REFERENCE : H-P-1-ASPI-IS-0121

DATE : 07/Nov/01

ISSUE : 01 Page : 1/48

ALCATEL SPACE

HERSCHEL / PLANCK

EGSE INTERFACE Requirements Specification
H-P-1-ASPI-IS-0121

Product Code: 00000

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(détentrice de l'original) :

ENREGISTREMENT DES EVOLUTIONS / *CHANGE RECORDS*

ISSUE	DATE	§ : DESCRIPTION DES EVOLUTIONS *§ : CHANGE RECORD*	REDACTEUR *AUTHOR*
01	07/Nov/01	First issue.	

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1 SCOPE

The purpose of this document is to establish, in a single document, and in an unambiguous way, the interface definitions that are used by the different EGSE constituents (Platform and Instrument), to communicate between each other.

This document is composed of two main parts :

- **§ 4 - EGSE INTERNAL INTERFACE REQUIREMENTS** describes the communication protocol used between CCS and all EGSE's item in order to emit commands and receive data.
  RC and RM paragraphs are split according to the LAN used to transmit data (SCOE/DFE LAN, IS LAN or www LAN).

- **§ 5 - EGSE EXTERNAL INTERFACE REQUIREMENTS** describes all electrical harness (connector, pin allocation, etc…) :
  - between each EGSE and the UUT (SVM, PLM, Spacecraft)
  - between EGSE item (ex : TT&C SCOE TM/TC DFE)

Nota : All TBD's to be defined during phase B.

2 DOCUMENTS

2.1 Standards

Ref.	Reference of document	Title
S1	H-P-1-ASPI-SP-0110	Ground Support Equipment Applicability Matrix of ECSS-E-40B
S2	ESA-PSS-04-105	TM Packet Standard
S3	ESA-PSS-04-106	TC Packet Standard
S4	SCI-PT-IF-07527	*Herschel/Planck Packet Structure Interface Control Document (PS-ICD)*

2.2 Reference Documents

Ref.	Reference of document	Title
RD1	HSCDT-TN-017	Understanding of the Interfaces between the CCS and the Herschel Instrument EGSEs in the IST

2.3 Applicable Documents

Ref.	Reference of document	Title
AD1	H-P-1-ASPI-SP-0045	EGSE General Requirements Specifications
AD2	H-P-1-ASPI-SP-0082	H-P System Database Specification
AD3	S2K-MCS-ICD-0001-TOS-GCI SRON-G/HIFI/ICD/2001-001 PACS-ME-??-???	SCOS-2000 Database Import ICD Herschel EGSE Packet Router ICD HCSS-Test Control ICD (Java version)
AD4	NDIU3-DR-0001-GSY ROS-MOC-NDIU-GSY RO-ESC-RS-5002	NDIU3 for ROSETTA SVT's Design Report NDIU3 for ROSETTA SVT's Usre Manual I/F ROSETTA Gateway – TM/TC FEE (NDIU lite)
AD5	TBD	Interfaces between the CCS and the Herschel Instrument EGSEs

2.4 Acronyms

Abbreviation	Signification
AIT	**A**ssembly, **I**ntegration and **T**est
AOCS	**A**ttitude **O**rbit **C**ontrôl **S**ystem
BCE	**B**attery **C**harge Equipment
BER	**B**it **E**rror **R**ate
BHC	**B**loc **H**ouse **C**onsole
BOB	**B**reak **O**ut **B**ox
BPSK	**B**i **P**hase **S**hift **K**eying
CCS	**C**entral **C**heckout **S**ystem
CCSDS	**C**onsultative **C**ommittee for **S**pace **D**ata **S**ystems
CLCW	**C**ommand **L**ink **C**ontrol **W**ord
CLTU	**C**ommand **L**ink **T**ransmission **U**nit
COTE	**C**heck **O**ut **T**erminal **E**quipment
EGSE	**E**lectrical **G**round **S**upport **E**quipment
EMC	**E**lectro**M**agnetic **C**ompatibility
FEE	**F**ront **E**nd **E**quipment
HK	**H**ouse **K**eeping
HPSDB	**H**erschel/**P**lanck **S**ystem **D**ata**B**ase
IF or I/F	**I**nter**F**aces
JU	**J**unction **U**nit
LAN	**L**ocal **A**rea **N**etwork
MMI	**M**an **M**achine **I**nterface
MTBF	**M**ean **T**ime **B**etween **F**ailure[1]
MTTR	**M**ean **T**ime **T**o **R**epare[2]
MOC	**M**ission **O**peration **C**enter
NDIU	**N**etwork **D**ata **I**nterface **U**nit
NRZ-L	**N**on **R**eturn to **Z**ero-**L**evel
NRZ-M	**N**on **R**eturn to **Z**ero-**M**ark
OBCP	**O**n-**b**oard **C**ontrol **P**rocedures
OBSW	**O**n **B**oard **S**oft**W**are
PIPE	**P**acket **I**nterface **P**rotocol for **E**GSE
PPS	**P**ulse **P**er **S**econd
RF	**R**adio **F**requency
SAS	**S**olar **A**rray **S**imulator
SCOE	**S**pecific **C**heck **O**ut **E**quipment
SDB	**S**atellite **D**ata**b**ase
SIS	**S**pacecraft **I**nterface **S**imulator
TBC	**T**o **B**e **C**onfirmed
TBD	**T**o **B**e **D**efined
TM/TC	**T**ele**m**etry & **T**ele**c**ommand
UTC	**U**niversal **T**ime **C**oordinated
VC	**V**irtual **C**hannels

[1] Average time between two breakdown of the system
[2] Average time before complete repair of the system

3 GENERAL DESCRIPTION

3.1.1 FUNCTIONAL DESCRIPTION

This document is applicable to each EGSE equipment used for system AIT.

This document is the interface control document which contains the interface description applicable to the EGSE constituents as designed for the Herschel/Planck Satellites. Following communication paths between the CCS and the SCOE's are defined :

- Telemetry
- Telecommand
- SCOE Monitoring
- SCOE Commands

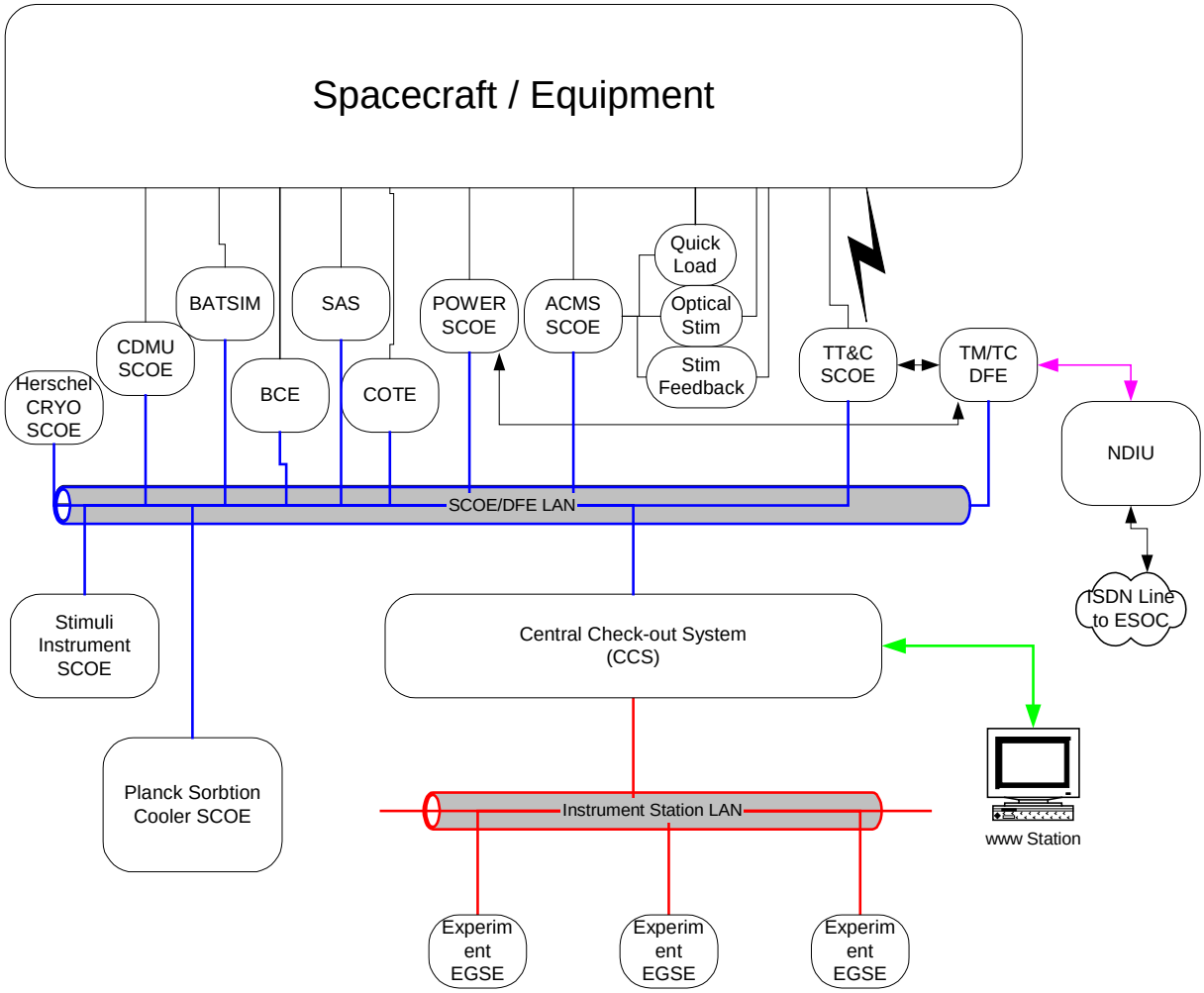


Figure 1 : Overview of the EGSE architecture

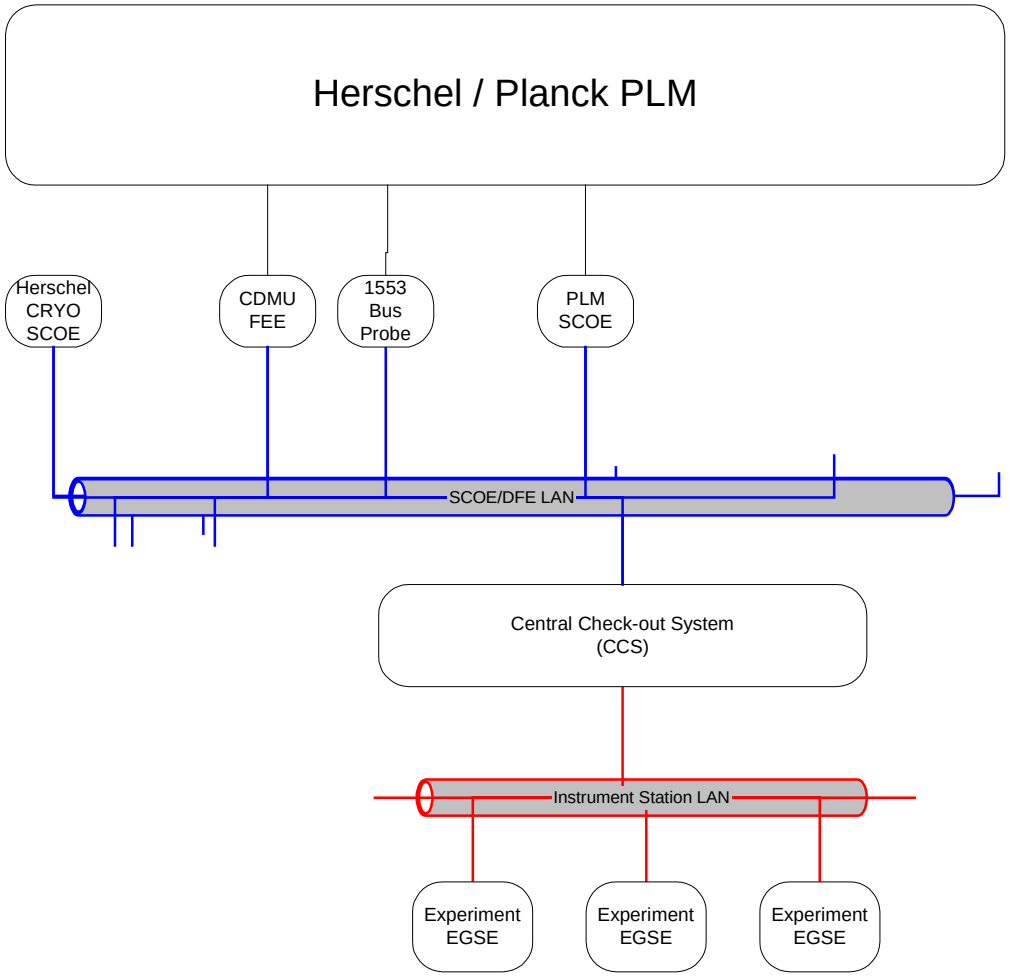


Figure 2 : EGSE PLM Configuration

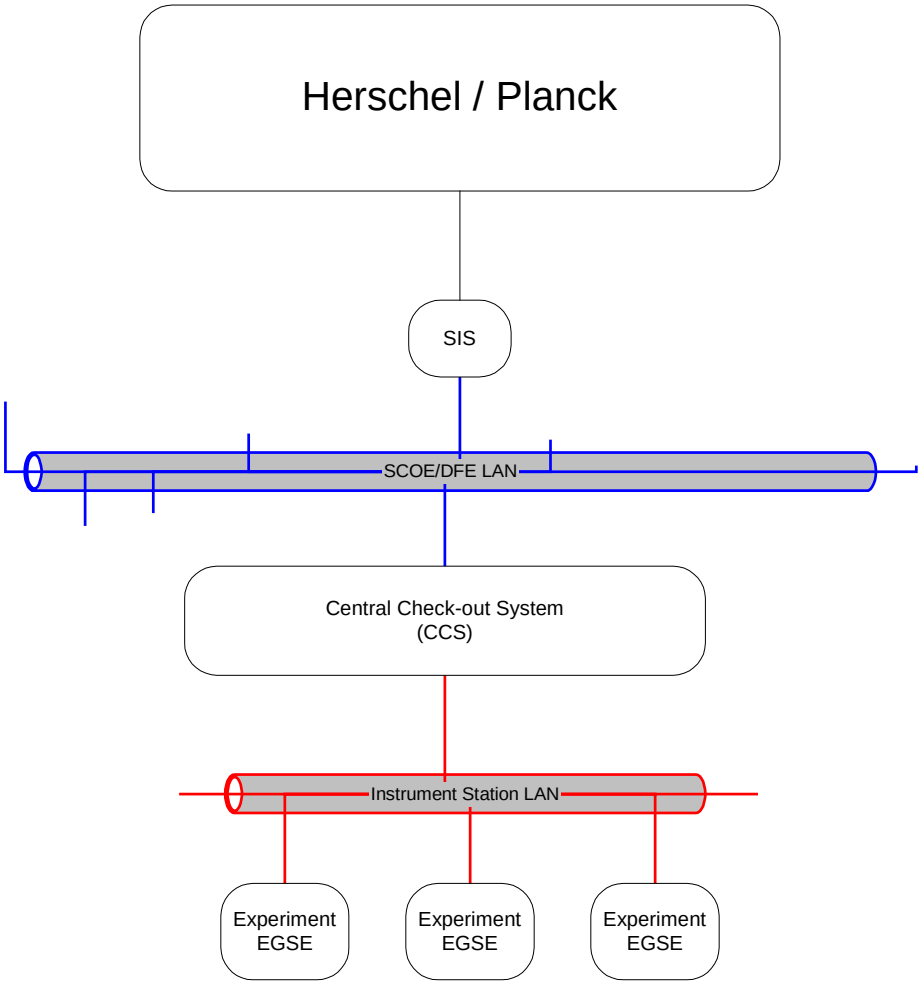
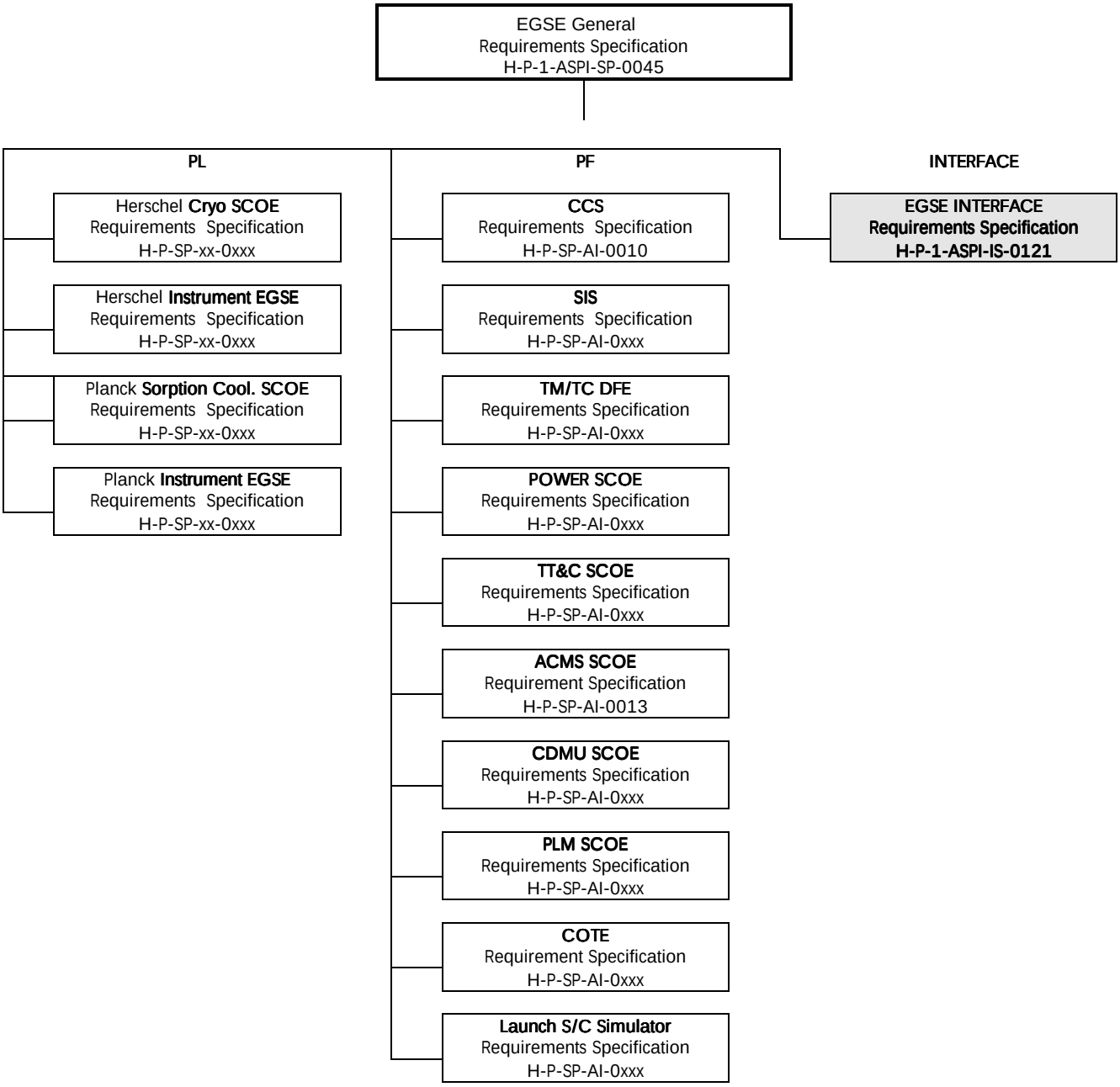


Figure 3 : EGSE Instrument Configuration

3.1.2 EGSE Specification Tree



3.1.3 SPECIFIC TERMS AND DEFINITION

There are a number of concepts that have been adopted within the EGSE that have an effect on the specification of the interfaces described in this document. These can be summarised as the following:

The CCS is solely responsible for sending telecommands and commanding the SCOE's.

The SCOE's are not required to support a test sequencing capability

The SCOE's shall be able to be controlled completely from the CCS without intervention on the SCOE

The CCS is responsible for archiving all Low rate Telemetry, Telecommand Data and all other CCS/SCOE traffic

4 EGSE INTERNAL INTERFACE REQUIREMENTS

4.1 PROTOCOL DEFINITION

4.1.1 General

Assuming that source packet are provided as the highest level data units for both TM and TC, typical EGSE and simulation systems would require a data routing mechanism that allows Packets to be transferred from one system to another.
The simplest solution can be found in routing the Source Packet from one location to another without any additional information or encapsulation. Analysis shows however that even in a simple environment, additional information would be required.

This solution allows PIPE protocol to adopt the following concepts:
- Allow for separate TM and TC data link
- Allow for dedicated command link (RC)
- Allow for SCOE monitoring link (RM)
- Allow for Telemetry distribution link

The main purpose of PIPE protocol is to allow Packets exchange between EGSE items connected via LAN.

> The protocol is structured in such a way that Packets are transferred without any changes. This is achieved by the attachment of an information header that contain additional information required for proper routing and processing of the Packets. This complete data structure is referred to as a PIPE message.
>
> The header contains a number of fixed fields that can be used to identify and allow further processing of the Packet.
>
> Following the header, a complete (unchanged) Packet is embedded into the message. The Packet can have a maximum length of 65542 Bytes as dictated by [S2] and [S3] although the protocol definition would allow larger data structures to be transported.

It should be noted that the PIPE-Protocol specification allows for larger data structures to be transported. For the purpose of describing CCSDS and ESA related Packets the recommended length is however limited to 65542 bytes.

[IFRQT-0010] [Analysis]

The communication and control interface between EGSE item shall be based under 100 Mb/s ETHERNET network using TCP/IP with a class B IP network addressing.

- Communication between CCS and SCOE shall be done via SCOE/DFE LAN
- Communication between CCS and Instrument Station shall be done via IS LAN
- Communication between CCS and www station shall be done via TBD
- Communication between TM/TC DFE and NDIU shall be done via TBD

[IFRQT-0020] [Analysis]

This control/command exchange is based on the PIPE protocol dedicated to real time communication.

[IFRQT-0030] [Analysis]

They are two types of exchanged data:

Control Flow:

Telecommand Packets sending on-board (TC)

EGSE Remote Command (RC) → *(Packets sent by CCS to SCOE for commanding this SCOE (configuration, set value, synch...))*

Monitoring Flow:

On-board Telemetry Packets (TM)

EGSE Remote Message Packets (RM) → *(Packet generated by one SCOE (one packet per SCOE identified by APID) sent to CCS containing its internal data like status, logging message, error report, data acquisition...)*

[IFRQT-0040] [Analysis]

It shall be foreseen to dedicate specific port for each type of message : TM, TC, RM and RC.

4.1.2 Communication Link

[IFRQT-0050] [Analysis]

Each SCOE, DFE or Instrument Station (IS) shall automatically accept a "connection request" coming from the CCS in order to try to establish the connection after the On-line software start-up and in general every time the connection itself is dropped or failed.

[IFRQT-0060] [Analysis]

If the connection is not successfully established, automatic retry shall be attempted every 30 seconds (TBC) approximately: while performing this operation the CCS shall neither suffer of performances degradation nor prevent the user to continue his normal tasks.

[IFRQT-0070] [Analysis]

After the connection request is accepted by the SCOE/DFE/IS, the following steps shall be performed:

The SCOE/DFE/IS shall wait the reception of a "Status request" message coming from CCS (Local/Remote and On-line/Off-line mode)

The SCOE/DFE/IS shall answer to the "Status request" sending a message with the proper format. The same message shall be sent by the SCOE/DFE/IS every time a new automatic operational mode is reached, for example after transition from Local mode to Remote and viceversa

After the described handshaking procedure completion, the SCOE/DFE/IS shall be ready to perform any further I/O operation foreseen by the operative requirements.

[IFRQT-0080] [Analysis]

The CCS shall regularly check (every TBD sec) that the SCOE to CCS logical connection is not broken.

[IFRQT-0090] [Analysis]

The SCOE shall regularly check (every TBD sec) that the CCS to SCOE logical connection is not broken.

[IFRQT-0100] [Analysis]

In case of logical connection broken between CCS and one specific SCOE, these two items shall automatically:

- Emit an alarm to local operator I/F
- Try to establish a new connection until success.

[IFRQT-0110] [Analysis]

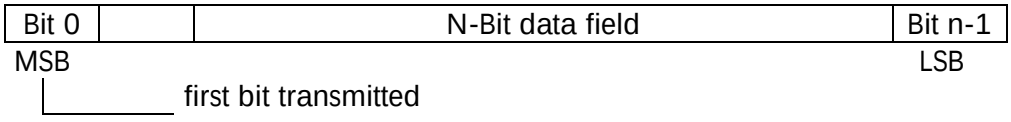
As soon as a the connection between the CCS and a SCOE is established, the SCOE shall send to the CCS its own Remote Message packet (RM) whatever its mode is (Local or Remote).

(See 4.6 MONITORING FLOW – Remote Message Packets)

4.1.3 Byte order

In this document the following convention is used to identify each bit in a forward-justified N-bit field.

The first bit in the field to be transmitted is defined to be ‘Bit 0’; the following bit is called ‘Bit 1’ and so on, up to ‘Bit n-1’. When the field is used to express a binary value (such as an integer), the Most Significant Bit (MSB) shall be the first transmitted bit of the field (i.e., ‘Bit 0’).



4.1.4 Message Structure

[IFRQT-0120] [Analysis]

All the TCP-IP messages exchanged between the CCS, the TM/TC DFE and other SCOE start with the PIPE Header followed by the Body.
The PIPE header is added/removed by PIPE layer (it is not seen at application level)
All the Integer value are under IEEE format

PIPE Header	Body message
8 bytes	User defined (7 bytes< <65542 bytes)

Tableau 1: PIPE message lay-out

4.1.5 PIPE Message HEADER

The PIPE Header consists of a fixed number of 8 bytes split up in several fields whose minimum length is one byte.

The detailed structure of the PIPE header is depicted in the figure below:

Field	Length (byte)	DESCRIPTION	TYPE
Message ID	1	Identification of the message	integer
Remaining length	2	Length of the message excluding the first 4 bytes	integer
Data quality indication	1	Filled only for TM message. 0x00 otherwise.	integer
Sequence quality indicator	1	Filled only for TM message. 0x00 otherwise.	integer
VCID	1	Filled only for TM message. 0x00 otherwise.	integer
Reserved	2		integer

Tableau 2 : PIPE message Header

Message ID
In order to support a number of different messages with different purpose, a PIPE message starts with a one byte message identifier. This ID can be used to make a distinction between different control, status and data messages.

Remaining Message length
The message length is a two-byte length field indicating the remaining length of the message including the remaining header fields and data.

Data quality
The one-byte data quality field provides an indication of the data quality of the embedded Packet (provided by TM/TC DFFE). This quality information is linked to the error detection and correlation codes as well as other system dependant data quality identifiers and is related to Telemetry rather than Telecommands.
This field will only be supported for the Telemetry data messages. For other messages, this field will be set to zero.

Sequence Quality Indication
The one-byte Sequence Quality Indication (provided by TM/TC DFFE) field indicates whether the sequence in which Packets were received by the system responsible for generation / decommutation maintained was correct or incorrect. This field, therefore, indicates anomalies in the Source packet Sequence Counters.
This field will only be supported for the Telemetry data messages. For other messages, this field will be set to zero.

VCID
The one-byte Virtual Channel ID field indicates on which VCID are downlinked the TM source packet.

Reserved
The three-bytes field is reserved for future application

4.1.6 Body message

The data field of a PIPE message can have a minimum length of 7 bytes and a maximum length of 65542 bytes as dictated by the CCSDS & ESA packet standards [S2] and [S3]

4.1.6.1 Monitoring Flow message (SCOE's/DFE/IS → CCS)

[IFRQT-0130] [Analysis]

For **on-board Telemetry Packet**, the complete body message shall be used to embed a Packet without any modifications to the contents or length of the Packet in question

[IFRQT-0140] [Analysis]

For **Remote Message (RM) Packets** provided by SCOE's, the complete body message shall be formatted as **TM** source packet and shall have the following structure :

SOURCE PACKET HEADER (48 bits)							PACKET DATA FIELD (VARIABLE)		
Packet Identification				Packet Sequence Control		Packet Length	Data Field Header	Source Data	Packet Error Ctrl
Version Number	Type	Data Fields 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

Spare	TM Source Packet PUS Version Number	Spare	Packet Type	Packet Sub-Type	Spare	Time
(1 bits)	(3 bits)	(4 bits)	(8 bits)	(8 bits)	(8 bits)	(48 bits)

field	length	VALUE	TYPE
Version number	3 bits	forced to '**000**'	binary
Type	1 bit	forced to '**0**'	binary
Data field header flag	1 bit	forced to '**1**'	binary
Application process ID	11 bits	*@ expéditeur du paquet TM*	integer
Segmentation flags	2 bits	forced to '**11**'	binary
Source sequence count	14 bits	Packet count per APID	binary
Packet length	16 bits	*length of packet data field - 1*	Integer
Packet header			
Spare	1 bits	forced to '**0**'	binary
PUS version number	3 bits	forced to '**000**'	binary
Spare	4 bits	forced to '**0000**'	binary
Packet type	8 bits	*depend on the service type*	binary
Packet sub-type	8 bits	*depend on the service sub type*	binary
Time	48 bits	Packet time	CUC
Source data	variable	*parameter list*	variable
Packet error control	16 bits	Not Used	binary

Application process ID
The APID field indicating uniquely identifies the source of the packet.
For ***Remote Message*** Packet, the APID identifies the SCOE emitting the packet.

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

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

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

Time:
This field represents the on-board reference time of the packet, referenced to TAI, expressed in CUC. Details of the time field are given in appendix 6 of [S4]

Source Data (Variable)
The source data constitutes the data element of the RM packet. It contains all internal parameter of each SCOE's.

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.

4.1.6.2 Control Flow message (CCS → SCOE's/DFE/IS)

[IFRQT-0150] [Analysis]

For **Telecommand Packets**, the complete body message shall be used to embed a Packet without any modifications to the contents or length of the Packet in question

[IFRQT-0160] [Analysis]

For **Remote Command (RC) Packets** sent to SCOE's, the complete body message shall be formatted as **TC** packet and shall have the following structure :

SOURCE PACKET HEADER (48 bits)							**PACKET DATA FIELD** (VARIABLE)		
Packet Identification				Packet Sequence Control		Packet Length	Data Field Header	Application Data	Packet Error Ctrl
Version Number	Type	Data Fields Header Flag	Application Process ID	Sequence Flags	Sequence count				
3	1	1	11	2	14				
16 bits				16 bits		16 bits	80 bits	N x 16 bits	16 bits

Seq flag	Seq Count
(3 bits)	(11 bits)

CCSDS Secondary Header flag	TC Source Packet PUS Version Nbr	Acknowledge	Packet Type	Packet Sub-Type	Spare
(1 bit)	(3 bits)	(4 bits)	(8 bits)	(8 bits)	(8 bits)

field	length	VALUE	TYPE
Version number	3 bits	forced to '**000**'	binary
Type	1 bit	forced to '**1**'	binary
Data field header flag	1 bit	forced to '**1**'	binary
Application process ID	11 bits	*SCOE destination address*	integer
Sequence flags	2 bits	forced to '**11**'	binary
Sequence count			binary
Sequence flag	3 bits	forced to '**111**'	binary
Sequence Count	11 bits	Packet count per APID	binary
Packet length	16 bits	*length of packet data field - 1*	Integer
Packet header			
CCSDS Sec Header flag	1 bits	forced to '**0**'	binary
PUS version number	3 bits	forced to '**000**'	binary
Acknowledge	4 bits	acknowledge at : *acceptance* : '**0001**' *start of execution* : '**0010**' *progress of execution* : '**0100**' *completion of execution* : '**1000**' *no acceptance* : '**0000**'	binary
Packet type	8 bits	*depend on the message type*	binary
Packet sub-type	8 bits	*depend on the service sub type*	binary
Spare	4 bits	forced to '**0000**'	binary
Application data	variable	*parameter list*	variable
Packet error control	16 bits	PEC variable	binary

Application process ID
The Application Process ID defines the application or unit that the Telecommand **is addressed to.**
For ***Remote Command*** Packet, the APID identifies the SCOE receiving the packet.

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, all sources (maintained by ground)
001 = Mission Time Line (maintained by ground)
010 = CDMS, all sources except mission time line (maintained by CDMS on-board)
011 = AOCS, (maintained by AOCS on-board) TBC
100-111 = Spare

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 counte**r.

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

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

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

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): **mandator**y, 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.

Application Data
The Telecommand application data constitute the data element of the Remote Command to be used by the CCS to command SCOE's.

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.

4.2 CONTROL FLOW – TELECOMMAND Packets

[IFRQT-0170] [Analysis]

CCS shall send **Telecommand Packets** to TM/TC DFE without any modifications to the contents or length of the Packet in question

Source	CCS
Destination	TM/TC DFE
Rate	4 kb/s (TBC)
LAN	SCOE/FEE LAN

PIPE structure	Field Description	Size (bytes)	Values	TYPE
Header	Message ID	1	TBD	integer
	Remaining length	2	Variable	integer
	Data quality indication	1	Forced to '**00**'	integer
	Sequence quality indicator	1	Forced to '**00**'	integer
	VCID	1	Forced to '**00**'	integer
	Reserved	2	Forced to '**0000**'	integer
Body	TC Packet	variable	variable	

[IFRQT-0180] [Analysis]

Message ID shall be used in order to differentiate all type of TC service that could be sent to the UUT.

[IFRQT-0190] [Analysis]

Depend on **Message ID** value, TM/TC DFE shall encode the TC source packet by using the service as specified

TC type	Service definition	Message ID value (hexa)
TC source packet AD	Sequence controlled service request	TBD
TC source packet BD	Expedited service request	TBD
TC source packet BC	Directive request	TBD
Raw format	Body = TC packet using the raw format	TBD
TBD	TBD	TBD

4.3 CONTROL FLOW – CCS REMOTE Commanding Packets

Source	CCS
Destination	SCOE's
Rate	N/A
LAN	SCOE/FEE LAN
	IS LAN
	www LAN

[IFRQT-0200] [Analysis]

CCS shall send **Remote Command (RC) Packets** to SCOE's using the following format

PIPE structure	Field Description	Size	Values	TYPE
Header	Message ID	1 byte	TBD	integer
	Remaining length	2 bytes	Variable	integer
	Data quality indication	1 byte	Forced to '**00**'	integer
	Sequence quality indicator	1 byte	Forced to '**00**'	integer
	VCID	1 byte	Forced to '**00**'	integer
	Reserved	2 bytes	forced to '**0000**'	integer
Body	Version number	3 bits	forced to '**000**'	binary
	Type	1 bit	forced to '**1**'	binary
	Data field header flag	1 bit	forced to '**1**'	binary
	Application process ID	11 bits	*SCOE destination address*	integer
	Sequence flags	2 bits	forced to '**11**'	binary
	Sequence flag	3 bits	forced to '**111**'	binary
	Sequence Count	11 bits	Packet count per APID	binary
	Packet length	16 bits	*length of packet data field*	Integer
	CCSDS Sec Header flag	1 bits	forced to '**0**'	binary
	PUS version number	3 bits	forced to '**000**'	binary
	Acknowledge	4 bits	TBD	binary
	Packet type	8 bits	TBD	binary
	Packet sub-type	8 bits	TBD	binary
	Spare	4 bits	forced to '**0000**'	binary
	Application data			
	RC_ID	8 bits	TBD	integer
	Parameter	variable	TBD	variable
	…			variable
	Parameter	variable	TBD	variable
	Packet error control	16 bits	PEC variable	binary

[IFRQT-0210] [Analysis]

Message ID shall be used in order to TBD.

[IFRQT-0220] [Analysis]

Each Remote Command shall be identified by one unique mnemonic defined in HPSDB (as for TC.)

[IFRQT-0230] [Analysis]

Application data shall be composed of: RC_ID field and parameters fields (optional)

[IFRQT-0240] [Analysis]

HPSDB will link the RC mnemonic with all the data in order to built the RC packet message :

RC Mnemo → RC_ID → SCOE IF Name → APID
IP name → IP address
Parameter → Transfer function
PIPE message length
RC Packet length
Packet type
Packet sub type

4.3.1 COMMUNICATION VIA SCOE/DFE LAN

4.3.1.1 CCS Commands

[IFRQT-0250] TBD [Analysis]

RC mnemo	RC_ID number	Ack	packet type	packet sub-type	parameter field	Parameter					
						Name	Type	Transfer function	Min value	Max value	Operational description

4.3.1.2 CCS → CDMU SCOE Commands

This § will include all commands for Quick load function, 1553 RT Simul, 1553 probe bus, controller

[IFRQT-0260] TBD [Analysis]

4.3.1.3 CCS → ACMS SCOE Commands

[IFRQT-0270] TBD [Analysis]

4.3.1.3.1 Quick Load Commands

TBD

4.3.1.3.2 Optical Stimuli Commands

TBD

4.3.1.3.3 Stimuli Feedback Commands

TBD

4.3.1.4 CCS → TT&C SCOE Commands

[IFRQT-0280] [Analysis]

4.3.1.5 CCS → TM/TC DFE SCOE Commands

[IFRQT-0290] [Analysis]

TBD

4.3.1.6 CCS → POWER SCOE Commands

This § will include all commands concerning Umbilical Interface (strap, power supply, TM/TC link, etc...)

[IFRQT-0300] TBD [Analysis]

RC mnemo	RC_ID number	Ack	packet type	packet sub-type	parameter field	Parameter					
						Name	Type	Transfer function	Min value	Max value	Operational description
POWRESET	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	255	Set the SCOE in predefined conf
POWSTART	TBD	TBD	TBD	TBD	1						Start a new Test Session
POWSTOP	TBD	TBD	TBD	TBD	1						Stop a Test Session
POWOUT	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	1	Power supply Enable/Disable
POWVSET	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	37	Program Power supply Voltage
POWISET	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	10	Program Power supply Current
POWSTP	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	1	Switch ON/OFF strap
POWSELTC	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	1	Select TC link Nominal/Redundant
POWSELTM	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	1	Select TM link Nominal/Redundant
POWLNKTC	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	1	Select TC link Umbilical/TT&C
POWLNKTM	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	1	Select TM link Umbilical/TT&C
Etc											

4.3.1.7 CCS → BATSIM SCOE Commands

[IFRQT-0310] [Analysis]

TBD

4.3.1.8 CCS → SAS SCOE Commands

[IFRQT-0320] TBD [Analysis]

RC mnemo	RC_ID number	Ack	packet type	packet sub-type	parameter field	Parameter					
						Name	Type	Transfer function	Min value	Max value	Operational description
SASRESET	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	255	Set the SCOE in predefined conf
SASSTART	TBD	TBD	TBD	TBD	1						Start a new Test Session
SASSTOP	TBD	TBD	TBD	TBD	1						Stop a Test Session
SASOUT	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	1	12	Enable/Disable selected Power supply
					2	TBD	TBD	TBD	0	1	
SASALL	TBD	TBD	TBD	TBD	1	TBD	TBD	TBD	0	1	Enable/Disable ALL Power supply
Etc ...											

4.3.1.9 CCS → BCE SCOE Commands

[IFRQT-0330] [Analysis]

TBD

4.3.1.10 CCS → COTE Commands

[IFRQT-0340] [Analysis]

TBD

4.3.1.11 CCS → SIS SCOE Commands

[IFRQT-0350] [Analysis]

TBD

4.3.1.12 CCS → Herschel PLM SCOE Commands

[IFRQT-0360] [Analysis]

TBD

4.3.1.13 CCS → Herschel Cryo SCOE Commands

[IFRQT-0370] [Analysis]

4.3.1.14 CCS → Planck PLM SCOE Commands

[IFRQT-0380] [Analysis]

TBD

4.3.1.15 CCS → Planck Sorption SCOE Commands

[IFRQT-0390] [Analysis]

4.3.1.16 CCS → CDMU FEE Commands

[IFRQT-0400] [Analysis]

TBD

4.3.1.17 CCS → 1553 Bus Probe Commands

TBD

4.3.1.18 CCS → Quick Load Commands

[IFRQT-0410] [Analysis]

TBD

4.3.2 COMMUNICATION VIA IS LAN

4.3.2.1 CCS → Instrument Stimuli SCOE Commands

[IFRQT-0420] [Analysis]
TBD

4.3.2.2 CCS → HFI EGSE Commands

[IFRQT-0430] [Analysis]
TBD

4.3.2.3 CCS → LFI EGSE Commands

[IFRQT-0440] [Analysis]
TBD

4.3.2.4 CCS → HCSS SCOE Commands

[IFRQT-0450] [Analysis]
TBD

4.3.2.5 CCS → HIFI EGSE Commands

[IFRQT-0460] [Analysis]
TBD

4.3.2.6 CCS → PACS EGSE Commands

[IFRQT-0470] [Analysis]

4.3.2.7 CCS → SPIRE EGSE Commands

[IFRQT-0480] [Analysis]

4.3.3 COMMUNICATION VIA www LAN

4.3.3.1 CCS → www.Server Commands

[IFRQT-0490] [Analysis]

TBD

4.4 MONITORING FLOW - On-Board Telemetry Packets acquisition

Source	TM/TC DFE
Destination	CCS
Rate	As soon as a valid packet is available
LAN	SCOE/FEE LAN

[IFRQT-0500] [Analysis]

CCS shall send **Remote Command (RC) Packets** to SCOE's using the following format

[IFRQT-0510] [Analysis]

TM/TC DFE shall transmit TM Packet as soon as a valid TM packet is available.

PIPE structure	Field Description	Size	Values	TYPE
Header	Message ID	1 byte	TBD	integer
	Remaining length	2 bytes	Variable	integer
	Data quality indication	1 byte	Variable	integer
	Sequence quality indicator	1 byte	Variable	integer
	VCID	1 byte	Variable	integer
	Reserved	2 bytes	forced to '**0000**'	Integer
Body	**TM Source Packet**	**variable**	**variable**	

4.5 MONITORING FLOW - Telemetry Packets Distribution

Source	CCS
Destination	SCOE's/DFE/IS
Rate	As soon as a valid packet is available
LAN	SCOE/FEE LAN
	IS LAN

[IFRQT-0520] TBC [Analysis]

The CCS shall be able to distribute all incoming Packets to the proper destination on the basis of their APID.
For this purpose the CCS user shall be able to edit a programmable 'dispatch tables' in which the list of packets to be sent (identified by APID, packet type, packet subtype, structure identifier – SID -(TBC)) are listed together with the identification of the destination EGSE equipment (ex. Instrument Station).

PIPE structure	Field Description	Size	Values	TYPE
Header	Message ID	1 byte	TBD	integer
	Remaining length	2 bytes	Variable	integer
	Data quality indication	1 byte	Forced to '**00**'	integer
	Sequence quality indicator	1 byte	Forced to '**00**'	integer
	VCID	1 byte	Variable	integer
	Reserved	2 bytes	forced to '**0000**'	Integer
Body	**TM Source Packet**	**variable**	**variable**	

4.6 MONITORING FLOW – Remote Message Packets

Source	SCOE's
Destination	CCS
Rate	1 packet/second
LAN	SCOE/FEE LAN
	IS LAN
	www LAN

[IFRQT-0530] [Analysis]

Each SCOE shall send its own (and unique) **Remote Message (RM) Packets** to the CCS every 1 second using the following format

PIPE structure	Field Description	Size	Values	TYPE
Header	Message ID	1 byte	TBD	integer
	Remaining length	2 bytes	Variable	integer
	Data quality indication	1 byte	Forced to '**00**'	integer
	Sequence quality indicator	1 byte	Forced to '**00**'	integer
	VCID	1 byte	Forced to '**00**'	integer
	Reserved	2 bytes	forced to '**0000**'	integer
Body	Version number	3 bits	forced to '**000**'	binary
	Type	1 bit	forced to '**0**'	binary
	Data field header flag	1 bit	forced to '**1**'	binary
	Application process ID	11 bits	*@ source SCOE*	integer
	Segmentation flags	2 bits	forced to '**11**'	binary
	Source sequence count	14 bits	Packet count per APID	binary
	Packet length	16 bits	*length of packet data field*	Integer
	Spare	1 bits	forced to '**0**'	binary
	PUS version number	3 bits	forced to '**000**'	binary
	Spare	4 bits	forced to '**0000**'	binary
	Packet type	8 bits	*depend on the service type*	binary
	Packet sub-type	8 bits	*depend on the service sub type*	binary
	Time	48 bits	Packet sending time	CUC
	Source data	**variable**	***parameter list***	variable
	Packet error control	16 bits	PEC variable	binary

[IFRQT-0540] [Analysis]

Message ID shall be used in order to TBD.

[IFRQT-0550] [Analysis]

Source data shall contain all the necessary information concerning the SCOE (status, current, tension, temperature, alarm, etc...)

[IFRQT-0560] [Analysis]

Each RM Packet shall be identified by its APID defined in HPSDB (as for TM packets.)

4.6.1 COMMUNICATION VIA SCOE/DFE LAN

4.6.1.1 RM CDMU SCOE Definition

PIPE structure	Field Description	Size	Values	TYPE
Header	Message ID	1 byte	TBD	integer
	Remaining length	2 bytes	TBD (Fix for this RM packet)	integer
	FIX1	5 bytes	Forced to '**00 0000 0000**'	integer
Body	FIX2	5 bits	forced to '**00001**'	binary
	Application process ID	11 bits	**APID of CDMU SCOE**	integer
	Segmentation flags	2 bits	forced to '**11**'	binary
	Source sequence count	14 bits	Packet count per APID	binary
	Packet length	16 bits	*length of packet data field*	Integer
	FIX3	1 bits	forced to '**00000000**'	binary
	Packet type	8 bits	*TBD*	binary
	Packet sub-type	8 bits	*TBD*	binary
	Time	48 bits	Packet sending time	CUC
	Source data			
	CDMMOD	**1 byte**	0/1 (Local/Remote)	variable
	CDMFUNC	**1 byte**	0/1/2/3 (idle, loading, running, simul)	variable
	CDMALM	**1 byte**	Alarm Status	variable
	CDMDISK	**1 byte**	0/1 (Disk capacity: ok/not ok)	variable
	CDMACK	**1 byte**	**0/1/2/3 (Not applicable, correct reception, correct execution, error)**	variable
	CDMRCID	**1 byte**	**RC_ID number if RM packet asynchrone following ASK request, 0 otherwise)**	variable
				variable
				variable
				variable
				variable
	Packet error control	16 bits	PEC variable	binary

4.6.1.2 RM ACMS SCOE Definition

[IFRQT-0570] TBD [Analysis]

4.6.1.2.1 Quick Load

TBD

4.6.1.2.2 Optical Stimuli

TBD

4.6.1.2.3 Stimuli Feedback

TBD

4.6.1.3 RM TT&C SCOE Definition

[IFRQT-0580] [Analysis]

4.6.1.4 RM TM/TC DFE SCOE Definition

[IFRQT-0590] [Analysis]
TBD

4.6.1.5 RM POWER SCOE Definition

[IFRQT-0600] TBD [Analysis]

4.6.1.6 RM BATSIM SCOE Definition

[IFRQT-0610] [Analysis]
TBD

4.6.1.7 RM SAS SCOE Definition

[IFRQT-0620] TBD [Analysis]

4.6.1.8 RM BCE SCOE Definition

[IFRQT-0630] [Analysis]
TBD

4.6.1.9 RM COTE Definition

[IFRQT-0640] [Analysis]

TBD

4.6.1.10 RM SIS SCOE Definition

[IFRQT-0650] [Analysis]

TBD

4.6.1.11 RM Herschel PLM SCOE Definition

[IFRQT-0660] [Analysis]

4.6.1.12 RM Herschel Cryo SCOE Definition

[IFRQT-0670] [Analysis]

4.6.1.13 RM Planck PLM SCOE Definition

[IFRQT-0680] [Analysis]

4.6.1.14 RM Planck Sorption SCOE Definition

[IFRQT-0690] [Analysis]

4.6.1.15 RM CDMU FEE Definition

[IFRQT-0700] [Analysis]

TBD

4.6.1.16 RM 1553 Bus Probe Definition

[IFRQT-0710] [Analysis]

TBD

4.6.1.17 RM Quick Load I/F Definition

[IFRQT-0720] [Analysis]

TBD

4.6.2 COMMUNICATION VIA IS LAN

4.6.2.1 RM Instrument Stimuli SCOE Definition

[IFRQT-0730] [Analysis]
TBD

4.6.2.2 RM HFI EGSE Definition

[IFRQT-0740] [Analysis]
TBD

4.6.2.3 RM LFI EGSE Definition

[IFRQT-0750] [Analysis]
TBD

4.6.2.4 RM HCSS SCOE Definition

[IFRQT-0760] [Analysis]
TBD

4.6.2.5 RM HIFI EGSE Definition

[IFRQT-0770] [Analysis]
TBD

4.6.2.6 RM PACS EGSE Definition

[IFRQT-0780] [Analysis]

4.6.2.7 RM SPIRE EGSE Definition

[IFRQT-0790] [Analysis]

4.6.3 COMMUNICATION VIA www LAN

4.6.3.1 RM www.Server Definition

[IFRQT-0800] [Analysis]

TBD

4.7 INTERFACES REQUIREMENTS

TBW

4.7.1 GENERIC INTERFACE NAME

EGSE	Interface Name	APID 2016 to 2046	IP Name	IP adrdress
CCS	*TBD*	*TBD*	*TBD*	*TBD*
CDMU SCOE	*TBD*	*TBD*	*TBD*	*TBD*
ACMS SCOE	*TBD*	*TBD*	*TBD*	*TBD*
TT&C SCOE	*TBD*	*TBD*	*TBD*	*TBD*
TM/TC DFE	*TBD*	*TBD*	*TBD*	*TBD*
POWER SCOE (Umb I/F)	*TBD*	*TBD*	*TBD*	*TBD*
SAS	*TBD*	*TBD*	*TBD*	*TBD*
BATSIM	*TBD*	*TBD*	*TBD*	*TBD*
BCE	*TBD*	*TBD*	*TBD*	*TBD*
COTE	*TBD*	*TBD*	*TBD*	*TBD*
SIS	*TBD*	*TBD*	*TBD*	*TBD*
Herschel PLM SCOE	*TBD*	*TBD*	*TBD*	*TBD*
Herschel CRYO SCOE	*TBD*	*TBD*	*TBD*	*TBD*
Planck PLM SCOE	*TBD*	*TBD*	*TBD*	*TBD*
Planck Sorption SCOE	*TBD*	*TBD*	*TBD*	*TBD*
CDMU FEE	*TBD*	*TBD*	*TBD*	*TBD*
1553 Bus Probe	*TBD*	*TBD*	*TBD*	*TBD*
Quick Load	*TBD*	*TBD*	*TBD*	*TBD*
Instrument Stimuli SCOE	*TBD*	*TBD*	*TBD*	*TBD*
HFI EGSE	*TBD*	*TBD*	*TBD*	*TBD*
LFI EGSE	*TBD*	*TBD*	*TBD*	*TBD*
HIFI EGSE	*TBD*	*TBD*	*TBD*	*TBD*
HCSS SCOE	*TBD*	*TBD*	*TBD*	*TBD*
PACS EGSE	*TBD*	*TBD*	*TBD*	*TBD*
SPIRE EGSE	*TBD*	*TBD*	*TBD*	*TBD*
NDIU	*TBD*	*TBD*	*TBD*	*TBD*
www server	*TBD*	*TBD*	*TBD*	*TBD*

Tableau 3 Generic Interface Name

4.7.2 DATABASE

[IFRQT-0810] [Analysis]

The sub-contractor responsible of each SCOE shall be in charge to provide the files describing all parameters constituting RM packets and RC Packets.

[IFRQT-0820] [Analysis]

This files shall have the following format (TBD) and shall be compatible with HPSDB [AD4]

(They will be used to update HPSDB)

4.7.3 DATE/TIME

[IFRQT-0830] [Analysis]

The date/time synchronisation between all EGSE's item shall be done by using standard service providing by network protocol software like NTP (Network Time Protocol) or other

[IFRQT-0840] [Analysis]

In this case, CCS shall be the master and all EGSE's item shall update and synchronise their local clock.

4.7.4 Quick loading function

[IFRQT-0850] [Analysis]

TBW

4.7.5 Interface TM/TC DFE↔ NDIU

[IFRQT-0860] [Analysis]

An EGSE interface shall be provided compatible with the ESA provided NDIU for TM and TC interface between the satellites and the Mission Operation Centre (MOC).

- Note: In recent projects ESOC have used an "NDIU lite", i.e. a ground segment simulator which interfaces with the CCS by TCP/IP and which issue Telecommands using the CCS protocol to the TM/TC interface. It is likely that a similar set-up will be used for Planck/Planck.

4.7.6 Interface Instrument Stimuli SCOE ↔ Herschel Satellite

[IFRQT-0870] [Analysis]

TBW

4.7.7 Interface Instrument Stimuli SCOE ↔ Planck Satellite

[IFRQT-0880] [Analysis]

TBW

5 EGSE EXTERNAL INTERFACE REQUIREMENTS → TBW

This chapter will define all electrical Harness Interfaces between EGSE and SVM / PLM / S/C, and between all EGSE's item in all the different configurations.

[IFRQT-0890] [Analysis]

Table below resumes all the H/P EGSE interfaces : To Be Completed

EGSE		Internal Interface (communication protocol)				External Interface (Harness)		
		TM/TC FEE	CCS			TM/TC FEE	Herschel S/C	Planck S/C
		NDIU LAN	www LAN	SCOE/FEE LAN	IS LAN			
Planck	LFI IS EGSE				AD5			
Planck	HFI IS EGSE				AD5			
Herschel	HCSS IS EGSE				AD 3			
Herschel	PACS IS EGSE				AD 3			
Herschel	SPIRE IS EGSE				AD 3			
Herschel	HIFI IS EGSE				AD 3			
NDIU		AD 4 TC -TM						
WWW	Server		§ 4.3.3.1 § 4.6.4.1					
SDB								
Instr Stim SCOE				RC - RM				
Herschel	Cryo SCOE			RC - RM				
Planck	Sorption SCOE			RC - RM				
H & P	PLM SCOE			RC - RM				
TT&C	RF SCOE			RC - RM		TBD		
TM/TC FEE	Bypass			**TC** – RC RM - **TM**				
CDMU SCOE	Quick Load			RC - RM				
	1553 FEE			RC - RM				
	1553 Bus prob			RC - RM				
Power SCOE	Umbilical I/F			RC - RM		TBD		
	Battery Sim			RC - RM				
	SA Sim			RC - RM				
	BCH SCOE			RC - RM				
	COTE			RC - RM		TBD		
ACMS SCOE	Quick Load			RC - RM				
	Optical Stim			RC - RM				
	Stim Feedbk			RC - RM				
SAT I/F Sim	SIS			RC - RM				

Tableau 4 : H/P EGSE Interfaces

6 PARAMETERS → TBC

This chapter will define (TBC) the physical encoding rules for each simple type, that is their permitted lengths and the internal format used to encode values.

[IFRQT-0900] [Analysis]

7 VERIFICATION MATRIX

7.1 GENERAL REQUIREMENTS

The acceptance tests of the EGSE shall be distributed in 3 acceptance test levels:

- Level 1 acceptance test at equipment level.
- Level 2 acceptance test of system EGSE level.
- Level 3 acceptance test of H/P EGSE.

Requirement	Test level 1	Test level 2	Test level 3

FIN DE DOCUMENT
END OF DOCUMENT