Supporting developments - HW/SW stacks for ECSS CAN

Alberto Valverde Carretero

TEC-EDD On Board Computer & Data Handling Section
Data Systems Division, ESA/ESTEC the Netherlands

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Introduction

- In the frame of the CAN ECSS standardization, several implementations were developed using the RASTA system
- The results of those activities, both internal and external ones, is being used as an input for the standard
- Latest versions of the standard are far less complex than previous ones. SDOs has been marked as optional, Node-guarding is not included, LDUT has been removed.
- Minimal implementation of the standard, suited for extremely simple payloads with hardwired configuration, is no more than an “enhanced” CAN bus.

ECSS-E-ST-50-15C Services (1)

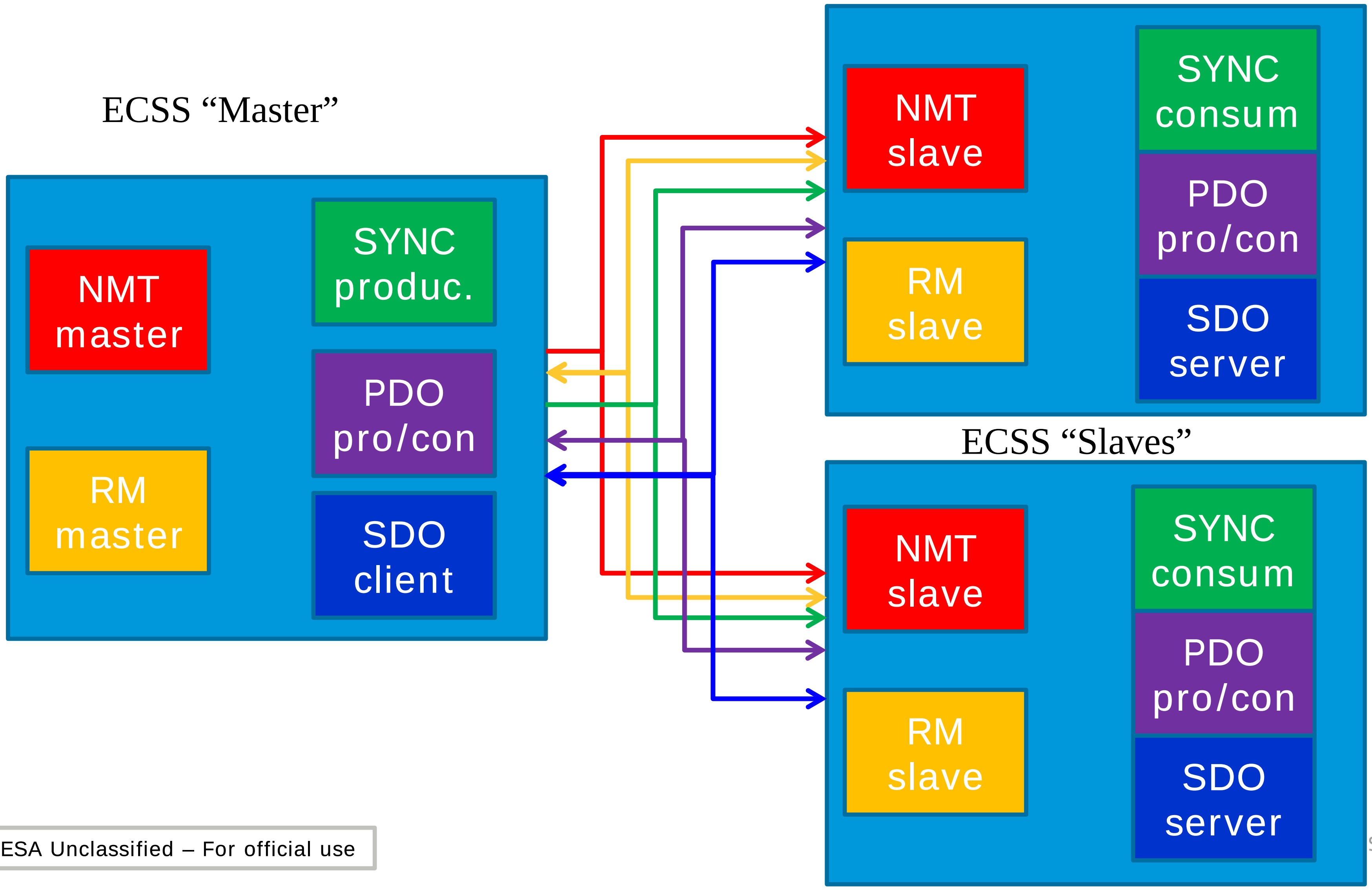
- Network Management - NMT
  - Master controls the operating mode of slaves
  - Slave communication capabilities can be managed remotely from the master

- Redundancy Management
  - Heartbeat message periodically sent by all nodes.
  - In case Redundancy Master Heartbeat is missed, slaves switch to redundant bus.
  - Redundancy is implemented with a single CAN controller + multiplexer and two CAN transceivers

ECSS-E-ST-50-15C Services (2)

- SYNC
  - Periodic transmission from the producer.
  - Enables the use of synchronous services.
  - High timing accuracy may be needed
- Process Data Objects - PDO
  - Data communications with real-time requirements.
  - Synchronous/Asynchronous. Cyclical/On-event.
- Service Data Objects - SDO
  - Low priority service, suited for asynchronous long data transfers with soft time constraints, such as memory dumps or payload configuration
  - Optional service in latest version of the standard

ECSS-E-ST-50-15C Services (3)



ECSS implementations. HW and SW

SW Implementations

- The ECSS has been successfully implemented over RTEMS 4.10 running on RASTA LEON2 using CAN Festival and Vector CANOpen Slave software packages
- They provide full-fleged CANOpen implementation. Redundancy management has to be implemented on top of the CANOpen heartbeat service
- Ideal for quick prototyping, validation and testing
- In general, low timing accuracy and determinism for real-time services
- In case of simple payloads with hardcoded configuration and no SDO services and OD, it would probably be more convenient to develop an ad-hoc ECSS communication stack.

ECSS implementations. HW and SW

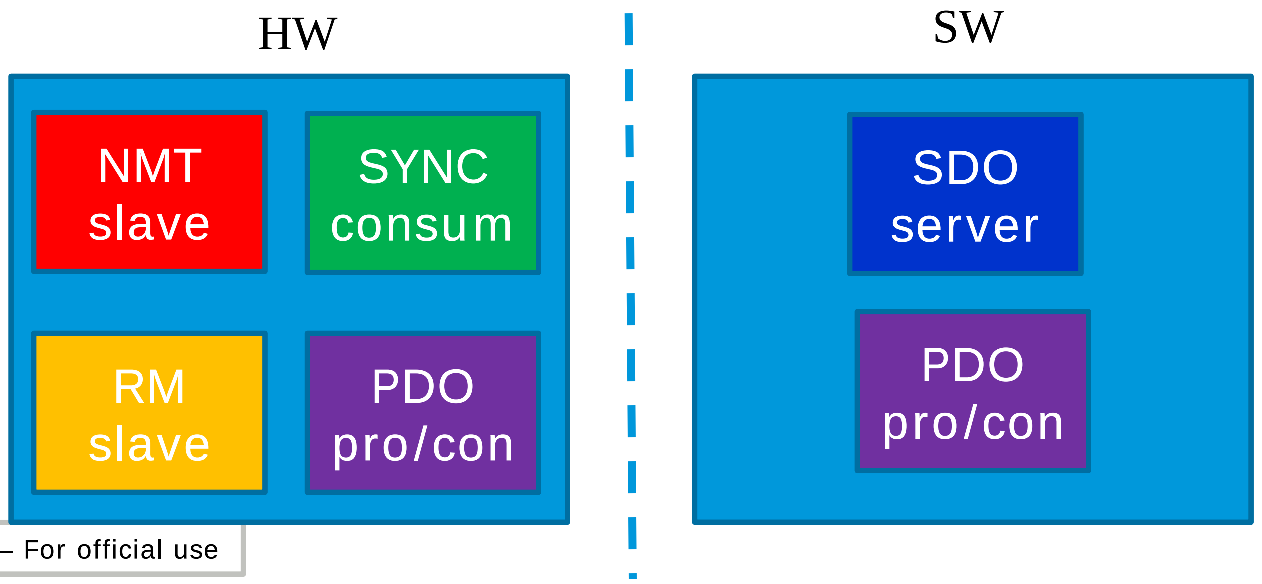
HW Implementation

- SITAEL S.p.A has developed, in the frame of ExoMars, two CANOpen IP Cores with bus redundancy, CCIPC and RCCIPC.
- ECSS “Slave” node implementation with all ECSS services, including SDO expedited, segmented and block modes
- Three different interfaces: Direct Interface, Generic I/O Interface and AMBA Bus Interface

- Flexible implementation of the complete standard. Tested and validated in the frame of ExoMars
- In general, size of the core can be too big for small payloads with limited resources and communication requirements

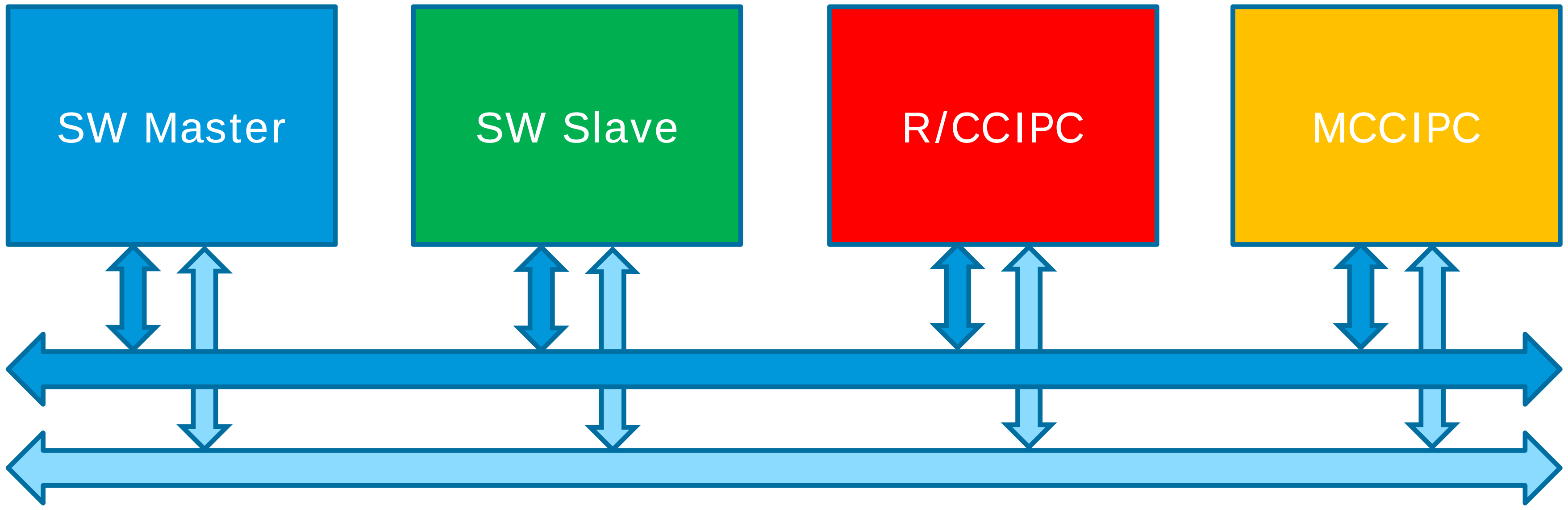
Reduced implementations and HW/SW solutions

- Minimal “slave” implementation of the standard can be much simpler than all those alternatives
- NMT, RM, SYNC and synchronous PDO services can easily be implemented around a CAN controller. In HW, it has actually been done and it just increase HurriCANe size by 20%.
- If needed, a small uC, such as openMSP430, can be connected to implement SDO or different PDO configurations



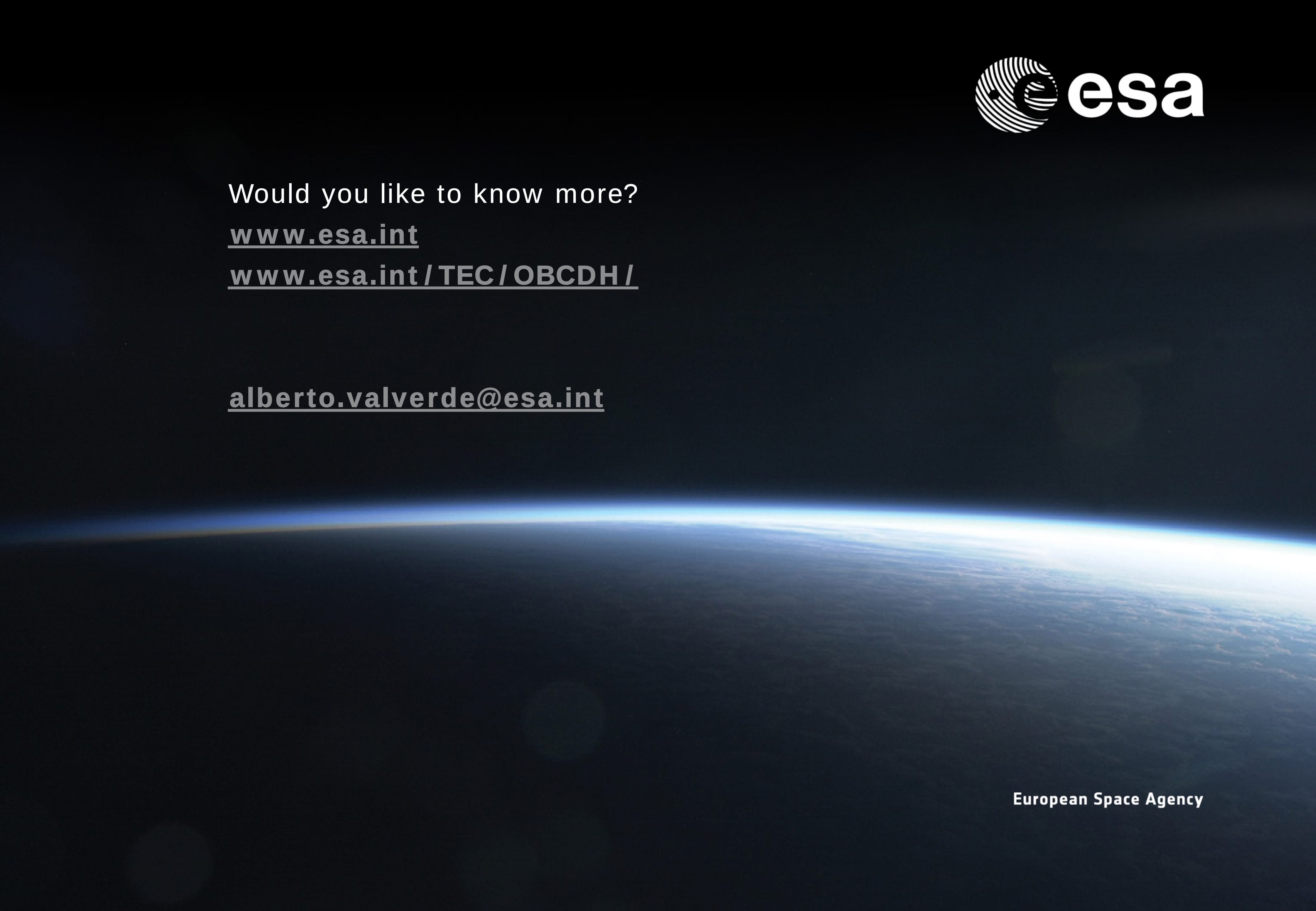
ECSS implementations. HW and SW

ESTEC Avionics Lab. ECSS Set-Up



Conclusions

- The standard is strongly based in CANOpen. The protocol specification is quite modular, which opens the possibility for a wide range of different network implementation
- Plenty of available tools to support the protocol development, testing and validation
- Open-source and commercial CANOpen SW stacks easily modifiable to implement the ECSS standard
- Fully-configurable slave VHDL IP cores for FPGA based units
- Reduced implementations can be easily developed for simple, low demanding applications



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alberto.valverde@esa.int

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