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DOCUMENT

GS inputs to on-board data architecture

European Space Agency
Agence spatiale européenne

APPROVAL

Title GS input to on-board data architecture	
Issue 2	**Revision** 5
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Approved by Pierre Viau, EOP-PE	**Date** 19-02-2026

CHANGE LOG

Reason for change	Issue	Revision	Date
First issue	1	1	06-Nov-2014
Added req on PVT and Quaternions frames	1	2	12-Dec-2014
Clarified APID vs PUS usage	1	3	12-Mar-2015
Customised for CFDP	1	4	12-Dec-2018
Update with comments from EOP-G	1	5	05-Apr-2019
Document maintenance following BIOMASS experience	1	6	05-May-2020
Update for re-distribution as generic req.	1	7	15-02-2022
Amended after review for TRUTHS and FORUM	1	8	13-10-2023
Amended after review for Harmony	1	9	23-11-2023
Amended following discussions in Forum	2	0	07-03-2025
Clean-up following review of ERD 1.1 and discussion with NGGM and feedback from Harmony. Added justifications	2	1	24-10-2025
Added consideration for Start and Stop CFDP commanding	2	2	04-11-2025
Internal- Not distributed	2	3	
Updated after joint review with ERD/OIRD	2	4.1	16-12-2025
Updated to include clarifications following NGGM comments	2	5	19-02-2026

CHANGE RECORD

Issue 1	Revision 1		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
First issue	06-Nov-2014	all	

Issue 1	Revision 2		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Added req on PVT and Quaternions frames	12-Dec-2014	8	

Issue 1	Revision 3		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Clarified APID vs PUS usage (added req 19 and 20)	12-Mar-2015	8	

Issue 1	Revision 4		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Renumbering of requirements	12-Dec-2018	all	
Evolution to support use of CFDP	12-Dec-2018	all	
Clarification of RAW and Level 0 product	12-Dec-2018	4	

Issue 1	Revision 5		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Corrections of typos and clarifications	05-Apr-2019	all	

Issue 1	Revision 6		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Update to req. numbering into separate groups Clarification on ancillary generation.	05-May-2020	all	

Issue 1	Revision 7		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Update header with ESA classification	15-Feb-2022	all	
Update comments on CFDP	15-Feb-2022	all	

Issue 1	Revision 8		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Additional definition in Glossary	13-Oct-2023	Section 1	
Rewritten section on CCSDS Space Packet: Reworded ambiguous requirements Negative requirements re-worded as positive Sorted the requirement per topic in dedicated subsections Removed requirement on SSC continuity as it is already part of CCSDS standard Renumbered the Requirements	13-Oct-2023	Section 4.1.1	

Issue 1	Revision 9		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Terminology clean-up	23-Nov-2023	all	

Removed Glossary	23-Nov-2023	5	
Simplification of introductory section	23-Nov-2023		Section 1
Removal of figures	23-Nov-2023		Section 1
Clarification of CFDP terminology to only refer to Payload Data and not to TT&C ones	23-Nov-2023		Section 3.1.3

Issue 2	**Revision** 0		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Added Requirements 16, 55 and 90	07-03-2025		
Amended req. 70	07-03-2025		

Reason for change	**Date**	**Pages**	**Paragraph(s)**
Re-introduced and extended acronyms and glossary sections following feedback from NGGN and Harmony	07-06-2025		
Corrected typo in change record for Issue 2.0	07-06-2025	3	
Reworded req. R-01 on use of APID	07-06-2025		
Reworded req. R-12 on subcommutation	07-06-2025		
Updated version of applicable CFDP standard to revision b5 (2020) as well as for CCSDS 103 and 132.	07-06-2025		Section 2
Reordered/renumbered reqs in the CFDP section.	24-10-2025		Section 4.1.3
Separating example/notes from requirement body (CFDP section)	24-10-2025		Section 4.1.3
Reworded req. R-73 to link data availability to CFDP file size.	24-10-2025		Section 4.1.3

Issue 2	**Revision** 2		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Created Req. 91 from 76 to generalise its implementation.	04-11-2025	15	

Issue 2	**Revision** 3		
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Issue 2	**Revision** 4.1		
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Updated to synchronise with discussion for the ERD + EO OIRD	16-12-2025	all	

Issue 2	**Revision** 5		
Reason for change	**Date**	**Pages**	**Paragraph(s)**
Tightened language describing the scope	19-02-2026	6	
Added figures about data flows	19-02-2026	7	
Updated to clarify req, terminology and notes following comments by NGGM	19-02-2026	all	

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1 PURPOSE AND SCOPE

This Technical Note (TN) provides a set of inputs for defining an on-board data architecture that enables efficient and standardised payload CCSDS data analysis, data generation, data simulation, algorithm development, and ground data processing.

(NB This document does not apply to TT&C/S-Band data links).

This TN also addresses the specific aspects introduced by the use of CFDP in addition to the Space Packet Protocol for space-to-ground data transfer. CFDP has not been used in previous EO missions, and the EO operational profile for Payload Data downlink differs from that of Space Science missions, both technically (multiple short visibility passes) and programmatically (Payload Data ground stations are typically procured as a service from external providers and are not operated by the FOS).

The requirements in this document are compliant with the applicable CCSDS standards — both the traditional Space Packet Protocol and CFDP — in terms of concepts and rationale. They also take into account the specific characteristics of a typical EO mission ground segment for Payload Data processing, namely:

- **multiple** physical or logical **on-board sources** generate data to be processed on ground;
- each source (application) produces data units in one of the following **formats**:
    - Space Packets;
    - CFDP files containing Space Packets;
    - CFDP files containing project-specific data formats;
- the **CFDP layer uses the Space Packet Protocol** as the Unitdata Transfer (UT) service;
- the same physical on-board source (instrument) generates measurement data **in different modes** (e.g. calibration, nominal, dual, interferometric, reduced, test), which require **different ground processing**;
- on-board sources other than the instrument generate **ancillary data** (e.g. navigation or thermal data);
- different Space Packet types are identified through the **Primary Space Packet Header**;
- different types and instances of CFDP files are **identified** by their **file names**;
- different Space Packet types may be processed by the same or by **different ground data sinks**;
- different CFDP file types may be processed by the same or by **different ground data sinks**;
- **end-to-end** application-level **routing** from on-board source to ground sink is performed on the basis of the Primary Space Packet Header or the CFDP file type (as identified by the file name);
- **commercially** available ground station equipment compliant with CCSDS standards (demodulators and FEPs) is **used without modification**;
- the **end consumer** (sink) of each data unit is the corresponding **Level-1 processor** for the relevant data product (see Fig. 2);
- Payload Data downlink is **preferably** performed in a full **open-loop** configuration, avoiding the need for uplink to control CFDP operations during the downlink.

These inputs (formulated as requirements) are intended to be applicable to the Space Segment for all on-board data structures (i.e. CADU, TF, ISP, PDU, CFDP files) that are downlinked for ground processing, unless explicitly waived for a specific project with proper justification.

The overall identification of the data flows is in Figure 1.

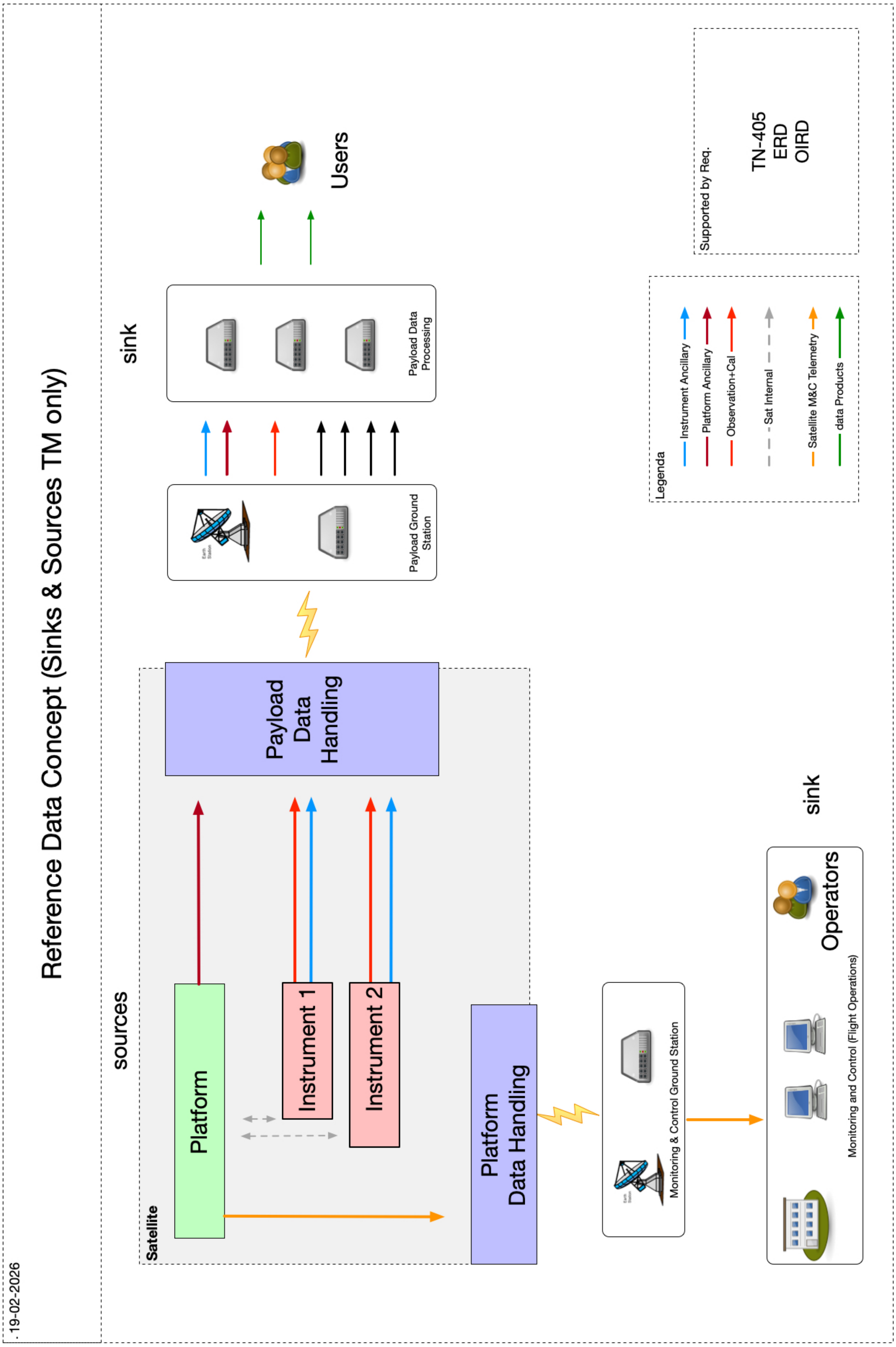

Figure 1end-to-end data flow

2 REFERENCE DOCUMENTS:

[CCSDLP]	TM Space Data Link Protocol CCSDS 132x0b3
[CCSADL]	AOS Space Data Link Protocol CCSDS 732x0b5
[CCSFDP]	CCSDS File Delivery Protocol (CFDP) CCSDS 727x0b5
[CCSUDL]	Unified Space data Link Protocol, CCSDS 732x1b3
[PUS]	ECSS Packet Utilisation Service
[L0RAW]	EO generic RAW and L0 specification, PE-TN-ESA-GS-586

3 ACRONYMS & GLOSSARY

3.1 Acronyms

The acronyms below are used within the scope of this activity and within this document.

ANC	Ancillary Data
AOCS	Attitude and Orbital Control System
APID	Application Process ID (CCSDS)
AUX	Auxiliary Data
CAL	Calibration Data
CCDB	Characterisation and Calibration Data Base
CCSDS	Consultative Committee for Space Data Systems
DU	Data Unit
GNSS	Global Navigation Satellite System
GS	Ground Segment
HKTM	Housekeeping Telemetry
(I)CCDB	(Instrument) Characterisation and Calibration Data Base
I/F	Interface
ISP	Instrument Source Packets (formatted as CCSDS Space Packets)[1]
L0P	Level 0 Processor
L1	Level 1 product
L1OP	L1 Operational Processor
L1PP	L1 Processing Prototype
L2	Level 2 product
L2OP	L2 Operational Processor
L2PP	L2 Prototype Processor
MRD	Mission Requirements Document
PDGS	Payload Data Ground Segment
PVT	Position Velocity Time
RAW	RAW Data
RD	Reference Document
(S)CCDB	(Satellite) Characterisation and Calibration Data Base
SP	(CCSDS) Space Packet
SS	Space Segment

[1] The term "*Source*" in the definition of ISP is due to legacy reason and does not have any semantic. The ISP acronym identifies the instrument generated data units.

3.2 Glossary

The table below describes preferred terminology. Alternative terminology is also described but not recommended.

Observation data (OBS)	Data Units output of the Instrument and formatted as CCSDS Space Packets exactly as generated by the Instrument(s) when the **stimuli correspond to the target to be observed** per to mission objectives (e.g. radiance of the ground scene, of the atmosphere, echo of the ground target, in-situ properties, etc
Measurements data	Output from the HW chain of the instrument (excluding ancillary): Same as **(Observation data + Calibration data)**.
Calibration data (CAL)	Data Units output of the Instrument and formatted as CCSDS Space Packets exactly as generated by the Instrument when the **stimuli** are internal or external targets or happen during special operation used **for calibration purposes** (e.g. internal black body, noise diode, internal receiving network, specific manouvres or external target like e.g. sun, moon, star, sea, ice, etc)
Auxiliary data (AUX)	Data needed, by the ground segment, to perform ground processing and **not part of the *Payload Data*** set. This auxiliary data (static or dynamic) is in format of files formatted as in the real GS to be used for configuration of the processor or as input to the processors (e.g. DEM, Land classification map, RTM lookup table, Orbit Files, Instrument Characterisation, Meteorological data, Offset tables, calibration coefficient, focal plane definition, etc.). Some auxiliary data can originate from offline calibration activities (see definition of calibration products). Within the E2ES they are supplied as part of the simulation scenario as an input e.g. to the scene generator module SGM, to the instrument simulation module ISM and to the Level 1 and Level 2 Processor Prototypes.
Ancillary data (ANC)	CCSDS Space Packet Data generated on-board generally by SW in support of the observation data, by the instrument and the platform, such as, navigation, temperature, timing data and configuration. When generated by the instrument these data are called "***instrument** ancillary*" when by the platform "***platform** ancillary*".
HouseKeeping TeleMetry (HKTM)	Data generated on-board and used for M&C purposes in the Mission Control Center. It is a separated stream not used in the Payload Data Processing.
Payload Data, *(Instrument Data, Science Data)*	(Alternative nomenclature). All data **generated by the payload** for purpose of scientific processing and composed of: **Observation, Calibration, Instrument Ancillary** data. It **excludes** Instrument HKTM destined to M&C and Platform Ancillary data. For clarity it is recommended to use only the term **Payload Data**.
Timing Data	Data related to the timing of the parameters and packets, including: the timestamps and the correlation of times between instrument time, platform time and external reference time (e.g GNSS PPS time).

Raw data (RAW)	Sequence of concatenated Instrument and Ancillary Space Packets as are transmitted on the space to ground RF link with no header and no annotation.
Level 0 product	Level 0 data files in the same format at the actual GS (Ground Segment header + concatenation of CCSDS Space Packets).
Calibration Products	Data files (products) generated in the ground segment or by the L1PP during the processing of instrument data and used in the Ground Segment processing. Calibration Products can be either dynamic or static. 1) **Dynamic**/on-line calibration data (referred to as CAL) are **automatically produced and applied** by ground processors . 2) **Static**/off-line calibration data (preferably called AUX) are: a) **produced** automatically or manually(off-line), based on measurements, on other dynamic calibration, on long term trending, analysis, manual setting etc. b) **applied** as **manual operational decision** to the processing chain as configuration items (e.g., dead pixel, instrument alignment, bias, mis-pointing, etc.).
On-line and off-line calibration	***dynamic calibration*** data (also called ***on-line*** calibration data) are: **calculated** automatically and **produced** by the L1 processor during the processing of input data from nominal or calibration modes of the instrument **used/applied** automatically in the processing chain either internally or preferably externally by use of CAL data files
Dynamic and static calibration	**static calibration** data (also called **off-line** calibration data) are: a. parameters typically **derived** either from dedicated calibration modes, or from nominal data spanning multiple files or longer time-series. Both these cases have in common that these parameter values are not derived and applied instantly to the same dataset from which they are derived (in contrast to online calibration). b. **contained** in auxiliary files (of type AUX in the ground segment). c. **produced** either automatically or by manual trigger of any of the following: • the L1 processor itself, • a dedicated calibration processor • a Monitoring or Calibration Facility • any other tool. d. **used** in the processing chain only following human review/intervention or authorisation e.g., a permanent update of a table of sensor gain parameters (initially holding the launch CCDB value see [CCDBTN]) computed using some *ad-hoc* observation of a calibration target. From the point of view of data-flow the static CAL data are implemented in the GS as AUX data (see Fig.3.8 and 3.9).

4 INPUTS

The requirements/inputs here below address separately the various CCSDS communication layer and the corresponding Data Units.

4.1 Data Categories

R-001 The data generated by each payload (referred as *Payload Data*), for purpose of scientific data processing and performance monitoring, shall be categorised as:

- Observation,
- Internal Calibration
- External Calibration
- Instrument Ancillary

Note*: Payload Data excludes Instrument HKTM and Platform Ancillary data.*

4.2 Data Layers

This section assumes all data is transported as CCSDS Application data Units (ADU) which are formatted as CCSDS Space Packets [CCSDLP] and transported using CCSDS Protocols from Satellite to the Ground consumer Application.

4.2.1 CCSDS Space Packets

4.2.1.1 Application Data Definition and Identification

R-010 All Payload Data Space Packets shall include a unique identifier that associates them with a logical stream identifier.

Note 1: *The CCSDS Space Packet Application Process Identifier (APID) in the Space Packet Primary Header serves as the logical stream identifier.*

Note 2: *The identification and the end-to-end Space-to-Ground data routing, from Instrument and Platform to the individual Ground Segment processes consuming the data shall be based exclusively on the Stream Identifier.*

Note 3: *On a given satellite, the logical stream identifier (i.e., APID) for each packet type is unique even if these packets are downlinked in different physical RF channels (e.g., S, X or Ka band) or are transmitted via different Virtual Channels or stored in different files.*

Note 4: *This requirement applies exclusively to Payload Data and does not relate to TT&C telemetry (e.g., telecommands or housekeeping telemetry), which is governed by separate requirements and may follow the ESA Packet Utilization Standard (PUS)*

R-020 Each payload or platform data Space Packet requiring distinct ground processing or routing shall be assigned a dedicated APID.

Note 1: *APID assignment is not constrained by physical hardware units but rather reflect logical application data streams. This includes, in particular, the assignment of separate APIDs for different internal calibration types, external calibration types, observation modes, and test modes.*

Note 2: *The purpose of this requirement is to enable semantic separation of logically independent or parallel-processable data streams already at the source (on-board), through the use of distinct APIDs. This aligns the Space Packet stream structure with the ground segment data flow and facilitates mapping to distinct Level-0 products, which becomes the unique input to a specific Level-1 processing chain, where the APID acts as a discriminator.*

Note 3: *While certain classes of data (e.g. internal calibration, external calibration, observation) are common across missions, the optimal differentiation granularity—particularly among subtypes of calibration or observation modes—is derived from the mission-specific processing architecture and data product structure.*

R-030 All *Platform* ancillary parameters needed for scientific/mission data processing (e.g., PVT, attitude, etc.) shall be contained in dedicated and independent ancillary Space Packets.

Note: *This segregation ensures distinct packets for efficient data processing.*

R-040 All *Instrument* ancillary parameters needed for scientific/mission data processing shall be contained in dedicated and independent ancillary Space Packets.

Note 1: *The Instrument Ancillary packet contains slow-varying acquisition parameters (e.g. temperatures, voltages and instrument status) to support independent monitoring and extraction. Parameters or flags varying at measurement frequency and directly associated with the measurements (e.g. SAR transmit/receive state, Waveform ID, etc) may be included in the Observation packet.*

Note 2: *This segregation ensures independence from TT&C HKTM monitoring packets generation, definition and frequency*

R-050 The CCSDS Space Packets containing ancillary data sets generated on-board by different sources shall be distinct.

Note 1: *For example, the following Space Packets are expected to be distinct with different APID:*

- *Platform ancillary data from Instrument ancillary data,*
- *Navigation ancillary from Thermal acquisition Space Packet*

Note 2*: Under this requirement, when Platform Ancillary Data are provided to the ground segment as multiple packet streams, each stream corresponding to a different on-board source uses a different APID. Conversely, when the platform generates a single Platform Ancillary Space Packet that aggregates parameters originating from multiple units (e.g. a NAVATT packet built from the data pool), a single APID is used, regardless of the internal parameter sources.*

4.2.1.2 Structure and format

Secondary Header

R-110 All Payload Data Space Packets shall include a secondary header common across all packet categories

Note: *Categories are defined in the requirement R-001*

R-120 The Payload Data Space Packets secondary header shall be compliant to CCSDS.

Note 1: *The requirement refers to CCSDS 133.0-B-2, Section 4.1.4.2, and mandates the presence of a timestamp in the Spacer Packet secondary header.*

***Note 2**: The use of the PUS-C secondary header format is permitted but not mandated. Its adoption does not require the implementation of any PUS services. In this case, the Service Type and Service Subtype fields are not be used to discriminate between different data types; this function remains with the APID.*

R-130 All Payload Data Space Packets shall contain in their secondary header a *time stamp field* formatted according to the PUS-C.

***Note 1:** The PUS-C time field format is described in section 7.3.10 (PTC 9) or 7.3.11 (PTC 10) of the PUS-C secondary header*

***Note 2:** This ensures that the Payload Data Space Packet is time stamped with common epoch and common format, even if originated by different on-board clocks or sources.*

<u>Packet Data Field content and format</u>

R-140 Each Payload Data Space Packet shall include a complete and unambiguous representation of all parameters values it contains, such that their decoding and interpretation does not depend on any external state, prior context, or future packets

***Note 1**: Examples of subcommutation techniques to be avoided are:*
- *Round-robin, where the interpretation of a fixed field changes across packets.*
- *Slice-based, where a single parameter is split across multiple packets.*

***Note 2:** This requirement also applies in case of use of CCSDS Sequence Flag, where each packet allows to identify and interpret its parameters, without requiring information from other packets in the same sequence.*

R-150 The utilization of the PUS Structure IDs (SIDs) for Payload Data shall be avoided.

***Note**: A packet with a given APID have always the same physical structure and parameter content.*

R-160 The Payload Data Space Packets shall contain only actual instrument observation or ancillary data.

***Note:** This implies that no padding is added when the data is shorter or varies in size.*

4.2.1.3 Navigation Data

IMPORTANT: The requirements in this section apply **only** to low-frequency data generated on board by the combined sensors of the position/attitude subsystem and the AOCS. These data are used as ancillary inputs to Payload Data processing for orbit and attitude determination, product generation, and Level-1 geolocation.

It does **not** apply to cases where data from these units—typically high-frequency or unprocessed (e.g., raw GNSS measurements, raw star-tracker quaternions)—are used as inputs to dedicated ground scientific algorithms or models. Such data are considered part of the **Observation** category, and their format, content, and acquisition rate are defined by the requirements of the specific scientific algorithm.

<u>PVT</u>

R-200 PVT (Position, Velocity, Time) parameters shall be generated as ancillary data and conveyed in a dedicated platform-generated packet referred to as NAVATT (Navigation and Attitude)

Note: *NAVATT packets are expected to be always available regardless of the payload operation or state, serving as the baseline for ground processors.*

R-210 The PVT information located in the platform ancillary Space Packet (NAVATT) used for data processing shall be expressed in **Earth Fixed** frame of reference in accordance to the Earth Fixed one used by the GNSS units.

Note: *PVT information expressed in Inertial frame negatively impacts the accuracy of ground processing*

R-220 The generation frequency of PVT data transmitted to ground shall be at least <PVT_Hz>

Note 1*: The frequency <PVT_Hz> is configurable according to mission specific needs.*

Note 2*: The default generation frequency corresponds to GNSS PPS of 1 Hz*

<u>Attitude</u>

R-230 The attitude (Quaternions) information shall be generated as ancillary data and conveyed in a dedicated platform-generated Space Packet referred to as NAVATT (Navigation and Attitude)

R-240 The attitude (Quaternions) information located in platform ancillary Space Packet (NAVATT) shall be expressed in Inertial frame of reference according to the one used by the AOCS.

Note: *attitude information expressed in Inertial frame minimises the ground processing geolocation error.*

R-250 "The generation frequency of Quaternions attitude data transmitted to ground shall be at least <Quat_Hz>.

Note: *The frequency <Quat_Hz> is configurable according to mission specific needs*"

Timing

R-260 The time correlation parameters linking OBT, Instrument, PPS/GNSS and other times times shall be generated as ancillary data and conveyed in a dedicated platform-generated Space Packet referred to as NAVATT (Navigation and Attitude)

Note 1: *One example of these parameters is the value of the OBT counter latched at PPS or at Synchronisation time accompanied by the time at PPS as reported by GNSS units.*

Note 2: *This might not apply in special cases the time correlation is part of the measurement chain (e.g. intersatellite interferometric measurements). In this case a dedicated correlation packets might be generated belonging to a dedicated Observation category.*

R-270 (goal) OSV and Quaternions with the same frequency shall be sampled and be associated at the same moment in time.

Note: *Alignment of the sampling times of PVT and Attitude reduces the geolocation errors during ground processing.*

4.2.1.4 Data availability and storage

R-300 All Platform Ancillary packets (e.g., NAVATT, Thermal, etc.) shall be generated and available for downlink via the Payload Data link, irrespective of the mode and state of the instrument.

Note: *This includes scenarios when the instrument is not measuring, in standby, or OFF, ensuring continuous availability of ancillary on the ground even outside the measurement interval.*

R-310 All Instrument Ancillary packets (e.g. thermal parameters, voltages, status information) shall be available for downlink via the Payload Data Link whenever they are acquired and generated.

Note*: This covers for instance scenarios where the instrument is ON acquiring ancillary data but not measuring.*

R-320 It shall be possible from ground to freely configure the allocation of any Payload Data type to any Packet Store.

Note 1*: The requirements is applicable when Packet Stores are used for on-board memory data storage.*

Note 2: *the identification of data type is nominally performed using APID but also PUS-C Service Type and Subtype depending on the approach selected on-board for Space Packet.*

Note 3: *allocation could also map multiple data type to the same Packet Store.*

4.2.2 Space Data Link (Transfer Frames) and Physical Link

TF format

R-400 The insertion zone of AOS Transfer Frame [CCSADL] shall be avoided.

TF Downlink

R-410 The Payload Data Space Packet generated by the instrument(s) and recorded on-board shall be downlinked via the Virtual Channel Packet Service, according to the applicable CCSDS Space Data Link Layer Protocol.

Note 1*: The requirements is applicable when Packet Stores are used for on-board memory data storage.*

Note 2: *Commonly used Space Data Link Layer Protocol includes TM [CCSDS 132.0-B], AOS [CCSDS 732.0-B-4], USLP [CCSDS 732.1-B-3].*

Physical Link

R-450 In case more than one physical communication channel (e.g., multiple RF, optical) is used to downlink the data, the downlink of a specific Packet Store (allocated to a VC) shall be performed using only a single physical communication channel.

Note: *The requirement is applicable when Packet Stores are used for on-board memory data storage.*

4.3 File Operation

This section addresses requirement whereby the mission make use of Files (e.g. CFDP protocol) for the transfer of Payload Data and relevant ancillary from space to ground.

File Definition and Identification

R-500 It shall be possible to segregate the storage of different type of data (e.g., science, calibration, ancillary, housekeeping) in dedicated files.

Note 1: *The requirement is applicable when files are used for on-board memory data storage.*

Note 2: *This is essential to identify the data contained in the files allowing further routing and processing on ground.*

Note 3: *This requirement considers the definition of data types as referred in R-001, R-010, R-030, R-040, R-050, R-200, R-230, R-260*

R-510 The payload files shall be identified by a unique filename compliant with [RAWL0].

Note*: The requirement is applicable when file-based space to ground protocol is used (e.g. CFDP).*

R-520 The name of each payload on-board file shall allow to fully identify type and instance (as defined in [RAWL0]) allowing direct on-ground routing to different processing facilities without requiring inspection of its content.

Note: *The requirement is applicable when file-based space to ground protocol is used (e.g. CFDP).*

File content

R-530 In case payload raw data, not formatted as CCSDS Space Packets, are directly stored in files, the raw data format and the associated metadata shall be agreed with the Agency

Note 1: *Files cannot contain a mixture of Space Packets and specific raw data.*

Note 2: *Examples of data not formatted as CCSDS could vary from binary memory image to commercial/scientific formats (FITS, TIFF, ASCII, etc).*

File transfer management

R-550 It shall be possible to configure the file downlink destination.

Note 1*: The requirements is applicable when files are used for on-board memory data storage.*

Note 2: *In the case of CFDP, different "destinationID" are used for each data types allowing them to be reconstructed and processed independently.*

Note 3: *Possible use cases are HKTM, Payload Data or host Payload Data to be routed directly from the Ground Station to a different processing centres.*

R-555 It shall be possible to dynamically configure from ground the priority of the autonomous download based on data type and file age.

Note 1: *The requirement is applicable when files are used for on-board memory data storage.*

Note 2: *A typical default file download order is:*
1- TM-Files “Housekeeping TM” from oldest to latest (if HKTM is transmitted on the Payload Data link)
2- Ancillary data files (Instrument and Platform)
3- Science Data Files. The assumed download order for science files is typically from oldest to newest

R-560 It shall be possible to downlink a file more than once.

Note 1: *The requirement is applicable when files are used for on-board memory data storage.*

Note 2*: In case CFDP Class 1 is used, the files containing specific ancillary data (e.g. NAVATT) could be downlinked twice at each downlink at different elevations.*

R-565 It shall be possible to re-download complete files in case they were only partially transmitted during the previous pass.

Note 1: *The requirement is applicable when files are used for on-board memory data storage.*

Note 2: *This requirement allows to fully re-download a file interrupted due to end of the pass, avoiding the need of merging data coming from different passes or acquisition stations.*

Data availability

R-590 Data availability shall be evaluated considering the combined effects of the link budget and file downlink protocol performance.

Note 1*: The requirements is applicable when files are used for on-board memory data storage.*

Note 2*: In particular, for unreliable links using CFDP Class 1, the CFDP file size is selected to be sufficiently small so that, given the statistically expected RF link outages, the amount of unrecovered data is minimized.*

Note 3*: The maximum file size for downlink is to be justified and agreed with the Agency.*

R-595 (**goal**) the on-board Payload Data handling system and overall operational concept shall be designed to ensure the required performance and data availability with an open-loop (CFDP Class-1) approach.

4.4 Others

Operations

R-600 It shall be possible to plan instrument(s) operational modes and calibration activities using:

a. Onboard time-based schedule: time tagged events

b. Onboard position-based schedule: position tagged events (e.g. orbital revolution number, and the angular position on orbit where the event should be executed)"

R-610 The angle used by onboard position-based schedule shall be compliant to [PE-TN-ESA-SY-0305] and [PE-TN-ESA-SY-0338]

Note: *This requirement ensures coherent geometrical definition on-board, on-ground planning system as well as across missions. It also enables a direct interpolation time to angle-position.*

Download

R-700 It shall be possible, at any point in time, to perform the downlink of all Payload Data stored on-board, regardless of the data size and the way the memory is managed.

Note: *This applies for example when the data is not aligned or filling entirely mass memory pages or sectors.*"

R-710 During downlink operations on a Ground Station, the System shall download only complete sequences of Space Packets making use of the CCSDS segmentation flag.

Note 1*: The requirement is applicable when Packet Stores are used for on-board memory data storage.*

Note 2: *This requirement simplifies the Space Packet handling process, eliminating the need for reassembly logic at the receiver.*

R-720 The on-board data-handling system shall be able to autonomously control the Payload Data Space Packet downlink as a function of ground-station visibility, giving the capability to apply a configurable time margin after acquisition and before loss of contact.

Note: *The implementation mechanism depends on the downlink protocol in use. It may consist of:*

- Commanding the dumping of Packet Stores,

- Issuing CFDP Suspend and CFDP Resume service directives, or
- Executing higher-level Downlink Manager Stop, Start and Suspend commands.