Guidelines for using COTS Components

ESA COTS Working Group 2/3

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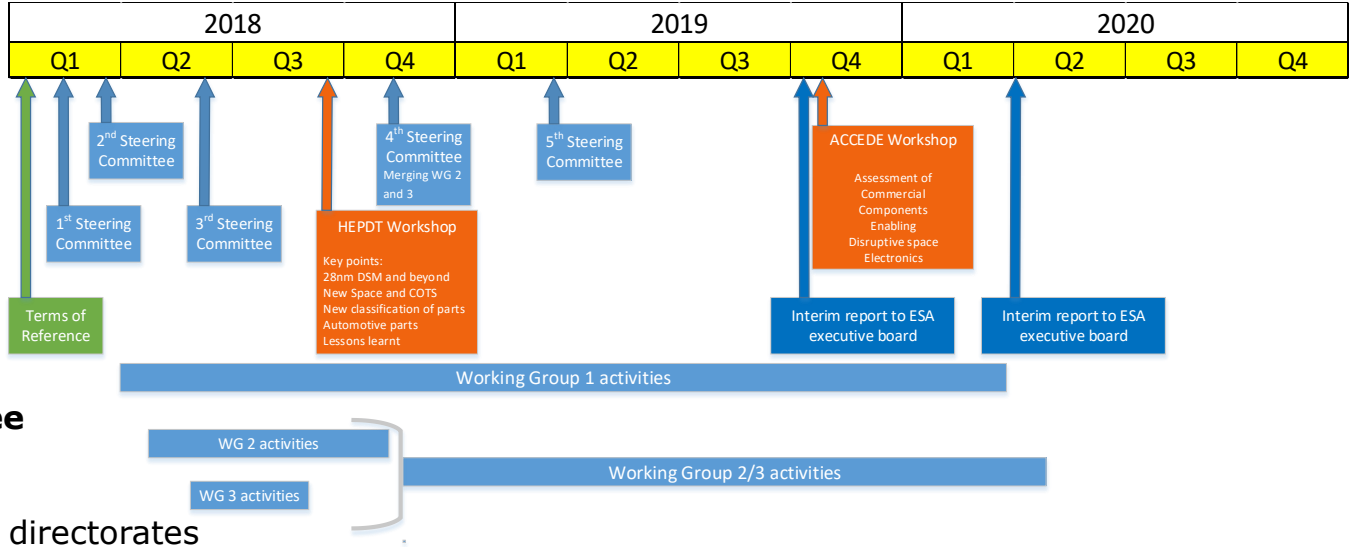
WHY COTS COMPONENTS AND MODULES IN SPACE ?

- **Cost advantage**, only for large volumes or low reliability/low radiation application where important risks might be taken.
- **Performance advantage** not obtainable by classical Hi-Rel components
- **Lack of Hi-Rel components** for performing that function
- **Availability of production capability of supply chain for terrestrial use**
- **Shorter lead times**

ESA's Initiative on COTS



ESA COTS Steering Committee

- Kick off Feb 2018
- Composition: all Programme directorates

Output

- **Interim report** to the ESA Executive Board (presented 29 Oct 2019) with set of recommendations for the use of COTS in future Agency programmes~~("new space", plus~~ a roadmap/ required next steps to achieve them

- **Final report** to the ESA Executive Board (to be prepared by Q1 2020)

Who's involved

Steering Committee	
Britta Schade	TEC-Q
Philippe Armbruster	TEC-E
Frederic Teston	TEC-S
Jean-Loup Terraillon	TEC-S
Mikko Nikulainen	TEC-QE
Dietmar Schmitt	TIA-TT
Martin Born	TIA-PRQ
Anders Elfving	EOP-PA
Géraldine Naja	IPL-I
Michael Kasper	HRE-Q

Working Group 1	
Philippe Armbruster	TEC-E
Albert Crausaz	TIA-PP
Karin Lundmark	TEC-EDC
Olivier Mourra	EOP-PPE
Ralf de Marino	TEC-Q
Rok Dittrich	NAV-PFS
Karim Mellab	TEC-SP
Sam Rason	TEC-QEC
Silvia Massetti	TEC-EDC
Laurent Marchand	TEC-QQ

Working Group 2 and 3		
Member name	**Expertise**	**Remark**
Anastasia Pesce	ESCC Components Standardisat & Qual.	
Christophe Delepaut	Power Management and Distribution	
Eike Kircher	Technical. Programmes Office	
Ferdinando Tonicello	TEC-E Lead Engineer	Convenor
François Deborgies	RF Technology Advisor	
Fulvio Capogna	Dependability (RAM) & Safety	
Gianluca Furano	On-Board Computer Engineer	
Jorge Alves	Technology Engineer	
Josep Rosello	Technology Coordination. & Frequency Management	
Karim Mellab	Projects Office	
Karin Lundmark	EEE Components	
Ludovic Duvet	Senior System and Technology Engineer	
Massimilano Pastena	Technology Coordination. & Frequency Management	
Patrizia Secchi	Navigation Product Assurance & Safety Office	
Paul Robert Nugteren	Technology and Strategy Coordinator	
Rok Dittrich	Navigation R&D Engineer	
Samantha Rason	Radiation Effects Engineer	
Sylvia Bayon	System Engineer	
Valerie Dutto	Space Segment Engineer	
Stefano Santandrea	Small Satellite Platform Unit	Substitute for KM
Christian Poivey	Radiation Effects Engineer	Substitute for SR
Keith Miller	Coordination Engineer	Secretary
Jussi Hokka	Materials Engineer	
Kostas Marinis	On Board Computers and Data Handling Engineer	
Veronique Ferlet-Cavrois	Power Systems, EMC & Space Environment	As radiation expert

WG tasks

WG1

- Definition of the COTS EEE components perimeter for space.
- What is available/industrial landscape? – Normative landscape?
- Where do we use COTS today?
- How do we use COTS today?
- Current best practices and lessons learned.

WG 2/3

- Perform the **classification of the COTS** component categories according to (applications) criticality categories;
- Identify procurement, screening, application and test methods for COTS components and modules in the different application criticality categories;
- Identify a roadmap of the necessary R&D (and other) activities to finalise the proposed COTS components and modules approach.

WG 2/3 finalised a TN

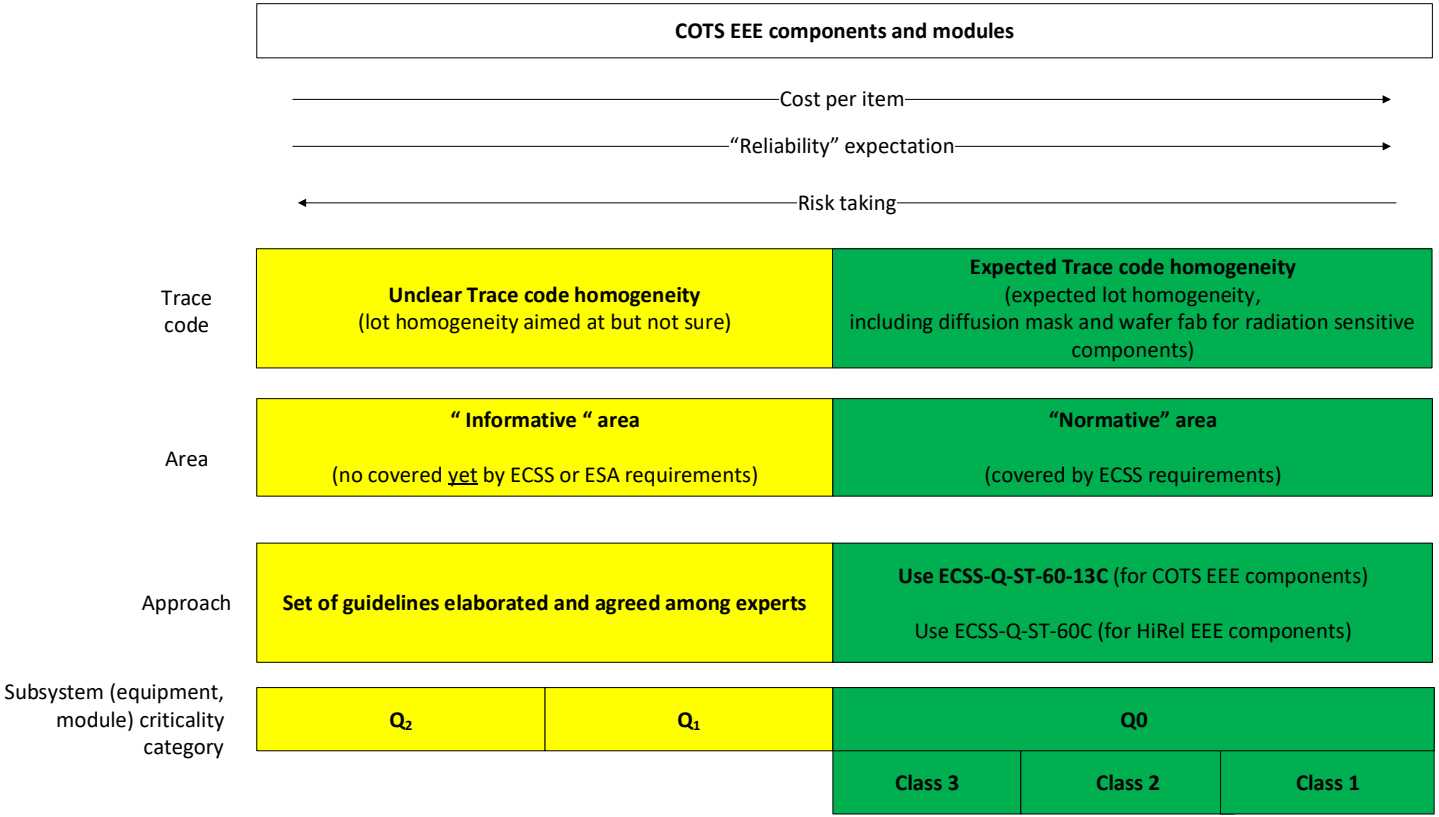
- Set of guidelines and not requirements
- Balanced approach especially between reliability and radiation performances, according to a progressive scheme from higher to less risk taking
- Addressing the issue of **small procurement lots** and relevant **lot homogeneity issues**
- Addressing the application of COTS parts in modules, equipment or subsystems of **different criticality categories** for ESA institutional missions.

TECHNICAL NOTE

ESA COTS initiative, WG 2/3 work synthesis

Projected advantage: on a given mission, different criticality categories can appear, depending on the nature of the considered modules, equipment or subsystem.
Example: essential vs experimental or "expendable" item.

Proposed COTS approach for ESA missions



Classification of criticality categories

			<----------Informative area---------->		<---------Normative area--------->
Mission references	Type		"Low cost - experimental" mission,	"Robust" mission with high quality / reliability needs.	"Hi Rel certified" mission
	Cost		Low	Low/medium	Medium/High
	Lifetime		few weeks/months up to 1 year	1 to 3 years	> 3 Year
	Reliability		low to medium	High	high
	Radiation	SEE	negligible due to lifetime	Relevant	relevant
	Example		ESEO, R&D payloads, serviceable systems?	SAT-AIS, Generic Constellation, Technology Demonstrators	MEX, GAIA, Bepi Colombo, Sentinel 1,2,3, METOP SG, EDRS, Electra, Galileo FOC, IOV...
Module, equipment or subsystem function	Radiation	TID	Minor (up to 5Krad)	Medium (up to 10-15 Krad)	Medium to High (higher than 10-15 Krad)
(Minimum) Equipment, Subsystem or System Criticality Category			Q_2	Q_1	Q_0 According to ECSS-Q-ST-60-13C*, ECSS-Q-ST-60C '* extended to passives

- The table is intended as informative and not normative.
- In this table, mission references are just given as examples. The link from criticality categories Q2, Q1, Qo to mission class is not subject of this document.
- The criticality categories apply to COTS components and modules at module, equipment or subsystem level and not necessarily at mission level.
- The adoption of criticality categories should be decided at specific mission level per module, equipment or subsystem.
- Radiation has been split (SEE at mission level, TID at module, equipment or subsystem level) because screening material (lead, aluminium, other) might be applied for improving TID tolerance but not to improve SEE one (at least SEGR and SEB on power MOSFETs).

Critical aspects coverage

For each criticality category Q_2, Q_1, Q_0 the following aspects are addressed:

- Perimeter of application

- Methods to resolve the critical points relevant to
  - ✓ **RAMS** (Safety, dependability, FMECA…)
  - ✓ **Material and processes**
  - ✓ **EEE components** general issues
  - ✓ **Radiation** (TID, TNID, SEE)
  - ✓ **Economy of scale/supply chain**
  - ✓ **Application**, including

    approaches for data sheets review, electrical analyses needs, mitigation techniques, reference application circuits, modules

Extensive coverage in the annexes

Recommended activities to finalize the proposed COTS components and modules approach

1. **Update of ECSS-Q-ST-60-13C**
   - This activity is running, ESA participates through TEC-QES (Requirements and Standards) and TEC-EDC (EEE components).
2. **Identification of safe operation factors for criticality categories Q_2 and Q_1**
   - Proposed ESA focal points: TEC-QEC (radiation), TEC-EDC (EEE components).
3. **COTS components and modules, information gathering**
   - Proposed ESA focal points: TEC-QEC (radiation), TEC-EDC (EEE components).
4. **Reference application circuits**
   - Proposed ESA focal points: TEC-ED (digital components), TEC-EPM (power and analogue components)

Recommended activities to finalize the proposed COTS components and modules approach

5. **New test methods for modules and boards**
   - Proposed ESA focal points: TEC-QEC (radiation) and TEC-EDC (EEE components)
6. **Lead free recommendations**
   - Proposed ESA focal points: TEC-MSP (Materials & Processes), TEC-EDC (EEE components), TEC-QEE (Materials' Physics & Chemistry)
7. **Good practices for Radiation**
   - Proposed ESA focal point: TEC-EPS (Space Environment and Effects)

Contact

The Guideline document can be provided to you, … if you commit to give comments to it.

Just contact me:

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