

- ▼ General : Science data return is limited by 3 factors
 - Mil 1553 Bus + ESA specified protocol
 - currently specified in kbps
 - PS ICD propose a basically synchronous scheme with a subframe concept and slots allocation
 - Mass Memory size
 - it is required to store the max average data rate (instruments+spacecraft) over 48h
 - Downlink capacity and time
 - it is required to permit the simultaneous transmission of :
 - the data acquired at the max average data rate over the past 24h
 - the data acquired in real time

Slot No.	Content/ Purpose	Duration in micro seconds
1	Subframe synchronization	150
2	Command/ Acquisition Slot	750
3	Command/ Acquisition Slot	750
4	Command/ Acquisition Slot	750
5	Packet transfer	750
6	Packet transfer	750
7	Packet transfer	750
8	Packet transfer	750
9	Packet transfer	750
10	Packet transfer	750
11	Packet transfer	750
12	Packet transfer	750
13	Packet transfer	750
14	Packet transfer	750
15	Packet transfer	750
16	Packet transfer	750
17	Packet transfer	750
18	Packet transfer	750
19	Packet transfer	750
20	Packet transfer	750
21	Packet control (e.g. polling)	150
22	Packet control	150
23	Packet control	150
24	Regulation Slot	≤ 775

→ 1x full length 1553 message

→ 1x full length TM packet

→ 1x 1553 mode code

→ 1x full length 1553 message (asynchronous)

Slots allocations within each subframe

▼ Sub frames allocations : assumptions

□ General

- proposed baseline is a very basic handshake mechanism :
 - no message resent

□ Instruments

- 4 subframes/s are reserved for instruments TC's. Accordingly, 4 TC's acknowledge subframes+ 4 TC's Content report subframes are allocated
- 1 subframe/s per instrument is allocated to HK TM

□ Spacecraft

- 1 subframe/s reserved for ACMS TC's. Accordingly, 1 TC's acknowledge subframes+ 1 TC's Content report subframes are allocated
- 2 subframe/s allocated for ACMS TM packets
- 1 subframe/s allocated for PCDU TM
- Slots n°3 & 4 reserved for PCDU & CCU commands/acquisition

▼ Sub frames allocations : sizing cases

☐ Herschel :

→ only PACS in operation (100kbps); HIFI and SPIRE only deliver HK packets

☐ Planck :

→ HFI delivers 48kbps +2kbps HK

→ LFI delivers 30kbps +2kbps HK

Planck

PACKET Budget for IIDB issue 1 scenario		
	Subframe/s	kb/s
TC reserved	4	
TC Acknowledge	4	
TC Content Report	4	
HFI Science	6	49.152
LFI Science	4	32.768
HFI HK	1	8.192
LFI HK	1	8.192
Sorption Cooler HK	1	8.192
Total Payload Science+HK	13	106.5
AOCS TM	2	
PCDU TM	1	
CDMS - AOCS TC	1	
CDMS - AOCS TC ACK	1	
CDMS-AOCS Content Report	1	
Margin	33	
Total	64	

Planck

PACKET Budget for LFI request of 12 Subframes		
	Subframe/s	kb/s
TC reserved	4	
TC Acknowledge	4	
TC Content Report	4	
HFI Science	6	49.152
LFI Science	12	98.304
HFI HK	1	8.192
LFI HK	1	8.192
Sorption Cooler HK	1	8.192
Total Payload Science+HK	21	172.03
AOCS TM	2	
PCDU TM	1	
CDMS - AOCS TC	1	
CDMS - AOCS TC ACK	1	
CDMS-AOCS Content Report	1	
Margin	25	
Total	64	

Planck

PACKET Budget for IIDB 2.0 Allocation		
	Subframe/s	kb/s
TC reserved	4	
TC Acknowledge	4	
TC Content Report	4	
HFI Science	6	49.152
LFI Science	8	49.1526
HFI HK	1	8.192
LFI HK	1	8.192
Sorption Cooler HK	1	8.192
Total Payload Science+HK	17	139.264
AOCS TM	2	
PCDU TM	1	
CDMS - AOCS TC	1	
CDMS - AOCS TC ACK	1	
CDMS-AOCS Content Report	1	
Margin	29	
Total	64	

Herschel

PACKET Budget for IIDB issue 1 scenario		
	Subframe/s	kb/s
TC reserved	4	
TC Acknowledge	4	
TC Content Report	4	
HIFI Science	0	0
PACS Science	13	106.5
SPIRE Science	0	0
HIFI HK	1	8.192
PACS HK	1	8.192
SPIRE HK	1	8.192
Total Payload Science+HK	16	131.072
AOCS TM	2	
PCDU TM	1	
CDMS - AOCS TC	1	
CDMS - AOCS TC ACK	1	
CDMS-AOCS Content Report	1	
Margin	30	
Total	64	

Herschel

PACKET Budget for PACS Burst mode		
	Subframe/s	kb/s
TC reserved	0	
TC Acknowledge	0	
TC Content Report	0	
HIFI Science	0	0
PACS Science	37	303.104
SPIRE Science parallel	0	0
HIFI HK	1	8.192
PACS HK	1	8.192
SPIRE HK	1	8.192
Total Payload Science+HK	40	327.68
AOCS TM	2	
PCDU TM	1	
CDMS - AOCS TC	1	
CDMS - AOCS TC ACK	1	
CDMS-AOCS Content Report	1	
Margin	18	
Total	64	

▼ Mass memory sizing

- Sizing assumption is 140kbps total (Science data + HK +margin) from instruments

S/C HK	432	Mbits
MTL	19	Mbits
Events	0.5	Mbits
Copy of Flight SW	16	Mbits
SubTotal	467.5	Mbits
Margin	467.5	
Total for Satellite System	935	Mbit
Instrument Data 140kb/s for 48hours including margin	24.192	Gbit
Total Mass Memory	25.127	Gbit

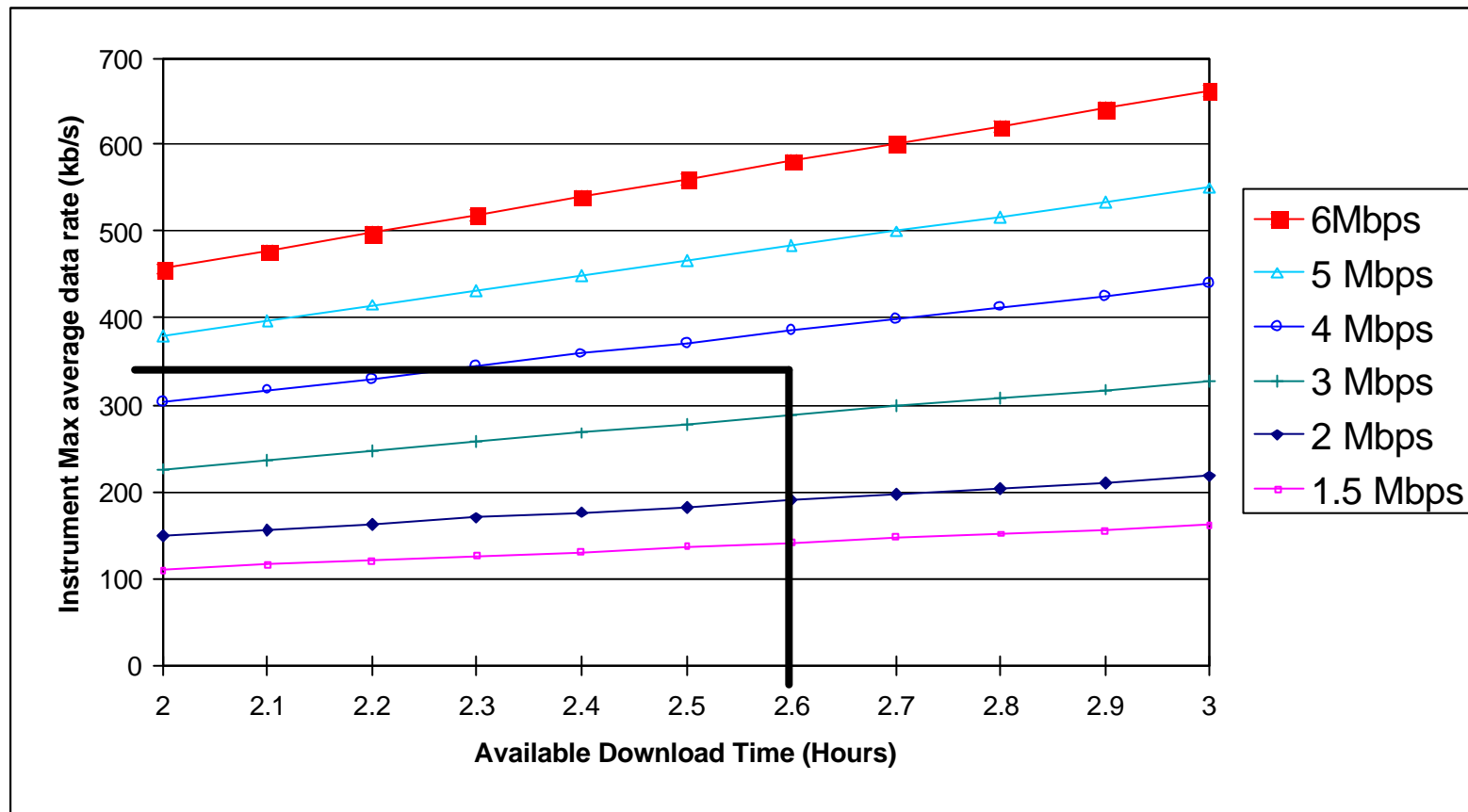
Instrument Max Data rate / Download Time

1.5Mbits/S with a contact time of 2.6 Hours means that a total of 14040Mbit can be downlinked. In 2.6hours, 1372Mbit realtime data can be generated on the bus so the mass memory has to be sized for
 $14040 - 1372 \text{ Mbit} = 12.7\text{Gbit}.$

To fill this memory over 24hours permits a maximum bus datarate of 147kb/s (which includes all spacecraft data + science + instrument TM).

Removing allocation for satellite HK + margins yields a **max average datarate of 140kb/s for the instruments.**

Therefore the IIDA allocation of 100kb/s is in line with the maximum datarate allowing for uncertainties.



Graph shows Instrument max average datarate as a function of download time and downlink datarate
 Absolute maximum on the databus is 350kb/s (with no TC and associated overheads)
 and typical 2.6hours contact time defines the possible working area