



# THE ELECTRICAL GROUND SUPPORT EQUIPMENT FOR SPECTROMETER/ TELESCOPE FOR IMAGING X-RAYS (STIX)



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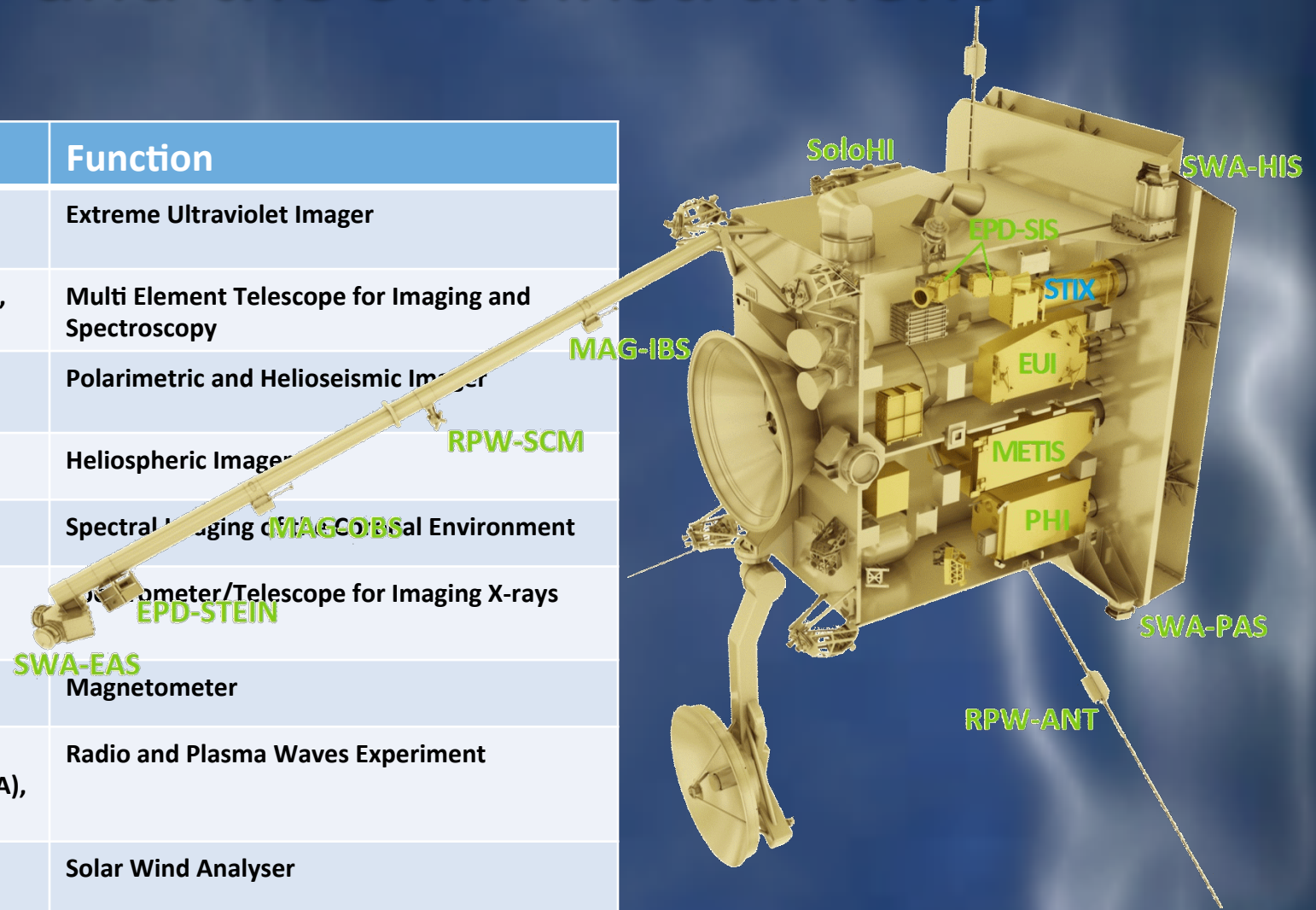
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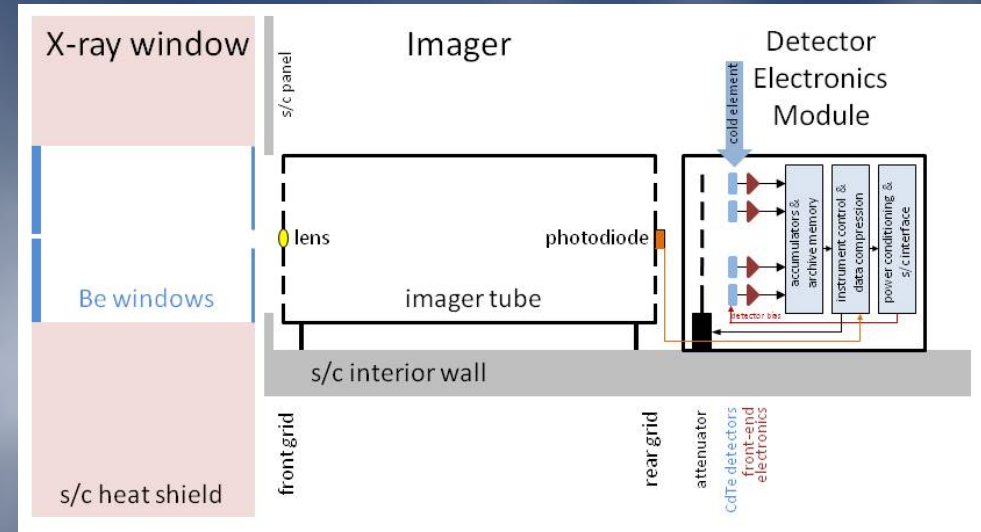
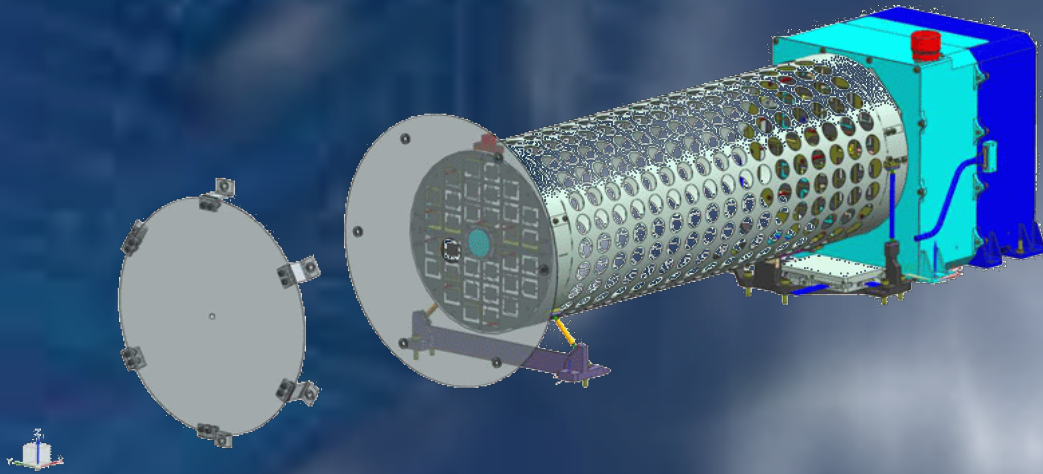
**Wrocław, Poland**

# Solar Orbiter and the STIX instrument

Instrument	PI institute	Function
EUI	Centre Spatial de Liège (CSL), Belgium	Extreme Ultraviolet Imager
METIS	Astrophysical Observatory of Turin (INAF), Italy	Multi Element Telescope for Imaging and Spectroscopy
PHI	Max Planck Institute for Solar System Research (MPS), Germany	Polarimetric and Helioseismic Imager
SoloHI	Naval Research Lab (NRL), USA	Heliospheric Imager
SPICE	ESA funded	Spectral Imaging of the Coronal Environment
STIX	University of Applied Sciences North Western Switzerland (FHNW)	Microcalorimeter/Telescope for Imaging X-rays
MAG	Imperial College London, UK	Magnetometer
RPW	Laboratoire d'études spatiales et d'instrumentation en astrophysique (LESIA), France	Radio and Plasma Waves Experiment
SWA	Mullard Space Science Lab (MSSL), UK	Solar Wind Analyser



# THE SPECTROMETER/?????????? TELESCOPE FOR IMAGING X-RAYS (STIX)

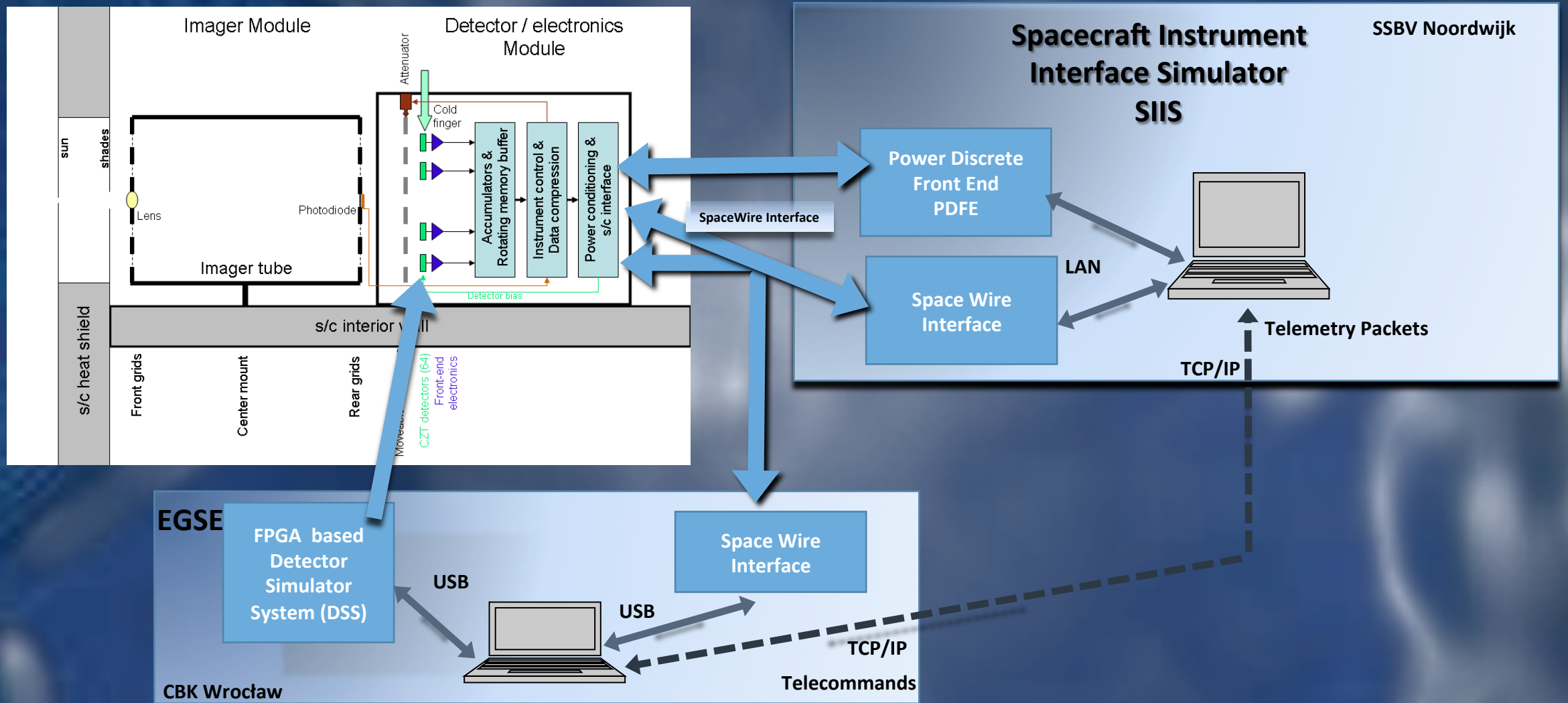


Energy Range	4 – 150 keV
Energy Resolution (FWHM)	1-15 keV (energy dependent)
Effective area	6 cm <sup>2</sup>
Finest angular resolution	7 arcsec
Field of view	2°
Image placement accuracy	~4 arcsec
Time resolution (statistics limited)	≥ 0.1 s

Collaboration  
spectrometer  
Features

Polish activities in SRC include Instrument Data Processing Unit,  
Instrument EGSE and Instrument Thermal Modelling.

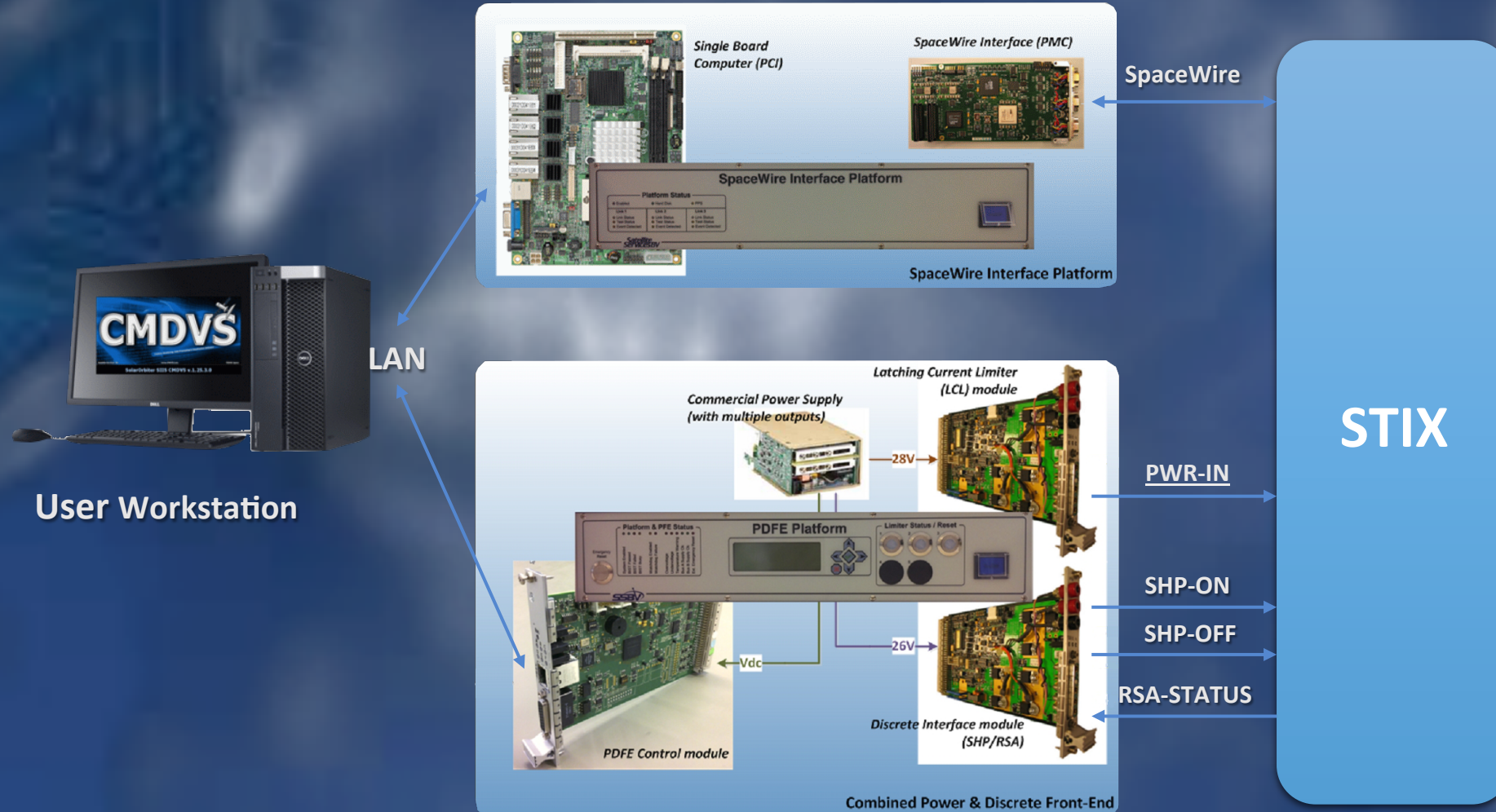
# THE STIX EGSE Block Scheme



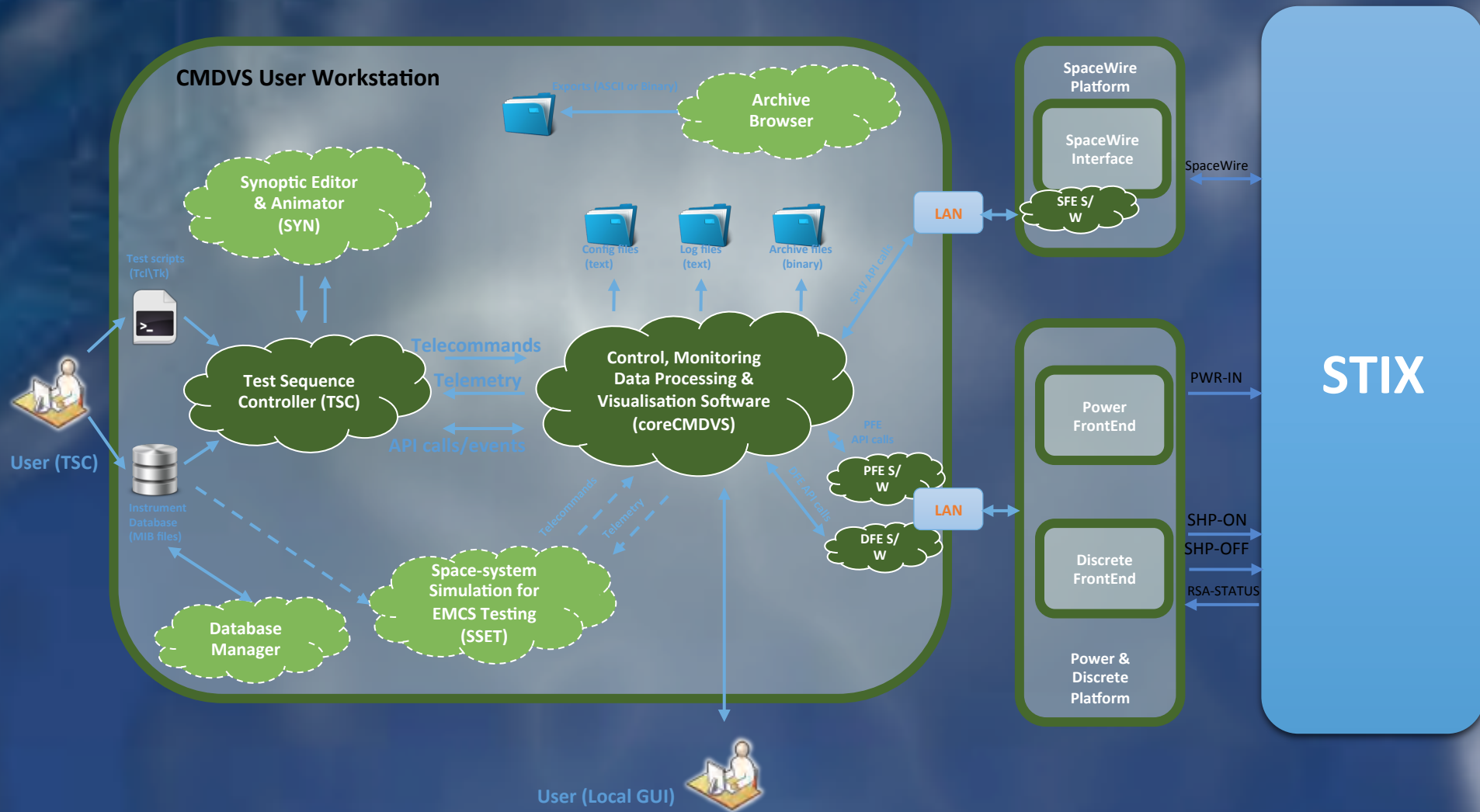
# Spacecraft Instrument Interface Simulator (SIIS) overview

- hard- and software elements which provide the tool for instrument power interface and TM/TC electrical and data protocol validation,
- specified for delivery phases of instrument models to integration,
- designed and manufactured by SSBV (NL), previously deployed and in-field proven (e.g. BepiColombo, EarthCARE)

# Spacecraft Instrument Interface Simulator (SIIS) - hardware



# Spacecraft Instrument Interface Simulator (SIIS) - software



# Space Wire Simulator software

The screenshot displays the Space Wire Simulator software interface, showing two main data windows: HK1 Data - SuSw and HK2 Data - ASw.

**HK1 Data - SuSw:**

- S/C Time:** Limits: high 0, low 0.
- Table:**

S/C Time	Seq Cnt	Value
02:12:460	00004	0
16:14:460	00005	1
06:17:460	00006	2
20:20:460	00007	3
10:22:460	00008	4
00:25:460	00009	5
14:28:460	00010	6
04:30:460	00011	7
18:33:460	00012	8
08:36:460	00013	9
22:38:460	00014	10
12:41:460	00015	11
- Parameters:**
  - SID: 0x01
  - SW running: 0x01
  - Instrument number: 0x01
  - IDPU SpW Voltage Main: 0x0446
  - IDPU SpW Voltage Red: 0x0444
  - HR/SW status 1: 0x80000000
  - HR/SW status 2: 0x00000000
  - ADC Self-check 1.5V: 0x0004
  - ADC Self-check 2.5V: 0x0504
  - IDPU 3V3 Supply Voltage: 0x0C44
- Table:**

Parameter	Value	Unit	Limit
PSU temperature	0x030	152,92	48,00
IDPU temperature 1	0x984	21,98	2436,00
IDPU temperature 2	0x386	67,98	902,00
IDPU 3.3V current	0x207	0,01	519,00
IDPU 2.5V current	0x105	0,00	261,00
IDPU 1.5V current	0xF05	0,19	3845,00
IDPU SpW current	0x008	0,00	8,00
- Graphs:** A line graph showing Current (left axis, 0-5000) and Temperature (right axis, 45-51) over Time (0-60). The graph includes data for PSU temperature, IDPU temperature 1, IDPU temperature 2, IDPU 3.3V current, IDPU 2.5V current, and IDPU 1.5V current.

**HK2 Data - ASw:**

- S/C Time:** Limits: high 0, low 0.
- Table:**

S/C Time	Seq Cnt	Value
02:12:460	00004	0
16:14:460	00005	1
06:17:460	00006	2
20:20:460	00007	3
10:22:460	00008	4
00:25:460	00009	5
14:28:460	00010	6
04:30:460	00011	7
18:33:460	00012	8
08:36:460	00013	9
22:38:460	00014	10
12:41:460	00015	11
- Parameters:**
  - SID: 0x01
  - SW running: 0x01
  - Instrument number: 0x01
  - IDPU SpW Voltage Main: 0x0446
  - IDPU SpW Voltage Red: 0x0444
  - Aspect voltage A: 0x00000000
  - Aspect voltage B: 0x00000000
  - Attenuator voltage: 0x00000000
  - HV PSU voltage 1: 0x00000000
  - HV PSU voltage 2: 0x00000000
- Table:**

Parameter	Value	Unit	Limit
PSU temperature	0x030	152,92	48,00
IDPU temperature 1	0x984	21,98	2436,00
IDPU temperature 2	0x386	67,98	902,00
IDPU 3.3V current	0x207	0,01	519,00
IDPU 2.5V current	0x105	0,00	261,00
IDPU 1.5V current	0xF05	0,19	3845,00
IDPU SpW current	0x008	0,00	8,00
Aspect temperature A0	0x0000	0,00	0,00
Aspect temperature A1	0x0000	0,00	0,00
Aspect temperature A2	0x0000	0,00	0,00
Aspect temperature B0	0x0000	0,00	0,00
Aspect temperature B1	0x0000	0,00	0,00
Aspect temperature B2	0x0000	0,00	0,00
Attenuator temperature	0x0000	0,00	0,00
Detector temperature 01	0x0000	0,00	0,00
Detector temperature 02	0x0000	0,00	0,00
Detector temperature 03	0x0000	0,00	0,00
Detector temperature 04	0x0000	0,00	0,00
All detectors' current	0x0000	0,00	0,00
Attenuator current	0x0000	0,00	0,00
- Graphs:** A line graph showing Current (left axis, 0-1.2) and Temperature (right axis, 1.0-1.2) over Time (0-60). The graph includes data for PSU temperature, IDPU temperature 1, IDPU temperature 2, IDPU 3.3V current, IDPU 2.5V current, IDPU 1.5V current, IDPU SpW current, Aspect temperature A0, Aspect temperature A1, Aspect temperature A2, Aspect temperature B0, Aspect temperature B1, Aspect temperature B2, Attenuator temperature, Detector temperature 01, Detector temperature 02, Detector temperature 03, Detector temperature 04, All detectors' current, and Attenuator current.

**Tools and Telemetry:**

- Tools:** send TC(9,129), Refresh, TC(9,129) on, auto Service 9, Status.
- Telecommands packets:** Status, 1D-AC-C0-F3-00-05-19-EC-08-00-6E-AC, 1D-AC-C0-F3-00-05-19-EC-0C-00-F7-38, 2D-TC-ZIX00002 PIX00001 4, = TC(3,6) => Disable HK parameter report generation, 1D-AC-C0-F3-00-06-19-03-06-00-04-BD-59, 37 bytes TC file has been read, 0D-TC-ZIX00004 PIX00003 0xD111, PIX00004 0x00000000, PIX00005 0x0000FF, PIX00006 ASW\_MID\_D111 bin, = TC(5,2) => Load Memory, 1D-AC-C0-F3-00-0F-19-06-02-00-D1-11-00-00-00-00-00-FF-FF-26-57, 22 bytes TC file has been read.
- packets:** 36CBB 349 37, HK report SID 1, 36CBB 350 37, HK report SID 1, 36CBB 351 37, HK report SID 1, 36CBB 352 37, HK report SID 1, 36CBB 353 37, HK report SID 1, 36CBB 354 37, HK report SID 1, 36CBB 355 37, HK report SID 1, 36CBB 356 37, HK report SID 1, 36CBB 357 37, HK report SID 1, 36CBB 358 37, HK report SID 1, 36CBB 359 37, HK report SID 1, 36CBB 360 37, HK report SID 1, 36CBB 361 37, HK report SID 1.
- Incoming events:** 0000000E2B436844500, Received: (4261), 0DA4C1650025100319008000DF36CBB019030987E88980680780680846A44D110001000000000E, 2B43684450036844500, 20020000DA4C1670025100319008000E076CBB019030987E88980680780680846A44D11000100, 0000000E2B436844500, Received: (4262), 0DA4C1660025100319008000DFD6CBB019030987E88980680780680846A44D110001000000000E, 2B43684450036844500, 20020000DA4C1670025100319008000E076CBB019030987E88980680780680846A44D11000100, 0000000E2B436844500, Received: (4263), 0DA4C1670025100319008000E076CBB019030987E88980680780680846A44D110001000000000E, 2B43684450036844500, 20020000DA4C1680025100319008000E116CBB019030987E88980680780680846A44D11000100, 0000000E2B436844500, Received: (4264), 0DA4C1680025100319008000E116CBB019030987E88980680780680846A44D110001000000000E, 2B43684450036844500, 20020000DA4C1690025100319008000E18CBB019030987E88980680780680846A44D11000100, 0000000E2B436844500, Received: (4265), 0DA4C1690025100319008000E18CBB019030987E88980680780680846A44D110001000000000E.

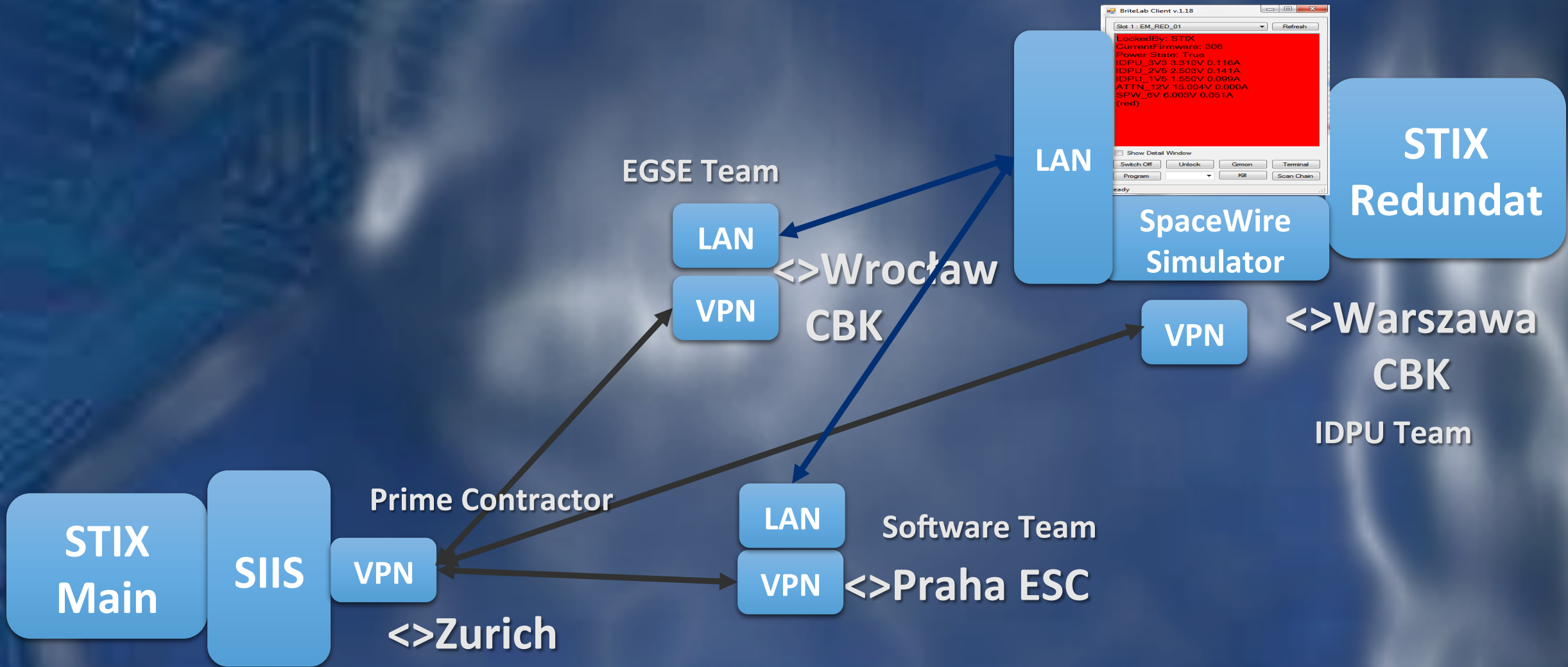
**Temperature Graph:** A line graph showing Temperature (0-8) over Time (0-3). The graph includes data for DS1820\_0, DS1820\_1, and DS1820\_2. The x-axis is labeled with T0, T1, and T2.

**Signals:** I -> SPW -> 0, FTDI, 0, Signals, 0, set.

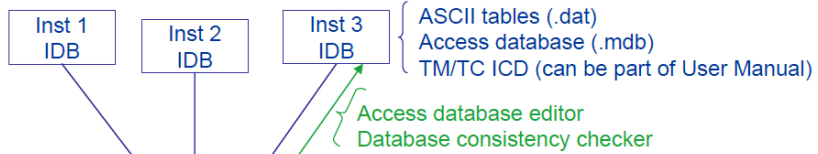
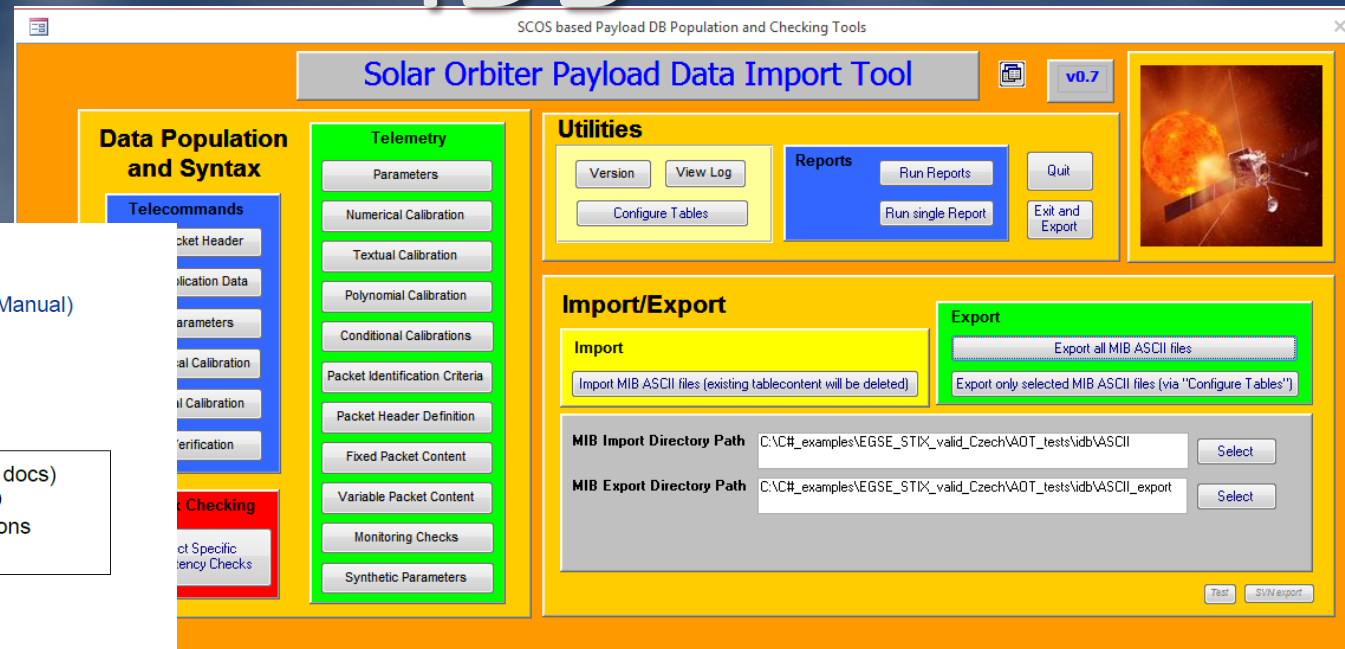
**Read/Write:** Read, Write.



# EGSE connecting people



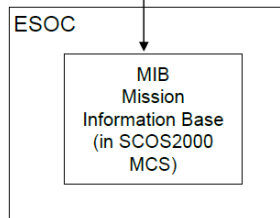
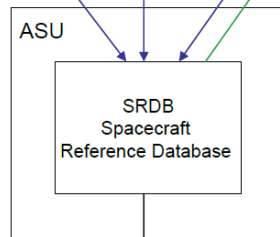
# IDB



SOL.S.ASTR.xx.xxxx (may be 2 docs)  
Mission Specific SRDB ICD  
-SO specific naming conventions  
-special restrictions

+

EGOS-MCS-S2K-ICD-0001  
SCOS2000 MIB ICD  
- Generic table and field definitions



# TM/TC


<b>CCSDS Secondary header flag = 0</b>	<b>PUS Version = 1</b>	<b>Ack</b>	<b>Service Type</b>	<b>Service Subtype</b>	<b>Source ID</b>
Boolean	Enumerated	Enumerated	Enumerated	Enumerated	Enumerated
1 bit	3 bits	4 bits	8 bits	8 bits	8 bits

PACKET HEADER (48 bits)							PACKET DATA FIELD										
PACKET ID					PACKET SEQUENCE CONTROL		PACKET LENGTH	DATA FIELD HEADER	SOURCE PACKET HEADER (48 bits)						PACKET DATA FIELD (VARIABLE)		
Version Number = 0	Packet Type = 1	Data Field Header Flag	APID		Sequence Flags = 11 <sub>bin</sub>	Sequence Count	Version Number = 0		Packet Type = 0	Data Field Header Flag	Application Process ID	Segmentation/Grouping Flags	Source Sequence Count	Packet Length	Data Field Header	Source Data	
			Process ID	Packet Category													
3	1	1	7	4	2	14											
16								16						16	80	Variable	
							<b>Spare</b>	<b>PUS Version = 1</b>	<b>Spare = 0</b>	<b>Service Type</b>	<b>Service Subtype</b>	<b>Destination ID</b>	<b>S/C Time</b>				
							1 bit	3 bits	4 bits	8 bits	8 bits	8 bits	8 bits	48 bits			
							Fixed bit string	Enumerated	Fixed bit string	Enumerated	Enumerated	Enumerated	Enumerated	Enumerated CUC			

←----- 248 octets max -----

# Set of TM/TC

SFT - Short functional tests  
FFT - Full functional tests

		<b>Solar Orbiter</b>	SOL.S.ASTR.TN.00079 Issue 4 Page 4 of 314
5.5	Service 4: Not Used .....		64
5.6	Service 5: Event Reporting .....		64
5.6.1	TM (5,1) Nominal/Progress Report .....		66
5.6.2	TM (5,2) Error/Anomaly Report - Low Severity .....		67
5.6.3	TM (5,3) Error/Anomaly Report - Medium Severity .....		67
5.6.4	TM (5,4) Error/Anomaly Report - High Severity .....		68
5.6.5	TC (5,5) Enable Event Packet Generation .....		68
5.6.6	TC (5,6) Disable Event Packet Generation .....		69
5.6.7	TC (5,128) Clear Critical Event Log .....		70
5.6.8	TC (5,129) Downlink Critical Event Log .....		71
5.6.9	TM (5,130) Critical Event Log Occurrence Table Report .....		71
5.6.10	TC (5,131) Report Enabled EID .....		72
5.6.11	TM (5,132) Enabled EID Report .....		73
5.6.12	TC (5,133) Report Disabled EID .....		73
5.6.13	TM (5,134) Disabled EID Report .....		74
5.7	Service 6: Memory Management .....		74
5.7.1	TC (6,2) Load Memory (patch) .....		78
5.7.2	TC (6,5) Dump Memory .....		81
5.7.3	TM (6,6) Memory Dump Report .....		83
5.7.4	TC (6,9) Check Memory .....		85
5.7.5	TM (6,10) Memory Check Report .....		88
5.7.6	TC (6,128) Apply Pre-loaded Set of RAM Patches .....		90
5.7.7	TC (6,129) Abort Dump .....		91
5.7.8	TC (6,130) Enable EEPROM Patch .....		92
5.7.9	TC (6,131) Disable EEPROM Patch .....		92
5.7.10	TC (6,140) Load Memory with Mask .....		93
5.8	Service 7: Not Used .....		95
5.9	Service 8: Function Management .....		95
5.9.1	TC (8,1) Start Function .....		95
5.9.2	TC (8,140) Enable Function Execution .....		96
5.9.3	TC (8,141) Disable Function Execution .....		97
5.9.4	TC (8,142) Enable Autoreset of Execution Enable Flag .....		98
5.9.5	TC (8,143) Disable Autoreset of Execution Enable Flag .....		98
5.9.6	TC (8,144) Report Function Status .....		99
5.9.7	TM (8,145) Function Status Report .....		100
5.10	Service 9: Time Management .....		100

## FFT - Full functional tests

- test procedures designed and implemented by STIX team,
- demonstrates the functionality of the instrument and all of its operational modes,
- performed before the delivery of the instrument to generate reference test data,
- maximal duration is 8 hours,
- planned to run twice after integration to the spacecraft: once before and once after environmental tests campaign

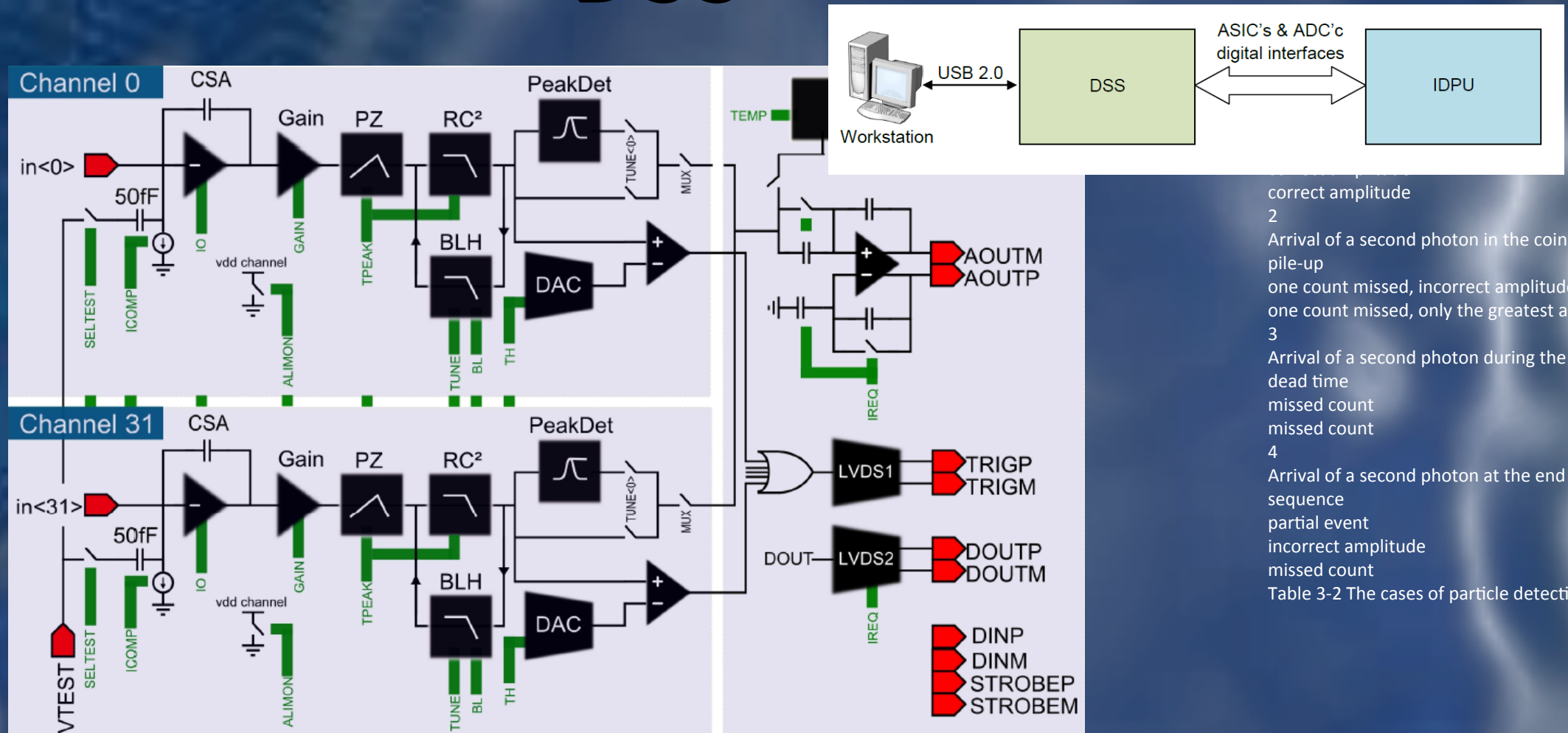
## SFT - Full functional tests

```
// HK telemetry packet - TM(3,25) SID = 1 (look Table 1)
TM,NIX00004,EQUAL,1
TM,NIX00005,LIMIT,0,1
TM,NIX00006,LIMIT,0,7
TM,NIX00007,LIMIT,0,4
TM,NIX00008,LIMIT,0x018,0x028
TM,NIX00009,LIMIT,0x019,0x029
TM,NIX00010,LIMIT,0x019,0x029
TM,NIX00017,LIMIT,0x059,0x129
TM,NIX000XX,LIMIT,0x059,0x069
TM,NIX00018,LIMIT,0x059,0x079
TM,NIX000XX,LIMIT,0x00000059,0x00000089
TM,NIX000XX,LIMIT,0x00000059,0x00000089

// SID
// SW running
// Instrument number ?? 3 bits
// Instrument mode
// PSU temperature
// IDPU temperature 1
// IDPU temperature 2
// 3.3V current
// 2.5V current This parameter is absent in IDB.
// 1.5V current
// HW/SW status 1 This parameter is absent in IDB.
// HW/SW status 2 This parameter is absent in IDB.
```

- simplified procedures derived from I-FFT and implemented by STIX team,
- demonstrates the integrity, functionality of the instrument and verifies the command and telemetry paths,
- performed before the delivery of the instrument to generate reference test data,
- maximal duration is 1 hour,
- planned to be performed a number of times at set points as the monitor of health during environmental tests campaign

# DSS



- correct amplitude
  - 2
  - Arrival of a second photon in the coincidence window pile-up
  - one count missed, incorrect amplitude
  - one count missed, only the greatest amplitude
  - 3
  - Arrival of a second photon during the readout phase
  - dead time
  - missed count
  - missed count
  - 4
  - Arrival of a second photon at the end of the readout sequence
  - partial event
  - incorrect amplitude
  - missed count
- Table 3-2 The cases of particle detection

IDeF-X HD front-end ASIC architecture. The 32 analog channels with level discrimination stages are connected to a

*University of Alcalá, Spain*

*USA, ESA*

tion functions of suprathermal and energetic particles. Scientific topics to be addressed include the sources, acceleration mechanisms, and transport processes of these particles.

*United Kingdom*

s of the heliospheric magnetic field with high precision. This will facilitate detailed studies into the way the Sun's magnetic field links into space and evolves over the solar cycle; how particles are accelerated at the Earth; how the corona and solar wind are heated and accelerated.

*Observatoire de Paris, France*

*Czech Republic, Austria*

ometer instruments in that it makes both *in situ* and remote-sensing measurements. RPW will measure magnetic and electric fields at high time resolution using a number of sensors/antennas, to determine the waves in the solar wind.

*Space Science Laboratory, United Kingdom*

*Italy, France, USA*

uite of sensors that will measure the ion and electron bulk properties (including, density, velocity, and temperature) of the solar wind, thereby characterising the solar wind between 0.28 and 1.4 AU from the Sun. SWA will provide measurements of solar wind ion composition for key elements (e.g. the C, N, O group and Fe, Si or Mg).

*Université de Liège, Belgium*

*United Kingdom, France, Germany, Switzerland*

ospheric layers above the photosphere, thereby providing an indispensable link between the solar surface and outer corona that ultimately shapes the characteristics of the interplanetary medium. EUI will also provide an out-of-ecliptic viewpoint (up to 34° of solar latitude during the extended mission phase).

*Astronomical Observatory of Turin, Italy*

*Czech Republic*

et and extreme ultraviolet emission of the solar corona and diagnose, with unprecedented temporal coverage and spatial resolution, the structure and dynamics of the full corona in the range from 1.4 to 3.0 AU from the Sun (maximum) perihelion during the nominal mission. This is a region that is crucial in linking the solar atmospheric phenomena to their evolution in the inner heliosphere.

*Institut für Sonnensystemforschung, Germany*

*France*

provide high-resolution and full-disc measurements of the photospheric vector magnetic field and line-of-sight (LOS) velocity as well as the continuum intensity in the visible wavelength range. The LOS velocity