



EARTH OBSERVATION
SYSTEM SUPPORT



Space-to-Ground (S2G) Data Viewer

Montserrat Pinol Sole
ESA-ESTEC / EOP-PES

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→ THE EUROPEAN SPACE AGENCY

- The Space to Ground (S2G) Data Viewer is an extensible and flexible graphical tool for **satellite telemetry data visualization** that is **freely** distributed by the ESA-ESTEC EOP System Support Division
- With this software application it is possible to inspect the contents of the **communication data units** generated on-board (both by platform and instruments) or included in products of the payload data-processing ground system
- S2G is also an useful tool to **support testing activities** related to

Space to Ground payload data verification

Data generation for science data processors

- These activities require the **analysis, visualization and diagnostic** of telemetry data files produced by

Satellites

Ground equipment

Simulators

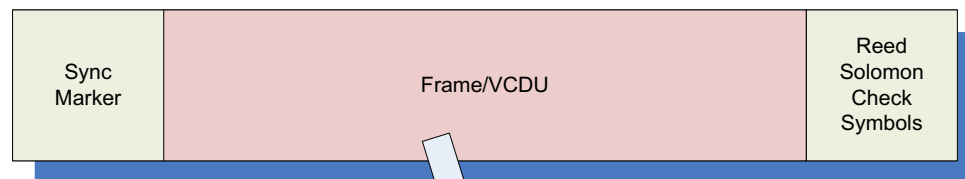


Types of Data Units

- The **house-keeping telemetry** or **science instruments data** is transmitted to the ground according to **CCSDS** standard formats. The data can be packaged as:

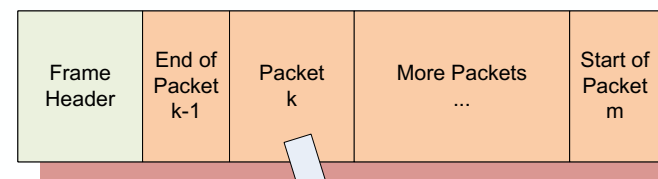
- CADUs** (Channel Access data Units)

CADU



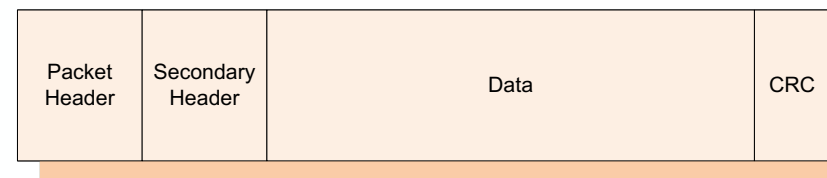
- TFs** (Transfer Frames)

VCDU



- ISPs** (Instrument Source Packets)

ISP



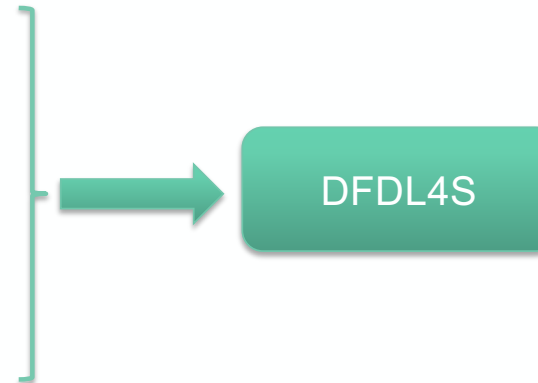
- Graphical User Interface

- ✓ Cross-platform

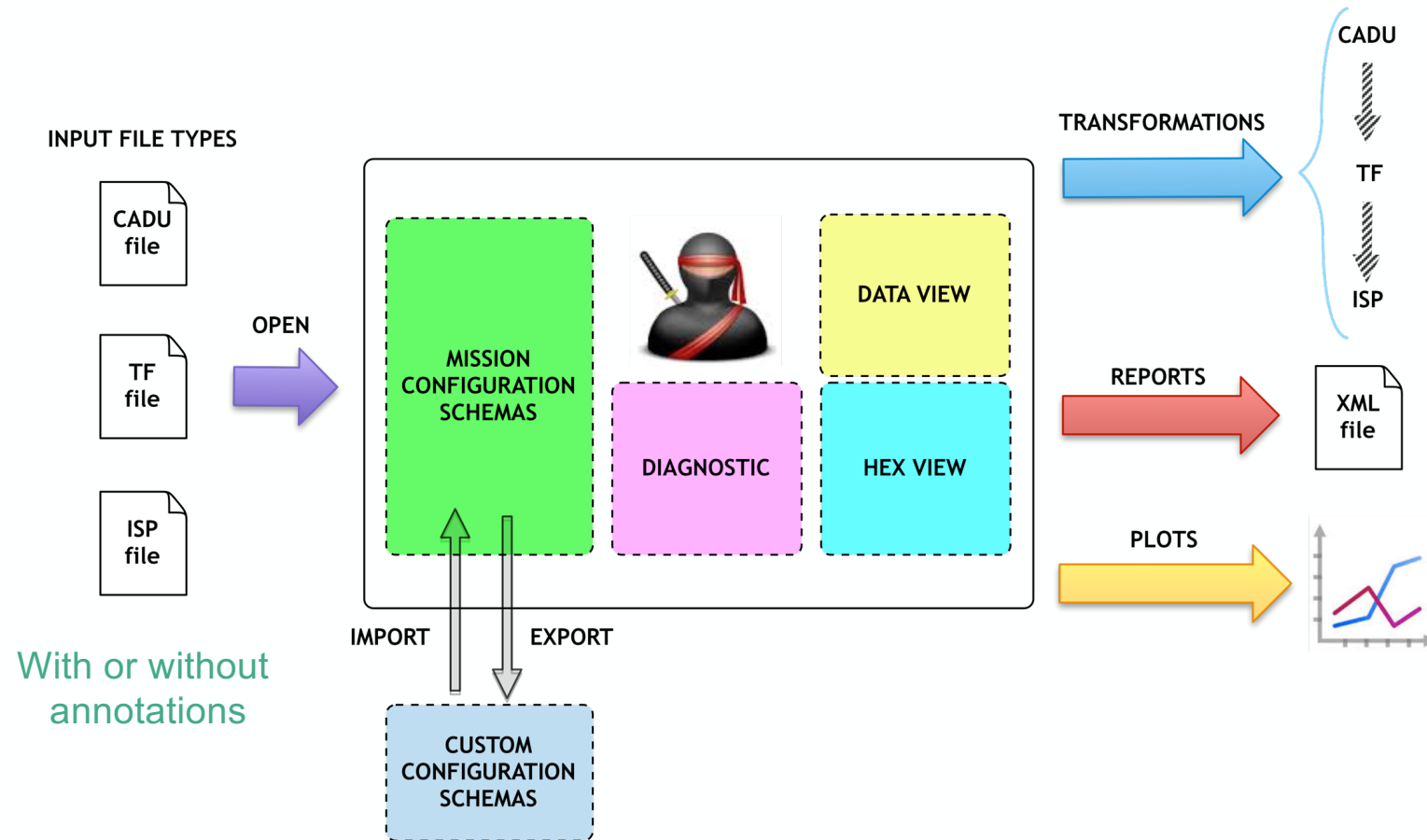


- Data Parsing Engine

- ✓ Description of binary data
 - Flexible user-editable description
 - Preserving logical data structure
 - Formal syntax
- ✓ Open technology and specification standard



S2G DATA VIEWER



S2G Application Layout



S2G Data Viewer --- Default Mission: FLEX X-band TM (Custom) --- Select File Mission: FLEX X-band TM (Custom)

Product Files

Name	Size	Type
? FLX_GPP_LO_NAVATT_20190914T103613_20190914T103728_20220201T15...	14896 bytes	ISP

ISP Fields

Name	Type	Value	Size
ISP	Complex	09 69 C0 00 00 BD 10 03 19...	196 bytes, 0 bits
Packet_Primary_Header	Complex	09 69 C0 00 00 BD	6 bytes, 0 bits
Packet_Version	Binary	000...	0 bytes, 3 bits
Packet_Identification	Complex	09 69	1 bytes, 5 bits
Packet_Type	Binary	...0....	0 bytes, 1 bits
Secondary_Header_Flag	Binary	...1....	0 bytes, 1 bits
APID	Hexadecimal	01 69	1 bytes, 3 bits
PID	Binary	...001 0110....	0 bytes, 7 bits
PCAT	Binary	...1.001	0 bytes, 4 bits
Packet_Sequence_Ctrl	Complex	C0 00	2 bytes, 0 bits
Sequence_Flags	Binary	11.....	0 bytes, 2 bits
SSC	UInteger16	0	1 bytes, 6 bits
Packet_Data_Length	UInteger16	189	2 bytes, 0 bits
Packet_Data_Field	Complex	10 03 19 00 4A A7 85 2F 78...	190 bytes, 0 bits
NAVATT_Packet_Secondary_Header	Complex	10 03 19 00 4A A7 85 2F 78...	12 bytes, 0 bits
PUS_Header	Complex	10 03 19	3 bytes, 0 bits
Spare	Binary	0.....	0 bytes, 1 bits
PUS_Version	Binary	.001....	0 bytes, 3 bits
Spare	Binary	...0000	0 bytes, 4 bits
Service_Type	UInteger8	3	1 bytes, 0 bits
Service_Subtype	UInteger8	25	1 bytes, 0 bits
Destination_Id	Binary	00000000	1 bytes, 0 bits
Time_Code_Field	Complex	4A A7 85 2F 78 57 3C 00	8 bytes, 0 bits
Time_Code	Time	2019-09-14T10:36:13.470	7 bytes, 0 bits
Coarse_Time	UInteger32	1252492591	4 bytes, 0 bits
Fine_Time	UInteger32	7886652	3 bytes, 0 bits
Time_Status	Binary	00000000	1 bytes, 0 bits
NAVATT_User_Data_Field	Complex	00 00 00 00 01 4A A7 85 2F...	178 bytes, 0 bits
ISP_Data	Complex	00 00 00 00 01 4A A7 85 2F...	176 bytes, 0 bits
Structure_ID	Complex	00 00 00 00	4 bytes, 0 bits
CSW_Field	Hexadecimal	00 00 00 00	4 bytes, 0 bits
Time_Correlation_Data	Complex	01 4A A7 85 2F 78 57 3C 4A...	15 bytes, 0 bits
Validity_Flag	Binary	00000001	1 bytes, 0 bits

Data Unit List

#	Type	Offset	SSC	APID	Time_Code_Field	Time_Code_Field_FLORIS
1	ISP	0 bytes	0	01 69	2019-09-14T10:36:13.470	Unable to retrieve value.
2	ISP	196 bytes	1	01 69	2019-09-14T10:36:14.470	Unable to retrieve value.
3	ISP	392 bytes	2	01 69	2019-09-14T10:36:15.470	Unable to retrieve value.
4	ISP	588 bytes	3	01 69	2019-09-14T10:36:16.470	Unable to retrieve value.
5	ISP	784 bytes	4	01 69	2019-09-14T10:36:17.470	Unable to retrieve value.
6	ISP	980 bytes	5	01 69	2019-09-14T10:36:18.470	Unable to retrieve value.
7	ISP	1176 bytes	6	01 69	2019-09-14T10:36:19.470	Unable to retrieve value.
8	ISP	1372 bytes	7	01 69	2019-09-14T10:36:20.470	Unable to retrieve value.
9	ISP	1568 bytes	8	01 69	2019-09-14T10:36:21.470	Unable to retrieve value.
10	ISP	1764 bytes	9	01 69	2019-09-14T10:36:22.470	Unable to retrieve value.
11	ISP	1960 bytes	10	01 69	2019-09-14T10:36:23.470	Unable to retrieve value.
12	ISP	2156 bytes	11	01 69	2019-09-14T10:36:24.470	Unable to retrieve value.
13	ISP	2352 bytes	12	01 69	2019-09-14T10:36:25.470	Unable to retrieve value.
14	ISP	2548 bytes	13	01 69	2019-09-14T10:36:26.470	Unable to retrieve value.
15	ISP	2744 bytes	14	01 69	2019-09-14T10:36:27.470	Unable to retrieve value.
16	ISP	2940 bytes	15	01 69	2019-09-14T10:36:28.470	Unable to retrieve value.
17	ISP	3136 bytes	16	01 69	2019-09-14T10:36:29.470	Unable to retrieve value.
18	ISP	3332 bytes	17	01 69	2019-09-14T10:36:30.470	Unable to retrieve value.
19	ISP	3528 bytes	18	01 69	2019-09-14T10:36:31.470	Unable to retrieve value.
20	ISP	3724 bytes	19	01 69	2019-09-14T10:36:32.470	Unable to retrieve value.
21	ISP	3920 bytes	20	01 69	2019-09-14T10:36:33.470	Unable to retrieve value.
22	ISP	4116 bytes	21	01 69	2019-09-14T10:36:34.470	Unable to retrieve value.
23	ISP	4312 bytes	22	01 69	2019-09-14T10:36:35.470	Unable to retrieve value.
24	ISP	4508 bytes	23	01 69	2019-09-14T10:36:36.470	Unable to retrieve value.
25	ISP	4704 bytes	24	01 69	2019-09-14T10:36:37.470	Unable to retrieve value.
26	ISP	4900 bytes	25	01 69	2019-09-14T10:36:38.470	Unable to retrieve value.
27	ISP	5096 bytes	26	01 69	2019-09-14T10:36:39.470	Unable to retrieve value.

Hexadecimal View

Hex	Offset: 6	Value: 10	Selection: 190 bytes
0000000000000000	00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17	09 69 C0 00 00 BD 10 03 19 00 4A A7 85 2F 78 57 3C 00 00 00 00 00 01 4A	...
0000000000000018	A7 85 2F 78 57 3C 4A A7 85 2F 78 57 3C 4A A7 85 2F 78 57 3C C1 50 6D E0		...
0000000000000030	B4 68 3F 03 41 41 51 15 EB E2 66 60 41 54 1C 74 34 37 D1 A9 C0 AF 01 A3		...
0000000000000048	E9 3D EF B1 40 AE C9 91 7A 5B 3A 91 C0 B3 3E CD C6 53 26 44 BF D7 0B 06		...
0000000000000060	5E D2 77 F5 8F CD 14 0E 23 2B CC B8 3F D2 18 79 0F 80 80 DC 3F EB 58 5D		...
0000000000000078	30 21 2F A2 3F 50 F7 40 44 7F A5 9B 3F 12 C0 2F 60 46 45 C5 BE E9 82 60		...
0000000000000090	28 50 0F 1A 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00		...
00000000000000A8	00 00		...
00000000000000C0	00 00 42 15 09 69 C0 01 00 BD 10 03 19 00 4A A7 85 30 78 57 3C 00 00 00		...
00000000000000D8	00 00 01 4A A7 85 30 78 57 3C 4A A7 85 30 78 57 3C 4A A7 85 30 78 57 3C		...
00000000000000F0	C1 50 71 C0 54 64 DD 69 41 41 58 C7 B3 B8 63 CD 41 54 17 A3 CB 73 DA 3A		...
0000000000000100	C0 AE E9 C0 C3 BE E9 03 40 AE F 8 00 00 71 E4 7E 70 44 70 01 E4 74 7E		...

Data Unit List

Hierarchic Data View

Hexadecimal View



Preferences (Select Mission) + Open File (Select File Type)



The screenshot shows the S2G Data Viewer interface. The main window displays a table of ISP fields with columns for Name, Size, Type, and Type. A context menu is open over the table, listing various mission types such as 'Aeolus X-Band TM (Standard)', 'Biomass X-band TM (Standard)', and 'FLEX X-band TM (Custom)'. The 'FLEX X-band TM (Custom) (ISP)' option is highlighted. To the left, an 'ISP List' table shows a list of ISP entries with columns for #, Type, Offset, SSC, and APID. Below this, a 'Mission Configuration' dialog box is visible, showing 'Application Settings', 'Mission Configuration', and 'Mission Explorer'. On the right, an 'Open Files' dialog box is open, displaying a list of files with their types, including 'FLEX X-band TM (Custom) (Scrambled CADU)', 'FLEX X-band TM (Custom) (CADU)', and 'FLEX X-band TM (Custom) (ISP)'. The 'FLEX X-band TM (Custom) (ISP)' option is selected. The dialog box also features a 'Drop files here' area and 'OK', 'File Selection', and 'Cancel' buttons.

#	Type	Offset	SSC	APID
1	ISP	0 bytes	0	01 69
2	ISP	196 bytes	1	01 69
3	ISP	392 bytes	2	01 69
4	ISP	588 bytes	3	01 69
5	ISP	784 bytes	4	01 69
6	ISP	980 bytes	5	01 69
7	ISP	1176 bytes	6	01 69
8	ISP	1372 bytes	7	01 69
9	ISP	1568 bytes	8	01 69
10	ISP	1764 bytes	9	01 69
11	ISP	1960 bytes	10	01 69
12	ISP	2156 bytes	11	01 69
13	ISP	2352 bytes	12	01 69
14	ISP	2548 bytes	13	01 69
15	ISP	2744 bytes	14	01 69
16	ISP	2940 bytes	15	01 69
17	ISP	3136 bytes	16	01 69
18	ISP	3332 bytes	17	01 69
19	ISP	3528 bytes	18	01 69
20	ISP	3724 bytes	19	01 69
21	ISP	3920 bytes	20	01 69
22	ISP	4116 bytes	21	01 69
23	ISP	4312 bytes	22	01 69
24	ISP	4508 bytes	23	01 69
25	ISP	4704 bytes	24	01 69
26	ISP	4900 bytes	25	01 69
27	ISP	5096 bytes	26	01 69



Visualisation, Analysis and Diagnostic



Product Files

Name	Size	Type
FLX_GPP_LO_NAV_TT_20190914T103613_20190914T103728_20220201T15...	14896 bytes	ISP
FLX_GPP_LO_VAU_TM_20190914T103613_20190914T103729_20220201T15...	2020 bytes	Annotated ISP
FLX_GPP_LO_VAU_TM_20190914T103613_20190914T103729_20220201T15...	283176 bytes	ISP

ISP Fields

Name	Type	Value	Size
ISP	Complex	0C 34 C0 0E 00 9B 4A A7 85...	162 bytes, 0 bits
Packet_Primary_Header	Complex	0C 34 C0 0E 00 9B	6 bytes, 0 bits
Packet_Version	Binary	000...	0 bytes, 3 bits
Packet_Identification	Complex	0C 34	1 bytes, 5 bits
Packet_Type	Binary	...0...	0 bytes, 1 bits
Secondary_Header_Flag	Binary	...1...	0 bytes, 1 bits
APID	Hexadecimal	04 34	1 bytes, 3 bits
PID	Binary	...100 0011...	0 bytes, 7 bits
PCAT	Binary	...0100	0 bytes, 4 bits
Packet_Sequence_Ctrl	Complex	C0 0E	2 bytes, 0 bits
Sequence_Flags	Binary	11...	0 bytes, 2 bits
SSC	UInteger16	14	1 bytes, 6 bits
Packet_Data_Length	UInteger16	155	2 bytes, 0 bits
Packet_Data_Field	Complex	4A A7 85 30 14 3E A8 00 00...	156 bytes, 0 bits
FLORIS_HR1_VAU_TM_Packet_Secondary_Header	Complex	4A A7 85 30 14 3E A8 00 00...	16 bytes, 0 bits
Time_Code	Time	2019-09-14T10:36:14.079	7 bytes, 0 bits
Time_Sync_Status	Binary	0...	0 bytes, 1 bits
Reserved	Binary	00000000	0 bytes, 7 bits
CAL_SubType	UInteger16	1	2 bytes, 0 bits
CAL_Spare	UInteger16	20	2 bytes, 0 bits
Calibration_ID	UInteger16	20	2 bytes, 0 bits
Validity	UInteger16	0	2 bytes, 0 bits
FLORIS_HR1_VAU_TM_User_Data_Field	Complex	00 00 00 0E 00 00 00 02 00...	140 bytes, 0 bits
ISP_Data	Complex	00 00 00 0E 00 00 00 02 00...	138 bytes, 0 bits
Data	Hexadecimal	00 00 00 0E 00 00 00 02 00...	138 bytes, 0 bits
Packet_Error_Control	Complex	7F EE	2 bytes, 0 bits
CRC	Binary	01111111 11101110	2 bytes, 0 bits

ISP List

#	Type	Offset	! SSC	APID	Time_Code_Field	Time_Code_Field_FLORIS
1	ISP	0 bytes	0	04 34	Unable to retrieve value.	2019-09-14T10:36:13.470
2	ISP	162 bytes	1	04 34	Unable to retrieve value.	2019-09-14T10:36:13.511
3	ISP	324 bytes	2	04 34	Unable to retrieve value.	2019-09-14T10:36:13.557
4	ISP	486 bytes	3	04 34	Unable to retrieve value.	2019-09-14T10:36:13.601
5	ISP	648 bytes	4	04 34	Unable to retrieve value.	2019-09-14T10:36:13.644
6	ISP	810 bytes	5	04 34	Unable to retrieve value.	2019-09-14T10:36:13.688
7	ISP	972 bytes	6	04 34	Unable to retrieve value.	2019-09-14T10:36:13.731
8	ISP	1134 bytes	7	04 34	Unable to retrieve value.	2019-09-14T10:36:13.775
9	ISP	1296 bytes	8	04 34	Unable to retrieve value.	2019-09-14T10:36:13.818
10	ISP	1458 bytes	9	04 34	Unable to retrieve value.	2019-09-14T10:36:13.862
11	ISP	1620 bytes	10	04 34	Unable to retrieve value.	2019-09-14T10:36:13.905
12	ISP	1782 bytes	11	04 34	Unable to retrieve value.	2019-09-14T10:36:13.949
13	ISP	1944 bytes	12	04 34	Unable to retrieve value.	2019-09-14T10:36:13.992
14	ISP	2106 bytes	13	04 34	Unable to retrieve value.	2019-09-14T10:36:14.036
15	ISP	2268 bytes	14	04 34	Unable to retrieve value.	2019-09-14T10:36:14.079
16	ISP	2430 bytes	15	04 34	Unable to retrieve value.	2019-09-14T10:36:14.123
17	ISP	2592 bytes	16	04 34	Unable to retrieve value.	2019-09-14T10:36:14.166
18	ISP	2754 bytes	17	04 34	Unable to retrieve value.	2019-09-14T10:36:14.210
19	ISP	2916 bytes	18	04 34	Unable to retrieve value.	2019-09-14T10:36:14.253
20	ISP	3078 bytes	19	04 34	Unable to retrieve value.	2019-09-14T10:36:14.297
21	ISP	3240 bytes	20	04 34	Unable to retrieve value.	2019-09-14T10:36:14.340
22	ISP	3402 bytes	21	04 34	Unable to retrieve value.	2019-09-14T10:36:14.384
23	ISP	3564 bytes	22	04 34	Unable to retrieve value.	2019-09-14T10:36:14.427
24	ISP	3726 bytes	23	04 34	Unable to retrieve value.	2019-09-14T10:36:14.471
25	ISP	3888 bytes	24	04 34	Unable to retrieve value.	2019-09-14T10:36:14.514
26	ISP	4050 bytes	25	04 34	Unable to retrieve value.	2019-09-14T10:36:14.558
27	ISP	4212 bytes	26	04 34	Unable to retrieve value.	2019-09-14T10:36:14.601
28	ISP	4374 bytes	27	04 34	Unable to retrieve value.	2019-09-14T10:36:14.645
29	ISP	4536 bytes	28	04 34	Unable to retrieve value.	2019-09-14T10:36:14.688

Hexadecimal

```

00000000000000E58 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17
00000000000000870 0A 34 28 28 20 03 14 09 00 03 04 03 18 36 3B 3B 08 C8 A0 64 20 78 00 00
00000000000000888 00 00 00 00 00 FF FF 00 00 00 00 08 00 00 00 EE 0E 01 11 00 00
000000000000008A0 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F
000000000000008B8 5D 10 56 98 28 78 34 E8 5D 18 4A 18 00 00 00 00 00 00 00 00 00 00 00 00 00
000000000000008D0 00 00 00 00 00 00 00 00 00 00 C7 D8 0C 34 C0 0E 00 9B 4A A7 85 30 14 3E
000000000000008E8 A8 00 00 01 00 14 00 00 00 00 00 00 00 00 00 02 00 00 A7 30 0E AE
00000000000000890 AE 31 7B 54 67 7D 64 64 00 3C 00 00 01 0C 00 01 51 14 0A 34 28 28 20 03
000000000000008918 14 09 00 03 04 03 18 36 3B 3B 08 C8 A0 64 20 78 00 00 00 00 00 00 00 00
000000000000008930 FF FF 00 00 00 00 00 00 00 00 EE 0E 01 11 00 00 5F 28 5F 28 5F 28
000000000000008948 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F 28 5F
000000000000008960 34 E8 5D 10 4A 18 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
000000000000008978 00 00 00 00 7F EE 0C 34 C0 0F 00 9B 4A A7 85 30 1F 61 78 00 01 00 14
000000000000008990 00 14 00 00 00 00 0F 00 00 00 02 00 00 A7 30 0E AE 31 7B 54 67 7D
00000000000089A8 64 64 00 3C 00 00 01 0C 00 01 51 14 0A 34 28 28 20 03 14 09 00 03 04 03
  
```

Report Transformation Error Check Plot

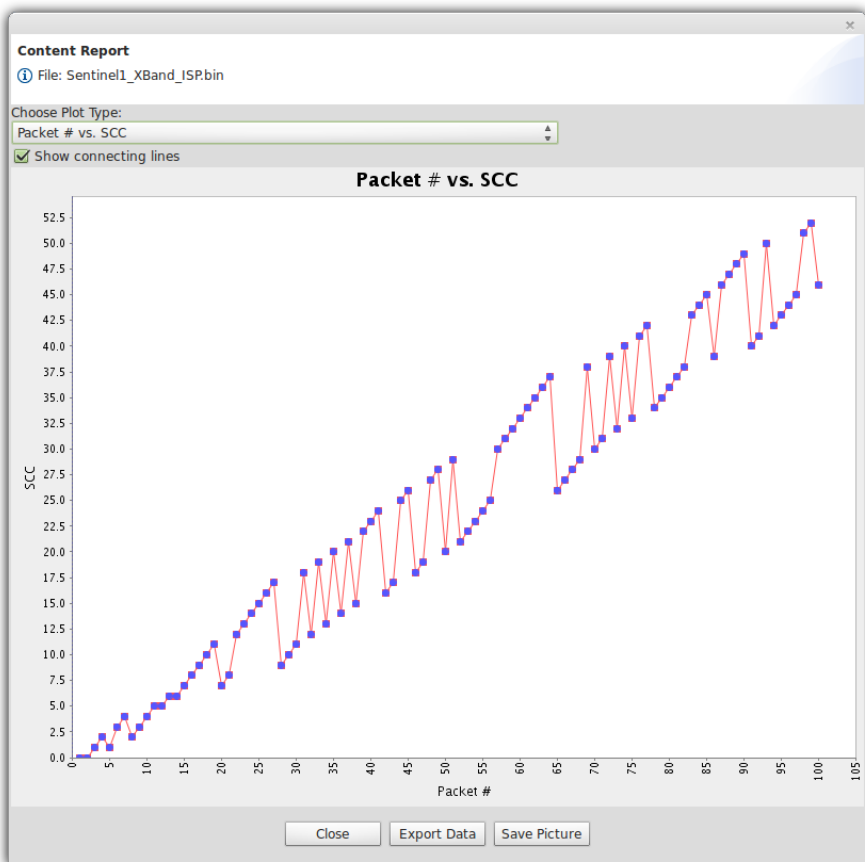
Filter by field value

Padlock Locked: Error check at Data Unit level

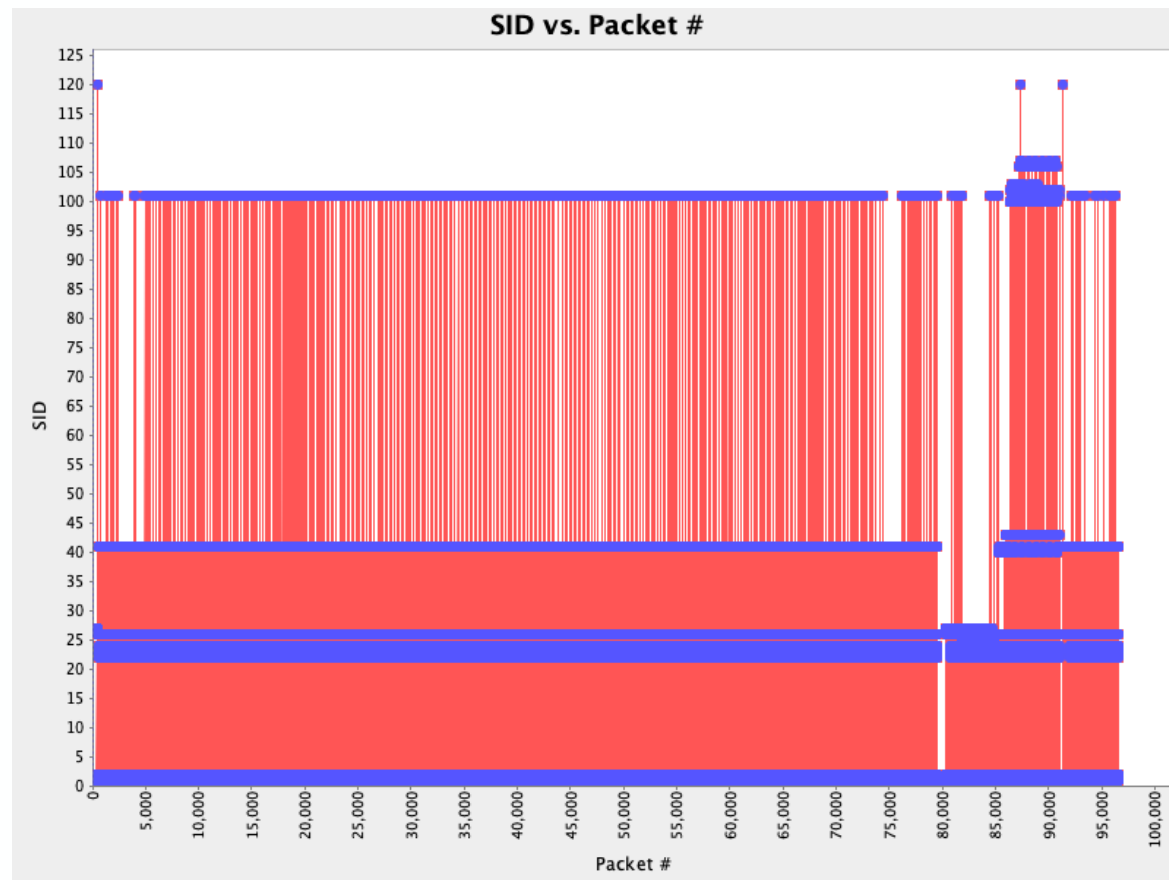
Export Data Unit

Example Plots

Source Sequence Counter vs ISP Packet



Structure ID vs ISP Packet



Error Check & Events in Quality Report



Error	Category	Foreground Color (text)	Background Color
Synchronization Error	Data error	-	Red (not configurable)
Expression malformed	Schema syntactic error	-	Orange (not configurable)
Element paths not found	Schema syntactic error	-	Orange (not configurable)
Assertion not true	Data error	Red (configurable)	-

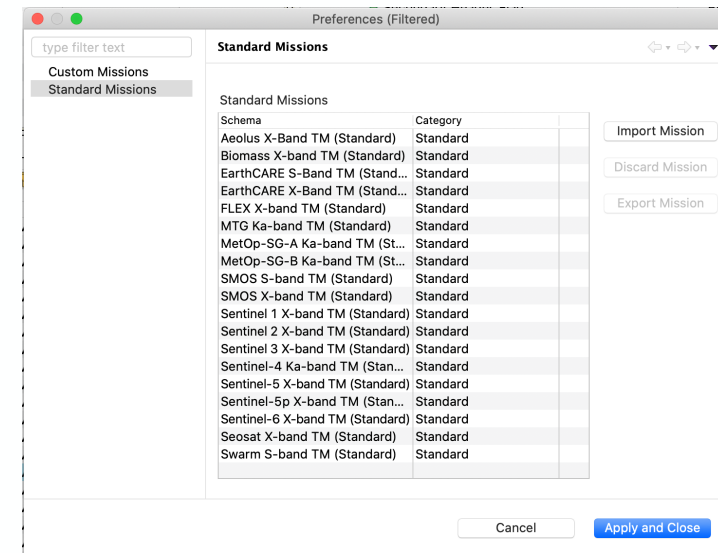
Event Message	Description	CADU	TF	ISP
Stream Synchronization	The synchronization was lost at some point.	x	x	x
Reed Solomon uncorrectable errors	Reed-Solomon errors that cannot be corrected were detected in the data unit	x		
Reed Solomon errors	Correctable Reed-Solomon errors were detected in the data unit.	x		
CRC error	The calculation of the CRC over the data unit fields does not match the CRC value provided.		x	x
Frame Counter discontinuity	A jump from the previous transfer frame number and the current one was detected, indicating a discontinuity.		x	
Unknown APID	An invalid APID value was detected.			x
Invalid SSC Gap	A jump in the SSC between the previous ISP and the current one was detected.			x
Timestamp discontinuity	A jump between the previous Time Code Field and the current one was detected, indicating a discontinuity. The timestamp is expected to be continuously increasing.			x
Duplicated ISP	An ISP with the same SSC, APID and Time Code Field values as a previously analyzed ISP is detected.			x



Mission Schema Files

- Pre-defined set of mission configuration schemas are delivered together with the S2G application:
 - ✓ Aeolus, Biomass, EarthCARE, FLEX, SMOS, SWARM
 - ✓ Sentinel-1/2/3/4/5/5P/6
 - ✓ MTG, MetOp-SG-A/B
 - ✓ Seosat
- The pre-defined mission schema files can be further customized by the user (extensible approach)
- Supporting other missions is possible by defining and importing in S2G new DFDL definition schemas for binary data

- Updates to mission schemas are automatically downloaded and installed (triggered by Help → Check for Updates)



S2G Download & User Support



- Software and documentation available in the EOP System Support Division Website:
<http://eop-cfi.esa.int/index.php/applications/s2g-data-viewer>
- Distribution packages available for:
 - ✓ Windows 64-bit
 - ✓ Linux 64-bit
 - ✓ macOS 64-bit
- For questions, suggestions or technical support, please contact the user support helpdesk at:
s2g@eopp.esa.int

