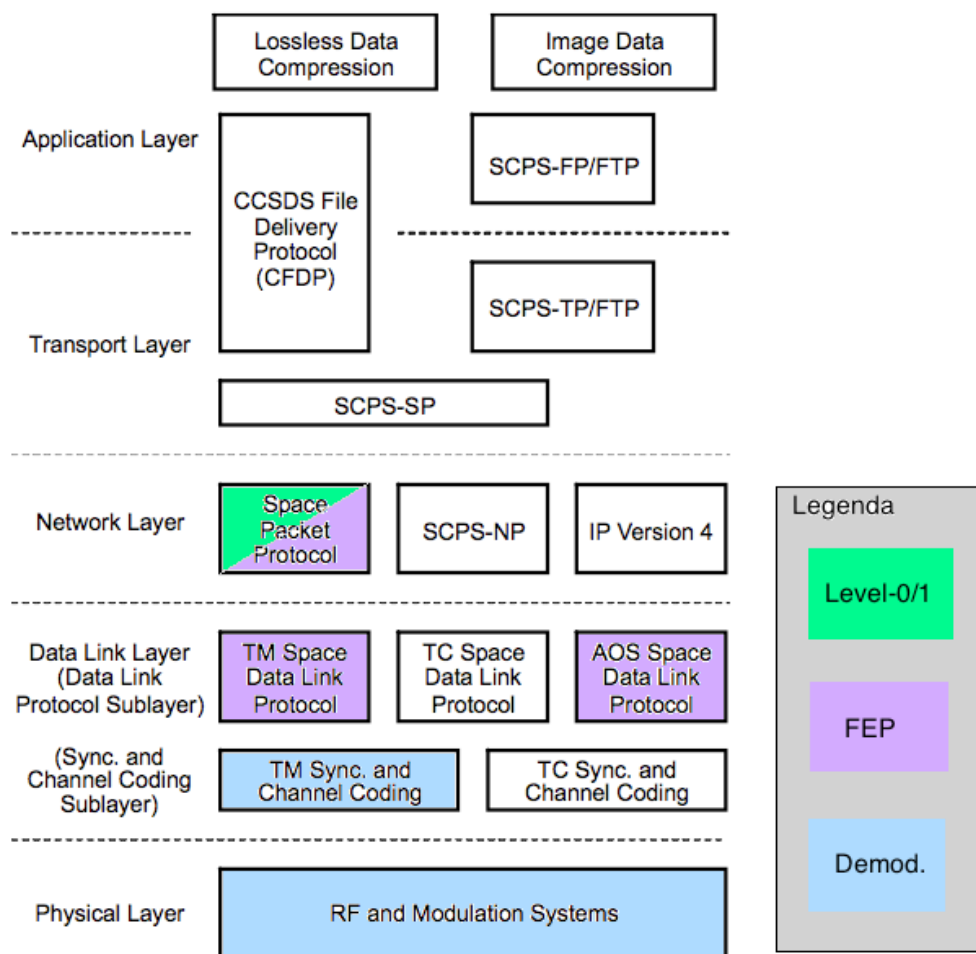


Basic degraded data definition for GSV

This TN describes 17 generic basic errors, based on CCSDS model, to build degraded Telemetry Test Data Set for non-nominal cases, typically used during GSV. This data could also be used to as sanity check for Ground System equipment like Demodulators, Front End Processors (FEP) and Level-0 Processors.

NB. Because it is a generic set of errors, it is possible that some of the errors presented here are not possible for a specific mission design.

This TN does **not** address: application level errors involving Source Packet secondary header and data fields, PUS standard usage and data, mission specific use (or abuse) of standard CCSDS headers data fields (SSC, APID, etc).



Simplified CCSDS Reference Model

1.1 CADUs

This section describes errors at CADU level exercising the bit and CADU synchronisation functionality of the Demodulator/FEP as well as the RS correction of the codeblock.

1.1.1 Gaps and corruptions

Downlink Transmission Failure can produce corruption and gaps into the CADU bit-stream.

Corruption:

1. Corrupted ASM (unrecoverable)
2. Corrupted Codeblock (RS recoverable)
3. Corrupted Codeblock (RS unrecoverable)
4. Corrupted RS

Gaps:

5. Missing CADUs (whole and partial)

1.2 Transfer Frames

This section describes errors at TF level exercising the FEP functionality (sometime included within the Demodulator equipment) regarding the extraction of TF from CADUs stream.

NB: It is oriented mostly to mission interfacing with the GS in S-Band at TF level (e.g. Swarm type) but describes the data format also in case CADU have to be generated.

1.2.1 Corruption

On-board equipment failure can result in TF corruption:

6. TF Header corruption (AOS Frame Header CRC error)

1.2.2 Gaps

Equipment or operational failures *on-ground* or *on-board* can potentially produce TF sequences with incomplete, invalid or missing frames.

Two cases are identified:

7. Short gap (smaller than a frame) fully contained in one frame: The frame is shorter in size, but the Header and Trailer(if applicable) are present.

If data is transferred as CADU then the enclosing CADU is of the correct length/format and the missing part within the codeblock after the TF trailer is padded with random data. The RS is the correct one for the actual datablock.

8. Long gap (several frames in length): Some data and the trailer of the first affected frame are lost, along with several complete frames and the header and some data of the last affected frame.

If data is transferred as CADU then the enclosing CADUs are of the correct length/format and the missing part within the codeblock is padded with random data. The RS is the correct one for the actual datablock.

1.2.3 Frame Repetitions and Duplications

Error cases involving the duplication of data within the same TF sequence:

9. Stuttering Frame: A single frame is identically repeated several times, consecutively. (TF Counter: 1,2,3,4,5,6,**6**,6,7,8,9,0)..

If data is transferred as CADU then the corresponding CADUs are correctly formatted and contain multiple instances of same TF

10. Repeated Frames: A number of frames re-appears, out of sequence, after several other frames; after that the sequence continues as normal (e.g. TF Counter: 1,2,3,4,5,6,**1,2**,7,8,9,0).

If data is transferred as CADU then the corresponding CADUs are correctly formatted and include CADUs containing repetition of earlier TFs

11. Overwritten Frames: A number of frames are corrupted (overwritten) by some already transmitted older frames (e.g. TF Counter: 1,2,3,4,5,6,**1,2**,9,0). Each frame is correctly formatted.

If data is transferred as CADU then the corresponding CADUs are correctly formatted and include CADUs containing repetition of earlier TFs

1.3 Space Packets (ISP)

This section describes errors exercising the functionality of the FEP (sometime included within the Demodulator equipment) and the Level-0 Processor regarding the ability to reconstruct and handle non-nominal ISP sequences within a nominal TF stream

NB: Space Packets errors are implemented within a corresponding TF and CADU stream

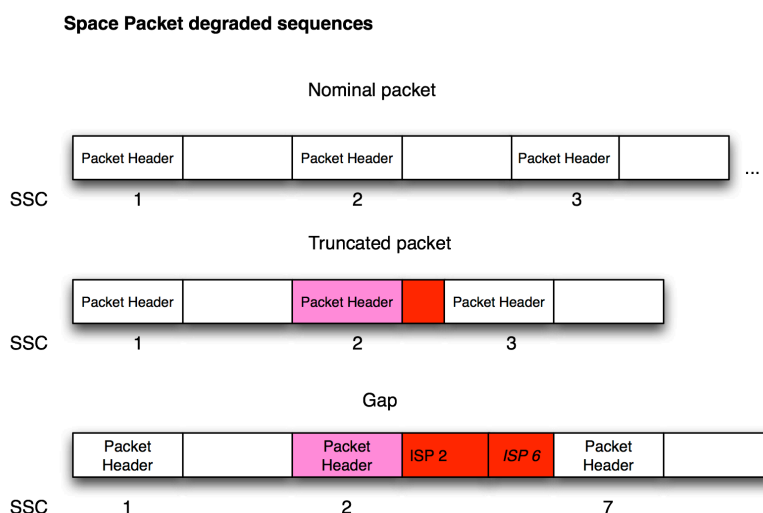
1.3.1 Corruption

On-board equipment failure can result in individual packet corruption:

12. Packet corruption (SP CRC error if present)

1.3.2 Truncation/Gaps

Equipment/software failures *on-board* or on-ground can potentially produce data sequences with incomplete or missing space packets.



Two cases are identified:

13. **Truncated packet:** one packet is shorter in size, the packet header is intact (including the correct intended packet length), but the data field is truncated. The subsequent packet starts immediately after (no padding) and is correct. The containing TF and CADU are correctly formatted. (SSC sequence is continuous 1,2,3,4,...)
14. **Gap** across multiple packets: The last part of the data field of one packet some entire packet and a packet header are lost. The subsequent packet starts immediately after (no padding). Depending on the packet size this can be contained within a single frame or be spread across many. The containing TFs and CADUs are correctly formatted. (SSC sequence is discontinuous 1,2,7,8,...)

1.3.3 Packets Repetitions and Duplications

Error cases involving the duplication of data within the same space packet sequence:

15. **Stuttering packet:** A single packet is repeated several times, consecutively. (ISP Counter: 1,2,3,4,5,6,6,6,7,8,9,0..)
The corresponding TF and CADUs are correctly formatted and frame counter behaviour is nominal (increasing TF counter):
(TF counter 1,2,3,4,5,6,7,8,9....)
16. **Repeated packet:** A number of packet re-appears, out of sequence, after several other packet; after that the sequence continues as normal (e.g. ISP Counter: 1,2,3,4,5,6,1,2,7,8,9,0).
The corresponding TF and CADUs are correctly formatted and frame counter behaviour is nominal (increasing TF counter)
(TF counter 1,2,3,4,5,6,7,8,9....)

17. Overwritten packets: A number of space packets are corrupted (overwritten) by some already transmitted older packets (e.g. ISP SSC Counter: 1,2,3,4,5,6,**1,2**,9,0).
The corresponding TF and CADUs are correctly formatted and frame counter behaviour is nominal (increasing TF counter)
(TF counter 1,2,3,4,5,6,7,8,9....)