

Generic Operability Interface Requirements Document (GOIRD) Past, present and future

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20/10/2020

14th ESA Workshop on Avionics, Data, Control and Software Systems

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Agenda



- **Introduction**
- The past: Generic OIRD overview
- The present: Generic OIRD current status
- The future: ISIS review and ECSS standards evolution
- Conclusions



- **Operability requirements** are an early input to the spacecraft development
 - Functional requirements for the space segment, including the payload, necessary for the conduction of all mission operations
 - Prepared by **ESA**

- For (most) ESA missions → **OIRD**: Operations Interface Requirements Document
 - **Mission-specific**
 - Standalone doc or integrated in System Requirements Document (**SRD**)
 - Tightly coupled with CCSDS and ECSS standards

- **The problem**
 - A dedicated Operations Interface Requirements Document (**OIRD**) per mission
 - New mission OIRDs are derived from previous OIRDs
 - Lessons learnt not always propagated to other missions and mission families
 - OIRDs are perceived as significantly different from one mission to another...
 - ...but difference not necessarily justified or not as big as perceived
 - A similar problem is perceived by operators for what concerns on-board SW implementations
 - The operability requirements drives the mission data management services on-board and the Mission Control System on-ground
 - The variability of requirements and implementations hamper product orientation
 - OIRDs evolved independently of standards (PUS-C, OBCP, etc.)
 - Partial overlap between OIRD and PUS requirements

- **Generic OIRD (GOIRD) foundations**
 - SAVOIR entrusted ESOC in June 2016 the task to establish a Generic OIRD
 - It shall form the baseline spec for future missions
 - It shall allow the definition of compatible OBSW libraries

- **The goal**
 - Create a **common** OIRD for **all** new missions
 - Maximize commonality among missions
 - Minimize differences and group them by **mission families**
 - Mission OIRDs to be created starting from the generic OIRD
 - Changes limited to mission specific deltas
 - Plus sizing of PUS-C services (e.g. MTL capacity, etc.)
 - Generic OIRD to be evolved with lessons learnt and feedback from new missions

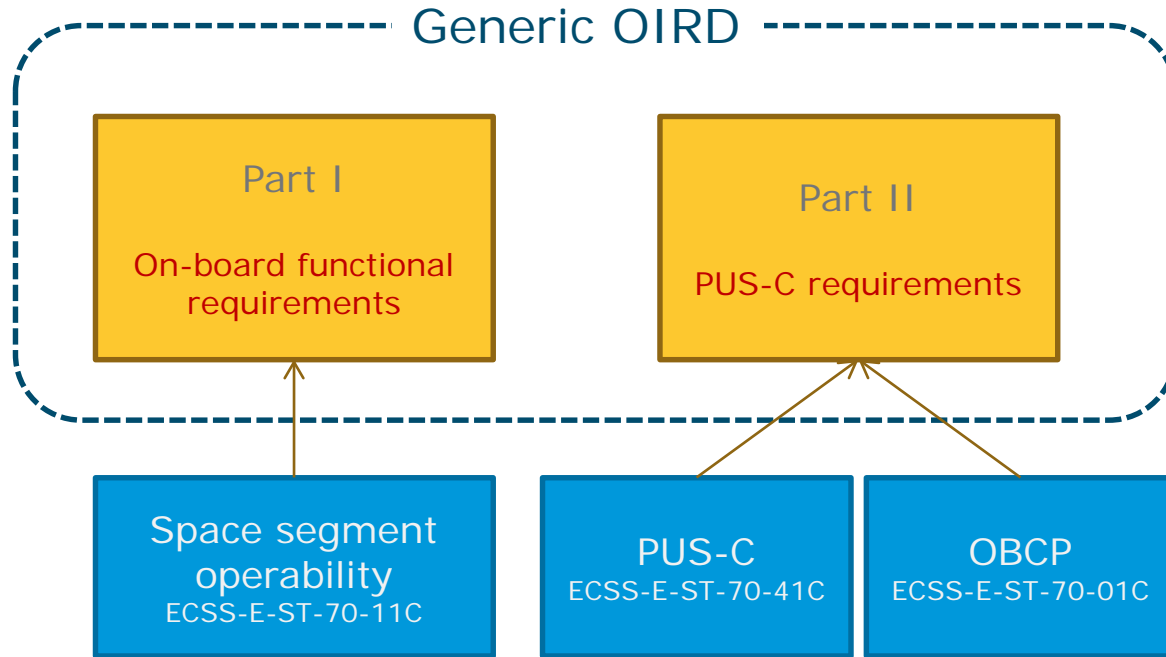
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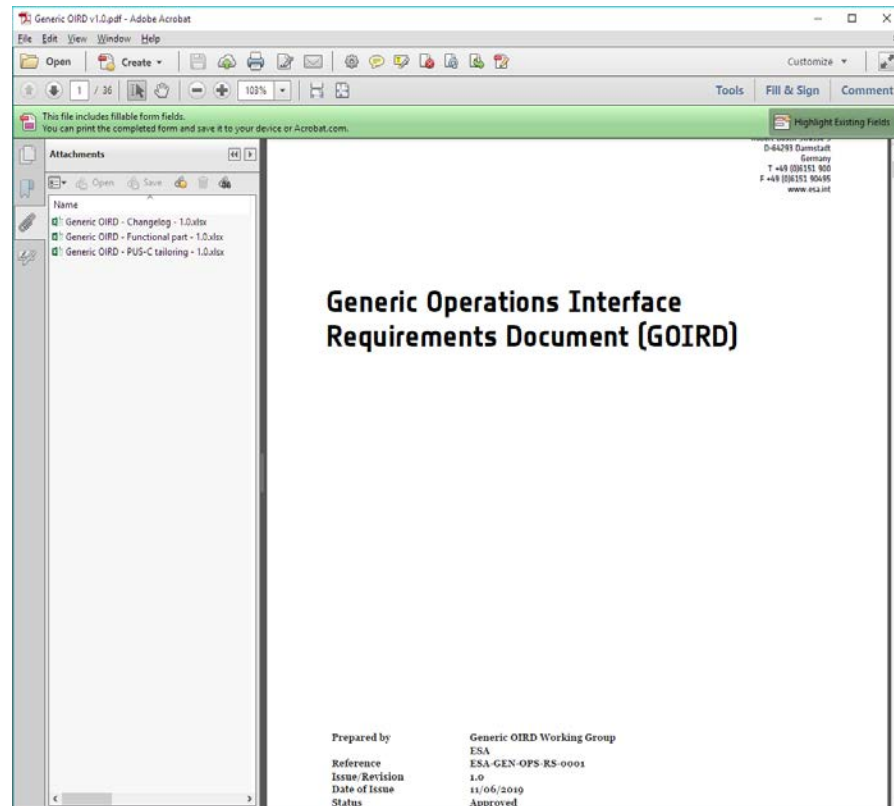
Generic OIRD - Structure



Generic OIRD - Format



- GOIRD delivered as a **PDF document**
- 3 Excel files attached → core of the GOIRD
 - **Functional requirements**
 - **PUS-C requirements**
 - Plus changelog
 - All changes to PUS-C & functional requirements since Draft A tracked



- Generic OIRD **document**
 - Motivation and scope
 - Scope limited to robotic (non tripulated) missions with an **avionics-like subsystem in mind**
 - Description of spreadsheet structure and requirements format
 - Including relationship with ECSS standards
 - Mission OIRD generation instructions

■ Function requirements

- High-level operability requirements
- No assumptions on the underlying system architecture
- PUS agnostic requirements
 - Which capabilities are required is left to the PUS-C tailoring
- Linked to ECSS Space Segment Operability Standard
 - Traceability maintained w.r.t. Operability Standard
 - But GOIRD functional requirements are self-consistent

- Functional requirements groups:
 - General
 - Modes
 - Operations/mission phases
 - Spacecraft control
 - Telecommands
 - Authentication
 - Only applicable to Earth Observation missions.
 - Telemetry
 - Timing
 - In-flight testing
 - General autonomy
 - Failure detection isolation and recovery
 - Safe mode
 - Subsystems: Attitude Control And Navigation, On-board Processors and Software, Data Storage and File System, Power, Thermal, TT&C, Payloads and Mechanisms.

- **PUS-C requirements** – A tailoring of PUS-C standard (ECSS-E-ST-70-41C) and more:
 - **Tailoring:** Services, subtypes and capabilities selection
 - Agreed in a common set of services and subservices for all future ESA missions
 - **Additional observables**
 - **New capabilities:** features required by ESA missions not covered by PUS-C standard
 - Critical event log / System log
 - Parameter extraction from HK
 - Backup MTL
 - File based operations
 - **Avionics architecture definition**
 - **Clarifications and refinements**
 - Lessons learnt from previous missions and mission OIRDs
 - **Changes to the standard**
 - Changes to PUS-C behavior limited to the **absolute minimum**

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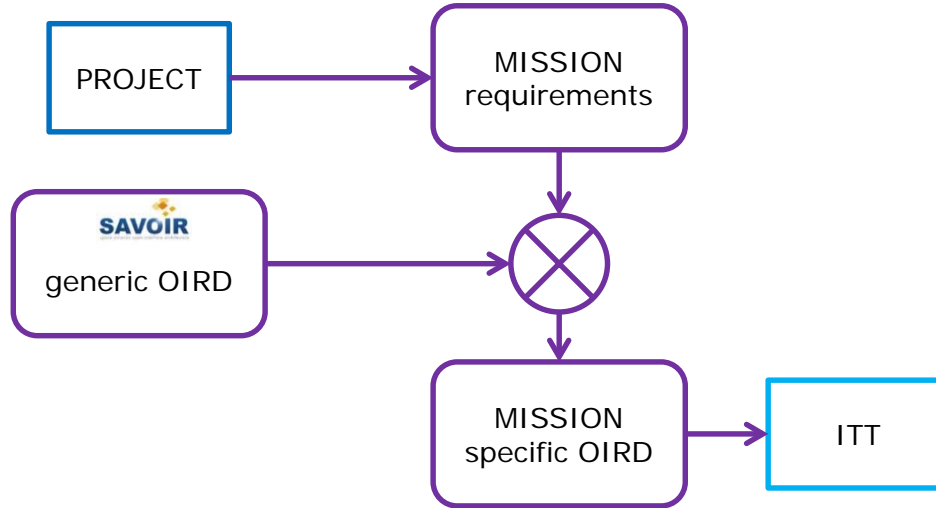
Mission OIRD generation



- GOIRD is **NOT** a replacement of mission OIRDs
 - Missions are still expected to generate their own mission OIRD
 - GOIRD is only a reference document for the mission

- Mission OIRDs shall be produced starting from GOIRD
 - No copy & paste from previous mission OIRDs
 - Instead take all GOIRD requirements and implement mission-specific changes
 - Clear tracing in mission OIRD of changes/additions with respect to GOIRD
 - Changes shall be truly mission specific:
 - Very few deltas with respect to the GOIRD expected in the mission OIRD
 - Definition of mission constants and sizing of PUS-C services
 - De-scope of PUS-C services and functional requirements not applicable to the mission

Mission OIRD generation



Generic OIRD - Status



- Generic OIRD 1.0 formally released in **July 2019**

- **Used already by multiple projects to build their mission OIRDs**
 - Copernicus high-priority candidate missions OIRD
 - ERO / Mars Sample Return OIRD
 - HERA OIRD
 - ARIEL OIRD



Generic OIRD - Status



Programme	Mission	Launch	PUS	G-OIRD	Notes
EOP	EarthCare	2022	A		
	Sentinels C/D models	2022 ++	A		
	BIOMASS	2022	A		
	FLEX	2024	A		
	Sentinels HPCM	end 2025	C	yes	
	FORUM	2026	tbd		(old Earth Explorer 9), the original schedule and available funds (and hence the Phase A/B1 OIRD) baselined this mission on PUS-A, etc etc but in the preparation of the Phase C/D/E1 ITT (for end of this year), discussing with Project what to do (the Primes may now want to re-use the proposals of the HPCM and indeed go to a PUS-C
	TRUTHS	2026-2028	tbd		the UK lead mission, still in Phase A/B1): same as FORUM (particularly Airbus UK has proposed PUS-C for the Sentinels HPCM
	Sentinels NG	2028 ++	C	yes	
	EE-10		tbd		still in phase A
SCI	JUICE	2022	A		with some PUS-C features introduced e.g. Service 11 GroupID
	Euclid	2022	A		
	Plato	2026	C		
	Comet Interceptor	2028	C	yes	at least at spec level for ITT, implementation proposal still to come
	Ariel	2028	C	yes	
HRE	ExoMars RSP	2022	A		
	MSR-ERO	2026	C	yes	
	MSR-SFR	2026	C	yes	at least at OIRD level (TBC, discussion on-going), but OBSW will re-use a lot of ExoMars Rover thus PUS-A
S2P	Hera	2024	C	yes	SW is partial re-use of Proba so some PUS-C features might not be there
	Lagrange	tbd	C	yes	
STS	Sapce Rider	2022	A		Not operated by OPS

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Generic OIRD - Status



- GOIRD **v1.1** under final review
 - Feedback from multiple sources
 - ESOC internal
 - Projects: Copernicus HPCM, HERA, MSR/ERO
 - CNES feedback to GOIRD document only (excluding PUS-C)
 - SAVOIR
 - Content
 - No big surprises, mainly clarifications and corrections
 - SAVOIR agreement on number of bytes to encode key parameters like Event ID
 - All changes fully traced in changelog



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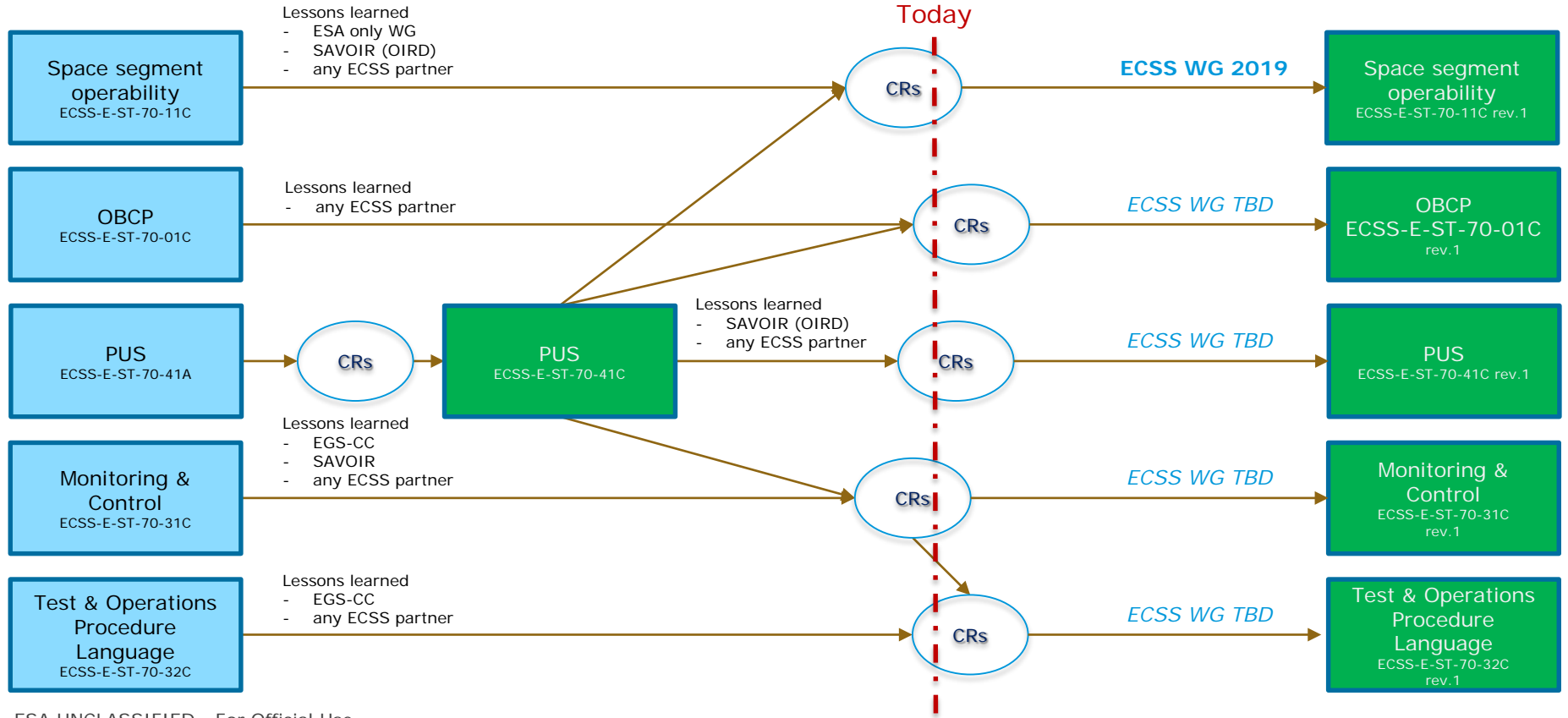
- CNES Initiative for Space Innovative Standards (**ISIS**)
 - ISIS original specification based on PUS-A
 - Similar goals to GOIRD → standardization of platform to payload interfaces
 - Ultimate goal: increase reuse → costs, technical and programmatical risks reduction
- **ISIS team** (CNES, ADS, TAS) has reviewed the complete GOIRD
 - **Could ISIS and GOIRD converge?**
 - Clear interest for all parties to **avoid very different PUS-C implementations** for ISIS-based missions and GOIRD-based missions
 - ... but devil is in the details!
 - Document and functional requirements feedback provided in 2019 (→ GOIRD v.1.1)
 - Extensive review of PUS-C requirements in 2020

- Working group with ISIS team (+OHB) & ESA started in July 2020
 - About 100 requirements to be discussed
 - Bottom-up approach, based on consensus
 - Constructive and positive atmosphere, but slow progress (consensus is hard!)

- Outcome of ISIS review
 - Proposed set of **changes for GOIRD → GOIRD v1.2**
 - Remarks and notes to clarify requirements
 - Address weaknesses in GOIRD discovered by ISIS team
 - Generalise GOIRD to cover some of the additional CNES needs
 - Set of **change requests to PUS-C standard → PUS-C review working group**
 - Same ESOC and CNES needs but not covered by PUS-C
 - Different needs that could be addressed by a more generic PUS-C implementation

- **Review 1** of relevant ECSS standards for operations
 - Scope (relevant to GOIRD)
 - ECSS-E-ST-70-11C - Space segment operability
 - ECSS-E-ST-70-41C - PUS-C
 - To start in Q4 2020 – Working group almost setup
 - Good opportunity to inject feedback from GOIRD (and ISIS review) into the ECSS framework
 - New functions (CEL, BMTL, File Based Ops...)
 - PUS-C modifications and enhancements

ECSS review



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■ Roadmap

- Complete ISIS review (end of October)
- Raise CRs to PUS-C standard (October/November)
- ECSS PUS WG and PUS-C update
- CR for all other ECSS-E-ST-70-x standards
 - And specially ECSS-E-ST-70-11C (Operability standard)
- After release of updated ECSS standards → **major GOIRD update** (v2.0?)
 - Re-align GOIRD requirements with standard
 - Target is to limit GOIRD scope to standards tailoring as much as possible

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Conclusions



- Generic OIRD
 - New approach at ESA for operability requirements
 - Common set of functional and PUS-C requirements for future ESA missions
 - **Goal is to reduce variability and cost**
 - Definition of compatible OBSW libraries
 - Further harmonisation of ground segment
 - **Actively used** now in most ESA future missions!

- Generic OIRD is **not static**
 - Feedback from projects and SAVOIR continuously processed
 - And even cooperation beyond ESA (ISIS review)

- Next major milestone
 - Contribute to the review of PUS-C and other ECSS standards
 - Future major GOIRD update to align to review 1 of relevant ECSS docs





THANK YOU!

QUESTIONS?

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