Standardisation of PF/PL Interfaces in the Scope of CNES Initiative for Space Innovative Standards

The need for standardization

- Main rationale for standarization of platform to payload interfaces:
  - Reuse => costs reduction, technical and programmatical risks reduction
  - Well suited to missions in cooperation, or submitted to georeturn
  - Allocation of ressources to innovation rather than to reworking service functions (ex: platforms, MCS…)
  - Anticipation of payload development
  - Step forward towards the « hosted payload » concept

- Well illustrated by the MERLIN and SWOT satellites ITT experience:
  - In both cases, the payload is a CFI
  - Platforms product lines exist, and huge savings are expected, as long as existing solutions are reused **as is**
  - However: lack of compatibility between product lines
    - » Difficult to freeze PL interface before platform selection
    - » High risk if the platform is selected whithout a clear definition of interfaces
    - » Payload design is slowered by the lack of interface definition

The conditions for reusability

- Technical conditions
  - Genericity of the functions
  - Independance of the functions with regard to each other
  - Scalability of the functions
  - Stable and well defined interfaces

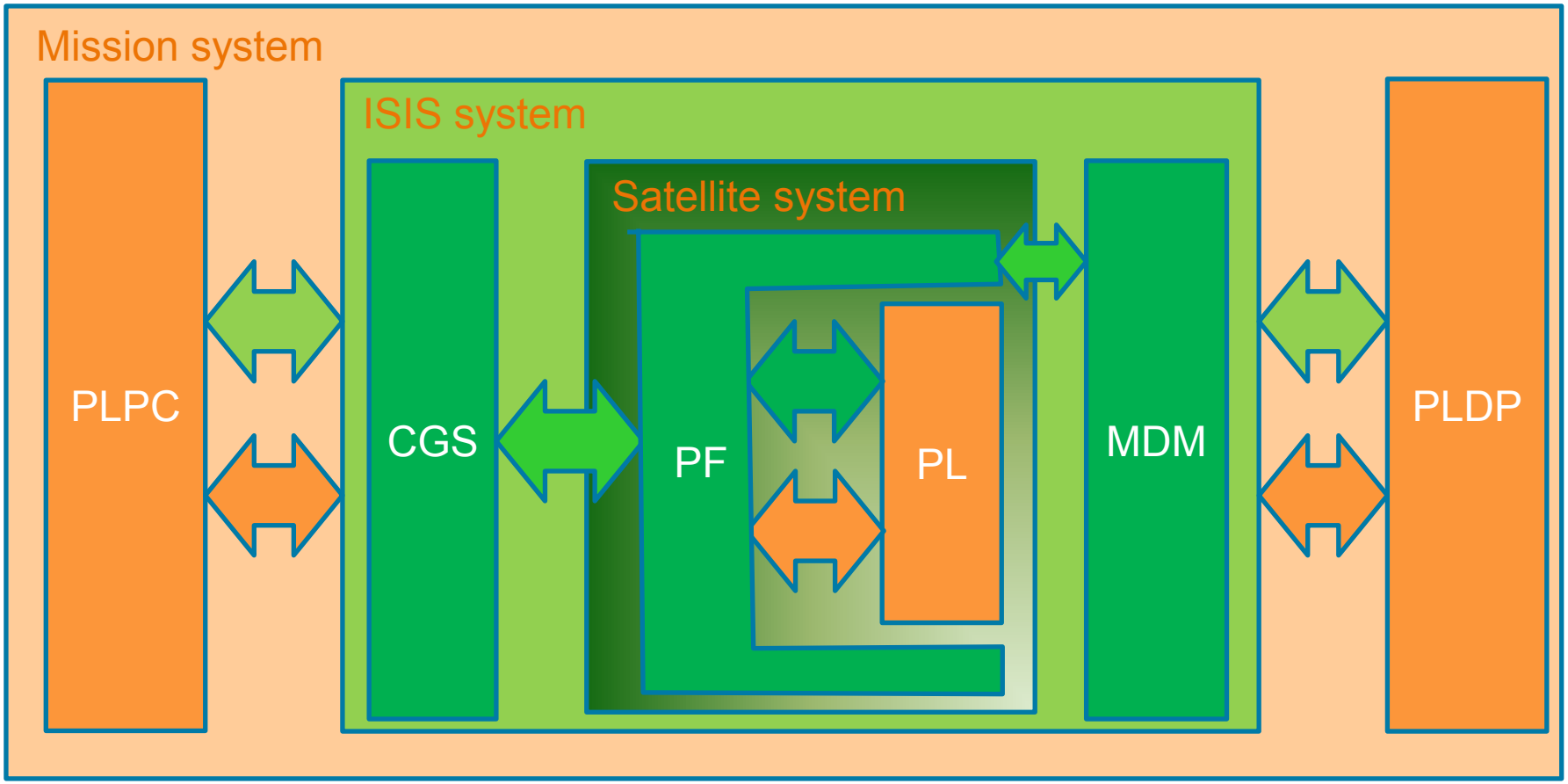
- Other condition: the standard must be seen by the missions as an opportunity rather than as a constraint
  - The standard must be easily included or referred to in the mission's specification tree
  - Differences with respect to the standard must be easily identified

The ISIS concept

- Think in terms of platform services to the payload
- Identify independent service functions
- Design the services (function and interfaces), based on state of the art standards (ECSS, CCSDS, MIL…)

- Gather all this information in a document (ISIS platform to PL IRD) easily usable to produce mission specifications
- Design process and tools to ease and master mission specifications generation and maintenance:
  - Missionisation process
  - Identifications of modifications with respect to the ISIS reference
  - Identification of later ISIS modifications impact on user mission

Overview of ISIS concept: technical interfaces & underlying reference architecture



Legend & acronyms:

- PLPC: PayLoad Programming Center
- PLDP: PayLoad Data Processing
- CGS: Control Ground Segment
- MDM: Mission Data Management (ground stations, TM servers…)

Generic / Product line
Mission specific
Generic Service (PF or system)
Specific Service

The ISIS standard services (1/3)

Low level interfaces

- Discrete (TM&TC), according to ECSS-ST-E-50-14C
- Data bus (physical) according to ECSS-E-ST-50-13C
- ISIS GDIR requirements coming from ECSS tailoring and industrial experience
- Power bus characteristics

Intermediate level

- 1553 protocol (data exchanges according to ECSS-E-ST-50-13C)

The ISIS standard services (2/3)

High level platform services

- Modes management
  - Definition of standard PL units modes: OFF/STANDBY/OPERATIONAL…
  - Platform services may be enabled/disabled or configured according to the PL unit mode
- TC routing
  - Ground TC are routed by the PF to PL units,
  - based on APID, and possibly on PUS service/subtype fields
- HK TM storage&routing
  - PL TM packets are routed by the PF in packet stores, direct telemetry,
  - Same addressing as TC
- Payload TM management (not yet defined in the ISIS IRD)
  - TM downloading process
  - MM management
  - PF data writing in the PL MM
- Payload basic FDIR
  - 1 FDIR = 1 triplet discrete parameter / criteria / action based on TC sequence or OBCP

The ISIS standard services (3/3)

Thermal control service

- Based on standard temperature acquisition and redounded heaters commanded by the platform
- Acquisitions and power lines are provided by the platform
- Parameters defined by the payload: target & regulation parameters
- Possible standard temperature FDIR associated to each thermal line

Power service

- One power line (possibly redundant) / payload unit
- An ON/OFF LCL and its status
- A current acquisition
- Possible standard FDIR of the current of each line

Time service:

- A HW time reference (discrete PPS, or based on 1553 bus)
- A time message indicating the time stamp of the PPS

Ancillary data service

- Cyclical broadcast of attitude & orbital data (in nominal PF mode)
- Other platform data (SA position, Bus voltage…: mission dependant)

Other interface requirements (1/2)

Platform to payload interface is not limited to platform services. Payload design requires assumptions on the platform design:

- Thermal:
  - Attitude in safe mode or during slews, duration of transitions…
  - Coupling between platform and payload
  - Power allocated to PL thermal control
- Mechanical design:
  - Handling,
  - Ground and launch environment
  - Field of view constraints from PL to PF and from PF to payload, ...
  - Requirements at mechanical interface (alignments, flatness, ...)
  - AOCS constraints (max rotations velocity, various possible inertia, ...)
- Electrical: power allocation in the different platform modes, EMC

⇨ Beside services definition, the ISIS IRD provides template requirements for all remaining aspects of the interface

Other interface requirements (2/2)

Some requirements on payload may flow down from the system concept:

- Uploading telecommands provided by the PLPC
  - Direct
  - Time-tag
- Providing telemetry to the PLPC
  - Payload data
  - Platform data
- PL telemetry (TBD):
  - Downloading
  - Data distribution
- Short term ground monitoring & reaction
  - Based on board & ground monitoring
  - Limited to discrete acquisition and a limited number of PL packets transmitted on the data bus
  - Assumptions are required for PL autonomy design
- Platform services management (thermal control, monitoring…)

Electronic data sheet

Electronic data sheet is a good way:

- To structure and define in a formal way the payload information required by the platform
- The platform to import in an efficient & secure way PL data in the satellite database
- To support to configuration management of the interface data

The concept of electronic data sheet could be extended to the ISIS platform services and support platform services configuration

Conclusion

- The ISIS PF to PL interface document (ISIS-SL-IRD-773-CNES) was initiated for MERLIN and SWOT satellites ITTs

- Feedback is very positive from both customer (MERLIN/SWOT CNES team) and prime contractors point of view:
  - Efficient mission IRD generation
  - Good compatibility with primes product lines
  - Good baseline for initial discussion with the payload provider

- Phase B is starting soon: feedback is expected and the ISIS document will be improved with real experience

- In the future:
  - ISIS initiative is local, and usefull only in the frame of CNES missions
  - Such an approach would certainly be interesting at European level but should be endorsed by ESA or ECSS
  - The ISIS partners will support such an Europeanization and provide ISIS information, as much as needed