P:SCI-PT-RS-07360#3.4.3-EVRP-1.

[P:SCI-PT-RS-07360#2.1.3-TM-18.

– Event Report (5,1) :

This sub-type shall be used for passing on information for any asynchronous event or warning, that has occurred within a unit or subsystem and for which no direct re-action by other units, except recording or transmission, is normally required. The CDMU may decide after reception of a specific Event Packet to initiate a related nominal activity (e.g. releasing a specific Telecommand to other units). See below figure giving TM(5,x) ADF layout.

\#   *

For telemetry bandwidth saving, the normal progress reporting shall be optimised for routine on-board software. As a general rule, routine software functions (in particular the cyclic ones) shall not require TC verification reporting.

Event Report(s) generated for observability of on-board software normal progress is subject to approval by ESA and Prime Contractor.

\# Reference 5360-EVRP

[P:SCI-PT-RS-07360#3.4.3-EVRP-6.

[P:SCI-PT-RS-07360#2.1.3-TM-18.

[P:SCI-PT-RS-07360#3.4.3-EVRP-1.

– Exception Report (5,2)

An Exception Report shall be generated by a unit in non-nominal cases for which an unscheduled on-board (recovery) action is required. This Report Packet is related to situations, which cannot be resolved by the unit alone but for which on-board procedures are available. On top of unit-internal actions related to that exception the CDMS may be asked to modify the MTL, activate an OBCP, or equiv. . See below figure giving TM(5,x) ADF layout.

\#   *

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#	Reference	5370-EVRP

[P:SCI-PT-RS-07360#3.4.3-EVRP-6.

[P:SCI-PT-RS-07360#2.1.3-TM-18.

[P:SCI-PT-RS-07360#3.4.3-EVRP-1.

– Error/Alarm Report (5,4)

An Error/Alarm Report shall be generated for non-nominal events which require intervention from the mission control centre on ground, i.e. no predefined recovery or saving procedures are resident on-board. See below figure giving TM(5,x) ADF layout.

Data Field Structure for TM-Packet type (5,1), (5,2), and (5,4) :

Event ID	SID	Parameters A	Event Sequence Counter	Parameters B
Enumerated 2 octets	Enumerated 2 octets	8 octets	Unsigned Integer 2 octets	Any

<----- Optional ---->

- Event ID :

    The Event Identifier allows to distinguish a certain Event unambiguously from any other, which may be generated by a certain Application Process or unit. It may be used by the on-board Event/Action Service, or by ground control, to initiate a foreseen activity, if that Event occurs.

- SID :

    The Structure ID (SID) defines the structure and interpretation of the associated parameter field.

- Parameters A :

    The Parameters A -field (fixed length) shall provide complementary information related to the particular event. Details of parameters and the associated SID are to be defined in the User Manual of the unit or subsystem.

- Event Sequence Counter :

    For each Application and for each Type/Subtype of Events a Event Sequence Counter shall be maintained and incremented each time an Event Report of a certain Type/Subtype is generated.

- Parameters B :

    The Parameters B -field may provide further complementary information related to the particular event. Details of parameters and the SID are to be defined in the User Manual of the unit or subsystem. For telemetry bandwidth saving, the length of this field shall be kept as short as possible and is subject to approval by ESA and Prime Contractor.

    In all cases the parameter field shall have a length corresponding to one or several 16-bit words.

*

As a design goal, it is recommended to define the Event Reporting packets : TM(5,1) ; TM(5,2) and TM(5,4) layouts such a way that no reference to SID is necessary to determine their structure.

As a consequence, this prevents to define different parameter contents for Event Reporting packets identified by a given Event-ID, and the SID field can be defined as «spare» or «don't care» in the User Manual of the subsystem or instrument.

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5.6 Service Type 6 : Memory Management

\#   Reference   5380-MM

The Memory Management service shall only be used in cases when the actual contents of a memory location is not accessible otherwise by nominal means. It covers the TC- and TM-structures needed for direct loading, dumping, and checking areas of on-board memories.

\#   *

However, the basic checking of the integrity of any user memory or of the correctness of code should be part of the selftest or Error Detection And Correction (EDAC) capabilities of each on-board unit.

This service relies on the capability of a certain on-board processor to execute at least several basic tasks like TM / TC communication via the data interface, and execution of this service, in a correct way.

\#   Reference   5390-MM

The granularity of the addressing capabilities may be different for the different on-board processors. It may correspond to a 8-bit, a 16-bit, a 32-bit or a 48-bit word. The base for the memory management service shall refer to a Smallest Addressable Unit (SAU), whose actual value is implementation-dependent and has to be defined in the User Manual of a subsystem / instrument.

\#   *

\#   Reference   5395-MM

In case octets are defined as SAU for a certain unit, and if the number of octets to be loaded or dumped is odd, a padding-octet (set to zero) shall be inserted at the end of the octet-field in order to create an even number of octets, compatible with 16-bit-words. The value of the N field below and the Checksum shall be calculated without the padding-octet.

\#   *

For addressing the complete span of memory of some subsystem (CDMS and ACMS) the address can require more than the 16-bit Start Address. To allow the full addressing capability for such subsystem, the appropriate combination of Memory ID and Start Address fields may be used.

5.6.1 Telecommand Packet Data Field Structure :

5.6.1.1 Loading data in memory using base plus offsets :   not used

5.6.1.2 TC(6,2) : Loading data in memory using absolute addresses

---

\#   Reference   5400-MM

[P:SCI-PT-RS-07360#3.5-MM-6.

[P:SCI-PT-RS-07360#3.5-MM-5.

[P:SCI-PT-RS-07360#3.5-MM-3.

[P:SCI-PT-RS-07360#3.5-MM-2.

[P:SCI-PT-RS-07360#3.5-MM-4.

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When the user receives this Telecommand, it shall store the checksum of the received data, write the data block to the memory at the specified start address and re-read the memory area just written to, calculate and compare the checksum and report successful execution, TM(1,7), or an error report TM(1,8).

\# *

The request to load data to one area of a memory block defined using absolute addresses is :

\# Reference 5410-MM a

[P:SCI-PT-RS-07360#3.5-MM-3.

[P:SCI-PT-RS-07360#3.5-MM-4.

[P:SCI-PT-RS-07360#3.5-MM-2.

– Load Memory Using Absolute Addresses (6,2)

Telecommand Packet, Application Data :

Memory ID	Start Address	Spare	N	Data	Spare	Checksum
Enumerated (16-bit)	Unsigned Integer (16-bit)	(8-bit)	Unsigned Integer (8-bit)	Variable (see below)	(8-bit)	Enumerated (16-bit)

<- Repeated N times -> | Optional

- Memory ID :

  This identifies the destination memory block.

- Start Address :

  This gives the start address (in SAUs, with the count starting from zero) within the memory block for loading the data.

  The combination of the two fields Memory ID and Start Address shall provide for a direct mapping to the desired absolute memory address. Further details are to be defined in the User Manuals of the respective units.

- Spare :

  8 bits, set to zero.

- N :

  The number of SAUs to be loaded. As the overall length of a TC packet cannot exceed 248 octets, the maximum length of the field "Data" will be 228 octets. N, expressed as number of SAUs, must be compatible with this boundary.

- Data :

  A data block to be loaded (in increasing order of SAU).

  Depending on granularity of on-board processor addressing capability, the type of the repeated N times «Data» parameter may be :

  Ø Unsigned integer (8-bit) for cases where SAU is 8-bit long.

  Ø Unsigned integer (16-bit) for cases where SAU is 16-bit long.

  Ø Unsigned integer (32-bit) for cases where SAU is 32-bit long.

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Ø   Three times Unsigned integer (16-bit) for cases where SAU is 48-bit long. In this case, there will be a repetition of 3 * N unsigned integer (16-bit).

- Spare :

  8 bits, set to zero.

  This spare octet will be inserted, to fulfil the packet 16-bit alignment requirement, when on-board processor SAU is 8-bit long and data block to be loaded is an odd number of octets.

- Checksum :

  An CRC checksum (see Appendix A.4) that is used by the on-board user to verify the integrity of the data being loaded. This checksum is generated over the unpadded Data block to be loaded, (i.e. : excluding the optional spare octet) and is additional and different to the CRC word at the end of each packet.

*

5.6.1.3 Dumping memory using base plus offsets :   not used

5.6.1.4 TC(6,5) : Dumping memory using absolute addresses

Reference   5420-MM

[P:SCI-PT-RS-07360#3.5-MM-9.

[P:SCI-PT-RS-07360#3.5-MM-7.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

When an on-board user receives this request it shall read the memory block, generate one or several report packets containing the contents of this area and send them to the downlink.

*

The request to dump the contents of one area of a memory block defined using absolute addresses is :

Reference   5430-MM a

[P:SCI-PT-RS-07360#3.5-MM-8.

[P:SCI-PT-RS-07360#3.5-MM-7.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

–   Dump Memory Using Absolute Addresses (6,5)

    Telecommand Packet, Application Data :

Memory ID	Start Address	N
Enumerated (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (16-bit)

- Memory ID :
  This identifies the memory block of the on-board user from which data shall be dumped.
- Start Address :

This gives the start address (in SAUs, with the count starting from zero) within the memory block for dumping the data.

The combination of the two fields Memory ID and Start Address shall provide for a direct mapping to the desired absolute memory address. Further details are to be defined in the User Manuals of the respective units.

- N :

The number of SAUs to be dumped.

The destination application process (APID) together with fields Memory-ID, Start Address and «N» identify the on-board memory area to be dumped. The length of Smallest Addressable Unit (SAU) in this on-board memory area (8-bit, 16-bit, 32-bit or 48-bit) is to be defined in the User Manuals of the respective units. Consequently, the TC packet specifies the number of octets to be dumped (N, 2*N, 4*N or 6*N octets depending on SAU size) and their location.

N, expressed as number of SAUs, must be compatible with on-board memory area allowed to be dumped.

---

*

5.6.1.5 TC(6,9) : Checking memory using absolute addresses

Reference   5440-MM

[P:SCI-PT-RS-07360#3.5-MM-11.

[P:SCI-PT-RS-07360#3.5-MM-10.

When the user receives this request it shall read and compute the checksum value of the indicated area of the memory using the CRC checksum algorithm defined in Appendix A.4. It then generates a report containing the checksum value computed.

---

*

The request to check the contents of one area of a memory block defined with absolute addresses is :

Reference   5450-MM a

[P:SCI-PT-RS-07360#3.5-MM-10.

  – Check Memory Using Absolute Addresses (6,9)

Telecommand Packet, Application Data :

Memory ID	Start Address	N
Enumerated (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (16-bit)

- Memory ID :

This identifies the memory block of the on-board user which data shall be checked.

- Start Address :

This gives the start address (in SAUs, with the count starting from zero) within the memory block for data to be checked.

- N :

The number of SAUs on which the CRC checksum algorithm shall be applied.

*

5.6.1.6 TC(6,11) : Aborting a Memory dump

Reference   5455-MM

The request to abort an in progress memory dumping is :

– Abort Current Memory dump (6,11)

Telecommand Packet, Application Data :   None

On receipt of this request the application addressed shall stop any memory dumping previously requested by means of TC(6,5).

*

5.6.2 TM(6,6) TM(6,10) : Telemetry Packet Data Field Structure :

Reference   5460-MM a

[P:SCI-PT-RS-07360#2.1.3-TM-8.

– Memory Dump, Absolute Addresses (6,6)

Telemetry Source Packet, Source Data :

Memory ID	Start Address	N	Data	Spare	Checksum
Enumerated (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (16-bit)	Variable (see below)	(8-bit)	Enumerated (16-bit)
			<- Repeated N times ->	Optional	

- Memory ID :

  This identifies the memory block of the on-board user from which data are dumped.

- Start Address :

  This gives the start address (in SAUs, with the count starting from zero) within the memory block for the data dumped in the current TM packet.

  The combination of the two fields Memory ID and Start Address shall provide for a direct mapping to the desired absolute memory address. The Memory ID and Start Address identify the absolute memory address of the first reported SAU in the current TM packet.

- N :

  The number of SAUs dumped in the current TM packet.

  As the overall length of a TM packet cannot exceed 1024 octets, the maximum length of the field «Data» will be 1016 octets. N, expressed as number of SAUs, must be compatible with this boundary.

- Data :

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The dumped data block (in increasing order of SAU).

Depending on granularity of on-board processor addressing capability, the type of the repeated N times «Data» parameter may be :

Ø Unsigned integer (8-bit) for cases where SAU is 8-bit long.

Ø Unsigned integer (16-bit) for cases where SAU is 16-bit long.

Ø Unsigned integer (32-bit) for cases where SAU is 32-bit long.

Ø Three times Unsigned integer (16-bit) for cases where SAU is 48-bit long. In this case, there will be a repetition of 3 * N unsigned integer (16-bit).

Data in the particular case of STR dump :

Ø STR address (32 bits) : address inside the STR memory that is associated with the first word in the Dump Data Field.

Ø STR length (16 bits) : length in 32 bits SAU of the Dump Data.

Ø STR Id (x bits) : identifies the star tracker.

Ø Dump Data (N*32 bits)

- Spare :

8 bits, set to zero.

This spare octet will be inserted, to fulfil the packet 16-bit alignment requirement, when on-board processor SAU is 8-bit long and the dumped data block is an odd number of octets.

- Checksum :

The Service calculates an CRC checksum according to Appendix A.4 for the data being dumped and places the result in this field.

\#   *

\#   Reference   5470-MM a

[P:SCI-PT-RS-07360#3.5-MM-11.

– Memory Check Report,Absolute Addresses (6,10)

Telemetry Source Packet, Source Data :

Memory ID	Start Address	N	Checksum
Enumerated (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (16-bit)	Enumerated (16-bit)

- Memory ID :

This identifies the memory block of the on-board user which data have been checked.

- Start Address :

This gives the start address (in SAUs, with the count starting from zero) within the memory block for the data that have been checked.

- N :

The number of SAUs on which the CRC checksum algorithm has been applied.

- Checksum :

  The Service calculates an CRC checksum according to Appendix A.4 for the data being checked and places the result in this field.

*

5.7 Service Type 7 : not used

5.8 Service Type 8 : Function Management

This section defines the application data structures for Function Management Telecommand and Telemetry Packets. The term «Function» refers to conceptual software processes, for which the ground normally has the capability to exercise direct control over these processes.

Reference 5480-a-FNM

Functions shall be used in support of (external) physical interfaces and to control the spacecraft-related functions of these interfaces, including mode- or configuration-changes. (The actual I/O-handler may be a part of a Function.)

*

Examples of such Application Functions could include control of the operation of a payload instrument or spacecraft units and subsystems, including changes of operational modes. Additionally, processes that are (mainly) devoted to internal data processing, and which rely on nominal control capability from ground, can be covered under the Function Service.

The Function Management Service shall be used to provide access to and visibility of different operational modes or configurations of Application Processes and their associated hardware units in an adequate way.

Reference 5490-FNM

Control structures similar to «Private Telecommands» shall be avoided.

*

A global mode change of a unit (caused by a single Telecommand TC(8,1)) may imply that certain specific (independent) Functions are started automatically, others may be stopped simultaneously. No specific commanding for these Functions may be required in such a case. However, for contingency cases it may be needed to start or stop these Functions explicitly.

When an application function is active, the ground may have the possibility to perform a number of activities in the current context of the function. For example, in a particular mode of operation of an instrument, certain specific control actions may be available.

An important characteristic of the Function Management Service is, that it can be implemented in a way that a two-step "Arm – Fire" or "Initiate – Execute" concept can be utilised, additionally to the immediate execution after reception of a Start Function Telecommand (8,1). This is achieved by separating the initialisation of a Function, and loading of new function-parameters, from executing a Function with these parameters. Also, for establishing precise control over the timing of Functions or Activities these Telecommands can be used (by releasing them to the executing unit according to a schedule).

It is recommended that Functions for critical operations are designed in a way that they terminate automatically after execution, after a certain time interval, or after time-out conditions are reached.

5.8.1 Telecommand Packet Data Field Structure :

5.8.1.1 TC(8,1) : Starting a Function

\#   Reference   5500-FNM

When the request is received without following parameters, the on-board application shall start/ initiate the specified Function with default parameters. If a number of parameters is present in the Telecommand, these parameters shall be used instead.

\#   *

\#   Reference   5510-FNM

---

deleted

\#   *

\#   Reference   5515-FNM

In all cases the Function shall start at an unambiguous entry-point and the status shall become «active». The request is ignored if the Function status was "active" and a Telecommand Acceptance Report – Failure (1,2) shall be generated.

\#   *

The request is :

\#   Reference   5520-FNM

[P:SCI-PT-RS-07360#3.7-FNM-1.

[P:SCI-PT-RS-07360#3.13-OTFM-7.

–   Start Function (8,1)

Telecommand Packet, Application Data :

Function ID	Spare	SID	Parameters
Enumerated 8 bits	8 bits	Enumerated 2 octets	Any

<----- Optional ----->

- Function ID (FID) :

  The Function ID, together with the Application ID in the packet header determines the activity, which can be controlled by that Telecommand. The Function ID is to be defined in the User Manual of the subsystem or instrument.

- Spare :

  This field shall be set to zero.

- SID :

The Structure ID defines the presence and the fixed structure of the Parameter Field which follows. If SID = zero no parameters are sent.

- Parameters :

  A number of data structures compliant with the Structure Rules according to Appendix 6. The parameters are used to configure the specific instance of the execution of the Function.

                                                                                    #   *

As a design goal, it is recommended to define the Start Function packet TC(8,1) layouts such a way that no reference to SID is necessary to determine its structure. i.e. : for a given Function-ID, one only set of parameters is allowed to be included (in a pre-defined order) in «Parameters» field.

As a consequence, the SID field can be defined as «spare» or «don't care» in the User Manual of the subsystem or instrument.

5.8.1.2 TC(8,2) : Stopping a Function

Reference   5525-FNM

[P:SCI-PT-RS-07360#3.7-FNM-1.

If a Function is not designed to execute and then terminate automatically, or for testing and contingencies, the Stop Function Telecommand (8,2) shall be used.

                                                                                    #   *

The request is :

Reference   5530-FNM

[P:SCI-PT-RS-07360#3.13-OTFM-7.

[P:SCI-PT-RS-07360#3.7-FNM-1.

- Stop Function (8,2)

  Telecommand Packet, Application Data :

Function ID	Spare
Enumerated 8 bits	8 bits

- Function ID (FID) :

  The Function ID, together with the Application ID in the packet header determines the activity which can be controlled by that Telecommand.

- Spare :

  8 bits, set to zero.

                                                                                    #   *

Reference   5535-FNM

When this request is received, the on-board Application Process shall stop the specified Function. In any case, the Function shall stop at an unambiguous exit-point in a deterministic way, and the Function status is

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then "stopped". The request is ignored if the Function status was "stopped" and a Telecommand Acceptance Report – Failure (1,2) shall be generated.

*

5.8.1.3 Not used

5.8.1.4 TC(8,4) : Performing an activity of a function

When this request is received, the Application Process indicates to the Function which activity it must execute and the parameters to be used. The Function status is unchanged by the execution of the Activity. If a certain Function does not need to be split into more than one Activities, or if no parameters need to be loaded to a function, TC type (8,4) can be omitted.

For the execution of commanding activity according to the Arm – Fire concept a sequence of TC(8,1) for initiating/ arming, and TC(8,4) for executing/ firing can be used.

Reference 5540-FNM

[P:SCI-PT-RS-07360#3.7-FNM-2.

If the status of a Function is «active» it shall be possible to load parameters by executing TC(8,4), and have them accepted immediately without changing the Function status. If designed accordingly, the Function continues/executes from an entry-point identified by the Activity-ID.

*

Reference 5545-FNM

If the status of the Function is «stopped», the sending of a Perform Activity of Function command, TC(8,4), shall result in an Telecommand Acceptance Report – Failure (1,2), and the status of the Function shall not change. Additionally, an Event Report (5,2) or (5,4) may be issued.

*

The request is :

Reference 5460-FNM

[P:SCI-PT-RS-07360#3.7-FNM-1.

– Perform Activity of Function (8,4)

Telecommand Packet, Application Data :

Function ID	Activity ID	SID	Parameter
Enumerated 8 bits	Enumerated 8 bits	Enumerated 2 octets	Any

<---------Optional-------->

- Function ID (FID) :

    The Function ID, together with the Activity ID and the Application ID in the packet header, defines the exact actual activity of the function.

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- Activity ID :

  This indicates which activity of the specified Application Function is to be performed.

- SID :

  The Structure ID defines the presence and the fixed structure of the Parameter Field which follows.

- Parameter :

  A number of data structures compliant with the Structure Rules according to Appendix 6. The parameters are used to configure the specific instance of the execution of the Function.

*

As a design goal, it is recommended to define the Perform Activity of Function packet TC(8,4) layouts such a way that no reference to SID is necessary to determine its structure. i.e. : for a given {Function-ID ; Activity-ID} pair, one only set of parameters is allowed to be included (in a pre-defined order) in «Parameter» field.

As a consequence, the SID field can be defined as «spare» or «don't care» in the User Manual of the subsystem or instrument.

5.8.1.5 TC(8,5) : Reporting Function Status and Parameters

Functions may be designed to return a specific Function Status Report (8,6) automatically at certain steps of execution. This includes specific status-reporting after start/initialisation and also, after a TC(8,4) with specific control parameters has been sent (Example : returning values of specific, requested parameters or tables). In other cases, a status report shall be initiated by the Telecommand (8,5) (at any time).

The request is :

Reference 5470-FNM

[P:SCI-PT-RS-07360#3.7-FNM-4.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

- Report Function Status (8,5)

  Telecommand Packet, Application Data :

Function ID	Spare
Enumerated 8 bits	8 bits

- Function ID (FID) :

  The Function ID, together with the Application ID in the packet header identifies the Function, for which a status-report is requested.

- Spare :

  8 bits, set to zero.

*

Reference 5475-FNM

[P:SCI-PT-RS-07360#2.1.3-TM-8.

[P:SCI-PT-RS-07360#3.7-FNM-4.

When this request is received, the on-board Application Process shall report the *actual status* of the specified Function by means of TM(8,6).

*

5.8.2 Telemetry Packet Data Field Structure :

5.8.2.1 TM(8,6) : Function Status Report

Reference 5480-FNM

[P:SCI-PT-RS-07360#3.7-FNM-4.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

This Telemetry Report shall return the current set of parameter values, which have been handed over to the Function (by a TC(8,1) or TC(8,4)). Additionally, the Activity ID field shall provide information about the actual execution step/ status of the Function.

If a Function Status Report (8,6) has been initiated by a TC(8,4), details about the returned set of parameters can be defined by that Telecommand (user-specific).

*

Reference 5485-FNM

[P:SCI-PT-RS-07360#3.7-FNM-4.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

− Function Status Report(8,6)

Telemetry Packet, Source Data :

Function ID	Activity ID	SID	Parameter
Enumerated 8 bits	Enumerated 8 bits	Enumerated 2 octets	Any

<---------------Optional------------>

- Function ID (FID) :

  The Function ID, together with the Activity ID and the Application ID in the packet header, defines the exact actual activity of the function.

- Activity ID :

  This indicates which activity of the specified Application Function is currently performed. This field may be used to indicate the actual activity step or status of a Function in a higher granularity than provided by TC(8,4) for the purpose of control.

  If the status of the Function is «Stopped» the Activity ID shall be set to zero.

- SID :

  The Structure ID defines the presence and the fixed structure of the Parameter Field which follows.

- Parameter :

    A number of data structures compliant with the Structure Rules according to Appendix 6. The parameters are used to configure the specific instance of the execution of the Function.

---

*

As a design goal, it is recommended to define the Function Status Report packet TM(8,6) layouts such a way that no reference to SID is necessary to determine its structure. i.e. : for a given {Function-ID ; Activity-ID} pair, one only set of parameters is allowed to be included (in a pre-defined order) in «Parameter» field.

As a consequence, the SID field can be defined as «spare» or «don't care» in the User Manual of the subsystem or instrument.

5.9 Service Type 9 : Time Management

The Time Management Service provides the capabilities to transfer a master time information on-board a spacecraft, the Central Time Reference (CTR), to other units or applications after activation, reset, or for the purpose of re-synchronisation in order to achieve a high accuracy of «local copies» of the CTR. Additionally, the service supports the verification of time information, which is maintained (independently) within applications, against the on-board master time.

This is accomplished by executing a time synchronisation procedure in the CDMS, and locally within the addressed end-user or Application. This consists of sending an Enable Time Synchronisation packet TC(9,4) and a Time Code TC(9,5) to this Application, and then sending a synchronisation signal or message to one or more end-users. The submitted Time Code is valid at this moment. Although lower communication layers may be involved in time-setting and synchronisation of end-users (see also Appendix 9 of this document), the nominal means of controlling on-board time for Packet end users is TM/TC Service 9.

The process to (re-)set the Central Time Reference on-board the spacecraft to a ground reference time consists of correlating the current CTR against UTC on ground in order to determine a delta correction value, and then sending a time to the spacecraft, at which a time-synchronisation of the CTR shall be performed, together with the new time, to which the CTR shall be set.

Reference 5490-OBTM

Neither the operation of a (local) on-board clock nor the time-tagging of TM packets shall be suspended at any time. The time format to be used on-board is defined in Appendix 6.3.8.

---

*

The verification of the on-board master time against a time reference on-ground is, according to [AD 1], a function, which is carried out by the CDMS on Transfer Frame Layer, and involves the generation of Standard Spacecraft Time Source Packets from the reserved Application ID Zero. This procedure is not covered in this section, for details see Appendix 7.

5.9.1 Telecommand Packet Data Field Structure :

5.9.1.1 TC (9,3) : Synchronise User

Reference 5500-OBTM a

[P:SCI-PT-RS-07360#3.8-OBTM-2. a

On receipt of this command, the CDMS shall execute the time synchronisation procedure of end user specified by the Application ID. If this Telecommand is addressed to Application Process controlling the CTR (in the CDMS) the TC shall be rejected.

– Application Data :

Spare	Application ID
5 bits	11 bits

– Spare :

Set to all zeros, i.e. '00000'$_{BIN}$.

– Application ID :

This field carries the APID of the user to be synchronised.

*

The time synchronisation procedure of end user specified by the Application ID consists, as defined in Table A-2.1, in :

– No TC sending : TC(9,3) with related Application ID is rejected.

– Sending of TC(9,4) with the specified Application ID.

– Sending of TC(9,4) and TC(9,5) with the specified Application ID.

5.9.1.2 TC (9,4) : Enable Time Synchronisation

Reference   5510-OBTM

[P:SCI-PT-RS-07360#3.8-OBTM-2. a

The CDMS sends this command to the user addressed, to start the local time synchronisation procedure. The user then waits for a Time Code Telecommand and the next synchronisation signal or message and then sets its local time to the time delivered in the Time Code Telecommand.

– Application Data :   None

*

5.9.1.3 TC (9,5) : Time Code

Reference   5520-OBTM

[P:SCI-PT-RS-07360#3.8-OBTM-2. a

The user sets its local clock to the time information delivered in the data field, in order to generate a copy of the on-board master time. The exact moment in time, at which this information is valid, is determined by the next synchronisation signal on the on-board data bus. User-internal latencies or corrections may be taken into account within the process of local time synchronisation, depending on the required accuracy.

– Application Data :

Time
48 bits

– Time : (48 bits)

The copy of the CDMS master time (CTR) to be used for synchronisation. The time code format shall be as specified in Appendix 6.3.8.

*

5.9.1.4 TC (9,6) : Verify User Time

Reference 5530-OBTM

[P:SCI-PT-RS-07360#3.8-OBTM-3. a

On receipt of this command, the CDMS shall generate an Enable Time Verification packet TC(9,7) for the user identified in the data field and then execute the time verification procedure, which includes the generation of a Central Time Reference packet TM (9,8).

– Application Data :

Spare	Application ID
5 bits	11 bits

– Spare :

Set to all zeros, i.e. '00000'$_{BIN}$.

– Application ID :

This field carries the APID of the user to be verified.

*

5.9.1.5 TC (9,7) : Enable Time Verification

Reference 5540-OBTM

[P:SCI-PT-RS-07360#3.8-OBTM-3. a

On receipt of this command, the application addressed shall generate a Time Verification Report TM(9,9)

– Application Data : None

*

5.9.1.6 TC (9,10) : Synchronise Central Time Reference

Reference 5550-OBTM

[P:SCI-PT-RS-07360#3.8-OBTM-6. a

The CDMS shall set its master clock, representing the CTR, to the value of New Sync. Time delivered in the data field, in order to synchronise the CTR to a time provided from ground. The exact moment in time, at which this information is valid, is determined by the value of Current Time.

- Synchronise Central Time Reference (9,10)

    Telecommand Packet, Application Data :

Current Time	New Sync. Time
Absolute Time	Absolute Time
48 bits	48 bits

- Current Time : (48 bits)

    The old value of the CDMS master time (CTR) at which synchronisation shall take place.

- New Sync. Time : (48 bits)

    The new value of the CDMS master time (CTR). The time code format shall be as specified in Appendix 6.3.8.

*

It can be assumed that such CTR (re-)synchronisation will be a rare activity and will be performed under the responsibility by Ground.

5.9.2 Telemetry Packet Data Field Structure :   Onboard Time Management Reports

The Time Management Reports are to be used by the CDMS and selected onboard applications to verify synchronisation to a common onboard time reference.

5.9.2.1 TM (9,8) : Central Time Reference

Reference   5555-OBTM

Within the time verification procedure the CDMS shall generate a Central Time Reference packet TM(9,8) with a copy of the CDMS Central Time Reference generated at the moment of the next synchronisation signal, which is sent to end-users.

- Application Data :

Time
48 bits

- Time : (48 bits)

    The copy of the Central Time Reference managed by the CDMS. The time code format shall be as specified in Appendix 6.3.6.

*

5.9.2.2 TM (9,9) : Time Verification Report

#	Reference	5560-OBTM

[P:SCI-PT-RS-07360#3.8-OBTM-3. a

After reception of a TC(9,7) the application addressed shall generate a Time Verification Report TM(9,9) at the moment of reception of the next synchronisation signal. The data field shall carry a copy of the local user time.

– Application Data :

Time
48 bits

- Time : (48 bits)

  The copy of the Central Time Reference managed locally by the application. The time code format shall be as specified in Appendix 6.3.8.

*

5.10 Service Type 10 : not used

5.11 Service Type 11 : On-board Scheduling

The On-board Scheduling Service provides for the capabilities to execute a sequence of time-tagged Telecommands from a Mission Timeline (MTL). These Telecommands are passed by the CDMU to end-users, identified by their APIDs, at execution time, for immediate execution. Additionally the Service 11 provides for means to insert and delete Telecommands in the MTL, and to report the contents and status of the MTL.

#	Reference	5570-OBTM

[P:SCI-PT-RS-07360#3.9-MTL-6. a

The MTL Service shall support the concept of Subschedules. They correspond to groups or sequences of Telecommands for one or several users, which normally control the execution of a certain independent activity. Subschedules can be enabled or disabled, or otherwise controlled, without affecting the rest of the MTL (i.e. several Subschedules can be active in parallel and/or sequentially).

Ground control may assign certain commanding activities to a specific schedule, which acts as a master schedule, and arrange other commanding sequences in other independent (sub-)schedules. However, no fixed, specific Schedule ID for a master timeline needs to be defined.

*

Examples for Subschedules are : all Telecommands belonging to a certain attitude manoeuvre, or a (sequence of) observation(s) of a single instrument. A master-schedule may cover a time-period up to several days, and contain Telecommands for configuring the RF-subsystem for the Daily Telecommunication Period, other scheduled maintenance activities, and configuring the spacecraft into a safe standby configuration after a period of 48 hours.

#	Reference	5575-OBTM

[P:SCI-PT-RS-07360#3.9-MTL-10.

[P:SCI-PT-RS-07360#3.9-MTL-8. a

If the Subschedule Identifier is set to zero in any of the Telecommands of Service 11 (except TC (11,4)) the complete Mission Timeline, i.e. all Subschedules that are currently residing on-board, shall be addressed in all these cases. As a consequence, all (Sub-)schedules shall have an identifier defined in the range (1, 4095).

*

This does not apply for TC (11,4) (Insert MTL-Telecommands in Command Schedule) because there is no need to insert the same MTL TC in all subschedules.

Reference 5577-OBTM a

[P:SCI-PT-RS-07360#3.9-MTL-2.1

The MTL Service shall support two categories of Subschedules :

a) Permanent Subschedules, Subschedule IDs in the range (1, PermSubSchMaxId),

b) Transient Subschedules, Subschedule IDs in the range (PermSubSchMaxId +1, 4095).

The MTL Service activity status after reset or initialisation of the CDMS is specified in RD-8.

Numerical value of PermSubSchMaxId shall be a compile time parameter.

*

Reference 5580-MTL

If an error is detected during the releasing of a Telecommand for execution, it shall not affect the processing of the remainder of the Telecommands of the MTL

*

5.11.1 Telecommand Packet Data Field Structure :

5.11.1.1 TC(11,1) : TC(11,2) : Controlling the release of Telecommands

The Service Requests to enable or disable the release of selected Telecommands are :

Reference 5585-MTL

[P:SCI-PT-RS-07360#3.9-MTL-5.

[P:SCI-PT-RS-07360#3.13-OTFM-7.

– Enable Release of Telecommands (11,1)

Telecommand Packet, Application Data : see Figure below

*

Reference 5590-MTL

[P:SCI-PT-RS-07360#3.13-OTFM-7.

[P:SCI-PT-RS-07360#3.9-MTL-5.

[P:SCI-PT-RS-07360#3.9-MTL-6. a

— Disable Release of Telecommands (11,2)

Telecommand Packet, Application Data : see Figure below

N	Subschedule-ID	M	Application-Process-ID
Unsigned Integer (16-bit)	Enumerated (16-bit)	Unsigned Integer (16-bit)	Enumerated (16-bit)
	<--- Repeated N times --->		<--- Repeated M times --->

- N :

  The number of Subschedule-IDs that follow.

  If N = 0 (consequently the TC Application Data field contains no Subschedule-ID)

  the TC does not address Command Schedule by subschedule. The release status shall be set according to the TC subtype : enabled for TC(11,1) ; disabled for TC(11,2) for MTL telecommands to Application Process(es) identified in the TC whatever is the subschedule they belong to.
  For TC execution, only M, and the Application Process list that follows, are taken into account.

  If N = 1 and subschedule ID = 0 :
  the TC addresses all subschedules residing on-board. The release status shall be set according to the TC subtype : enabled for TC(11,1) ; disabled for TC(11,2) for all MTL telecommands (whatever is the subschedule they belong to).

  If N >0 and subschedule ID <> 0 :
  the TC addresses the identified subschedules residing on-board. The release status shall be set according to the TC subtype : enabled for TC(11,1) ; disabled for TC(11,2) for all MTL telecommands belonging to identified subschedule(s).
  For TC execution, M, and the Application Process list that may follow, are taken into account independently.

- Subschedule-ID :

  The Subschedule Identifier allows to identify a set of Telecommands for one or several Applications/ users, and to distinguish them from the rest of the MTL.

- M :

  The number of Application IDs that follow.

  If M = 0 (consequently the TC Application Data field contains no Application Process-ID) :

  the TC does not address Command Schedule by Application Process. The release status shall be set according to the TC subtype : enabled for TC(11,1) ; disabled for TC(11,2) for MTL telecommands belonging to subschedule(s) identified in the TC whatever is their destination Application Process.
  For TC execution, only N, and the subschedule list that follows, are taken into account.

  If M >0 and Application Process ID <> 0 (considering the limited number of Process ID there is no need of value 0 for identification of all Process IDs) :
  the TC addresses the identified Application Process. The release status shall be set according to the TC subtype : enabled for TC(11,1) ; disabled for TC(11,2) for all MTL telecommands addressed to identified Application Process.
  For TC execution, N, and the subschedule list that may follow, are taken into account independently.

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- Application Process-ID :

    The identification of the destination Application Process(es) for which the MTL is to be enabled/disabled.

\# *

\#   Reference   5595-MTL

[P:SCI-PT-RS-07360#3.9-MTL-5.

On receipt of TC(11,1) [resp. TC(11,2)] release status of MTL telecommands

- belonging to any of the «N» subschedules listed in the TC shall be enabled [resp. disabled] whatever is their destination Application Process.

- related to any of the «M» APID listed in the TC shall be enabled [resp. disabled] whatever is the subschedule they belong to.

These TCs allows to control independently the release status of MTL commands by APID or by subschedule.

Execution of the MTL shall always start from the actual value of the master on-board time (CTR) onwards.

\# *

\#   Reference   5597-MTL

Each change of release status of a Subschedule, or a sequence of Telecommands identified by AP-ID, shall be reported with an Event Report TM(5,1), returning at least the affected Subschedule ID, Application ID, and release status as parameters.

\# *

5.11.1.2 TC(11,3) : Resetting the Command Schedule

The request is :

\#   Reference   5600-MTL

- Reset Command Schedule (11,3)

    Telecommand Packet, Application Data : None

\# *

\#   Reference   5605-MTL

When the Service Provider receives this request it clears all entries in the Command Schedule (MTL) for all Application Processes.

\# *

5.11.1.3 TC(11,4) : Inserting MTL-Telecommands in the Command Schedule

With this command one Telecommand for a certain end-user, identified by its APID, can be added to the on-board Mission Timeline, together with the time of release. This Telecommand type serves for inserting specific MTL-Telecommands into the Command Schedule, and for loading the complete MTL for a longer period of operation, by sending all MLT-Telecommands for that period.

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Reference 5610-MTL

With each TC(11,4) one executable MTL-Telecommand shall be loaded.

\# *

The actual size of executable Telecommands is limited to 228 octets (216 octets for the application data field) because the data space available to end-users is reduced by the schedule control parameters.

Note : As Herschel and Planck will be operated from the MTL most of their time this restriction applies for the majority of all Telecommands.

The request to insert (e.g. add) one Telecommand in the Command Schedule is :

Reference 5620-MTL

[P:SCI-PT-RS-07360#3.9-MTL-1.

[P:SCI-PT-RS-07360#3.9-MTL-3.

[P:SCI-PT-RS-07360#3.9-MTL-7.

– Insert MTL-Telecommands in Command Schedule (11,4)

Telecommand Packet, Application Data :

Absolute Time Tag	Subschedule ID	Telecommand Packet
Absolute Time (48-bit)	Enumerated (16-bit)	Variable OctetString

- Absolute Time Tag :

  The Absolute Time Tag is the on-board CUC time of the Central Time Reference, at which the Telecommand packet is to be sent to its Application Process ID.

- Subschedule ID :

  The Subschedule Identifier allows to identify a set of Telecommands for one or several Applications/ users, and to distinguish them from the rest of the MTL.

- Telecommand Packet :

  This is a standard Telecommand packet of any Type/ Subtype. Type of inserted telecommand packet is the «Variable Octet String» type specifically defined for TC packet in Appendix A.6.

  The source of the Telecommand packet is indicated in the Source Part of the Packet Sequence Control field, its value shall be 010 (i.e. Telecommand from the on-board MTL). The length of this field is defined by the Length-field of the Packet-Header of the Telecommand.

\# *

Reference 5625-MTL

[P:SCI-PT-RS-07360#3.9-MTL-7.

[P:SCI-PT-RS-07360#3.9-MTL-3.

When this request is received, the Telecommand in the request shall be checked for consistency with the rest of the MTL and, if no error is detected, it is added to the Command Schedule.

\# *

5.11.1.4 Deleting Telecommands from the Command Schedule

5.11.1.4.1 TC(11,5) : Deleting a Set of Telecommands from the MTL

The request to delete sets of Telecommands from the Command Schedule is :

Reference 5640-MTL

[P:SCI-PT-RS-07360#3.9-MTL-8. a

– Delete MTL-Telecommands (11,5)

Telecommand Packet, Application Data :

N	Subschedule -ID	Application Process-ID	Absolute Time Tag	Packet Sequence Control	Number of Telecommands
Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (16-bit)	Absolute Time (48-bit)	Enumerated (16-bit)	Unsigned Integer (16-bit)

- N :

  This field specifies the number of telecommand sequence(s) that shall be deleted.

  N shall be set to 1 multiple deletion criteria is not used/accepted on board.

- Subschedule-ID :

  The Subschedule Identifier identifies a set of Telecommands for one or several Applications/ users.

  In this TC, Subschedule-ID identifies the subschedule to which belongs a telecommand sequence that shall be deleted.

- Application-ID :

  The APID identifies the Application affected. In this TC, APID identifies the destination Application Process of the first Telecommand packet belonging to the sequence that shall be deleted.

- Absolute Time Tag :

  The Absolute Time Tag indicates the date of release (in CTR) of the first Telecommand packet belonging to the sequence that shall be deleted.

- Packet Sequence Control :

  The Packet Sequence Control field indicates the first Telecommand packet belonging to the sequence that shall be deleted :

  Ø The Sequence Flag part (2 bits). Shall be set to 11b (as a consequence of Sequence Flag value defined in above requirement 3000-TC).

  Ø The Source part (3 bits). Shall be set to 010b (as a consequence of allocation defined in above requirement 3000-TC).

  Ø The Sequence Count part (11 bits) identifies the first TC to be deleted.

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- Number of Telecommands :

  The number of (successive in date of release order) Telecommand packets that shall be deleted from the specified MTL subschedule (regardless of their destination APID).

*

Reference 5650-MTL

[P:SCI-PT-RS-07360#3.9-MTL-8. a

When this request is received, the Telecommand which satisfy the selection criteria defined by the Subschedule-ID, the Application Process ID, the Absolute Time Tag and the Sequence Count shall be deleted as well as the [Number of Telecommands-1] Telecommands that follow in the identified subschedule.

*

Reference 5655-MTL

After successful completion of a Delete-Telecommand a Telecommand Execution Report TM(1,7) shall be generated. If any error is detected during the processing of a deletion request and if the number of deleted TC is higher than 0 and lower then the number specified in TC(11,5) a Telecommand Execution Failure Report TM(1,8) shall be issued.

*

5.11.1.4.2 TC(11,6) : Deleting Telecommands over a Time Period

The request is :

Reference 5660-MTL

[P:SCI-PT-RS-07360#3.9-MTL-8. a

- Delete Telecommands over Time Period (11,6)

  Telecommand Packet, Application Data :

Time Tag 1	Time Tag 2	Subschedule ID	N	Application Process ID
Absolute Time	Absolute Time	Enumerated	Unsigned Integer	Enumerated
48 bits	48 bits	16 bits	16 bits	16 bits

<--- Repeated N times --->

- Time Tag 1 :

  All Telecommands selected by AP-ID and SS-ID with an execution time equal or larger than Time Tag 1, up to including Time Tag 2, shall be deleted.

- Time Tag 2 :

  Time Tag 2 determines the latest absolute time for which Telecommands shall be deleted from the current MTL.

- Subschedule ID :

The Subschedule Identifier allows to identify a set of Telecommands for one or several Applications/ users that shall be deleted.

If Telecommands from all Subschedule shall be deleted, this field shall be set to zero.

- N :

  This field specifies the number of Applications for which a sequence of Telecommands shall be deleted.

  If N is set to zero all Telecommands between Time Tag 1 and 2 (for the identified Subschedule) shall be deleted.

- Application Process ID :

  The AP-ID is the identification of the destination Application Process from which Telecommands are to be deleted.

*

Reference 5665-MTL

[P:SCI-PT-RS-07360#3.9-MTL-8. a

When this request is received, the specified Telecommands between Time Tag 1 and Time Tag 2 are deleted from the Command Schedule.

*

Reference 5670-MTL

After successful completion of a Delete-Telecommand a Telecommand Execution Report TM(1,7) shall be generated. If any error is detected during the processing of a deletion request, no Telecommands shall be deleted and an Telecommand Execution Failure Report TM(1,8) shall be issued.

*

5.11.1.5 Reporting of the Command Schedule contents

This subservice provides the capabilities to produce a complete or partial report of the contents of the MTL.

5.11.1.5.1 TC(11,9) : Reporting of the complete command schedule

This request serves for obtaining a detailed report of all Telecommands in the on-board Command Schedule Memory, irrespective of their execution status or time tag.

The request is :

Reference 5675-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

- Report Command Schedule (11,9)

  Telecommand Packet, Application Data : see Figure below

N	Subschedule ID
Unsigned Integer (16-bit)	Enumerated (16-bit)

<---- Repeated N times ----->

- N :

  The number of Subschedule-IDs that follow.

  If N = 0 (consequently the TC Application Data field contains no Subschedule-ID) : the TC addresses all subschedules residing on-board.

- Subschedule-ID :

  The Subschedule Identifier allows to identify a set of Telecommands for one or several Applications/ users, and to distinguish them from the rest of the MTL.

*

Reference 5677-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

When this request is received, a **Detailed Schedule Report** (set of TM(11,10) packets) shall be generated containing all Telecommands of the identified subschedule(s).

*

5.11.1.5.2 TC(11,11) : Reporting of the MTL over a time period

The request for a report of selected part(s) of the Command Schedule over an absolute time period is :

Reference 5680-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

– Report Command Schedule over Time Period (11,11)

  Telecommand Packet, Application Data :

Time Tag 1	Time Tag 2	Subschedule ID	N	Application Process ID
Absolute Time 48 bits	Absolute Time 48 bits	Enumerated 16 bits	Unsigned Integer 16 bits	Enumerated 16 bits

<-- Repeated N times -->

- Parameters of Data Field :

  The structure and function of these fields is equivalent to the Telecommand of type/subtype (11,6).

  When this request is received, a **Detailed Schedule Report** (set of TM(11,10) packets) covering the specified time period for the identified subschedule and application Process(es) shall be generated.

*

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5.11.1.6 Reporting a Summary of the MTL

5.11.1.6.1 TC(11,12) : Reporting a Complete Summary of the MTL Command Schedule

The request to obtain a summary report of all telecommands in the command schedule shall be :

Reference 5690-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

– Report Command Schedule in Summary Form (11,12)

Telecommand packet, application data : Identical to TC(11,9)

When this request is received, a **Summary Schedule Report** (set of TM(11,13) packets) shall be generated containing all Telecommands of the identified subschedule(s).

*

5.11.1.6.2 TC(11,14) : Reporting a Summary of the MTL over a Time Period

The request to obtain a summary report of a selected part of the telecommands in the command schedule shall be :

Reference 5700-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

– Report Command Schedule Summary over Time Period (11,14)

Telecommand packet, application data : Identical to TC(11,11)

When this request is received, a **Summary Schedule Report** (set of TM(11,13) packets) covering the specified time period for the identified subschedule and application Process(es) shall be generated.

*

5.11.1.7 TC(11,18) : Reporting of the Status of the Command Schedule

Reference 5702-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

The request to report, which Telecommands are enabled/disabled for release from the command schedule, shall be :

– Report Status of Command Schedule (11,18)

Telecommand packet, application data : None

When this request is received, a **Command Schedule Status Report** (set of TM(11,19) packets) shall be generated containing the release status (enabled or disabled) of the Application Processes and of the used Subschedules .

*

5.11.2 Telemetry Packet Data Field Structure :

5.11.2.1 TM(11,10) : Detailed Report of the Command Schedule

Reference 5710-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

The structure of the fields shall be a copy of Type/Subtype (11,4), i.e. for the selected MTL-Telecommands the contents of the MTL is reported by the TM(11,10) packets the same way as it was loaded or inserted.

*

Reference 5720-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

– Detailed Schedule Report (11,10)

Telemetry Packet, Source Data :

N	Absolute Time Tag	Subschedule ID	Telecommand Packet
Unsigned Integer (16-bit)	Absolute Time (48-bit)	Enumerated (16-bit)	Variable OctetString

<------------------------------- Repeated N times ------------------------------ >

- N :

  N specifies the number of MTL-Telecommands reported in the current TM(11,10).

- Absolute Time Tag :

  The Absolute Time Tag is the on-board CUC time of the Central Time Reference, at which the Telecommand packet is to be sent to its Application Process ID.

- Subschedule ID :

  The Subschedule Identifier allows to identify a set of Telecommands for one or several Applications/ users, and to distinguish them from the rest of the MTL.

- Telecommand Packet :

  This is a standard Telecommand packet of any Type/ Subtype.Type of reported telecommand packet is the «Variable Octet String» type specifically defined for TC packet in Appendix A.6.

  The source of the Telecommand packet is indicated in the Source Part of the Packet Sequence Control field, its value shall be 001 (i.e. Telecommand from the on-board MTL).

*

Reference 5725-MTL a

[P:SCI-PT-RS-07360#3.9-MTL-10.

When completion of a request Report Command Schedule TC(11,9) or Report Command Schedule over Time Period TC(11,11) requires several TM(11,10) packets, these TM(11,10) packets shall be

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generated such a way that the reported MTL telecommand packets are ordered in increasing Absolute Time Tag, regardless of the subschedule they belong to and of their destination APID.

At completion of the requested command schedule reporting, an Event Report TM(5,1) indicating the number of reported TM(11,10) shall be issued.

*

5.11.2.2 TM(11,13) : Summary Schedule Report

Reference   5730-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

Telemetry source packet, source data :

N	Absolute Time Tag	Subschedule -ID	Application Process-ID	Packet Sequence Control
Unsigned Integer (16-bit)	Absolute Time (48-bit)	Enumerated (16-bit)	Enumerated (16-bit)	Enumerated (16-bit)
	< ---------------------- Repeated N times ---------------------- >			

- N :

  N specifies the number of Telecommand Identifiers, consisting of Subschedule-ID, APID, and Sequence Count, reported in the TM(11,13).

- Absolute Time Tag :

  The Absolute Time Tag is the on-board CUC time of the Central Time Reference, at which the Telecommand packet is to be sent to its Application Process ID.

- Subschedule ID :

  The Subschedule Identifier allows to identify a set of Telecommands for one or several Applications/ users, and to distinguish them from the rest of the MTL.

- Application ID :

  The APID identifies the Application affected.

- Packet Sequence Control :

  The identification of an individual Telecommand packet to be sent to the specified destination Application Process. It includes :

    Ø Sequence flag (2 bits) set to 11b

    Ø Sequence source (3 bits) set to 010b

    Ø Sequence count (11 bits)

*

Reference   5731-MTL a

[P:SCI-PT-RS-07360#3.9-MTL-10.

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When completion of a request Report Command Schedule in Summary Form TC(11,12) or Report Command Schedule Summary over Time Period TC(11,14) requires several TM(11,13) packets, these TM(11,13) packets shall be generated such a way that the reported parts of MTL telecommand packets is ordered in increasing Absolute Time Tag, regardless of the subschedule they belong to and of their destination APID.

At completion of the requested command schedule reporting, an Event Report TM(5,1) indicating the number of reported TM(11,13) shall be issued.

*

5.11.2.3 TM(11,19) : Report of the Status of the Command Schedule

Reference 5732-MTL

[P:SCI-PT-RS-07360#3.9-MTL-10.

– Command Schedule Status Report (11,19)

Telemetry source packet, source data :

N1	Subschedule -ID	Status	N2	Application Process-ID	Status	Spare
Unsigned integer (8-bit)	Enumerated (16-bit)	Enumerated (8-bit)	Unsigned integer (8-bit)	Enumerated (16-bit)	Enumerated (8-bit)	(8-bit)
	<-----Repeated N1 times---->			<-----Repeated N2 times---->		optional

- N1 :

  The number of Subschedules that follow.

- Sub-schedule ID :

  The identification of the Subschedule being reported.

- Status :

  The status of the corresponding Subschedule, as follows :

  Ø   Value = 0 (Disabled)

  Ø   Value = 1 (Enabled).

- N2 :

  The number of Application IDs that follow.

- Application Process ID :

  The identification of the Application Process being reported.

- Status :

  The status of the corresponding Application Process, as follows :

  Ø   Value = 0 (Disabled)

  Ø   Value = 1 (Enabled).

- Spare :

   8 bits, set to zero. An optional spare octet (set to zero) will be included into TM(11,19) source data to fulfil the TM packets 16-bit alignment requirement.

*

Reference 5735-MTL

At completion of the Report Status of Command Schedule TC(11,18) request, that may require the reporting of several Command Schedule Status Report TM(11,19), an Event Report TM(5,1) indicating the number of reported TM(11,19) shall be issued.

*

Completion of a request Report Status of Command Schedule TC(11,18) may require several TM(11,19) packets. A dedicated TM(11,19) packet can be used to report the release status of all spacecraft APID.

Note that if a TM(11,19) packet reports no Subschedule release status, N1 shall be set to 0 in this TM packet ; if a TM(11,19) packet reports no spacecraft APID release status, N2 shall be set to 0 in this TM packet. A spare octet (set to zero) can be added to TM(11,19) source data to fulfil the TM packets 16-bit alignment requirement.

5.12 Service Type 12 : On-board Monitoring

The On-board Monitoring Service provides the capability to monitor on-board parameters with respect to checks defined by the ground for the purpose of initiating adequate actions on-board (during autonomy phases of the spacecraft) or on ground. These actions can be confined to reporting in some cases, or predefined on-board functions (like nominal OBCPs, or FDIR functions) may be involved, if applicable. In any case the service shall report all check status transitions to the ground.

To achieve this, the service maintains a monitoring list, and checks parameter samples according to the information contained therein. If a check results in a positive result, a Monitoring Identifier determines if an activity shall be triggered and if an Event packet (type 5,x) shall be generated. This can be evaluated on-board by the Event/ Action Service (Type 19), or on ground in order to initiate related further activities. The Monitoring Service is considered to be a CDMS capability, as far as S/C-related parameters are concerned. For instrument-internal monitoring this service may be implemented as part of the instrument applications.

The on-board Monitoring Service maintains static monitoring information for each parameter to be monitored.

Reference 5740-OBMF

The parameter monitoring information shall specify :

- The Identification of the on-board parameter to be monitored ;

- The Monitoring Status, stating whether the monitoring of the parameter is enabled or disabled (normally controlled by ground) ;

- The parameter monitoring information shall include a set of Check Definitions. A check definition provides the information required to checking a sample of the parameter against either a limit, or an expected value. Two or more check definitions may be associated with a given parameter, if a certain action is defined for a set of Warning limits (typically reporting), and more severe Alarm limits (typically starting a recovery action). In general, each individual Check Definition is normally associated with a certain operational condition of the unit to be monitored, and an individual action to be taken (Example : an upper and lower limit of a HK parameter must be monitored, with different associated actions. The monitoring only takes place, if the unit is switched-on and in the foreseen operational mode.).

*

Reference 5750-OBMF

If different sets of check definitions for a certain parameter are associated with different operational conditions of a unit or application, the check definitions and the monitoring status shall be changed adequately and timely by commanding (from ground or CDMS/ OBCP). This includes the power status of units and activation status of (SW-) applications /functions.

In this sense the samples of a parameter are always valid.

*

Reference 5760-OBMF

The monitoring of that parameter shall be enabled, together with a correct Check Definition such that the monitoring does not result in a monitoring event under nominal conditions, in contrast to unscheduled or non-nominal behaviour of that parameter.

*

Reference 5770-OBMF

For all parameters to be monitored a checking status list shall be maintained, which reflects for all parameters the current/last status of the checks performed on them (i.e. «within limits», «below low limit», «above high limit», etc.).

*

Reference 5780-OBMF

[P:SCI-PT-RS-07360#3.10-OBMF-7. b

If a check status transition occurs for a parameter, an Event TM packet (Type 5,x) shall be generated immediately, i.e. both the exceeding of limits and returning into the nominal range shall be reported (equivalently for an expected-value-check). Contents of this Event TM packet is defined in the following.

*

Reference 5790-OBMF

For a limit-check or an expected-value-check, the number of successive samples of the parameter which must fail (or succeed) the check in order to establish a new checking status for the parameter shall be 3, as default value. However, this value can be modified by ground-command in line with specific needs.

*

Reference 5800-OBMF

Repetitive generations of identical monitoring Event packets must be avoided, details are defined in [AD 3].

*

Reference 5810-OBMF

The basic monitoring period for these parameters shall be a sub-multiple (negative power of two) of the basic sampling period defined for the Housekeeping & Diagnostics Service (Service 3). However, for certain

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parameters, or for certain time periods, it may be adequate to conduct the monitoring activity at a slower rate than the basic monitoring period. Therefore the Monitoring Interval can be configured by Telecommand.

*

5.12.1 Telecommand Packet Data Field Structure :

5.12.1.1 TC(12,1) TC(12,2) : Controlling the on-board monitoring

It is possible to enable or disable the monitoring of parameters globally or to enable or disable the monitoring of a specified subset of parameters. The requests are :

Reference   5820-OBMF

   – Enable Monitoring of Parameters (12,1)

      Telecommand Packet, Application Data : see Figure below

*

Reference   5830-OBMF

   – Disable Monitoring of Parameters (12,2)

      Telecommand Packet, Application Data : see Figure below

N	Parameter-ID	Monitoring-ID
Unsigned Integer 16 bits	Enumerated 16 bits	Enumerated 16 bits

<--------------------- Repeated N times ----------------->

- N :

   N provides the number of parameters for which monitoring is to be enabled/disabled. By convention, N = 0 means "Enable/disable the entire Monitoring Service ".

- Parameter-ID :

   The P-ID is the unique identification of a parameter, as also used for the Housekeeping Service.

- Monitoring ID :

   The Monitoring Identifier associates a certain parameter with a specific Check Definition and with specific Event Packets. If applicable, the action which will be initiated in case of monitoring event is defined on-board by the Event/ Action Service.

   When the CDMS receives this request :

   Ø   If N = 0, it sets the overall monitoring status to "Enabled" or "Disabled", depending on the request sub-type.

   Ø   If N > 0 and if "enable" is requested, these parameters in the Monitoring List start being monitored.

   Ø   If N > 0 and if "disable" is requested, the monitoring of these parameters in the Monitoring List is stopped.

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An error shall be flagged if the TC transmitted Monitoring-ID is not in the list or if the TC transmitted Parameter-ID does not match the one defined for the Monitoring-ID present in the list. In such cases, the processing of the remaining parameters (i.e. : the other {Parameter-ID ; Monitoring-ID} pairs specified in the TC) is not affected.

For a given Monitoring-ID, the checking status shall be set to «IN_RANGE» when Parameter-Monitoring-Status is enabled.

*

5.12.1.2 TC(12,4) : Clearing the monitoring list

The request is :

Reference   5840-OBMF

[P:SCI-PT-RS-07360#3.10-OBMF-5.

– Clear Monitoring List (12,4)

Telecommand Packet, Application Data : None

When the CDMS receives this request, it sets the Service monitoring status to "Disabled" and clears all entries in the Monitoring List and in the Transition Reporting List.

*

5.12.1.3 TC(12,5) : Adding Parameters to, and Modifying Parameters of the Monitoring List

The request is :

Reference   5850-OBMF a

[P:SCI-PT-RS-07360#3.10-OBMF-3. a

[P:SCI-PT-RS-07360#3.10-OBMF-4.

– Modify Monitoring List (12,5)

Telecommand Packet, Application Data :

N	Parameter-ID	Monitoring-ID	Parameter-Monitoring Status	Monitoring-Interval	Spare	REP-Number	
Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (16-bit)	Enumerated (8-bit)	Unsigned Integer (16-bit)	8-bit	Enumerated (8-bit)	
	<------------------------------------- Repeated N times -------------------------------------						

Check-Value	Check-Mask	Check-Type-ID	Event-ID-1	Event-ID-2
Unsigned Integer (16-bit)	Unsigned Integer (16-bit)	Enumerated (8-bit)	Enumerated (16-bit)	Enumerated (16-bit)

-------------------------------- Repeated N times (continued) -------------------------------- >

- **N :**

  The number of parameters to be added to the Monitoring List, or to be modified.

- **Parameter-ID :**

  The identification of a parameter to be monitored (also used for the Housekeeping Service).

- **Monitoring-ID :**

  The Monitoring Identifier associates a certain parameter with a specific Check Definition and with specific Event Packets. If applicable, the action which will be initiated in case of monitoring event is defined on-board by the Event/ Action Service.

- **Parameter-Monitoring-Status :**

  This indicates whether the monitoring of the corresponding parameter shall be enabled (value = 1) or disabled (value = 0) immediately after modifying the Monitoring List.

- **Monitoring-Interval :**

  The Monitoring Interval for this parameter, expressed in multiples of the basic monitoring period of this parameter. Allowed values : 1 to 65535 (The monitoring of a parameter can take place at the basic period, or at a smaller rate/ frequency).

- **Spare :**

  8 bits, set to zero.

- **REP-Number :**

  The number of successive samples of the parameter, which must fail (or succeed) the check in order to establish a new checking status.

- **Check-Value :**

  This field provides a value against which the specified Parameter shall be compared. The Check Value can be a Low Limit, High Limit, or Expected Value. The parameter to be monitored shall be submitted to right alignment and to «bitwise-AND» masking before to be compared against the 16-bit specified Check-Value.

- **Check-Mask :**

  This field provides the bit-masking to be applied (after right alignment) to the parameter to be monitored. The «bit-masking» operation consist in «bitwise-AND» between Check-Mask and the value of the right aligned parameter to be monitored. The result of this operation is here after referred to as : «Masked Parameter Value».

  Examples :

  Ø Parameter-ID referring to an 8-bit parameter with value A5h and a Check-Mask specified to be FF5Ah will give a Masked Parameter Value of 0000h.

  Ø Parameter-ID referring to a 16-bit parameter with value ABCDh and a Check-Mask specified to be F0F0h will give a Masked Parameter Value of A0C0h.

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- Check-Type-ID :

  The Check Type Identifier determines the type monitoring test to be performed on the pair {Masked Parameter Value ; Check Value} and the expected result of the test.

  Ø If Check-Type-ID = 1 the monitoring-test 'Masked Parameter Value equal to Check Value' shall be performed. The expected result of test is «FALSE» (i.e. : parameter value is expected to be not equal to Check Value).

  Ø If Check-Type-ID = 2 the monitoring-test 'Masked Parameter Value larger than Check Value' shall be performed. The expected result of test is «FALSE» (i.e. : parameter value is expected to be smaller or equal to Check Value).

  Ø If Check-Type-ID = 4 the monitoring-test 'Masked Parameter Value smaller than Check Value' shall be performed. The expected result of test is «FALSE» (i.e. : parameter value is expected to be larger or equal to Check Value).

  Ø If Check-Type-ID = 8 the monitoring-test 'Masked Parameter Value not equal to Check Value' shall be performed. The expected result of test is «FALSE» (i.e. : parameter value is expected to be equal to Check Value).

  Ø If Check-Type-ID = 16 the monitoring-test 'Masked Parameter Value larger or equal to Check Value' shall be performed. The expected result of test is «FALSE» (i.e. : parameter value is expected to be smaller than Check Value).

  Ø If Check-Type-ID = 32 the monitoring-test 'Masked Parameter Value smaller or equal to Check Value' shall be performed. The expected result of test is «FALSE» (i.e. : parameter value is expected to be larger than Check Value).

- Event-ID-1 and Event-ID-2 :

  The identifier of the specific Event Report (5,x) that shall be generated, when a transition of the checking status is detected.

  For a given Monitoring-ID, the checking status shall be set to «IN_RANGE» when Parameter-Monitoring-Status is enabled. A checking status transition shall be detected when the monitoring-test gives REP-Number successive results opposite to the current value of checking status.

  Ø If a transition of checking status from «IN_RANGE» to «OUT_OF_RANGE» is detected (this correspond to REP-Number successive «TRUE« results of the specified monitoring-test while checking status = «IN_RANGE»), the Event-Packet identified by Event-ID-1 shall be generated.

  Ø If a transition of checking status from «OUT_OF_RANGE» to «IN_RANGE» is detected (this correspond to REP-Number successive «FALSE« results of the specified monitoring-test while checking status = «OUT_OF_RANGE»), the Event-Packet identified by Event-ID-2 shall be generated.

  With this convention, the issuing of Event-Packet identified by Event-ID-1 will in all cases indicate a transition to non expected result of monitoring-test (i.e. : in a general case, the monitoring-test define an abnormal condition).

  Definition of monitoring Event packets identified by Event-ID-1 and by Event-ID-2 is given in the following.

*

Reference 5855-OBMF

[P:SCI-PT-RS-07360#3.10-OBMF-3. a

[P:SCI-PT-RS-07360#3.10-OBMF-4.

When the CDMS receives this request, it shall add the parameter monitoring information to the Monitoring List, and set the parameter monitoring status according to the value provided in the Monitoring Status field. In case a parameter has already an entry in the Monitoring list with an identical Monitoring Identifier, the values provided with the new Telecommand shall replace the previous values, in order to facilitate a modification.

If an error is detected during the processing of the monitoring information for a given parameter, this parameter is not added to the Monitoring List. This does not affect the processing of the remaining parameters

*

Reference 5856-OBMF

The value of Event-ID-1 and Event-ID-2 specified in a TC(12,5) request shall be higher than 32767 (from 8000h to FFFFh). i.e. : the first bit of Event-ID for monitoring Event shall be 1b.

*

5.12.1.4 TC(12,6) : Deleting parameters from the monitoring list

The request to delete a specified Monitoring activity for a certain parameter from the monitoring list is :

Reference 5860-OBMF

[P:SCI-PT-RS-07360#3.10-OBMF-6.

– Delete Parameter from Monitoring List (12,6)

Telecommand Packet, Application Data :

N	Parameter-ID	Monitoring-ID
Unsigned Integer 16 bits	Enumerated 16 bits	Enumerated 16 bits

<-------------- Repeated N times ----------------->

- N :

  The number of parameters to be removed from the Monitoring List.

- Parameter-ID :

  The identification of a parameter to be monitored.

- Monitoring-ID :

  The Monitoring Identifier associates a certain parameter with a specific Check Definition and with specific Event Packets. If applicable, the action which will be initiated in case of monitoring event is defined on-board by the Event/ Action Service.

  This definition will be cleared from the Monitoring list by this Telecommand (12,6), without affecting other definitions (for the same parameter).

  An error shall be flagged if the TC transmitted Parameter-ID does not match the one defined for the Monitoring-ID present in the list. In such case, the processing of the remaining parameters (i.e. : the other {Parameter-ID ; Monitoring-ID} pairs specified in the TC) is not affected.

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*

Reference 5865-OBMF

[P:SCI-PT-RS-07360#3.10-OBMF-6.

When the CDMS receives this request, it processes each parameter in turn and removes its corresponding monitoring information, if any, from the Monitoring List (the entry becomes free).

If a certain parameter is not in the Monitoring List there shall be no effect on the deletion of the parameters which have an entry in the Monitoring List.

*

5.12.1.5 TC(12,8) : Request for the current monitoring list contents

If there is uncertainty on ground about the current contents and setting of the on-board monitoring list the ground may request a dump of the monitoring list.

The request is :

Reference 5870-OBMF

[P:SCI-PT-RS-07360#3.10-OBMF-9.

– Report Current Monitoring List (12,8)

Telecommand Packet, Application Data : None

When the CDMS receives this request, it issues one or several reports with the current static contents of the Monitoring List (TM packet type (12,9)).

*

5.12.2 Telemetry Packet Data Field Structure :

5.12.2.1 TM(12,9) : Reporting the current monitoring list contents

Reference 5880-OBMF

[P:SCI-PT-RS-07360#3.10-OBMF-9.

– Current Monitoring List Report (12,9)

Telemetry Source Packet, Source Data :

N	Parameter-ID	Monitoring-ID	Parameter-Monitoring Status	Monitoring-Interval	Spare	REP-Number	
Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (16-bit)	Enumerated (8-bit)	Unsigned Integer (16-bit)	8-bit	Enumerated (8-bit)	
	<-------------------------------------- Repeated N times -------------------------------------						

Check-Value	Check-Mask	Check-Type-ID	Event-ID-1	Event-ID-2
Unsigned Integer (16-bit)	Unsigned Integer (16-bit)	Enumerated (8-bit)	Enumerated (16-bit)	Enumerated (16-bit)

-------------------------------- Repeated N times (continue d) --------------------------------

Unit-ID	Unit Status
Enumerated (16-bit)	Enumerated (16-bit)

---- Repeated N times (cnt'd) --->

- **N :**

  The number of parameters from the Monitoring List reported in the current packet.

- **Parameter-ID :**

  The identification of monitored parameter as defined in TC(12,5).

- **Monitoring-ID :**

  The Monitoring Identifier as defined in TC(12,5).

- **Parameter-Monitoring-Status :**

  The Monitoring status for this parameter of the Monitoring List as defined in TC(12,5), TC(12,1) or TC(12,2).

- **Monitoring-Interval :**

  The Monitoring Interval for this parameter of the Monitoring List as defined in TC(12,5).

- **Spare :**

  8 bits, set to zero.

- **REP-Number :**

  The number of successive samples for this parameter of the Monitoring List as defined in TC(12,5).

- **Check-Value :**

  This value against which the specified parameter shall be compared as defined in TC(12,5).

- **Check-Mask :**

  The bit-masking to be applied as defined in TC(12,5).

- **Check-Type-ID :**

  The monitoring test to be performed as defined in TC(12,5).

- **Event-ID-1 and Event-ID-2 :**

  The identifier of Event Report (5,x) that shall be generated as defined in TC(12,5).

- **Unit-ID and Unit Status :**

  The identifier of the unit (and of its status) to which this parameter of the Monitoring List is linked.

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This information is represented as follows :

Unit Status = 1 (OFF) Monitoring Check is performed only if the unit identified by Unit-ID is in OFF state,

Unit Status = 2 (ON) Monitoring Check is performed only if the unit identified by Unit-ID is in OFF state,

Dedicated value of Unit-ID is used for parameter of the Monitoring List that are not linked to any unit.

These parts of the Check Definition are defined by means of dedicated TC of Function Management Service (Service 8).

*

Reference   5885-OBMF a

[P:SCI-PT-RS-07360#3.10-OBMF-9.

The structure and contents of the data field of TM(12,9) shall be the one defined in above figure. All Monitoring Definitions shall be reported. If one TM packet is not large enough a sequence of TM(12,9) packets shall be generated.

At completion of the TC(12,8) request an Event Report TM(5,1) indicating the number of reported TM(12,9) shall be issued.

*

5.12.3 Monitoring Event packets Data Field Structure

When a transition of the checking status is detected for a given Monitoring-ID, the Event-Packet identified by Event-ID-1 or Event-ID-2 in the associated check definition is generated. The contents of these Monitoring Event packets is :

Reference   5886-OBMF

[P:SCI-PT-RS-07360#3.10-OBMF-7. b

When a transition of checking status from «IN_RANGE» to «OUT_OF_RANGE» is detected, the generated Monitoring Event packet shall be an Exception Report, i.e. : Type/subtype = (5,2) identified by Event-ID-1.

*

Reference   5887-OBMF

[P:SCI-PT-RS-07360#3.10-OBMF-7. b

When a transition of checking status from « OUT_OF_RANGE» to «IN_RANGE» is detected, the generated Monitoring Event packet shall be an Event Report, i.e. : Type/subtype = (5,1) identified by Event-ID-2.

*

Reference   5888-OBMF a

[P:SCI-PT-RS-07360#3.10-OBMF-8.

With the objective to give to ground users some element of monitored parameter trend, the contents of Monitoring Event packets shall be :

Telemetry Source Packet, Source Data :

Event-ID	Spare	Monitoring -ID	First-Masked- Parameter- Value	REPth-Masked- Parameter- Value	Check-Value	Event- Sequence -Counter
Enumerated (16-bit)	16-bit	Enumerated (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (16-bit)	Unsigned Integer (16-bit)

- Event-ID :

  The identifier of the Event packet that shall be generated for the detected transition of checking status (i.e. : Event-ID-1 or Event-ID-2 higher than 32767).

- Spare :

  16-bit set to zero corresponding to the SID field of Event reporting Service.

- Monitoring-ID :

  The Monitoring Identifier for which a transition of checking status was detected.

- First-Masked-Parameter-Value :

  The Masked Parameter Value that has caused the first monitoring-test result opposite to the current value of checking status.

- REPth-Masked-Parameter-Value :

  The Masked Parameter Value that has caused the transition of checking status.

- Check -Value :

  The value against which the parameter is compared in the Check definition referred to by the reported Monitoring-ID.

- Event-Sequence-Counter :

  Count of generated Events as defined for Event reporting Service.

\# *

5.13 Service Type 13 : not used

5.14 Service Type 14 : Packet Transmission Control

The Packet Transmission Control Service allows for enabling or disabling :

- The transmission of TM Packets of the addressed Application Process or end-user by controlling the generation of TM packets (buffer management etc.) appropriately.

- The Real Time down-linking and/or SSMM storage from any Application Process or of any Type and Subtype by controlling dedicated CDMU parameters.

Packet Transmission Control Service allows for packet generation disabling during re-definition of an Housekeeping / Diagnostic TM packet. Packet generation enabling is not allowed before completion of Housekeeping / Diagnostic TM packet re-definition.

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\# Reference 5890-PTXC

If a process, function, or task has started, or has been resumed, or changes into a state or mode nominally, in which it starts to generate data of a certain packet type, it shall not be necessary to enable the generation and transmission of that TM packet via this Service 14.

\# *

\# Reference 5900-PTXC

Only in exceptional or contingency cases the Packet Transmission Control Service shall be used to control the generation of TM packets by disabling or enabling certain packet types.

\# *

\# Reference 5910-PTXC

Equivalently, the generation of TM Packets shall stop automatically for nominal status changes equivalent to the ones above (stopping, suspending, etc.).

\# *

\# Reference 5911-PTXC

The Packet Transmission Control Service shall be used autonomously on-board to control the Real Time down-linking of TM packets in case of autonomous spacecraft mode transition causing a modification of available TM bandwidth.

\# *

\# Reference 5912-PTXC

Only in exceptional or contingency cases the Packet Transmission Control Service shall be used to disable the SSMM storage of TM packets.

\# *

5.14.1 Telecommand Packet Data Field Structure :

5.14.1.1 TC(14,1) TC(14,2) : Controlling the generation of specified Telemetry Packets

The requests to enable or disable the generation of telemetry source packets of specified type, sub-type, and structure from the destination Application Process are :

\# Reference 5920-PTXC

[P:SCI-PT-RS-07360#3.11-PTXC-1.

[P:SCI-PT-RS-07360#3.4.1-PERP-7.

– Enable Generation of Telemetry Packets (14,1)

Telecommand Packet, Application data : see Figure below

\# *

Reference 5930-PTXC

[P:SCI-PT-RS-07360#3.11-PTXC-1.

[P:SCI-PT-RS-07360#3.4.1-PERP-7.

– Disable Generation of Telemetry Packets (14,2)

Telecommand Packet, Application data : see Figure below

N	Type	Sub-Type	Packet-ID
Unsigned Integer (16 bits)	Enumerated (8 bits)	Enumerated (8 bits)	Enumerated (16 bits)

<-------------------- Repeated N times ------------------------>

- N :

  The number of TM Packet definitions that follow.

- Type :

  The Telemetry Packet Service Type.

- Sub-Type :

  The Telemetry Packet Service Sub-Type for the specified Service Type

- Packet-ID :

  The Packet –Identifier allows to identify specific groups of TM-packets within a certain Type/Subtype.

  Ø If all TM Packets belonging to a certain Type/Subtype shall be enabled /disabled, the Packet-ID is set to 65535 (FFFF$_{HEX}$).

  Ø For the HK & Diagnostic Service 3 the Packet-ID shall be equal to the HK Packet ID defined for that Service.

  Ø For the Event Reporting Service 5 the Packet-ID shall be equal to the Event ID defined for that Service.

  Ø For the Scientific Data Service 21 the Packet-ID shall be equal to the Structure ID defined for that Service.

*

5.14.1.2 TC(14,3) : Requesting the list of enabled Telemetry Packets

The request to report the list of telemetry packet types and sub-types from the Application Process with an "Enabled" generation status is :

Reference 5940-PTXC

[P:SCI-PT-RS-07360#3.11-PTXC-2.

– Report Enabled Telemetry Packets (14,3)

Telecommand Packet, Application Data : None

When this request is received, the enabled telemetry source packet of the addressed Application Process are determined and a report (14,4) is generated.

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*

Reference 5941-PTXC

deleted

*

5.14.1.3 TC(14,5) : Controlling the Real Time down-linking and/or SSMM storage of specified Telemetry Packets

The CDMS request to enable or disable the Real Time down-linking and/or SSMM storage of a specified Application Process or of a specified Type and Subtype is :

Reference 5945-PTXC

[P:SCI-PT-RS-07360#3.11-PTXC-1.

– Select Down-linking / Storage of Telemetry Packets (14,5)

Telecommand Packet, Application data : see Figure below

N	Application ID	Type	Sub-Type	Transmit flag	Storage flag
Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (8-bit)	Enumerated (8-bit)	Enumerated (8-bit)	Enumerated (8-bit)

<------------------------------ Repeated N times -------------------------------->

- N

  The number of TM packet definition that follow.

- Application ID

  The identifier of Application Process from which TM packets Real Time down-linking and/or SSMM storage shall be Enabled/Disabled.

- Type

  The TM packets Type which Real Time down-linking and/or SSMM storage shall be Enabled/Disabled.

- Sub-Type

  The TM packets Sub-Type which Real Time down-linking and/or SSMM storage shall be Enabled/Disabled.

- Transmit flag

  This field can take two values and indicate if TM packets identified by preceding {Application ID ; Type ; Sub-Type} down-linking is to be Enabled (when Transmit flag has the value : Enabled) or Disabled (when Transmit flag has the value : Disabled).

  Ø Value = 0 (Disabled)

  Ø Value = 1 (Enabled).

- Storage flag

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This field can take two values and indicate if TM packets identified by preceding {Application ID ; Type ; Sub-Type} SSMM storage is to be Enabled (when Storage flag has the value : Enabled) or Disabled (when Storage flag has the value : Disabled).

Ø   Value = 0 (Disabled)

Ø   Value = 1 (Enabled).

The {Application ID ; Type ; Sub-Type} set identifies the TM packets to which the Real Time down-linking and/or SSMM storage control shall be applied as follows :

Ø   If Application ID > 0, Real Time down-linking and/or SSMM storage of all TM packets carrying the selected Application ID shall be Enabled/Disabled according to the Transmit flag and Storage flag values.

Ø   If Application ID = 0 and Type > 0 (then Sub-Type shall be > 0), Real Time down-linking and/or SSMM storage of all TM packets carrying the selected {Type ; Sub-Type} shall be Enabled/Disabled according to the Transmit flag and Storage flag values.

Ø   If Application ID = 0 and Type = 0, Real Time down-linking and/or SSMM storage of all TM packets shall be Enabled/Disabled according to Transmit flag and Storage flag values.

*

Reference   5946-PTXC

deleted

*

Reference   5947-PTXC

[P:SCI-PT-RS-07360#3.11-PTXC-1.

When CDMS receives this request, the dedicated parameters update and Real Time down-linking and/or SSMM storage shall be performed according to received flags.

*

5.14.1.4 TC(14,6) : Requesting the Telemetry Packets Real Time down-linking and SSMM storage status

The request to report the list of telemetry packets real time down-linking and SSMM storage status is :

Reference   5948-PTXC

[P:SCI-PT-RS-07360#3.11-PTXC-2.

–   Report Telemetry Packets Down-linking / Storage status (14,6)

Telecommand Packet, Application Data : None

When CDMS receives this request, the real time down-linking and SSMM storage status are determined for all telemetry packet {Application ID ; Type ; Sub-Type} and a report (14,7) is generated.

*

5.14.2 Telemetry Packet Data Field Structure :

5.14.2.1 TM(14,4) : Reporting the list of enabled Telemetry Packets

\# Reference   5950-PTXC

[P:SCI-PT-RS-07360#3.11-PTXC-2.

– TM Packet Generation Status Report (14,4)

Telemetry Source Packet, Source Data :

N	Type	Sub-Type	Packet-ID
Unsigned Integer (16 bits)	Enumerated (8 bits)	Unsigned Integer (8 bits)	Enumerated (16 bits)

<------------------- Repeated N times -------------------->

- N :

  The number of TM Packet definitions that follow.

- Type :

  The Telemetry Packet Service Type.

- Sub-Type :

  The Telemetry Packet Service Sub-Type for the specified Service Type.

- Packet-ID :

  The Packet –Identifier allows to identify specific groups of TM-packets within a certain Type/Subtype.

  Ø -If the structure of a certain TM-packet is fixed for all applications, the Packet Identifier field is set to Zero.

  Ø If all TM Packets belonging to a certain Type/Subtype shall be enabled /disabled, the Packet-ID is set to Zero.

  Ø For the HK & Diagnostic Service 3 the Packet-ID shall be equal to the HK Packet ID defined for that Service.

  Ø For the Event Reporting Service 5 the Packet-ID shall be equal to the Event ID defined for that Service.

  Ø For the Scientific Data Service 21 the Packet-ID shall be equal to the Structure ID defined for that Service.

\#   *

\# Reference   5951-PTXC

deleted

\#   *

5.14.2.2 TM(14,7) : Reporting the Telemetry Packets Real Time down-linking and SSMM storage status

Reference 5955-PTXC

[P:SCI-PT-RS-07360#3.11-PTXC-2.

– Telemetry Packets Down-linking / Storage status Report (14,7)

Telemetry Source Packet, Source Data :

The structure and contents of the data field of TM(14,7) shall be identical to TC(14,5). Down-linking and Storage status shall be reported for all telemetry packet {Application ID ; Type ; Sub-Type}.

*

5.15 Service Type 15 : On-board Storage and Retrieval

The On-board Storage and Retrieval Service works in support of the Solid State Mass Memory and Non-volatile Memory, which are in charge of storing all TM data (at any time) in several Packet Stores. These recorded TM packets can be transmitted to ground in parallel with real-time data during (daily) periods of contact with a ground station. The functions of the Service 15 are executed by the unit in charge controlling the involved memories i.e. the CDMS.

The selective storing and retrieval of TM packets can be controlled on-board according to a few basic criteria (which are long-term static during nominal operation). Detailed data extraction and ordering shall be done on ground. As all TM packets are time-stamped and uniquely identified by several other means they need not to be re-formatted during the process of storing and retrieval.

Packet Stores can be defined to be circular or linear with an upper bound. For Packet Stores that are organised as circular buffers, nominal periodic clearing of the «oldest» part of a Store is not needed. In all cases data are recorded in the sequence as they arrive at or are released by the CDMS.

Type (circular or linear) of a Packet Store as well as the Virtual channel through which its content will be downlinked will be defined when the Packet Store is allocated in Solid State Mass Memory (Virtual Channel and Store Type of a Packet Store will be associated to its Store-ID). TM and TC packets to control the Mass Memory allocation of a packet store are defined at CDMS level and are part of Service 8.

Reference 5960-OBSR

If certain TM packet Types/Subtypes are not required to be downlinked for a certain period of time, this shall be controlled by using the capabilities of Service 14 at the sources of packet generation.

*

Reference 5965-OBSR

All TM packets that are generated on-board shall be available for downlinking, and shall be downlinked under nominal conditions unless their downlinking and/or storage as specifically been disabled using capabilities of Service 14.

*

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5.15.1 Telecommand Packet Data Field Structure :

5.15.1.1 TC(15,1) TC(15,2) : Controlling the storage in specified packet stores

The requests are :

Reference 5970-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-8.

[P:SCI-PT-RS-07360#3.12-OBSR-2.1

[P:SCI-PT-RS-07360#3.12-OBSR-3. a

– Enable Storage in Packet Stores (15,1)

Telecommand Packet, Application Data : see Figure below

*

Reference 5980-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-8.

[P:SCI-PT-RS-07360#3.12-OBSR-2.1

– Disable Storage in Packet Stores (15,2)

Telecommand Packet, Application data : see Figure below

N	Store-ID	Spare
Unsigned Integer (16-bit)	Enumerated (8-bit)	8-bit

<---------------------- Repeated N times --------------------->

- N :

  The number of packet stores to be controlled. By convention, N = 0 means "all Packet Stores". In this case all Packet Stores shall be en-/disabled according to their last, or default assignment to a Store Type.

- Store-ID :

  An on-board Packet Store is uniquely identified by a "Store-ID". Its characteristics are defined when Packet Store is allocated in Solid State Mass Memory.

- Spare :

  8 bits, set to zero.

*

Reference 5985-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-2.1

When the CDMS receives this request, it starts or stops (depending on whether it is an "enable" or "disable" request) sending the relevant packets to the specified Packet Stores.

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\# *

5.15.1.2 TC(15,3) TC(15,4) : Modifying the definition of a storage selection criterion

The storage selection definition used by CDMS to send packets for storage in a given Packet Store consists of the identification of the Application Identifier, Type and Subtype of the relevant packets. It is possible to add definitions to (or remove from) a set of storage selection definitions.

The requests to modify the storage selection definition for a specified Packet Store are :

\#   Reference   5990-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-2.1

[P:SCI-PT-RS-07360#3.12-OBSR-3. a

– Add Packet Definitions to Storage Selection Definition (15,3)

Telecommand Packet, Application Data : see Figure below

\# *

\#   Reference   6000-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-2.1

– Remove Packet Definitions from Storage Selection Definition (15,4)

Telecommand Packet, Application Data : see Figure below

Store-ID	Spare	N1	Application Process ID	Type	N2	Sub-Type	Spare
Enumerated (8-bit)	(8-bit)	Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (8-bit)	Unsigned Integer (16-bit)	Enumerated (8-bit)	(8-bit)
						Repeated N2 times	Optional
			<------------------Repeated N1 times------------------>				

- Store-ID :

  The identifier of the Packet Store in which TM packets are stored.

- Spare :

  8 bits, set to zero.

- N1 :

  The number of TM packet APIDs in the Packet Store Storage Selection Definition that follows.

- APID :

  The identifier of the unit/application for which TM packets are stored.

- Type :

  A Telemetry source packet Type.

- N2 :

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The number of Subtype definition that follows.

- Sub-Type :

  A Telemetry packet Subtype of the specified Type.

  When the CDMS receives this request :

  Ø   if N1 = 0 and Add, TC(15,3), was commanded, all types of TM packets from all Application Processes, which are generated on-board, are to be stored in the specified Packet Store ;

  Ø   if N1 = 0 and Remove, TC(15,4), was commanded, the storing list for the specified Packet Store is cleared completely ;

  Ø   if N1 > 0 and N2 = 0, the specified Type of Telemetry packet from the Application Process, covering all Subtypes, is added to (if not yet present), or removed from, the list of stored packets of the specified Packet Store (depending on the type of request) ;

  Ø   if N1 > 0 and N2 > 0, the specified Subtypes of Telemetry packets from the Application Process are added to, or removed from, the list of stored packets of the specified Packet Store (depending on the type of request).

  Note that if N1 > 1 then there may be a mixture of empty (N2 = 0) and non-empty arrays (N2 > 0).

  The current content of the Packet Store is not affected by the request and, if storage is enabled, packets start or stop to be appended to the Packet Store immediately after the command is executed.

- Spare :

  8 bits, set to zero. An optional spare octet (set to zero) will be added to TC(15,3) and to TC(15,4) application data to fulfil the TC packets 16-bit alignment requirement.

*

5.15.1.3 TC(15,5) : Reporting a storage selection definition

The request is :

Reference   6010-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-6.

−   Report Storage Selection Definition (15,5)

    Telecommand Packet, Application Data :

Store ID	Spare
Enumerated	
8 bits	8 bits

- Store ID :

  The identifier of the Packet Store for which a report is requested.

- Spare :

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8 bits, set to zero.

When this request is received by the CDMS, the storage selection definition for the specified Packet Store is read and a report (15,6) is generated.

*

5.15.1.4 TC(15,7) : Downlinking the contents of a packet store (for a selected packet subset)

This Telecommand serves for actually starting the downlinking of stored TM packets. The retrieval and downlinking is controllable in four different ways with this command :

−   downlinking the entire contents of a selected Packet Store for a default (relative) time period, or a previously commanded period of time.

−   downlinking a selected subset of a selected Packet Store for a default (relative) time period, or a previously commanded period of time.

Reference   6020-OBSR

If no Telecommand (15,9) with a new downlink time period has been sent to the S/C after a previous retrieval session, the default downlink period shall start at the previous end time of the addressed Packet Store, and last to the time of reception of the TC(15,7) under execution.

*

Reference   6030-OBSR

If a TM packet subset selection is commanded, this selection shall only be effective until the requested downlinking session has finished. The default condition for the subset selection shall be that all data, that are stored in a Packet Store, are downlinked later on.

*

The request is :

Reference   6040-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-5.

−   Downlink Packet Store Contents (15,7)

Telecommand Packet, Application Data :

Store ID	Spare	N1	Application ID	Type	N2	Sub-Type	Spare
Enumerated (8 bit)	(8-bit)	Unsigned Integer (16-bit)	Enumerated (16 bit)	Enumerated (8-bit)	Unsigned Integer (16 bit)	Enumerated (8-bit)	(8-bit)
						Repeated N2 times	Optional
			<-------------------- Repeated N1 times -------------------->				

•   Store ID :

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The identifier of the Packet Store from which TM packets are to be downlinked.

- N1 :

  The number of TM packet APIDs in the Packet Store downlinking request that follows.

  Ø if N1 = 0 (default), all stored TM packets for the specified Packet Store is downlinked completely, taking into consideration a previously specified Time Period TC(15,9), or a default time setting ;

  Ø if N1 > 0, the specified Types/Subtypes of Telemetry packets from the specified Application Processes shall be downlinked, taking into consideration a previously specified Time Period TC(15,9), or a default time setting.

- APID :

  The identifier of the unit/application for which TM packets are downlinked.

- Type :

  The associated Telemetry source packet Type.

- N2 :

  The number of Subtype definition that follows.

- Sub-Type :

  The associated Telemetry packet Subtype of the specified Type.

- Spare :

  8 bits, set to zero. An optional spare octet (set to zero) will be added to TC(15,7) application data to fulfil the TC packets 16-bit alignment requirement.

*

Reference 6045-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-5.

When this request is received by the CDMS, the contents of the specified Packet Store matching with the specified packet subset is downlinked.

If a certain TM packet definition has no matching entry in the list of stored TM packets for the addressed Packet Store, it shall be ignored and the downlinking of the rest of the data shall be unaffected.

*

5.15.1.5 TC(15,9) : Downlinking the contents of a packet store for a specified time period

The request is :

Reference 6050-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-5.

– Specify Downlink Time Period (15,9)

  Telecommand Packet, Application Data :

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Store ID	Spare	Time Span	Storage Time 1	Storage Time 2
Enumerated		Enumerated	Absolute Time	Absolute Time
8 bits	8 bits	16 bits	48 bits	48 bits
			<---- Optional ----->	<----- Optional ----->

- Store ID :

  The identifier of the Packet Store from which TM packets are to be downlinked.

- Time Span :

  This indicates how the packet range is specified. If Time Span is "All" (value = 0), the full contents of the Packet Store are to be downlinked, otherwise it is the set of packets whose storage times are :

  Ø between Storage Time 1 and Storage Time 2 inclusive, if Time Span is Between" (value = 1) ;

  Ø less than or equal to Storage Time 1 if Time Span is "Before" (value = 2) ;

  Ø greater than or equal to Storage Time 1 if Time Span is "After" (value = 3).

- Storage Time 1, Storage Time 2 :

  The absolute time(s) defining the boundary(ies) of the range of packets to be downlinked. Storage Time 1 is present if Time Span is not "All". Storage Time 2 is present if Time Span is "Between".

*

Reference   6055-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-5.

When this request is received by the CDMS, the time period for the next packet retrieval from Packet Stores shall be set (different from the default setting). When the downlinking is actually started by executing a Telecommand (15,7) the CDMS downlinks the contents of the specified Packet Store falling within the specified time period. Whatever the value of Time Span, the retrieval ends at the latest when the last packet stored at the time of reception of the request has been downlinked.

After completion of execution of the packet retrieval the downlink time period shall be set to its default values, i.e. the next packet retrieval starts where the last retrieval has ended.

*

5.15.1.6 TC(15,11) : Deleting the contents of specified packet stores up to a specified storage time

The request is :

Reference   6060-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-9. b

– Delete Packet Stores Contents up to Specified Storage Time (15,11)

  Telecommand Packet, Application Data :

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End Time	N	Store ID	Spare
Absolute Time (48-bit)	Unsigned Integer (16-bit)	Enumerated (8-bit)	(8-bit)

<------------- Repeated N times ----------->

- End Time :

   The absolute time defining the upper boundary (inclusive) of the packet range to be deleted.

- N :

   The parameter defines the number of Packet Stores. By convention, N = 0 means "All Packet Stores".

- Store ID :

   The identifier of the Packet Store from which TM packets are to be deleted.

- Spare :

   8 bits, set to zero.

*

Reference 6065-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-9. b

[P:SCI-PT-RS-07360#3.12-OBSR-10. a

When this request is received by the CDMS, the packets in the specified Packet Stores (all Packet Stores if N = 0), which have a storage time earlier than or equal to the specified time, are deleted. The deletion ends at the latest when the last packets stored at the time of reception of the request have been deleted.

While deletion from a Packet Store is in progress, the storage operation of arriving packets shall not be interrupted.

*

5.15.1.7 TC(15,12) : Reporting packet store catalogues

The request to report the catalogue of selected Packet Store is :

Reference 6070-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-7. b

– Report Catalogue for Selected Packet Store (15,12)

   Telecommand Packet, Application Data :

Store ID	Spare
Enumerated (8-bit)	(8-bit)

- Store ID :

The identifier of the Packet Store for which a catalogue report is to be generated.

- Spare :

  8 bits, set to zero.

When this request is received by the CDMS, the catalogue for the specified Packet Store is reported with TM(15,13).

\#   *

5.15.2 Telemetry Packet Data Field Structure :

As TM packets, that are retrieved from the Packet Stores, are downlinked to ground without any further modification via one or several dedicated Virtual Channels, there is no need for the definition of an encapsulating TM packet, which belongs to Service 15.

The CDMS has no control over the TM packets that are actually generated by other units/applications (and then stored in one of the Packet Stores). This process may be non-continuous for certain TM packet Types. Therefore only setup parameters and global parameters about Packet Store utilisation are reported.

5.15.2.1 TM(15,6) : Reporting the Storage Selection Definition

The format of this report is :

\#   Reference   6080-OBSR a

[P:SCI-PT-RS-07360#3.12-OBSR-6.

– Storage Selection Definition Report (15,6)

Telemetry Source Packet, Source Data :

Store-ID	Store-Type	Storage Status	Spare	Virtual-Channel
Enumerated (8-bit)	Enumerated (1-bit)	Enumerated (1-bit)	(3-bit)	Enumerated (3-bit)

N1	Application Process ID	Type	N2	Sub-Type	Spare
Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (8-bit)	Unsigned Integer (16-bit)	Enumerated (8-bit)	(8-bit)
				Repeated N2 times	Optional

<------------------------Repeated N1 times----------------------- >

- Store ID :

  The identifier of the Packet Store for which a report is generated.

- Store-Type :

  The Store Type parameter determines whether the associated buffer is cyclic or bounded, linear (Stop at End).

  Ø   Store Type = Zero : cyclic buffer,

  Ø   Store Type = One : linear bounded buffer

  Store Type of a Packet Store is connected to its Store-ID at packet store allocation using the CDMS dedicated Service 8 function.

- Storage Status :

  Ø   Storage Status = Zero : enabled,

  Ø   Storage Status = One : disabled.

  Storage Status is controlled by TC(15,1) and TC(15,2).

- Spare :

  3 bits, set to zero.

- Virtual Channel :

  Virtual channel through which the Packet Store contents will be downlinked.

  Virtual Channel of a Packet Store is connected to its Store-ID at packet store allocation using the CDMS dedicated Service 8 function.

- N1 :

  The number of TM packet APIDs in the Packet Store Storage Selection Definition that follows.

- APID :

  The identifier of the unit/application for which TM packets are stored.

- Type :

  The Telemetry source packet Type which is stored for the specified APID.

- N2 :

  The number of Subtype definition that follows.

- Sub-Type :

  A Telemetry packet Subtype of the specified Type

- Spare :

  8 bits, set to zero. An optional spare octet (set to zero) will be included into TM(15,6) source data to fulfil the TM packets 16-bit alignment requirement.

*

5.15.2.2 TM(15,13) : Reporting the Packet Store Catalogue, (15,13)

The format of this report is :

Reference   6090-OBSR

[P:SCI-PT-RS-07360#3.12-OBSR-7. b

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– Packet Store Catalogue Report (15,13)

Telemetry Source Packet, Source Data :

Store ID	Store Type	First Pointer	Downlink Pointer	Current Pointer	Downlink End Pointer	Write Pointer
Enumerated (8-bit)	Enumerated (8-bit)	Unsigned Integer (32-bit)	Unsigned Integer (32-bit)	Unsigned Integer (32-bit)	Unsigned Integer (32-bit)	Unsigned Integer (32-bit)

First Coarse-Time	Downlink Coarse-Time	Current Coarse-Time	Downlink End Coarse-Time	Last Write Coarse-Time
Unsigned Integer (32-bit)	Unsigned Integer (32-bit)	Unsigned Integer (32-bit)	Unsigned Integer (32-bit)	Unsigned Integer (32-bit)

Start address	End address
Unsigned Integer (32-bit)	Unsigned Integer (32-bit)

- Store ID :

  The identifier of the Packet Store for which the catalogue report is generated.

- Store Type :

  The Store Type parameter determines whether the associated buffer is cyclic or bounded, linear (Stop at End).

  Ø   Store Type = Zero : cyclic buffer,

  Ø   Store Type = One : linear bounded buffer

  Store Type of a Packet Store is connected to its Store-ID at packet store allocation using the CDMS dedicated Service 8 function.

- First Pointer :

  The SSMM logical address pointed by the "First Pointer". The first byte of the "oldest" packet in this Packet Store is stored at this address. Lower addresses of this Packet Store typically correspond to locations where packets that have been previously deleted (or overwritten in case of cyclic Packet Store) were stored.

- Downlink Pointer :

  The SSMM logical address pointed by the "Downlink Pointer". The first byte of the "oldest" packet to be downlinked on receipt of proper TC(15,7) or TM(15,9),or of the current downlinking, is stored at this address.

- Current Pointer :

  The SSMM logical address pointed by the "Current Pointer". The first byte of the next packet to be downlinked in the current downlinking, is stored at this address. If no downlinking is in progress, this address is identical to the one pointed by Downlink Pointer.

- Downlink End Pointer :

  The SSMM logical address pointed by the "Downlink End Pointer". The last byte of the last packet to be downlinked in the current downlinking, is stored at this address.

- Write Pointer :

  The SSMM logical address pointed by the "Write Pointer". The first byte of the next incoming packet for storage in this Packet Store, will be stored at this address.

- First Coarse-Time (in second) :

  The storage time of packet pointed by First Pointer.

- Downlink Coarse-Time (in second) :

  The storage time of packet pointed by Downlink Pointer.

- Current Coarse-Time (in second) :

  The storage time of packet pointed by Current Pointer.

- Downlink End Coarse-Time (in second) :

  The storage time of packet pointed by Downlink End Pointer.

- Last Write Coarse-Time (in second) :

  The storage time of the last packet stored in this Packet Store.

- Start address :

  Logical address (in SSMM) of Packet Store lower boundary. This start address is defined, using the CDMS dedicated Service 8 function, at packet store allocation time.

- End address :

  Logical address (in SSMM) of Packet Store upper boundary. This end address is defined, using the CDMS dedicated Service 8 function, at packet store allocation time.

*

5.16 Service Type 16 : On-board Traffic Management :

For the TM / TC Packet Service 16 no specific packet data structures are defined.

Reference   6095-OBTM

[P:SCI-PT-RS-07360#3.13-OTFM-3. a

[P:SCI-PT-RS-07360#3.13-OTFM-4.

The CDMS shall generate the appropriate Event Packets in order to report anomalies of the TM / TC Packet routing and distribution functions. Control over the generation and transmission of individual packets is executed by utilising Service 14.

*

5.17 Service Type 17 : Test Service

A generic test for all on-board users is an end-to-end "connection test" between the ground/ CDMS and the Application Process.

The function exercised by this Test Service Request is the generation of a corresponding one-shot Service Report by the Application Process. The reception on the ground of the Service Report will serve to confirm that the routes (uplink and downlink) between itself and the Application Process are operational and that the Application Process itself is performing a minimum set of functions (which includes Telecommand processing).

5.17.1 TC(17,1) : Telecommand Packet Data Field Structure :

Reference 6100-FTS

[P:SCI-PT-RS-07360#3.14-FTS-3.

[P:SCI-PT-RS-07360#3.14-FTS-1.

The request to perform an end-to-end connection test is :

- Perform Connection Test (17,1)

    Telecommand Packet, Application Data :   None

*

5.17.2 TC(17,2) : Telemetry Packet Data Field Structure :

Reference 6110-FTS

[P:SCI-PT-RS-07360#3.14-FTS-1.

On successful receipt of a Telecommand of type TC(17,1), the Application shall respond with a nominal Successful Command Acceptance report, TM(1,1), and then with a Link Connection Report, TM(17,2).

*

Reference 6120-FTS

deleted

*

On unsuccessful receipt of a Telecommand of type TC(17,1), the Application will respond with a Failure Command Acceptance Report, TM(1,2).

Reference 6130-FTS

[P:SCI-PT-RS-07360#3.14-FTS-1.

- Link Connection Report (17,2)

    Telemetry source packet, source data :   None.

*

5.18 Service Type 18 : On-board Control Procedures

On-Board Control Procedures (OBCPs) are flight procedures, which are resident on-board of the Herschel or Planck satellite. After activation they are interpreted and executed in the on-board system, e.g. the CDMS, the ACC, and potentially other intelligent on-board users, like instrument control units. They serve for controlling processes, which may be active for an extended period of time and which may involve the (conditional)

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execution of a (longer) sequence of commands. These on-board Telecommands may affect one or several application processes or functions. More than one on-board unit may be involved.

Reference 6135-CPM a

The TC-Packets released by an OBCP during execution carry a Sequence Count and a CRC-field, which must be incremented or modified each time this TC is released in order to represent the actual TC-Sequence Count.

When these TCs are reported in TM(1,9) the last values (i.e. : the one they had at release time) of Sequence Count and CRC-field shall be reported.

*

In order to retain predictable and robust behaviour of the spacecraft and its systems the number of OBCPs shall be kept to a minimum, and the internal structure of each OBCP must be kept simple.

Reference 6140-CPM

OBCPs have to comply with the same requirements on structure, syntax, operability, and maintainability. Further details are specified via the Herschel/ Planck OIRD, AD 3, and the Herschel/ Planck CDMU ASW Requirement Spec, RD-6.

*

Reference 6145-CPM

Each OBCP residing on-board shall be identified by an unique «Procedure ID» within [1, 65535].

If the procedure ID is set to 0 (zero) in TC(18,4) : Stop Procedure, all on-board procedure shall be stopped.

*

5.18.1 Telecommand Packet Data Field Structure :

5.18.1.1 TC(18,1) : Loading a procedure

The request is :

Reference 6150-CPM a

[P:SCI-PT-RS-07360#2.2.5-OBCP-1.

[P:SCI-PT-RS-07360#3.15-CPM-1. a

– Load Procedure (18,1)

Telecommand Packet, Application Data :

Procedure ID	Segment-ID	N	Procedure Code	Spare
Enumerated (16-bit)	Unsigned Integer (8-bit)	Unsigned Integer (8-bit)	Fixed length OctetString (8-bit)	(8-bit)

< - Repeated N times - > < - Optional - >

• Procedure ID :

The unique identification of the On-Board Control Procedure that is being loaded.

- Segment-Identifier :

  As a new OBCP may contain more code than can be loaded with a single TC-packet, it has to be loaded by a sequence of TC-packets, each of them identified by a unique Segment-Identifier and carrying a segment of the overall OBCP code.

  If the to be loaded OBCP is divided into K Segments, the Segment-ID shall always start with 1, and be incremented one by one up to K for the last segment of the new OBCP (allowed range : 1 to 254). After transmission of K Telecommands a TC(18,1) shall be sent with Segment-ID set to FFhex.

  If a new OBCP is loaded with a single TC-packet only, the Segment-ID shall be set to zero.

- N :

  The length (in octets) of the loaded part of procedure code that follows. With each TC(18,1) a maximum of 232 octets can be loaded for the definition of a new OBCP. Maximal value of N is therefore 232.

- Procedure Code :

  The part of code of the procedure (in increasing order of octet) to be loaded.

- Spare :

  8 bits, set to zero.

  This spare octet will be inserted, to fulfil the packet 16-bit alignment requirement, when the loaded part of procedure code is an odd number of octets.

*

Reference 6155-CPM a

[P:SCI-PT-RS-07360#3.15-CPM-1. a

When this request is received, the addressed unit shall store the procedure code, and updates its list of loaded on-board procedures accordingly. If the Procedure ID is the same as a procedure currently in the list, the TC shall be rejected. The status of the loaded procedure is set to «stopped».

After a completed (Re-)Load a Confirmation of Execution (1,7) shall be generated, or a TM(1,8) in case of a failure.

*

5.18.1.2 TC(18,2) : Deleting a procedure

The request is :

Reference 6160-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

[P:SCI-PT-RS-07360#2.2.5-OBCP-1.

- Delete Procedure (18,2)

  Telecommand Packet, Application Data :

Procedure ID
Enumerated
16 bits

*

Reference 6165-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

When this request is received, the specified on-board procedure is deleted from the list of loaded on-board procedures and the area occupied by the procedure code is cleared.

The request is ignored if the procedure status is "active" or «suspended».

*

5.18.1.3 TC(18,3) : Starting a procedure

The request is :

Reference 6170-CPM

[P:SCI-PT-RS-07360#2.2.5-OBCP-1.

[P:SCI-PT-RS-07360#3.15-CPM-1. a

[P:SCI-PT-RS-07360#3.13-OTFM-7.

– Start Procedure (18,3)

Telecommand Packet, Application Data :

Procedure-ID	N1	OBCP-PID	Value	N2	OBCP-PID	Value
Enumerated (16-bit)	Unsigned Integer (16-bit)	Enumerated (16-bit)	Any (32-bit)	Unsigned Integer (16-bit)	Enumerated (16-bit)	Any (64-bit)
		<--- Repeated N1 times --->			<---- Repeated N2 times --->	
					<--------------- Optional ----------------->	

- Procedure-ID :

    The unique identification of the On-Board Control Procedure that is stared.

- N1 :

    The number of couplets of OBCP parameter identifiers (OBCP-PID) and 32-bit long OBCP parameter values which follow. If N1 = zero, no 32-bit long OBCP parameter is sent together with the Start-Telecommand.

- N2 :

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The number of couplets of OBCP parameter identifiers (OBCP-PID) and 64-bit long OBCP parameter values which follow. If no 64-bit long OBCP parameter is sent together with the Start-Telecommand, N2 can be omitted or set to zero.

- OBCP-PID :

  The identification of the parameter whose value follows.

- Value :

  The value of the corresponding parameter.

  Any of the types (conforming to length – either 32-bit or 64-bit – defined for OBCP parameter) defined in Appendix A.6 can be used in TC packet. The addressed on-board processor shall interpret the loaded value as an octet string – either 4-octet or 8-octet –.

*

Reference 6175-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

[P:SCI-PT-RS-07360#3.13-OTFM-7.

When this request is received, the specified on-board procedure is started using (or passing) the specified activation parameters. The procedure status is then «active». The parameters are used to configure the specific instance of execution of an on-board procedure.

The request is ignored if the status of the procedure was "active" or «suspended».

The verification of execution of this «start procedure» request must be reported by using the standard reports of the Telecommand Verification Service (Type 1). For the reporting of the progress of execution of the procedure TC Verification packets or Event packets may be involved.

*

5.18.1.4 TC(18,4) : Stopping a procedure

The request is :

Reference 6180-CPM

[P:SCI-PT-RS-07360#3.13-OTFM-7.

[P:SCI-PT-RS-07360#2.2.5-OBCP-1.

[P:SCI-PT-RS-07360#3.15-CPM-1. a

– Stop Procedure (18,4)

  Telecommand Packet, Application Data :

Procedure ID
Enumerated
16 bits

*

\# Reference 6185-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

When this request is received, the specified on-board procedure is stopped. The procedure status is then "stopped".

The request is ignored if the procedure already has the "stopped" status.

\# *

5.18.1.5 TC(18,5) : Suspend a procedure

The request is :

\# Reference 6190-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

[P:SCI-PT-RS-07360#2.2.5-OBCP-1.

– Suspend Procedure (18,5)

Telecommand Packet, Application Data :

Procedure ID	Step ID
Enumerated 16 bits	Enumerated 16 bits
	Optional

- Procedure ID :

  The unique identification of the On-Board Control Procedure that is being suspended.

- Step ID :

  The Step ID indicates a user-specific step at the completion of which the procedure shall be suspended.

  If Step ID = 0 or absent, the addressed OBCP shall be suspended immediately.

\# *

\# Reference 6195-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

When this request is received, the specified on-board procedure is suspended at the completion of the indicated step. The procedure status is then "suspended".

If the OBCP does not enter the «suspended» state (after a specific period of time) an error message shall be generated.

The request is ignored if the procedure status was "stopped" or «suspended».

\# *

5.18.1.6 TC(18,6) : Resume a procedure

The request is :

Reference 6200-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

[P:SCI-PT-RS-07360#2.2.5-OBCP-1.

– Resume Procedure (18,6)

Telecommand Packet, Application Data :

Procedure ID
Enumerated
16 bits

*

Reference 6205-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

When this request is received, the specified on-board procedure is resumed after the step where it was previously suspended. The procedure status is then "active".

The request is ignored if the procedure status was "stopped" or «active».

*

5.18.1.7 TC(18,7) : Communicate parameters to a procedure

When this request is received, new parameter values are handed over to the OBCP, which replace previous or default values of parameters. The status of the OBCP is unchanged. If a certain OBCP does not need to be provided with new parameter values, TC(18,7) can be omitted.

Reference 6210-CPM

[P:SCI-PT-RS-07360#3.15-CPM-2.

If the status of an OBCP is «active» it shall be possible to load parameters by executing TC(18,7), and have them accepted immediately without changing the status.

*

Reference 6220-CPM

[P:SCI-PT-RS-07360#3.15-CPM-2.

If the status of the OBCP is «stopped» or «suspended», the new parameter values shall be stored. In a second step, the reception of a Start OBCP TC(18.3), or Resume OBCP TC(18,6) Telecommand, these parameters shall replace any old or default parameter values, and the status of the OBCP shall change to «active».

*

The request is :

Reference 6230-CPM

[P:SCI-PT-RS-07360#3.15-CPM-2.

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[P:SCI-PT-RS-07360#2.2.5-OBCP-1.

– Communicate Parameters to a Procedure (18,7)

Telecommand Packet, Application Data :

Procedure-ID	N1	OBCP-PID	Value	N2	OBCP-PID	Value
Enumerated (16-bit)	Unsigned Integer (16-bit)	Enumerated (16-bit)	Any (32-bit)	Unsigned Integer (16-bit)	Enumerated (16-bit)	Any (64-bit)

<--- Repeated N 1 times --->   <---- Repeated N2 times --->

<-------------- Optional -------------->

- Procedure-ID :

    The unique identification of the On-Board Control Procedure for which parameters are being loaded.

- N1 :

    The number of couplets of OBCP parameter identifiers (OBCP-PID) and 32-bit long OBCP parameter values which follow. If N1 = zero, no 32-bit long OBCP parameter is sent together with the Communicate Parameters Telecommand.

- N2 :

    The number of couplets of OBCP parameter identifiers (OBCP-PID) and 64-bit long OBCP parameter values which follow. If no 64-bit long OBCP parameter is sent together with the Communicate Parameters Telecommand, N2 can be omitted or set to zero.

- OBCP-PID :

    The identification of the parameter whose value follows.

- Value :

    The value of the corresponding parameter.

    Any of the types (conforming to length – either 32-bit or 64-bit – defined for OBCP parameter) defined in Appendix A.6 can be used in TC packet. The addressed on-board processor shall interpret the loaded value as an octet string – either 4-octet or 8-octet –.

*

5.18.1.8 TC(18,8) : Requesting the list of on-board operations procedures

Reference   6240-CPM

[P:SCI-PT-RS-07360#3.15-CPM-4.

The request is :

– Report List of On-board Control Procedures (18,8)

    Telecommand Packet, Application Data : None

    When this request is received, a report Type (18,9) is generated.

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\#   *

5.18.1.9 TC(18,10) : Requesting the list of active on-board operations procedures

\#   Reference   6250-CPM

[P:SCI-PT-RS-07360#3.15-CPM-4.

The request is :

– Report List of Active On-board Control Procedures (18,10)

Telecommand Packet, Application Data : None

\#   *

\#   Reference   6255-CPM

When this request is received, a report Type (18,11) is generated

\#   *

5.18.1.10 TC(18,12) : Reporting OBCP Status and Parameters

\#   Reference   6260-CPM

[P:SCI-PT-RS-07360#3.15-CPM-3.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

The request is :

– Report OBCP Status (18,12)

Telecommand Packet, Application Data :

Procedure ID
Enumerated
16 bits

• Procedure ID :

The Procedure ID, together with the Application ID in the packet header determines the OBCP for which the status is requested.

\#   *

\#   Reference   6265-CPM

[P:SCI-PT-RS-07360#2.1.3-TM-8.

[P:SCI-PT-RS-07360#3.15-CPM-3.

When this request is received, the on-board Application Process shall report the actual status of the specified OBCP by means of TM(18,13).

\#   *

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5.18.1.11 TC(18,14) : Requesting the Dumping of an OBCP

Reference 6270-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

[P:SCI-PT-RS-07360#3.15-CPM-3.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

The request is :

– Dump OBCP Contents (18,14)

Telecommand Packet, Application Data :

Procedure ID
Enumerated
16 bits

- Procedure ID :

The Procedure ID, together with the Application ID in the packet header determines the OBCP for which a dump is requested.

*

Reference 6275-CPM

[P:SCI-PT-RS-07360#3.15-CPM-1. a

[P:SCI-PT-RS-07360#3.15-CPM-3.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

When this request is received, the on-board Application Process shall report one or more TM-Reports (18,15) of the specified OBCP. After completion of the dumping a Successful Execution Report TM(1,7) shall be generated.

*

5.18.2 Telemetry Packet Data Field Structure :

5.18.2.1 TM(18,9) : Reporting the list of on-board control procedures

Reference 6280-CPM

[P:SCI-PT-RS-07360#3.15-CPM-4.

– On-board Control Procedures List Report (18,9)

Telemetry Source Packet, Source Data :

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N	Procedure ID
Unsigned Integer 16 bits	Enumerated 16 bits

<---Repeated N times--->

- N :

  The number of procedures loaded on-board that follow.

- Procedure ID :

  The unique identification of the On-Board Control Procedure that is being reported.

*

5.18.2.2 TM(18,11) : Reporting the list of active on-board control procedures

Reference 6290-CPM

[P:SCI-PT-RS-07360#3.15-CPM-4.

– Active On-board Control Procedures List Report (18,11)

  Telemetry Source Packet, Source Data :

N	Procedure ID
Unsigned Integer 16 bits	Enumerated 16 bits

<---Repeated N times--->

- N :

  The number of active on-board procedures that follow.

- Procedure ID :

  The unique identification of the active On-Board Control Procedure that is being reported.

*

5.18.2.3 TM(18,13) : OBCP Status Report

Reference 6300-CPM

[P:SCI-PT-RS-07360#3.15-CPM-3.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

– OBCP Status Report(18,13)

  Telemetry Packet, Source Data :

Procedure -ID	Procedure Status	Step-ID	N1	OBCP-PID	Value
Enumerated (16-bit)	Unsigned Integer (2-bit)	Enumerated (14-bit)	Unsigned Integer (16-bit)	Enumerated (16-bit)	Any (32-bit)

<---- Repeated N1 times ---->

<------------------- Optional ------------------->

N2	OBCP-PID	Value
Unsigned Integer (16-bit)	Enumerated (16-bit)	Any (64-bit)

<----- Repeated N2 times ----->

<---------------------- Optional ---------------------->

- Procedure-ID :

  The unique identification of the On-Board Control Procedure for which the status is being reported.

- Procedure Status and Step-ID :

  Shall provide information about the actual execution step together with the status of the OBCP (active, suspended, stopped).

  This information is represented as follows :

  Ø Procedure Status = 0   The identified procedure is STOPPED

  Ø Procedure Status = 1   The identified procedure is RUNNING

  Ø Procedure Status = 2   The identified procedure is SUSPENDED

  Step-ID indicates the current progress of procedure execution according to be definition given in the User Manual.

- N1 / N2 :

  The number of couplets of OBCP parameter identifiers (OBCP-PID) and OBCP parameter values which follow. If no OBCP parameter are reported (i.e. : the reported OBCP handles no parameter of that length), N1 or N2 can be omitted or set to zero.

- OBCP-PID :

  The identification of the parameter whose value follows.

- Value :

  The current value of the corresponding parameter that has been handed over to the OBCP by TC(18,3) or TC(18,7).

*

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Reference 6305-CPM

[P:SCI-PT-RS-07360#3.15-CPM-3.

[P:SCI-PT-RS-07360#2.1.3-TM-8.

This Telemetry Report shall return the last set of parameter values, which have been handed over to the OBCP (by a TC(18,3) or TC(18,7). Additionally, the Step ID field shall provide information about the actual execution status of the OBCP.

*

5.18.2.4 TM(18,15) : Dumping the Copy of a Procedure

The report is :

Reference 6310-CPM a

[P:SCI-PT-RS-07360#2.1.3-TM-8.

[P:SCI-PT-RS-07360#3.15-CPM-3.

OBCP Contents Report (18,15)

Telemetry Packet, Application Data :

Procedure ID	Segment-ID	N	Procedure Code	Spare
Enumerated (16-bit)	Unsigned Integer (8-bit)	Unsigned Integer (8-bit)	Fixed length OctetString (8-bit)	(8-bit)
			<- Repeated N times ->	<- Optional ->

- Procedure ID :

  The unique identification of the On-Board Control Procedure that is being dumped.

- Segment-Identifier :

  If the length of an OBCP code allows its reporting with a single TM-packet (18,15), the Segment-Identifier shall be set to zero.

  If the length of an OBCP code requires, for its reporting, a sequence of TM-packets, each of them shall be identified by a unique Segment-Identifier and shall carry a segment of the overall OBCP code.

  If the to be dumped OBCP is divided into K Segments, the Segment-ID shall always start with 1, and be incremented up to K (allowed range : 1 to 254).

  After transmission of the K TM-packets a TM(18,15) shall be sent with Segment _ID set to FFhex, and Length set to zero.

- N :

  The length (in octets) of the part of procedure code that follows.

- Procedure Code :

  The part of code of the procedure (in increasing order of octets) that is being dumped.

- Spare :

  8 bits, set to zero.

This spare octet will be inserted, to fulfil the packet 16-bit alignment requirement, when the dumped part of procedure code is an odd number of octets.

*

5.19 Service Type 19 : Event / Action Service

Reference 6380-EVNT

[P:SCI-PT-RS-07360#3.16-EVNT-1.

[P:SCI-PT-RS-07360#3.16-EVNT-3.

The Event / Action Service, implemented in the CDMS, shall maintain a list of events to be detected, which contains the following information :

– Application Process ID generating the event report ;

– Event ID ;

– Associated action (Telecommand Packet) ;

– Status of the action - enabled or disabled.

*

Reference 6400-EVNT

[P:SCI-PT-RS-07360#3.16-EVNT-1.

[P:SCI-PT-RS-07360#3.16-EVNT-2.

On reception of an event report of Type/Subtype (5,4), (5,2) and (5,1), the CDMS (optionally ACMS) shall scan the detection list and if a matching Event Report is detected and the associated action is enabled, the corresponding Telecommand packet is sent to the destination Application Process.

*

Severe events, which are classified as errors/alarms, Type/Subtype (5,4), should either be covered by an action, or are so unpredictable in nature that no autonomous on-board activity can be initiated.

Reference 6410-EVNT

The TC-Packets representing the actions carry a Sequence Count and a CRC-field, which must be incremented or modified each time this TC is released in order to represent the actual TC-Sequence Count.

*

Reference 6415-EVNT a

When these action-TCs are reported in TM(19,7) the stored values of Sequence Count and CRC-field (typically the value when loaded by TC(19,1)) shall be reported.

When these action-TCs are reported in TM(1,9) the last values (i.e. : the one they had at release time) of Sequence Count and CRC-field shall be reported.

*

In exceptional cases, the Event/Action List may be modified by adding or deleting events or activating / deactivating related actions. The related Telecommands may have mission-wide implications and have therefore to be classified as hazardous.

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5.19.1 Telecommand Packet Data Field Structure :

5.19.1.1 TC(19,1) : Adding events to the detection list

The request is :

\# Reference 6420-EVNT a

[P:SCI-PT-RS-07360#3.16-EVNT-3.

– Add Events to the Detection List (19,1)

Telecommand Packet, Application Data :

Application Process ID	Event ID	Telecommand Packet
Enumerated 16 bits	Enumerated 16 bits	Variable OctetString

- Application Process ID :

    The identifier of the Application Process generating this event report (TM packet type (5,1) or (5,2) or (5,4)).

- Event ID :

    The Event ID, together with the Application Process ID and TM-Packet type, which is always 5 for this service, identifies unambiguously the event, which is reported, (and the presence, structure and interpretation of the associated parameter field). Events of different subtype have different Structure IDs.

- Telecommand Packet :

    The action to be taken (i.e. Telecommand to be sent) when this event report is detected.

    The used «Variable Octet String» type is the one specifically defined for TC packet in Appendix A.6.

\# *

\# Reference 6430-EVNT

[P:SCI-PT-RS-07360#3.16-EVNT-3.

When this request is received, the event is added to the detection list, the corresponding Action, i.e. the Telecommand delivered with a TC(19,1) is stored in the Action-Store, and the corresponding action status is set to «disabled». If a given event is already in the detection list, the Action replaces the existing one, providing that the current Action status is «disabled». Otherwise, the request to replace that event results in a corresponding error report (Telecommand execution failure, type (1,8)).

Note that the actual size of Action-Telecommands is limited to 232 octets (220 octets for the application data field) because the data space available to end-users is reduced by the control parameters.

\# *

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5.19.1.2 TC(19,2) : Deleting events from the detection list

The request is :

\#   Reference   6440-EVNT a

[P:SCI-PT-RS-07360#3.16-EVNT-3.

– Delete Events from the Detection List (19,2)

Telecommand Packet, Application Data :

N	Application Process ID	Event ID
Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (16-bit)

<--------------------Repeated N times------------------->

- N :

  The number of events to be deleted that follow.

- Application Process ID :

  The identifier of the Application Process generating this event report (TM packet type (5,1) ; (5,2) or (5,4)).

- Event ID :

  The Event ID, together with the Application Process ID, identifies unambiguously the event to be deleted from the Detection List.

\#   *

\#   Reference   6445-EVNT

[P:SCI-PT-RS-07360#3.16-EVNT-3.

When this request is received, the indicated event and its associated Action-Telecommand is deleted from the detection list, provided that the current action status is «disabled». Otherwise, the corresponding error report must be generated.

\#   *

5.19.1.3 TC(19,3) : Clearing the event detection list

\#   Reference   6450-EVNT

[P:SCI-PT-RS-07360#3.16-EVNT-3.

The request is :

– Clear the Event Detection List (19,3)

  Telecommand Packet, Application Data : None

  When this request is received, all entries in the detection list are cleared.

\#   *

5.19.1.4 TC(19,4) TC(19,5) : Controlling the actions associated with events

The requests are :

Reference 6460-EVNT a

[P:SCI-PT-RS-07360#3.16-EVNT-3.

[P:SCI-PT-RS-07360#3.13-OTFM-7.

– Enable Actions (19,4)

Telecommand Packet, Application Data :

N	Application Process ID	Event ID
Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (16-bit)

<-------------------Repeated N times------------------ >

- N :

    The number of events to be enabled that follow.

- Application Process ID :

    The identifier of the Application Process generating this event report (TM packet type (5,1) ; (5,2) or (5,4)).

- Event ID :

    The Event ID, together with the Application Process ID, identifies unambiguously the event to be disabled in the Detection List.

---

*

Reference 6470-EVNT a

[P:SCI-PT-RS-07360#3.16-EVNT-3.

[P:SCI-PT-RS-07360#3.13-OTFM-7.

– Disable Actions (19,5)

Telecommand Packet, Application Data :

N	Application Process ID	Event ID
Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (16-bit)

<-------------------Repeated N times------------------ >

- N :

    The number of events to be disabled that follow.

- Application Process ID :

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The identifier of the Application Process generating this event report (TM packet type (5,1) ; (5,2) or (5,4)).

- Event ID :

The Event ID, together with the Application Process ID, identifies unambiguously the event to be disabled in the Detection List.

                                                                                    #   *

Reference 6475-EVNT

[P:SCI-PT-RS-07360#3.16-EVNT-3.

When this request is received, the Action-Telecommand associated with the corresponding event shall be enabled/disabled.

An error is flagged if an event, whose action is requested for enabling/disabling, is not in the detection list. Changing the enable/disable status of an action shall be executed irrespective of the previous state of the action.

                                                                                    #   *

5.19.1.5 TC(19,6) : Reporting the event detection list

The request is :

Reference 6480-EVNT

[P:SCI-PT-RS-07360#3.16-EVNT-4.

– Report the Event Detection List (19,6)

Telecommand Packet, Application Data : None

When this request is received, a report of type (19,7) is generated.

                                                                                    #   *

5.19.2 Telemetry Packet Data Field Structure :

5.19.2.1 TM(19,7) : Report of the event detection list

Reference 6490-EVNT a

[P:SCI-PT-RS-07360#3.16-EVNT-4.

– Event Detection List Report (19,7)

Telemetry Source Packet, Source Data :

Rank in Report	Application Process-ID	Event-ID	
Unsigned Integer (16-bit)	Enumerated (16-bit)	Enumerated (16-bit)	

Spare	Parameter Passing Status	AFO-Status	AFS-Status	Action Status	Telecommand Packet
(12-bit)	Enumerated (1-bit)	Enumerated (1-bit)	Enumerated (1-bit)	Enumerated (1-bit)	Variable OctetString

- Rank in the Report :

  Reporting of the complete Event Detection List generally requires several TM packets. This field is a counter of issued TM(19,7) packets.

  Rank in the Report shall always start with 1, and be incremented one by one up to the number of Events defined in the Event Detection List.

- Application Process ID, Event ID :

  as for TM packet type (19,1)

- Spare :

  12 bits, set to zero.

- Parameter Passing Status :

  This indicates if the value of parameters present in the Event (identified by the reported Application Process-ID and Event-ID) that triggers the Action have to be included into the Telecommand Packet that has to be sent.

  This information is represented as follows :

  Parameter Passing Status = 0 (Disabled),

  Parameter Passing Status = 1 (Enabled).

  This bit is set and reset by means of dedicated TC of Function Management Service (Service 8).

- AFO-Status :

  This indicates if the action has to be executed (i.e. : the Telecommand Packet has to be sent) when the spacecraft is in Autonomous Fail Operational (AFO) mode.

  This information is represented as follows :

  AFO-Status = 0   (Disabled) Action not executed when spacecraft is in AFO mode,

  AFO-Status = 1   (Enabled) Action executed when spacecraft is in AFO mode.

  This bit is set and reset by means of dedicated TC of Function Management Service (Service 8).

- AFS-Status :

  This indicates if the action has to be executed (i.e. : the Telecommand Packet has to be sent) when the spacecraft is in Autonomous Fail Safe (AFS) mode.

  This information is represented as follows :

  AFS-Status = 0 (Disabled) Action not executed when spacecraft is in AFS mode,

  AFS-Status = 1 (Enabled) Action executed when spacecraft is in AFS mode.

- Action Status :

  This indicates the status of the action associated with the event, as follows:

  Value = 0 (Disabled), Value = 1 (Enabled).

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This bit is set and reset by means of TC(19,4) and TC(19,5).

- Telecommand Packet :

   The action to be taken (i.e. Telecommand to be sent) when this event report is detected.

   The used «Variable Octet String» type is the one specifically defined for TC packet in Appendix A.6.

*

The defined Telemetry Source Packet for TM(19,7) requires that one TC packet is reported in each TM(19,7).

Reference   6495-EVNT

At completion of the Report the Event Detection List TC(19,7) request, that may require the reporting of several Event Detection List Report TM(19,7), an Event Report TM(5,1) indicating the number of reported TM(19,7) shall be issued.

*

5.20 Service Type 20 : Information Distribution Service

not used

5.20.1 Telecommand Packet Data Field Structure :

5.20.1.1 Controlling the on-board distribution of Telecommand packets

Reference   6500-INFO

deleted

*

Reference   6510-INFO

deleted

*

Reference   6515-INFO

deleted

*

5.20.1.2 Reporting the list of distributed Information TC packets

Reference   6520-INFO

deleted

*

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5.20.1.3 Distributing Information Telecommands

Reference 6530-INFO
deleted

*

5.20.2 Telemetry Packet Data Field Structure :

Reference 6540-INFO
deleted

*

5.21 Service Type 21 : Science Data Transfer

This section defines the telemetry packet structures for Science Data. Instrument HK and status data are covered by Telemetry packets of type/subtype TM(3,25) and TM (3,26).

In order to avoid an unnecessarily large number of Application IDs for a single instrument several subtypes of Science TM packets are introduced. These subtypes should be used to identify groups of scientific data of significantly different character or origin (e.g. different detectors). Each subtype can make use of several structure definitions. The individual naming of the Science TM packets can be chosen by the instruments, the number of allowed subtypes is TBC.

5.21.1 Telecommand Packet Data Field Structure :

not applicable

5.21.2 TM(21,1) TM(21,2) TM(21,3) TM(21,4) : Telemetry Packet Data Field Structure :

5.21.2.1 Reporting Scientific Data

The report packets of the values of a set of scientific parameters are :

Reference 6600-INFO
[P:SCI-PT-RS-07360#3.18-SCI-1. a
–   Nominal Science Data Report (21,1)
Telemetry Source Packet, Source Data : see Figure below

*

Reference 6620-INFO
[P:SCI-PT-RS-07360#3.18-SCI-1. a
–   Science Type B Data Report (21,2)

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Telemetry Source Packet, Source Data : see Figure below

*

Reference 6640-INFO

[P:SCI-PT-RS-07360#3.18-SCI-1. a

– Diagnostic Science Report (21,3)

Telemetry Source Packet, Source Data : see Figure below

*

Reference 6660-INFO

[P:SCI-PT-RS-07360#3.18-SCI-1. a

– Auxiliary Science Data Report (21,4)

Telemetry Source Packet, Source Data : see Figure below

SID	Parameters
Enumerated 16 bits	Any

- SID :

  The SID, together with the Application Process ID and the nature of the packet (packet type / subtype) implicitly identifies the structure of the parameter field. Details are to be found in the respective Instrument User Manuals.

- Parameters :

  This field consists of a sequence of values of instrument (science) parameters that are sampled or prepared once per collection interval followed by a sequence of fixed-length arrays of records.

  The only authorised parameter types are those described in Appendix 6.

*

5.22 Service Type 22 : Context Saving Service

not used

5.22.1 Telecommand Packet Data Field Structure :

not applicable

5.22.2 Telemetry Packet Data Field Structure :

not applicable

APPENDIX 1: CONVENTIONS

A1-1 Bit Numbering Conventions

Reference   1000-A1

The following convention shall be used to identify each bit in an N-bit field :

N-bit data field
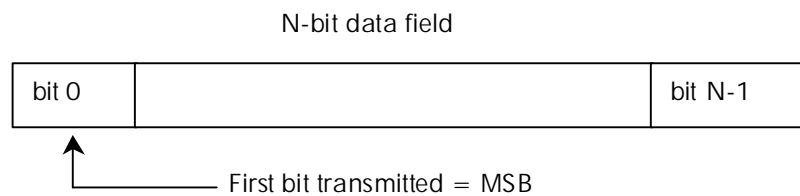
Figure A1.1: Bit Numbering

1) The first bit in the field (starting from the left) is defined to be «Bit 0» and will be represented as the left most justified bit in a figure. The next bit is called «Bit 1», and so on, up to «Bit N-1», the bits being represented in this order from left to right in a figure.

2) If the N-Bit field is to be interpreted as «Unsigned Integer» value, Bit 0 is the MSB and Bit N-1 is the LSB.

3) If the N-Bit field is to be interpreted as «Signed Integer» value, Bit 0 indicates the sign with Bit 0 = 0 corresponding to a positive number and Bit 0 = 1 corresponding to a negative number.

4) Adjacent groups of bits are described in terms of octets and words.

5) Octet = 1 byte = 8 bits (1 word = 2 octets = 16 bits).

*

A1-2 Field Alignment Conventions

Reference   1020-A1

The following convention shall be used to construct packet parameter fields :

1) Parameters with a length longer or equal 16 bits shall be word aligned, i.e. the LSB shall coincide with the word boundary.

2) Parameters with a length shorter than 16 bits shall not be allowed to span over word boundaries.

3) Parameters with a length shorter than 16 bits shall be right-adjusted within the occupied 16-bit word, leaving any required padding-bits in the most significant bits of the 16-bit word.

4) If more than one parameter is held in a single word the parameters shall be right adjusted.

*

A1-3 Packet Numbering Conventions

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\# Reference 1040-A1

Packet class and function is provided by packet type and packet subtype, included in the data field header of the packet.

The Packet Type numbering scheme is devised to provide correlation between TC packets and the resulting TM packets and is therefore non-contiguous : there are cases where for a certain TC type, there is no corresponding TM type. Appendix 2 provides a complete cross-reference table down to sub-type level.

To make identification simpler, service type and subtype are represented by two numbers, separated by a comma, for example, TC (1,1) is a Telecommand packet type 1, subtype 1 and TM (1,2) is a telemetry packet type 1, subtype 2. Subtype numbers within a service shall be unique.

\# *

APPENDIX 2: TM/ TC PACKET TYPES AND SUBTYPES FOR HERSCHEL/ PLANCK

Reference 1100-A2

deleted

*

Here after Table A-2.1 presents the TM/ TC Packet Types/Subtypes used by the subsystem or instrument to support (by execution of TC packets and issuing of TM packets) the Services specified in this document.

More specific details are given in the User Manual for these units.

TC-Pckt ST/SST	TM-Pckt ST/SST	TM/TC Packet Name	USED BY							
			CDMS	ACMS	HIFI	PACS	SPIRE	HFI	LFI	SCS
	TM(1,1)	Telecommand Acceptance Report – Success	YES	YES	YES	YES	YES	YES	YES	YES
	TM(1,2)	Telecommand Acceptance Report – Failure	YES	YES	YES	YES	YES	YES	YES	YES
	TM(1,3)	Telecommand Execution Report – Started	YES	YES		YES	YES			
	TM(1,5)	Telecommand Execution Report – Progress	YES	YES			YES			
	TM(1,7)	Telecommand Execution Report – Completed	YES	YES	YES	YES	YES	YES	YES	YES
	TM(1,8)	Telecommand Execution Report – Failure	YES	YES	YES	YES	YES	YES	YES	YES
	TM(1,9)	Telecommand Contents Report	YES	YES						
TC(2,1)		Distribute Pulse Commands	YES	YES						
TC(2,2)		Distribute Register Load Commands	YES	YES						
TC(2,3)		Standard Distribute CPDU Commands	YES							
		HP specific Distribute CPDU Commands	YES	YES						
TC(3,1)		Define New HK Parameter Report	YES	YES						
TC(3,2)		Define New Diagnostic Parameter Report	YES	YES						
TC(3,3)		Clear HK Parameter Report Definitions	YES	YES						
TC(3,4)		Clear Diagnostic Parameter Report Definitions	YES	YES						
TC(3,9)		Report HK Parameter Report Definitions	YES	YES						
	TM(3,10)	HK Parameter Report Definitions Report	YES	YES						
TC(3,11)		Report Diagnostic Parameter Report Definitions	YES	YES						
	TM(3,12)	Diagnostic Parameter Definitions Report	YES	YES						
	TM(3,25)	Essential Housekeeping Parameter Report	YES	YES	YES	YES	YES	YES	YES	YES
		Non-Essential Housekeeping Param. Report	YES	YES	YES	YES	YES	YES	YES	YES
	TM(3,26)	Diagnostic Parameter Report	YES	YES				YES	YES	
	TM(5,1)	Event Report	YES	YES	YES	YES	YES	YES	YES	YES
	TM(5,2)	Exception Report	YES	YES	YES	YES	YES	YES	YES	YES
	TM(5,4)	Error/Alarm Report	YES	YES	YES	YES	YES	YES	YES	YES

TC-Pckt ST/SST	TM-Pckt ST/SST	TM/TC Packet Name	USED BY							
			CDMS	ACMS	HIFI	PACS	SPIRE	HFI	LFI	SCS
TC(6,2)		Load Memory Using Absolute Addresses	YES	YES	YES	YES	YES	YES	YES	YES
TC(6,5)		Dump Memory Using Absolute Addresses	YES	YES	YES	YES	YES	YES	YES	YES
	TM(6,6)	Memory Dump, Absolute Addresses	YES	YES	YES	YES	YES	YES	YES	YES
TC(6,9)		Check Memory Using Absolute Addresses	YES	YES	YES	YES	YES	YES	YES	YES
	TM(6,10)	Memory Check Report, Absolute Address es	YES	YES	YES	YES	YES	YES	YES	YES
TC(6,11)		Abort Current Memory dump	YES	YES						
TC(8,1)		Start Function	YES	YES	YES		YES		YES	YES
TC(8,2)		Stop Function	YES	YES	YES		YES		YES	YES
TC(8,4)		Perform Activity of Function	YES	YES	YES	YES	YES	YES	YES	
TC(8,5)		Report Function Status	YES	YES			YES		YES	
	TM(8,6)	Function Status Report	YES	YES	YES		YES		YES	
	TM(8,7)	SREM Data Report	YES							
	TM(8,8)	VMC Data Report	YES							
	TM(8,9)	Mass Memory Dump Report	YES							
TC(9,3)		Synchronise User	YES							
TC(9,4)		Enable Time Synchronisation		YES				YES	YES	YES
TC(9,5)		Time Code							YES	YES
TC(9,6)		Verify User Time	YES							
TC(9,7)		Enable Time Verification		YES	YES	YES	YES	YES	YES	YES
	TM(9,8)	Central Time Reference	YES							
	TM(9,9)	Time Verification Report		YES	YES	YES	YES	YES	YES	YES
TC(9,10)		Synchronise Central Time Reference	YES							

TC-Pckt ST/SST	TM-Pckt ST/SST	TM/TC Packet Name	CDMS	ACMS	HIFI	PACS	SPIRE	HFI	LFI	SCS
TC(11,1)		Enable Release of Telecommands	YES							
TC(11,2)		Disable Release of Telecommands	YES							
TC(11,3)		Reset Command Schedule	YES							
TC(11,4)		Insert MTL-Telecmds in Command Schedule	YES							
TC(11,5)		Delete MTL-Telecommands	YES							
TC(11,6)		Delete MTL-Telecommands over Time Period	YES							
TC(11,9)		Report Command Schedule in Detailed Form	YES							
	TM(11,10)	Detailed Schedule Report	YES							
TC(11,11)		Report Sche in Detail Form over Time Period	YES							
TC(11,12)		Report Command Sche in Summary Form	YES							
	TM(11,13)	Summary Schedule Report	YES							
TC(11,14)		Report Schedule Summary over Time Period	YES							
TC(11,18)		Report Status of Command Schedule	YES							
	TM(11,19)	Command Schedule Status Report	YES							
TC(12,1)		Enable Monitoring of Parameters	YES							
TC(12,2)		Disable Monitoring of Parameters	YES							
TC(12,4)		Clear Monitoring List	YES							
TC(12,5)		Modify Monitoring List	YES							
TC(12,6)		Delete Parameters from Monitoring List	YES							
TC(12,8)		Report Current Monitoring List	YES							
	TM(12,9)	Current Monitoring List Report	YES							

TC-Pckt ST/SST	TM-Pckt ST/SST	TM/TC Packet Name	USED BY							
			CDMS	ACMS	HIFI	PACS	SPIRE	HFI	LFI	SCS
TC(14,1)		Enable Generation of Telemetry Packets	YES	YES	YES	YES	YES	YES	YES	YES
TC(14,2)		Disable Generation of Telemetry Packets	YES	YES	YES	YES	YES	YES	YES	YES
TC(14,3)		Report Enabled Telemetry Packets	YES	YES	YES	YES	YES	YES	YES	YES
	TM(14,4)	Enabled Telemetry Packets Report	YES	YES	YES	YES	YES	YES	YES	YES
TC(14,5)		Select Down-linking / Storage of TM Packets	YES							
TC(14,6)		Report TM Packets Down-link. / Stor. Status	YES							
	TM(14,7)	TM Packets Down-link. / Stor. Status Report	YES							
TC(15,1)		Enable Storage in Packet Stores	YES							
TC(15,2)		Disable Storage in Packet Stores	YES							
TC(15,3)		Add Packet Definitions to Packet Store	YES							
TC(15,4)		Remove Packet Definitions to Packet Store	YES							
TC(15,5)		Report Storage Selection Definition	YES							
	TM(15,6)	Storage Selection Definition Report	YES							
TC(15,7)		Downlink Packet Store Contents	YES							
TC(15,9)		Specify Downlink Time Period	YES							
TC(15,11)		Delete Pkt Stor Contents up to Specified Time	YES							
TC(15,12)		Report Catalogues for Selected Packet Stores	YES							
	TM(15,13)	Packet Stores Catalogue Report	YES							
TC(17,1)		Perform Connection Test	YES	YES	YES	YES	YES	YES	YES	YES
	TM(17,2)	Connection Test Report	YES	YES	YES	YES	YES	YES	YES	YES

TC-Pckt ST/SST	TM-Pckt ST/SST	TM/TC Packet Name	USED BY							
			CDMS	ACMS	HIFI	PACS	SPIRE	HFI	LFI	SCS
TC(18,1)		Load Procedure	YES			YES				
TC(18,2)		Delete Procedure	YES			YES				
TC(18,3)		Start Procedure	YES			YES				
TC(18,4)		Stop Procedure	YES			YES				
TC(18,5)		Suspend Procedure	YES			YES				
TC(18,6)		Resume Procedure	YES			YES				
TC(18,7)		Communicate Parameters to a Procedure	YES			YES				
TC(18,8)		Report List of On-board Control Procedures	YES			YES				
	TM(18,9)	On-board Control Procedures List Report	YES			YES				
TC(18,10)		Report List of Active OBCPs	YES			YES				
	TM(18,11)	Active OBCPs List Report	YES			YES				
TC(18,12)		Report OBCP Status	YES			YES				
	TM(18,13)	OBCP Status Report	YES			YES				
TC(18,14)		Dump OBCP Contents	YES							
	TM(18,15)	OBCP Contents Report	YES							
TC(19,1)		Add Events to Detection List	YES							
TC(19,2)		Delete Events from Detection List	YES							
TC(19,3)		Clear the Event Detection List	YES							
TC(19,4)		Enable Actions	YES							
TC(19,5)		Disable Actions	YES							
TC(19,6)		Report the Event Detection List	YES							
	TM(19,7)	Event Detection List Report	YES							
	TM(21,1)	Nominal Science Data Report			YES	YES	YES	YES	YES	
	TM(21,2)	Science Type B Data Report				YES	YES	YES	YES	
	TM(21,3)	Diagnostic Science Data Report			YES	YES	YES	YES	YES	
	TM(21,4)	Auxiliary Science Data Report						YES	YES	

Table A-2.1: TM/ TC Packet Types/Subtypes Summary

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APPENDIX 3: APPLICATION PROCESS ID ASSIGNMENT

Table A-3.1 below lists the allocation of APIDs to the various on-board users within the Herschel / Planck Project. The assignment of Application IDs is managed by the Herschel / Planck Project Office. A common structure of APID-allocation shall be adopted for all users for standardised functions.

APIDs are allocated to end users according to specific needs. Additionally, one range of APIDs is reserved for testing and EGSE-related messages. This range shall not be used for the addressing of any on-board unit or application. It may be utilised by several groups in parallel during their unit-level test activities before integration of these units into the spacecrafts.

In support of a routing and multiplexing of telemetry data streams according to priority, which is based on the concept of Virtual Channels, APIDs are associated with certain TM/TC-packet types according to the tables below.

The Application Process ID (APID) is structured into two fields :

– The most significant bits of each APID form a base address, which identifies in general terms the user or process generating the TM packet (or which the TC packet is addressed to) in a unique way. Each instrument and subsystem on-board is associated to one base APID.

– The least significant 4 bits within the APID form a field, are used to identify different categories of TM packets and/or the unit (Prime or Redundant) that issues the TM packets. This allows to perform some part of packet identification without decoding its Data Field Header.

Table A-3.2 provides a mapping of telemetry Packet Types/ Subtypes to APID Base Address + offset and Virtual Channel for Real Time down-linking in a generic way (i.e. : for APID Base Address defined in Table A-3.1).

Reference   1140-A3 c

[P:SCI-PT-RS-07360#3.1-PACK-0.

[P:SCI-PT-RS-07360#3.1-PACK-1.

[P:SCI-PT-RS-07360#3.1-PACK-2.

[P:SCI-PT-RS-07360#3.1-PACK-13. a

The following AP-IDs shall be used on-board the Herschel and Planck spacecraft :

APID		Assigned to :	
Decimal	Hex.	TC packets	TM packets
0	0h	Standard Distribute CPDU commands	Standard Spacecraft Time Source
16 (BA)	10h	All CDMS Telecommands	All CDMS TM packets <u>except</u> : – Non-Essential HK Parameter Report, – Diagnostic Parameter Report
18 (BA + 2)	12h		– CDMS Non-Essential HK Parameter Report, - CDMS Diagnostic Parameter Report
512 (BA)	200h	All ACMS Telecommands	All ACMS TM packets <u>except</u> : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report
514 (BA + 2)	202h		– ACMS Non-Essential HK Parameter Report, - ACMS Diagnostic Parameter Report
1024 (BA)	400h	All HIFI Telecommands	For HIFI Prime, all TM packets <u>except</u> : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report - Science Data Transfer TM-Packets
1025 (BA + 1)	401h		For HIFI Redundant, all TM packets <u>except</u> : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report - Science Data Transfer TM-Packets
1026 (BA + 2)	402h		For HIFI Prime : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report
1027 (BA + 3)	403h		For HIFI Redundant : – Non-Essential HK Parameter Report, – Diagnostic Parameter Report

| APID | | Assigned to : | |
Decimal	Hex.	TC packets	TM packets
1028 (BA + 4) 1029 (BA + 5) 1030 (BA +6) 1031 (BA + 7)	404h ; 405h ; 406h ; 407h		For HIFI (Prime and Redundant) : - HIFI Science Data Transfer TM -Packets : TM(21,x)
1152 (BA)	480h	All PACS Telecommands	For PACS Prime , all TM packets except : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report - Science Data Transfer TM -Packets
1153 (BA + 1)	481h		For PACS Redundant , all TM packets except : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report - Science Data Transfer TM -Packets
1154 (BA + 2)	482h		For PACS Prime : - Non-Essential HK Parameter Report - Diagnostic Parameter Report
1155 (BA + 3)	483h		For PACS Redundant : - Non-Essential HK Parameter Report – Diagnostic Parameter Report
1158 (BA + 6)	486h		For PACS Prime : - Diagnostic Science Data Report : TM(21,3)
1159 (BA + 7)	487h		For PACS Redundant : - Diagnostic Science Data Report : TM(21,3)
1160 (BA + 8) and 1162 (BA+10)	488h and 48Ah		For PACS Prime : - PACS Science Data Transfer TM -Packets : TM(21,x)
1161 (BA + 9) and 1163 (BA+11)	489h and 48Bh		For PACS Redundant : - PACS Science Data Transfer TM -Packets : TM(21,x)

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| APID | | Assigned to : | |
Decimal	Hex.	TC packets	TM packets
1280 (BA)	500h	All SPIRE Telecommands	For SPIRE Prime, all TM packets <u>except</u> : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report - Science Data Transfer TM-Packets
1281 (BA + 1)	501h		For SPIRE Redundant, all TM packets <u>except</u> : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report - Science Data Transfer TM-Packets
1282 (BA + 2)	502h		For SPIRE Prime : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report
1283 (BA + 3)	503h		For SPIRE Redundant : – Non-Essential HK Parameter Report, – Diagnostic Parameter Report
1284 (BA + 4) 1286 (BA + 6) 1288 (BA + 8)	504h ; 506h ; 508h		For SPIRE Prime : - SPIRE Science Data Transfer TM-Packets : TM(21,x)
1285 (BA + 5) 1287 (BA + 7) 1289 (BA + 9)	505h ; 507h ; 509h		For SPIRE Redundant : - SPIRE Science Data Transfer TM-Packets : TM(21,x)
1408 (BA)	580h	All HFI Telecommands	For HFI Prime, all TM packets <u>except</u> : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report - Science Data Transfer TM-Packets
1409 (BA + 1)	581h		For HFI Redundant, all TM packets <u>except</u> : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report - Science Data Transfer TM-Packets

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APID		Assigned to :	
Decimal	Hex.	TC packets	TM packets
1410 (BA + 2)	582h		For HFI Prime : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report
1411 (BA + 3)	583h		For HFI Redundant : – Non-Essential HK Parameter Report, – Diagnostic Parameter Report
1412 (BA + 4) and 1414 (BA + 6)	584h and 586h		For HFI Prime : - HFI Science Data Transfer TM-Packets : TM(21,x)
1413 (BA + 5) and 1415 (BA + 7)	585h and 587h		For HFI Redundant : - HFI Science Data Transfer TM-Packets : TM(21,x)
1536 (BA)	600h	All LFI Telecommands	For LFI (Prime and Redundant) , all TM packets except : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report - Science Data Transfer TM-Packets
1538 (BA + 2)	602h		For LFI (Prime and Redundant) : – Non-Essential HK Parameter Report, - Diagnostic Parameter Report
1540 (BA + 4)	604h		For LFI (Prime and Redundant) : - LFI Science Data Transfer TM-Packets : TM(21,x)

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| APID | | Assigned to : | |
Decimal	Hex.	TC packets	TM packets
1664 (BA)	680h	All SCS Telecommands	For SCS Prime, all TM packets <u>except</u> : - Non-Essential HK Parameter Report, - Diagnostic Parameter Report
1665 (BA +1)	681h		For SCS Redundant, all TM packets <u>except</u> : - Non-Essential HK Parameter Report, - Diagnostic Parameter Report
1666 (BA +2)	682h		For SCS Prime : - Non-Essential HK Parameter Report, - Diagnostic Parameter Report
1667 (BA +3)	683h		For SCS Redundant : - Non-Essential HK Parameter Report, - Diagnostic Parameter Report
2016 to 2046	7E0h to 7FEh		SCOE / EGSE reserved
2047	7FFh		Idle TM-Packets

Table A-3.1: Application Process ID Assignment

*

Reference   1180-A3 c

[P:SCI-PT-RS-07360#3.1-PACK-2.

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TM-Packet Typ/Subtype	TM Packet Name	APID (BA = Base Add.)	VC Real-Time
	Idle packet	2047	Any
	Time packet	0	0
TM(1,1)	Telecommand Acceptance Report - Success	BA *	0
TM(1,2)	Telecommand Acceptance Report – Failure	BA *	0
TM(1,3)	Telecommand Execution Report – Started	BA *	0
TM(1,5)	Telecommand Execution Report – Progress	BA*	0
TM(1,7)	Telecommand Execution Report – Completed	BA *	0
TM(1,8)	Telecommand Execution Report – Failure	BA *	0
TM(1,9)	Telecommand Contents Report	BA *	0
TM(3,10)	HK Parameter Report Definitions Report	BA *	0
TM(3,12)	Diagnostic Parameter Definitions Report	BA *	0
TM(3,25)	Essential Housekeeping Parameter Report	BA *	0
TM(3,25)	Non-Essential Housekeeping Parameter Report	BA + 2 **	4
TM(3,26)	Diagnostic Parameter Report	BA + 2 **	4
TM(5,1)	Event Report	BA *	0
TM(5,2)	Exception Report	BA *	0
TM(5,4)	Error/Alarm Report	BA *	0
TM(6,6)	Memory Dump, Absolute Addresses	BA *	0
TM(6,10)	Memory Check Report, Absolute Addresses	BA *	0
TM(8,6)	Function Status Report	BA *	0
TM(8,7)	SREM Data Report	BA *	0
TM(8,8)	VMC Data Report	BA *	0
TM(8,9)	Mass Memory Dump Report	BA *	0
TM(9,8)	Central Time Reference	BA *	0
TM(9,9)	Time Verification Report	BA *	0

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TM-Packet Typ/Subtyp	TM Packet Name	APID (BA = Base Add.)	VC Real-Time
TM(11,10)	Detailed Schedule Report	BA *	O
TM(11,13)	Summary Schedule Report	BA *	O
TM(11,19)	Command Schedule Status Report	BA *	O
TM(12,9)	Current Monitoring List Report	BA *	O
TM(14,4)	Enabled Telemetry Packets Report	BA *	O
TM(14,7)	TM Packets Down-linking/Storage Status Report	BA *	O
TM(15,6)	Storage Selection Definition Report	BA *	O
TM(15,13)	Packet Stores Catalogue Report	BA *	O
TM(17,2)	Connection Test Report	BA *	O
TM(18,9)	On-board Control Procedures List Report	BA *	O
TM(18,11)	Active OBCPs List Report	BA *	O
TM(18,13)	OBCP Status Report	BA *	O
TM(18,15)	OBCP Contents Report	BA *	O
TM(19,7)	Event Detection List Report	BA *	O
TM(21,1)	Nominal Science Data Report	See Table A-3.1	1
TM(21,2)	Science Type B Data Report	See Table A-3.1	1
TM(21,3)	Diagnostic Science Data Report	See Table A-3.1	1
TM(21,4)	Auxiliary Science Data Report	See Table A-3.1	1

* :   BA + 1 when issued by Redundant HIFI, PACS, SPIRE, HFI, SCS instrument.

** :   BA + 3 when issued by Redundant HIFI, PACS, SPIRE, HFI, SCS instrument.

Table A-3.2: Packet Category Assignment

*

Stored TM packets are down-linked through the Virtual Channel associated to Packet Store in which they are stored. Association between Packet Store and Virtual Channel is performed at time of Packet Store allocation in Mass Memory using dedicated CDMS packet (part of Service 8).

It is recommended to associate :

–   Virtual Channel 3 to Packet Store(s) devoted to the storage of Science Data Transfer TM-Packets.

–   Virtual Channel 2 to Packet Store(s) devoted to the storage of other TM-Packets.

Idle packets and Time packets are not stored On-board.

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APPENDIX 4: THE CHECKSUM ALGORITHMS

Reference 1180-A4

A4.1 Cyclic Redundancy Check Code Specification

The Packet Error Control Field is a 16-bit field, which occupies the two trailing octets of a TC Packet.

The purpose of this field is to provide a capability for detecting errors which may have been introduced into the frame by the lower protocol layers during the transmission process and may have remained undetected.

The standard error detection encoding/decoding procedure, which is described in detail in the following paragraphs, produces a 16 bit Packet Check Sequence (PCS) which is placed in the Packet Error Control Field.

This code is intended only for error detection purpose and shall not be used for error correction.

The characteristics of the PCS are those of a cyclic redundancy check code (CRC) and are generally expressed as follows :

a) The generator polynomial is $G(x) = X^{16} + X^{12} + X^5 + 1$

b) Both encoder and decoder are initialised to the «all-ones» state for each Packet.

c) PCS generation is performed over the entire Packet including the Packet Header less the final 16-bit PCS. (In case the CRC checksum algorithm is applied for the checking of memory data blocks, the checksum is generated over the entire contents of this block.)

d) The code has the following capabilities when applied to an encoded block of less than 32768 bits (2^{15} bits) :

- All error sequences composed of an odd number of bit errors will be detected

- All error sequences containing two bit errors anywhere in the coded block will be detected

- If a random error sequence containing an even number of bit errors (greater than or equal to four) occurs within the block, the probability that the error will be undetected in approximately 2^{-15} (or 3 x 10^{-5}).

- All single error bursts spanning 16 bits or less will be detected provided no other errors occur within the block.

A4.2 Encoding Procedure

The encoding procedure accepts an (n-16)-bit message and generates a systematic binary (n, n-16) block code by appending a 16-bit Packet Check Sequence (PCS) as the final 16 bits of the block. This PCS is inserted into the Packet Error Control Field. The equation for PCS is :

$$PCS = [X^{16}. M(X) + X^{(n-16)}. L(X)] \text{ MODULO } G(X)$$

Where

- M (X) is the (n-16)-bit message to be encoded expressed as a polynomial with binary coefficients, n being the number of bits in the encoded message (i.e. the number of bits in the complete Packet).

- L (X) is the pre-setting polynomial given by :

$$L(X) = S_{i=0}^{15} X_i \qquad \text{(all «1» polynomial of order 15)}$$

- G (X) is the CCITT Recommendation V.41 generating polynomial given by :

$$G(X) = X^{16} + X^{12} + X^5 + 1$$

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– Where + is the modulo 2 addition operator (exclusive OR)

Note that the encoding procedure differs from that of a conventional cyclic block encoding operation in that the $X^{(n-16)}$. L (X) term has the effect of presenting the shift register to an all ones state (rather than a conventional all zeros state) prior to encoding.

A4.3 Decoding Procedure

The error detection syndrome, S (X) is given by

$$S (X) = (X^{16} . C^*(X) + X^n . L (X) \text{ MODULO } G (X)$$

Where C*(X) is the received block in polynomial form.

S (X) is the syndrome polynomial which will be zero if no error has been detected.

A4.4 Verification of Compliance

The binary sequences defined in this section are provided to the designers of packet systems as samples for testing and verification of a specific CRC error detection implementation.

All data are given in hexadecimal notation. For a given field (data or CRC), the left most hexadecimal character contains the most significant bit (i.e. bit 0 of the CCSDS convention).

DATA	Packet Check Sequence (CRC)
00 00	1D 0F
00 00 00	CC 9C
AB CD EF 01	04 A2
14 56 F8 9A 00 01	7F D5

A4.5 Possible realisations of Packet Check Sequence Encoders/Decoders

CRC encoders and decoders can be implemented in hardware as well as in software. A possible H/W implementation of an encoder and decoder is described in [AD-1] and [AD-2]. A C-language version is provided in [RD-1].

*# ***

APPENDIX 5: ACRONYMS AND GLOSSARY OF TERMS

A5-1 Acronyms

ACK	Acknowledgement
AD	Applicable Document
ACMS	Attitude Control & Measurement Subsystem (AOCS)
APID	Application Process Identifier
BIN, bin	Binary
CDMS/CDMU	Command and Data Management System / Unit
CCSDS	Consultative Committee for Space Data Systems
CPDU	Command Pulse Distribution Unit
CRC	Cyclic Redundancy Check
CUC	CCSDS Unsegmented Time Code
CTR	Central Time Reference
DEC, dec.	Decimal
DMS	Data Management System (On-board Data Handling System (OBDH))
EEPROM	Electrically Erasable PROM
EGSE	Electrical Ground Support Equipment Check
EID	Event Identifier
EPS	Electrical Power Subsystem
ESA	European Space Agency
ESOC	European Space Operations Centre
FID	Function Identifier
FIFO	First In First Out
HEX, hex.	Hexadecimal
HFI	High Frequency Instrument (Planck)
HIFI	Heterodyne Instrument for Herschel
HK	Housekeeping
HL	High Limit
ICD	Interface Control Document
ID	Identifier
ISO	International Standards Organisation
LFI	Low Frequency Instrument (Planck)

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LGA	Low Gain Antenna
LL	Low Limit
LSB	Least Significant Bit
MID	Memory Identifier
MINT	Monitoring Interval
MOC	Mission Operations Centre
MSB	Most Significant Bit
MSSW	Mission Specific Software
MTL	Mission Time Line
N/A, n.a.	Not Applicable
OBCP	On-Board Control Procedure
OCF	Operational Control Field
PACS	Photoconductor Array Camera and Spectrometer (Herschel)
PB	Play Back
PEC	Packet Error Control
PID	Parameter Identifier
PROM	Programmable Read Only Memory
PSS	Procedures, Specifications and Standards
PUS	Packet Utilisation Standard
RCS	Reaction Control Subsystem
RAM	Random Access Memory
RF	Radio Frequency
RL	Register Load
RLA	Register Load Address
ROM	Read Only Memory
RSS	Root Sum Square
RT	Real Time
RTU	Remote Terminal Unit
SASW	Standard Application Software
SAU	Smallest Addressable Unit
S/C	Spacecraft
SCET	Spacecraft Elapsed Time
SCOE	Special Check Out Equipment
SCS	Sorption Cooler Subsystem (Planck)
SDU	Service Data Unit
SID	Structure Identifier

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SOC	Science Operations Centre
SPIRE	Spectral and Photometric Imaging Receiver (Herschel)
S/S	Subsystem (of Spacecraft)
SSMM	Solid State Mass Memory / Solid State Recorder
TAI	Temps Atomique International
TBC	To Be Confirmed
TBD	To Be Defined
TBM	Time Broadcast Message
TBW	To Be Written
TC	Telecommand
TCS	Thermal Control Subsystem
TID	Task Identifier
TM	Telemetry
TT&C	(RF) Tracking, Telemetry, and Command
UTC	Universal Time Coordinate(d)
VC	Virtual Channel

A5-2 Glossary of Terms

Application (Process)

A continuous series of actions to bring about a result for a user. Such process may be on-board (or on ground in special cases). Usually an application process can be associated with a unit, subsystem, or instrument. An Application can receive TC packets and/or generate TM packets.

Application data

Data associated with an (on-board) application process, encapsulated in a TC or TM Packet.

Application Process ID

An 11 bit address field. The APID of a TM packet identifies the application process which generates the packet. The APID of a TC packet identifies the application process which receives the packet. An APID is unique across the system (space and ground segment of a certain spacecraft).

Function

A definite amount of actions to bring about a result for a user. A Function has a control/command interface. One or more Functions may be active simultaneously within a application process.

Function ID

Function Identifier, identifies a function and defines the structure of the parameter field in the packet. The same FID may be used by different APIDs.

Memory ID

Memory Identifier, identifies a memory within an application or unit, which can be addressed individually . The same MID may be used by different APIDs.

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Mission Timeline

Sequence of time-tagged Telecommands, which are stored in mass memory of the CDMS and are used to control the nominal operation of the satellite and its instruments for up to 48 hours.

Non-intelligent (end-)user / terminal

On-board user which does not decode TC packets or encode TM packets.

On-Board Control Procedure

On-board resident sequence of commands, similar to a flight procedure as executed from ground. A OBCP can be activated for autonomous interpretation and execution in order to control one or more units/ applications or functions.

Packet (end-)user / terminal

On-board user (unit, subsystem, instrument), which decodes TC packets and encodes TM packets. A packet end user may have more than one application process.

(Functional) Parameter

Variable that controls the result of a command, task or process or delivers the value of a measurement, status acquisition, or data processing.

Parameter ID

Parameter Identifier that uniquely identifies a parameter across the system. The same PID may not be used by different APIDs.

Private Telecommands

Telecommand (-Packets) for which (part of) the structure or parameters are not defined and maintained in the System Data Base. They must not be used on-board the Herschel and Planck spacecraft.

Process

See application process.

Register

A set of binary memory cells, fixed by design, to which data can be written and/or data can be read from.

Structure ID

Structure Identifier, defines the structure of the parameter field in the packet. The SID shall be unique for a certain application, however the same SID may be used by different APIDs.

Source Data

Data generated by an on-board application process, encapsulated in a TM packet.

Task

A definite amount of actions to bring about a result for a higher level process like a Function or OBCP. One or more tasks may be active simultaneously within a application process. Operational Telecommands shall not be used to interface directly with Tasks.

User

See Packet end user

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APPENDIX 6: PARAMETER TYPES AND STRUCTURES

A6-1 Introduction

This appendix defines the terminology to be used for any packet description referred to in section 3 or 4.

Each field in a Telecommand or telemetry packet described in this document is designed to hold a parameter value. Each parameter field has a type, defining the set of values that can be assigned to the parameter. The parameter types are defined below.

This appendix defines the physical encoding rules for each type, i.e. the permitted lengths of the parameter fields and the internal format used to encode values. This appendix does not define the conversion of data parameters into physical or engineering units or user messages.

\#   Reference   1200-A6

When defining Telecommand- and Telemetry- Packets only parameter types defined in this Appendix shall be allowed, and they shall follow all formatting rules outlined here below.

\#   *

A6-2 Encoding formats of parameter types

The parameter type defines the range of possible parameter values. A given parameter type can vary in format and length. Each combination of parameter type and encoding format has an associated parameter code, which defines the type and its physical encoding.

The parameter code shall be used whenever a definition of a parameter field is required. The parameter codes shall be applicable to both Telecommand and telemetry data.

The parameter code, PC, is defined as follows :

Parameter Type Code (PTC)	Parameter Format Code (PFC)
8 bits	8 bits

The parameter code is written as (PTC, PFC) in the tables below.

The following parameter types shall be supported :

- Boolean parameter (PTC = 1)
- Enumerated parameter (PTC = 2)
- Unsigned Integer parameter (PTC = 3)
- Signed Integer parameter (PTC = 4)
- Real parameter (PTC = 5)
- Bit-String parameter (PTC = 6)
- Octet-String parameter (PTC = 7)
- Character-String parameter (PTC = 8) - On-board use limited to SW version identification

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- – Absolute Time parameter   (PTC = 9)
- – Relative Time parameter   (PTC = 10) - Not used
- – Deduced parameter   (PTC = 11)

A6-3 Parameter type definitions

A6-3.1   Boolean

Parameter Type	PTC	PFC	Length	Value/Range
Boolean	1	0	1 bit	0 = false, 1 = true

A6-3.2   Enumerated Parameter

Enumerated parameters are parameters with distinct integer values only involved in logical operations (as opposed to numeric operations). The values that such a parameter can take are discrete and un-ordered. An error code is a typical example.

Parameter Type	PTC	PFC	Length
Enumerated Parameter	2	1	1 bit
	2	2	2 bits
	2	3	3 bits
	2	4	4 bits
	2	5	5 bits
	2	6	6 bits
	2	7	7 bits
	2	8	8 bits
	2	12	12 bits
	2	16	16 bits
	2	32	32 bits

A6-3.3   Unsigned Integer

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Parameter Type	PTC	PFC	Length	Value/Range
Unsigned Integer	3	0	4 bits	{0...15}
	3	1	5 bits	{0...31}
	3	2	6 bits	{0...63}
	3	3	7 bits	{0...127}
	3	4	8 bits	{0...255}
	3	5	9 bits	{0...511}
	3	6	10 bits	{0...1023}
	3	7	11 bits	{0...2047}
	3	8	12 bits	{0...4095}
	3	9	13 bits	{0...8191}
	3	10	14 bits	{0...16383}
	3	11	15 bits	{0...32767}
	3	12	2 octets	{0...65535}
	3	13	3 octets	{0...2exp24 - 1}
	3	14	4 octets	{0...2exp32 - 1}

A6-3.4   Signed Integer

Parameter Type	PTC	PFC	Length	Value/Range
Signed Integer	4	0	4 bits	{-8...7}
	4	1	5 bits	{-16...15}
	4	2	6 bits	{-32...31}
	4	3	7 bits	{-64...63}
	4	4	8 bits	{-128...127}
	4	5	9 bits	{-256...255}
	4	6	10 bits	{-512...511}
	4	7	11 bits	{-1024...1023}
	4	8	12 bits	{-2048...2047}
	4	9	13 bits	{-4096...4095}
	4	10	14 bits	{-8192...8191}
	4	11	15 bits	{-16384...16383}
	4	12	2 octets	{-32768...32767}
	4	13	3 octets	{-2exp23...2exp23 - 1}
	4	14	4 octets	{-2exp31...2exp31 - 1}

A6-3.5   Real

Parameter Type	PTC	PFC	Length	Sign	Exponent	Fraction
Real	5	1	4 octets	bit 0	bit 1 - bit 8	bit 9 - bit 31
	5	2	8 octets	bit 0	bit 1 - bit 11	bit 12 - bit 63

Two formats for real numbers shall be allowed :

- PC(5,1) : 32-bit single format according to ANSI/IEEE Std 754-1985.

  (used also for internal parameter of DSP21020)

- PC(5,2) : 64-bit double precision format (IEEE standard)

A6-3.5.1   IEEE standard : PC(5,1), PC(5,2)

The simple-precision format and the double-precision format are defined in «IEEE 754 Standard for Binary Floating-Point Arithmetic». The important features of their definitions are repeated here. Each format permits the representation of the numerical values of the form :

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$$(-1)^S \times 2^E \times (b_0 \bullet b_1 b_2 ..... b_{p-1})$$

where :

$b_0 \bullet b_1 b_2 ..... b_{p-1}$ means $b_0/2^0 + b_1/2^1 + b_2/2^2 + ------ + b_{p-1}/2^{p-1}$;

$S = 0$ or 1 ;

E = any integer between E_{min} and E_{max}, inclusive ;

$b_I = 0$ or 1 ;

p = number of significant bits (precision).

Each format also permits the representation of two infinities, «+µ»and«-µ»and special values which are not numbers.

Real numbers in both formats are composed of 3 subfields :

- Sign : unsigned integer, contains the value S

- Exponent : unsigned integer, contains the value E+127 on 8 bits (single precision) or E+1023 (double precision)

- Fraction : bit string, contains the value $\bullet b_1 b_2 ..... b_{p-1}$ with p = 24 (single precision) or p = 53 (double precision)

The encoded value of a single-precision and double-precision real parameter shall be constituted as defined in above table.

The value of a single-precision parameter shall be :

	Value
If exponent = 255 and fraction <> 0	Not a Number
If exponent = 255 and fraction = 0	$(-1)^{sign} \times \infty$
If 0 < exponent < 255	$(-1)^{sign} \times 2^{exponent-127} \times (1.fraction)$
If exponent = 0 and fraction <> 0	$(-1)^{sign} \times 2^{-126} \times (0.fraction)$
If exponent = 0 and fraction = 0	0

The value of a double-precision parameter shall be :

	Value
If exponent = 2047 and fraction <> 0	Not a Number
If exponent = 2047 and fraction = 0	$(-1)^{sign} \times \infty$
If 0 < exponent < 2047	$(-1)^{sign} \times 2^{exponent-1023} \times (1.fraction)$
If exponent = 0 and fraction <> 0	$(-1)^{sign} \times 2^{-1022} \times (0.fraction)$
If exponent = 0 and fraction = 0	0

A6-3.6   Bitstring Parameter (PTC = 6)

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Parameter Type	PTC	PFC	Length
Bitstring	6	1	1 bit
	6	2	2 bits
	6	4	4 bits
	6	8	8 bits

A fixed-length bit-string parameter shall be of the form :

$B_1...B_n$
n bits

Where :

- $B_1....B_n$ are bits ;

- n   is the number of bits and is equal to PFC.

A6-3.7   Octetstring Parameter (PTC = 7)

PFC = 0 :   Variable-length octet string.

PFC > 0 :   Fixed-length octet string with a number of octets equal to PFC.

An Octetstring consists of variable-length or fixed-length sequences of octets, each octet being an ordered sequence of eight bits. The meaning and interpretation of a value shall be application process specific.

When a field of telecommand packet is defined to be of OctetString type (PTC = 7), it cannot be «edited» by spacecraft operator at TC building/sending time.

A variable-length octet-string parameter shall be of the form :

Length	O_1	O_2	- - - - -	O_n
Unsigned Integer	octet	octet		Octet

Where :

- $O_1....O_n$: octets ;

- Length : indicates the number of octets which follows. If the contents of a Variable Octetstring is defined to be a TM/TC-packet the Length-field shall be omitted and the value provided in the Length-field of that Packet shall be used.

A fixed-length octet-string parameter is of the form :

O_1	O_2	- - - -	O_n
octet	octet		octet

Where :

- $O_1....O_n$ are octets ;

- n   is the number of octets and is equal to PFC.

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A6-3.8 Time

Parameter Type	PTC	PFC	Length	Coarse Time	Fine Time	Format
Time	9	17	6 octets	4	2	CUC

The fields «Coarse Time» and «Fine Time» contain the Spacecraft Elapsed Time, consistent with the CCSDS Unsegmented Time Code (CUC) format, as defined in [AD1] without P-field. This field is synchronised to TAI after setting of the on-board time.

A packet end user that can not provide in telemetry a time synchronised with CTR shall flag this by setting the MSB of the Time Field to «1». In this case the meaning of the rest of the field is user specific.

A6-3.9 Deduced

PFC = 0

A type which is unspecified and can only be instantiated to one of the simple types defined in the previous defined ones. Its actual type and encoding format for an instance of the parameter field in a packet is deduced from the value(s) of other preceding parameter field(s) in the packet or from the value(s) of mission constants or a combination of both.

For Herschel / Plank this Deduced parameter type could be used for the reporting of OBCP Status Report : TM(18,13). In this packet, the format and type of the reported OBCP parameter is deduced from the value of OBCP-PID reported at the preceding location in packet. For Herschel / Plank, only 32-bit or 64-bit long OBCP parameters are used.

- 32-bit long OBCP parameters are used for all parameter types (boolean, integer, real single precision, …) except double precision real.

- 64-bit long OBCP parameters are used for double precision real.

A6-3.10 Character-string parameter (PTC = 8)

On-board use of Character-string parameter shall be restricted to the PROM stored identifier of software version.

This restriction does not apply SCOE / EGSE equipments that may use more largely this PTC = 8.

PFC = 0: A variable-length character string.

PFC > 0: A fixed-length character string with a number of characters equal to PFC.

The values that such a parameter can take are variable-length or fixed-length sequences of visible characters (visible characters are defined in ANSI X3.4). A visible character shall be represented by its ASCII code on one octet. The meaning and interpretation of a value is application process specific.

A variable-length character-string parameter shall be of the form :

n	C_1	C_2	- - - - -	C_n
Unsigned Integer	ASCII	ASCII		ASCII

Where :
$C_1…C_n$ are ASCII character codes on 8 bits;
n indicates the number of ASCII character codes which follow.

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A fixed-length character-string parameter shall be of the form :

C_1	C_2	- - - -	C_n
ASCII	ASCII		ASCII

Where :
C1…Cn are ASCII character codes;
n is the number of ASCII character codes and is equal to PFC.

APPENDIX 7: STANDARD SPACECRAFT TIME SOURCE PACKET

#	Reference	1300-A7 a

[P:SCI-PT-RS-07360#3.1-PACK-12. a

The Standard Spacecraft Time Source Packet shall be used to transport the regular Spacecraft Elapsed Time samples to ground for time correlation with UTC by the ground segment during periods of ground contact. Its structure is defined in [AD-1] and it is shown in figure A7-1 below.

SOURCE PACKET HEADER (48 bits)							PACKET DATA FIELD (64 bits)		
PACKET ID				PACKET SEQUENCE CONTROL		PACKET LENGTH	S-FIELD	P-FIELD	T- FIELD
Version Number	Type	Data Field Header Flag	Application Process ID	Segmentation Flags	Source Sequence Count				
3	1	1	11	2	14				
16				16		16	8	8	48

Figure A7-1: Standard Spacecraft Time Source Packet Fields

The time carried by the T-field of the packet shall relate to the instant of occurrence of the leading edge of the first bit of the attached synchronisation marker of the telemetry transfer frame of virtual channel «0» with a virtual channel frame count multiple of 64 (i.e. : equal to «0 modulo 64»).

The field contents of the Standard Spacecraft Time Source Packet header and data field are specified below :

– Packet ID :

• Version Number :

The version number must be set 000_{BIN}.

• Type :

The type must be set to zero.

• Data Field Header Flag :

The data field header flag must be set to zero. No data field header.

• Application Process ID :

The Application process ID shall be set to all zeros.

– Sequence Control :

• Segmentation [Grouping] Flags :

The segmentation flags must be set to «11».

• Source Sequence Count :

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The source sequence count of the time packet must be incremented by 1 whenever the source releases a packet. Ideally, this counter should never re-initialise, however, under no circumstances shall it «short-cycle» (i.e. have a discontinuity other than to a value zero).

The counter wraps around from 2^{14} -1 to zero.

–   Packet Length :

    The packet length field specifies the number of octets contained within the Packet Data Field. The number is an unsigned integer «C» where :

    C = (Number of octets in Packet Data Field) - 1

    In this case, the number of octets is eight (i.e. C=7).

    It should be noted that the actual length of the entire Standard Spacecraft Time Source Packet, including the Packet Header, is 6 octets longer.

–   S-Field :

    Bits 0 through 3 are not used and must be set to zeros.

    Bits 4 through 7 shall be set to a value corresponding to the generation frequency of a Standard time packet

–   P-Field :

    Must be set to «00101110» to indicate that the following time format consists of 4 coarse time octets and 2 fine time octets.

–   T-Field :

    This field will contain the Spacecraft Elapsed Time, consistent with the CCSDS Unsegmented Time Code (CUC) format, This field is synchronised to TAI after setting of the on-board time.

    Bits 0 through 31 must contain the coarse Spacecraft Elapsed Time as an unsegmented binary count of seconds.

    Bits 32 through 47 must contain the fine Spacecraft Elapsed Time as an unsegmented binary power of subseconds.

*

APPENDIX 8: IDLE PACKET STRUCTURE

[P:SCI-PT-RS-07360#3.1-PACK-12. a

The idle packet shall be used to fill the telemetry transfer frame when a frame has to be transmitted and an insufficient number of source packets are available to complete the transfer frame. This may be the case when the source data rate is low compared to the frame period. Its structure is as shown in figure A8-1 below.

SOURCE PACKET HEADER (48 bits)						PACKET DATA FIELD (VARIABLE)
PACKET ID				PACKET SEQUENCE CONTROL		PACKET LENGTH	FILLER PATTERN
Version Number	Type	Data Field Header Flag	Application Process ID	Segmentation Flags	Source Sequence Count		
3	1	1	11	2	14		
16				16		16	Variable

Figure A8-1: Idle Packet Fields

The field contents of the Idle Packet header and data field are specified below :

– Packet ID :

  • Version Number :

    The version number must be set to 000_{BIN}.

  • Type :

    The type must be set to zero.

  • Data Field Header Flag :

    The data field header flag must be set to zero. No data field header.

  • Application Process ID :

    The Application process ID must be set to all ones ($7FF_{hex}$).

– Sequence Control :

  • Segmentation [Grouping] Flags :

    The segmentation flags must be set to «11».

  • Source Sequence Count :

    The source sequence count of the Idle Packet shall be set to 0000_{hex}.

– Packet Length :

    The packet length field specifies the number of octets contained within the Packet Data Field. The number is an unsigned integer «C» where :

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C = (Number of octets in Packet Data Field) - 1

The length of the packet may be chosen freely by the user. It should be noted that the actual length of the entire Idle Packet, including the Packet Header, is 6 octets longer.

– Filler Pattern :

The content of the Idle Packet data field shall be (pseudo-) random data.

*

APPENDIX 9: SATELLITE DATA BUS PROTOCOL SPECIFICATION

The specification provided in Appendix 9 of this ICD, defines the basic electrical and data protocol requirements for instruments and other units, which are connected via a Serial Data Bus according to MIL-STD-1553B to the Data Management Subsystem.

Because it addresses requirements, which are associated with the three lowermost layers of the on-board communication infrastructure (Physical, Data Link, and Transfer Layer), these requirements are treated within this ICD as a self-standing set. They are largely independent from the requirements of the Application Layer (i.e. the specifications for TM/TC packet structures in the main body of this ICD).

Consequently the Appendix 9 is written with its own paragraph numbers, figure and table numbers, and its own list of applicable and reference documents. If references are made to certain paragraphs etc., or to applicable documentation, they refer to the corresponding items of Appendix 9 only.
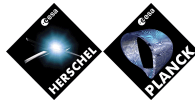
HERSCHEL / PLANCK

PSICD Appendix 9: Satellite Data Bus Protocol Specification

SCI-PT-ICD-07527 (App9)

Product Code : 000 000

Data management : Christiane GIACOMETTI

Entité Emettrice : Alcatel Space - Cannes
(détentrice de l'original) :

THALES

ENREGISTREMENT DES EVOLUTIONS / CHANGE RECORD

Issue	Date	Change Record	Author
4.0	07-Nov-2003	First official release generated by DOORS 5.2 / TREK 3. Legendes of tables and figures are systematically put below table or figure. The requirements deleted in this issue or before will not be displayed in the core of the next issues. They are therefore listed hereafter and displayed in the core of this issue.	F.Sauvage I.Bénilan

List of requirements deleted in issue 4.0 or before

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§2.1	[2025-PHL-]	Deleted in	4.0 or before		
§3.2.3	[3160-DLL-T]	Deleted in	4.0 or before		
§3.2.3	[3161-DLL-T]	Deleted in	4.0 or before		
§3.2.3	[3165-DLL-T]	Deleted in	4.0 or before		
§3.2.3	[3170-DLL-T]	Deleted in	4.0 or before		
§4.1.1	[4065-TFL-T]	Deleted in	4.0 or before		
§4.1.1	[4075-TFL-T]	Deleted in	4.0 or before		
§4.1.1	[4080-TFL-T]	Deleted in	4.0 or before		
§4.1.4.1	[4225-TFL-T]	Deleted in	4.0 or before		
§4.4	[4385-TFL-T]	Deleted in	4.0 or before		
§4.5.2	[4440-TFL-D]	Deleted in	4.0 or before		
§4.5.2	[4445-TFL-T]	Deleted in	4.0 or before		
§4.5.2	[4450-TFL-T]	Deleted in	4.0 or before		
§4.5.2	[4455-TFL-T]	Deleted in	4.0 or before		
§4.5.2	[4460-TFL-T]	Deleted in	4.0 or before		
§4.5.2	[4465-TFL-T]	Deleted in	4.0 or before		
§4.5.2	[4470-TFL-T]	Deleted in	4.0 or before		
§4.5.2	[4475-TFL-T]	Deleted in	4.0 or before		
§4.6.1.1	[4525-TFL-T]	Deleted in	4.0 or before		
§4.6.1.1	[4530-TFL-T]	Deleted in	4.0 or before		
§4.6.1.1	[4535-TFL-T]	Deleted in	4.0 or before		

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§4.6.1.1	[4540-TFL-T]	Deleted in	4.0 or before		
§4.6.1.2	[4670-TFL-D]	Deleted in	4.0 or before		
§4.6.2	[4800-TFL-D]	Deleted in	4.0 or before		
§4.6.2	[4805-TFL-T]	Deleted in	4.0 or before		
§4.6.2	[4810-TFL-T]	Deleted in	4.0 or before		
§4.6.2	[4815-TFL-T]	Deleted in	4.0 or before		
§4.6.2	[4820-TFL-T]	Deleted in	4.0 or before		
§4.6.2	[4830-TFL-T]	Deleted in	4.0 or before		
§4.6.2	[4835-TFL-R]	Deleted in	4.0 or before		
§4.6.2	[4840-TFL-T]	Deleted in	4.0 or before		
§4.6.2	[4845-TFL-R]	Deleted in	4.0 or before		
§4.6.2	[4850-TFL-R]	Deleted in	4.0 or before		
§4.6.2	[4855-TFL-R]	Deleted in	4.0 or before		
§4.6.2	[4860-TFL-T]	Deleted in	4.0 or before		
§4.6.2	[4865-TFL-N]	Deleted in	4.0 or before		

Issue	Date	Change Record	Author
5.0	20-Jul-2004	Issue generated by DOORS 5.2 / TREK 3.2. Requirements modified, new or deleted in this issue: see list below. The requirements deleted in issue 4.0 or before are not displayed in the core of the document.	F.Sauvage

List of requirements modified, new or deleted in issue 5.0

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§3.2.1	[3110-DLL-R]	Modified in	5.0	Modified to cover RT address assignment previously specified in 3115-DLL-D.	H-P-ASP-MN-5160
§3.2.1	[3115-DLL-D]	Deleted in	5.0	Replaced by extended requirement 3110-DLL-R.	H-P-ASP-MN-5160
§4.4	[4392-TFL-R a]	Modified in	5.0	Rectification of TM PTC length (32-bit) in RT Status Data.	H-P-ASP-MN-5160
§4.5.1	[4410-TFL-T]	Modified in	5.0	Clarification of TC packet counter initialisation.	H-P-ASP-MN-5160
§4.5.1	[4425-TFL-T a]	Modified in	5.0	Clarification of requirement for TC PTC evaluation by RT.	H-P-ASP-MN-5160

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§4.6.1.2	[4625-TFL-D a]	Modified in	5.0	Clarification of requirement for TM PTC evaluation by RT.	H-P-ASP-MN-5160

Issue	Date	Change Record	Author
6.0	25 Jan. 2008	Formal release for application. Requirements modified, new or deleted in this issue : see list below. The requirements deleted in issue 4.0 or before are not displayed in the core of the document.	F.Sauvage

List of requirements modified, new or deleted in issue 6.0

§ nb	Req. identifier	Change Status	Doc. issue	Reason of Change	Change Ref.
§1.3	[RD-7]	Modified in	6.0	Update of RD-7 (SOFDIR) issue.	
§1.3	[RD-8]	New in	6.0	Addition of RD-8 (SVM-IFS) as reference document.	
§3.2.1	[3110-DLL-D]	Modified in	6.0	Reference to RD-5 (SVM RS) replaced by reference to RD-8 (SVM-IFS) for definition of SVM RT address.	
§4.5.1	[4410-TFL-T]	Modified in	6.0	Following NCR 3623 : Modification of TC Packet Counter initial value for BC. Requirement completed with TC Packet Counter value in retry.	Outcomes of "HP-350000-ASED-NC-3623".

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1. INTRODUCTION

1.1 Scope of this Specification

The environment for the Satellite Data Bus Protocol (SDBP) is a spacecraft carrying several instruments, which are connected via a serial data bus according to MIL-STD-1553B to the Data Management Subsystem.

A common interface specification is established within this document, which is binding for all units on-board, that exchange data across the data bus. This document is the basis for covering all necessary aspects, which enables a party to design, develop, and test this interface as part of a certain unit in a way, that it communicates properly together with other units of the spacecraft after integration.

This specification is made applicable for the corresponding S/C interfaces of the experiments and for S/C Service Module units. The corresponding details of the data bus and the protocol for certain SVM units are to be specified during Phase B activities.

#	Reference	1000-SDBP-R

Where applicable, this specification refers directly to requirements laid down in AD 1, which are applicable.

		#	*

#	Reference	1010-SDBP-R

For test and verification, the reference values, test methods and procedures, which are defined in Section 100 of AD 2, are directly applicable. For test cases, which are not covered by AD 2, or which are mission-specific, special test procedures have to be defined.

		#	*

1.2 Applicable Documents

#	Reference	AD-1

MIL-STD-1553B, Notice 2, 8.9.1986
DIGITAL TIME DIVISION COMMAND/RESPONSE MULTIPLEX DATA BUS

		#	*

#	Reference	AD-2

MIL-HDBK-1553A, Multiplex Applications Handbook
Department of Defense, 1.11.1988

		#	*

1.3 Reference Documents

#	Reference	RD-1

Herschel / Planck Instrument Interface Document – IID Part A
SCI-PT-IIDA-04624

*

Reference RD-2

Herschel / Planck Packet Structure Interface Control Document PS-ICD
SCI-PT-ICD-07527

*

Reference RD-3

ESA Packet Telemetry Standard
PSS-04-106, Issue 1, 1988

*

Reference RD-4

ESA Packet Telecommand Standard
PSS-04-107, Issue 2, 1992

*

Reference RD-5

SVM Requirements Specification
H-P-4-ASPI-SP-0019

*

Reference RD-6

CDMU HW / SW ICD
P-HPL-ICD-00001-SE, issue 1

*

Reference RD-7

System Operations & FDIR Requirements (SOFDIR)
H-P-1-ASPI-SP-0209, issue 4.4

*

Reference RD-8

SVM Interface Specification, H-P-4-ASPI-IS-0042

#

1.4 Acronyms

AD   Applicable Document

BC   Bus Controller

CCSDS   Consultative Committee for Space Data Systems

CDMS   Command and Data Management Subsystem

ESA	European Space Agency
FDIR	Fault Detection, Isolation and Recovery
H/K	House Keeping
H/W	Hardware
I/F	Interface
ICD	Interface Control Document
kbps	kilobits per second
LSB	Least Significant Bit
MSB	Most Significant Bit
MSByte	Most Significant Byte
PDU	Power Distribution Unit
PSS	Procedures, Specifications and Standards
RD	Reference Document
RT	Remote Terminal
SA	Subaddress
S/C	Spacecraft
SDBP	Satellite Data Bus Protocol
TBC	To Be Confirmed
TBD	To Be Determined
TC	Telecommand
TM	Telemetry

1.5 Bit and Field Numbering Conventions

– Bit numbering

The relation between a 20 bit MIL-Bus word and the Bit Position numbering is given below. For all Data Fields the MSBs correspond to Bit Position 00.

Bit times :	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
Bit # (Bit Position) :	S	S	S	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	P

The most significant bit shall be transmitted first with the less significant bits following in descending order of value in the data word.

See AD 1, paragraph §4.3.

Higher-layer data structures shall be mapped to MIL-Bus words and Messages such that the MSB of these data structures correspond to the MSB of the first word of the first Message belonging to a certain transfer.

1.6 General Conventions

1.6.1 Subaddresses

Subaddress naming in the following chapters is done by using this arrangement :

Subaddress + Number (used range 1-30) + Transmit or Receive

Example :

SA 10 R   - has the meaning : Subaddress Number 10 Receive

1.6.2 Meaning of RT/ Instrument

The meaning of RT (Remote Terminal) / Instrument, which is in the MIL STD 1553B only the bus I/F, encloses in the following chapters the RT, and also the attached subsystems, host controllers and so on. Exceptions are explicitly mentioned.

1.6.3 Meaning of BC

The meaning of BC (Bus Controller), which is in MIL STD 1553B only the bus master, encloses in the following chapters the BC bus I/F, and the Host Controller, and the applications and services behind the bus I/F of the BC.

1.6.4 Requirement Numbering and Verification Methods

The Requirements in this specification are combined with Requirement Identifications.

This Requirement Identification is a combination of :

–   A requirement dedicated number (for tracking purpose)

–   An indication which layer of the (OSI-) communication model is involved :

- PHL - Physical Layer
- DLL- Data Link Layer
- TFL - Transfer Layer

–   The foreseen Verification method for this requirement :

- N -   Not to be tracked
- T -   Test
- R - Review of Design
- A -   Analysis
- I -   Inspection
- D -   Definition

Example :   100-PHL-R,T

Meaning : Requirement no. 100 , Physical Layer, Verification method : Review of Design and Test.

2. PHYSICAL LAYER

2.1 Data Bus Topology

Reference 2005-PHL-R

The data bus topology shall be in accordance to AD 1, see paragraph §4.5, §30.10.

*

Reference 2010-PHL-T

The physical characteristics of the Bus interfaces shall be in accordance with MIL STD 1553 B, see AD1.

*

Reference 2015-PHL-R

All terminals shall use transformer coupled stubs.

*

Reference 2020-PHL-R

The BC shall use transformer coupled stubs.

*

Reference 2025-PHL-

deleted

*

2.2 Data Bus Medium

Reference 2030-PHL-R

The data bus medium shall be a TSP cable with 75 Ohms.

*

Reference 2035-PHL-R

See AD 1, paragraph §4.5, §30.10.

*

2.3 Stubs, Connectors, Shielding

Reference 2040-PHL-R

See AD 1, paragraph §4.5, §30.10.

*

2.4 Electrical Signal Characteristics

#	Reference	2045-PHL-R

See AD 1, paragraph §4.5, §30.10.

*

3. DATA LINK LAYER

3.1 General Requirements

3.1.1 Bus Controller (BC) Functions

#	Reference	3005-DLL-R

The (redundant) Command and Data Management System (CDMS) shall act as Bus Controller (BC).

	#	*

#	Reference	3010-DLL-R

Automated message repetition by the BC in case of transmission errors is authorised.

	#	*

#	Reference	3015-DLL-R

RT to RT transmissions are not foreseen.

	#	*

#	Reference	3020-DLL-R

The usage of broadcast messages is allowed.

	#	*

#	Reference	3025-DLL-R

The BC shall be able to send MIL-Bus messages to the units or instruments working as RTs on the bus.

	#	*

#	Reference	3030-DLL-R

The BC shall support Mode Commands as shown in Table 3.2.4-1 : List of Mode Commands, with the corresponding patterns.

	#	*

#	Reference	3035-DLL-R

The BC shall support the RT SA allocation as shown in Table 3.2.3-1 : SA utilization table.

	#	*

3.1.2 Remote Terminal Functions

Reference   3040-DLL-R

All spacecraft units or instruments connected to the data bus shall act as Remote Terminals (RT).

*

Reference   3045-DLL-R

The RT shall support Mode Commands as shown in table 3.2.4-1 : List of Mode Commands, with the corresponding patterns.

*

Reference   3050-DLL-R

Each RT shall support this SA allocation as shown in Table 3.2.3-1 : SA utilization table.

*

Reference   3052-DLL-R

The RT shall support broadcast messages.

*

3.1.3 Message Formats and Word Formats

3.1.3.1 Word Formats

Reference   3055-DLL-R

The used word formats shall be in accordance to AD 1. See below.

Bit times :	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
Bit # (Bit Position) :	S	S	S	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	P
MIL 1553 B - Command Word :	Sync			RT Address					T/R	Subaddress					Data Word Count					P
MIL 1553 B - RT Status Word :	Sync			RT Address					a	b	c	Reserved ´000´			d	e	f	g	h	P
MIL 1553 B - Data Word :	Sync			Data																P

Figure 3.1.5-1 : Word Formats

Notes:

−   a: Message Error

−   b: Instrumentation

– c: Service Request

– d: Broadcast Command Received

– e: Busy

– f: Subsystem Flag

– g: Dynamic Bus Control Acceptance

– h: Terminal Flag   P= Parity Bit

*

3.1.3.2 Message Formats

Reference   3060-DLL-D

The MIL Bus transfer formats to be utilized are shown in figure 3.1.3.2-1. There are three basic types of messages, which are always initiated by a specific Command of the BC :

*

Reference   3065-DLL-D

– Receive Messages

These messages are sent from the BC to the addressed RT (and/or attached equipment / subsystem), which responds with dedicated actions. There is always a Status Word reply but no Data reply.

*

Reference   3070-DLL-D

– Transmit Messages

These messages are sent from the addressed RT or equipment / subsystems to the BC ; they carry the requested data.

*

Reference   3075-DLL-D

– Broadcast Messages

These messages are used by the BC to send Commands (with or without data) to all RTs in parallel, which initiate dedicated actions at the RTs (e.g. synchronization). There is no status or data reply allowed.

BC to RT Transfer	RECEIVE COMMAND	DATA WORD	DATA WORD	....	DATA WORD	RESPONSE TIME	STATUS WORD	INTER-MESSAGE GAP / NEXT COMMAND WORD
RT to BC Transfer	TRANSMIT COMMAND	RESPONSE TIME	STATUS WORD	DATA WORD	DATA WORD	....	DATA WORD	INTER-MESSAGE GAP / NEXT COMMAND WORD
Mode Command without Data Word	MODE COMMAND	RESPONSE TIME	STATUS WORD	INTER-MESSAGE GAP	NEXT COMMAND WORD			
Mode Command with Data Word (Transmit)	MODE COMMAND	RESPONSE TIME	STATUS WORD	DATA WORD	INTER-MESSAGE GAP	NEXT COMMAND WORD		
Mode Command with Data Word (Receive)	MODE COMMAND	DATA WORD	RESPONSE TIME	STATUS WORD	INTER-MESSAGE GAP	NEXT COMMAND WORD		
Broadcast BC to RT Transfer	RECEIVE COMMAND	DATA WORD	DATA WORD	....	DATA WORD	INTER-MESSAGE GAP	NEXT COMMAND WORD	
Broadcast Mode Command without Data Word	MODE COMMAND	INTER-MESSAGE GAP	NEXT COMMAND WORD					
Broadcast Mode Command with Data Word	MODE COMMAND	DATA WORD	INTER-MESSAGE GAP	NEXT COMMAND WORD				

Figure 3.1.3.2-1 : Used Information Transfer Formats

*

3.1.4 Message Timing

Reference   3080-DLL-T

The timing of messages shall be in accordance to AD 1.

*

Reference   3085-DLL-R

The BC No Response Timeout shall be adjusted to 14 microsecond.

*

THALES

3.2 Command Word

Reference 3090-DLL-D

See figure 3.1.5-1 : Word formats

*

Reference 3095-DLL-T

The utilization of the Command Word shall be in compliance to AD 1, § 4.3.3.5.1.

*

3.2.1 RT Address Field

Reference 3100-DLL-N

Each Remote Terminal (RT) connected to a MIL Bus has a unique address, which allows the Bus Controller (BC) to communicate with selected equipment. The address range for equipment is 1 to 30. Address 0 is reserved. Address 31 is used for broadcast.

*

Reference 3105-DLL-R

The RT Address shall be configurable via an external connector of the RT unit, see AD1 § 30.3.

*

Reference 3110-DLL-R

The RT Address of all onboard units shall be as specified in RD 1 to instruments contractors and RD 8 to SVM contractor.

*

Reference 3115-DLL-D

deleted

*

Reference 3120-DLL-N

Notes :

– One RT Address must be reserved for BC, because of H/W and testing needs.

– An implementation example of an address connector is shown in Figure 3.2.1-1. All Address- and Parity lines have pull up resistors, so that a ‚0' on a line is coded by connecting it to common secondary return (secondary zero volt), as shown below. The type of Parity is odd.
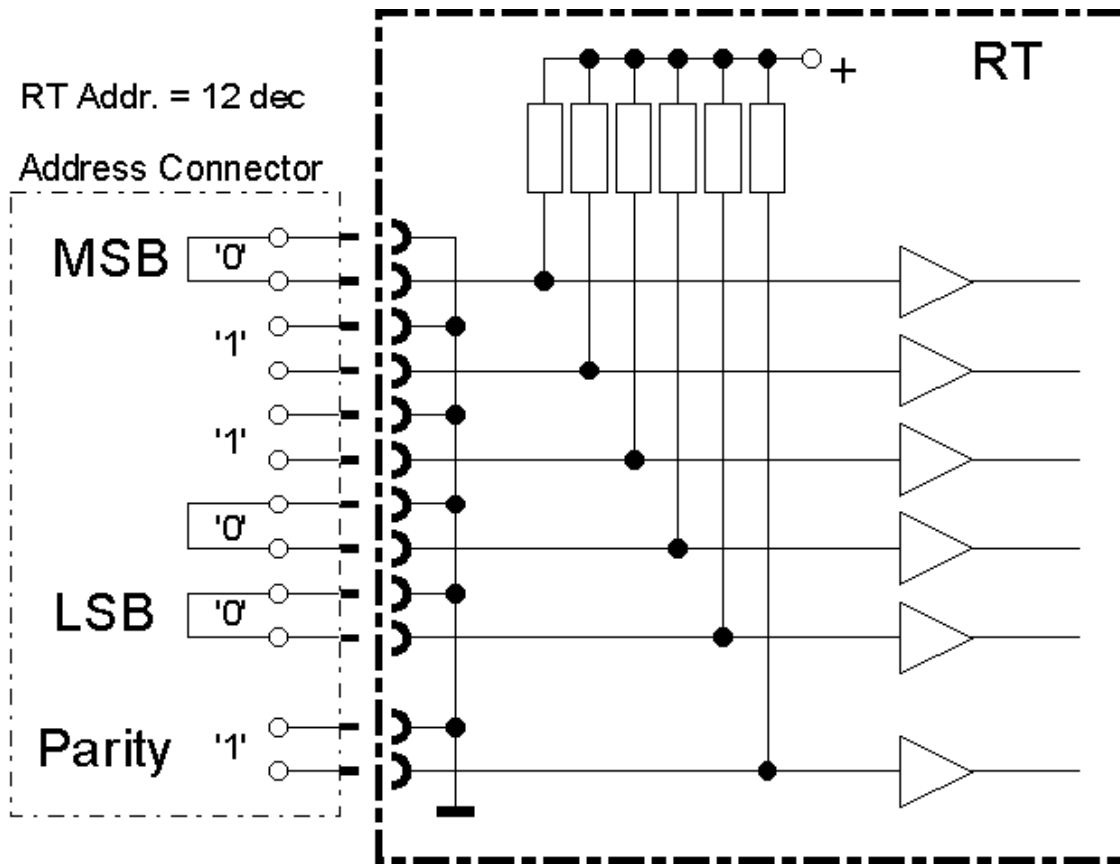
Figure 3.2.1-1 : Principle of RT Address Coding via Connector Pin Functions (Odd Parity)

---

*

3.2.2 T/R Bit Field

Reference 3125-DLL-T

The usage of this bit shall be in accordance to AD1 § 4.3.3.5.1.3.

*

Reference 3130-DLL-N

A logic zero indicates that the RT shall receive data from the BC and a logic one indicates that the RT shall transmit data to the BC.

*

3.2.3 Subaddress/ Mode Field

Reference 3135-DLL-R

The allocation of Subaddresses (SAs) shall be as shown in table 3.2.3-1 : SA utilization table.

*

Reference 3140-DLL-D

Subaddress (dec.)	Transmit T	Receive R
0	reserved for Mode command	reserved for Mode command
1	Unit status data	Unit control
2	Data send	Data receive
3	Data send	Not used
4	Data send	Not used
5	Not used	Not used
6	Not used	Not used
7	Data send	Data receive
8	Internal Time	Time Messages
9	Data send	Data receive
10	TM Packet Transfer Request	TM Packet Transfer Confirmation
11	TM Data send MSBytes	TC Data receive MSBytes
12	TM Data send	TC Data receive
13	TM Data send	TC Data receive
14	TM Data send	TC Data receive LSBytes
15	TM Data send	Data receive
16	TM Data send	Data receive
17	TM Data send	Data receive
18	TM Data send	Data receive
19	TM Data send	Data receive
20	TM Data send	Data receive
21	TM Data send	Data receive
22	TM Data send	Data receive
23	TM Data send	Data receive
24	TM Data send	Data receive
25	TM Data send	Data receive
26	TM Data send LSBytes	Data receive
27	TC Packet Transfer Confirmation	TC Packet Transfer Descriptor
28	Low Level Command – Status	Low Level Command
29	Data send	Data receive
30	Data Wrap read	Data Wrap write
31	reserved for Mode command	reserved for Mode command

Table 3.2.3-1 : SA Utilization Table

*

– Usage of Subadresses :

Reference 3145-DLL-T

Mode command   (SA 0, 31)

Compliant to the MIL STD 1553B, see AD1.

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*

Reference   3150-DLL-R

Unit status data   (SA 1T)

Via this SA the RT shall provide H/K data and status data about the RT/ unit.

*

Reference   3155-DLL-T

Unit control   (SA 1R)

Via this SA the RT shall receive unit related Low Level commands.

*

Reference   3160-DLL-T

deleted

*

Reference   3161-DLL-T

deleted

*

Reference   3165-DLL-T

deleted

*

Reference   3170-DLL-T

deleted

*

Reference   3175-DLL-R

Internal Time   (SA 8T)

This SA is reserved for a read of the local/ internal time and clock status of a unit.

*

Reference   3180-DLL-T

Time messages   (SA 8R)

By using this SA the BC shall distribute time information on the bus. The time message shall be send as broadcast message to all RTs.

*

Reference   3185-DLL-T

TM Packet Transfer Request   (SA 10T)

The RT provides via this SA its request for a TM packet transfer.

#　*

#　Reference　3190-DLL-T

TM Packet Transfer Confirmation　　　　　　(SA　10R)

The BC shall place here, after reading the TM packet from the RT, the Confirmation message.

#　*

#　Reference　3195-DLL-T

TM Data send　　　　(SA　11 - 26T)

This SA contains the nominal TM packet data. The data shall be transferred with its MSByte first.

#　*

#　Reference　3200-DLL-T

TC Data receive　　　　(SA 11 - 14R)

This SA contains the nominal TC packet data. The data shall be transferred with its MSByte first.

#　*

#　Reference　3205-DLL-T

TC Packet Transfer Descriptor　　　　(SA　27R)

To this SA the BC shall send the Control words to inform the RT about the presence of a new TC packet.

#　*

#　Reference　3210-DLL-T

TC Packet Transfer Confirmation　　　　　　(SA　27T)

The RT shall place here, after reading the TC packet from the BC, the Confirmation message.

#　*

#　Reference　3215-DLL-T

Low Level Command　　　　(SA　28R)

This SA is reserved for low level commanding of RTs.

#　*

#　Reference　3220-DLL-T

Low Level Command - Status　　　　(SA　28T)

This SA is reserved for supporting a low level command execution status.

#　*

#　Reference　3225-DLL-R

Data send　　　　(SA　2,3,4,7,9,29T)

Unused Transmit SA.

*

Reference 3230-DLL-R

Data receive   (SA 2,7,9,15 – 26,29R)

Unused Receive SA.

*

Reference 3235-DLL-T

Data Wrap read   (SA 30T)

SA used for test purpose, see AD1and AD2.

The implementation of this feature is mandatory for the RT.

*

Reference 3240-DLL-T

Data Wrap write   (SA 30R)

SA used for test purpose, see AD1 and AD2.

The implementation of this feature is mandatory for the RT.

*

Reference 3242-DLL-T

Subaddress Allocation, non-intelligent Remote Terminals

For non-intelligent Remote Terminals (which do not handle TM/TC-Packets) the same SAs as for Packet Terminals/ RTs shall be used for standardized functionalities. For nominal data transfer the Subaddresses SA 11T/R to SA 26T/R may be used and/or Subaddresses identified as unused.

*

– Data Word Count/ Mode Code Field

Reference 3245-DLL-T

The Data Word Count Field indicates the quantity of data words to be transferred to/ from the BC. It shall be used according to AD1 § 4.3.3.5.1.5.

*

Reference 3250-DLL-D

In case the Subaddress Field is set to ´00000´or ´11111´ the BC and RTs shall support Mode Commands as follows :

Mode Command	Pattern (bin)	Assigned SA (bin)	See AD 1 § No. :	Supported by :			
				BC	S/C RTs non intelligent	S/C RTs	Instrument RTs
Dynamic Bus Control	00000	00000	4.3.3.5.1.7.1	NO	NO	NO	NO
Synchronize (without data word) *)	00001	00000	4.3.3.5.1.7.2	YES	YES	YES	YES
Transmit Status Word	00010	00000	4.3.3.5.1.7.3	YES	YES	YES	YES
Initiate Self-test **)	00011	00000	4.3.3.5.1.7.4	YES	YES	YES	YES
Transmitter (TX) Shut-Down	00100	00000	4.3.3.5.1.7.5	YES	YES	YES	YES
Override TX Shut-Down	00101	00000	4.3.3.5.1.7.6	YES	YES	YES	YES
Inhibit Terminal Flag	00110	00000	4.3.3.5.1.7.7	YES	YES	YES	YES
Override Inhibit Terminal Flag Bit	00111	00000	4.3.3.5.1.7.8	YES	YES	YES	YES
Reset Remote Terminal **)	01000	00000	4.3.3.5.1.7.9	YES	YES	YES	YES
Transmit Vector Word	10000	00000	4.3.3.5.1.7.11	YES	YES	YES	YES
Synchronize (with data word) *)	10001	00000	4.3.3.5.1.7.12	YES	YES	YES	YES
Transmit Last Command	10010	00000	4.3.3.5.1.7.13	YES	YES	YES	YES
Transmit BIT (Built-In Test data) Word **)	10011	00000	4.3.3.5.1.7.14	YES	YES	YES	YES
Selected TX Shut Down (SD)	10100	00000	4.3.3.5.1.7.15	NO	NO	NO	NO
Override Selected TX SD	10101	00000	4.3.3.5.1.7.16	NO	NO	NO	NO
Remaining Possible Command pattern (reserved for future use)	All other	00000	4.3.3.5.1.7.10 4.3.3.5.1.7.17	N/A	N/A	N/A	N/A

*) These Mode Commands are used as Broadcast Commands

**) According to the MIL1553B Standard, the Remote Terminal on the bus is not the total unit/equipment connected to a MIL Bus, but the interfacing circuitry only (e.g. MIL Bus chip set or H/W including the necessary buffers). E.g. the ‚Reset Remote Terminal' command described in the MIL 1553B Standard, does not reset the unit/equipment itself, but the interface only. The MIL Bus chip set is affected, not the unit.

Table 3.2.4-1 : List of Mode Commands with the corresponding patterns.

---

*

Reference 3255-DLL-N

Certain functions of Mode Commands are used within the Data Bus Protocol , details are specified in chapter 4 of this specification. Further Mode Command usage is unit specific and must be specified in the User Manual of each RT.

---

*

3.3 RT Status Word

3.3.1 Status Word structure

See figure 3.1.5-1 : Word formats

3.3.2 Status Word bits

Reference 3260-DLL-T

After the reception of any MIL Bus message (except a MIL Bus broadcast message), a RT responds with a status word which shall be in accordance with A.D 1, § 4.3.3.5.3.

*

Reference 3265-DLL-D

The status word has the following content :

Bit #	Bit Meaning	Supported by RT	Status indication
0-4	Address of responding RT	YES	none
5	Message Error	YES	‚1'=yes , ‚0'=no
6	Instrumentation	YES	set to zero
7	Service Request	YES	‚1'=yes , ‚0'=no
8-10	Reserved	YES	set to zero = ´0´
11	Broadcast Command Received	YES	‚1'=yes , ‚0'=no
12	Busy	YES	‚1'=yes , ‚0'=no
13	Subsystem Flag	YES	‚1'=fault , ‚0'=no fault
14	Dyn. Bus Control Acceptance	YES	set to zero
15	Terminal Flag (RT fault)	YES	‚1'=fault , ‚0'=no fault

Table 3.3.2 -1 : MIL Bus RT Status Word

*

Reference 3270-DLL-T

The RT shall support the Status Word Flags as shown in Table 3.3.2 -1 : MIL Bus RT Status Word.

*

Reference 3275-DLL-R

The RT shall support at least the Status word bits as required by AD 1 § 30.5.2., The use of the Service Request bit, Subsystem Flag bit, the Busy bit, and the Terminal Flag bit shall be defined by each RT in its User Manual.

*

3.4 Data Word

3.4.1 Data Word Structure

Reference 3280-DLL-N

See figure 3.1.5-1 : Word Formats

*

3.5 Data Link Layer FDIR

3.5.1 Conditions for Invalid/ Illegal Transfers on the DLL

Reference 3285-DLL-

The MIL Bus Data Link Layer FDIR shall be performed according to SOFDIR Annex 1 (RD7) and IID-A (RD1) requirements.

*

3.5.2 Management of Bus Errors

3.5.2.1 Scope of MIL Bus-level FDIR

Reference 3300-DLL-D

The MIL Bus FDIR has the capability to manage the bus redundancy switch-over. This function collects the data necessary to monitor the status of the communications on the bus, isolates bus medium failure, and performs an automatic reconfiguration of the bus from communication medium A to communication medium B as necessary to maintain the integrity of the bus communication path.

The MIL Bus FDIR also collects FDIR data from the MIL Bus that is also relevant to RT equipment FDIR. For example, if a RT does not answer anymore on the bus, this may be because the MIL Bus communication medium is cut, or because the RT itself has failed or has been powered OFF. The bus FDIR will first try to isolate whether the error is caused by a bus failure or not. If a RT failure is confirmed instead, the failure shall be managed by a RT FDIR function. The data bus FDIR will report the error to the equipment FDIR layer.

The present section 3.5.2 describes the main principles for MIL Bus-level FDIR. These principles are detailed in SOFDIR (RD7) and in the IID-A (RD1).

*

3.5.2.2 Interfaces necessary to support Bus-level FDIR

Reference 3305-DLL-D

No specific RT interface is required to support MIL Bus FDIR. Only standard and mandatory features of the MIL-STD-1553B protocol are used.

For failure detection, the MIL Bus FDIR relies on nominal data traffic, and does not generate additional specific data traffic. Only for failure isolation a specific data traffic is generated.

*

Reference 3310-DLL-T

The following bus FDIR error conditions shall be collected by the MIL Bus communication service in the BC :

– RT message error bit,   (from RT MIL-STD-1553B Status Word)

– RT Busy bit,   (from RT MIL-STD-1553B Status Word)

– RT subsystem flag bit,   (from RT MIL-STD-1553B Status Word)

– RT Terminal flag bit,   (from RT MIL-STD-1553B Status Word)

– RT transmission error,   (from BC Bus I/F)

– RT no response time-out,   (from BC Bus I/F)

– BC loop back test fail,   (from BC Bus I/F)

*

3.5.2.3 Ground command interfaces for bus FDIR

Reference 3320-DLL-T

The following MIL Bus FDIR related commands shall be provided for usage by ground/ mission control or for usage by on-board functional layers.

– Switch to bus medium A

– Switch to bus medium B

– Disable bus automatic reconfiguration function

– Enable bus automatic reconfiguration function

*

Reference 3340-DLL-T

The format of these commands is to be defined in the CDMU HW/SW ICD.

*

3.5.2.4 Functional Requirements of Bus-level FDIR

Reference 3345-DLL-T

By default, the BC shall use bus medium A.

*

Reference 3350-DLL-T

If the BC Bus FDIR isolates a failure on bus A, the whole MIL Bus traffic shall be reconfigured on bus B.

*

\# Reference 3355-DLL-T

No automatic reconfiguration from bus B to bus A shall be implemented. In case a further failure occurs on bus B, no further autonomous recovery is triggered, and the traffic is maintained on bus B.

\#   *

\# Reference 3360-DLL-T

The BC shall provide the Bus A/B switch status to Ground/ Mission Control.

\#   *

\# Reference 3365-DLL-T

The isolation of the bus failure shall be an automatic procedure performed by the BC, sampling the status of bus B via dedicated asynchronous messages, while the main traffic remains on bus A. A bus failure is confirmed if bus B is sampled OK, while bus A is sampled as failed, see Figure 3.5.2.4-1 below.

\#   *

\# Reference 3370-DLL-T

If the bus channel A was used, and a bus error is detected, an automatic and global (for all messages exchanged with all RTs) switch to bus channel B is performed.

\#   *

\# Reference 3375-DLL-T

BC detected bus error condition for bus switch-over are :

– RT No response time out

– RT Transmission error

– BC Loop-back test error

Further details are given in SOFDIR Annex 1 (RD7) and IID-A (RD1).

\#   *

\# Reference 3380-DLL-T

This switch shall be effective within SOFDIR Annex 1 (RD7) defined delay.
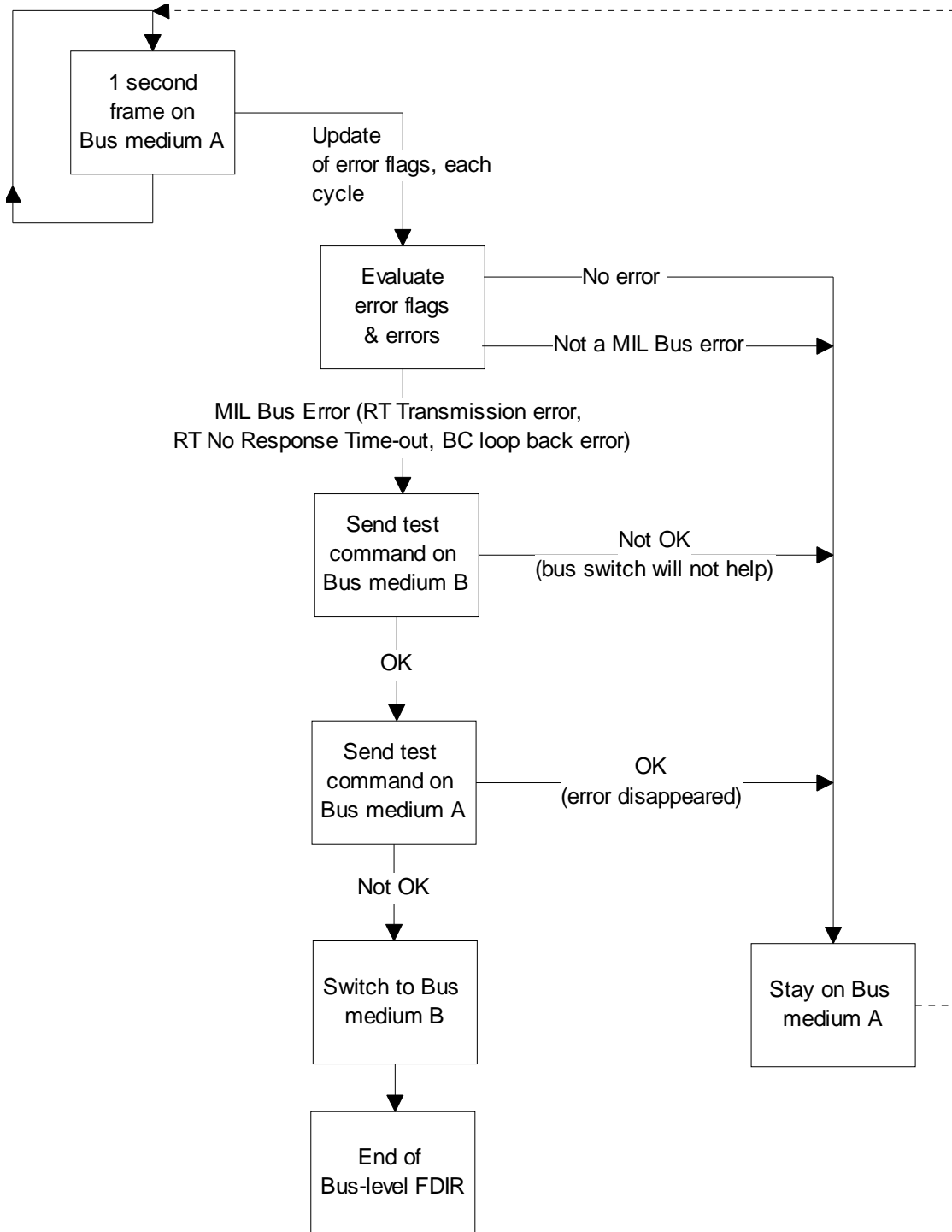
Figure 3.5.2.4-1 : Principle of MIL Bus failure isolation

3.5.2.5 Interface of Bus-level FDIR to Equipment FDIR

Reference 3385-DLL-T

The BC shall support an I/F to system-level FDIR and/ or equipment FDIR.

*

Reference 3390-DLL-T

The error conditions shall be reported to higher level FDIR, see Figure 3.5.2.5-1.

*

Reference 3395-DLL-R

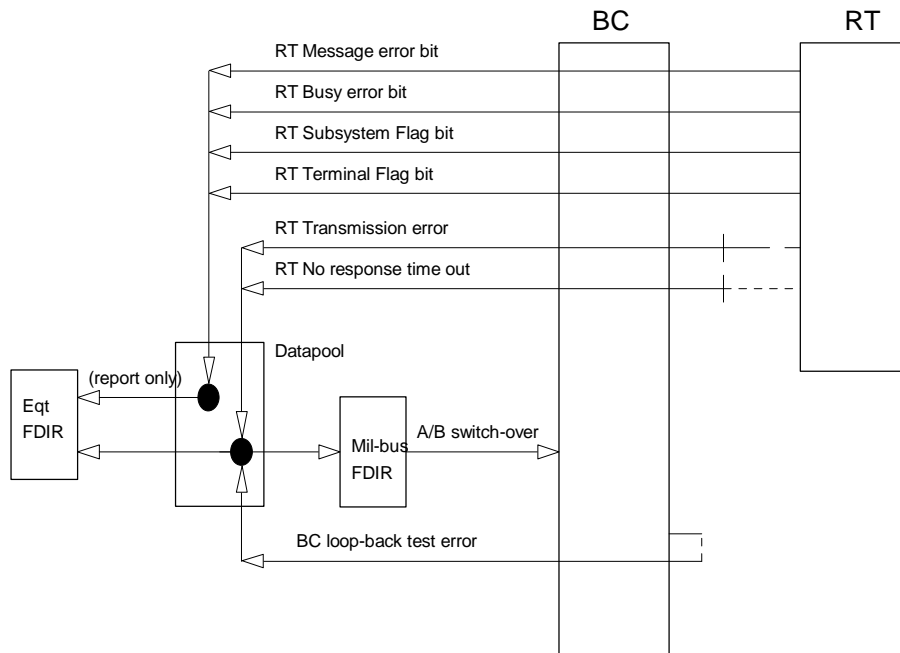The RTs shall provide dedicated FDIR services in line with requirements of the SOFDIR (RD7) and IID-A (RD1).

Figure 3.5.2.5-1 : MIL Bus FDIR concept.

*

4. TRANSFER LAYER

4.1 General Requirements

4.1.1 Functional and Performance Requirements

Reference 4005-TFL-R

BC MIL-Bus messages and RT response messages shall be assigned to predefined time slots.

*

Reference 4010-TFL-T

Maximum throughput for all users shall be at least 350 kbps on TM/TC packet level.

*

Reference 4015-TFL-T

The minimum latency for a single user between the end of a packet transfer and the start of a new transfer of the same type (TM or TC) shall be 2,5 milliseconds.

*

Reference 4020-TFL-R

The maximum size of TM-Packets shall be 1024 octets.

*

Reference 4025-TFL-R

The maximum size of TC-Packets shall be 248 octets.

*

Reference 4030-TFL-T

The BC and RT shall support the transfer of TM/TC-Packets with variable length.

*

Reference 4040-TFL-R

One complete packet shall be exchanged with a user without interruptions for the user (RT).

*

Reference 4045-TFL-T

The BC shall support each second the exchange of at least 50 TM-Packets.

*

\#   Reference   4050-TFL-T

The BC shall support each second the exchange of at least 12 TC-Packets.

\#   *

\#   Reference   4060-TFL-T

The BC shall support each second the exchange of at least 1 time synchronization.

\#   *

\#   Reference   4065-TFL-T

deleted

\#   *

\#   Reference   4070-TFL-T

The accuracy for timing and synchronization across all on-board systems up to the data interface of users shall be better than 100 microseconds.

\#   *

\#   Reference   4075-TFL-T

deleted.

\#   *

\#   Reference   4080-TFL-T

deleted

\#   *

\#   Reference   4085-TFL-T

Each on-board user shall be served in a periodic way for at least two times per second.

\#   *

\#   Reference   4090-TFL-N

Note : The actual data traffic may be a combination of all data types described above.

\#   *

4.1.2 Cyclic Transfer Protocol

\#   Reference   4100-TFL-R

The cyclic Satellite Data Bus Protocol (SDBP) shall have a deterministic, periodic structure, which is synchronized with the central on-board time, implemented in the CDMS.

\#   *

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\#   Reference   4105-TFL-R

The SDBP shall be based on a 1 second period called Frame. This Frame is divided into 64 Subframes, each containing a number of MIL STD 1553B messages. These messages shall occur in a Subframe within a defined timing structure called Message Slots.

\#   *

\#   Reference   4110-TFL-R

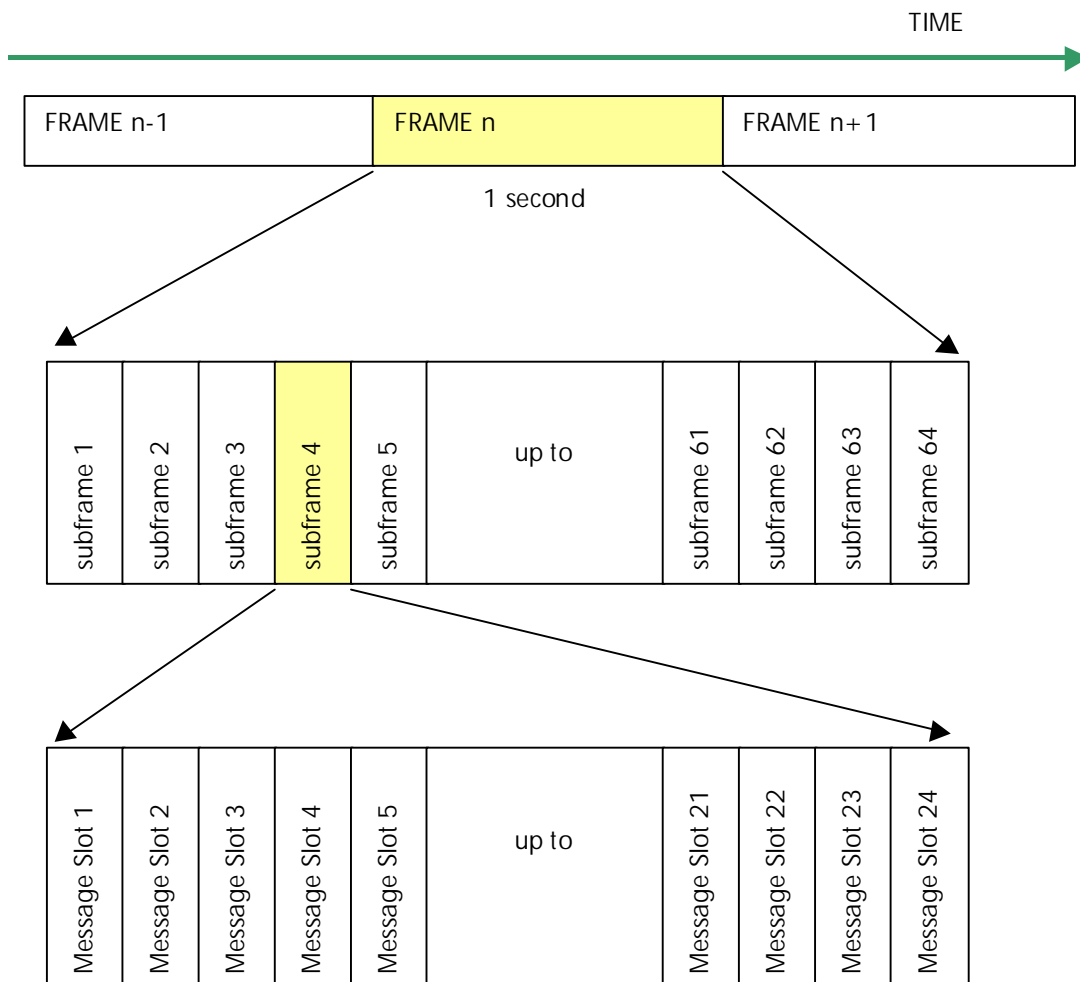The TM Packet transfer from a RT (Instrument) to the CDMU shall be Subframe allocated. This means that any Instrument TM Packet shall fit into the Subframe boundaries.

Figure 4.1.2-1 : Data Bus profile

Definition:

–   1 FRAME = 64 SUBFRAMES

–   1 SUBFRAME = 24 MESSAGE SLOTS

Duration:

–   1 FRAME = 1 second

–   1 SUBFRAME = 1/64 second

– 1 SLOT = see Table 4.1.3.1-1

*

4.1.3 Frame Timing

Reference 4120-TFL-R

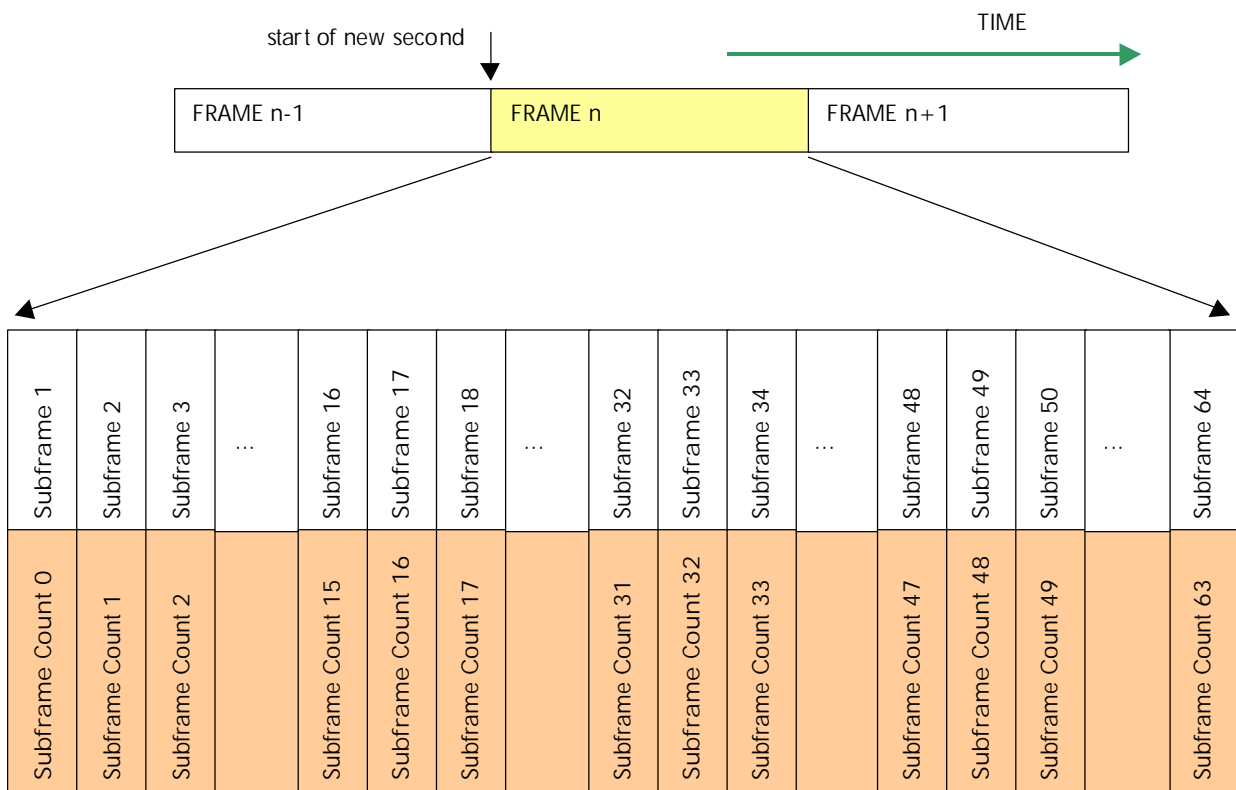One second / one Frame shall be divided into 64 Subframes.

Figure 4.1.3-1 : Subframe and Subframe count

*

Reference 4125-TFL-R

The first Subframe every second shall start with the Mode Command "Sync without Data word" in the first message slot.

*

Reference 4130-TFL-R

This Subframe is reserved and no instrument TM data transfer is allowed (TC packets may be sent).

*

Reference 4135-TFL-N

Note : This provides time for the instrument internal processes like clock (time) maintenance, etc.

Subframe	Subframe Count	Usage
1	0	First Subframe in the second, reserved for TC Packet transfer
2 to 16	1 to 15	TM Packet transfer (or TC Packet)
17	16	reserved for TC Packet transfer
18 to 32	17 to 31	TM Packet transfer (or TC Packet)
33	32	reserved for TC Packet transfer, Time information distribution
34 to 48	33 to 47	TM Packet transfer (or TC Packet)
49	48	reserved for TC Packet transfer
50 to 64	49 to 63	TM Packet transfer (or TC Packet)

Table 4.1.3-1 : Subframe Utilization

*

Reference   4140-TFL-R

At least Subframes 1, 17, 33,49 shall be reserved for TC Packet transfer.

Note : If more TC Packets than can be routed during Subframes 1, 17, 33, 49 are needed in a certain operational phase, more than 4 Subframes can be allocated to TC Packet handling.

*

Reference   4145-TFL-T

In Subframe 33 the time information shall be distributed.

*

Reference   4150-TFL-R

The remaining Subframes (60 out of 64) shall be used for TM packet transfers (TC packets may be send also).

*

Reference   4155-TFL-R

The Mode Command "Sync with Data word" is inserted into the first message slot of Subframes 2 to 64. Further details are specified in para. 4.2

*

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4.1.3.1 Subframe Timing

Slot No.	Content/ Purpose	Duration in micro seconds
1	Subframe synchronization	150
2	Command/ Acquisition Slot	750
3	Command/ Acquisition Slot	750
4	Command/ Acquisition Slot	750
5	Data transfer, Most Significant Message	750
6	Data transfer	750
7	Data transfer	750
8	Data transfer	750
9	Data transfer	750
10	Data transfer	750
11	Data transfer	750
12	Data transfer	750
13	Data transfer	750
14	Data transfer	750
15	Data transfer	750
16	Data transfer	750
17	Data transfer	750
18	Data transfer	750
19	Data transfer	750
20	Data transfer	750
21	Packet control (e.g. polling)	150
22	Packet control	150
23	Packet control	150
24	Regulation Slot	≤ 775

Table 4.1.3.1-1 : Message Slot Allocation Table

\#   Reference   4160-TFL-R

Subframe synchronization : In the first Subframe every second the Mode Command Sync distributed as broadcast message will be used. In all other Subframes the broadcast message Mode Command Sync with Data Word will be utilized.

\#   *

\#   Reference   4165-TFL-R

The Regulation Slot (slot No. 24) duration shall be adjusted in accordance to subframe message duration.

\#   *

\#   Reference   4170-TFL-T

The BC shall support the Slot Allocation according to Table 4.1.3.1-1 with respect to their timing constrains.

For Packet-Terminals TM- or TC-Packet-data shall be transferred during message slots 5 to 20, as needed. For non-intelligent RTs data can be transferred with a message slot allocation similar to Packet-Terminals, and in addition in slots 2 to 4 and 21 to 23, as needed.

In a certain Subframe it shall be possible to exchange Messages with one or several RTs. This applies for TC-Packets and related handshake, handshake in conjunction with TM-Packets, and for non-intelligent RTs.

\#   *

4.1.4 Data Transfer

4.1.4.1 General

\#   Reference   4175-TFL-N

The BC will be commanded by ground to activate one of several predefined fixed Bus Profiles. Each Bus Profile defines the function of all 64 Subframes, which belong to a cyclic 1 second frame. Each set-up is static for a longer period of time (typically for up to some hours). All instruments will be commanded independently into modes, in which they stay below their allocated maximum data rates.

\#   *

\#   Reference   4180-TFL-T

The BC shall accept ground commands for activating, deactivating, and modifying predefined Bus Profiles for data transfer.

\#   *

\#   Reference   4185-TFL-T

The BC shall support predefined Bus Profiles and shall use different Profiles without interruption of service.

\#   *

\#   Reference   4190-TFL-T

The RT shall accept ground commands which will start predefined operational modes.

\#   *

\#   Reference   4195-TFL-T

Each packet transfer is controlled by the exchange of a Packet Transfer Request/Descriptor and a Packet Transfer Confirmation, which are providing the necessary (handshake) information about the transfer.

\#   *

\#   Reference   4200-TFL-T

At the latest with the receiving of a next Subframe Sync Message the RT shall check the status of the packet transfer, that has taken place in the previous Subframe.

\#   *

If the packet transfer was performed, then the RT:

Reference 4205-TFL-T

– shall update the TM packet data buffer within 2 msec.

*

Reference 4210-TFL-T

– shall update the TM Packet Transfer Request Words within 2 msec.

*

Reference 4220-TFL-R

Only one TM packet transfer from each RT at a time is allowed. If there is more than one packet to be send the RT shall queue the TM packets.

*

Reference 4225-TFL-T

deleted

*

Reference 4230-TFL-R

TM packets shall be transferred within one Subframe.

*

Reference 4235-TFL-R

Transmission of multiple small TM Packets should be avoided and the RT should generate maximum length packets as much as possible for an optimised utilisation of allocated RT data rate.

*

4.1.4.2 Packet transfer control commands

Reference 4240-TFL-T

The BC and RT shall support Packet Transfer Requests via SA 10T and Packet Transfer Descriptors via SA 27R.

*

Reference 4245-TFL-D

For control purposes Packet Transfer Requests and Descriptors are introduced. Each of them consists out of two words.

Each sender, BC in case of TC packets or RT in case of TM packets, shall provide the following parameters with these words :

– The number of needed messages
– The number of words in the last message (equal to the word count pattern).

Details are defined in chapter 4.5 for TC Packet transfer and chapter 4.6 for TM Packet transfer.

*

Reference 4250-TFL-R

Each receiver shall utilize this information to re- assemble the TM or TC packet.

*

4.2 Frame Synchronization by BC

Reference 4260-TFL-T

In the first Subframe each second the BC shall issue the Broadcast Mode Command Synchronize, transmitted in the first message slot .

*

Reference 4265-TFL-T

The BC shall issue in all other Subframes the Broadcast Mode Command Synchronize with Data Word, transmitted in the first message slot .

*

Reference 4270-TFL-T

The distributed word formats shall be as shown below.

Broadcast Mode Command Synchronize	MIL BUS COMMAND	Sync	RT Address 11111	T/R 1	SA 00000	Mode code 00001	Parity

| Broadcast Mode Command Synchronize with Data Word | MIL BUS COMMAND | Sync | RT Address 11111 | T/R 0 | SA 00000 | Mode code 10001 | Parity |
| | DATA WORD | Sync | Subframe User 5 bit | Reserved bits 5 bit | | Subframe Count 6 bit | Parity |

Figure 4.2-1 : Subframe Synchronize messages

*

– Subframe User

Reference 4275-TFL-T

In the Subframe User field the BC shall insert the RT address of the Remote Terminal, which is allowed to send its TM data contained in SA 11T to SA 26T.

*

Reference 4280-TFL-T

If this Subframe is not allocated to an specific RT/ Instrument, the BC shall insert ´00000´B in this field.

THALES

*

Reference   4285-TFL-T

Any RT, which is not in Burst Mode, shall not interpret the field as a command or enable signal.

*

–   Subframe Count field

Reference   4290-TFL-T

In the Subframe Count field the BC shall transmit the Subframe Count value.

*

Reference   4295-TFL-T

The RT shall support an internal Subframe Counter and shall provide the value for BC access, see chapter 4.4.

*

Reference   4300-TFL-T

When receiving the first Subframe each second the Subframe Counter shall be set to 0 and the RT shall increment this value by one with every received Sync with Data Word command.

*

4.3 Time Synchronization

Reference   4305-TFL-T

The BC shall provide system time information (Central Time Reference) via the MIL Bus.

*

Reference   4310-TFL-T

The time information shall be a broadcast message send to SA 8R.

*

Reference   4315-TFL-R

The layout of this message is shown in figure 4.3-1.

*

Reference   4320-TFL-T

The BC shall send the time information in Subframe no. 33 (Subframe count : 32).

*

Reference   4325-TFL-T

The value of the time information field shall be the time at the beginning of the next frame. Reference is the beginning of the Mode Command Synchronize of Subframe 1.

THALES

*

Reference 4330-TFL-T

The relative accuracy of the time information shall be max. 100 microseconds with respect to the system time (CTR) of the BC.

*

Reference 4335-TFL-R

The BC shall provide the Central Time Reference signal to an external test I/F for verification purpose.

*

Reference 4340-TFL-T

The time format shall be CUC-TAI with Coarse Time (seconds) using 4 octets and two octets for Fine Time, see RD 3.

*

| Bit # (Bit Position): | S | S | S | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | P |

| MIL 1553 B Command Word: | Sync | RT Address (= 31) | T/R = 0 | Subaddress (= 8) | Data Word Count (= 4) | P |

Data Words:

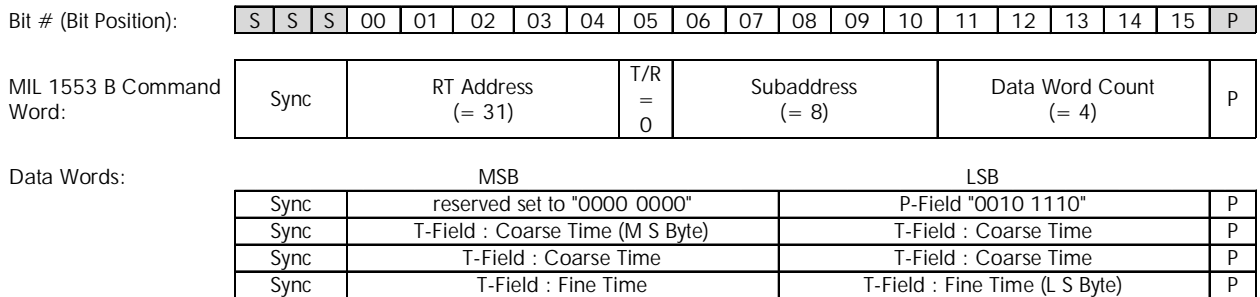|	MSB	LSB	
Sync	reserved set to "0000 0000"	P-Field "0010 1110"	P
Sync	T-Field : Coarse Time (M S Byte)	T-Field : Coarse Time	P
Sync	T-Field : Coarse Time	T-Field : Coarse Time	P
Sync	T-Field : Fine Time	T-Field : Fine Time (L S Byte)	P

Figure 4.3-1: Time Distribution Broadcast Message

Reference 4345-TFL-T

The RT shall copy the Time Message to SA 8T immediately after receiving the Mode Command Synchronize at the beginning of each Frame. In order to reflect subsecond-timing, further updates can be made in a user-specific way.

At initialisation, before receiving any valid Time Distribution Message, the RT shall set the buffer at SA 8T to zero.

*

4.4 Status Polling

Reference 4350-TFL-T

The BC shall acquire the RT status data from SA 1T at least once in a second.

*

Reference 4355-TFL-T

The RT shall provide its health status data and additional information.

*

Reference 4360-TFL-T

The RT status information shall be available via SA 1T using the layout shown in figure 4.4-1 below.

*

Reference 4365-TFL-T

SA 1R shall be available to receive RT Low Level Commands, see also 4490-TFL, (e.g. Start of BIT, Reset, etc.).

*

| Bit # (Bit Position): | S | S | S | 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | P |

Data Words:

	MSB	LSB	
Sync	Reserved	Subframe count	P
Sync	BIT data	BIT data	P
Sync	TM Packet Transfer Confirmation (1 st word)		P
Sync	TM Packet Transfer Confirmation (2 nd word)		P
Sync	Reserved	Invalid TM Subframe count	P
to	…	…	P
Sync	TBD	TBD	P

Figure 4.4-1 : RT Status Data Format.

– First data word :

Reference 4370-TFL-T

– reserved bits : These bits shall be set to zero.

*

Reference 4375-TFL-T

Subframe count : Here the RT shall provide either :

– a fixed pattern (in case of non-packet RTs)

    or

– a copy of the RT internal Subframe count value (used for intelligent RTs)

*

Reference 4385-TFL-T

deleted

*

– Second data word :

Reference 4390-TFL-R

In the second data word the RT shall provide :

– BIT information

- dynamic status (e.g. Watchdog)

- other health information

*

- Third and Fourth data word :

Reference 4392-TFL-R a

In the third and fourth words the RT shall provide either :

- a fixed pattern (in case of non-packet RTs)

    or

- Copy of the TM Packet Transfer Confirmation of the last invalid TM (used for intelligent RTs). Layout of the TM Packet Transfer Confirmation is given in Table 4.6.1.2-1.

*

- Fifth data word :

Reference 4393-TFL-T

- reserved bits : These bits shall be set to zero.

*

Reference 4394-TFL-T

- Subframe count : Here the RT shall provide either :

Ø a fixed pattern (in case of non-packet RTs)

    or

Ø a copy of the RT internal Subframe count value for the last invalid TM packet (used for intelligent RTs)

*

Reference 4395-TFL-T

Further details of the layout shall be defined on a user-specific basis.

*

4.5 Telecommand Packet Delivery

4.5.1 Nominal TC Packet Delivery Mechanism (BC to RT)

Reference 4400-TFL-T

The BC shall send in the same Subframe all messages belonging to a TC packet followed by the Packet Transfer Descriptor message.

*

THALES

\# Reference 4405-TFL-T

For TC Packet Descriptor command word layout see table 4.5.1-1.

Note : To provide bus throughput capability there are at least 4 Subframes reserved for commanding.

\# *

\# Reference 4410-TFL-T

Each RT and the BC shall provide, for each Remote Terminal Address, a circular TC Packet counter for command identification within the Transfer Layer.

At RT initialisation or restart, this TC Packet counter shall be set to 0.
The 8-bit TC Packet counter shall wrap-around from 255 to 0.

At BC initialisation or restart, this TC Packet counter shall be set to 1.
The 8-bit TC Packet counter shall wrap-around from 255 to 2.
If TC Packet Confirmation from RT to the initial TC packet (with TC Packet counter = 1 in TC PTD) is erroneous, the BC shall perform the second attempt (retry) required by SOFDIR (RD 7) with the same TC packet and TC Packet counter = 2 in TC PTD.

Note : This requirement (valid only for BC initialisation or restart) supersedes requirement "HP-SOFDIR-1553-REQ-0200" in RD 7.

\# *

\# Reference 4415-TFL-T

The TC packet shall be send to TC Data receive SAs, beginning with SA 11R.

\# *

\# Reference 4420-TFL-T

The Packet Transfer Descriptor shall be send to SA 27R.

\# *

\# Reference 4421-TFL-T

1. Data word (Packet size)				2. Data word (Packet Control)		
(3 Bit)	(5 Bit)	(3 Bit)	(5 Bit)	(6 Bit)	(2 Bit)	(8 Bit)
Reserved ´000´	No. of messages for TC-next packet	Reserved ´000´	No. of Data Words in the last message of the TC- packet	Reserved, set to ´00 0000´	set to ´01´	Packet Count

Table 4.5.1-1 : Layout of the TC Packet Transfer Descriptor (BC to RT SA 27R)

– Reserved bits :

These bits are reserved for later use. The bits shall be set to zero.

– No. of messages for TC packet :

This data field indicates the number of messages needed for the packet the BC is intending to send. The first message of a TC Packet is always stored at SA 11T, in accordance to table 3.2.3-1 SA utilization table.

– No. of Data Words in the last message of the next TC Packet :

This data field indicates the number of data words transmitted in the last message. In case of 32 words this field is set to "00000"B.

Data packets always have a size of n x 16 Bit. As there shall be always an even number of octets no fill area is foreseen.

*

Reference 4425-TFL-T a

The RT shall evaluate the TC Packet Transfer Descriptor after receiving of the next Subframe Sync, within one Subframe.

Evaluation of the TC PTD consists in :

- TC PTD 'reserved' bits verification (i.e. : TC PTD = [000X XXXX 000X XXXX 0000 0001 XXXX XXXX]$_{BIN}$). In case of verification failure the associated TC packet shall be rejected.

- Comparison of the Packet Count from the received TC PTD with the previously received TC PTD Packet Count.

  Ø If no difference is found the associated TC packet shall be rejected.

  Ø If a difference is found the associated TC packet shall be accepted (new TC packet).

*

Reference 4430-TFL-T

The RT shall store the new TC packet immediately, within the Subframe, and copy the associated words of the Packet Transfer Descriptor to SA 27T, to become the TC Packet Confirmation. For the layout see table 4.5.1-2 below.

1. Data word (Packet size)				2. Data word (Packet Control)		
(3 Bit)	(5 Bit)	(3 Bit)	(5 Bit)	(6 Bit)	(2 Bit)	(8 Bit)
Reserved ´000´	No. of messages of the last packet	Reserved ´000´	No. Of Data Words in the last message of the last packet	Reserved, ´00 0000´	Reserved ´01´	Packet Count

Table 4.5.1-2 : Layout of the TC Packet Confirmation (from RT, SA 27T)

*

Reference 4435-TFL-N

Figure 4.5.1-1 describes the main principles of RT behaviour for nominal data transfer. Details of bus FDIR are given in SOFDIR (RD7) and in IID-A (RD1).

*

THALES

\#   Reference   4440-TFL-T

The BC shall check the TC Packet Confirmation not earlier than 3 Subframes after a TC Packet has been sent to a certain RT. In case the reception of a TC Packet is not confirmed by a RT, the BC shall report immediately, within one Subframe, to the Transfer Layer FDIR.
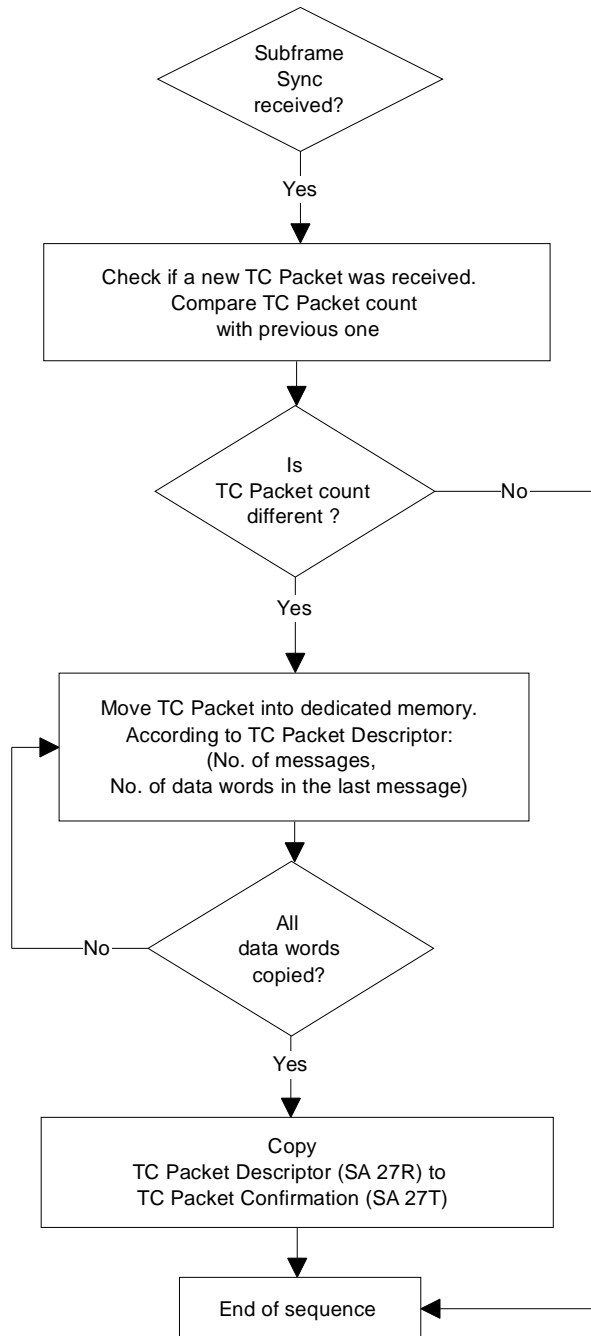

Figure 4.5.1-1: Principle of RT behaviour for TC Packet transfer

---

4.5.2 High-Priority TC Messages

Not used

#	Reference	4440-TFL-D

deleted

		#	*

#	Reference	4445-TFL-T

deleted

		#	*

#	Reference	4450-TFL-T

deleted

		#	*

#	Reference	4455-TFL-T

deleted

		#	*

#	Reference	4460-TFL-T

deleted

		#	*

#	Reference	4465-TFL-T

deleted

		#	*

#	Reference	4470-TFL-T

deleted

		#	*

#	Reference	4475-TFL-T

deleted

		#	*

4.5.3 Low level commanding

#	Reference	4480-TFL-T

Sending of Low Level Commands to non-intelligent RTs shall be possible via a dedicated SA (Low Level Command SA 28R).

*

Reference 4485-TFL-T

For low level command verification a separate Transmit SA (SA 28T) shall be supported.

*

Reference 4490-TFL-T

Sending of Low Level Commands to RTs for Unit Control purpose shall be possible via SA 1R.

*

Reference 4495-TFL-T

The BC shall support Low Level Commands according to the CDMU HW/SW ICD, RD 6.

*

4.6 Telemetry Packet Retrieval

4.6.1 Nominal TM Packets

4.6.1.1 RT TM Packet Transfer Request

Reference 4500-TFL-T

The RT shall request a TM packet transfer (RT to BC) by setting its TM Packet Transfer Request control words (SA 10T).

1. Data word (Packet size)				2. Data word (Packet Control, Event handling)				
(3 Bit)	(5 Bit)	(3 Bit)	(5 Bit)	(2 Bit)	(1 Bit)	(2 Bit)	(3 Bit)	(8 Bit)
Reserved ´000´	No. of messages for next packet	Reserved ´000´	No. of Data Words in the last message of next packet	Reserved ´00´	Burst Mode	Flow control	Reserved ´000´	Packet Count

Table 4.6.1.1-1 : Layout of the Packet Transfer Request

*

– Reserved bits

Reference 4505-TFL-T

These bits are reserved for later use. The bits shall be set to zero.

*

– No. of messages for next packet

\#   Reference   4510-TFL-T

This data field indicates the number of messages needed for the packet the RT is intending to send in the next Subframe. The first message of a TM Packet is always stored at SA 11T.

In accordance to table 3.2.3-1 SA utilization table.

\#   *

– No. of Data Words in the last message of the next TM Packet

\#   Reference   4515-TFL-T

This data field indicates the number of data words transmitted in the last message. In case of 32 words this field is set to "00000"B.

\#   *

\#   Reference   4520-TFL-D

Data packets always have a size of n x 16 Bit. Because they are build out of a even number of bytes there is no fill area foreseen.

\#   *

\#   Reference   4525-TFL-T

deleted

\#   *

\#   Reference   4530-TFL-T

deleted

\#   *

\#   Reference   4535-TFL-T

deleted

\#   *

\#   Reference   4540-TFL-T

deleted

\#   *

– Burst Mode

\#   Reference   4545-TFL-T

0 - Nominal Mode

\#   *

\#   Reference   4550-TFL-T

1 - Burst Mode

\#   *

– Flow control

Meaning of Flow Control pattern :

\# Reference 4555-TFL-T

00 - No transfer pending

\# *

\# Reference 4560-TFL-T

01 - Transfer is pending

\# *

\# Reference 4565-TFL-T

10 - reserved

\# *

\# Reference 4570-TFL-T

11 - Transfer is finished (this pattern is used by BC only)

\# *

\# Reference 4572-TFL-T

The RT shall set the Flow Control field according to the status of TM transfers immediately (i.e. within 2 ms after the beginning of a Subframe).

\# *

– Packet Count

\# Reference 4575-TFL-D

This field is used to support a RT-generated counter. By using a counter, which is incremented with every new request, and which is returned to the RT after a successful transfer, the RT is able to detect the completion of a specificTM packet transfer, even if successive packets are identical in size.

To avoid that after an RT initialisation or reset an identical packet number will be used, there is one number foreseen for that case. This number does never appear in the cyclical transmission, it is skipped in the normal sequence.

\# *

\# Reference 4580-TFL-T

No check on (the completeness of) the sequence will be performed by the BC depending on the Packet Count value.

\# *

\# Reference 4585-TFL-T

The RT shall support a circular Packet Counter (increment counter).

\# *

\#   Reference   4590-TFL-T

The allowed range during nominal operation is 1 to 255 decimal.

\#   *

\#   Reference   4595-TFL-T

After initialization or restart the RT shall set the counter value to 0 for the first TM Packet Transfer.

\#   *

\#   Reference   4600-TFL-R

The RT is not allowed to use this counter for any other purpose than defined in this chapter (Packet Counter).

\#   *

\#   Reference   4605-TFL-T

The BC shall identify a new TM Packet Transfer Request by comparing the Packet Counter value with the previous one.

\#   *

\#   Reference   4610-TFL-T

If these values are identical the BC shall ignore the request, except if a retry attempt is made (i.e. the BC has declared a last TM-packet transfer failed and the same TM-packet is acquired a second time).

\#   *

4.6.1.2 TM Packet Confirmation from the BC

\#   Reference   4625-TFL-D a

The RT, which has requested a TM packet transfer, must be able to determine, if the packet transfer was performed and the next packet data can be loaded to the message buffers. After a successful packet transfer the BC sends a handshake signal to the sending RT (TM Packet Confirmation). This handshake informs the RT which packet was the last one transmitted, by returning a modification of the Packet Transfer Request including the last Packet Count value and a transfer status.

RT shall perform, at a minimum, the following check :

- Verification of Flow control bits = «Transfer is finished» (i.e. : TM PTC bit 19 and bit 20 = $[11]_{BIN}$).

- Comparison of the Packet Count from TM PTC with the Packet Count sent in the TM PTR.

In case of failure in one of these checks, RT shall not require any new TM packet transfer

\#   *

\#   Reference   4630-TFL-T

The BC shall support a TM packet transfer handshake by using the TM Packet Transfer Confirmation.

\#   *

\# Reference 4635-TFL-T

The BC shall send this Command to SA 10R.

\# *

\# Reference 4640-TFL-T

The layout is shown in the table 4.6.1.2-1, see below.

\# *

\# Reference 4645-TFL-T

The BC shall send the TM Packet Confirmation in the same Subframe in which the TM Packet transfer was performed.

1. Data word (Packet size)				2. Data word (Packet Control)					
(3 Bit)	(5 Bit)	(3 Bit)	(5 Bit)	(1 Bit)	(1 Bit)	(1 Bit)	(2 Bit)	(3 Bit)	(8 Bit)
Reserved ´000´	No. of messages of the last TM packet	Reserved ´000´	No. of Data Words in the last message of the last packet	Reserved ´0´	Reserved ´0´	Burst Mode	Flow control	Reserved ´000´	Packet Count

Table 4.6.1.2-1 : Layout of the TM Packet Transfer Confirmation

\# *

\# Reference 4650-TFL-D

The first data word is a duplication of the first Packet Transfer Request control word acquired from the RT :

The second data word shall contain all necessary information for the handshake purpose :

\# *

– Packet Count

\# Reference 4655-TFL-T

This field shall be identical to the packet count field of the TM packet which was acquired.last.

\# *

\# Reference 4660-TFL-R

The packet count value itself is with no further meaning.

\# *

– Flow control

\# Reference 4665-TFL-T

After a successful transfer the Flow Control is set by the BC to :11 - Meaning of Flow Control pattern : Transfer is finished.

---

*

Reference   4670-TFL-D

deleted

---

*

Reference   4675-TFL-N

Figure 4.6.1.2-1 illustrates the main principles of logical flow of BC Sequence behaviour for nominal data transfer. Details of bus FDIR are given in SOFDIR (RD7) and in IID-A (RD1).
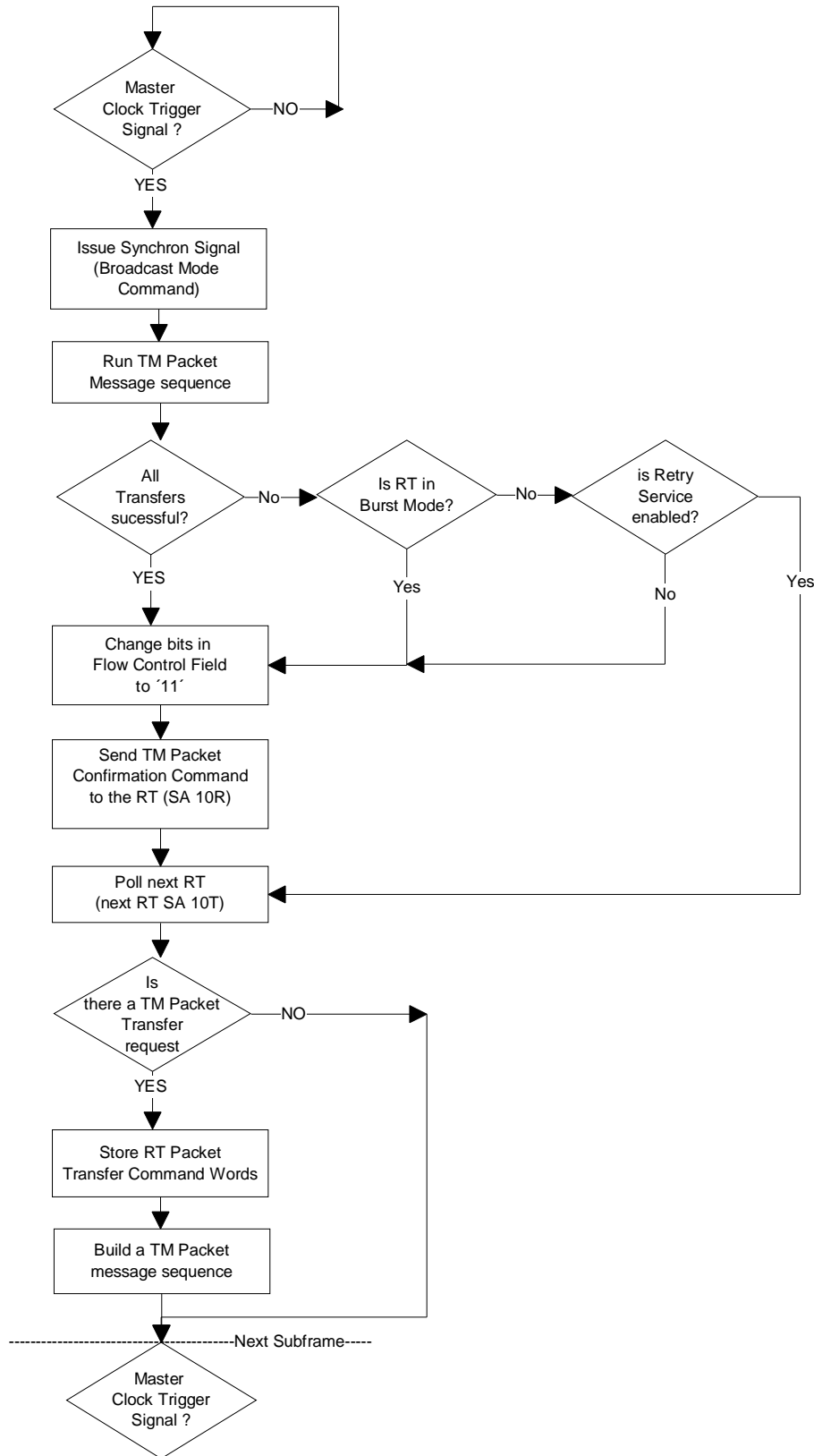
Figure 4.6.1.2-1: BC Subframe Sequence

*

4.6.1.3 TM Packet Transfer mechanism

Reference 4685-TFL-T

– Initialization

After the BC has been commanded by ground to execute a predefined bus traffic profile (or the BC makes use of a default profile after initialisation/ reset) it shall starts the polling of the RTs.

The RT shall request a TM packet transfer (RT to BC) by setting its TM Packet transfer control words (SA 10 Transmit).

At least one Subframe before the next scheduled TM packet transfer for a certain RT, the BC shall poll the RT for a need of transfer. This will be done by reading the RT TM Packet Transfer Request words from SA 10T.

*

4.6.1.4 Normal Data Bus Mode

Reference 4690-TFL-T

– Packet Delivery

If there was a packet transfer request, the BC shall acquire this TM Packet within the next Subframes by using as many transmit message commands as requested by the RT.

After the valid transmission (no error occurred) the BC sends the Transfer Confirmation message to the RT within that Subframe, see chapter 4.6.1.2 .

After the occurrence of a transmission error for any message involved in the transfer (request, packet, and confirmation) the transfer shall be declared unsuccessful, the TM-packet shall be discarded, no TM Transfer Confirmation is sent, and one retry shall be conducted in one of the next Subframes.

The RT shall check the content of the Confirmation message at the latest after receiving of the next Mode Command Synchronize. If the transfer is confirmed by the BC, the RT shall modify the TM Transfer Request according to the current status. It shall also prepare the next data packet transfer, if new data are available. No further transfer of a TM-packet from the RT will occur in this Subframe in Normal Data Bus Mode.

If a new TM packet shall be sent (in any Subframe), the RT shall load the new TM Packet Data and the new TM Packet Request Command within 2 msec after beginning of the Subframe.

Figure 4.6.1.3-1 illustrates the logical flow of RT Sequence behavior.

*

Reference 4695-TFL-T

– End of Transfer

In case there is no new TM packet pending the RT shall set the first word of the TM Packet Transfer Request to ´0000 0000´B, and the Packet Count value of the second word shall stay unchanged.

The Flow Control field bits shall be set to ´00´.

*

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4.6.1.4.1 Burst Data Bus Mode

#	Reference	4700-TFL-T

– Burst Data Bus Mode Initialization :

Burst Data Bus Mode is used in the case that the needed data throughput for one RT is so high that several consecutive Subframes have to be used to acquire the TM Packet data from this RT.

After receiving the corresponding Telecommand the BC changes to a Bus Profile, with which data from one RT can be transferred in Burst Mode (while data from all other RTs are acquired as in Normal Data Bus Mode). Independently, the Burst-Mode –RT may be commanded into a configuration, in which TM-packets are generated at high rate in line with allocations.

*

#	Reference	4720-TFL-T

– Burst Data Bus Mode Packet Delivery :

The RT in Burst Mode shall use fixed TM Packet sizes for Science TM-packets.

The Science TM-packets shall have their maximum size of 1024 octets.

The Burst Mode shall be indicated by the RT by setting the bit in the Burst Mode Field of the TM Packet Transfer Request Words (see chapter 4.6).

After the BC has acquired the RT´s TM Packet Transfer Request message, the BC shall acquire in one of the following Subframes the TM Packet (SA 11T to SA 26T), and shall send TM Packet Transfer Confirmation Command words belonging to this TM Packet to SA 10R.

The BC shall perform the polling of the RT in burst mode by reading the RT TM Packet Transfer Request Words (SA 10T) immediately after the acquisition and confirmation of the last TM Packet.

The BC shall not check the validity of a last packet transfer and shall not support any retry on packet level.

In the Burst Mode the RT shall provide an update of the TM Packet Transfer Request (SA 10T) and the TM Packet Transfer messages (SA 11T to SA 26T) according to following timing :

- In the Burst Mode the TM Packet Transfer Request, SA 10T, is updated either after :

  Ø The Subframe has started and the RT address of the RT in Burst Mode was transmitted in the Data word of the Synchronization message

    or after

  Ø The requested TM Packet Transfer has actually started in this Subframe. This is detected by the BC-access to SA 11T.

- In the Burst Mode the TM Packet output buffers (SA 11T to SA 26T) shall be updated either after

  Ø Receiving of the BC TM Packet Transfer Confirmation message (SA 10R)

    or after

  Ø The next Subframe is started and the RT address of the RT in Burst Mode was transmitted within the Synchronization message within 2 msec after beginning of the Subframe.

*

THALES

Reference 4740-TFL-T

   –   End of Transfer :

     In case there is no new TM packet pending in Burst Data Bus Mode the RT shall indicate End of Transfer as in Normal Data Bus Mode.

*

4.6.2 High Priority TM Messages

Not used

Reference 4800-TFL-D

deleted

*

Reference 4805-TFL-T

deleted

*

Reference 4810-TFL-T

deleted

*

Reference 4815-TFL-T

deleted

*

Reference 4820-TFL-T

deleted

*

Reference 4830-TFL-T

deleted

*

Reference 4835-TFL-R

deleted

*

Reference 4840-TFL-T

deleted

*

#	Reference	4845-TFL-R

deleted

		#	*

#	Reference	4850-TFL-R

deleted

		#	*

#	Reference	4855-TFL-R

deleted

		#	*

#	Reference	4860-TFL-T

deleted

		#	*

#	Reference	4865-TFL-N

deleted

		#	*

4.7 Transfer Layer FDIR

#	Reference	4900-TFL-T

The BC shall generate an error report to higher protocol layers for any error detected at message-level.

		#	*

#	Reference	4904-TFL-T

If in case of a retry no success is achieved, the BC shall declare the whole transfer (incl. handshake messages) failed at Transfer Layer, with corresponding reporting.

		#	*

#	Reference	4905-TFL-T

Further details, because of their dependence on details of CDMS-design are to be included in a dedicated CDMU FDIR Spec., RD 7 and/or CDMU HW/ SW ICD, RD 6.

		#	*

4.8 Data Rate Monitoring

Reference   4910-TFL-T

The BC bus protocol layers shall provide information to the higher application layers of the BC about the amount of acquired TM data per RT and per second.

*

Reference   4915-TFL-N

Further details, because of their dependence on details of CDMS-design are to be included in a dedicated CDMU HW/SW ICD, RD 6.

*

- End of Document -

THALES