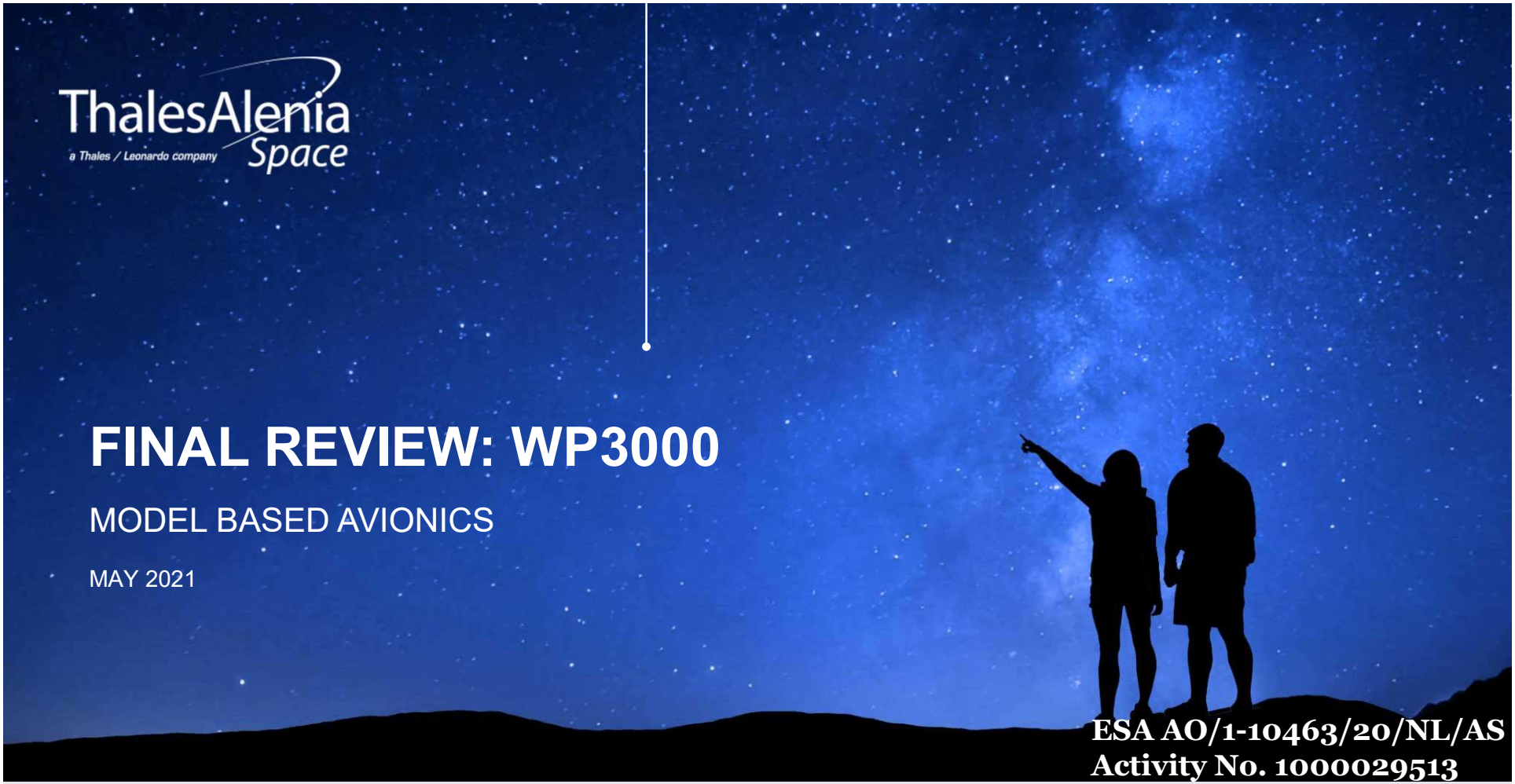

FINAL REVIEW: WP3000

MODEL BASED AVIONICS

MAY 2021

ESA AO/1-10463/20/NL/AS
Activity No. 1000029513

Date: 28/06/2022
Ref: xxxxx
Template: 83230347-DOC-TAS-EN-006

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GENERAL DISCUSSIONS: INTERFACES

/// Interface Requirements to Physical Layers: **Informative sentences and not requirement.**

8 INTERFACE REQUIREMENTS 96
8.1 Electrical Interfaces 96
8.1.1 General 96
8.1.2 SDI Interface Type Definition 96
8.1.3 SpaceWire Interfaces 96
8.1.4 MIL-STD-1553B Interface 96
8.1.5 BDM Interface Type Definition 97
8.1.6 BSM Interface Type Definition 97
8.1.7 HV-HPC Interface Type Definition 97
8.1.8 CAN Bus Interface 97

8.1 Electrical Interfaces

8.1.1 General

Requirement Number : SAVOIR.OBC.IF.10
The OBC shall continue to function nominally if one input or output is left non connected.
Note: This requirement is not applicable to the power bus.

8.1.2 SDI Interface Type Definition

Requirement Number : SAVOIR.OBC.IF.SDI.10
SDI Input Electrical Interface
The SDI Input shall be implemented according to clause 8.8 in ECSS-E-ST-50-14C

Requirement Number : SAVOIR.OBC.IF.SDI.20
SDI Output Electrical Interface
The SDI Output shall be implemented according to clause 8.8 in ECSS-E-ST-50-14C with the following exception:
* The differential output impedance (8.8 a.4) shall be between 100 and 140 ohms.

8.1.8 CAN Bus Interface

Requirement Number : SAVOIR.OBC.IF.CAN.10
CAN Electrical Interface
The CAN Bus shall be compliant to ECSS-E-ST-50-15C clause 5.

/// ECSS is already applicable so it is useless to remind a requirement on it.

/// References to ECSS, how to manage?

/// ToC or chapter reference?

/// If number of Links shall be required: ok but with variant and parameters. Depending on the choice of implementation, parameters can be set.

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GENERAL DISCUSSIONS: INTERFACES

/// Under each function there are “Interfaces” paragraph: Req with “communication path” notion.

7.4.3 Platform TM Encoder Interfaces

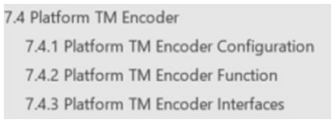
Requirement Number : SAVOIR.OBC.TM.200 /// TC.70
Platform TM Encoder CLCW input
The Active Platform TM Encoder shall have one communication path from each TC function.
Requirement Rationale : Required for CLCW data inclusion in the downlink

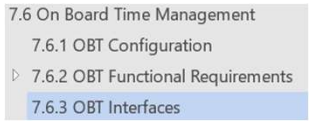
Requirement Number : SAVOIR.OBC.TM.210
Platform TM Encoder Essential TM Input
The Active Platform TM Encoder shall have one communication path from the Active Essential TM.
OptionInfo : Option HPTM=Yes
Requirement Rationale : For downlink of TM packets

Requirement Number : SAVOIR.OBC.TM.220
Platform TM Encoder PM input
The Active Platform TM Encoder shall have one communication path from the Active PM.
Requirement Rationale : For downlink of TM packets and configuration of the Active TM Encoder

Requirement Number : SAVOIR.OBC.TM.230
Platform TM Encoder PFDS inputs
The Active Platform TM Encoder shall have a communication path with the Platform Data Storage
Requirement Rationale : For downlink of TM packets

Requirement Number : SAVOIR.OBC.RM.20
RM enable/disable
It shall be possible to individually enable and disable each RM via a CPDU Pulse Command accessible from ground. *Requirement Rationale* : Ensure that RMs can be activated and controlled regardless of ASW state.





/// We need the interfaces but wherever it is coming from. We need the link with the function, whatever there is in the middle. It should be only functional need expressed and not communication path.

/// Not to map or map in the same functional exchange than the functional requirement?

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GENERAL DISCUSSIONS: INTERFACES

1) Receiver and sender paragraph have the same requirement: duplication of the requirement

Requirement Number : SAVOIR.OBC.PIO.20
Parallel Input to Essential TM
The Active Discrete Parallel IO function shall be able to send the status of the Essential TM external inputs to the Active Essential TM Function.
OptionInfo : Option PIO=YES HPTM=YES
Requirement Rationale : Used for inclusion of for instance the end result of external CPDU commands in the essential TM data packets)

Requirement Number : SAVOIR.OBC.ETM.60
Discrete Parallel IO Communication Path
The Active Essential TM Function shall have a communication path to the Active Discrete Parallel IO Function.
OptionInfo : Option PIO=YES HPTM=YES
Requirement Rationale : Used for inclusion of Discrete Parallel IO in Essential TM (e.g. external relay status)

Requirement Number : SAVOIR.OBC.PIO.40
Essential TM Communication Path
The Active Discrete Parallel IO function shall have a communication path to the Active Essential TM Function.
OptionInfo : Option PIO=YES HPTM=YES
Requirement Rationale : Used for inclusion of Discrete Parallel IO in HPTM (e.g. status of external CPDU commandable functions)

2) Implementation req are often already covered by “mother” functional req

Requirement Number : SAVOIR.OBC.RM.20
RM enable/disable
It shall be possible to individually enable and disable each RM via a CPDU Pulse Command accessible from ground. *Requirement Rationale* : Ensure that RMs can be activated and controlled regardless of ASW state.

Requirement Number : SAVOIR.OBC.RM.40
RM task 2
The RM shall be able to reset, power off and power on the currently active PM, to switch to the redundant PM and to generate CPDU commands to external equipment upon occurrence of alarm events.
Requirement Rationale : This provides the safest way of switching from a malfunctioning PM.

7.13.3 Reconfiguration Interfaces

Requirement Number : SAVOIR.OBC.RM.60
RM Enable / Disable Inputs
Each Essential TC shall have one communication path to each RM function.
Requirement Rationale : Used to turn on/off the reconfiguration modules.

Requirement Number : SAVOIR.OBC.RM.80
RM TC Segment Output
Each RM shall have a communication path to one Essential TC function.
Requirement Rationale : This link sends reconfiguration TC commands to the essential TC function for execution

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GENERAL DISCUSSIONS: PERFORMANCE

/// Requirements in the performance sections of each logical function are often too specific

MORE IMPORTANT TO STATE WHAT WE NEED THAT PERFORMANCE FOR

Requirement Number : SAVOIR.OBC.PM.575
Inter-PM Link Capability
The link connecting the Active and the Inactive PM shall be capable of transferring data at rates up to 100 kbps.
Requirement Rationale : This data rate is sufficient to support patching and dumping of Inactive PM memory at typical TC and TM link rates used by missions.

Requirement Number : SAVOIR.OBC.PM.575
Inter-PM Link Capability
The link connecting the Active and the Inactive PM shall be capable of transferring data at rates that allow patching and dumping of Inactive PM memory at typical TC and TM link rates used by missions.

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GENERAL DISCUSSIONS: PHYSICAL LEVEL

/// Some requirements are going too deep in the implementation of functional needs

Requirement Number : SAVOIR.OBC.PM.250
Software Storage Memory
Each PM function shall have at least <CPUNVM> MiBytes of non-volatile memory for storing independent software images.

Note: Typical size of a software image today is ~2MiByte. Future expected requirement is ~4MiByte.
Software images may also contain data like system parameters and On-Board Control Procedures (OBCP).

Requirement Number : SAVOIR.OBC.PM.250
Software Storage Memory
Each PM function shall have a non-volatile memory for storing independent software images.

Note: Typical size of a software image today is ~2MiByte. Future expected requirement is ~4MiByte.
Software images may also contain data like system parameters and On-Board Control Procedures (OBCP).

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MULTI-PROCESSOR APPROACH

/// List obsolete requirement with Multi-Processor System-on-Chip components:

- **PM**

SAVOIR.OBC.TC.200	The OBC shall allow the ASW to receive TC Packets distributed to the PM from both TC Decoders.
SAVOIR.OBC.PM.60	The Active PM shall be able to receive TC Segments from the TC communication paths.

  - the integration of TC chain components in SoC leads to consider all its elements as a whole, because it is difficult to declare and use a SoC as partially failed. The consequence is that no physical cross-strap is planned between internal elements of the TC chains embedded in each SoC. Of course this requirement is still functionnaly valid but with a SW routing.

- PM/ETC

SAVOIR.OBC.ETC.20	Each Essential TC function shall accept commands from either one TC Decoder, one RM or from the Active PM.

  - Functionally it is true, but the command goes to a routing function and is received from the Inactive PM.

Essential TC control

Each Essential TC function shall accept commands from either the TC Decoder, ~~at least~~the RM ~~one RM~~ or from the ~~Active~~ PM.

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MULTI-PROCESSOR APPROACH

/// List obsolete requirement with Multi-Processor System-on-Chip components:

- **PM/TME**

SAVOIR.OBC.TM.180	It shall be possible to set up the Platform TM Encoder to retrieve the CLCW alternatively from the two TC Decoders and from a single TC Decoder.
SAVOIR.OBC.TM.200	The Active Platform TM Encoder shall have one communication path from each TC function.

  - MP SoC implementation may not meet physical cross-straps requirements coming from OBC specifications and requirements should be reworded.

- SGM/PM

SAVOIR.OBC.SGM.100	Each SGM shall have a communication path to the currently active PM.

  - Functionally it is true, but the command goes to a routing function and for one SGM it is received from the Inactive PM and for the other SGM it is coming from the Active PM

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AD/RD TO REVIEW AND UPDATE

/// SpaceWire reference

- **REV 1 INSTEAD OF 2008 REFERENCE**

ECSS-E-ST-50-12C Rev1	SpaceWire - Links, nodes, routers and networks	15 May 2019

/// Typo PUS C

- **TYPO « ST »**

ECSS-E-ST-70-41C	Telemetry and telecommand packet utilization	15 April 2016

/// Cryptography elements:

- **CCSDS 352.0-B-2 INSTEAD OF B1**

CCSDS 352.0-B-2	CCSDS Cryptographic Algorithms	November 2012

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INTEGRATION APPROACH

/// Lower or smaller platform (thinner) for GEO satellites, smaller platform for some ESA missions, and ADHA approach.

/// Integration of RTU but also PCDU and PPU

- **NEO EXAMPLE: PFDIU, PLDIU, PCDU, PPU ➔ SPACE INSPIRE: ACE + HPU**

/// SAVOIR POWER is in construction. Synergies could be found on the modelling. What about the specifications?

/// The RTU document is already oriented in the good direction: RTU functions

/// That specifies functional requirements, to a “Unit” that will be in charge of the RTU Functions but not necessarily restricted to that.

/// But it doesn’t put constraints on other functionalities that could be realized by the same Physical “Unit”.

/// Recommendation : PCDU Specification should be written the same way,

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IDEAS OF RESTRUCTURATION

/// Study the potential restructuration of the SAVOIR documentation

- **RESTRUCTURATION BETWEEN OBC, RTU, MMU. THERE ARE SOME PHYSICAL REQUIREMENTS OR PHYSICAL HYPOTHESIS ON THE ARCHITECTURE.**
- **FUNCTIONS CAN BE MIXED AND GATHERED IN THE SAME UNIT (MULTI-PURPOSE UNIT).**
  - OBC/RTU
  - RTU/PCDU
- **PICKING SOME SECTIONS OF SOME DOCUMENTS.**

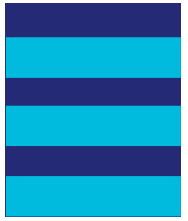
1 Savoir Avionics Spec

SAVOIR OBC | rtu | Data Storage

3 Keep the same structure with corrections

obc | rtu | Data Storage

2 Integrate lighter requirements in one single document as in programs at DHS level



Delete some implementation requirements of rephrase some requirements

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LINKS WITH REQUIREMENTS

a) requirements export

Linked in the model: refers to PDR presentation to have the Doors modules, ReqIF file and Capella import.

b) traceability matrix from requirements to functional components

M2Doc

Requirement	Allocation status (If field is empty, then no allocation)
[SAVOIR.OBC.TC.10] *No of TC Decoders*	Process Telecommands *As* LogicalFunction Provide Redundancy *As* LogicalFunction

Different views:

- Req vs Function
- Req vs Type
- Req vs function, exchanges and type

c) traceability matrix from functional components to physical components

Not possible but physical functions are linked to logical functions through the « realized » parameter. It is not done in the model but for each implementation, that could be done.

M2Doc: to Do. With Realized parameter filter, Not Done but can be done relatively rapidly. Table existing in Capella but not good and efficient to read.

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