ANNEX 6

SPIASW USER'S MANUAL AND TRANSFER MANUAL

C-S SI	INTEGRAL SPECTROMETER SPI	SPI-ST-7-5747-DIAF Issue : 3 Revision : 0 Date : 18/03/02 Page No. : 1

INTERNATIONAL GAMMA RAY ASTROPHYSICS LABORATORY

SPIASW USER'S MANUAL AND TRANSFER MANUAL

	Name :	Date and Signature :
Prepared by :	Marie Hélène DE ROSNAY	18/03/02
Agreed by :	Marie Hélène DE ROSNAY	18/03/02
For application and approved by :		

Secretariat of origin: C-S SI
Host system: PC
Word processing : WORD V7.0

Internal diffusion		External diffusion		
Name	**Company**	**Name**		**Department**
M-H. DE ROSNAY	**C-S SI**	**CAROLE**	**LARIGAUDERIE**	**DTS/ED/DI/SI**
		NICOLE	**MILHET**	**DTS/ED/DI/SI**

E:\SPIASW\doc\Doc_livree_en_maintenance\USRMAN_30.doc

DOCUMENTATION CHANGE RECORD

Issue	Revision	Date	Modified Pages	Observations
1	0	17/08/99		First issue
1	1	10/12/99	On Event messages	DM299 and DM300
1	2	19/06/00	All	Document updated with regards to IASW release 2.5.0
1	3	04/09/00	All	Document updated with regards to IASW release 3.0.1
2	0	26/03./01	All	Document updated with regards to IASW release 3.1.1
3	0	18/03/02	On Event messages + TM share rate + CMD MGR task stack	Document updated with regards to IASW release 4.0.0 CR 395 revision 3 and CR 457 NCR INT-AI-C-350

TABLE OF CONTENTS

1 INTRODUCTION

The SPIASW User's Manual and Transfer Manual Document purpose is to help the user to achieve the finest SPIASW configuration and to help the user to interpret correctly the SPIASW software reactions.
This document explains too the transfer of a new SPIASW software release and its regeneration.

1.1 DOCUMENT ORGANISATION

The SPIASW User's Manual and Transfer Manual document is structured as follows :

- the introduction which includes :
  - the document organisation
  - the reference documents
  - the SPIASW project description
- the user's manual which includes on one hand the descriptions of :
  - the configuration parameters
  - the on event messages
  - the tasks
  - the timeouts
  - the spectra organisation and location
  - DFEE and PSD I/F buffers location

  it includes on another hand the descriptions of the different IASW treatments :
  - the dithering
- the transfer manual which includes the description of :
  - the software files transfer
  - the SPIASW software regeneration

1.2 REFERENCE DOCUMENTS

[RD1] DPE IASW USER'S REQUIREMENTS DOCUMENT SPI-ST-7-1047-CNES Issue 4.0.

[RD2] SPIASW SOFTWARE REQUIREMENTS DOCUMENT SPI-ST-7-5505-CNES Issue 2.1 08/10/98.

[RD3] SPIASW DYNAMIC ARCHITECTURE DOCUMENT SPI-DD-7-5744-DIAF Issue 2.2.

[RD4] SPIASW CONFIGURATION DESCRIPTION FILE SPI-RC-7-5710-DIAF Issue 5.0.

1.3 SPIASW PROJECT DESCRIPTION

The SPI (SPectrometer INTEGRAL) is part of a platform which gathers four scientific instruments. SPI launching is planned for April 2002.
The SPI instrument aims to analyse the spectral structure of astrophysical sources such as black holes, novae, ... in the high resolution gamma-ray domain. With regards to the equipment, the SPI instrument is built around :

- the AFEE (Analog Front End Electronics) to transform the energy information into an electric signal,
- the DFEE (Digital Front End Electronics to digitalise the information),
- the PSD (Pulse Shape Discriminator) which is a kind of memory storing past events,
- the ACS (Anti coincidence System) to discriminate "vetoed" events,
- the DPE (Data Processing electronics) to manage the SPI instrument.

The SPI management function is done by a dedicated processor called DPE (Data Processing Electronics). The DPE SPIASW project aims to define, product and validate the Spectrometer Instrument Application Software whose main functions are :

- Scientific data management
- SPI instrument monitoring
- SPI instrument commanding

2 USER'S MANUAL

2.1 PARAMETERS AND ADDRESSES

2.1.1 CONFIGURATION PARAMETERS

2.1.1.1 Configuration parameters valorisation

Radiation mode	CONF	STANDBY or CONF	SPIASW_CONFIGURATION_MANAGER
High background count detection capability	Enable	Enable / Disable	MISSION MONITORING
Counting threshold for radiation overflow	40 000	0 → 65 535	MISSION_MONITORING
Counting filter for radiation overflow	10	0 →32 767	MISSION_MONITORING
Counting threshold for radiation nominal level	20 000	0 → 65 535	MISSION_MONITORING
Counting filter for radiation nominal level	10	0 →32 767	MISSION_MONITORING
Radiation belts crossing detection capability	Enable	Enable / Disable	MISSION MONITORING
Delay before radiation belts	8s		MISSION_MONITORING
Delay after radiation belts	8s		MISSION_MONITORING
Imminent eclipse detection capability	Enable	Enable / Disable	MISSION MONITORING
Delay before eclipse	0s		MISSION_MONITORING
Imminent switch off detection capability	Enable	Enable / Disable	MISSION MONITORING
ESAM detection capability	Enable	Enable / Disable	MISSION MONITORING
Correlation capability	Enable	Enable / Disable	SCIENCE CONTROLLER
Cold plate temperature monitoring capability	Disable	Enable/disable	MONITORING
Counting filter for cold plate monitoring	3	0 -> 15	MONITORING
Cold plate temperature threshold 1	Eng. val. 109K Raw val. 2936	0 -> 65535	MONITORING
Cold plate temperature threshold 2	Eng. val. 109K Raw val. 2936	0 -> 65535	MONITORING

Cold plate temperature threshold 3	Eng. val. 109K Raw val. 2936	0 -> 65535	MONITORING
Cold plate temperature threshold 4	Eng. val. 109K Raw val. 2936	0 -> 65535	MONITORING
HK acquisition rate	1	0 →32 767	LSL_MANAGER
Length of the HSL block for the DFEE	**3 072**	**0 →32 767**	**HSL_MANAGER**
Delay before autotest acquisition function triggering	8s	0 →32 767 (= 68,26mn)	CONFIGURATION_MANAGER
Delay before configuration acquisition function triggering	32s	0 →32 767 (= 68,26mn)	CONFIGURATION_MANAGER
Constituents of the spectra data in Emergency_TM mode	ALL PE	0 : all PSD correlated 1 : just multiple	SCIENCE_CONTROLLER
Automatic reconfiguration capability	Enable	Enable / Disable	SPIASW_CONFIGURATION_MANAGER
Spectra accumulation duration	**1620**	**0 →32 767 (= [illegible])**	**SCIENCE_CONTROLLER**
AFEE low voltage temperature monitoring capability	Enable	Enable / Disable	MONITORING
AFEE low voltage temperature monitoring threshold	Eng. val 333K Raw val. 164	0 → 65 535	MONITORING
AFEE low voltage temperature monitoring filter	3	0 → 15	MONITORING
LSL error filter	3	0 →32 767	LSL_MANAGER
ACS ROM RAM delay	8	0 →32 767 (= 68,26mn)	MAINTENANCE_MANAGER
PSD ROM RAM delay	1	0 →32 767 (= 68,26mn)	MAINTENANCE_MANAGER
DFEE ROM RAM delay	72	0 →32 767 (= 68,26mn)	MAINTENANCE_MANAGER
Cold Plate temperature monitoring capability	Disable	Enable / Disable	MONITORING
Cold Plate temperature monitoring filter	3	0 → 32 767	MONITORING
Cold Plate temperature monitoring threshold 1	Eng. val 109K Raw val. 2936	0 → 65 535	MONITORING
Cold Plate temperature monitoring threshold 2	Eng. val 109K Raw val. 2936	0 → 65 535	MONITORING
Cold Plate temperature monitoring threshold 3	Eng. val 109K Raw val. 2936	0 → 65 535	MONITORING
Cold Plate temperature monitoring threshold 4	Eng. val 109K Raw val. 2936	0 → 65 535	MONITORING
AFEE Energy mode	**Automatic**	**Automatic / Manual**	**SPECTRA_BUILDER**

Be careful : any modification of these configuration data will not be taken into account until the starting of the next operational mode

2.1.1.2 Recommendations

If these parameters are valorised and sent to IASW by the adequate TC and if one of their values is different from the authorised values described in the paragraph 2.1.1 then

- a message of exception will be raised and
- the TC won't be nominally performed and a message of « TC badly executed » will be raised too.

2.1.2 ON EVENT MESSAGES

Event	Message	Class	Par. 1	Par. 2	Par. 3
Mode change	HEX 80 DEC 128	0	000100:commanded 001000: automatic 001100: protected 010000: off	Old mode	New mode
				HEX0049: INIT HEX0059: STANDBY1 HEX0060: STANDBY2 HEX0058: CONF HEX0053: PHOTON HEX0043: CALIBRATION HEX0045: EMERGENCY_TM HEX0044: DIAGNOSTIC	
On board events	HEX 81 DEC 129	0	0	HEX0000: Begin HEXFFFF: End	1: switch off 2: eclipse 3: flare 4: esam
State change	HEX 82 DEC 130	0	0	Old state	New state
				0 : commanded 1 : automatic 2 : protected 3 : off imminent	
mRTU Error	HEX 90 DEC 144	1	Error type: 000100: time-out 001000: ex_analog_acquisition_error	MSB: channel / LSB: 0 6: E3985 27: E3996 12: E3989 28: E3993 14: E3990 32: E3995 16: E3987 33: E3994 22: E3981 34: E3997 23: E3982 35: E3988 24: E3983 36: E3991 25: E3984 37: E3986 26: E3992 59: REF ANALOG 60: REF PT 500 65: REF YSI	HEX0000
LSL Error	HEX 91 DEC 145	1	Error type: 000100: time-out 001000: overrun-error 001100: checksum error 010000: nack received 010100: cmd not sent (too late)	MSB: channel 0 : DFEE 1 : PSD 2 : AFEE 3 : ACS LSB: if nack received, value of the nack, otherwise 0	MSB: type of the command (K,C,M...) LSB: HK or Conf command number or 0.
HSL Error	HEX 92 DEC 146	1	001000 : HSL busy	0	0
Autotest acquisition Error	HEX A0 DEC 160	2	Sub assembly: 000100 : AFEE 001000 : ACS 001100 : PSD	MSB: high byte. LSB: medium byte.	MSB: low byte. LSB: 0.

Event	Message	Class	Par. 1	Par. 2	Par. 3
			010000 : DFEE		
Configuration status acquisition Error	HEX B0 DEC 176	2	Sub assembly: 000100 : AFEE 001000 : ACS 001100 : PSD 010000 : DFEE	MSB: high byte. LSB: medium byte.	MSB: low byte. LSB: 0.
Automatic reconfiguration Error	HEX B1 DEC 177	2	Automatic step: 000100 : autotest step 001000 : conf mode step 001100 : conf load step 010000 : patch load step 010100 : conf status step 011000 : start mode step	HEX0000	HEX0000
TC not executed	HEX C0 DEC 192	3	Reason of the reject: 1: Incorrect type or subtype 2: TC not allowed 3: TC executed badly 4 : TC timeout 5 : Imminent switch OFF 6 : S/A OFF *1)	Bits 0 to 4 : 00 Bits 5 to 15 : APID of the rejected TC	Bits 0 to 1 : 00 Bit 2 : SRC Bit 3 to 15 : source sequence count of the rejected TC
BT AFEE switch off	HEX D0 DEC 208	2	HEX0000	Channel (0..18)	HEX0000
Cold plate temperature overflow	HEX D1 DEC 209	2	HEX0000	MSB sensor 1 LSB sensor 2 0 : No trigger / 1 : Trigger	MSB sensor 3 LSB sensor 4
Software error	HEX E0 DEC 224	1	HEX0000	Faulty task id	0
Patches area overflow	HEX E2 DEC 226	1	HEX0000	Patch TC source sequence count	HEX0000
Partial Flag	HEX E5	1	HEX0000	Subblock Identifier : **0** SE **1** ME **2** PE **3** SP0 **4** SP1 **5** SP2 **6** SP3 **7** SP4 **8** SP5 **9** SP6 **10** SP7 **11** SP8 **12** SP9 **13** SP10 **14** SP11 **15** SP12 **16** SP13 **17** SP14 **18** SP15 **19** SP16 **20** SP17 **21** SP18	0
Subblock of words >= 8192	HEX E6	1	HEX0000	Subblock Identifier : idem previous case	0

Event	Message	Class	Par. 1	Par. 2	Par. 3
Spectra building / compression transmission messages	HEX F0 DEC 240	1	Spectra phases : 000000 : start building 000001 : stop building 000100 : start compression 000101 : stop compression 001000 : start transmission 001001 : stop transmission	 upper 16 Id Pointing upper 16 Id Pointing 0 0 0 0	 Low 16 Id Pointing Low 16 Id Pointing 0 0 0 0
Failure in analysing HSL data	HEX F2 DEC 242	1	HSL lines DFEE : HEX0000 PSD : HEX0001	Synchro word error : 1 : EOT 2 : EOP 3 : SOP 4 : invalid number of events and curves	Level of error : 1 : single 2 : double 3 : invalid 0
Spectra building not completed	HEX F3 DEC 243	1	HEX 0000	Detector identifier (when the task was pre-empted)	0
Spectra compression not completed	HEX F4 DEC 244	1	HEX 0000	Detector identifier (when the time-out has occurred)	0
Spectra compression overflow	HEX F5 DEC 245	1	HEX 0000	Detector identifier (when the time-out has occurred)	0
Max number of packets per 8s exceeded *2)	HEX FB DEC 251	1	HEX 0000	00	0
Photon/photon buffer reading error *2)	HEX FC DEC 251	1	HEX 0000	00	0

*1) The control of the state OFF or ON off the concerned S/A is only performed in the following TC reception cases :

- TC record conf,
- TC report param,
- TC record patch,
- TC load patch
- TC dump.

*2) These messages are not destined to the User but could give information to the Maintenance in case of wrong software behaviour.

2.1.3 TASKS

2.1.3.1 Tasks list

List of the IASW tasks with their identifier number :

Task name	Task identifier	Stack start address & length	
SPECTRA TRANSMITTER TASK	1	FFB80	300
SPECTRA COMPRESSOR TASK	3	FFA22	350
SPECTRA BUILDER TASK	4	FF8C4	350
SCIENCE CONTROLLER TASK	6	FF50E	650
MAINTENANCE MANAGER TASK	7	FF194	400
CONFIGURATION MANAGER TASK	8	EF0A	650
MISSION MONITORING TASK	10	EBEA	300
MONITORING TASK	11	FF324	490
TM CYCLIC TASK	12	E302	280
TM ASYNCHRONOUS TASK	13	E41A	880
MODES MANAGER TASK	14	ED16	500
COMMAND MANAGER TASK	15	E78A	820
LSL MANAGER TASK	16	E000	500
MRTU MANAGER TASK	17	EABE	300
HSL MANAGER TASK	18	E1F4	270
SCIENCE SUPERVISOR TASK	19	FF798	300

2.1.3.2 Tasks priority

The tasks priorities are already defined in the document of dynamic architecture [RD3].

2.1.4 USEFUL PHYSICAL ADDRESSES

2.1.4.1 DFEE AND PSD I/F BUFFERS LOCALISATION

The DFEE I/F buffer is a FLIP-FLOP buffer. Its localisation is :

- for the FLIP, at the physical address 16#23000#
- for the FLOP, at the physical address 16#28000#

The PSD I/F buffer is a FLIP-FLOP buffer. It is located in memory just behind the DFEE I/F buffers :

- for the FLIP, at the physical address 16#2F000#
- for the FLOP, at the physical address 16#2F200#

2.1.4.2 PATCH AREA LOCALISATION

The Patch area is an array of (512 * 16) words. Its localisation is :

- at the physical address 16#1D52C#

2.1.4.3 SPECTRA LOCALISATION

	Rough Spectra		Compressed spectra	
Detector	Start	End	Start	End
0	50000	54FFF	B0000	B2FFF
1	55000	59FFF	B3000	B5FFF
2	5A000	5EFFF	B6000	B8FFF
3	5F000	63FFF	B9000	BBFFF
4	64000	68FFF	BC000	BEFFF
5	69000	6DFFF	BF000	C1FFF
6	6E000	72FFF	C2000	C4FFF
7	73000	77FFF	C5000	C7FFF
8	78000	7CFFF	C8000	CAFFF
9	7D000	81FFF	CB000	CDFFF
10	82000	86FFF	CE000	D0FFF
11	87000	8BFFF	D1000	D3FFF
12	8C000	90FFF	D4000	D6FFF
13	91000	95FFF	D7000	D9FFF
14	96000	9AFFF	DA000	DCFFF
15	9B000	9FFFF	DD000	DFFFF
16	A0000	A4FFF	E0000	E2FFF
17	A5000	A9FFF	E3000	E5FFF
18	AA000	AEFFF	E6000	E8FFF

2.1.4.4 UNUSED MEMORY ADRESSES RANGE

Can be used for patch and dump purposes: **9000 to CFFF**

2.2 IASW TRAITMENTS DESCRIPTION

2.2.1 TCS

The TCs are performed sequentially i.e. a TC is first read from the ICB buffer, then is performed by IASW, and when the TC treatment is over, a new one, if there is in the ICB buffer, is performed in its turn by IASW.

2.2.1.1 Conf On Off TC treatment

Conf On Off TC definition : checks the S/A autotest, starts the HK Technological acquisitions to the S/A and at the beginning of IASW changes the mode from STANDBY1 to STANDBY2.

- First TC control : if IASW state is different from **COMMANDED** or if IASW mode is different from **STANDBY1** or **STANDBY2** then the Conf On Off TC is rejected.
- If the first control is OK, then, the **S/A On-Off status** (parameters of the TC) are **recorded** in the dedicated IASW tab.
- Then the S/A autotest acquisition is required for each S/A declared « ON ». **From this point, IASW will send LSL commands (aperiodic or cyclical) only to the S/A declared « ON ».**
- If there is no LSL problem met, the S/A autotest result is checked :
  For the S/A concerned by a bad autotest result, the cyclical acquisitions are stopped (the aperiodic LSL commands are still allowed, it means that the concerned S/A can still be commanded via TCs);
  for the S/A concerned by a good autotest result , the cyclical acquisitions are started (if a LSL problem is raised, see chapter LSL errors).
- Then IASW changes its mode to **STANDBY2**.

Maximum TC execution timing (without any LSL problem) : 4 minor cycles + 64 minor cycles (default value of the configuration parameter « delay before autotest ») = 68 minor cycles (with configuration parameters default values)

2.2.1.2 Change Mode TC treatment

- First TC control : if IASW state is different from **COMMANDED** or if IASW mode is equal to **INIT** then the Change Mode TC is rejected.
- If the first control is OK, then, a **S/A change mode command is sent to each S/A**. If the change mode command is a standby or a conf command, it is sent first to the DFEE, then to the PSD, to the ACS and at last to the AFEE. If the change mode command is an operational one, it is sent first to the AFEE, then to the ACS, to the PSD and at last to the DFEE. Anyway, the change mode command is a LSL aperiodic command.
- If there is no LSL problem met, **each S/A changes its mode** at its turn and **finally IASW updates too its mode** (if a LSL problem is raised, see chapter LSL errors).

Maximum TC execution timing (without any LSL problem) : 4 minor cycles

2.2.1.3 Record Conf TC treatment

Record Conf TC definition : loads on the concerned S/A of a part of its configuration and records it in IASW memory.

- First TC control : if IASW state is different from **COMMANDED** or if IASW mode is equal to **INIT** then the Record Conf TC is rejected.
- If the first control is OK, then, a **load conf command is sent to the concerned S/A, after having checked that the S/A is ON**. Thus the S/A is asked to load a part of a new configuration.
- If there is no LSL problem met, then the configuration command is recorded in the dedicated IASW S/A configuration tab (if a LSL problem is raised, see chapter LSL errors). Whatever the future status of the S/A, even if a S/A is declared OFF for a while , each S/A configuration command already stored in IASW memory by a Record Conf TC is kept in memory by IASW.
- Each IASW S/A configuration tab contents lines, each line being a configuration command with an identifier which is the configuration command identifier.

Maximum TC execution timing (without any LSL problem) : 1 minor cycle

2.2.1.4 Send All Conf TC treatment

Send All Conf TC definition : loads S/A by S/A all the configuration commands already stored in IASW memory.

- First TC control : if IASW state is different from **COMMANDED** or if IASW mode is different from **CONF** then the Send All Conf TC is rejected.
- If the first control is OK, then, S/A by S/A (first AFEE , then ACS, PSD and finally DFEE) each S/A configuration command previously recorded in IASW memory is sent via aperiodic LSL command to the S/A.
- Thus all the configuration commands are sent sequentially, without checking an eventual LSL problem (if a LSL problem is raised, see chapter LSL errors).

Maximum TC execution timing (without any LSL problem) : 3 minor cycles (DFEE configuration commands) + 23 minor cycles (ACS conf. cmd.) + 10 minor cycles (PSD conf. cmd.) + 4 minor cycles (AFEE conf. cmd.) = 40 minor cycles

2.2.1.5 Start Maintenance TC treatment

Start Maintenance TC definition : allows to patch or to dump a S/A and stops the cyclical HK acquisitions.

- First TC control : if IASW state is different from **COMMANDED** or if IASW mode is equal to **INIT** then the Start Maintenance TC is rejected.
- If the first control is OK, then, the **Start Maintenance command is sent to the concerned** S/A. Thus the S/A is asked to go in maintenance.
- Whatever the LSL command execution result, the cyclical HK acquisitions are stopped for the concerned S/A.
- IASW updates the S/A maintenance status in the CSSW HK packet (maintenance active + name of the concerned S/A).

Nota bene : to restart again the cyclical HK acquisitions, it is necessary to send a Stop Maintenance TC.

Maximum TC execution timing (without any LSL problem) : 1 minor cycle

2.2.1.6 Record Patch TC treatment

Record Patch TC definition : loads on the concerned S/A of a patch and records it in IASW memory.

- First TC control : if IASW state is different from **COMMANDED** or if IASW mode is equal to **INIT** then the Record Patch TC is rejected.
- If the first control is OK, then, a **Load Maintenance command is sent to the concerned S/A, after having checked that the S/A is ON**. Thus the S/A is asked to load a new patch.
- If there is no LSL problem met (if a LSL problem is raised, see chapter LSL errors), then the patch command is recorded in the dedicated IASW Patch Area; except if the Patch Area is full then the patch is not recorded and an On Event Message of full patch area is sent. The Patch Area is an array sequentially filled, by a patch per line.

Maximum TC execution timing (without any LSL problem) : 1 minor cycle

2.2.1.7 Load Patch TC treatment

Load Patch TC definition : loads on the concerned S/A of a patch

- First TC control : if IASW state is different from **COMMANDED** or if IASW mode is equal to **INIT** then the Load Patch TC is rejected.
- If the first control is OK, then, a **Load Maintenance command is sent to the concerned S/A, after having checked that the S/A is ON**. Thus the S/A is asked to load a new patch.
- if a LSL problem is raised, see chapter LSL errors.

Maximum TC execution timing (without any LSL problem) : 1 minor cycle

2.2.1.8 Stop Maintenance TC treatment

Stop Maintenance TC definition : stops to allow to patch or to dump a S/A and restarts the cyclical HK acquisitions.

- First TC control : if IASW state is different from **COMMANDED** or if IASW mode is equal to **INIT** then the Stop Maintenance TC is rejected.
- If the first control is OK, then, the **Stop Maintenance command is sent to the concerned S/A**. Thus the S/A is asked to leave the maintenance.
- Whatever the LSL command execution result, the cyclical HK acquisitions are started again for the concerned S/A.
- IASW updates the S/A maintenance status in the CSSW HK packet (maintenance not active).

Maximum TC execution timing (without any LSL problem) : 1 minor cycle

2.2.1.9 Send All Patch TC treatment

Send All Patch TC definition : loads S/A by S/A all the patch commands already stored in IASW memory.

- First TC control : if IASW state is different from **COMMANDED** or if IASW mode is different from **CONF** then the Send All Patch TC is rejected.
- If the first control is OK then **for each S/A ON** (first ACS, then PSD and at last DFEE), a **Start Maintenance command is sent to the S/A,** the cyclical HK acquisitions to the S/A are stopped. Then **a S/A init ram command is sent** followed

by a waiting time (which is a configuration parameter specific to each S/A). The IASW Patch Area is read, and **each IASW Patch Area line, concerned by the S/A, which is in fact a patch command is sent at its turn to the S/A.**

- Like that, all the patch commands are sent sequentially, even if an eventual LSL problem is detected (if a LSL problem is raised, see chapter LSL errors).
- Then when all the LSL commands have been executed then IASW sends a **Stop Maintenance command** to the different S/A so the cyclical HK acquisitions to the S/As are restarted.

Nota bene : the maintenance status in the CSSW HK packet is meaningless.

Maximum TC execution timing (without any LSL problem) : 6 minor cycles + (8 + 1 + 72) minor cycles (default value of the configuration parameters « ROM RAM delay ») + 512 minor cycles (patch area full) + 3 minor cycles = 602 minor cycles (with configuration parameters default values)

2.2.1.10 Eclipse Exit TC treatment

Eclipse Exit TC definition : allows to leave an eclipse.
This TC is very specific thus it is executed by IASW only in state PROTECTED and it allows to go on the automatic reconfiguration usually triggered by a BCP reception.

- First TC control : if IASW state is different from **PROTECTED** or if IASW mode is equal to **INIT** then the Eclipse Exit TC is rejected.
- If the first control is OK and if IASW mission status is in eclipse then IASW is asked to get out of eclipse the DPE. If IASW mission status is not in eclipse then the TC is rejected.
- If before to be in eclipse, IASW mode was STANDBY1, then IASW mode doesn't change and IASW state changes to COMMANDED. In the other cases, IASW performs as follows :

- On one hand, if IASW **mission status is in radiation belt, in high background count or in esam**, IASW performs the first step of the automatic reconfiguration, i.e. **S/A autotest acquisitions** with restart of the cyclical HK acquisitions for the S/A with good autotest results (if a LSL problem is raised, see chapter LSL errors), then **IASW changes its mode to STANDBY2** and **keeps its state to PROTECTED**. IASW updates its mission status (no more eclipse).

- On another hand, if IASW **mission status is no more in radiation belt, in high background count or in esam**, IASW performs an automatic reconfiguration, according to the previous IASW mode before to be in eclipse (here is described a complete automatic reconfiguration with a previous mode OPERATIONAL, for more details, see chapter BCP) :
  - the first step of the automatic reconfiguration, i.e. **S/A autotest acquisitions** with restart of the cyclical HK acquisitions for the S/A with good autotest results (if a LSL problem is raised, see chapter LSL errors),
  - the following steps of the automatic reconfiguration, i.e. **the change to CONF mode, the load of all the patches on the S/A and the load of each configuration on the S/A** (if a LSL problem is raised, see chapter LSL errors),
  - the next step, i.e. **S/A configuration status acquisitions** to check the S/A are well configured (if a LSL problem is raised, see chapter LSL errors),
  - the last step, i.e. **the change to OPERATIONAL mode** (if a LSL problem is raised, see chapter LSL errors),
  - at last, **IASW updates its mode to OPERATIONAL, its state to COMMANDED, updates its mission status** (no more eclipse).

Maximum TC execution timing (without any LSL problem) : 4 minor cycles + 64 minor cycles (default value of the configuration parameters « delay before autotest ») + 4 minor cycles (conf. mode cmd.) + 602 minor cycles (send all patches) + 40 minor cycles (send all conf) + 4 minor cycles + 256 minor cycles (default value of the configuration parameters « delay before conf.

status») + 4 minor cycles (oper. Mode cmd.) = 978 minor cycles (with configuration parameters default values)

2.2.1.11 Load Param TC treatment

Load Param TC definition : loads IASW configuration parameters in IASW memory (IASW configuration parameters described in chapter 2.1.1)

The Load Param TC represents in fact a group of 8 distinct TCs :
- a TC for the non exposure parameters. This TC allows to store in IASW the non exposure IASW configuration parameters.
- a TC for the exposure parameter. This TC allows to store in IASW the exposure IASW configuration parameter.
- 6 TCs for the 6 diagnostic configuration tables. These 6 TCs allow to store in IASW the 6 diagnostic configuration tables.

All these TCs perform the same treatment, described just below :
- First TC control : if IASW state is different from **COMMANDED or PROTECTED** or if IASW mode is equal to **INIT** then the Load Param TC is rejected.
- If the first control is OK, then IASW stores the TC' s parameters in memory.
- At last, IASW ends the current TC treatment in order to be able to read the next TC.

Maximum TC execution timing (without any LSL problem) : 1 minor cycle

2.2.1.12 Report Param TC treatment

Report Param TC definition : reports IASW configuration parameters from IASW memory to the TM and S/A configuration parameters from S/A to the TM

The Report Param TC represents in fact 2 sorts of Report TCs; one sort to report IASW parameters and another sort to report S/A parameters.

2.2.1.12.1 Report IASW Param TC Treatment

The Report IASW Param TC represents in fact a group of 8 distinct TCs :
- a TC for the non exposure parameters. This TC allows to report from IASW memory the non exposure IASW configuration parameters.
- a TC for the exposure parameter. This TC allows to report from IASW memory the exposure IASW configuration parameter.
- 6 TCs for the 6 diagnostic configuration tables. These 6 TCs allow to report from IASW memory the 6 diagnostic configuration tables.

All these TCs perform the same treatment, described just below :
- First TC control : if IASW state is different from **COMMANDED or PROTECTED** or if IASW mode is equal to **INIT** then the Report IASW Param TC is rejected.
- If the first control is OK, then IASW gets the parameters from IASW memory and writes them into an On Request TM packet. Then IASW sends the packet to the TM.
- At last, IASW ends the current TC treatment in order to be able to read the next TC.

2.2.1.12.2 Report S/A Param TC Treatment

- First TC control : if IASW state is different from **COMMANDED or PROTECTED** or if IASW mode is equal to **INIT** then the Report S/A Param TC is rejected.
- If the first control is OK and if the concerned S/A is ON, then IASW requests the parameters to the S/A via a LSL command. With the S/A response, IASW writes the S/A parameters into an On Request TM packet and sends it to the TM.
- At last, IASW ends the current TC treatment in order to be able to read the next TC.

Maximum TC execution timing (without any LSL problem) : 1 minor cycle

2.2.1.13 BCP TC treatment

BCP definition : the BCP (Broadcast Packet) is generated by the CDMU MSSW and its scope is to inform SPI about specific events which could require a SPI reconfiguration.
The major part of the information provided by the BCP concerns the On Board Events treatment, i.e. the analysis result of these information can be the raise of On Board Events which are going to trigger some configuration changes in SPI (see chapter BCP).
Another part of the information provided by the BCP concerns the Dithering (see chapter Dithering).
At last, the BCP provides too a TM share rate information which is used by the TM (see 2.2.4.1).

- First TC control : if IASW state is equal to **OFF** or if IASW mode is equal to **INIT** then the BCP TC is rejected.
- Refer to the different chapters previously designed.

Maximum TC execution timing (without any LSL problem) : 978 minor cycles (with configuration parameters default values)

2.2.1.14 TEST TC treatment

Test TC definition : checks the IASW TC reception capability

- This TC just allows to check that IASW is able to receive a TC with IASW state different from OFF and IASW mode different from INIT. That's it.

Maximum TC execution timing (without any LSL problem) : 1 minor cycle

2.2.2 BCP AND ON BOARD EVENTS

2.2.2.1 BCP description

The BCP (Broadcast Packet) is generated by the CDMU MSSW and its scope is to inform SPI about specific events which could require a SPI reconfiguration.
The major part of the information provided by the BCP concerns the On Board Events treatment, i.e. the analysis result of these information can be the raise of On Board Events which are going to trigger some configuration changes in SPI. This is the subject of this chapter.

Description of the BCP information used to detect On Board Events raises :

- Radiation Belt Crossing Start Time or Belt Start OBT : give the time value of the next Radiation Belts Crossing start.
- Radiation Belt Crossing Exit Time or Belt Exit OBT : give the time value of the next Radiation Belts exit.
- Eclipse Entry Time or Eclipse Begin OBT : give the time value of the next Eclipse event.
- Eclipse Exit Time or Eclipse Exit OBT : give the time value of the next exit of Eclipse event.
- Information ; if equal to 1 means disregarding Radiation Monitor Count Rate Information.
- Imminent Instruments Switch Off or Switch Off : identifies that SPI will be switched off in TBD sec.
- RadiationMonitor Count Rate 1 or Radiation Rate : identifies the Radiation Monitor count rate 1.
- ESAM : identifies the ESAM Mode enter condition.

2.2.2.2 BCP analysis

Every 8s, the previously described BCP information are analysed in order to detect if an On Board Event has to be raised or not. To perform this, some IASW configuration parameters are necessary ; they are described just below :

Description of the concerned IASW configuration parameters :

- Radiation mode
- High Background Count Detection Capability
- Counting Threshold Radiation Overflow
- Counting Filter Radiation Overflow
- Counting Threshold Radiation Nominal Level
- Counting Filter Radiation Nominal Level
- Radiation Belt Detection Capability
- Delay Before Radiation Belt
- Delay After Radiation Belt
- Imminent Eclipse Detection Capability
- Delay Before Eclipse
- Imminent Switch Off Detection Capability
- ESAM Detection Capability

In order to know if SPI is already in Eclipse, in ESAM, in Imminent Switch Off, in radiation belts or in High Background Count, IASW manages an array in memory called MISSION STATUS which stores these information. It just describes the current SPI mission state. It is present in the CSSW HK packet.

Description of IASW mission status :

- IMMINENT_ECLIPSE : TRUE or FALSE
- IMMINENT_SWITCH_OFF : TRUE or FALSE
- IN_RADIATION_BELTS : TRUE or FALSE

- HIGH_BACKGROUND_COUNT : TRUE or FALSE
- ESAM : TRUE or FALSE

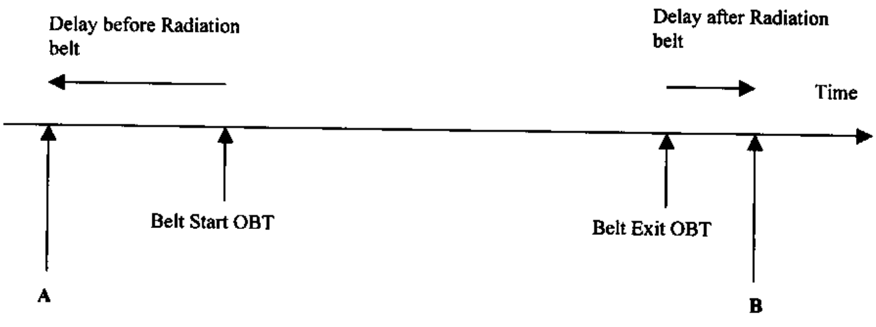
2.2.2.2.1 Analysis of SPI position related to Radiation Belts

If the IASW configuration parameter Radiation Belt Detection Capability is enabled and if the Belt Start OBT and Belt Exit OBT are meaningless (equal to 0) then SPI position is unchanged, so no On Board Event is generated and SPI MISSION STATUS for the Radiation Belt is unchanged.

If the IASW configuration parameter **Radiation Belt Detection Capability is disabled** and the current SPI MISSION STATUS for the Radiation Belt is **TRUE** then SPI is considered leaving radiation belts so the SPI MISSION status relative to the Radiation Belt is changed to **FALSE** and a potential On Board **Event FLARE_END** is detected (this means SPI configuration is going to change, but we don't know yet how).

If the IASW configuration parameter **Radiation Belt Detection Capability is enabled** and if the Belt Start OBT and the Belt Exit OBT are **not meaningless** then in the case **Belt Start OBT inferior to Belt Exit OBT**, according to the diagram below :

Delay before Radiation Belt and Delay after Radiation Belt , IASW configuration parameters values, are used to increase the provided Radiation Belt interval for safety reasons.
*According to the SPI current OBT, comparing it to A and **B**, and according to the current SPI mission status relative to the Radiation Belt, it is possible to conclude if there is any change to perform.*

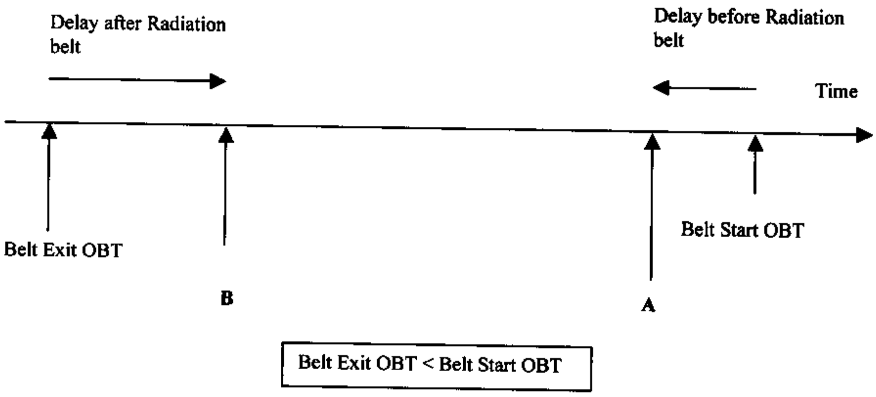


Belt Start OBT < Belt Exit OBT

- If current SPI MISSION STATUS for the Radiation Belt is **FALSE** (no current radiation belt) and if (**A** <= current OBT <= **B**) then SPI is considered being in radiation belts so the SPI MISSION status relative to the Radiation Belt is changed to **TRUE** and a potential On Board Event **FLARE_BEGIN** is detected.

- If current SPI MISSION STATUS for the Radiation Belt is **TRUE** (current radiation belt) and if (current OBT < **A** or current OBT > **B**) then SPI is considered leaving radiation belts so the SPI MISSION status relative to the Radiation Belt is changed to **FALSE** and a potential On Board **Event FLARE_END** is detected.

If the IASW configuration parameter **Radiation Belt Detection Capability is enabled** and if the Belt Start OBT and the Belt Exit OBT are **not meaningless** then in the case **Belt Start OBT superior to Belt Exit OBT** (which means that the current OBT has been recently reset to 0), according to the diagram below :



- If current SPI MISSION STATUS for the Radiation Belt is **FALSE** (no current radiation belt) and if (current OBT <= **B** or current OBT >= **A**) then SPI is considered being in radiation belts so the SPI MISSION status relative to the Radiation Belt is changed to **TRUE** and a potential On Board Event **FLARE_BEGIN** is detected.

- If current SPI MISSION STATUS for the Radiation Belt is **TRUE** (current radiation belt) and if (current OBT > **B** or current OBT < **A**) then SPI is considered leaving radiation belts so the SPI MISSION status relative to the Radiation Belt is changed to **FALSE** and a potential On Board **Event FLARE_END** is detected.

2.2.2.2.2 Analysis of SPI position related to High Background Count

If the IASW configuration parameter **High Background Count Detection Capability is enabled** and if the BCP **DRMC** information (value 0) **regards** the Radiation Monitor Count Rate then :

- If current SPI MISSION STATUS for High Background Count is **FALSE** and if the **Radiation Rate** (provided by the current BCP) **is superior to the Counting Threshold Radiation Overflow** (IASW configuration parameter) then the number of radiation overflow is first incremented and then compared to the **Counting Filter Radiation Overflow** (IASW configuration parameter).
- If the number of radiation overflow **is superior to this Counting Filter Radiation Overflow** then SPI is considered being in High Background Count so the SPI MISSION status relative to the High Background Count is changed to **TRUE** and a potential On Board Event **FLARE_BEGIN** is detected, the number of radiation overflow is reset to 0.
- If the number of radiation overflow is inferior to the Counting Filter Radiation Overflow then the number of radiation overflow is reset to 0 and that's all.

- If current SPI MISSION STATUS for High Background Count is **TRUE** and if the **Radiation Rate** (provided by the current BCP) **is inferior to the Counting Threshold Radiation Nominal Level** (IASW configuration parameter) then the number of radiation underflow is first incremented and then compared to the **Counting Filter Radiation Nominal Level** (IASW configuration parameter).
- If the number of radiation underflow **is superior to this Counting Filter Radiation Nominal Level** then SPI is considered leaving High Background Count so the SPI MISSION status relative to the High Background Count is changed to **FALSE** and a potential On Board Event **FLARE_END** is detected, the number of radiation underflow is reset to 0.
- If the number of radiation underflow is inferior to the Counting Filter Radiation Nominal Level then the number of radiation underflow is reset to 0 and that's all.

If the IASW configuration parameter **High Background Count Detection Capability is enabled**, if the BCP **DRMC** information **disregards** the Radiation Monitor Count Rate and the current SPI MISSION STATUS for the High Background Count is **TRUE** then SPI is considered leaving the High Background Count so the SPI MISSION status relative to the High Background Count is changed to **FALSE** and a potential On Board **Event FLARE_END** is detected.

If the IASW configuration parameter **High Background Count Detection Capability is disabled** and the current SPI MISSION STATUS for the High Background Count is **TRUE** then SPI is considered leaving the High Background Count so the SPI MISSION status relative to the High Background Count is changed to **FALSE** and a potential On Board **Event FLARE_END** is detected.

2.2.2.2.3 Raising conditions of the On Board Events FLARE_BEGIN and FLARE_END

SPI position analysis relative on one hand to the **Radiation Belts** and on another hand to the **High Background Count** can detect some potential On Board Events **FLARE_BEGIN** and **FLARE_END.**
In order to avoid to obtain contradictious results of radiation belts analysis and high background count analysis , which could trigger some contradictious SPI configuration changes, some simple rules have been chosen :

- If the Radiation Belts analysis result is the detection of a potential **FLARE BEGIN** or **FLARE END** On Board Event and if SPI MISSION STATUS for High Background Count is **FALSE** then there is really detection of a potential **FLARE BEGIN** or **FLARE END** On Board Event.

- If the High Background Count analysis result is the detection of a potential **FLARE BEGIN** or **FLARE END** On Board Event and if SPI MISSION STATUS for Radiation Belt is **FALSE** then there is really detection of a potential **FLARE BEGIN** or **FLARE END** On Board Event.

- If the High Background Count analysis result is the detection of a potential **FLARE BEGIN** or **FLARE END** On Board Event and if, for the same BCP analysis, the Radiation Belts analysis result is the detection of a potential **FLARE BEGIN** or **FLARE END** On Board Event then there is really detection of a potential **FLARE BEGIN** or **FLARE END** On Board Event.

- In the other cases, there is no detection of a potential **FLARE BEGIN** or **FLARE END** On Board Event.

2.2.2.2.4 Analysis of SPI position related to the ESAM

If the IASW configuration parameter **ESAM Detection Capability is enabled** and if **current SPI MISSION STATUS for ESAM** is **FALSE** then :

- If ESAM information provided by the BCP is **YES** then SPI is considered being in ESAM so the SPI MISSION status relative to ESAM is changed to **TRUE** and a potential On Board Event **ESAM_BEGIN** is detected.

If the IASW configuration parameter **ESAM Detection Capability is enabled** and if **current SPI MISSION STATUS for ESAM** is **TRUE** then :

- If ESAM information provided by the BCP is **NO** then SPI is considered leaving ESAM so the SPI MISSION status relative to ESAM is changed to **FALSE** and a potential On Board Event **ESAM_END** is detected.

If the IASW configuration parameter **ESAM Detection Capability is disabled** and the current SPI MISSION STATUS for ESAM is **TRUE** then SPI is considered leaving ESAM so the SPI MISSION status relative to ESAM is changed to **FALSE** and a potential On Board **Event ESAM_END** is detected.

In the other cases, there is no detection of a potential **ESAM BEGIN** or **ESAM END** On Board Event.

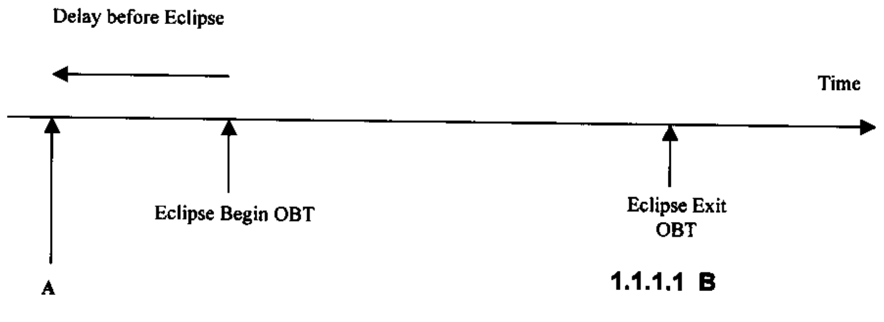
2.2.2.2.5 Analysis of SPI position related to the ECLIPSE

SPI position related to the eclipse is a specific case. The current BCP analysis may result by the detection of a potential **ECLIPSE_BEGIN** On Board Event. But it won't result by the detection of an ECLIPSE END On Board Event. Thus the end of eclipse, which is typically an on board phenomenon is in fact driven by the ground via the TC Eclipse Exit for safety raisons. Therefore the **ECLIPSE_END** On Board Event is detected only on **TC Eclipse Exit** reception (see chapter TCs).

2.2.2.2.5.1 Analysis of the current BCP in order to detect a potential ECLIPSE_BEGIN On Board Event.

If the IASW configuration parameter **Imminent Eclipse Detection Capability is enabled** and if **Eclipse Begin OBT is inferior to Eclipse Exit OBT**, according to the diagram below :

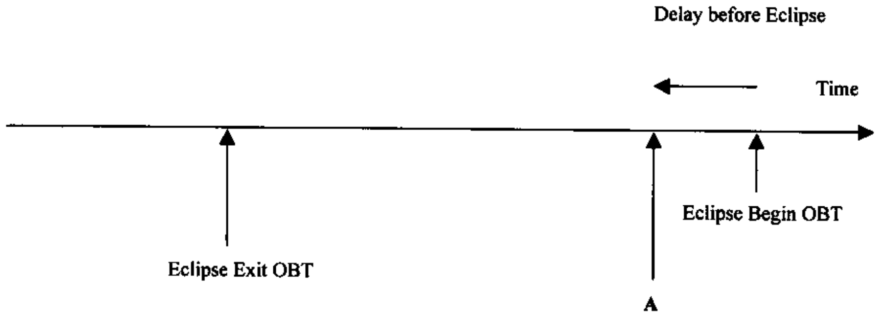
Delay before Eclipse, IASW configuration parameter value, is used to increase the provided Eclipse interval for safety reasons.
*According to the SPI current OBT, comparing it to **A** and **B**, and according to the current SPI mission status relative to the Imminent Eclipse, it is possible to conclude if there is any change to perform .*



Eclipse Begin OBT < Eclipse Exit OBT

- If current SPI MISSION STATUS for the Imminent Eclipse is **FALSE** and if (**A** <= current OBT <= **B**) then SPI is considered being in eclipse so the SPI MISSION status relative to the Imminent Eclipse is changed to **TRUE** and a potential On Board Event **ECLIPSE_BEGIN** is detected.

If the IASW configuration parameter **Imminent Eclipse Detection Capability is enabled** and if **Eclipse Begin OBT is superior to Eclipse Exit OBT**, according to the diagram below :



Eclipse Exit OBT < Eclipse Begin OBT

- If current SPI MISSION STATUS for the Imminent Eclipse is **FALSE** and if (current OBT <= **B** or current OBT >= **A**) then SPI is considered being in imminent eclipse so the SPI MISSION status relative to the Imminent Eclipse is changed to **TRUE** and a potential On Board Event **ECLIPSE_BEGIN** is detected.

In the other cases, there is no detection of a potential **ECLIPSE_BEGIN** On Board Event.

2.2.2.2.6 Analysis of SPI position related to the EXPECTED OFF

If the IASW configuration parameter **Imminent Switch Off Detection Capability is enabled** and if **current SPI MISSION STATUS for Imminent Switch Off** is **FALSE** then :

- If the Switch Off information provided by the BCP is **YES** then SPI is considered being in Imminent Switch Off so the SPI MISSION status relative to Imminent Switch Off is changed to **TRUE** and a potential On Board Event **EXPECTED OFF** is detected.

In the other cases, there is no detection of a potential **EXPECTED OFF** On Board Event.

2.2.2.2.7 Finale selection of the detected On board Event for the current BCP

In the chapters below, according to the BCP analysis result, is considered on one hand the **SPI MISSION STATUS update**, and on another hand the detection of a **potential On Board Event** such as a FLARE BEGIN, a FLARE END, an ECLIPSE BEGIN and so on…
For the current BCP, all these analysis may have for result the detection of several different On Board Events.
But the main purpose of this BCP analysis is to trigger eventually a SPI configuration change and this can be performed via the detection of **only ONE On Board Event.** So it is necessary to select by priority ONE On Board Event among the On Board Events eventually already detected.

From the highest priority to the lowest one :
EXPECTED OFF
ECLIPSE BEGIN
FLARE BEGIN
ESAM BEGIN
FLARE END
ESAM END

So if, potentially, an On Board Event **ESAM END** and an On Board Event **FLARE BEGIN** have been detected during the current BCP analysis, the On Board Event **FLARE BEGIN** only will be selected and its treatment will be performed by IASW as it is described in the next chapter (On Board Event treatment and automatic reconfiguration).

The On Board Event ECLIPSE END when it is detected (on a TC eclipse exit reception), always triggers a SPI configuration change.

2.2.2.3 On Board Event Treatment

The raise of an On Board Event triggers a SPI configuration change.
Nota bene : IASW mode designs in fact SPI mode so if IASW mode is changed to STANDBY2 it means that every S/A mode is changed too to STANDBY, idem in CONF mode and in oper mode.

2.2.2.3.1 Begin of On Board Event treatment : ESAM BEGIN, FLARE BEGIN, ECLIPSE BEGIN

If a S/A is in maintenance when a BEGIN of On Board Event is raised then a stop maintenance command is sent to the S/A and the cyclical HK acquisitions with this S/A are restarted. This is the first action performed each time.

2.2.2.3.1.1 Raise of an ESAM BEGIN

If IASW mode is operational (PHOTON, DIAG, EMERGENCY, CALIBRATION) at this moment then the mode is changed to CONF and IASW state is changed to PROTECTED.

2.2.2.3.1.2 Raise of a FLARE BEGIN

If IASW mode is STANDBY1 or STANDBY2 then IASW stays unchanged and IASW state is changed to **PROTECTED**.
If Radiation mode (IASW configuration parameter) is equal to STANDBY2 then IASW mode is changed to **STANDBY2** and IASW state is changed to **PROTECTED**.
If Radiation mode is equal to CONF then

- either IASW is already in CONF mode and then a LSL command of switch off High Voltage is sent to the ACS, IASW mode stays unchanged and IASW state is changed to **PROTECTED** ;
- or IASW is in oper mode and then IASW mode is changed to **CONF**, a LSL command of switch off High Voltage is sent to the ACS and IASW state is changed to **PROTECTED**.

2.2.2.3.1.3 Raise of an ECLIPSE BEGIN

If IASW mode is STANDBY1 then IASW stays unchanged and IASW state is changed to **PROTECTED**, else IASW mode is changed to **STANDBY1** and IASW state is changed to **PROTECTED**.

2.2.2.3.2 End of On Board Event treatment (ESAM END, FLARE END, ECLIPSE END)

2.2.2.3.2.1 Raise of an ESAM END

- **If** SPI MISSION STATUS for the Radiation Belt or for the high Background Count or for the Imminent Eclipse is TRUE then IASW state stays equal to **PROTECTED** and IASW mode stays unchanged ;
- **else** IASW state is changed to **AUTOMATIC** which means start of the Automatic Reconfiguration (see below chapter Automatic Reconfiguration).

2.2.2.3.2.2 Raise of a FLARE END

- **If** SPI MISSION STATUS for the ESAM or for the Imminent Eclipse is TRUE then IASW state stays equal to **PROTECTED** and IASW mode stays unchanged ;
- **else**
  - **if** IASW mode was equal to **CONF** before the raise of the On board Event **FLARE BEGIN** then IASW mode stays unchanged, IASW state is changed to **AUTOMATIC** which means execution of the Automatic Reconfiguration only for the steps **AUTO LOAD ALL PATCHES** and **AUTO LOAD ALL CONF** (see below chapter Automatic Reconfiguration).
  - **Else** IASW state is changed to **AUTOMATIC** which means start of the Automatic Reconfiguration (see below chapter Automatic Reconfiguration).

2.2.2.3.2.3 Raise of an ECLIPSE END

See chapter TCs, Eclipse Exit TC treatment.

2.2.2.3.3 Automatic Reconfiguration

The purpose of the Automatic Reconfiguration is to retrieve IASW working again as it used to before to be in ESAM, in Eclipse, in Radiation Belt or in High Background Count.
The Automatic Reconfiguration is only performed when IASW state is equal to **AUTOMATIC**.
At the end of a complete Automatic Reconfiguration, IASW state is changed to **COMMANDED** (IASW state AUTOMATIC is a state of transition).
The IASW mode value before the raise of the On Board Event which changed IASW state from COMMANDED to PROTECTED is the IASW mode the automatic reconfiguration is going to reach in order to work as before: this mode is called the **Commanded Mode.**

If the automatic Reconfiguration Capability (IASW configuration parameter) is disabled then IASW state is changed to **COMMANDED** and the Automatic Reconfiguration is stopped there.

If the Automatic Reconfiguration Capability is enabled, then the current IASW mode and the Commanded mode are compared. When both modes are equal the Automatic Reconfiguration is ended, except in the case described previously in the chapter « raise of a Flare End » (there both modes are equal to Conf but 2 steps of the Automatic Reconfiguration have to be performed).
The Automatic Reconfiguration is composed of 6 steps. At the end of each step the current IASW mode and the Commanded Mode are compared, if they are different, the automatic Reconfiguration goes on to the next step.

Current IASW mode :
STANDBY1
- Step **AUTO ASK FOR AUTOTEST** => update current mode to STANDBY2

STANDBY2
- Step **AUTO UNITS CONF** => update current mode to CONF

CONF
- Step **AUTO LOAD ALL PATCHES**
- Step **AUTO LOAD ALL CONF**
- Step **AUTO ASK FOR STATUS CONF**
- Step **AUTO UNITS START** => update current mode to OPER

End of the complete Automatic Reconfiguration

2.2.2.3.3.1 Description of each step :

AUTO ASK FOR AUTOTEST

IASW asks to each S/A declared ON its autotest status and if it is OK restarts their cyclical HK acquisitions. IASW changes its mode to STANDBY2.

AUTO UNITS CONF

IASW asks to each S/A declared ON to go to CONF mode and IASW changes its mode to CONF.

AUTO LOAD ALL PATCHES

For each S/A ON (first ACS, then PSD and at last DFEE), a Start Maintenance command is sent to the S/A, the cyclical HK acquisitions to the S/A are stopped. Then a S/A init ram command is sent followed by a waiting time (which is a configuration parameter specific to each S/A). The IASW Patch Area is read, and each IASW Patch Area line, concerned by the S/A, which is in fact a patch command is sent at its turn to the S/A.
Then when all the LSL commands have been executed then IASW sends a Stop Maintenance command to the different S/A so the cyclical HK acquisitions to the S/As are restarted.

AUTO LOAD ALL CONF

S/A by S/A (first AFEE , then ACS, PSD and finally DFEE) each S/A configuration command previously recorded in IASW memory is sent via aperiodic LSL command to the S/A.

AUTO ASK FOR STATUS CONF

IASW asks to each S/A declared ON its conf status.

AUTO UNITS START

IASW asks to each S/A declared ON to go to OPER mode and IASW changes its mode to OPER.

Nota Bene : in case of LSL problem, see chapter LSL errors.

2.2.2.3.4 EXPECTED OFF On Board Event treatment

This On Board Event is a very special one.
If IASW mode is STANDBY1 then IASW stays unchanged and IASW state is changed to **OFF**, else IASW mode is changed to **STANDBY1** and IASW state is changed to **OFF**.

When IASW state is OFF, this means that IASW doesn't read any received TC.
The way to go out from this state is to restart IASW.

2.2.3 DITHERING AND SPECTRA ACCUMULATION

2.2.3.1 Dithering and Spectra Accumulation Description

The Spectra Accumulation is used to perform both nominal dithering (i.e. Galatic plane survey) and extended observations of one pointed target. This means that Spectra Accumulation needs to be started and stopped according to the current pointing and to the satellite stability, so it has to be synchronised with the information provided by the BCP. Spectra Accumulation can only be performed in a SPI scientific mode.

On an IASW point of view, Spectra Accumulation designs Spectra Building based on the energy enumeration of spectrum events sent by the DFEE in a scientific mode.
It means that to perform Spectra Accumulation, the DFEE has to be acting, the DFEE has to have an IASW conf on off status equal to ON and IASW has to be either in OPERATIONAL, CALIBRATION, EMERGENCY or DIAGNOSTIC mode. It means too that every BCP, every 8s, is analysed in order to know if there is something to change in the Spectra Accumulation.

2.2.3.2 Spectra Accumulation Treatment

This designs the spectra building in IASW memory.
As these spectra represent a huge amount of data to be sent to the ground, then IASW compresses these spectra and then transmits them to the TM. The spectra accumulation treatment designs all these phases.

2.2.3.2.1 Synchronisation of the Spectra Accumulation with the BCP pointing information

2.2.3.2.1.1 About Nominal Dithering

The Nominal Dithering is started when the ***Start-Pointing*** condition is OK and is stopped when the ***Stop-Pointing*** condition is OK. These conditions are results of analysis performed on information provided by the previous BCPs and the current one.
These information are :

- the lowest word of the Pointing ID in the BCP (the Exposure Number in the current Orbit),
- the Pointing Duration in the BCP,
- the ACC Current Mode in the BCP, which is set to « Inertial Pointing Mode » when the AOCS is in nominal operational mode,
- the On Target Flag in the BCP ,which is set to « Y » when a stable pointing is achieved on a predefined target.

- About the ***Start-Pointing*** condition :

This condition is **OK** when the **arming step** is first performed and when **the fire step** is performed in its turn, both steps are described just below :
- the **arming step** is performed when :
    - in the previous BCP the Exposure Number is equal to 0 AND in the current BCP the Exposure Number is different from 0, AND
    - when in the previous BCP the Pointing Duration is equal to 0 AND in the current BCP the Pointing Duration is different from 0, AND
    - when in the current BCP, the ACC Current Mode is equal to « Inertial Pointing Mode ».

- the **fire step** is performed when first the **arming step** is OK and when the On Target Flag is equal to « Y » in the current BCP and is equal to « N » in the previous BCP.

In conclusion : *Start-Pointing* OK = arming step OK + fire step OK
Just after the update of the Start_Pointing to OK, the arming step is considered as no more valid.

This condition is **NOK** when :

- the ***Start-Pointing*** condition stays OK until the next BCP reception and then is updated to NOK.

- About the ***Stop-Pointing*** condition :

This condition is **OK** when :

- in the previous BCP the Exposure Number is different from 0 AND in the current BCP the Exposure Number is equal to 0, OR
- when in the previous BCP the Pointing Duration is different from 0 AND in the current BCP the Pointing Duration is equal to 0, OR
- when in the current BCP, the ACC Current Mode is different from « Inertial Pointing Mode ».

2.2.3.2.1.2 About Extended Pointing Observation

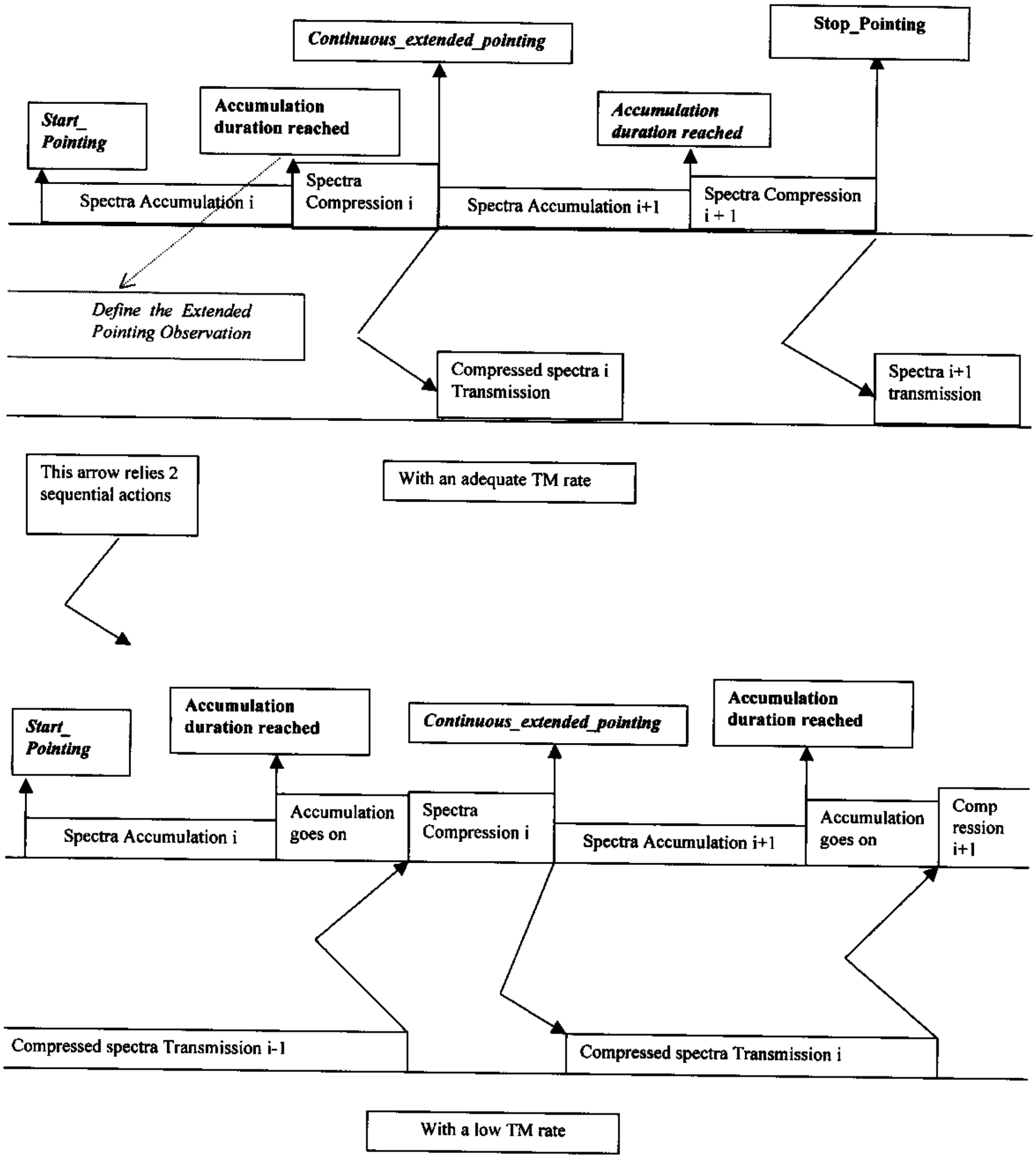
The IASW configuration exposure parameter (updated by the TC 519) is a parameter of Accumulation Duration. A change of value of this parameter is taken into account after a transition OPER to CONF and then a transition CONF to OPER.
The **Accumulation Duration** is used in the case of **Extended Pointing Observation** when the spectra accumulation has lasted the Accumulation Duration value. So, the spectra accumulation is stopped (if the previous spectra transmission is over), then the spectra compression is started ; at the end of the spectra compression, the spectra transmission is started in its turn and the spectra accumulation is restarted, after having checked that the **Exposure Number during the previous accumulation is still equal to the current Exposure Number** (in the current orbit) provided by the last BCP. This condition on the Exposure Number is called ***the_continuous-extended-pointing*** condition.
The Exposure Number is the lowest word of the Pointing ID in the BCP.

2.2.3.2.1.3 Nominal Dithering and Extended Pointing Observation

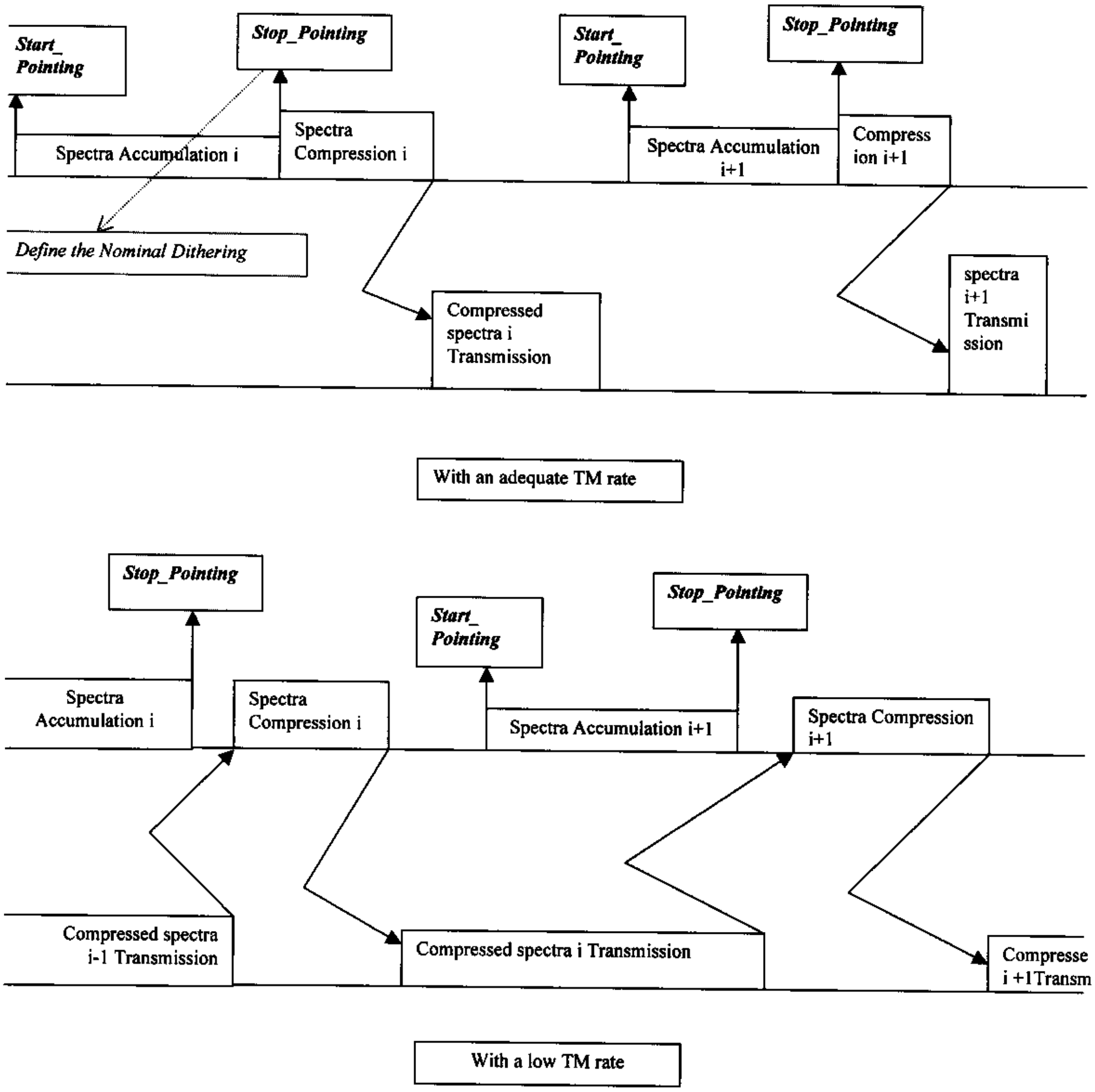
The Nominal Dithering and the Extended Pointing Observation are mixed according to the way a spectra accumulation is ended. If the spectra accumulation ends thus the ***Accumulation Duration*** is reached then the next spectra accumulation will be performed according to the Extended Pointing Observation way.
If the spectra accumulation ends thus the ***Stop_Pointing*** is OK then the next spectra accumulation will be performed according to the Nominal Dithering way. And so on ...

Remark : An On Event Message is sent by IASW :
- at the start and at the end of the spectra building,
- at the start and at the end of the spectra compression
- at the start and at the end of the spectra transmission.

C-S SI
INTEGRAL
SPECTROMETER
SPI
SPI-ST-7-5747-DIAF
Issue : 3
Revision : 0
Date : 18/03/02
Page No. : 36



EXTENDED POINTING OBSERVATION



NOMINAL DITHERING

2.2.3.2.2 Focus on Spectra building

- **Spectra composition**

The spectra composition is the same in the different IASW modes : OPERATIONAL, CALIBRATION and DIAGNOSTIC.
The energy word of each spectrum event is evaluated and the corresponding energy range channel is then incremented.
The spectra composition is a little bit different in EMERGENCY mode.
The energy word of the **correlated PSD flagged events** is evaluated too and the corresponding energy range channel is incremented too. According to the IASW configuration parameter « spectra constituents », either all the correlated PSD flagged events or only the multiple correlated PSD flagged events, are concerned.
By default, in EMERGENCY mode, all the correlated PSD flagged events are concerned.

- **Manual or Automatic energy mode**

A spectra is composed of three parts :
- the first low energy part, array storing channels of low energy, coded on 16 bits,
- the second low energy part, array storing channels of low energy, coded on 8 bits,
- the high energy part, array storing channels of high energy, coded on 8 bits.

The range bit of the spectrum event energy word indicates if the energy has to be classified either in high energy range (value 1) or in low energy range (value 0).
In **automatic energy mode**, for each energy word, the value of the range bit is considered. So the spectra is built among the three parts described just before.
In **manual energy mode**, IASW doesn't take care about energy word 's range bit. So the spectra is built among only both low energy parts.
The default value of the energy mode is **automatic**.

- **Spectra Building not completed**

IASW, via its spectra builder task, builds the spectra, detector by detector, starting by the detector 0, ending by the detector 18.
If IASW has no time enough to finish to build the 19 spectra in the minor cycle then IASW is surprised by the end of the minor cycle building the spectra for the detector « **i** » (0<= « i »<= 18). So, next cycle, IASW checks it didn't finish properly its work in the previous cycle, IASW stops the spectra builder task and restarts it in order to build again spectra properly starting by the detector « **i** » (then « i+1 », and so on). An On Event Message is sent meaning that the spectra building for the detector « i » has not been completed in the previous cycle.

- **Timeout on Spectra Compression**

Spectra compression has not to last too much.
If the spectra compression lasts more than 2000s (IASW constant) then IASW ends it by stopping the spectra compression task. Then it restarts the spectra compression task in order to be ready to compress next time. An On Event Message is sent meaning that the compression for the detector « i » has not been completed.

2.2.4 TM

The TM (Telemetry) is the part of IASW which manages the sending of packets to the ground.
This activity is cyclical, packets are sent every 8s.

2.2.4.1 TM treatment description

A packet is sent when this one is complete.

Every 8s the TM sends to the ground :

- 1 CSSW HK packet
- 2 HK techno packets maximum
- 5 HK science packets (only in oper mode)
- 4 HK diag packets (only in mode DIAG)

If the Polling Sequence Table (PST) is equal to 46, for example then, in PHOTON mode, IASW is able to send to the ground :
46 – 8 = 38 packets of scientific data every 8s.

The packets of scientific data are of 2 sorts : photon packets and spectra packets.
The photon packets have a higher priority than the spectra packets.

The HK techno packets frequencies are : 8 s, 1mn, 10 mn 1 h.
These packets are sent together by frequency.
The number of HK techno packets by frequency is as follows :
1 packet HK techno 8s
1 packet HK techno 1mn
2 packets HK techno 10mn
4 packets HK techno 1h

So the TM is quite busy with the HK techno packets every 10mn and every hour.

Another parameter, from the BCP, called TM share rate is considered too in the TM mechanism.
Except for the dump packets, if the TM share rate is inferior to 64 then IASW is able to post ONE TM packet MAXIMUM per 125ms. If the TM share rate is superior (or equal) to 64 and inferior to 128 then IAW is able to post TWO TM packets MAXIMUM per 125ms. If TM share rate is superior or equal to 128 then IASW is able to post THREE TM packets MAXIMUM per 125ms.
For Dump TM packets, IASW is allowed to post more TM packets per 125ms, depending only on the PST.

2.2.5 LSL

A LSL command allows to communicate between the DPE and a S/A via a bi-directional Low Speed Line.
There are two sorts of LSL commands :

- the cyclical LSL commands,
- the aperiodic LSL commands.

The cyclical LSL command is used to acquire HK technological data, in case of failure the command is not repeated.

The aperiodic LSL command is generated by a TC or a BCP execution, in case of failure the command is repeated once. Only one aperiodic LSL command is sent per 125 ms cycle.

To send a LSL command to a S/A, this one has to be declared « ON » in IASW memory via the Conf On Off TC.
Before to send a command to a S/A, IASW checks if it's not too late in the 125ms cycle ; if it's too late in the cycle then IASW sends an On Event Message « too late to send the command » and waits for the next cycle to send the command to the S/A.

In case of LSL problem, see chapter LSL errors.

2.2.6 LSL ERRORS

Purpose of the LSL errors management : to have, at the end of the LSL errors treatment, the same mode for each S/A and for the DPE.

2.2.6.1 Treatment of LSL errors raised during TCs execution

- In case of a change mode TC :

If a LSL error is raised on a S/A change mode command, the command is repeated once. Then, if the LSL command fails again, IASW sends back **a standby command to each S/A** (repeatable once) **and IASW changes its mode to STANDBY2.**

- In case of a conf on off TC :

If a LSL error is raised on an autotest acquisition command, the command is repeated once.
Then, if the LSL command fails again, **the TC is rejected** (but new units conf on off status are yet updated in the dedicated IASW tab).
The cyclical HK acquisitions are still performed as before the TC reception.
ANOTHER CONF ON OFF TC HAVE TO BE SENT AGAIN, MODIFIED BY GROUND AFTER PROBLEM ANALYSIS.
IASW doesn't change its mode (STANDBY1 or STANDBY2).

- In case of the other TCs (On Request, Dump, Record Conf, Load Patch, Record Patch, Reset Patch, Start CalACS, Start Maint, Stop Maint, Sendallconf, Sendallpatch) :

If a LSL error is raised on the command, the command is repeated once.

Remarks :

- In case of a Startmaintenance TC, the cyclical HK acquisitions are stopped, whatever the TC execution result.
- In case of a Stopmaintenance TC, the cyclical HK acquisitions are started again, whatever the TC execution result.
- In case of a Sendallconf TC or of a Sendallpatches TC, every LSL command is sent, even if one of them fails.

Nota Bene :
The case of the **TC eclipse exit** is taking into account in the chapter « Treatment of LSL errors raised during on board event execution ».

2.2.6.2 Treatment of LSL errors raised except TCs and on board events execution

- In case of AFEE LVPS switch off :

If a LSL error is raised on the AFEE LVPS switch off command, **the command is repeated once.**
Then, if the LSL command fails again, IASW doesn't perform any specific treatment.
As the AFEE LVPS monitoring is based on use of cyclical temperature acquisition commands , the LSL error will be considered as a LSL error in case of cyclical LSL commands (see just below).

- In case of cyclical LSL commands :

Except the command which gives time to ACS , in case of LSL error, **the cyclical LSL command is not repeated.**
The number of successive LSL errors is managed by S/A and is compared to a filter. This filter is an IASW configuration parameter whose default value is equal to 3. When the number of successive LSL errors for a S/A is equal to the filter value, then **the cyclical LSL commands are stopped for this S/A.**
IASW sends back **a standby command to each S/A** (repeatable once) **and IASW changes its mode to STANDBY2. The automatic reconfiguration capability is inhibited too.**
It will be necessary to send back a conf on off TC in order to restart the cyclical LSL commands.

2.2.6.3 Treatment of LSL errors raised during on board event execution

- In case of an on board event begin :

If a LSL error is raised on a S/A change mode command or on an ACS high voltage switch off command, the command is repeated once. Then, if the LSL command fails again, IASW sends back **a standby command to each S/A** (repeatable once), **IASW changes its mode to STANDBY2** (to STANDBY1 if it is an eclipse) and **changes its state to PROTECTED. The automatic reconfiguration capability is inhibited too.**

In case of LSL error on a LSL command of unit stop maintenance, the command is just repeated once.

In case of the on board event « EXPECTED_OFF », if a LSL error is raised on a change mode command, the command is repeated once. Then, if the LSL command fails again, **IASW changes its mode to STANDBY2 and changes its state to OFF.**

- In case of an on board event end :

During the automatic reconfiguration, if a LSL error is raised on a command, this one is repeated. Then if the LSL command fails again, the automatic reconfiguration is stopped at the end of its current step.
According to the automatic reconfiguration step, the IASW mode management changes :
- in case of LSL error during the **autotests acquisition step**, IASW keeps its mode **STANDBY1,**
- in case of LSL error during the **conf mode transition step**, IASW keeps its mode **STANDBY2*,**
- in case of LSL error during the **patches loading step** or during **the configuration loading step** or during **the configuration status acquisition step**, IASW keeps its mode **CONF,**
- in case of LSL error during the **operational mode transition step**, IASW changes its mode to **STANDBY2*.**
In all these cases, **IASW changes its state to COMMANDED.**

* **on an end of eclipse**, (which means in this particular case that the « on board event » is in fact a ground event i.e. a TC end of eclipse), IASW changes its mode to **STANDBY1** (and not STANDBY2).

In case of an end of eclipse combined with a flare or an esam , if a LSL error is raised on a S/A change mode command, the command is repeated once. Then, if the LSL command fails again, **IASW changes its mode to STANDBY1** and keeps **its state PROTECTED. The automatic reconfiguration capability is inhibited too.**

2.2.6.4 Simultaneity of LSL errors treatments

A LSL error treatment raised on a TC execution can't be simultaneous with a LSL error treatment raised on an on board event execution.
Thus an on board event execution is linked to a BCP reception which is considered like a TC reception by IASW and so is performed sequentially with the TCs by IASW.
So, in that case, there is no problem of simultaneity of LSL errors treatments.

The simultaneity problem is set when a LSL error is raised on a TC or BCP execution on one hand and when a LSL error is raised on cyclical LSL commands execution on another hand.
In that case, these LSL errors can perform on one hand the treatment of LSL errors raised during TCs or BCP execution and on another hand the treatment of LSL errors raised during cyclical LSL commands.
These distinct LSL errors treatments can be performed at the same time, though they can managed differently the IASW mode. And this seems to be unacceptable.
So, this LSL errors treatments simultaneity is stopped as follows :
The LSL errors treatment raised during cyclical LSL commands execution will start only if there is no TC or BCP execution running.
If a TC or BCP execution is running, the LSL errors treatment raised during cyclical LSL commands execution will start at the end of the current TC or BCP execution.

2.2.7 ON EVENTS MESSAGES

2.2.7.1 On Events Messages Description

See previous chapter « 2.1.2 ».

2.2.7.2 On Events Messages Treatment

IASW is able to store **64 On Event Messages** per TM cycle i.e. **every 8s**. This means that, in certain cases, if IASW sends more than 64 On Event Messages per 8s then some of the messages will be lost.

There is 2 ways of managing the On Event Messages :
- The first one by giving information about the DPE living (change of mode, of state …),
- The second one by giving information's about the DPE unusual behaviour.
This chapter tries to explain the way On Event Messages are sent by a DPE in nominal state.
For On Event Messages sent by a DPE in error state, just see chapter « 2.1.2 ».

- When IASW **changes its mode** (STANDBY1, STANDBY2, CONF ..) then it sends an On Event Message of change mode indicating the old and new mode.
- When **IASW changes its state** (COMMANDED, PROTECTED, AUTOMATIC, OFF) then it sends an On Event Message of change state indicating the old and new state.
- When **IASW receives a TC**, if the **TC is rejected by IASW**, an On Event Message is sent.
- When **IASW receives a BCP**, every 8s, if the **BCP analysis raises an on board event** (FLARE BEGIN, FLARE END, ESAM BEGIN, ESAM END, EXPECTED OFF, …), then an On Event Message describing the type of the raised on board event is sent.
- When IASW performs **Spectra Accumulation**, in a scientific mode, then an On Event Message is sent, describing the start and the end of either spectra building, spectra compression or spectra transmission.

3 TRANSFER MANUAL

3.1 SOFTWARE FILES TRANSFER

3.1.1 TRANSFER OF THE COMPLETE SOFTWARE

3.1.1.1 Execution command of the transfer procedure

Check first your DAT is present in your tape recorder then do :
« **archiver <version>** »

Example : « **archiver 301** »

3.1.1.2 Description of the transfer procedure

IASW release <version> is first transferred by tar in a temporary space.
There, the IASW 1750 libraries are suppressed.
Then the IASW, still in the temporary space, is transformed again in a tar file.
The IASW tar file is compressed by gzip in a gzip tar file.
Then, the IASW gzip tar file is moved to the directory $HOME/ARCHIVE_LIVRAISON with the following name : SPIASW_v<version>.tar.gz.
Example : SPIASW_v301.tar.gz
At last, all the directory $HOME/ARCHIVE_LIVRAISON is recorded by tar on a DAT (that you haven't forget to put in the tape recorder before the transfer execution).

Notice you will have to suppress IASW from the temporary space in order to clean the temporary space.

3.1.2 TRANSFER OF THE SOFTWARE EXECUTABLES

On $HOME/DELIVERY/code/IASW (DIAF IASW space), do :

"**livrer <issue_release>**" for example for the release 301 do "**livrer 301**".

It creates the directory **$HOME/integration/IASW_v<issue_release>** if it doesn't already exist.
For example, it creates the directory : $HOME/integration/IASW_v301 .

Then it copies from the DIAF IASW space on this **$HOME/integration/IASW_v<issue_release>** space the following files : **main_<version>.dbg**
main_<version>.ldm
main_<version>.trb
main_<version>.map

For example, in a 301 version case, you will have in the directory $HOME/integration/IASW_v301 the following files :

main_301.dbg
main_301.ldm
main_301.trb
main_301.map

3.2 SPIASW SOFTWARE REGENERATION

We will take for hypothesis that $HOME/DIRCNES/code is the regeneration space, in which CSSW is already well generated.
The IASW code, we wish to regenerate, is stored in the directory $HOME/ARCHIVE_LIVRAISON, in the gzip tar file « SPIASW_v<version>.tar.gz.
So, first, we decompress this file by executing :
« **gzip -d SPIASW_v<version>.tar.gz** »
Then, we have now a « SPIASW_v<version>.tar » file.
Now, move this « SPIASW_v<version>.tar » file to $HOME/DIRCNES/code.
And then, reinstall IASW code by executing :
« **tar xvf SPIASW_v<version>.tar** ».

For example : « tar xvf SPIASW_v221.tar »

Then, go to $HOME/DIRCNES/code/IASW by executing « **cd IASW** ».
And, finally, execute the command file Install_IASW by executing :
« **Install_IASW** »

Install_IASW is the IASW regeneration procedure which calls all the different IASW makefiles and which generates the IASW executable files.

3.3 SPECIFIC FILES

- The file IASW/LSL/fast_lssl.asm is specific to SPI IASW. It allows to manage directly the IT14 (without using ASTRES services).
- The two files: CSSW/Services/tm_cycle.ada and CSSW/Drivers/obdh_b.adb are specific to the EOTM management and were introduced in IASW 4.0.0.

These 3 files are stored in the folder code specific on the CDROM IASW 4.0.0.
Be careful! If a new CSSW delivery has to be performed, gather or replace the corresponding files with these specific files.