How ESA can help European industry to be competitive – recurrent product development and TM/TC classes

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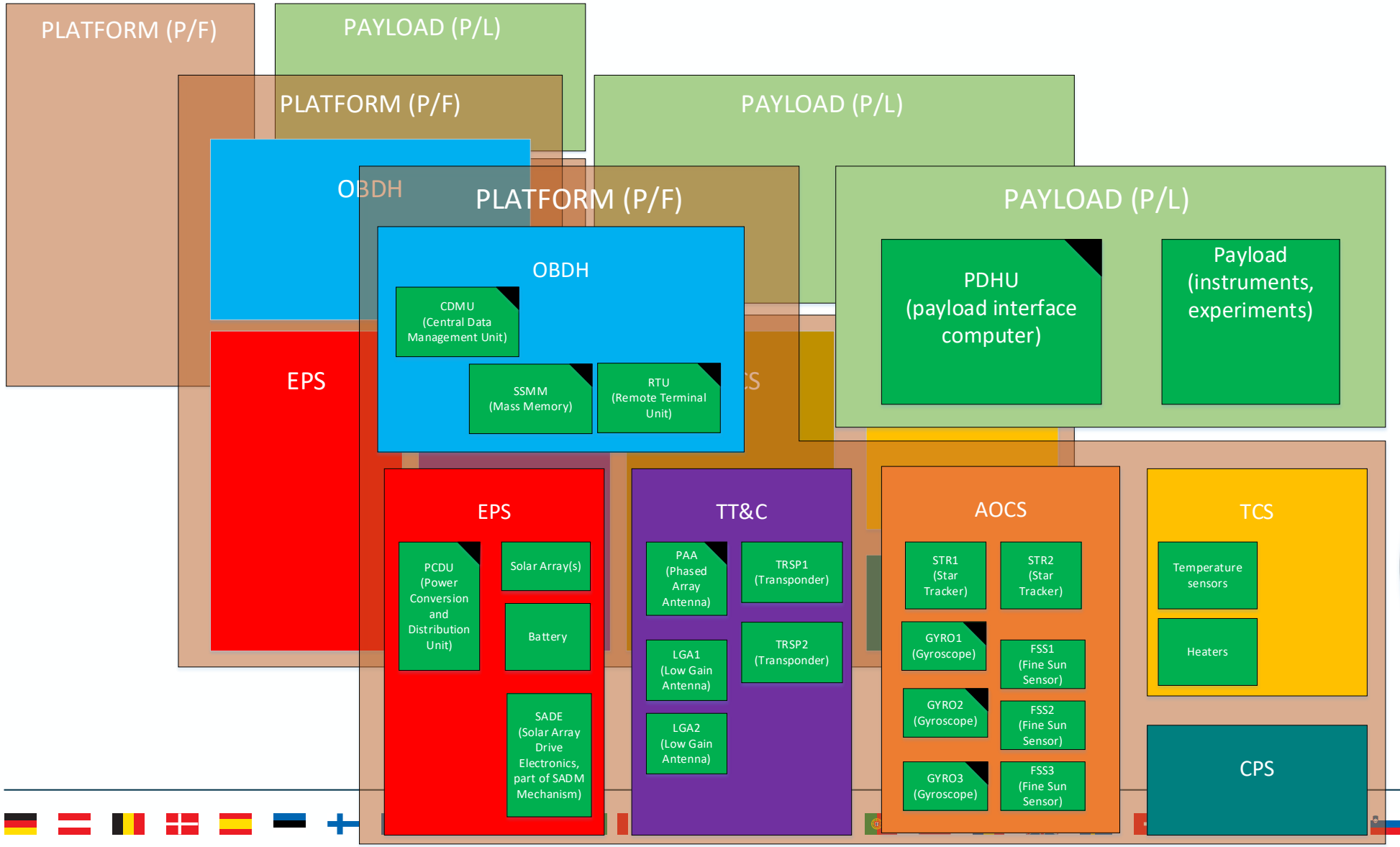
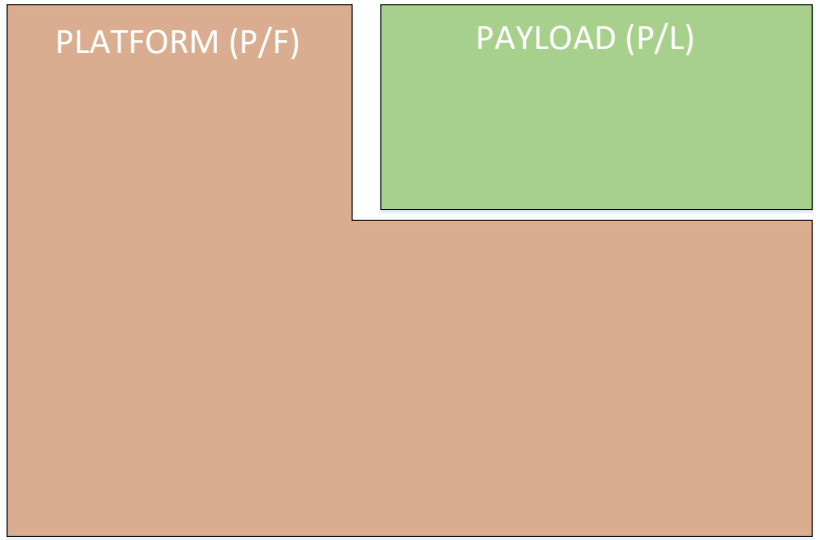
Legenda


PLATFORM (P/F)
PAYLOAD (P/L)
PLATFORM (P/F)
PAYLOAD (P/L)
OBDH
PLATFORM (P/F)
PAYLOAD (P/L)
OBDH
CDMU (Central Data Management Unit)
SSMM (Mass Memory)
RTU (Remote Terminal Unit)
EPS
PDHU (payload interface computer)
Payload (instruments, experiments)
EPS
PCDU (Power Conversion and Distribution Unit)
Solar Array(s)
Battery
SADE (Solar Array Drive Electronics, part of SADM Mechanism)
TT&C
PAA (Phased Array Antenna)
TRSP1 (Transponder)
TRSP2 (Transponder)
LGA1 (Low Gain Antenna)
LGA2 (Low Gain Antenna)
AOCS
STR1 (Star Tracker)
STR2 (Star Tracker)
GYRO1 (Gyroscope)
GYRO2 (Gyroscope)
GYRO3 (Gyroscope)
FSS1 (Fine Sun Sensor)
FSS2 (Fine Sun Sensor)
FSS3 (Fine Sun Sensor)
TCS
Temperature sensors
Heaters
CPS
Equipment (internally redundant)
SET of ALL MISSIONS
Subset

The first big question



Recurrent design?

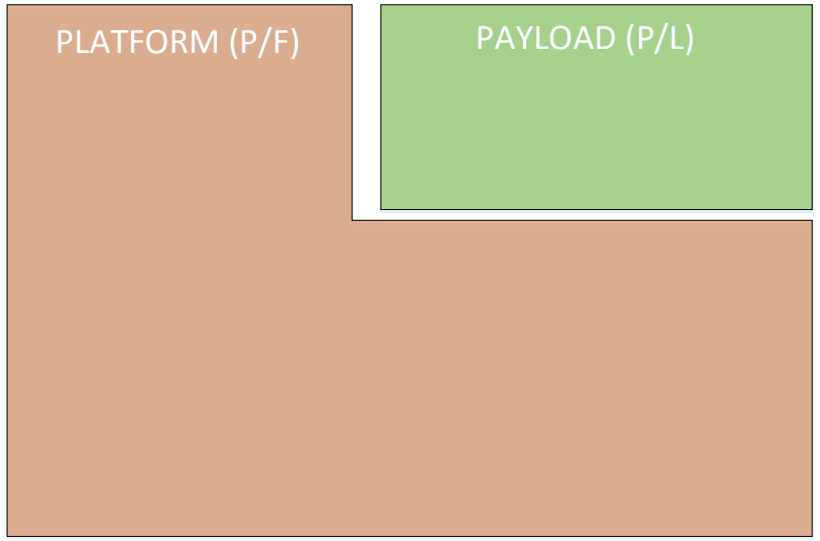
… or …

Design on demand?

Recurrent design

- Good for a number of **equal** satellites (constellations)
- Recurrent design **at satellite level** is also recurrent design **at subsystem/equipment level**
- For traditional Agency's missions (one or few off satellites) it seems **more adequate for (part of) the platform** and not so practical at payload level
- At best it requires (and it implies) **qualified production lines** which might reduce or even remove the need of subsystem/equipment acceptance

The first big question



Recurrent design?

… or …

Design on demand?

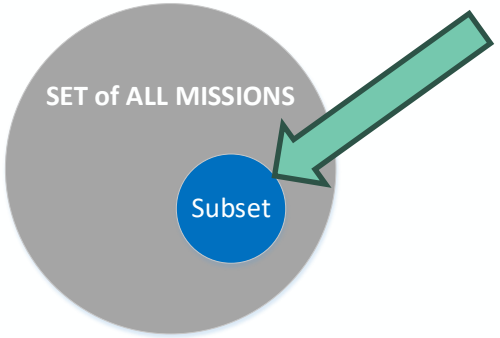
Design on demand

- It seems more adequate to traditional Agency's missions (one or few off satellites), both **for platform and payload**
- It typically requires **subsystem/equipment qualification and acceptance**

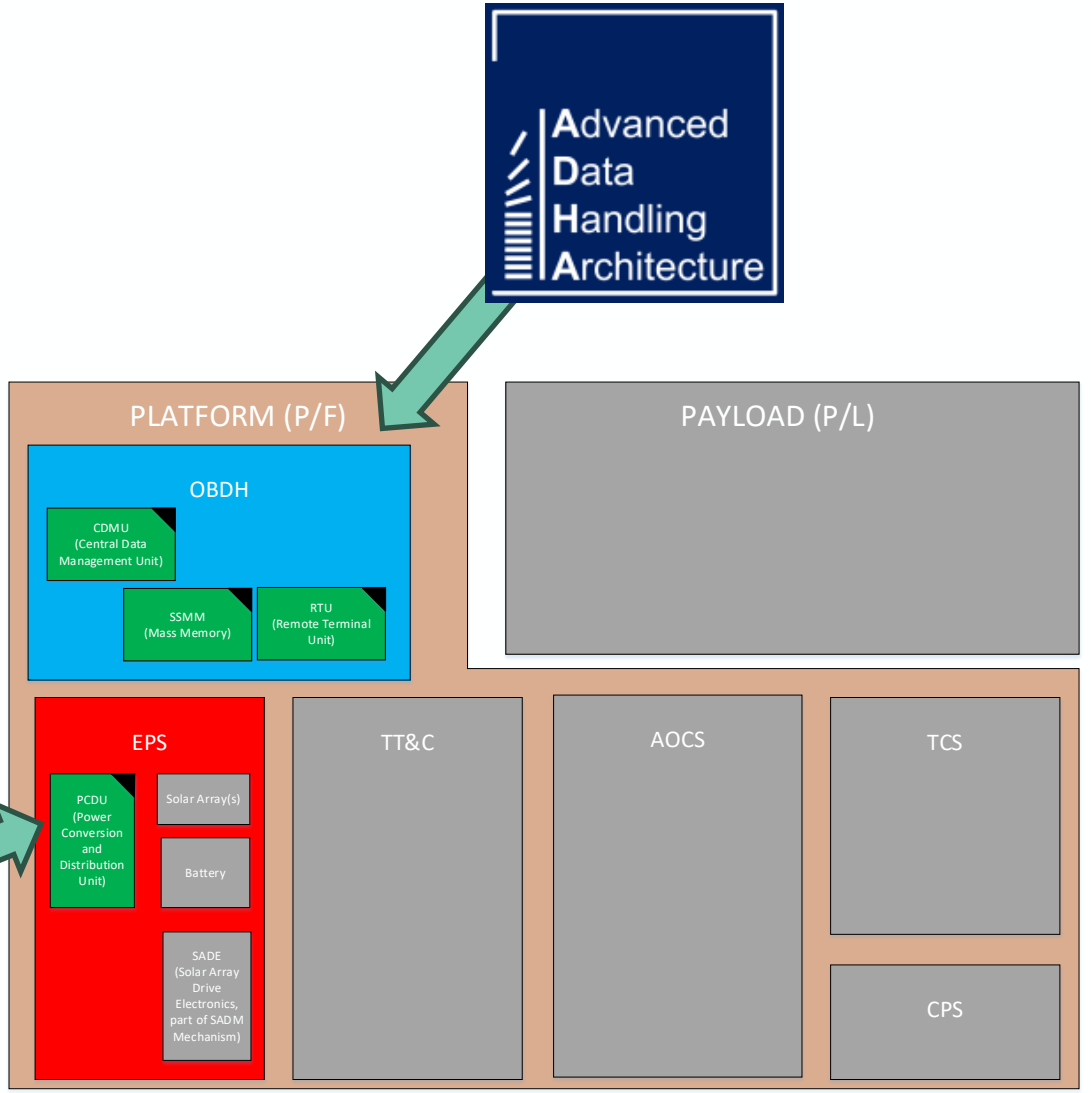
How can ESA facilitate EU industry then?

Recurrent design

- Where practical/possible, stimulate/fund/follow activities for development of
  - Recurrent satellites
  - Recurrent subsystems
  - Recurrent equipment
- For the **widest envelope of** possible **missions**
- **Up to qualification** with all set of **enveloping environmental and quality/engineering requirements**

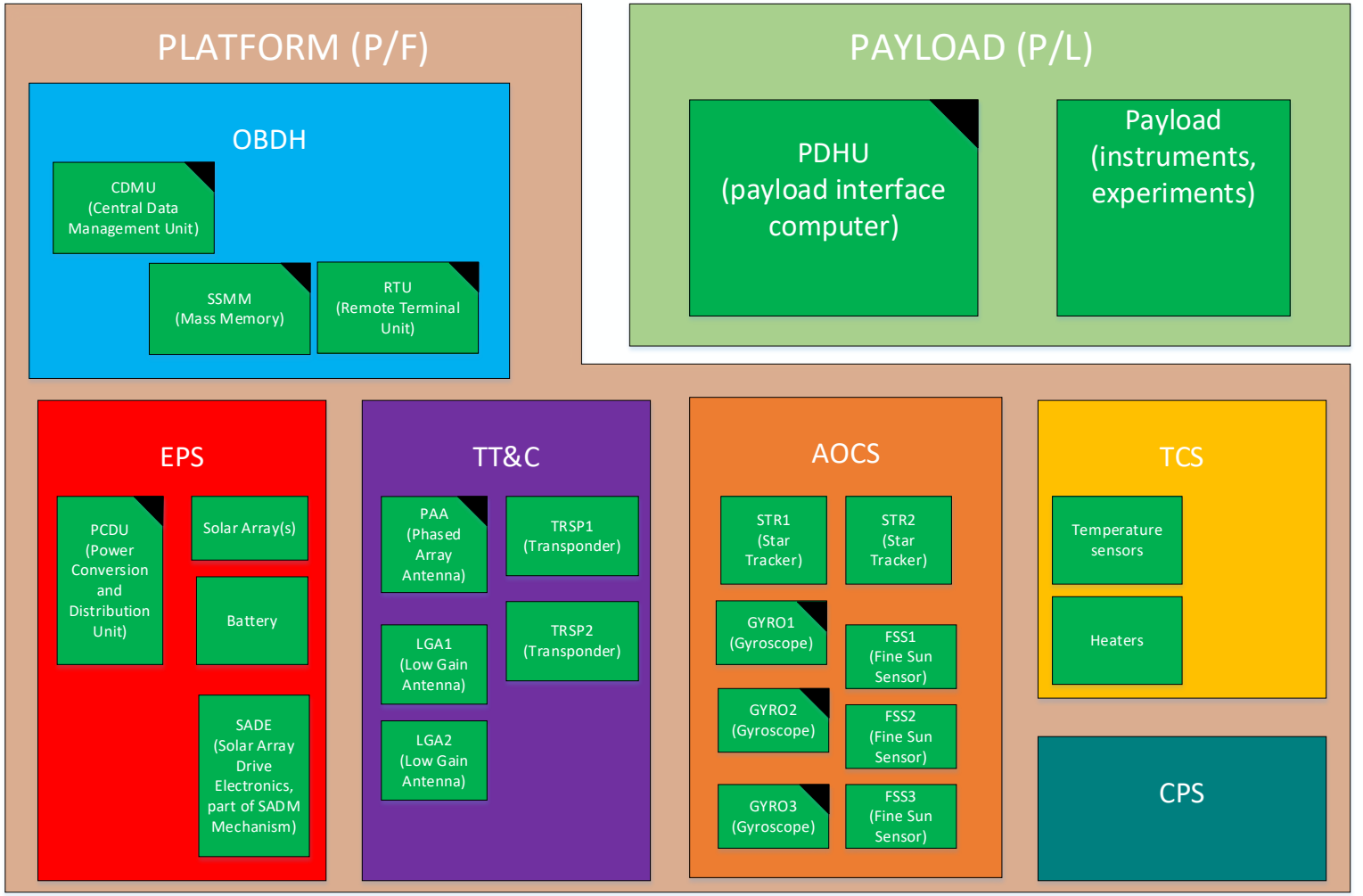


APA
Advanced
Power
Architecture



How can ESA facilitate EU industry then?

Design on demand (also recurrent design)…

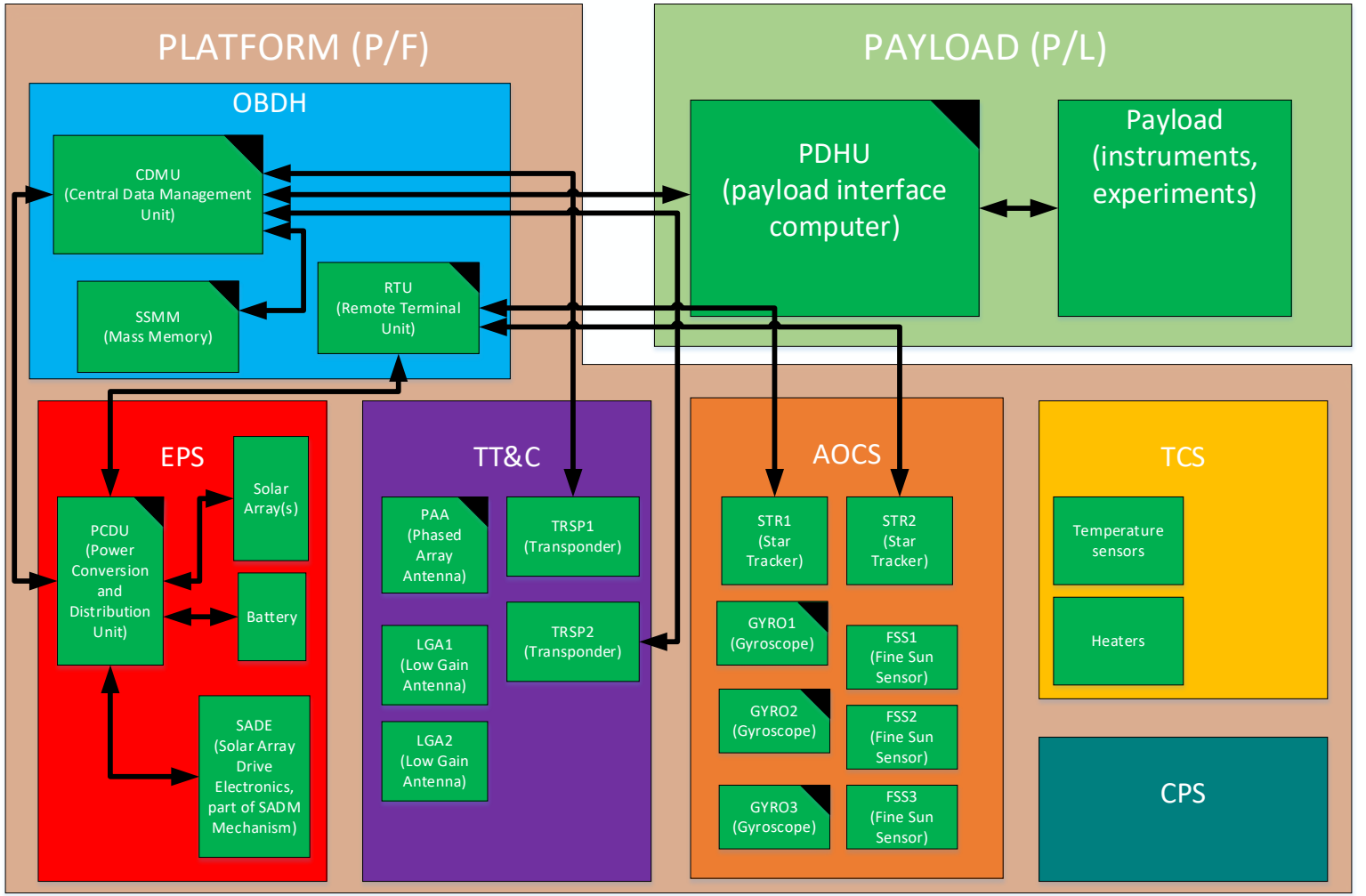


SET of ALL MISSIONS

How can ESA facilitate EU industry then?

Design on demand (also recurrent design)…

Common, *agreed* Electrical interfaces



SET of ALL MISSIONS

Common,agreed Electrical Interfaces – TM/TC classes

Present Power SAVOIR activity

Definition of **common, agreed TM/TC classes to be used by all LSIs and equipment manufacturers to cover all EPS identified needs.**

What is a TM/TC class?

=> The full set of specification parameters for the TM or the TC before its *instantiation*.

The TM/TC classes **definition** should be **as exhaustive as possible**, to be able to use them as far as practical for any required application.

In the Power WG, we made **use** of the **developed EPS MBSE model** to derive the required classes of TM's and TC's from all the identified **observability** and **commandability** needs.

Common, agreed Electrical Interfaces – TM/TC classes

TM/TC class example

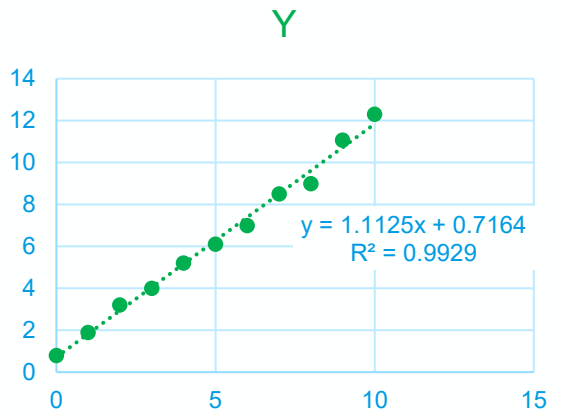
“ANL12”

TM class for analogue acquisition purposes, of linear nature.
12 bits, to support accuracy down to 0.1% of full-scale value.
Completely characterised when the following parameters are additionally specified:

- range of validity (min and max);
- max reading/polling rate (if acquired in the HK flow);
- max reading/polling rate, command code triggering the acquisition, max response delay from command trigger, settling time (if acquisition is ON demand);
- accuracy (with respect to a given model)
- linearity (min value of R^2, correlation coefficient applied to a linear relation)
- acquisition bandwidth
- max noise content (LSBs in a given frequency range)
- availability (max interruption events within a given time – to cover ESDs, SEEs, other effects)

On instantiation, the following parameters shall be further specified:

- source and target equipment
- calibration adjustment (corrections at min and max value)



Common, agreed Electrical Interfaces – TM/TC classes – TN is released!

New!

All participants to Power SAVOIR WG contributed and agreed to the release of the relevant TN

The TN file (.pdf version) is embedded in this presentation:

Adobe Acrobat Document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POWER SAVOIR WG - EPS TM/TC CLASSES

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=> Your comments are welcome!

Common, agreed Electrical Interfaces – TM/TC classes – TN is released!

New!

In practice, just **5 main TM classes** and **3 TC classes** seem sufficient to address all (present and next future) observability and commandability needs of the EPS!

Initial basis for SAVOIR EDS work?

Table 1, TM or Acquisition classes

Aclass	Description
ANL	analog linear
ANL8	analog linear - 8 bits -
ANL10	analog linear - 10 bits -
ANL12	analog linear - 12 bits -
ANLHS	analog linear high speed
ANLHS8	analog linear high speed - 8 bits -
ANLHS10	analog linear high speed - 10 bits -
ANLHS12	analog linear high speed - 12 bits -
ANNL	analog non linear
ANNL8Px	analog non linear - 8 bits - xth order polynomial
ANNL10Px	analog non linear - 10 bits - xth order polynomial
ANNL12Px	analog non linear - 12 bits - xth order polynomial
ANNLHS	analog non linear high speed
ANNLHS8Px	analog non linear high speed - 8 bits - xth order polinomial
ANNLHS10Px	analog non linear high speed - 10 bits - xth order polinomial
ANNLHS12Px	analog non linear high speed - 12 bits - xth order polinomial
DIGx	digital - x bits -

Table 2, Command classes

Cclass	Description
DSB	digital single bit
DMBx	digital multiple bits - x bits -
ANSVx	analog set value - x bits -

Common, agreed Electrical Interfaces – TM/TC classes

Which are the advantages?

Being commonly agreed and in perspective, used by all EU LSIs and equipment manufacturers, the TM/TC classes **allow recurrent interfaces design**, even **before** their application to a particular mission.
This is the basis for more automatization in integration, with reduction of interface adaptation costs and very likely making plug and play dreams possible.
The recurrent nature of the interfaces is expected to increase industrial quality and reduce errors.

What is different with respect to today's situation?

The difference is that if similar "common" interfaces exist, they are **limited** to each industrial consortium.
Basically, they are similar but not equal and definitively not such to allow a seamless adaptation across them.

Is this initiative only valid for EPS?

No, it started within the Power WG for contingent reasons, but it is expected to be assessed for all subsystems dealing with electrical interfaces (avionics, AOCS, TT&C, and also thermal, propulsion, etc).

TM/TC classes will be first implemented in the running APA development.

Common, agreed Electrical Interfaces – TM/TC classes

New!

The time seems mature to extend the approach to all subsystems dealing with electrical interfaces (avionics, AOCS, TT&C, and also thermal, propulsion, etc).

Can we use the present SAVOIR forum to make it happen?