SPIRE-ALC-MOM-001726

ALCATEL SPACE

REF. : HP-ASPI-MN. 3204

DATE : 5/6 /2003 | PAGE : 1/7

COMPTE RENDU DE REUNION / *MINUTES OF MEETING*

LIEU / *PLACE* : CANNES

OBJET / *PURPOSE* : DATA HANDLING WORKING GROUP MEETING # 15

CLASSIFICATION :

PARTICIPANTS *ATTENDEES*	SOCIETE *FIRM*	SIGNATURE *SIGNATURE*	PARTICIPANTS *ATTENDEES*	SOCIETE *FIRM*	SIGNATURE *SIGNATURE*
P. COUZIN	ASP.		R.C. BUTLER	IASF/CNR	
K.R. HIBBERD	ASP.		J. CHARRA	IAS	
S. Thürey	ESA		P. STASSI	LPSC (ISN)	
K. King	RAL		O. H. Bauer	MPE	
P. Esforia	ESA		J. Dodsworth	ESA.	
M. MICCOLIS	LABEN				
REDACTEUR / *WRITTEN BY* :					

CONCLUSION :

DISTRIBUTION : PARTICIPANTS / *ATTENDEES*	POUR ACTION : *FOR FURTHER ACTION*
	POUR INFORMATION : *FOR INFORMATION*

APPROUVE PAR / *APPROVED BY*

NOM / *NAME*	COUZIN			
SIGNATURE / *SIGNATURE*				

SUITE / *CONTINUED* :

ACTION

AGENDA & PROPOSED POINTS FROM PARTICIPANTS : -
SEE ANNEX.

ESOC HAVE SENT YESTERDAY A QUESTIONNAIRE REGARDING ON-BOARD SOFTWARE MAINTENANCE. ALL PARTIES ARE REQUESTED TO ANSWER, IF THERE ARE ANY QUERIES THEN ESOC ARE PREPARED TO PROVIDE ASSISTANCE.

AI 1
INSTRUMENTS + ASP
30/06/03

WG#14 AI REVIEW

AI 1 NOTE OF SUBSCHEDULE IMPLEMENTATION HAS BEEN PREPARED BY ESA. INSTRUMENTS HAVE NOT BEEN ON THE DISTRIBUTION LIST FOR THIS DOCUMENT. ESA WILL SEND THE DOCUMENT TO THE INSTRUMENTS.
HOWEVER THIS DOCUMENT DOES NOT FULLY CLOSE THE ACTION SINCE IT DOES NOT SAY HOW THE SUBSCHEDULES WILL BE USED BUT ONLY THE CAPABILITIES OF THE SUBSCHEDULES and MTL are described.
ALL PARTIES AGREE THAT THIS AI IS OBSOLETE TODAY, IT WILL BE ADDRESSED IN DETAIL IN FUTURE.

SUITE / *CONTINUED* :

ACTION

AI 2. NOT ALL INSTRUMENTS HAVE PROVIDED INPUTS. A NEW DUE DATE IS 15/9/03

AI 3. CLARIFY USE OF SERVICES. IS CLARIFIED IN ISSUE 3.0 OF THE PSICD. FORMAL DISTRIBUTION OF THIS DOCUMENT IS IN PROCESS. AI CLOSED.

AI 4. MEMORY LOAD ADDRESS FORMAT.
CLOSED FOR SORPTION COOLER
OPEN FOR HFI, TO ANSWER BY 30/6/03

AI 5. PEAK UP FORMAT - CLOSED. ASP WILL DISTRIBUTE TO ALL PARTIES THE CLOSURE DOCUMENT.

AI 6: - I/F TESTING APPROACH.
CLOSED FOR HERSCHEL INSTRUMENTS.
OPEN FOR PLANCK. DUE DATE 15/09/03.

AI 7. - CLOSED DURING THIS MEETING. - SEE ANNEX

6

SUITE / CONTINUED :

ACTION

USER MANUAL

ESA CONFIRM THE NEED FOR THE USER MANUAL, EVEN IF THE DATA might be also PROVIDED IN OTHER DOCUMENTATION.
INSTRUMENTS TO COMMENT THE PROPOSED TABLE OF CONTENTS. (Reference E-mail dated 20/05/03 - ST).

AI 2.
INSTRUMENTS
30/6/03.

ESA WILL PROVIDE AN EXAMPLE USER MANUAL (ELECTRONIC FORMAT).

AI 3.
ESA
15/6/03.

FDIR - SEE ANNEX.

ASP NEEDS TO KNOW FROM THE INSTRUMENTS HOW THE RT MESSAGE ERROR BIT, RT BUSY ERROR BIT, RT SUBSYSTEM FLAG, RT TERMINAL FLAG BIT, ARE HANDLED (ARE THEY USED? ARE THEY SET? WHEN? CONDITIONS? .....).

AI 4
INSTRUMENTS
30/6/03.

ASP WILL PREPARE A TECHNICAL NOTE WHICH IDENTIFIES THE EFFECTS UPON THE INSTRUMENT DURING FDIR (e.g. LOSS OF TIME STAMP, LOSS OF NUMER OF SUBFRAMES .....)

AI 5
ASP
15/07/03.

COMPTE RENDU DE REUNION / *MINUTES OF MEETING* | LIEU / PLACE : CANNES

SUITE / CONTINUED :

ACTION

ASP will distribute SOFTOIL Version 4.1 to the Instruments

IT IS AGREED THAT IT IS NOT NECCESSARY FOR THE RT TO WRITE TO SA1 THE TC PACKET TRANSFER DESCRIPTOR AS THIS IS ALREADY WRITTEN TO SA 27.

ASP WILL CLARIFY THE REQUIREMENT FOR THE TIMING OF THE PTC / PTD. — AI 6 ASP 15/7/03

ESA & ALCATEL WILL REVIEW & COMMENT THE EXTRACT FROM HFI OBSW TS-PHBC-100006-LAL PROVIDED BY HFI BY EMAIL 30/4/2003. IN PARTICULAR FOR THE METHOD OF TRANSFERRING HK DATA BACK TO HFI. — AI 7 ASP 30/6/03

Time Synchronisation

LFI express concern about the way the ACMS time is maintained (via the bus). Action is on going on LFI and HFI sides to analyse the impact in term of degradation of scientific return, induced by the present ACMS time sync mechanism.

ASP points out that:

- the present baseline complies with SRS requirements (see ASP presentation)
- any change would significantly [illegible] impact the ACC HW and BSW

SUITE / CONTINUED : S. Thuery + P. Estaria Leaving.

ACTION

THE PLM EGSE COULD BE AVAILABLE FOR INTERFACE TESTS WITH THE DPU DURING SEPTEMBER. PACS COULD HAVE A DPU AVAILABLE IN SEPTEMBER.

ASP TO CHECK ON AVAILABILITY OF PLM EGSE. AI 8 ASP 30/06/03.

PACS CONFIRM THAT THE DPU WILL BE AVAILABLE CW 37 & 38 2003.

ASP WILL PREPARE A TEST PLAN FOR THE 1553 INTERFACE CHECK. AI 9 ASP 15/07/03

BUS PROFILE - SEE ANNEX - IT WAS NOT POSSIBLE TO HAVE A DETAILED DISCUSSION DURING THE MEETING FOR THIS PRESENTATION. MEETING PARTICIPANTS ARE INVITED TO READ / REVIEW THE PRESENTATION AND GIVE COMMENTS / QUESTIONS.

SUITE / *CONTINUED* :

ACTION

MASS MEMORY MANAGEMENT.

LFI HAVE SCIENCE PACKETS WHICH SHOULD BE STORED SEPARATELY AND CAN BE DOWNLOADED JUST AFTER THE HK DATA. LFI ASK IF IT IS POSSIBLE TO HAVE A DEDICATED PACKET STORE THAT WOULD BE THE FIRST SCIENCE PACKET STORE TO BE DOWNLOADED, ACCORDING TO THE PSICD THIS WOULD BE ACCEPTABLE, AND ASP CONFIRM THAT FOR THIS POINT THE MASS MEMORY MANAGEMENT IS IN ACCORDANCE WITH THE PSICD.

NEXT D.H.W.G. MEETING IS PLANNED FOR 14/15 OCTOBER 2003 IN CANNES.

ALCATEL SPACE

LISTE D'ACTIONS / *ACTION ITEM LIST*

REF. : H-P-ASPI-MN-

OBJET / *PURPOSE* : **HERSCHEL/PLANCK**

DATE :

PAGE :

Origine	ACTION N°	ACTION Description	Responsable / *Responsible*	DATE Echéance / *Due*
ESOC	1	PROVIDE ANSWERS TO QUESTIONNAIRE	ALCATEL + INSTRUMENTS	30/6/03
ESOC	2.	COMMENT USER MANUAL T.O.C.	INSTRUMENTS	30/6/03
INSTRUMENTS	3	ESA TO PROVIDE ELECTRONIC VERSION EXAMPLE OF		
		USER MANUAL.	ESOC.	15/6/03
ASP	4	INSTRUMENTS TO PROVIDE INFO FOR RT STATUS BITS.	INSTRUMENTS	30/06/03
ESA	5	ASP TO ISSUE T.N. HIGHLIGHTING IMPACTS ON		
		INSTRUMENTS DURING FOIR.	ASP	15/07/03
ESA	6	ASP TO CLARIFY/UPDATE REQUIREMENT FOR PTC.	ASP	15/07/03
HFI	7	REVIEW OBSW FOR EXCHANGE OF DATA	ASP/ESA	30/06/03
ASP	8	ASP TO CHECK AVAILABILITY OF PLM EGSE	ASP	30/06/03
ASP	9	ASP TO ISSUE A TEST PLAN FOR 1553 INTERFACE CHECK	ASP	15/07/03

DMWG 15 Agenda

1- DM WG14 Actions review/closure

2- Design status

- 2.1- Communication FDIR : the updated baseline
- 2.2- Spacecraft support to instruments
- 2.3- data bus subframes allocation : the working baseline
- 2.4- Bus profile
  - ★ updates
  - ★ principles of implementation within the S/C software

3- Time Synchronization mechanisms

- 3.1- Planck time synchronisation requirements (Planck instruments)
- 3.2- Prime contractor System Requirements (recall)
- 3.3- Current Implementation and Timing Budgets (recall)

4- Protocol validation Issue : the PLM EGSE design status

5- AOB

DMWG 15 Agenda- additional items

- LFI
  - discussion about the actual implementation of the on-board mass memory management that seems to be connected to the management of the LFI science calibration packets
- PACS
  - Testing of the 1553 interface
- HFI
  - Instrument FDIR involving S/C actions:
    - → - how do we implement Instrument-S/C communication
    - → - discussion about instrument propositions (Planning)
- ESOC
  - information required from the Instruments with respect to setting up the MOC SCOS 2000 system for the maintenance of the instrument on-board software

2.1 Communication FDIR -DLL (1)

FDIR levels

- the communication via the 1553 data handling Bus is broken down into well identified layers : the physical layer, the Data Link Layer plus, for the «intelligent units», the Transfer Frame Layer and the Packet layer.
  - ➔ the physical layer FDIR is handled by the Bus Spec and the RT and BC designs
  - ➔ the Packet layer in linked to the functional level
  - ➔ the DLL and TFL are addressed here

2.1 Communication FDIR -DLL (2)

The Data Link Layer

- this is the low level bus protocol as per Mil STD 1553B)
- DLL FDIR is addressed in PS ICD §3.5.2.
  - ★ It aims to first isolate whether the error comes from the Bus
  - ★ Failure detection relies on nominal data traffic
  - ★ It is based on the monitoring by the BC of
    - the RT transmission error bit : : this identifies a RT or physical link failure. It is set by the BC upon detection of an error in the message received from the RT, ie :
      - = > if a word of the message has not passed the validity test defined in Mil STD 1553
      - => if the message is not contiguous
      - => if the BC fail safe hardware has timed out
    - the RT no response timeout bit : set if RT response has not arrived within typically 14μs after has mode command has been sent by the BC

2.1 Communication FDIR -DLL (3)

- the BC loop back test fail flag : this identifies a BC 1553 I/F failure. It is set if the BC self test fails. The self test typically involves a wraparound test of the BC encoder/decoder and transceiver sections. Its detailed implementation depends on the BC design (SES)

★ In addition the RT's shall report

- RT message error bit : set by the RT upon detection of an error in the message (message has not passed the validity test) or an illegal command. If this bit is set this means none of the data received within the message is used by the RT. This is a MANDATORY bit

  =>processing or not of illegal command shall be stated clearly by users

- RT busy bit: provided as a feedback to the BC that the RT is « being moving » data between the RT electronics and the host subsystem in response to a command.

  Note that this is an « historical bit » which use is discouraged by the notice 2 of the STD. If used notice requires it to be set only after as a result of a particular command received from the BC, and NOT due to routine operation.

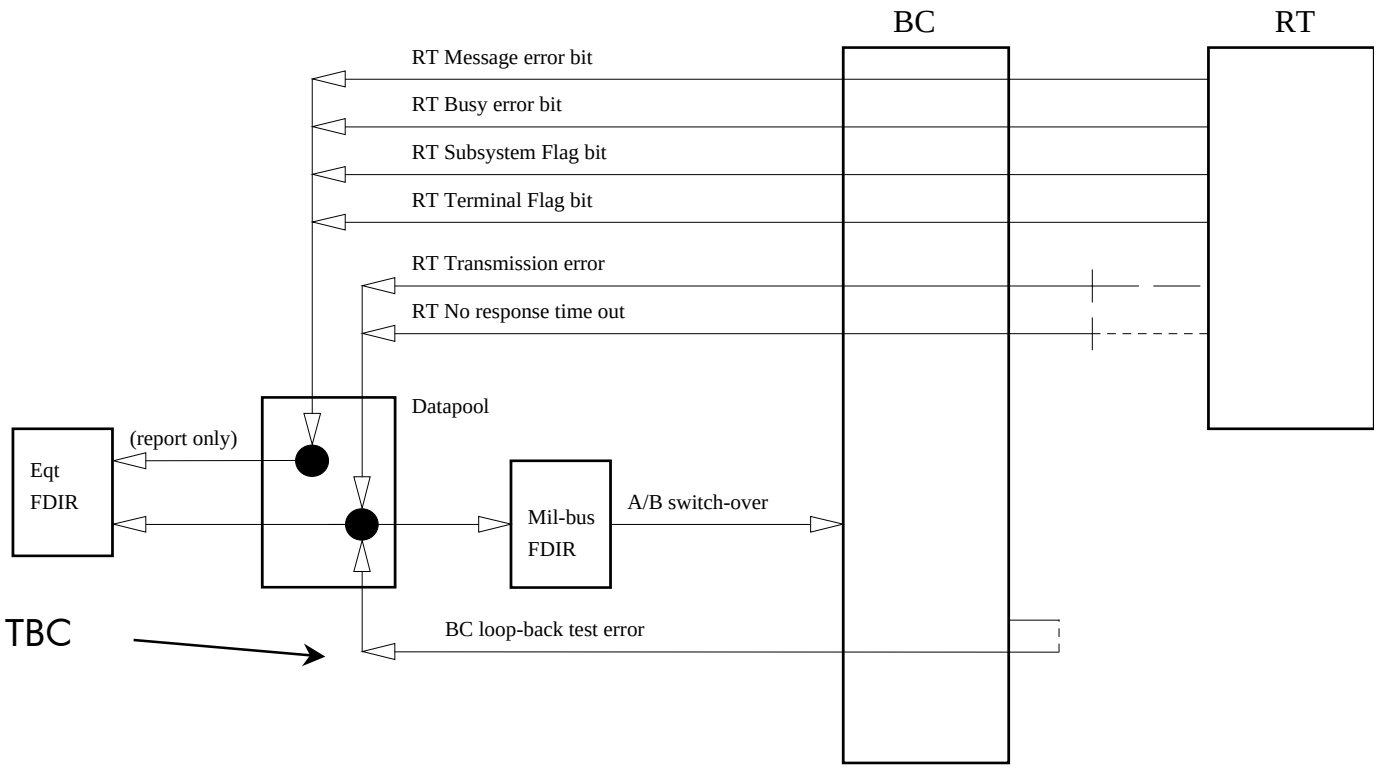
2.1 Communication FDIR -DLL (4)

=> Busy bit usage shall be stated clearly by each RT

- RT subsystem flag : used to provide « health » data regarding the subsystem (instr.) the RT is connected to. It serves as a failure indicator (« watchdog ») without providing information on the nature of the failure which must be provided via a given SA : PSICD proposes **SA1T** for RT status messsage.
- Terminal flag : informs the BC about a fault/failure within the RT (not the connected subsystem) circuitry. Further information on the nature of the failure shall be reported via a defined SA. **SA1T** is proposed. Note that this bit is requested to reflect the status of the whole RT, ie the channels A & B.

2.1 Communication FDIR -DLL (5)

★ Bus failure detection applies only on BC reported status as shown below. RT's message error, terminal error and busy bits are used as criteria evaluate TM packet acquisition process

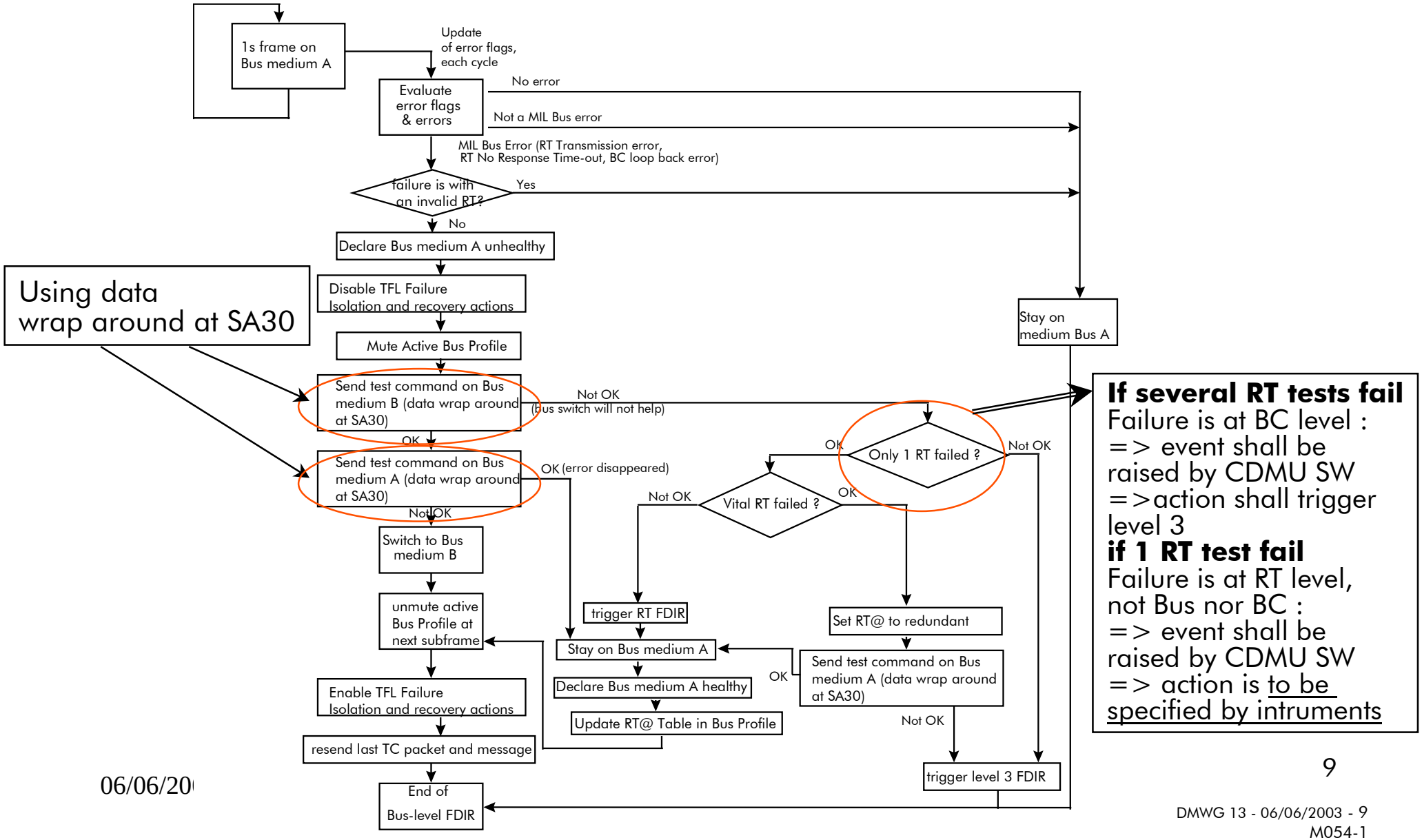


2.1 Communication FDIR -DLL (6)

➔DLL FDIR design aims to permit a Bus recovery **without interruption of the On Board operations**

- ★ Conditions for Bus recovery are met if any one of the fail bits at BC interface level are set. Bus is then declared Unhealthy
- ★ When bus is declared unhealthy an event is raised by CDMU SW :
  - bus profile is « muted »
  - Transfer Frame Layer Isolation and Recovery actions are momentarily disabled
- ★ healthyness of Bus B/Bus A further confirmed by data wrap around test with each RT at SA30R/SA30T on bus B then Bus A
- ★ switch over happens only if Bus B is proved to be healthy while bus A is not - see figure below
- ★ overall recovery sequence shall be less than 250ms => instruments shall be able to buffer > 250ms of TM data
- ★ Bus profile is « unmuted » after recovery sequence. Any last TC packet and TC message sent shall be repeated

2.1 Communication FDIR -DLL (5)



If several RT tests fail
Failure is at BC level :
=> event shall be raised by CDMU SW
=>action shall trigger level 3
if 1 RT test fail
Failure is at RT level, not Bus nor BC :
=> event shall be raised by CDMU SW
=> action is to be specified by intruments

2.1 Communication FDIR -DLL (8)

2.1 Communication FDIR-DLL (9)

➔To support DLL FDIR, and TFL FDIR, the BC (CDMU) shall maintain in Safe Guard Memory, for each RT@, a RT configuration matrix typically composed of :

- the **RT ON/OFF status**
- the **RT Dead/Alive status**, to permit to identify RT's which are definitely failed, and cannot be turned OFF (eg. because a standard limiter has failed, or because the unit is powered via FCL). The dead/alive status is managed by the ground,
- **RT Well/Sick status**, to permit to mark a failed RT during a TFL FDIR sequence,
- **RT Valid/Invalid status**, to permit to mark a RT recognized as non available (eg. RT is under reconfiguration) during a DLL FDIR sequence,
- **RT Vital/Non Vital status** in order to be able to allocate specific recovery actions to selected RT's. Currently, only the ACC is identified as a Vital RT ; confirmed communication failure with a Vital RT (on both A & B 1553 Buses) leads to a CDMU level 3 reconfiguration. Vital/Non Vital status is maintained by the ground.

2.1 Communication FDIR-TFL (10)

The Transfer Link Layer

- it addresses the protocol which organizes the RT <=> BC data exchange on top of 1553 STD
- TFL FDIR shall implement mechanisms to detect, isolate and recover from failures,
- TFL FDIR shall be simple and robust,
- TFL FDIR mechanisms shall mainly rely on mechanisms implemented within the Bus Controller
- TFL FDIR applies at a level higher than DLL FDIR and shall be momentarily disabled during DLL level Failure detection, isolation and recovery

2.1 Communication FDIR -TFL (11)

- TFL for packets users is based on the exchange of well identified messages
  - ★ Sync Mode Commands : **BC** to **RT**
  - ★ TM Packet Transfer Request : **BC** to **RT**
  - ★ TM Packet Transfer Confirmation : **RT** to **BC**
  - ★ TC Packet Transfer Descriptor : **BC** to **RT**
  - ★ TC Packet Transfer Confirmation : **RT** to **BC**

  Purpose of FDIR is to set up mechanisms to permit to exhaustively detect failures which prevent the proper TM packets acquisition and TC packets transmission over the 1553 Bus, to isolate and possibly to recover from these failures.
- TFL failure detection shall be essentially based on the existing protocol, with the 2 cases : the TM acquisition protocol and the TC sending protocol

2.1 Communication FDIR -TFL (12)

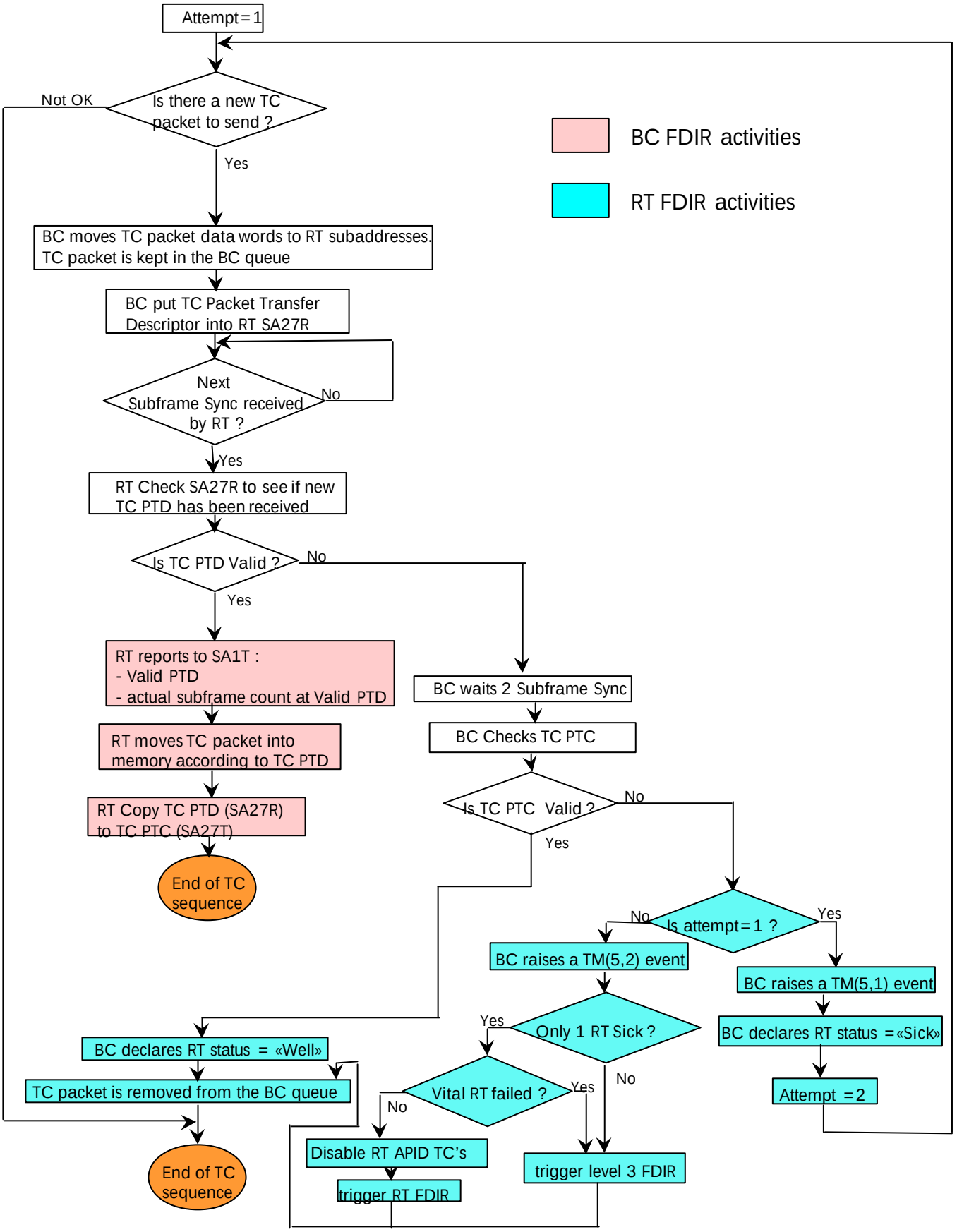
- TC transmission FDIR
  - ➔ Proper TC transmission is the key to nominal H/P operations : autonomous mission cannot continue in case of lost Packet TC's.
  - ➔ FDIR mainly relies on the analysis by the BC of the TC Packet Transfer Confirmation returned by the RT
    - ★ TC PTC is declared *invalid* if, when checked 3 subframes after TC Packet Transfer Descriptor has been put by BC at SA27R, TC PTC is different from corresponding TC PTD,
    - ★ It is proposed to implement a «one retry» capability for the packet TC : if the TC packet acquisition by the RT is not Confirmed via PTC, TC packet is kept in the BC queue, and re-sent at the next TC slot. TC is removed from the TC queue when a Valid TC PTC is recognized by the BC

2.1 Communication FDIR -TFL (13)

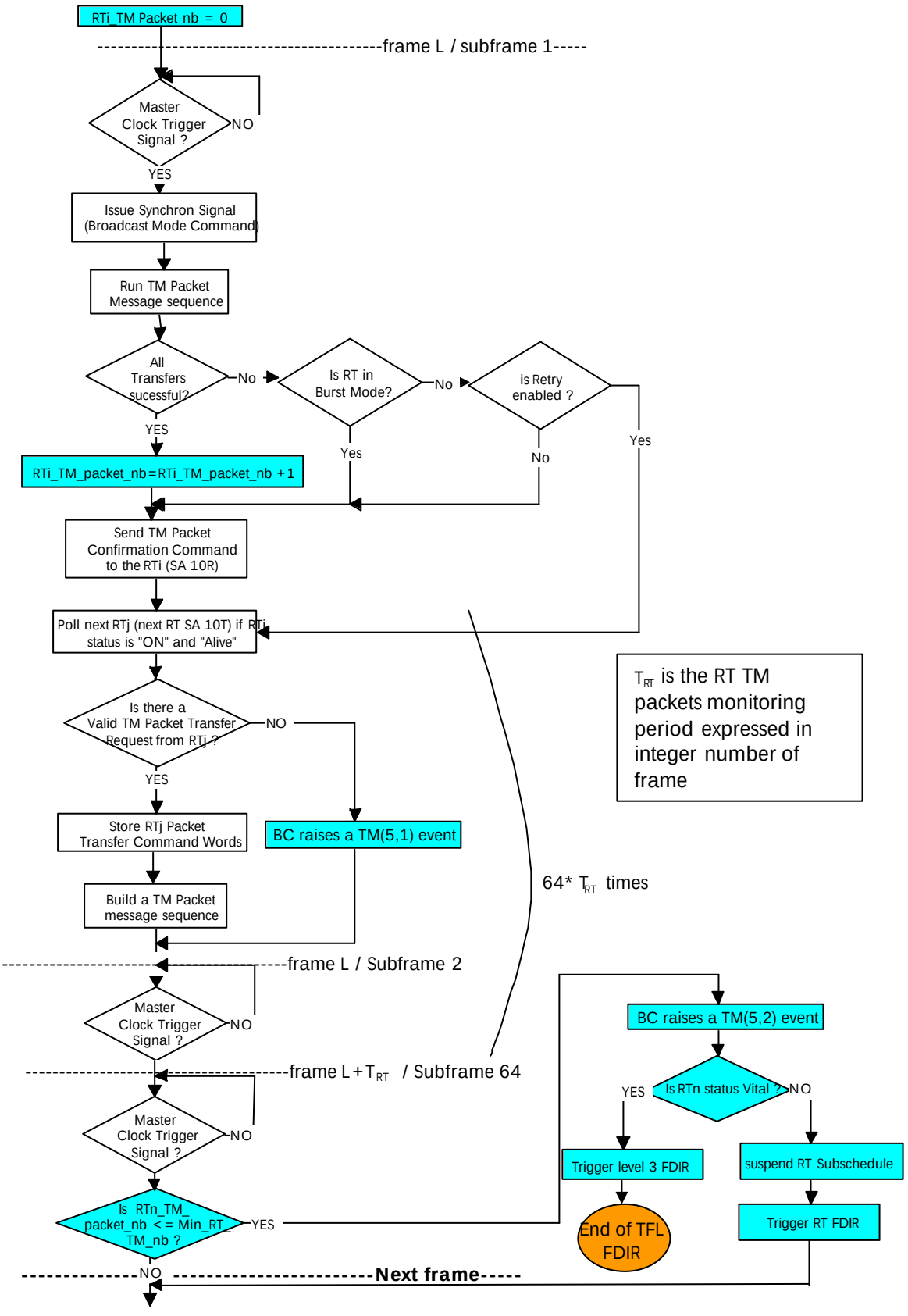
- If TC PTC is still invalid after retry,
  - BC shall raise a TM(5,2) event
  - RT FDIR (TBD by RT) is triggered if one single RT Non Vital is found Sick
  - Level 3 Recovery is triggered if several RT are found Sick (ie failure is likely to be at BC), or if a Vital RT is found Sick

➔FDIR requests the RT to report TC PTD status via SA1T (RT status message

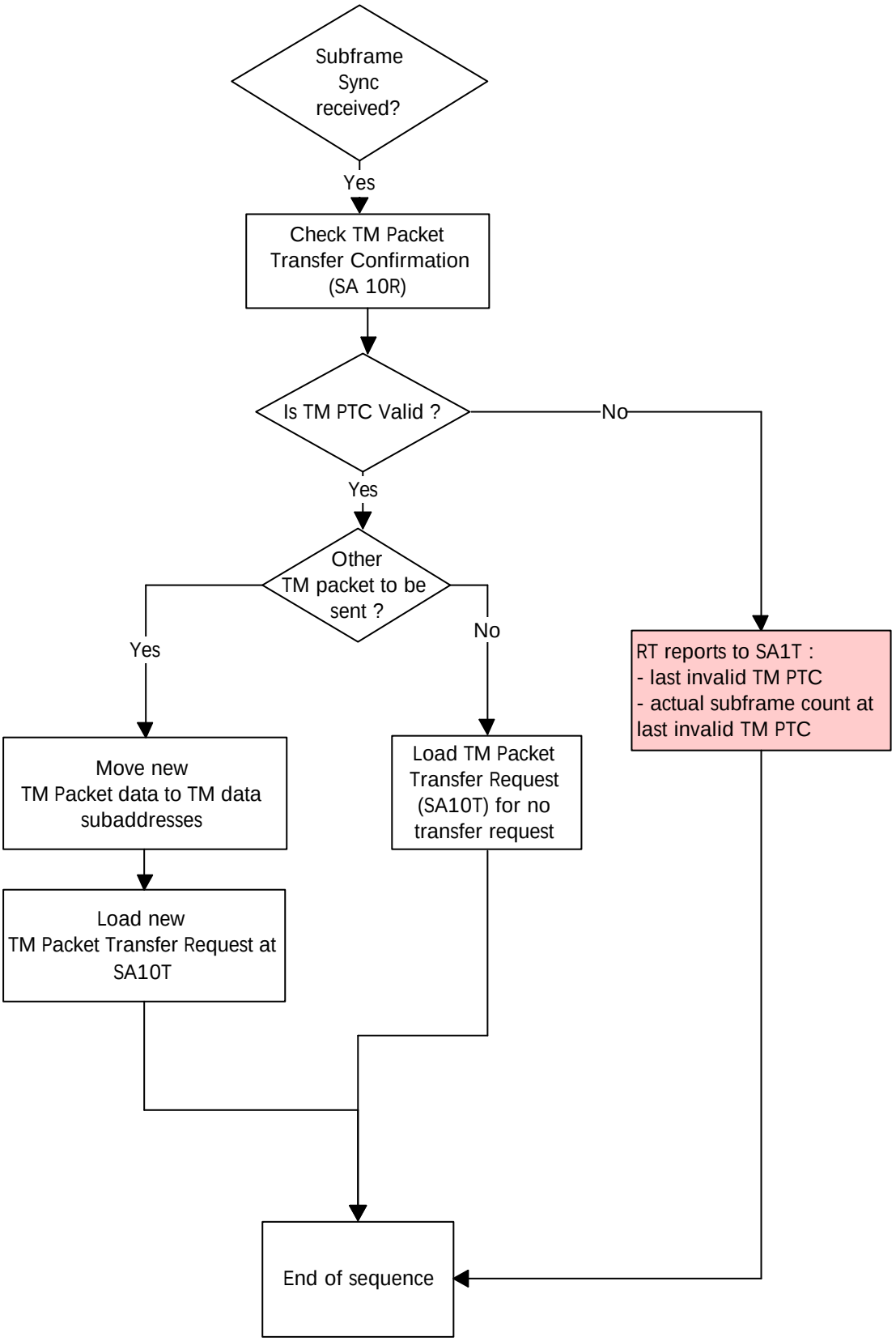
- TC PTD is declared *Valid* if the command word layout is correct and if the TC PTD Packet Count field is different from the previous Valid TC PTD Packet Count.
- The *Valid* TC PTD with the corresponding subframe number shall be reported at SA1T



TFL TM protocol Flow chart & FDIR from the BC



TFL TM protocol Flow chart & FDIR from the BC



TFL TM protocol Flow chart & FDIR from the RT

2.1 Communication FDIR -TFL (15)

- TM Acquisition FDIR
  - ➔FDIR marginally relies on the analysis by the BC of the TM Packet Transfer Request sent by the RT
    - ★ TM PTR is declared *invalid* if, when polled by BC, the command word layout is found incorrect, or the Packet Count field is identical to the previous TM Packet properly
    - ★ a TM(5,1) shall be raised by BC in case of Invalid PTR (TBC)
    - ★ BC shall maintain a 8 bits TM packet counter, reset by the Sync without Data Word Mode Command
  - ➔FDIR marginally relies on the analysis by the RT of the TM Packet Transfer Confirmation sent by the BC
    - ★ TM PTC is declared *invalid* if, when polled by RT, the command word layout is found incorrect, or the TM PTC does not reflect the last TM PTR
    - ★ RT is requested to report to SA1T, the last invalid TM PTC and the subframe count at last invalid PTC.

2.1 Communication FDIR -TFL (17)

➔FDIR is essentially based on a more general criterion : the count of the number of correctly acquired TM packets over a 1s period :

- ★ each intelligent RTn is requested to provide, for each mode, a Min_RTn_TM_nb
- ★ RTn_TM_Packet_nb is increased by one each time the transfer into the BC memory of the TM packets is successfull. A TM packet acquisition is successful if none of the RT_Busy_bit, RT_terminal_flag, Message_error_bit are set during the Packet messages acquisition.
- ★ If acquired RTn_TM_Packet_nb < Min_RTn_TM_nb
  - BC shall raise a TM(5,2) event
  - RTn FDIR (TBD by RTn) is triggered if RTn is Non Vital
  - Level 3 Recovery is triggered if RTn is Vital
- ★ FDIR isolation and recovery can start more than 1s after the failure (failure is TM packets are not generated by BC, or BC is unable to correctly acquire TM packets)

2.1 Communication FDIR -TFL (20)

Conclusion

➔The TFL FDIR is essentially based on 2 mechanisms :

- ★ the analysis of the TC PTC for each RT, to assess the proper TC transmission
- ★ the analysis, for each RT, of the TM packet return over 1s, to assess the proper TM packets acquisition
- ★ in both cases, a one-retry feature is proposed before initiating any recovery
- ★ it permits to isolate the failed instruments communication by starting dedicated RT FDIR. It permits to isolate a failed ACC (Vital RT) by triggering a CDMU 3a recovery in case of confirmed failures
- ★ RT is generally requested to report the identified TFL failures or non failures via the status word at SA1T. SA1T is considered as a more reliable mean in case of communication anomaly.

2.2 Spacecraft Support to instruments

- **Baseline from spacecraft side is extremely simple :**
  - instruments communicate with S/C only via events TM(5,x). These events possibly trigger a sequence of actions under the form of dedicated OBCP's.
  - the spacecraft monitors the instruments behaviour only via the 1553 Bus FDIR (see chapter 2.1)
  - the instruments are «suggested» (recommended ?) to report status, events, ..., via the SA1T. SA1T is polled every 1s for each RT.
  - Current CDMU SW specifications and preliminary design are in line with this approach

2.3 Subframes allocation baseline

HERSCHEL SUBFRAME ALLOCATION	Launch Mode	S/C Sun Acquisition	Nominal Normal	Nominal Burst Mode	S/C Earth Acquisition	Survival
Prime Instrument TM	0	3	27	40	3	0
Non-Prime1 Instrument TM	0	3	3	3	3	0
Non-Prime2 Instrument TM	0	3	3	3	3	0
AOCS TM	4	4	4	4	4	4
PCDU TM	1	1	1	1	1	1
CCU-Nominal TM	1	1	1	1	1	1
CCU-Redundant TM	1	1	1	1	1	1
AOCS TC receipt Report TM	2	2	2	2	2	2
Subframes allocated to TC sending	4	4	4	4	4	4
Total number of subframes allocated	13	22	46	59	22	13
Number of spare subframes	51	42	18	5	42	51

PLANCK SUBFRAME ALLOCATION	Launch Mode	S/C Sun Acquisition	Nominal Normal	Nominal Burst Mode	S/C Earth Acquisition	Survival
LFI TM	0	3	15	28	3	0
HFI TM	0	3	15	3	3	0
Sorption Cooler HK TM	0	2	2	2	2	0
AOCS TM	4	4	4	4	4	4
PCDU TM	1	1	1	1	1	1
AOCS TC receipt Report TM	2	2	2	2	2	2
Subframes allocated to TC sending	4	4	4	4	4	4
FOG TM/TC	TBD	TBD	TBD	TBD	TBD	TBD
Total number of subframes allocated	**11**	**19**	**43**	**44**	**19**	**11**
Number of spare subframes	**53**	**45**	**21**	**20**	**45**	**53**

2.4 Bus Profile (1)

Bus Profile

- Established for each spacecraft
- proposed to be used as « representative case » for the validation of the data interface
- basic assumptions are
  - each frame is self consistent (a frame doesn't depends on the previous frame) except last point
  - in line with subframes allocations in §2.3
  - in line with PS ICD services and appendix 9 rules and requirements
  - TC acknowledge TM can be reported from one frame to the next one.

2.4 - S/C 1553B Bus Profile Management

- **The S/C 1553B Bus Profile Management function implemented on board shall satisfy the following ESA Requirements in the PS-ICD (see Appendix 9 section 4.1.4.1**

  ➔4175-TFL- N

  ➔ "The BC will be commanded by ground **to activate one of several predefined fixed Bus Profiles**. Each Bus Profile defines the function of all 64 Sub-frames, which belong to a cyclic 1 second frame. Each set-up is static for a longer period of time (typically for up to some hours). All instruments will be commanded independently into modes, in which they stay below their allocated maximum data rates."

  ➔4180-TFL- T

  ➔ "The BC shall accept ground commands for **activating, deactivating, and modifying predefined Bus Profiles** for data transfer."

  ➔4185-TFL- T

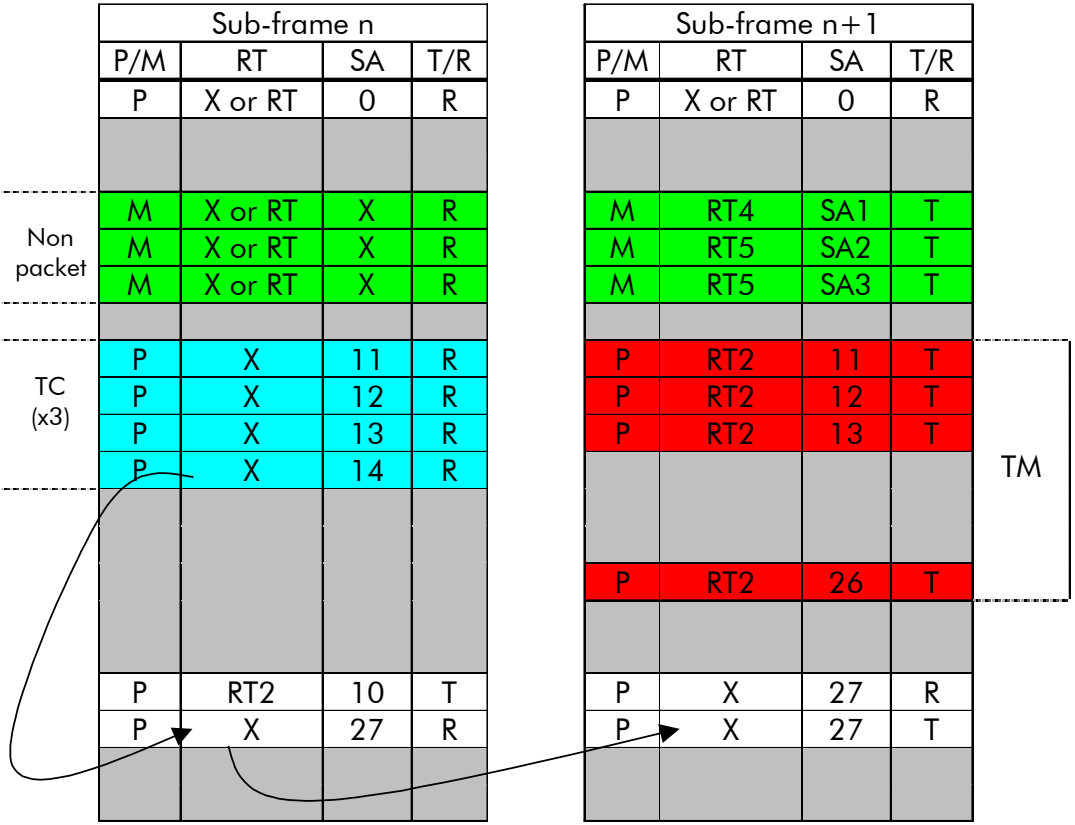
  ➔ "The BC shall **support predefined Bus Profiles** and shall **use different Profiles without interruption of service**."

2.4 - S/C 1553B Bus Profile Management

- **In order to comply with these requirements the OBSW design will allow:**
  - ➔To handle **16** S/C Bus Profiles stored on-board in a dedicated table.
    - ★Note that 16 is assumed to be largely sufficient to handle any predefined bus profile at launch (basically nominal and burst modes)
  - ➔To modify any of these Bus Profiles **down to the slot level**.
  - ➔To define a complete Bus Profile providing the following information:
    - ★ (64 sub-frames) x (24 slots) x (slot information) where **slot information** is composed of the following fields:
      - Spare : 4 bits
      - Packet/Message : 1 bit
      - Remote Terminal ID : 5 bits
      - T/R : 1 bit
      - SA : 4 bits

2.4 - S/C 1553B Bus Profile Management

- Example S/C Bus Profile (2 Sub-frames only, not all slots filled in)



X means "don't care" => OBSW to fill in

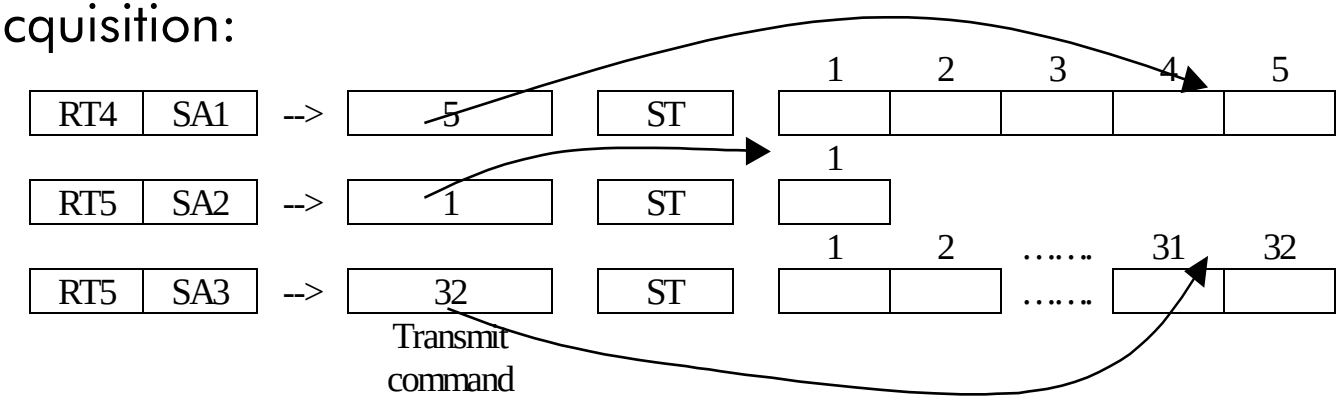
Implicit rules:

➔For non packet terminals, the OBSW will decide on FIFO basis if no RT is given.

➔OBSW will not check sanity of SCBP. Ground will have to ensure correctness, i.e. compliance to PS-ICD requirements (Appendix #9). This supposes some specific ground testing before modified BP use

➔The RT for packet slots (P/M filed == P) will contain logical device ID. RTA to be found via RT configuration table including redundancy.

➔The BSW will maintain a table for the non packet terminal TM acquisition:



2.4 - S/C 1553B Bus Profile Management

➔This table will give, for 16 1553 RT, the address of Nominal and Redundant side as well as the side currently in use.

➔A dedicated TC (**Set RT configuration**) will be defined in order to be able to modify this table.

★Suggested TC(8,4) with parameters:

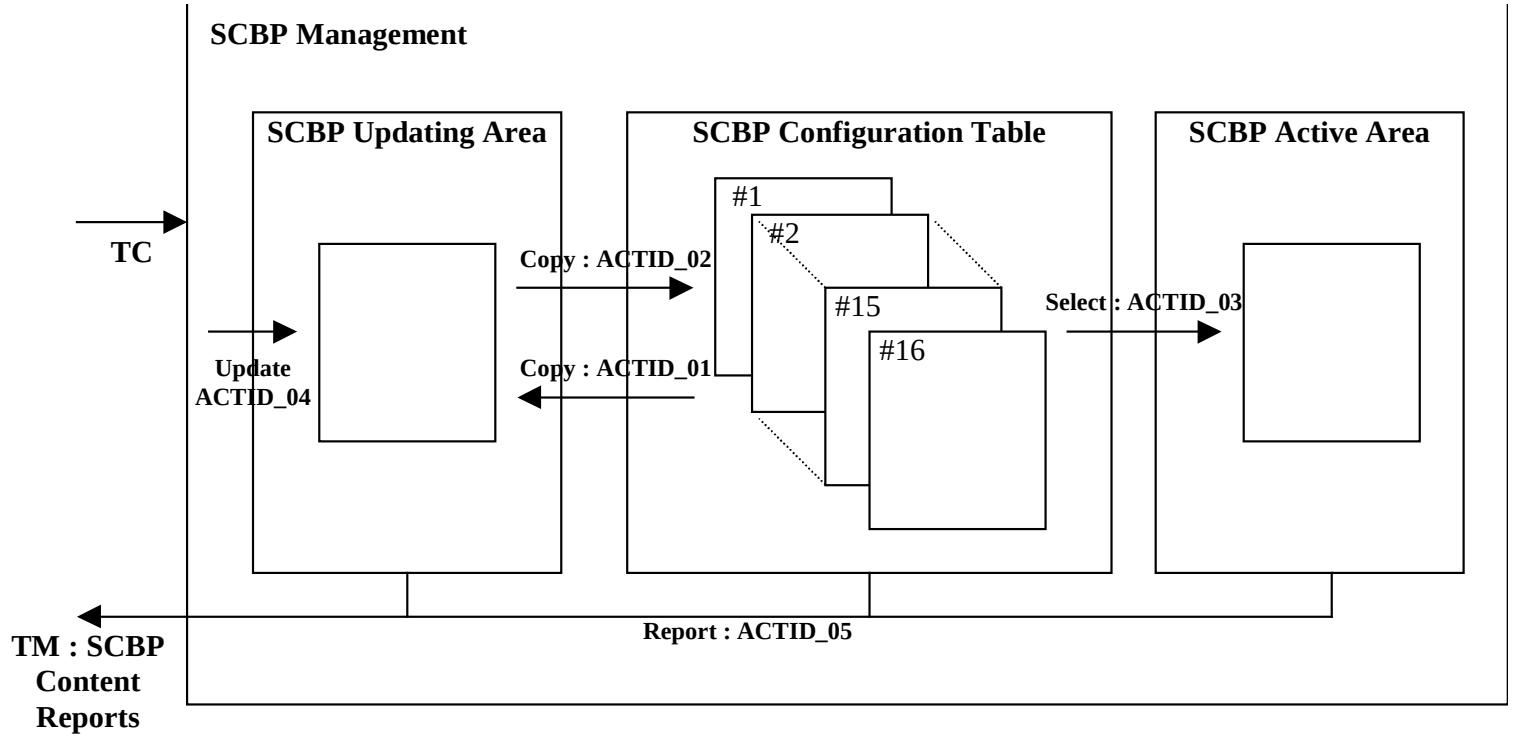
- FUNCTION_ID : <BSW_RTCONF_FUNID_02>
- ACTIVITY_ID : <BSW_RTCONF_ACTID_01>
- SID : <BSW_RTCONF_SID_01>
- Parameter (8-bit) : Identifier of the 1553 packets RT from #1 to #16.
- Parameter (8-bit) : Identifier of the used side from Sid_A to Sid_B.

★This definition of function supports the bus profile. Additional requirements (typically coming from FDIR) acting on the same table could be defined, leading to additional Activity Ids and/or SID and parameters.

★An implementation scheme (arm and fire like) will be necessary for synchronisation between table update and its taking into account at 1553 BP level.

2.4 - S/C 1553B Bus Profile Management

- **In order to allow modification of any S/C Bus Profile (SCBP) without interfering with the active BC processing, the following design based on separate working area updated via telecommands will be implemented:**



2.4 - S/C 1553B Bus Profile Management

- The following Telecommands will be defined using Service #8 (function management) in order to handle S/C Bus Profiles (SCBP) as described previously:

➔Copy Selected SCBP from SCBP Table to SCBP Updating Area:

★This activity is performed via TC(8,4) with the following parameters:

- FUNCTION_ID : <BSW_SC1553BP_FUNID_01> 08 bits
- ACTIVITY_ID : <BSW_SC1553BP_ACTID_01> 08 bits
- SID : <BSW_SC1553BP_SID_01> 16 bits
- BUS_PROFILE_ID : from #1 to #16 16 bits

★On receipt of this TC, the OBSW shall extract the selected SCBP identified by <BUS_PROFILE_ID> from the SCBP Table and copy it into the SCBP Updating Area.

➔Copy Updated SCBP into SCBP Table:

★This activity is performed via TC(8,4) with the following parameters:

- FUNCTION_ID : <BSW_SC1553BP_FUNID_01> 08 bits
- ACTIVITY_ID : <BSW_SC1553BP_ACTID_02> 08 bits
- SID : <BSW_SC1553BP_SID_01> 16 bits
- BUS_PROFILE_ID : from #1 to #16 16 bits

★On receipt of this TC, the OBSW shall overwrite the selected SCBP identified by <BUS_PROFILE_ID> into the SCBP Table by the SCBP contained in the SCBP Updating Area.

➔Select Active SCBP from SCBP Table:

★This activity is performed via TC(8,4) with the following parameters:

- FUNCTION_ID : <BSW_SC1553BP_FUNID_01> 08 bits
- ACTIVITY_ID : <BSW_SC1553BP_ACTID_03> 08 bits
- SID : <BSW_SC1553BP_SID_01> 16 bits
- BUS_PROFILE_ID: from #1 to #16 16 bits

★On receipt of this TC, the BSW shall use the selected SCBP identified by <BUS_PROFILE_ID> into the SCBP Table for the management of the traffic on the 1553 Bus.

➔Update Selected Sub-frame of SCBP contained in SCBP Updating Area:

★This activity is performed via TC(8,4) with the following parameters:

- FUNCTION_ID : <BSW_SC1553BP_FUNID_01> 08 bits
- ACTIVITY_ID : <BSW_SC1553BP_ACTID_04> 08 bits
- SID : <BSW_SC1553BP_SID_02> 16 bits
- SUBFRAME_ID : from #1 to #64 16 bits
- SUBFRAME_DEF: New Sub-frame Definition 24*16 bits

★On receipt of this TC, the BSW shall update the selected sub-frame identified by <SUBFRAME_ID> of the SCBP contained in the SCBP Updating Area with the new definition given by <SUBFRAME_DEF>.

➔Report SCBP:

★This activity is performed via TC(8,4) with the following parameters:

- FUNCTION_ID : <BSW_SC1553BP_FUNID_01> 08 bits
- ACTIVITY_ID : <BSW_SC1553BP_ACTID_05> 08 bits
- SID : <BSW_SC1553BP_SID_01> 16 bits
- BUS_PROFILE_ID : 16 bits

  #0 for SCBP contained in the SCBP Updating Area
  #1 to #16 for the SCBP contained in the SCBP Table
  0xFFFF for the Active SCBP

★On receipt of this TC, the OBSW shall report the selected SCBP identified by <BUS_PROFILE_ID> generating one "SCBP Sub-frame Content Report" per Sub-frame (64).

★The associated "**SCBP Sub-frame Content Report**" shall be a TM(8,6) with the following parameters:

- FUNCTION_ID : <BSW_SC1553BP_FUNID_01> 08 bits
- ACTIVITY_ID : <BSW_SC1553BP_ACTID_05> 08 bits
- SID : <BSW_SC1553BP_SID_03> 16 bits
- BUS_PROFILE_ID : 16 bits

  #0 for SCBP contained in the SCBP Updating Area
  #1 to #16 for the SCBP contained in the SCBP Table
  0xFFFF for the Active SCBP
- SUBFRAME_ID : from #1 to #64 16 bits
- SUBFRAME_DEF : Sub-frame Definition 24*16 bits

★The SUBFRAME_ID shall be contiguous (from #1 to #64) in the sequence of generated "SCBP Sub-frame Content Reports".

2.4 - S/C 1553B Bus Profile Management

- Additional Information:
  - ➔RTA for the 16 terminals will be passed to OBSW through HPSDB for the generation of the OBSW image.
  - ➔The 16 RTA used side identifiers will be available in data-pool.
  - ➔Default values for the 16 predefined Bus Profiles will be passed to OBSW through HPSDB for the generation of the OBSW image.
  - ➔Active Bus Profiles identifier will be available in data-pool.
  - ➔Any of SCBP management telecommands can be sent by ground or on-board functions (basically S/C mode function, MTL, OBCP).

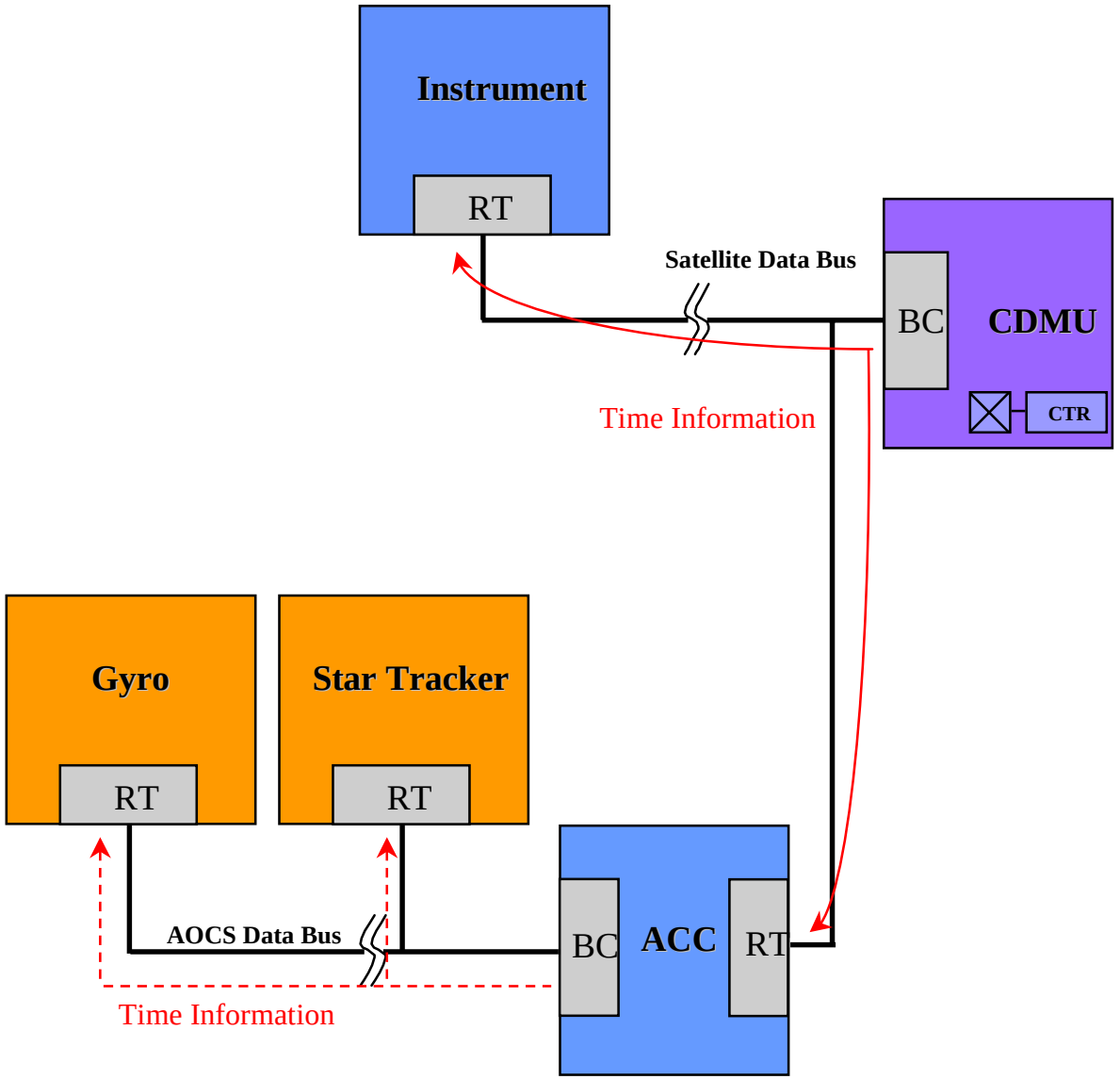
3.2 Time Synchronisation

BASED ON SYSTEM REQUIREMENTS :

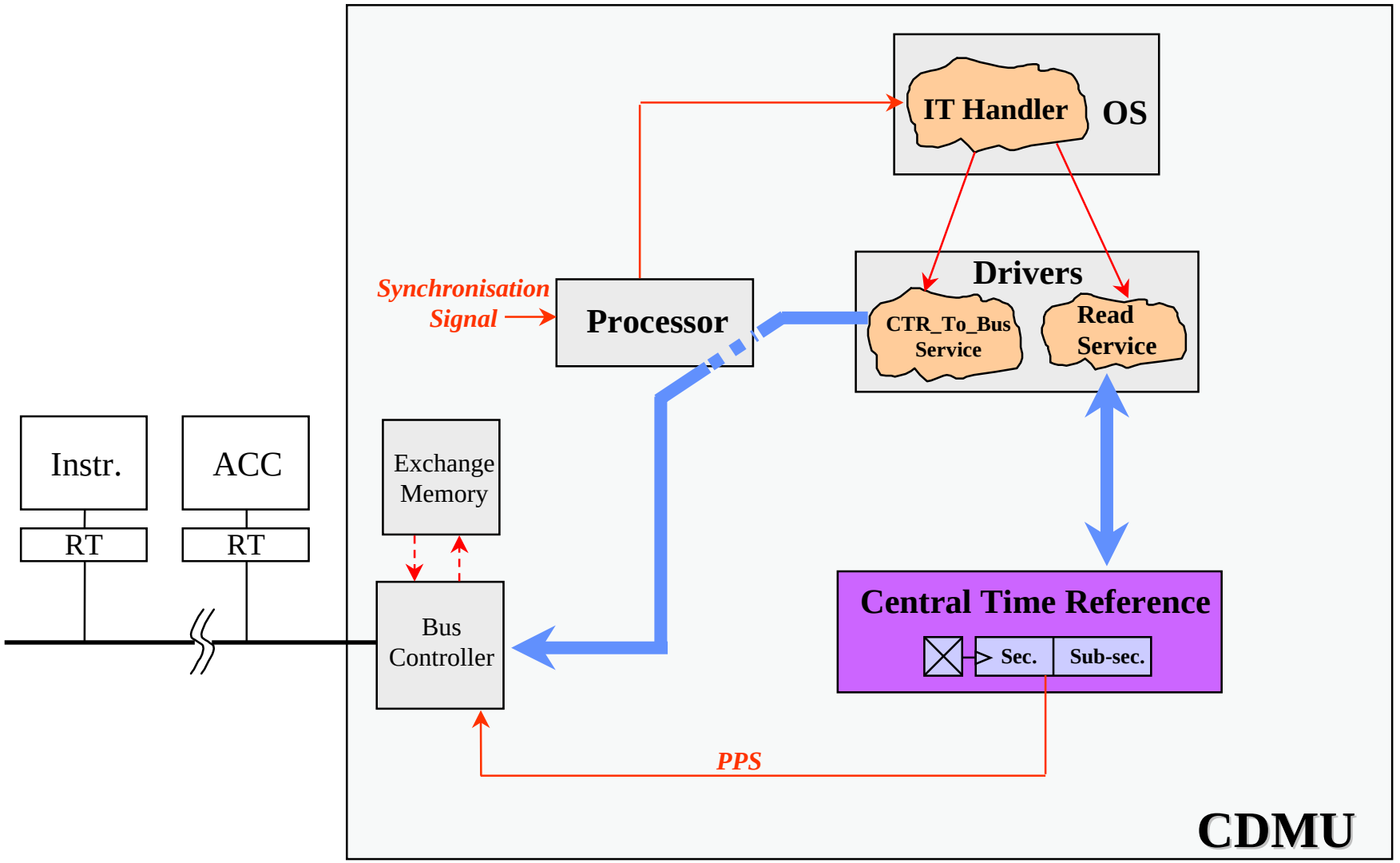
SINT-075 H/P : The time correlation between the attitude information and science data shall be better than 0.5 ms.

SMCD-225 H/P : The spacecraft shall deliver the timing information (time in TAI [Temps Atomique International] format) including synchronisation signals and clock to the instruments for datation of their information with an accuracy of 0.1 ms.

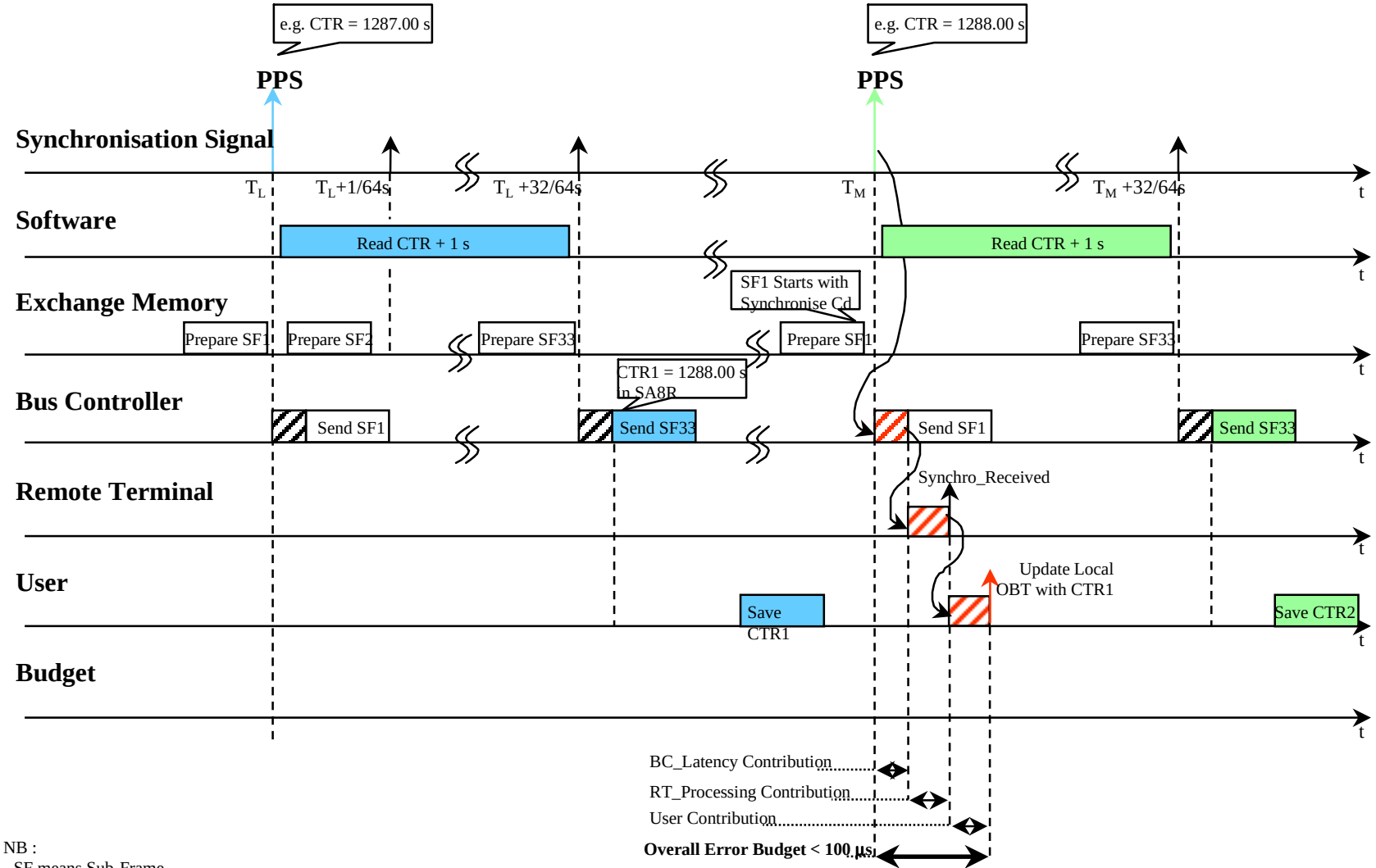
3.3 Time Synchronisation (1)



3.3 Time Synchronisation (2)



3.3 Time Synchronisation (3)

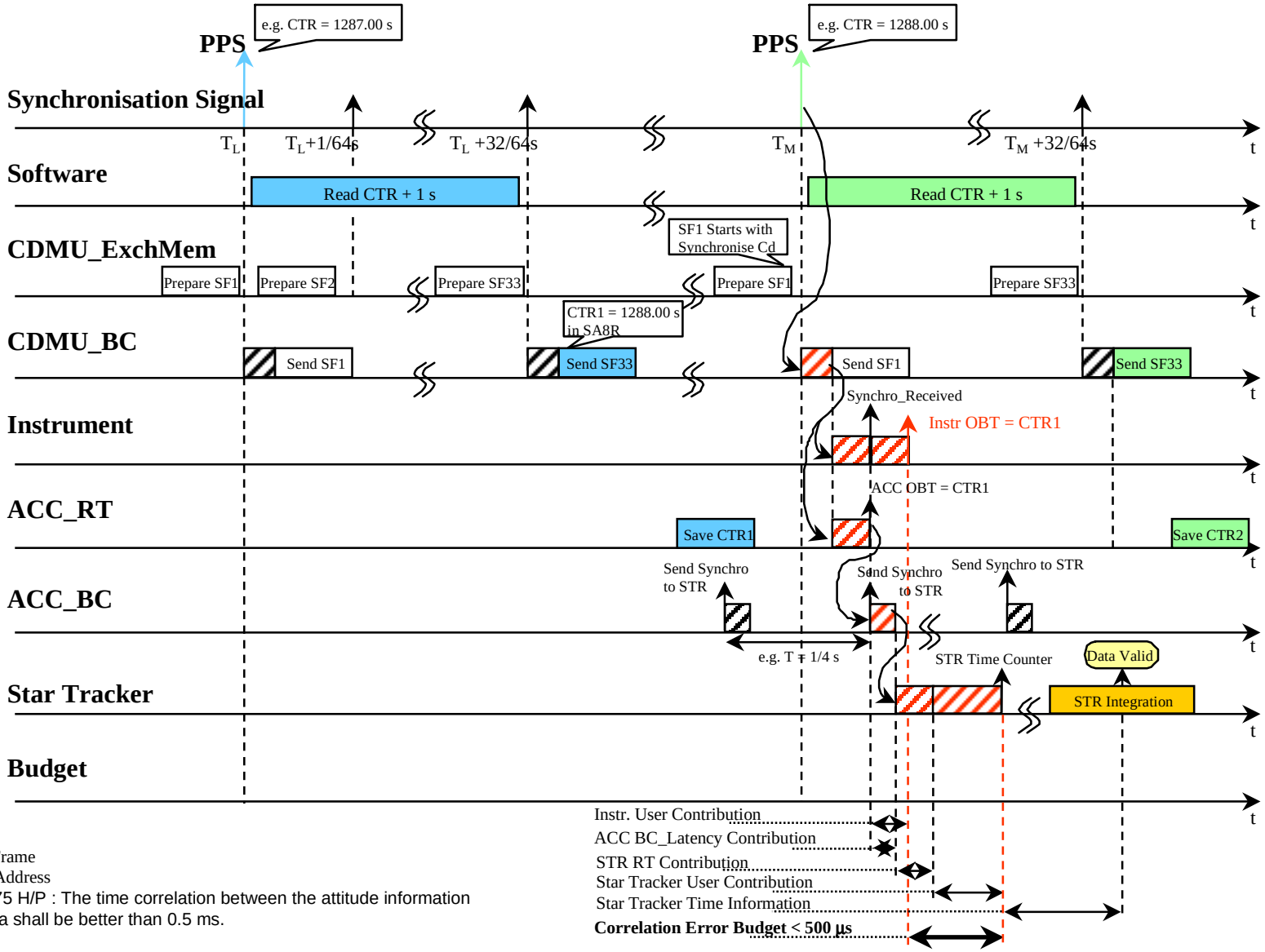


Timing Diagram Regarding the System Requirement #SMCD-225

NB :
- SF means Sub-Frame
- SA means Sub-Address
- Req. #SMCD-225 H/P : The spacecraft shall deliver the timing information (time in TAI [Temps Atomique International] format) including synchronisation signals and clock to the instruments for datation of their information with an accuracy of 0.1 ms.

3.3 Time Synchronisation (4)

Timing Diagram Regarding the System Requirement #SINT-075



NB :
- SF means Sub-Frame
- SA means Sub-Address
- Req. #SINT-075 H/P : The time correlation between the attitude information and science data shall be better than 0.5 ms.

3.3 Time Synchronisation (5)

Location	Contribution	Timing error contribution		Remark
		Requirement (µs)	Performance (µs)	
CDMU	(1) **BC_Latency**	10±10	5±5 (TBC)	
Data Handling Bus	**Transmission**	-	-	Negligible
Instrument	(2) **RT_Processing**	20±20	15±15 (TBC)	
	(3) **User_Contribution**	20±20	5±5 (TBC)	Includes error contribution up to the Local OBT sync with the CTR
(4) **Margin**		-120/+20		
Time Error Budget vs #SMCD-225 (1)+(2)+(3)+(4)		**0±100**	**25±16.6 (TBC)**	

Compliance to System Requirement #SMCD-225

3.3 Time Synchronisation (6)

Location	Contribution	Timing error contribution		Remark
		Requirement (μs)	Performance (μs)	
CDMU	(1) **BC_Latency**	10±10	5±5 (TBC)	
Data handling Bus	**Transmission**	-	-	Negligible
ACCt	(2) **RT_Processing**	20±20	15±15 (TBC	
	(3) **BC_Latency**	10±10	5±5 (TBC)	
ACMS Bus	**Transmission**	-	-	Negligible
Star Tracker	(4) **RT_Processing**	20±20	15±15 (TBC)	
	(5) **User Contribution**	0±100	TBD	Perfo not available
Time Error Budget (1)+(2)+(3)+(4)+(5)		**60±105**	**TBD**	

Timing Budget from the CTR to the Sensors - details

3.3 Time Synchronisation (7)

Location	Contribution	Timing error contribution		Remark
		Requirement (μs)	Performance (μs)	
ACC	(1) **BC_Latency**	10±10	10	
Star Tracker	(2) **RT_Processing**	20±20	30	
	(3) **User_Contribution**	0±100	TBD	
Instrument	(4) **User_Contribution**	-370/+430	TBD	This includes errors contributions up to the Science Data datation process..
Time Error Budget vs #SINT-075 (1)+(2)+(3)-(4)		**0±500**	**TBD**	

Compliance to System Requirement #SINT-075

4. PLM EGSE (1)

PLM EGSE context

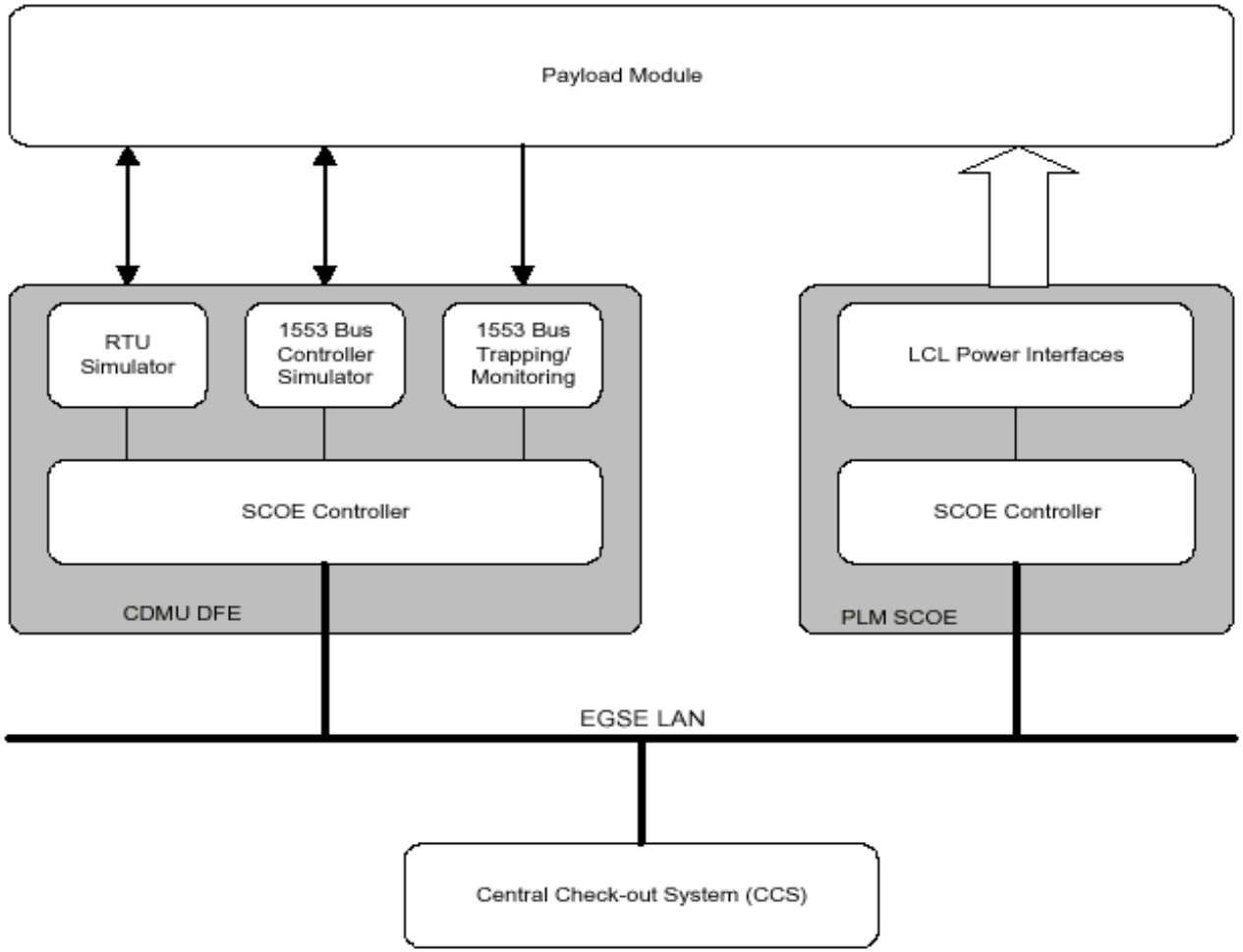
- aims to interface in a «representative way» with Herschel & Planck PLM's during CQM tests
- procured by Alenia essentially to «guarantee» the SVM I/F representativity
- delivered to ALCATEL which accept it and, in Herschel case, deliver it to ASTRIUM as a CFE
- delivery is planned in the July-August 03 time frame
- the PLM EGSE will be the first opportunity for a communication protocol cross validation

4. PLM EGSE (2)

PLM EGSE design

- 2 major functions are implemented
  - ➔ the CDMU DFE simulates the CDMU behaviour in order to interact in a representative way with the instruments
  - ➔ the PLM SCOE distributes the 28V regulated power via the different classes of LCL's.
- the 2 functions are implemented as 2 operating units, physically and logically separated
- the PLM EGSE is remotely controled and monitored by the CCS (CCS lite here) via a LAN

4. PLM EGSE (3)



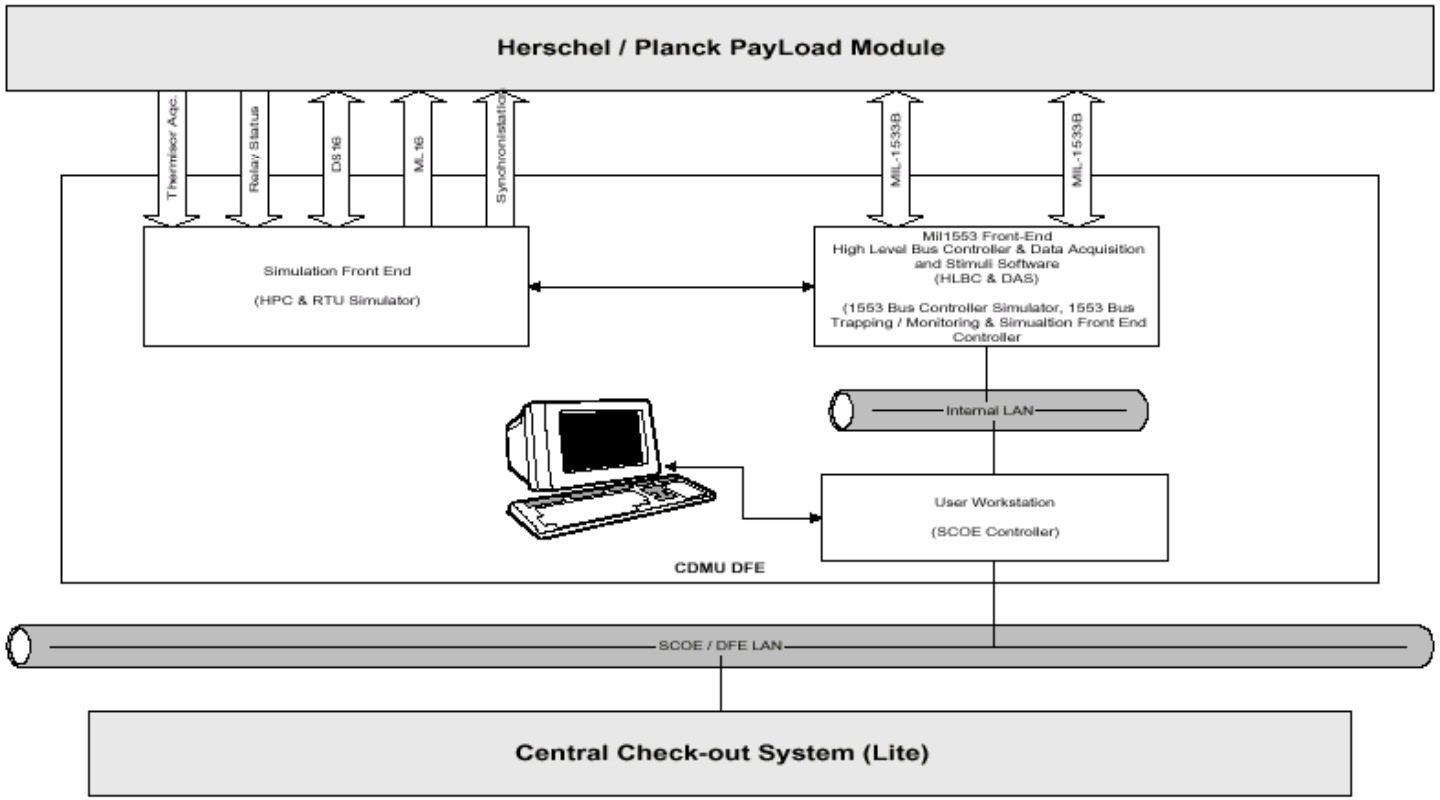
PLM EGSE Architecture

4. PLM EGSE (4)

CDMU DFE architecture

- it provides both the electrical and functional data interfacing with the PLM, including the 1553 interfacing with the payload and the discrete I/O's
- 3 main blocks are identified
  - the MIL 1553 front end
  - the simulation front end, for the discrete interfaces
  - the user workstation for the overall system control, and CCS I/F
- the MIL 1553 FE implements
  - the bus protocol on top of the 1553 Std (ie the PS ICD appendix 9)
  - the TM/TC packet level processing
- the simulation front end implements
  - H+P PLM's required I/O interfaces (essentially thermistors)
  - the 132kHz Sync lines

4. PLM EGSE (5)



CDMU DFE Architecture

4. PLM EGSE (6)

Time Sync implementation

- the 132kHz clock is internally used to update a counter used as the time reference.
  - The time counter is implemented as a 57 bits counter and is divided into a «coarse time» (1s resolution), and a «fine time»
  - the coarse time counter can be preset by SW (otherwise it starts from 0)
  - this is the time broadcast every subframe #33 at SA8R
  - this clock is synchronized with the 1s Sync without data word message on the Bus. The time message will be in entire seconds
- The overall CDMU DFE implementation is very similar to the real CDMU one. Representativity is believed very good, and synchronisation requirements are fullfiled
- the service 9 TC's will be generated autonomously within the CDMU DFE to permit a consistent time Synchronisation

Bus profile concept

- implemented via PST's (Polling Sequence Tables)
  - the PST permits to precisely define, on a slot basis, the activity to perform in each subframe of a frame.
  - Different PST's (ie configuration files) can be defined, and a new PST can be called on line. It is applied at the next Sync without Data word (1s boundary). Note that a PST could be «empty», ie contain only the sync messages
  - This implementation is consistent with the real CDMU SW one
- some restrictions apply
  - a low level read/write to a SA always transfers all 32words of the SA
  - the first 20 slots of a subframe last 710μs, the next 3 about 110μs. The regulation slot thus lasts more than 1ms.
  - A frame can only contain 63 subframes where data can be transferred. The subframe 64 is used as regulation period.

4. PLM EGSE (8)

Additional features

- The 1553 Bus FDIR concept shall be implemented in the CDMU DFE as far as applicable (the CDMU DFE does not represent *functionally* the CDMU SW...) : especially, the bus switcoever logic will be implemented
- the CDMU DFE feature a Bus monitoring function to collect status and data from the Bus; all the bus messages can be
  - ★ read
  - ★ time stamped
  - ★ decoded in a readable text form

  In addition the Bus monitor can recognize a number of Bus failures
- the CDMU DFE offers the capability to introduce 1553 level errors (1 error type in each subframe, ie 64 errors/s max)

4. PLM EGSE (9)

- The CDMU DFE reports periodically a list of status info, typically :
  - Onboard time (coarse and fine time)
  - 1553Bus(A, B)
  - Number of PST cycles
  - Number of queued TC blocks
  - Number of queued event TC packets
  - Number of queued low level access entries
  - Number of TC blocks sent
  - Number of event TC packets sent
  - Number of TM blocks received
  - Number of event TM packet received
  - Number of RT low level access writes
  - Number of RT low level access reads
  - Number of sub-frames with error
  - Number of TC blocks with error
  - Number of event TC packets with error
  - Number of TM blocks with error
  - Number of event TM packet with error

4. PLM EGSE (10)

- Number of RT low level access writes with error
- Number of RT low level access reads with error

★ For every RT:

- Number of 1553 messages
- Number of normal TM packet transfers
- Number of event TM packet transfers
- Number of normal TC packet transfers
- Number of event TC packet transfers
- Number of RT low level access writes
- Number of RT low level access reads
- Number of messages with error
- Number of normal TM packet transfers with error
- Number of event TM packet transfers with error
- Number of normal TC packet transfers with error
- Number of event TC packet transfers with error
- Number of RT low level access writes with error
- Number of RT low level access reads with error
- Number of transmit errors
- Number of status response timeouts
- LastRTstatusWord

4. PLM EGSE (11)

Conclusion

- the PLM EGSE is a tool which should be both
  - flexible, and possibly permitting to test - limited - error conditions
  - good enough representative of the way the communication protocol is (will be !) implemented within the real CDMU
- However
  - the design constraints (restrictions), although believed acceptable, need to be monitored
  - the acceptance testing of the PLM EGSE is not yet established. Real risk is to have a cross validation together with the instruments warm units. But could this risk be realistically avoided ?...

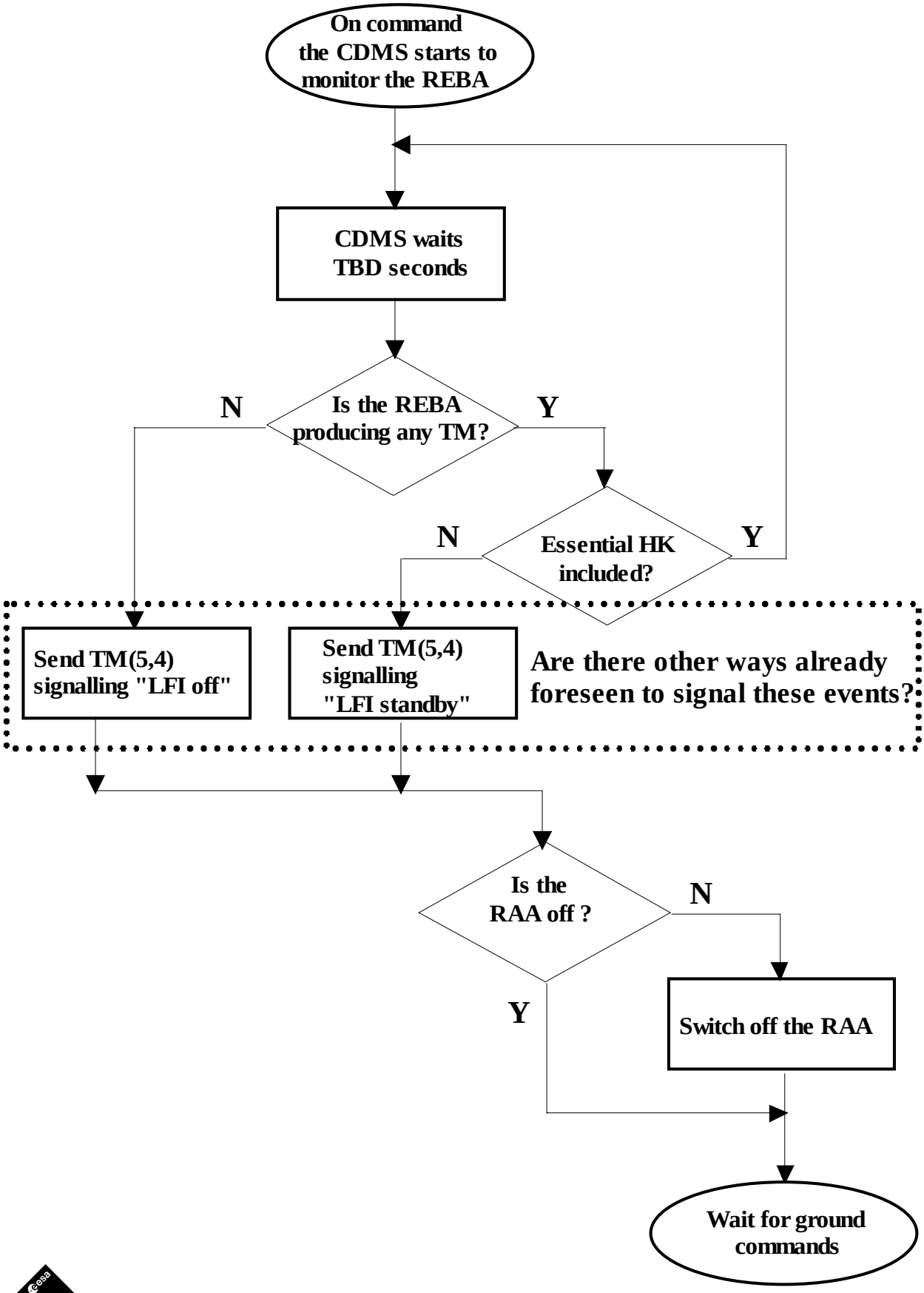
PLANCK - LFI

Data Management Working Group #15

Cannes, 05/06/2003

LABEN
A FINMECCANICA COMPANY

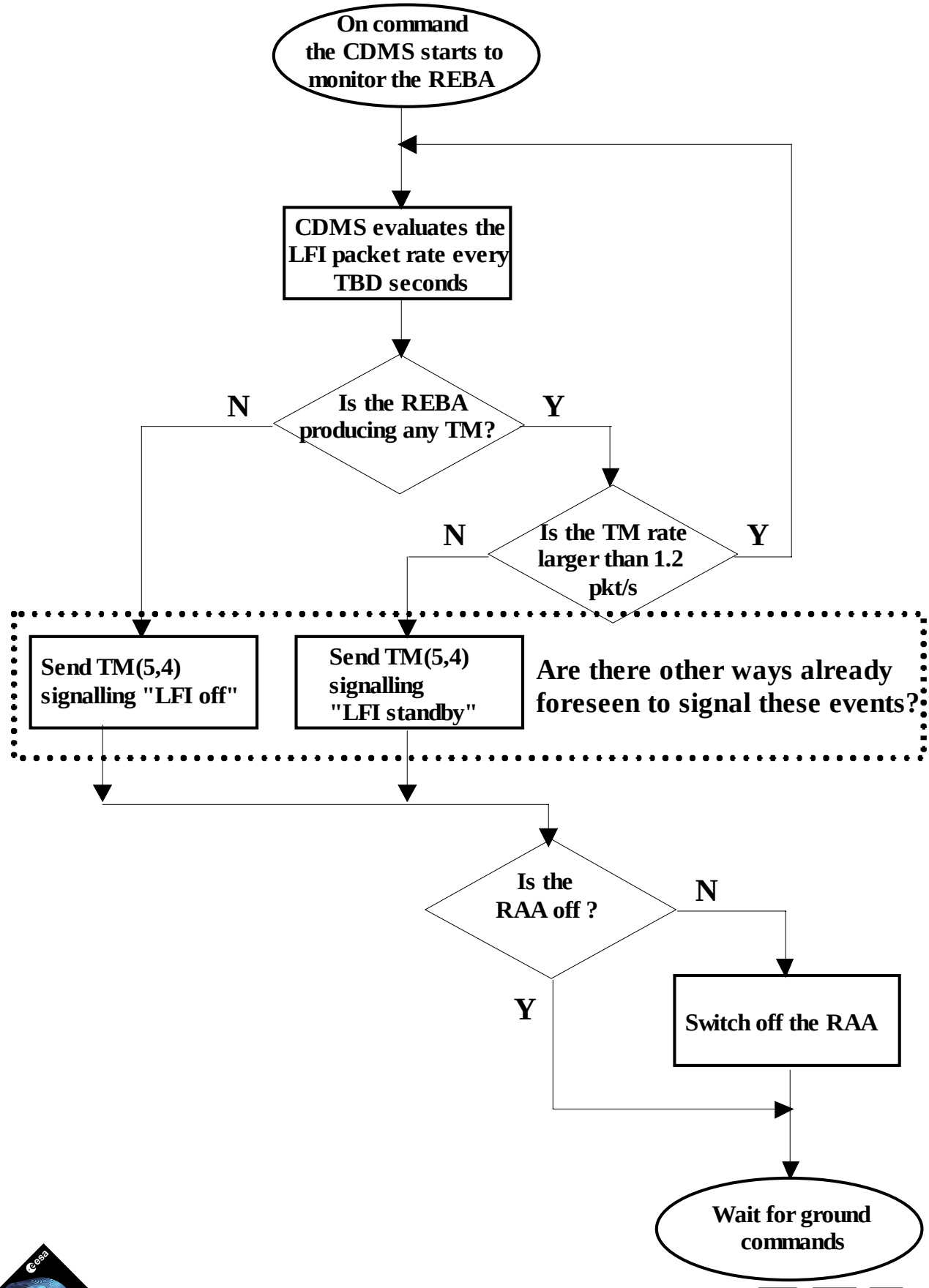
PLANCK - LFI FDIR concept



PLANCK - LFI FDIR concept

1 The monitoring activity is started on the TM packets coming from the REBA.
2 After TBD seconds the CDMS evaluate whether any packet has been delivered by the REBA.
3 If at least a packet has been produced the CDMS should check whether this packet is an "Essential HK" looking at its APID, Type and Subtype.
3 If the answer is again "Yes" no further actions are required and the CDMS could start again its monitoring on the packets produced by the REBA
3 If no "Essential HK" packets at present in the packet stream this means that only the StartUp SW (SUSW) of the REBA is running. In this condition LFI op-mode is "Standby". Since it is expected that this monitoring algorithm will be used only during the observation, the absence of "Essential HK" means that a reset has occurred in the REBA and the RAA is no more under intelligent control.
3 As a consequence of the point 5, before restarting the REBA it is necessary to wait for a ground contact because no automatic switch-on procedure is foreseen. Therefore it is required to the CDMS to signal this condition to ground, the suggested way is that CDMS sends to ground a TM(5,4), but any other means are welcome and under CDMS control.
3 Finally, since the instrument is no more controlled, the required actions are to switch off the RAA to keep it safe, acting on the corresponding LCL in the S/C PCU. The REBA shall be kept on in order to try a troubleshooting of the occurred problem using the content of the REBA memories.
3 Recalling the point 2, if the REBA is not producing anything this could be due to some kind of failure that has to be investigated. As for the point 6 this condition should be signalled to ground using the tools available to the CDMS (e.g. TM(5,4)) and after that switch the RAA off as for the point 7.

PLANCK - LFI FDIR modified



PLANCK - LFI FDIR modified

1 The monitoring activity is started on the TM packets coming from the REBA.
2 Every TBD seconds the CDMS evaluate the packet rate produced by the REBA.
3 If some packet has been produced, the CDMS should check the TM rate to see if the rate is higher than a certain value here set to 1.2 pkt/s.
4 If the answer is again "Yes" no further actions are required and the CDMS could start again its monitoring on the packets produced by the REBA
4 If no, this means that only the StartUp SW (SUSW) of the REBA is running. In this condition LFI op-mode is "Standby". Since it is expected that this monitoring algorithm will be used only during the observation, the low rate of TM means that a reset has occurred in the REBA and the RAA is no more under intelligent control.
6 As a consequence of the point 5, before restarting the REBA it is necessary to wait for a ground contact because no automatic switch-on procedure is foreseen. Therefore it is required to the CDMS to signal this condition to ground, the suggested way is that CDMS sends to ground a TM(5,4), but any other means are welcome and under CDMS control.
6 Finally, since the instrument is no more controlled, the required actions are to switch off the RAA to keep it safe, acting on the corresponding LCL in the S/C PCU. The REBA shall be kept on in order to try a troubleshooting of the occurred problem using the content of the REBA memories.
6 Recalling the point 2, if the REBA is not producing anything this could be due to some kind of failure that has to be investigated. As for the point 6 this condition should be signalled to ground using the tools available to the CDMS (e.g. TM(5,4)) and after that switch the RAA off as for the point 7.

PLANCK - LFI FDIR consequences

In principle the approach proposed by ASPI could be used, but it doesn't fully guarantee the success.

In fact during the normal operation LFI produces slightly more than 0.5 HK packets per second plus the science data. The rate of the science packets is related to the number of activated channels and to the compression rate.

In case of sudden reset LFI goes to Standby mode where it produces 1 HK packet per second.

The modified aproach covers well the case of LFI uncontrolled reset, but theoretically it could intervene also when is not needed. For example when in a unlikely case the compression rate rises up to 10 for a while, the packets produced are really a few and trigger the FDIR actions.

This risk can be reduced averaging the TM packets produced over a longer time.

The capability of counting different types of packets would anyway solve the prob lem.

PLANCK - LFI Synchronisation

The different approaches between AOCS and the instruments would cause a jitter between the OBTs cause by two effects.

• During each second between two synchronisation of the AOCS its own OBT will be not locked to the others and will drift w.r.t. the instruments' OBTs. Reasonable values for this drift are expected to be a few ppm, that is a few μs that should be negligible

• The synchronisation process performed through the 1553 involves several SW layers. On the CDMS side the SW shall copy the satellite OBT on the 1553 bus (time delay of the order of a few hudred of μs). On the AOCS side the SW should copy the 1553 time into its own OBT; uncertainty on this is unknown.

The satellite OBT is locked in phase with the instruments OBT therefore the SW caused uncertainties in AOCS time doesn't generate an accumulating time shift but the effect could be detected in a frequency analysis of the consolidated science data.