Payload Data Handling Sub-system

1. Payload Data Handling Sub-System
2. PDHS Functional requirements
3. Technical analysis and trade-offs
4. PDHS Demonstrator
5. From SpaceWire to TOPNET

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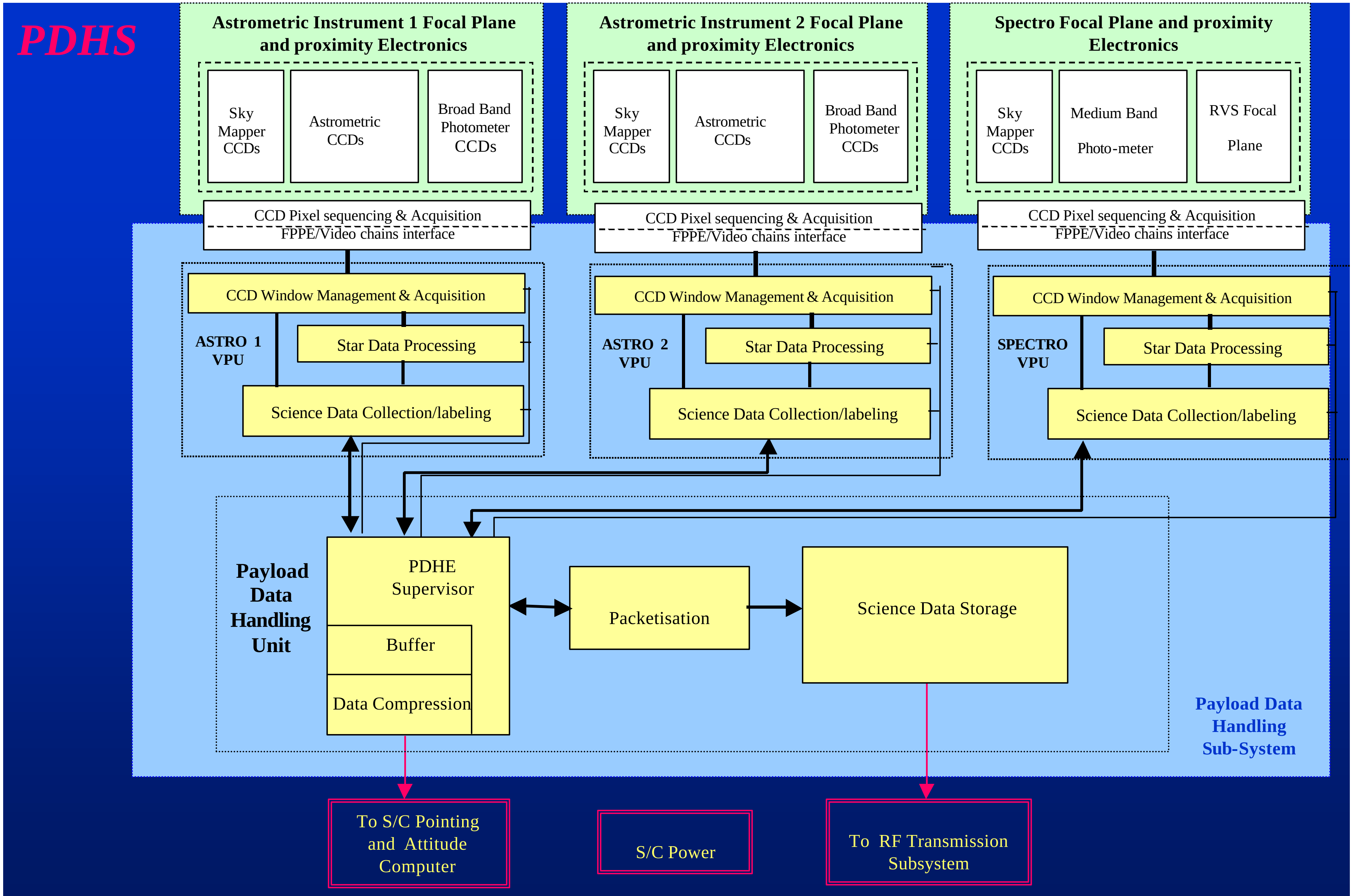
GAIA Concept & Technology Study (CTS)

® **List of Necessary Technological Studies & Technological Development Activities**

G21 : **Payload Data Handling Electronics**

G 16 : **Optimized On-Board Compression Techniques for GAIA Science Data**


PDHS
Astrometric Instrument 1 Focal Plane and proximity Electronics
Sky Mapper CCDs
Astrometric CCDs
Broad Band Photometer CCDs
Astrometric Instrument 2 Focal Plane and proximity Electronics
Sky Mapper CCDs
Astrometric CCDs
Broad Band Photometer CCDs
Spectro Focal Plane and proximity Electronics
Sky Mapper CCDs
Medium Band Photo-meter
RVS Focal Plane
CCD Pixel sequencing & Acquisition
FPPE/Video chains interface
CCD Pixel sequencing & Acquisition
FPPE/Video chains interface
CCD Pixel sequencing & Acquisition
FPPE/Video chains interface
CCD Window Management & Acquisition
ASTRO 1 VPU
Star Data Processing
Science Data Collection/labeling
CCD Window Management & Acquisition
ASTRO 2 VPU
Star Data Processing
Science Data Collection/labeling
CCD Window Management & Acquisition
SPECTRO VPU
Star Data Processing
Science Data Collection/labeling
Payload Data Handling Unit
PDHE Supervisor
Buffer
Data Compression
Packetisation
Science Data Storage
Payload Data Handling Sub-System
To S/C Pointing and Attitude Computer
S/C Power
To RF Transmission Subsystem

PDHS Functional Requirements (1)

VPUs functional requirements

CCD Windows Management & Acquisition

- ✓ Video processing synchronisation
- ✓ Real time CCD « windowing » function (SPECTRO and ASTRO instruments)

Star Data Processing

- ✓ Cosmic ray mitigation
- ✓ Sky background estimation
- ✓ Star detection / discrimination function within the sky mapper and photometer fields
- ✓ Star position / centroiding
- ✓ Scan rate determination and transmission to the ACMS subsystem

PDHS Functional Requirements (2)

Science Data Collection/labeling

- ✓ Acquisition of star data stream
  (the star background, star patches, colour patches, photometric data and spectral data)

- ✓ Acquisition of ancillary data and insertion within the data stream

- ✓ Insertion of datation / localisation of detected events within the star data stream

PDHS Functional Requirements (3)

PDHU functional requirements

PDHE Supervisor

- ✓ Primary payload sequencing
- ✓ Digitised science data acquisition, multiplexing, and temporary storage (variable flux of data coming from all instruments and hundreds of video chains)
- ✓ Management of the star density and of the ground station visibility period fluctuations
- ✓ Control and management of VPUs and SSR
- ✓ Command / control interface with the spacecraft central computer (SCC)

Data Compression and data Packetisation

- ✓ Possibly data compression and formatting prior to the delivery to the transmission subsystem

Technical Analysis and Trade-offs

Star Population Fluctuation Management

Star population density (mV <= 20)		
Average value	Ns = 14 300 stars/deg²	
« Worst case »	Ns = 155 000 stars/deg²	Scaling factor = 11
Maximum Star Density	Ns = 3 10^6 stars/deg²	Scaling factor = 200

VPUs implementation trade-offs

➪ Common parts between ASTRO VPU & SPECTRO VPU

Architecture trade-offs

First Phase : Simulation of the PDHS through UML

Technology Options

PDHS

Computation

FPGA
- Antifuse based on Actel 1280A state of the art
- RAM based still under study allows reconfiguration

Use only for the Breadboard (SEU Problem in orbit)

ASIC
- 0.35 mm Fixe point arithmetic
- 0.25 mm ↗ gates per chip Þ more functions

Processors
- DSP 21020 20 MIPS, 20 ↔60 MFLOPS EOL : 2005 ↔2007
- LEON(SPARC V8) 50/100 MIPS, 25 MFLOPS available 2003

Main Objective : Privilege Flexibility

Memory

High Capacity Memory Modules

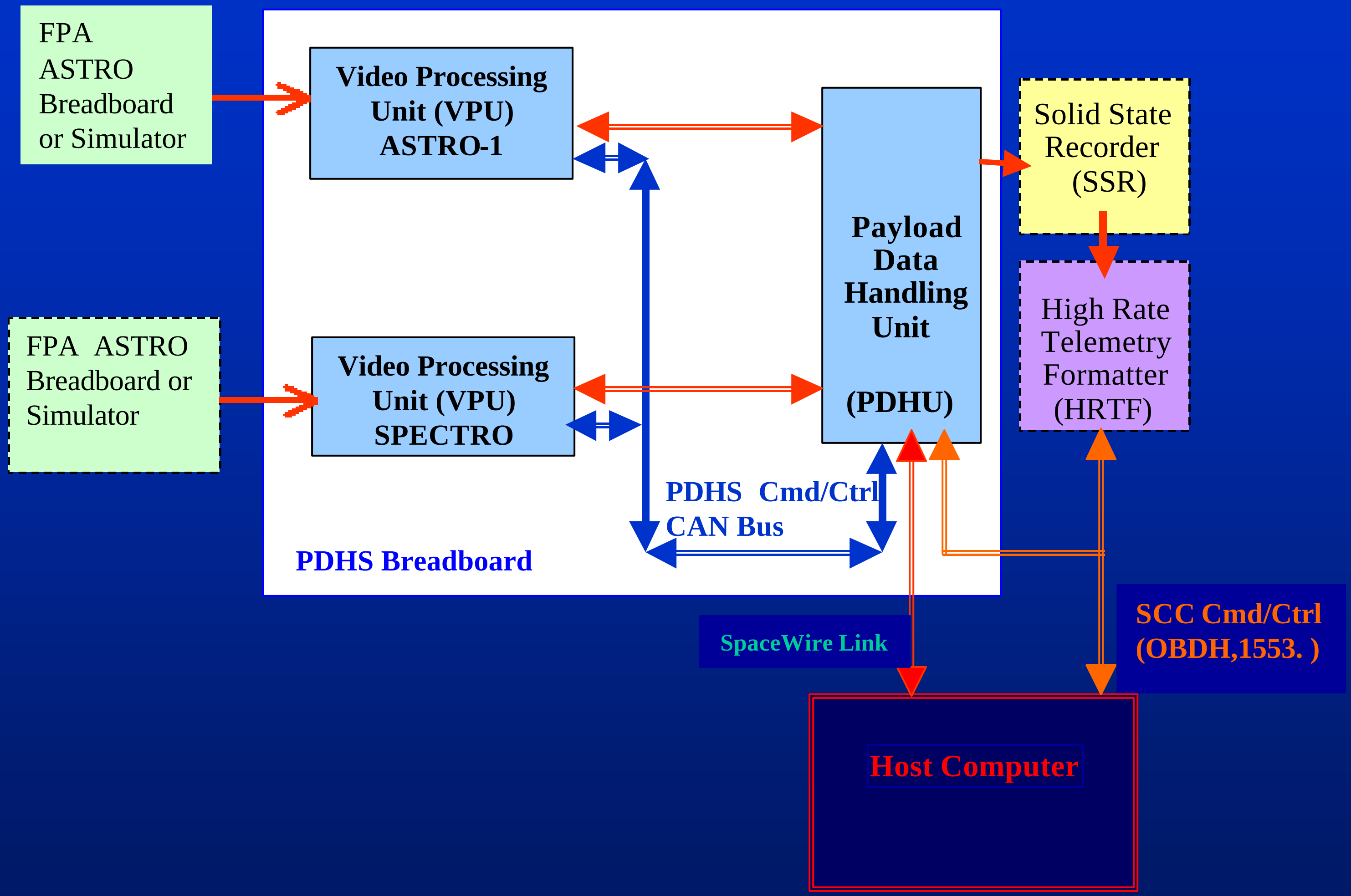
Capacity from 32 to 128 Gbits based on DRAM devices assembled in high density packages

Communication

Low rate for control : CAN bus

High rate for processing : SpaceWire (ECSS standard)

PDHS demonstrator



From SpaceWire to TOPNET

SpaceWire provides the high-speed network infrastructure for communications

- 1) within the unit
- 2) between units
- 3) directly with EGSE

TOPNET complements the OSI (CCSDS-SOIF) model with Network / Transport Layers

- 4) as a bridge to the Internet
- many other features

TOPNET initiative will complement SpaceWire