



REF.: H-P-ASPI-MN-2705

DATE: 13/2/03

PAGE: 1/1

COMPTE RENDU DE REUNION / MINUTES OF MEETING

LIEU / PLACE: CANNES

OBJET / PURPOSE:

CLASSIFICATION:

*Data Management WG 14*

PARTICIPANTS ATTENDEES	SOCIETE FIRM	SIGNATURE SIGNATURE	PARTICIPANTS ATTENDEES	SOCIETE FIRM	SIGNATURE SIGNATURE
SEE PAGE 2 FOR	2 FOR	LIST OF	ATTENDEES,		
				ESA	<i>[Signature]</i>
P. COUZIN	ASP	<del>[Signature]</del>		ESA	P. Estarra
REDACTEUR / WRITTEN BY: A YAKOUBI					

CONCLUSION:

*sujet dossier = DIA 1553 -> point ouvert  
Validation probouge + 1553 instrument  
-> point a clarifier*

DISTRIBUTION:

PARTICIPANTS /  
ATTENDEES

POUR ACTION:  
FOR FURTHER ACTION

POUR INFORMATION:  
FOR INFORMATION

APPROUVE PAR / APPROVED BY

NOM / NAME				
SIGNATURE / SIGNATURE				

SUITE / CONTINUED :

ACTION

## ATTENDEES :

P. COUZIN - ASP

BOB HIBBERD - ASP

P. ESTAKIA - ESA

S. TIMRELY - ESA

J. CHARRA - IAS

P. STASSI - ISN

M. MICCOLIS - LABEN

O. H. POZIER - MPE / PACS



L DUBBELDAM - SRON / HIFI

K. KING - RAL / SPIRE

H. FEUCHTGRUBER MPE / PACS

JOHN DODSWORTH - ESA.

Rachid YAKOUBI - ASP

 <b>ALCATEL</b> SPACE	 <b>HERSCHEL/PLANCK</b>	REF. : H-P-ASPI-MN-2705	
		DATE : 13/2/03	PAGE : 31
<b>COMPTE RENDU DE REUNION / MINUTES OF MEETING</b>		LIEU / PLACE : CANNES	

SUITE / CONTINUED :

ACTION

AGENDA - SEE ANNEX I.

ACTION ITEM STATUS

DM WG 13 :

AI 1 : SERVICE 20 DELETION, ALL INSTRUMENTS AGREE THAT IT MAY BE DELETED. AI CLOSED. NEXT ISSUE OF PSICD TO REFLECT THIS (issue 4)

AI 2 : COMMENTS TO PSICD - NOT ALL INSTRUMENTS HAVE RESPONDED - TO BE DISCUSSED DURING THIS MEETING AND ACTION CLOSED.

AI 3 : } TO PROVIDE ACTION SEQUENCES

AI 4 : } OR TO GIVE A DATE WHEN INFORMATION WILL BE AVAILABLE. AI STILL OPEN. AI DATE TO BE NOW SHIFTED TO AUGUST 2003 FOR HERSCHEL OCTOBER 2003 FOR HFI OPEN FOR LFI


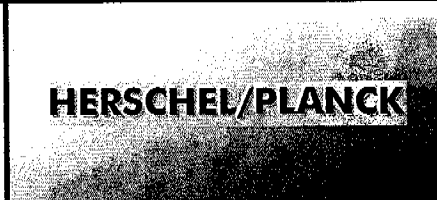
" " SORPTION COOLERS

ESA ARE REQUESTED TO PROVIDE A NOTE

DESCRIBING SUBSCHEDULES AND HOW THE INSTRUMENTS SHOULD USE THEM. INSTRUMENTS TO PROVIDE ANY SPECIFIC INPUTS/REQUIREMENTS FOR SUBSCHEDULE USE

AI 1  
ESA/ESOC  
31/3/2003

AI 2  
INSTRUMENTS  
28/2/2003

 <b>ALCATEL</b> SPACE	 <b>HERSCHEL/PLANCK</b>	REF. : H-P-ASPI-MN- 2705	
		DATE : 13/2/03	PAGE : 41
COMpte RENDU DE REUNION / MINUTES OF MEETING		LIEU / PLACE : CANNES	

SUITE / CONTINUED :

ACTION

AI 5 - TOC/TEMPLATE NOT YET PROVIDED

AI DATE SHIFTED TO 7/3/2003

DM WG 12; -

AI 10 - ASCII FILES STILL REQUIRED.

AI 11 - AI CLOSED BY SPIRE  
(SEE ANNEX II)

AI 6 FROM LFI STILL OPEN -  
TO BE CLOSED BY 15/3/03



### PSICD UPDATE

ESA agree that acceptance report TM(1,1) is mandatory.  
For special cases like commands  
executed during Instr. bootstrap sequence, an  
exception is acceptable.

Planck-LFI: comments to PSICD are included in the minutes  
as ANNEX III.

↳ Comments on "Service type 3 - General Description" are  
acceptable.

↳ Service TC (6,2) comment: The text has been changed  
"... It shall calculate the checksum." is replaced by  
"... It shall store the checksum."

 <b>ALCATEL</b> SPACE	 <b>HERSCHEL/PLANCK</b>	REF.: H-P-ASPI-MN-	
		DATE:	PAGE: 51
COMpte Rendu de Reunion / MINUTES OF MEETING		LIEU / PLACE:	

SUITE / CONTINUED :

ACTION

Step 1 of the comment is then no more applicable.

↳ Service type 8: General Description:

"Private Telecommands" are telecommands that are not defined in the database. ESA will add a definition of "Private TC" in PS-100.

↳ Service type 8: critical Functions

Comment is acceptable (No arm & fire mechanism for LFI).

↳ Appendix 3: APID for non-periodic HK  
LFI understanding is correct

↳ Service T(8,4) comment.

ESA to clarify the use of service (5,2) or (5,4) or alternatively of service (4,8).

AI# 3 ESA

↳ Service 14: Packet ID field

Comment is acceptable, HK-ID used. (= SID).



↳ Appendix 3, chap 4.6. status polling data structure

There is only one data structure. The first word is reserved, other words being available for users, and can be defined by users.

↳ Appendix 3, Rec. 4572-TFL-T

"immediately" means within the same subframe

#End of LFI comments presentation #

		REF. : H-P-ASPI-MN-	
		DATE :	PAGE : 61
COMpte Rendu de Reunion / MINUTES OF MEETING		LIEU / PLACE :	

SUITE / CONTINUED :

ACTION

Memory load address format (service 6):

APP Herschel instruments use 8 bits for Memory ID field and 24 bits for Start address field. For Planck ZFI uses 8+24 bits as well.

HFI + Sorption Cooler will check the address format they use.

AI # 4 HFI + SSC

PS-100 will be updated after having consulted all parties concerned by memory load address format, if a unified definition for Mem-ID and Addr-ID is defined. (issue 4).

Communication FDIR:

1) Data Link layer FDIR

The "busy" bit field of the status word is not used by instruments.

When the bus profile is "unmuted", stored TC are re-issued with the same packet count. Instruments will be able to receive twice the same command with the same packet count, without double-execution of this TC-packet (prevented by TC-packet handshake, if correctly implemented).

SUITE / CONTINUED :

ACTION

Peak Data Format (Herschel)

The ACC is able to receive command from SPIRE & HIFI (via CDMU<sup>\*</sup>) to perform some small attitude changes using TC(8,4) service.

Dutch Space has proposed a Data structure based on a quaternion format (see annex IV). This proposal is considered unacceptable and then rejected.

A preferred data structure, proposed by SPIRE, is composed of two 16 bits signed integers (one for Y axis and the other one for Z axis), data being expressed in arc seconds unit.

SPIRE & HIFI to confirm the peakup data structure as proposed by SPIRE.

AI # 5  
SPIRE + HIFI  
24 Feb. 2003

\* CDMU converts data from TM-data field into TC(8,4).

SUITE / CONTINUED :

ACTION

Protocol Validation Issue

Today no test equipment is identified neither at instrument nor at system level to validate the various levels of the communication protocol: low level, as required on 1010SDBP § 1.1 of PSICD, TFL FDIR.

Instruments are requested to explain their 1553 bus and protocol I/F testing approach before delivery (during ILT).

ALCATEL shall assess the PLM EGSE capabilities in view of the validation of the 1553 bus and protocol I/F ("all" requirements of Appendix 9, PS-ICD).

AI6 Instr  
7/3/03

AI7 ALCATEL  
13/3/03





**LISTE D'ACTIONS / ACTION ITEM LIST**

REF.: H-P-ASPI-MN-



OBJET / PURPOSE :

**HERSCHEL/PLANCK**

DATE :

PAGE : 9

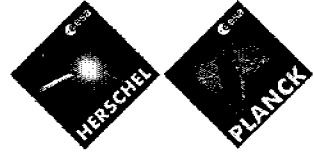
Origine	ACTION			DATE
	N°	Description	Responsable / Responsible	Echéance / Due
ESA	1	PROVIDE A NOTE DESCRIBING SUBSCHEDULE USE	ESA / ESOC	30/3/2003
ESA	2	PROVIDE SPECIFIC INPUTS/REQUIREMENTS FOR SUBSCHEDULES	INSTRUMENTS	28/2/2003
	3	CLARIFY USE OF SERVICES (5,2) & (5,4)	ESA	
	4	CHECK MEMORY LOAD ADDRESS FORMAT	HFI & SORPTION COOLER	
	5	CONFIRM PEAK UP DATA STRUCTURE	SPIRE & HFI	21 Feb 2003
	6	EXPLAIN 1553 BUS & PROTOCOL I/F TESTING APPROACH	INSTRUMENTS	7 March 2003
	7	ASSESS PLT EGSE CAPABILITIES	ALCATEL	13 March 2003

		REF. : H-P-ASPI-MN-	
		DATE :	PAGE : /
<b>COMPTE RENDU DE REUNION / MINUTES OF MEETING</b>		LIEU / PLACE :	

SUITE / CONTINUED :

ACTION

Annex I : Agenda (To be included)  
 Annex II : AI#11 DRAWG#12  
 Annex III LFI Comments on PS-100  
 Annex IV . Peak Up format proposal from DS (To be included)



---

## AGENDA DMWG #14

### 1- DM WG13 Actions review/closure

### 2- PS ICD Issue 3.6 comments

2.1- Instruments/industry comments

2.2- clarifications (TC acceptance report issue)

### 3- 1553 Bus FDIR

### 4- Current Activity Status

4.1- Data Flow modelling

4.2- communication Protocol and data management implementation status

### 5- Peak Data Format (Herschel)

### 6- Protocol validation Issue

### 7- AOB

13/2/03

ANNEX II



"King, KJ (Ken)" <K.J.King@rl.ac.uk> on 11/02/2003 10:18:43

Pour: "Patrice.Couzin@space.alcatel.fr" <Patrice.Couzin@SPACE.ALCATEL.FR>  
 cc: "Sidher, SD (Sunil)" <S.D.Sidher@rl.ac.uk>  
 "Swinyard, BM (Bruce)" <B.M.Swinyard@rl.ac.uk> (ccc : Patrice Couzin/ALCATEL-SPACE)  
 Objet: DMWG Actions

---

SPIRE Response to DMWG Actions:

Meeting#12

-----

Action 10:

-----

Is the initial draft SPIRE MIB still required? If so we can forward it on -  
 to whom?

Action 11:

-----

SPIRE agrees that the baseline should be for the CDMU to react only to  
 instrument event reports (TM (5,1) and (5,2)) and not the contents of the  
 instrument housekeeping (TM (3,25)).  
 It should be noted that the CDMU will be required to monitor, and react to,  
 parameters related to SPIRE in other spacecraft housekeeping (for example  
 the current supplied to the instrument electronics).

Meeting#13

-----

Action 1:

-----

We confirm that SPIRE does not use Service 20

Action 2:

-----

Comments on PS-ICD Issue 3 draft 6:

Section 5.3.1.1:

The definition of sampling interval implies that it is impossible to define  
 periodic housekeeping at a rate faster than the default rate. We would  
 expect that in the case of diagnostic housekeeping we may indeed want to  
 sample at a faster rate. We recommend changing the sampling interval to  
 absolute units (e.g. millisec).

This section combines two functions: defining the contents of a housekeeping  
 packet and defining the associated information (in this case sampling  
 interval and HK Packet ID). We find this a problem to deal with because; it  
 is possible that we need to change the sampling interval without changing  
 the packet contents; we have more information that needs to be associated  
 with a particular HK packet. For this reason we would like this TC split  
 into two separate TCs.

Our OBS currently does this by using a different mechanism for loading the  
 packet contents (this was necessary because the original PS-ICD did not  
 provide for defining a complete SPIRE HK packet). We will continue to use  
 this mechanism if necessary.

Section 5.6:

We have previously noted that the size of the data memory in the DPU  
 requires 24 bits to specify a particular start address. We have therefore  
 defined all service 6 TCs to use a Memory ID of 8 bits with a 24 bit Start  
 Address. This has impact on the Memory Management functions of SCOS, when  
 they are defined.

Section 5.14.1.1 and 5.14.2:

The specification of Packet-ID = zero as applying to 'all applications'

# PLANCK - LFI

## Data Management Working Group #14

Cannes, 13/02/2003



**LABEN**

A FINMECCANICA COMPANY

*Annex III*

# PLANCK - LFI Comments to last PS-ICD issue (1/7)

## ◆ TM (1,2): Alignment of the error

“... the parameter causing the rejection shall be reported on its original position of certain word ...”

**How the wrong item should be aligned within the parameter field?**

**For example in case of illegal packet subtype (field of 8 bits):**

Option 1:

1 <sup>st</sup> octet	2 <sup>nd</sup> Octet	3 <sup>rd</sup> Octet	4 <sup>th</sup> Octet
0x00	0x00	Packet subtype	Spare (0x00)

Option 2:

1 <sup>st</sup> octet	2 <sup>nd</sup> Octet	3 <sup>rd</sup> Octet	4 <sup>th</sup> Octet
First octet of Data field header ( 1 nit spare + 3 bits PUS version + 4 bits spare)	Packet type	Packet subtype	Spare (0x00)

Option 3:

1 <sup>st</sup> octet	2 <sup>nd</sup> Octet	3 <sup>rd</sup> Octet	4 <sup>th</sup> Octet
Packet subtype	Spare (0x00)	1 <sup>st</sup> octet of Time	2 <sup>nd</sup> Octet of Time



# PLANCK - LFI Comments to last PS-ICD issue (2/7)

## ◆ TM (1,2): Last sentence

“... In all cases the code field plus the parameter field shall have a length corresponding to two or several 16-bit words ...”

Actually the code field is one 16-bits word + at least 4 octect of parameters give 3 or more 16-bits word.

## ◆ Service type 3: General description

Is it missing in the first paragraph the requirement number?



# PLANCK - LFI Comments to last PS-ICD issue (3/7)

## ◆ Service type 3: General description

“... In nominal conditions only one nominal HK Packet per unit /subsystem / instrument should be generated ...”

LFI is producing 1 pkt every 4s coming from the REBA processes, 1 pkt every 4s coming from the DAE data and 1 pkt every 64s containing the instrument settings.

The Essential HK packets will be also produced according to the data rate limitations.

## ◆ Service type 3: General description

LFI is implementing only TM(3,25) and TM(3,26) and not the other services of type 3 because it is not going to change its HK packet definition





## **PLANCK - LFI Comments to last PS-ICD issue (4/7)**

### **◆ TC(6,2): Use of the checksum in the memory load telecommand**

**“... When the user receives this Telecommand, it shall calculate the checksum of the received data, write the data block to the memory at the specified start address and re-read the memory area just written to, calculate, compare and report successful execution, TM(1,7), or an error report TM(1,8) ...”**

**We understand that the process to be implemented is:**

- 1) Calculate the checksum of the data field just received and compare it with the one contained in the same packet. If different a TM(1,8) is produced with the received checksum as parameter.**
- 2) Copy the data in the memory, read back them and calculate again the checksum.**
- 3) Finally verify that the last calculated checksum is identical to the one delivered with the data. If not a TM(1,8) is produced with the last calculated checksum as parameter.**



# **PLANCK - LFI Comments to last PS-ICD issue (5/7)**

## **◆ Service type 8: General description**

**“... Control structures similar to “Private Telecommands” shall be avoided ...”**

**We understand that “Private Telecommands” are some kind of TCs routed to other units by means of another TC. Is it correct?**

## **◆ Service type 8: Critical functions**

**LFI is not implementing any Critical Function therefore we are not using the Arm-Fire concept, but only single commands directed to simple functions.**

## **◆ Appendix 3: APID for Non-periodic HK**

**Could you confirm that the APID assigned to non periodic diagnostic packets TM(3,26) is the same as for TM(3,25)?**



**LABEN**

A FINMECCANICA COMPANY

# **PLANCK - LFI Comments to last PS-ICD issue (6/7)**

## **◆ TC (8,4): Stopped function**

**“... If the status of the Function is “stopped”, the sending of a Perform Activity of Function command, TC(8,4), shall result in an Event Report (5,2) or (5,4), and the status of the Function shall not change. ...”**

**This approach seems to be different from what is done with other illegal commands that are rejected with a TM(1,8). It is intended that an event report shall be used only when using the Arm-Fire concept.**

## **◆ Service 14: Packet-ID field**

**“... For the HK & Diagnostic Service 3 the Packet-ID shall be equal to the HK Packet ID defined for that Service ...”**

**In LFI the Packet-ID for the service type 3 is identical to the SID.**



# **PLANCK - LFI Comments to last PS-ICD issue (7/7)**

## **◆ Appendix 9, Chapter 4.4: Status polling data structure**

**The format defined in the requirement 4395-TFL-T for RT Health Status Data Word is TBD.**

**It is not clear how this is related to the RT Status Data Format of requirement 4360-TFL-T.**

**It is understood that the RT Status has a structure that is user-defined at least to certain extent.**

**Is the BIT referred to the standard 1553 chip Built In Test format?**

## **◆ Appendix 9, Req. 4572-TFL-T**

**“... The RT shall set the Flow Control field according to the status of TM transfers immediately ...”**

**Could you specify the time constraints for the term “immediately”**



**LABEN**

A FINMECCANICA COMPANY

#### 4.8.8 Herschel – Perform peak-up TC(8,4)

The peak-up command serves to make instrument calculated adjustments to fine pointings contained in the Mission TimeLine. It is used only in SCM to make small change (typically some arcsecs) of the spacecraft attitude without a slew to the required target attitude and maintain that attitude until the next command arrives.

##### Telecommand summary

Description                      Perform peak-up  
Type, subtype                    8,4  
Data length                       Fixed: 10 words

##### Telecommand structure

Function ID	Activity ID	Structure ID	$q_{\text{peak-up}}$
Enumerated 8 bits	Enumerated 8 bits	Enumerated 16 bits	Real 4*32 bits

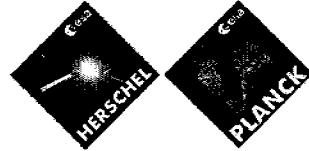
##### Telecommand application data

- **Function ID :**            TBD
- **Activity ID :**            TBD
- **Structure ID :**           TBD
- **$q_{\text{peak-up}}$  :**            Peak-up correction quaternion, expressed as TBD

##### Telecommand execution

The commanded peak-up correction shall only affect the next SCM fine pointing command. If the next command is not a SCM fine pointing command, then the peak-up command shall be discarded and an event report TM(5,1) shall be generated.

The boundaries for the peak-up command are specified by database parameters (with the default value of 10 arcsec about both Y and Z axes of ACMS frame).



## ▼2 FDIR levels

### □ The Data Link Layer

→ this is the low level bus protocol as per Mil STD 1553B)

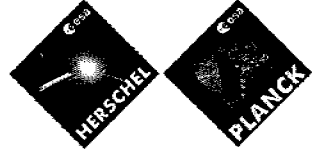
→ DLL FDIR is addressed in PS ICD §3.5.2.

★ It aims to first isolate whether the error comes from the Bus

★ Failure detection relies on nominal data traffic

★ from BC 1553 I/F shall be monitored

- the RT transmission error bit : to be set by the RT upon detection of an error in the message (message has not passed the validity test on sync fiel, code, size, parity, RT @, continuous words)
- the RT no response timeout bit : set if RT response has not arrived within typically 14 $\mu$ s after has mode command has been sent
- the BC loop back test fail flag : to be set if BC self test fails - implementation is TBC



★ from RT's 1553 status words

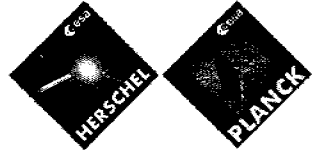
- RT message error bit : set by the RT upon detection of an error in the message (message has not passed the validity test) or an illegal message. If this bit is set this means none of the data received within the message is used by the RT. This is a MANDATORY bit  
=> processing of illegal command shall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

=> 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 message.

3

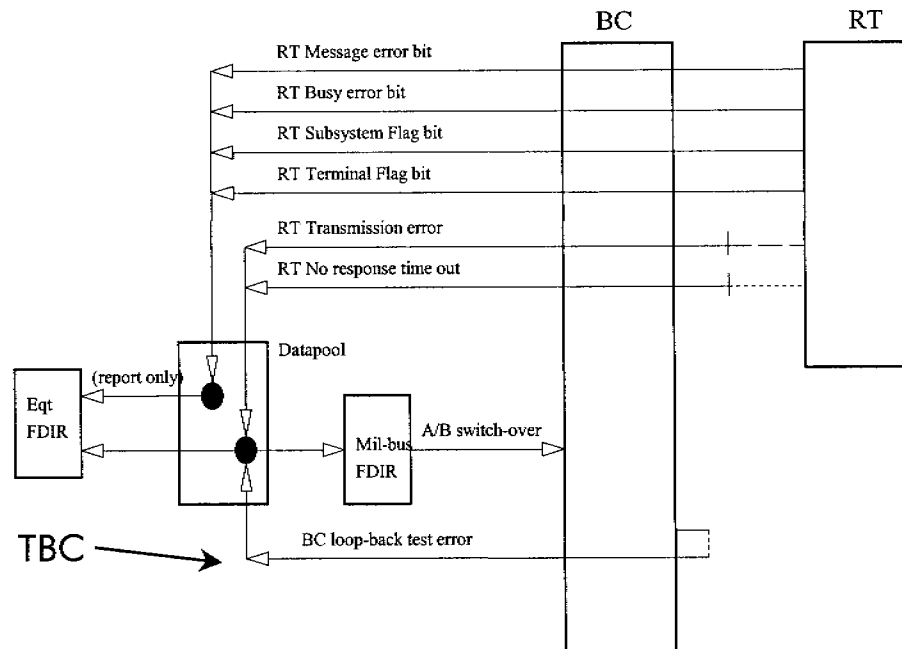


## Communication FDIR (3)

- 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.

=> Terminal Flag coverage shall be stated by each RT

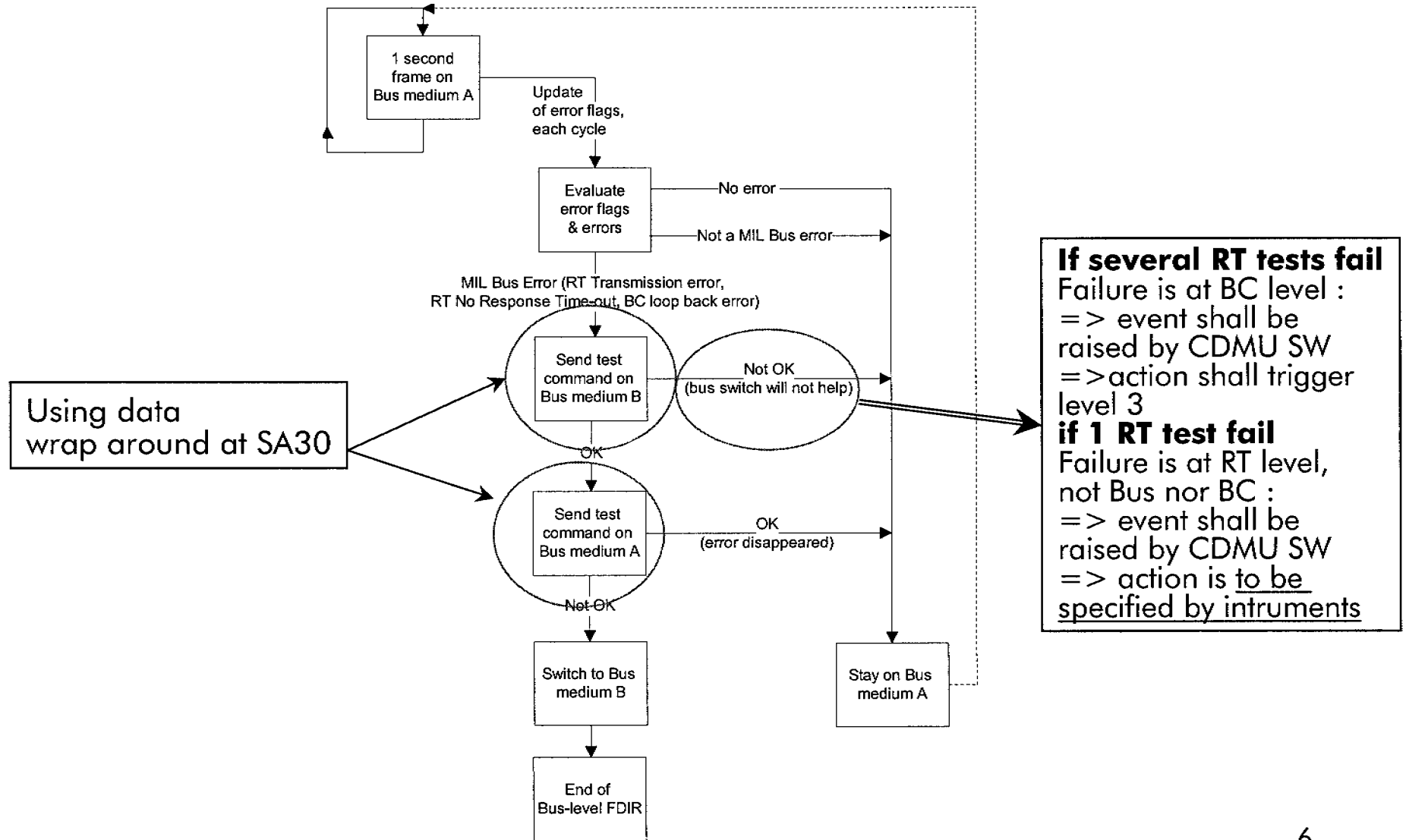
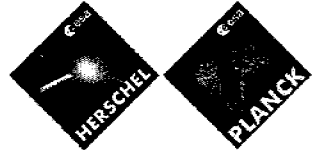
- ★ Bus failure detection applies only on BC reported status as shown below. RT's message error, terminal error and busy bits are used as criteria to send TM PTC and for failure analysis on ground (TBC)







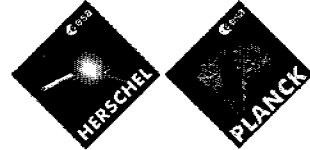
- ★ Conditions for Bus recovery are met if any one of the fail bits at BC interface level are set. Bus is then declared Unhealthy
- ★ When bus is declared unhealthy an event is raised by CDMU SW :
  - bus profile is « muted »
  - Transfer Frame Layer Isolation and Recovery actions are momentarily disabled
- ★ healthiness 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 sent shall be repeated



### □ The Transfer Link Layer

- it addresses the protocol which organizes the RT  $\Leftrightarrow$  BC data exchange on top of 1553 STD
- 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**
- TFL FDIR shall implement mechanisms to detect, isolate and recover from failures identified at messages receiver end.  
HOWEVER any failure origin can be in RT or BC
- TFL FDIR applies at a level higher than DLL FDIR

- To support TFL FDIR, BC (CDMU) shall maintain in Safe Guard Memory, for each RT@, a RT configuration matrix composed of :
- ★ on/off status
  - ★ dead/alive status
  - ★ vital/non vital status (TBC)



### → Sync With and Without Data word

#### ★ FDI to be implemented in :

- **RT**

#### ★ Failure Mode :

- Subframe Count is Wrong

#### ★ Failure detection :

- The RT shall maintain a subframe counter ,
- it shall be reset at reception of each Sync without Data word mode command,
- it shall be incremented by 1 at reception of each Sync with data word mode command,
- At reception of each Sync with Data Word mode command, the RT shall compare the content of the " Subframe count " field in the Data Word, with its internal subframe counter, and identify discrepancy. Sync\_fail is declared if 2 (TBC) consecutive discrepancies are identified



### ★ Failure Isolation :

- Instruments shall be robust to loss of Sync mode command (ie it shall not induce a reset), by eg. working on internal frame counter

### ★ Failure Recovery :

- In case of Sync\_fail identified, RT shall raise a TM event AND report to SA1T :
  - 1- the subframe counter at first discrepancy occurrence
  - 2- flags to identify type of anomaly.Information related to anomaly shall be maintained until anomaly is cleared
- BC shall react upon SA1T anomaly flag; if anomaly is reported in 1s (SA1T acquisition period) by :
  - 1 non vital RT (instrument) only => CDMU SW raises an event TM and start action TBD by instrument
  - 1 vital RT (ACC) => CDMU SW raises an event TM and reports to higher level FDIR to engage level 3 recovery (computer reset)
  - several RT's => CDMU SW raises an event TM and reports to higher level FDIR to engage level 3 recovery (computer reset)

## → TM Packet Transfer Confirmation

### ★ FDI to be implemented in :

- **RT**

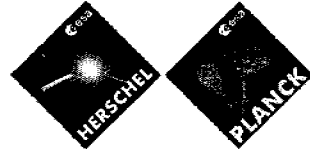
### ★ Failure Mode :

- message content is Wrong (eg. 1st data word different from PTR, packet count is wrong, flow control different from #11 => RT understands TM packet is not acquired)

### ★ Failure detection :

- compare 1st word with corresponding PTR (taking into account the retry capability if not in Burst Mode ,
- Check packet count,
- check burst/flow bits

TM\_PTC\_fail is declared at 1st anomaly occurrence



## ★ Failure Isolation :

- Instruments shall be robust to wrong TM PTC message (ie this shall not induce a reset)
- instruments shall be robust to TM packets not acquired

## ★ Failure Recovery :

- In case of TM\_PTC\_fail identified, RT shall raise a TM event AND report to SA1T :
  - 1- the wrong PTC
  - 2- flags to identify type of anomaly.Information related to anomaly shall be maintained until anomaly is cleared
- BC shall react upon SA1T anomaly flag; if anomaly is reported in 1s by :
  - 1 non vital RT (instrument) only => CDMU SW raises an event TM and start action TBD by instrument
  - 1 vital RT (ACC) => CDMU SW raises an event TM and reports to higher level FDIR to engage level 3 recovery (computer reset)
  - several RT's => CDMU SW raises an event TM and reports to higher level FDIR to engage level 3 recovery (computer reset)

12



### → TC Packet Transfer Descriptor

★ FDI to be implemented in :

- **RT**

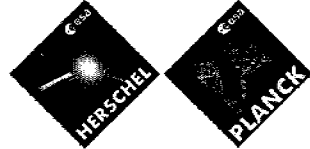
★ Failure Mode :

- message content is Wrong (eg. layout is incorrect, TC packet size is not OK for RT, packet count not OK) => RT rejects incoming TC

★ Failure detection :

- maintain a 8 bits «RT TC packet counter» equal to the packet count of the last accepted TC
- anomaly is detected if «RT TC packet counter»=current TC PTD packet count
- check consistency of reserved bits
- TC size compared to expected

TC\_PTD\_fail is declared at 1st occurrence of any anomaly



### ★ Failure Isolation :

- Instruments shall be robust to wrong TC PTD message (ie it shall not induce a reset)
- instrument shall reject TC corresponding to erroneous TC PTD

### ★ Failure Recovery :

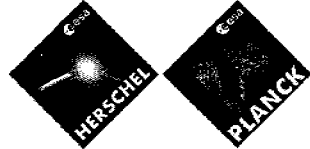
- In case of TC\_PTD\_fail identified, RT shall :

1- raise a TM event

2- report to SA1T : the wrong TC PTD+flags to identify type of anomaly

3- not copy TC PTD to TC PTC subaddress

Information related to anomaly shall be maintained until anomaly is cleared



- BC shall react upon PTC analysis (at latest 3 subframe after PTD) and SA1T anomaly flag (every 1s) whichever is the first; if anomaly is reported by :
  - 1 non vital RT (instrument) only => CDMU SW raises an event TM and starts action : suspend subschedule to which TC belongs + TBD by instrument
  - 1 vital RT (ACC) => CDMU SW raises an event TM and reports to higher level FDIR to engage level 3 recovery (computer reset)
  - several RT's => CDMU SW raises an event TM and reports to higher level FDIR to engage level 3 recovery (computer reset)

### → TM Packet Transfer Request

★ FDI to be implemented in :

- **BC**

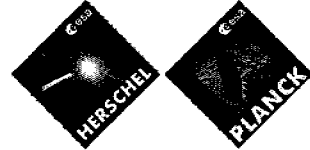
★ Failure Mode :

- message content is Wrong (eg. layout is incorrect, TM packet size is not OK for RT, packet count not OK) => BC does not initiate TM packet transfer

★ Failure detection :

- BC shall maintain a 8 bits «RT TM packet counter» for each RT, equal to the packet count of the last accepted TM transfer
- anomaly is detected if «RT TM packet counter»=current TC PTD packet count after retry attempt has been made
- check consistency of reserved bits
- TM size compared to expected (TBC)

TM\_PTR\_fail is declared at 2nd occurrence of any anomaly (TBC)



### ★ Failure Isolation :

- BC is robust to wrong TM PTR messages (ie it shall not induce a reset)
- BC rejects TM transfer request corresponding to TM PTR

### ★ Failure Recovery :

- In case of TM\_PTR\_fail identified, BC (CDMU) shall :
  - 1- raise a TM event including the failed TM PTR and the corresponding RT address. If the failure involves:
    - 1 non vital RT (instrument) only => the event starts an action TBD by instrument
    - 1 vital RT (ACC) => the event starts an action to reports to higher level FDIR to engage level 3 recovery (computer reset)
    - several RT's => the event starts an action to reports to higher level FDIR to engage level 3 recovery (computer reset)
  - 2- not copy TM PTR to TM PTC subaddress (SA10R)

### → TC Packet Transfer Confirmation

★ FDI to be implemented in :

- **BC**

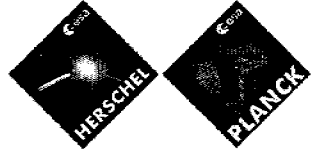
★ Failure Mode :

- message content is Wrong (TC PTC different from TC PTD => BC understands TC packet is not acquired)

★ Failure detection :

- compare TC PTC with corresponding TC PTD

TC\_PTC\_fail is declared at 1st occurrence of any anomaly (TBC)



★ Failure Isolation :

- BC is robust to wrong TC PTC messages

★ Failure Recovery :

- In case of TC\_PTC\_fail identified, BC (CDMU) shall :

1- raise a TM event including the failed TC PTC and the corresponding RT address. If the failure involves:

- 1 non vital RT (instrument) only => action is to suspend subschedule to which TC belongs + TBD by instrument
- 1 vital RT (ACC) => action is to report to higher level FDIR to engage level 3 recovery (computer reset)
- several RT's => action is to report to higher level FDIR to engage level 3 recovery (computer reset)



## Data Flow simulation



---

## Foreword

### ▼ 2 Kinds of End Users

- ↳ Intelligent End Users (e.g. Instruments, ACC, SW)

  - TC Source Packets dialogue-based

- ↳ Non Intelligent End Users (e.g. PCDU, VMC)

  - 1553 Message dialogue-based for users connected via a 1553 bus

  - DS16 Messages dialogue-based for VMC

### ▼ Several Independent & Prioritised TC Generators

- ↳ FDIR Generator : Both TC Source Packets & 1553 messages (Highest Priority)

- ↳ MTL Generator : Both TC Source Packets & 1553 messages

- ↳ Ground Generator : Only TC Source Packets

- ↳ OBCP Generator : Both TC Source Packets & 1553 messages (Lowest Priority)

### ▼ TC Source Packets & 1553 messages are sent via a 1553 serial bus.

- ↳ Each TC Source Packets has to be segmented into a series of 1553 messages (series of segments)

---

## Hypotheses

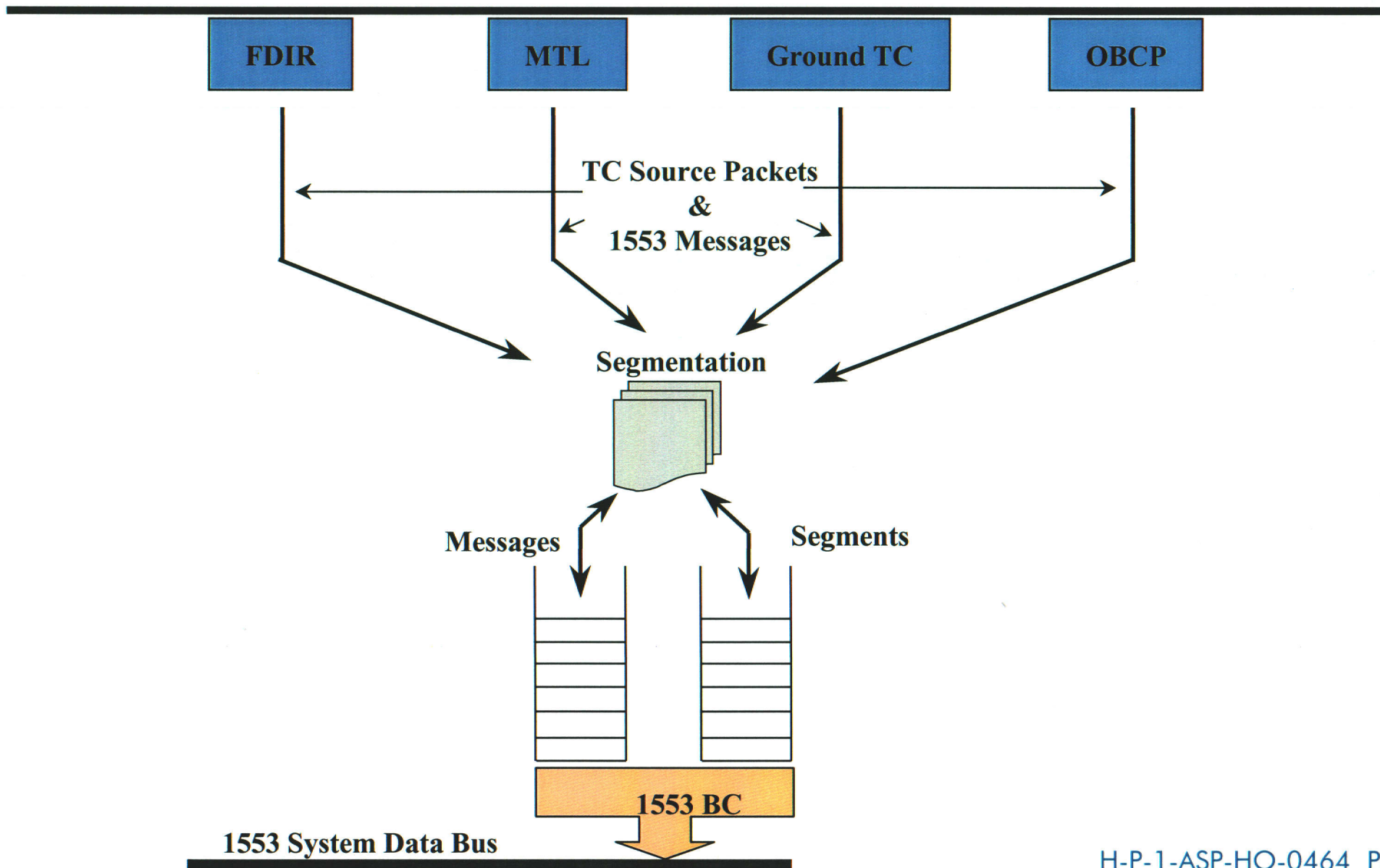
- ▼ The relative date (i.e. within a second) when a TC Source Packet or 1553 message is generated is always the same.
  
- ▼ No bottleneck effects for I/O interface
  - ↳ VMC rate is ~700 DS16 per second
  - ↳ Other I/O acquisitions are used to update the data pool (less than 200 x DS16/sec)
    - Flow between I/O and Data Pool is not modelled
    - Copy of the Data Pool content is regularly stored in Mass Memory using TM Source Packets format
      - Data Pool will be modelled as a TM Generator : 1 TM Source Packet/sec
  
- ▼ TC Generator Rates are defined with respect to the Technical Note "HW/SW Sizing Cases"
  - ↳ Ref. : H-P-1-ASPI-TN-0398

---

## Data flow context

- ▼ TC Source Packet Segmentation has to be performed
- ▼ The size max of a TC Source Packet is 248 bytes
  - ↳ Equivalent to 4xSegments (1 segment being  $32 \times 16 = 512$  bits)
- ▼ The size min of a TC Source Packet is 12 bytes
  - ↳ Equivalent to 1 Segment (1 segment being  $32 \times 16 = 512$  bits)
- ▼ Transmission over the 1553 is performed by a Bus Controller
  - ↳ One Sub-queue (SQ UnSeg) is dedicated to handle 1553 messages arrival
  - ↳ One other Sub-queue (SQ Seg) is dedicated to handle segments arrival

# 1553 Interface Illustration



---

## TC Generators Throughputs towards 1553 bus :

### ▼ FDIR Generator :

- ↳ 2xTC Source Packets per second for Intelligent End Users
- ↳ 4x1553 messages per second for Non Intelligent End Users

### ▼ MTL Generator :

- ↳ 6xTC Source Packets per second for Intelligent End Users
- ↳ 4x1553 messages per second for Non Intelligent End Users

### ▼ Ground Generator (Only TC Source Packets) :

- ↳ Between 1.63xTC Source Packets per second for Intelligent End Users (scenario 1)
- ↳ and 14.3xTC Source Packets per second for Intelligent End Users (scenario 2)

### ▼ OBCP Generator :

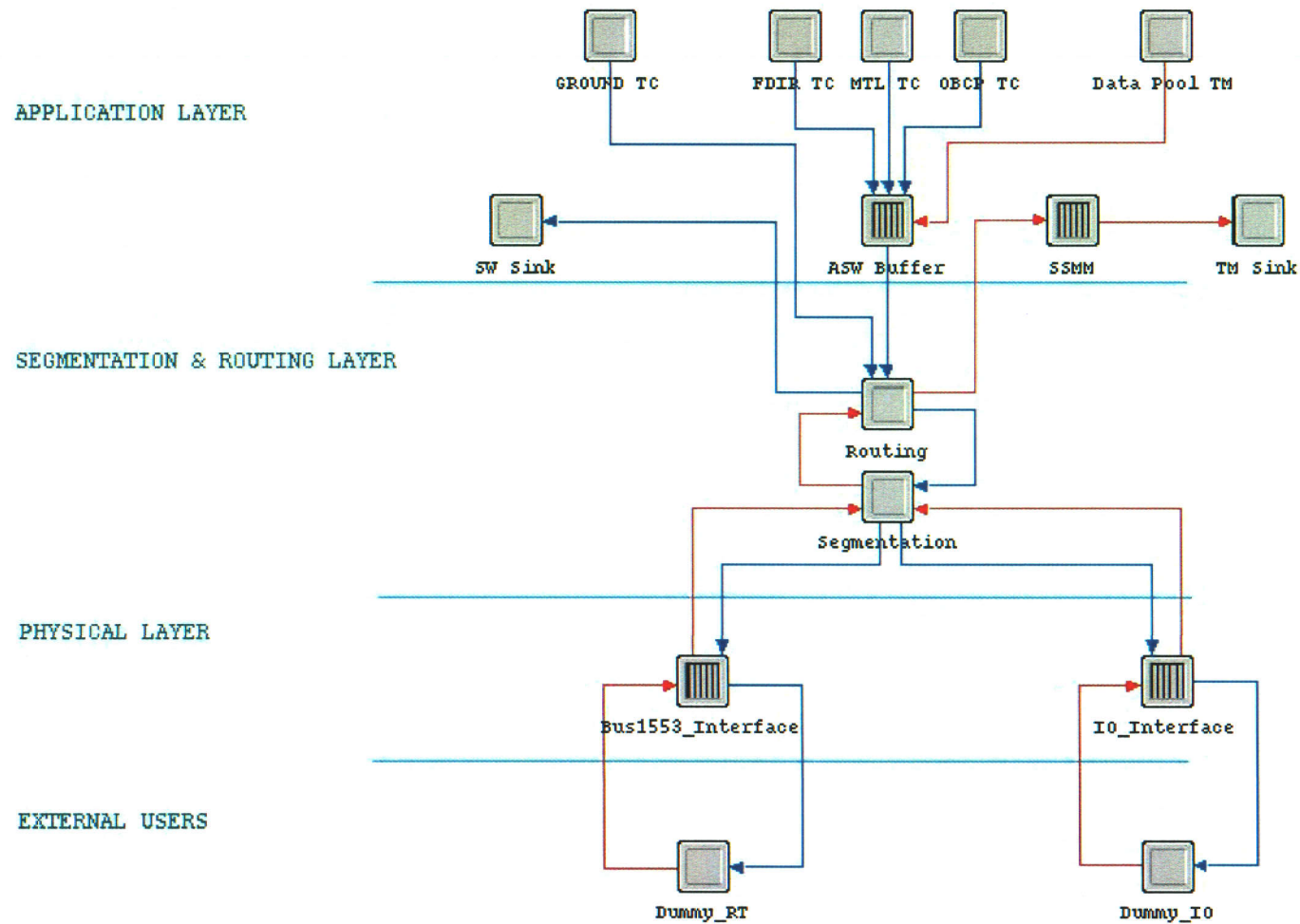
- ↳ 2xTC Source Packets per second for Intelligent End Users
- ↳ 2x1553 messages per second for Non Intelligent End Users

---

## Opnet Modeler Tool

- ▼ Dedicated to the modelling of communication networks
  - ↳ validation of data flows scenarios compared to protocol restrictions and/or architecture
  
- ▼ Well adapted to the modelling of sub-queue systems ( at least one generator, a buffer and a server)
  
- ▼ An Opnet Model is based on a layered implementation
  - ↳ Connections between each functional part involved in the data flow activity are defined using the node layer
  - ↳ The behaviour of a functional part is defined within the process model layer based on a state machine approach, each state being C coded

# Architecture of the Data Flow Model



---

## Protocol between the Bus Controller and 1553 End Users

- ▼ Based on a time division into frames (1 frame/sec), sub-frames (64 per frame) and slots (24 per sub-frame)
- ▼ 4 sub-frames are used to perform TC Source Packets transfer and 60 for TM Source Packet transfers
- ▼ Only One BC request and one End User response per time slot
  - ↳ According to the slot purpose of a TC sub-frame the BC will :
    - send a segment (slots n°5-20)
      - extracted from sub-queue containing segments (SQ Seg)
    - send a message (slot n°2)
      - extracted from sub-queue containing messages (SQ UnSeg)
    - perform Packet control Activity (slots n°21-24)
      - generated directly at BC interface
    - handle RT sync, HK... (slots n°1, 3, 4)
      - generated directly at BC interface



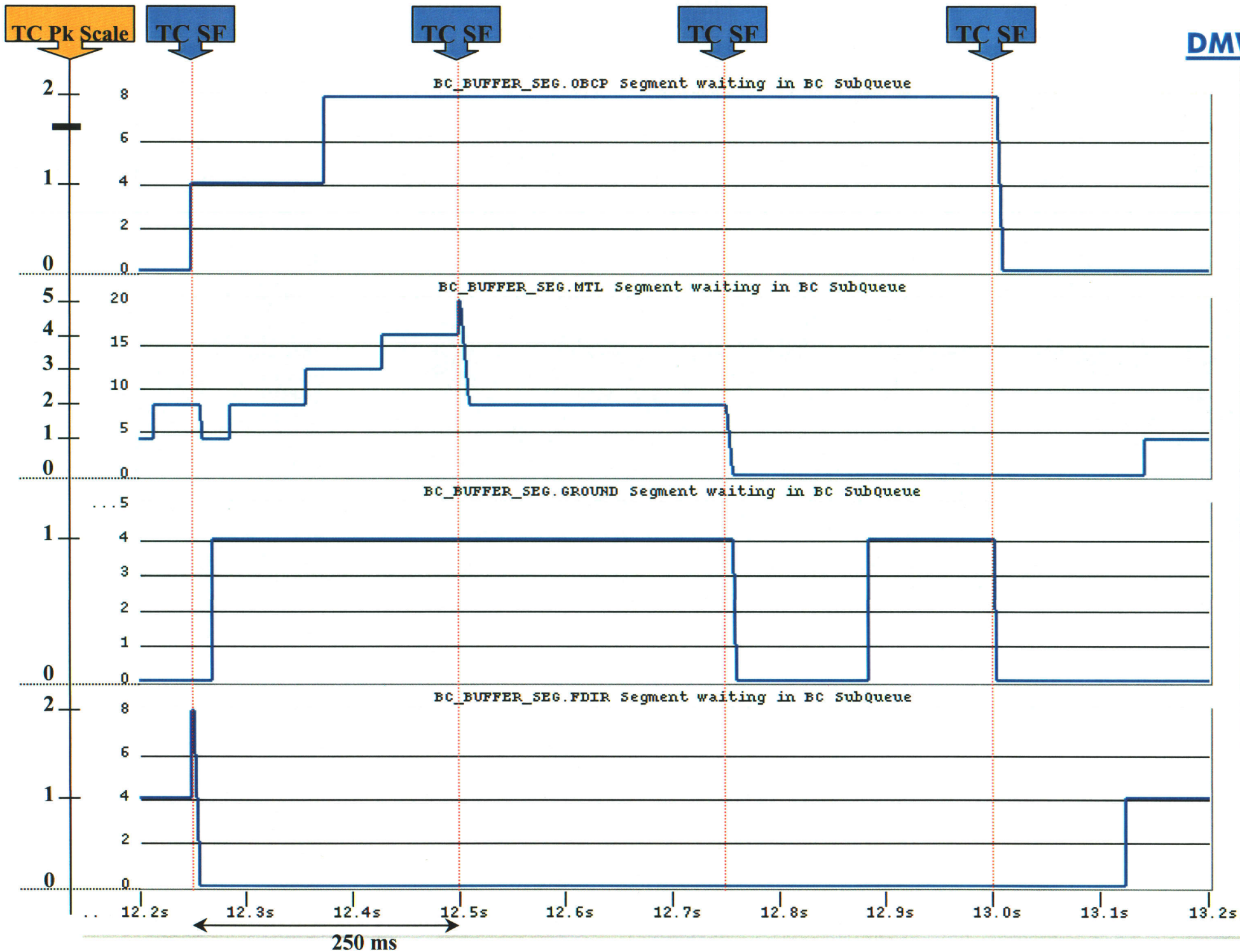
---

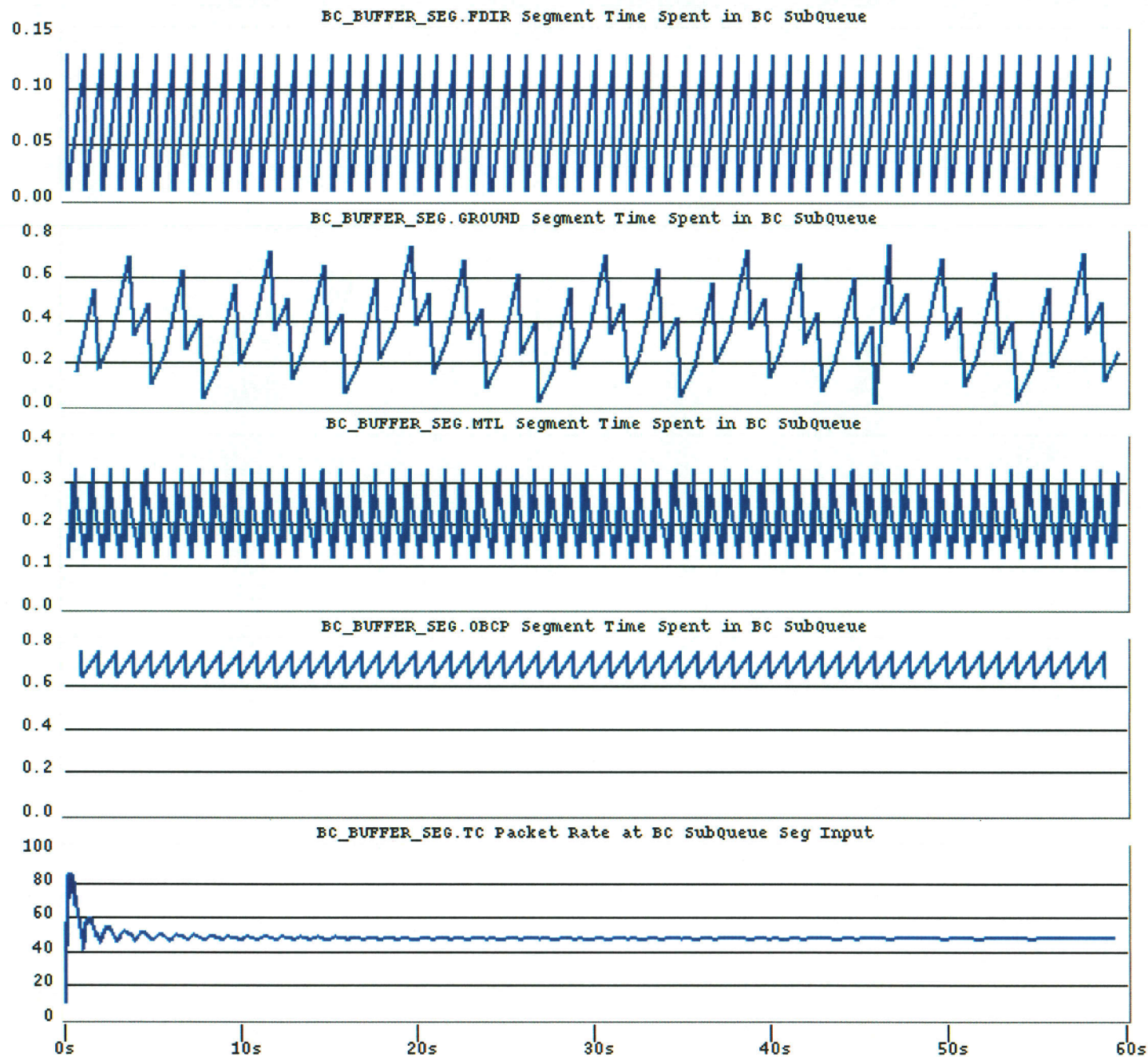
## Expected behaviour

- ▼ The PS-ICD protocol allows to transmit at most 48 (4x3x4) Segments per frame
  - ↳ Scenario 1 (ground TC rate is 1.63) : the BC will receive 11.63x4 Segments per second
    - Under the PS-ICD limit
      - No bottle neck effect (over 1 second) is expected
  - ↳ Scenario 2 (ground TC rate is 14.3) : the BC will receive 24.3x4 Segments per second
    - Above the protocol capabilities
      - Bottleneck effect is expected

## **Results for Scenario 1**

- ▼ Zoom on sub-queue extraction for TC transfers (See after)





## Results for Scenario 1

- ▼ Wait Time of a segment in the sub-queue Seg depending on the priority

## **Results for Scenario 2**

- ▼ Zoom on sub-queue extraction for TC transfers (See after)

# DMWG#14

New Frame

TC SF

TC SF

TC SF

BC\_SYNC.Frame Scheduler Clock

BC\_SYNC.SubFrame Scheduler Clock

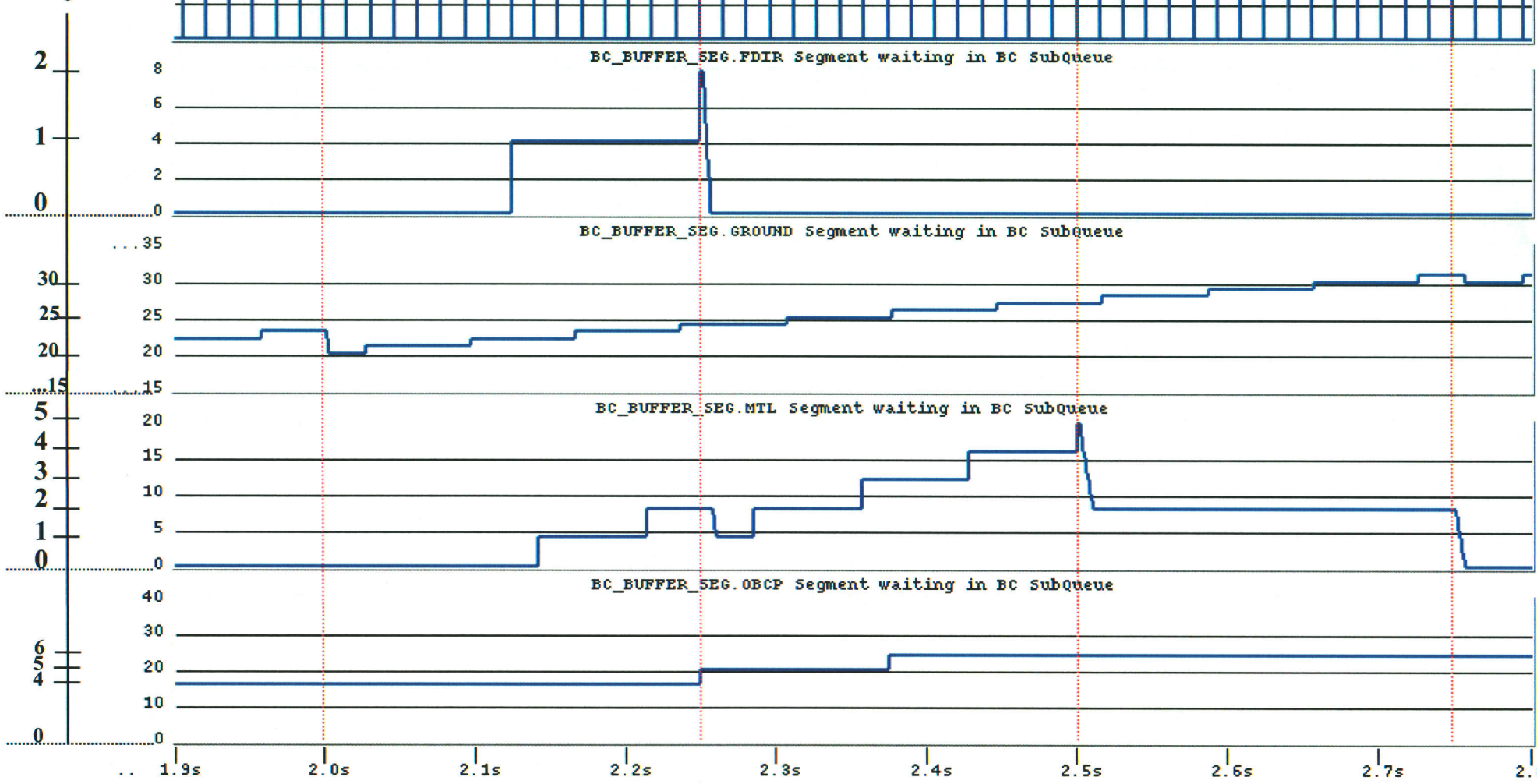
BC\_BUFFER\_SEG.FDIR Segment waiting in BC SubQueue

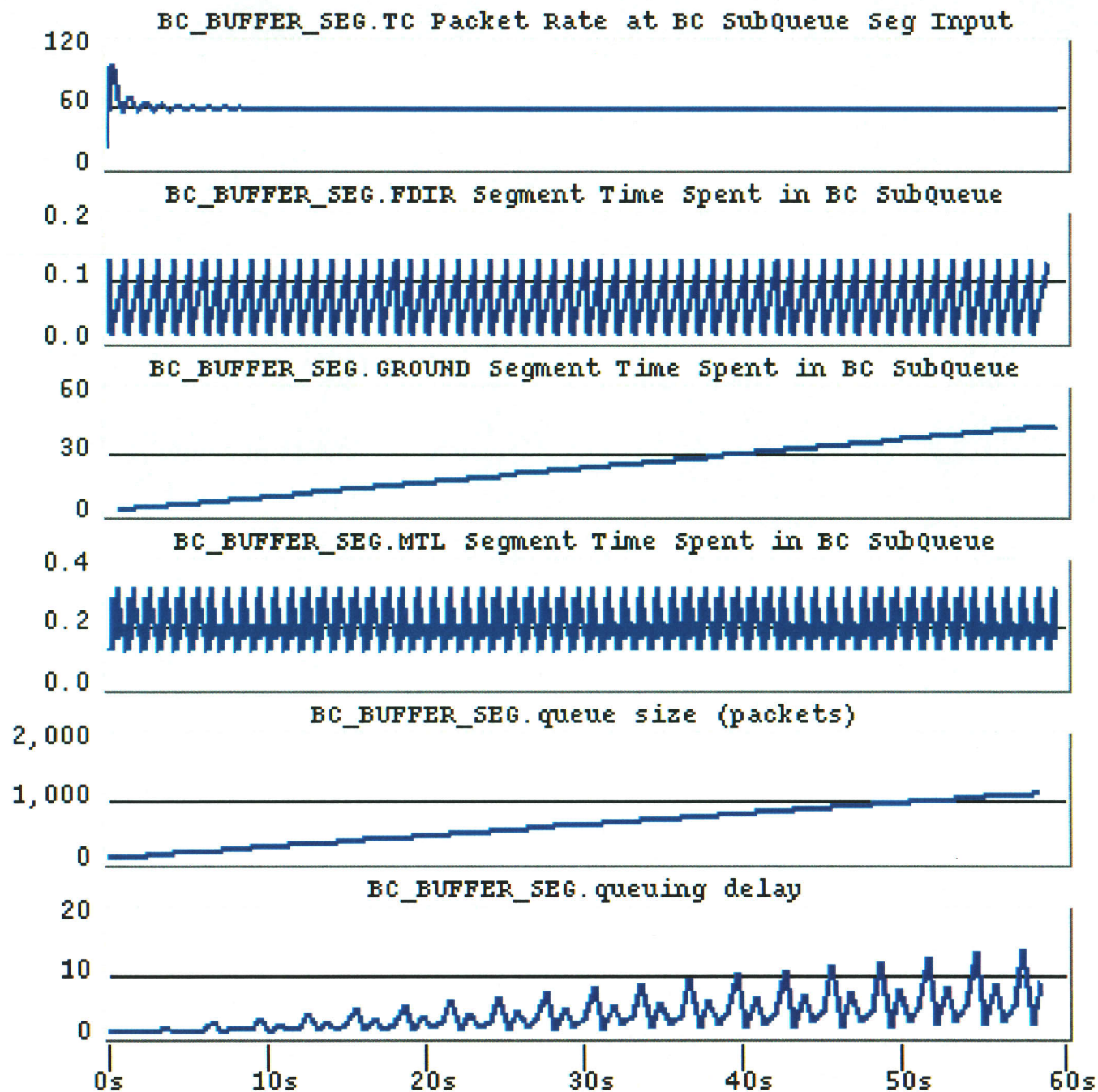
BC\_BUFFER\_SEG.GROUND Segment waiting in BC SubQueue

BC\_BUFFER\_SEG.MTL Segment waiting in BC SubQueue

BC\_BUFFER\_SEG.OBCP Segment waiting in BC SubQueue

TC Pk Scale





## Results for Scenario 2

- ▼ Wait Time of a segment in the sub-queue Seg depending on the priority

## Next Step

- ▼ Randomise the date of creation of TC Source Packets and 1553 messages within one second.
- ▼ Implement and validate the nominal scenario.
- ▼ Check I/O interface flow when a Polling Scenario will be available
- ▼ Provide different Remote Terminal Units instead of one unique Dummy RT