

Usage of COTS EEE Components in ESA Space Programs

ESCCON 2019



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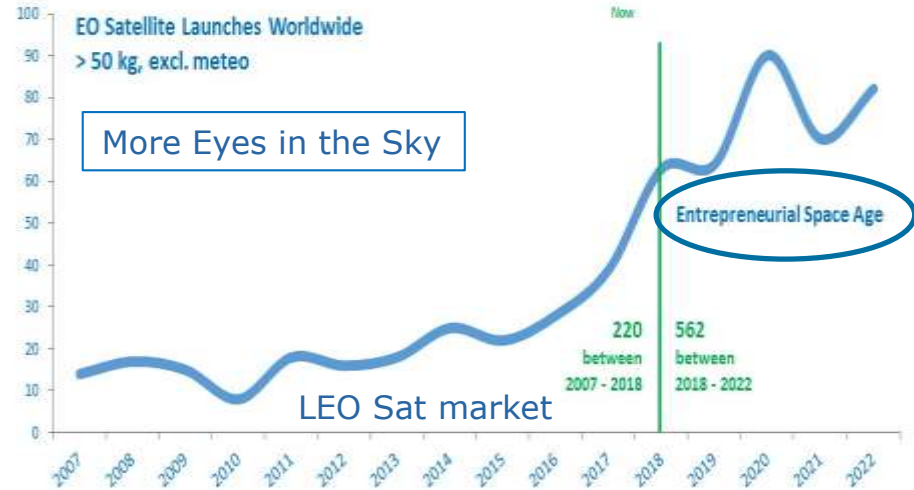
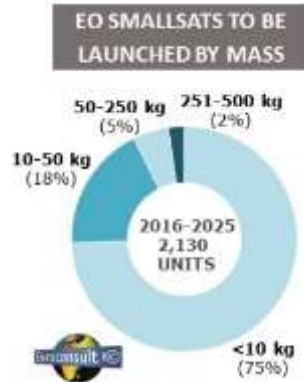
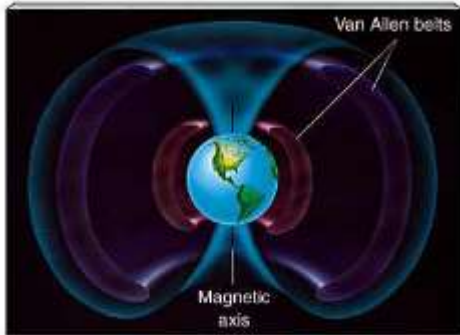
Introduction



Space physics has not changed, but

- Strong Emergence of the Low Earth Orbit market
- New ways of assessing/ taking risks with Venture Capital and PPP
- Mass production concepts emerging
- Need to access fast the new technologies with increased performance

Requires a rethink on how we select EEE components to match our future mission profiles.



ESA UNCLASSIFIED – ESA-TEC-HO-Q-0013223



EEE Components and Sat Payloads

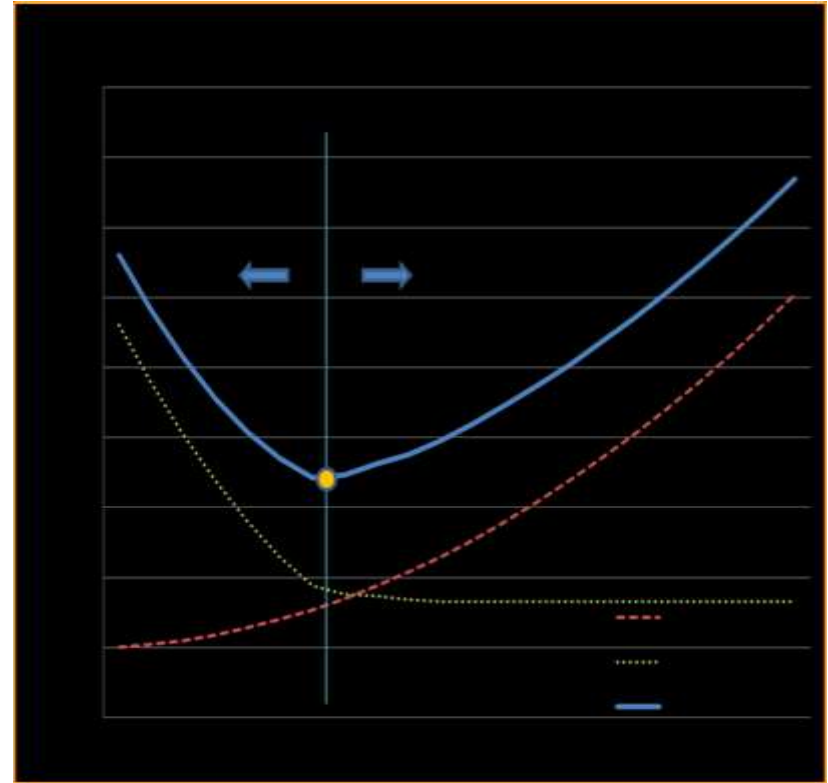


- Applications are more and more sophisticated and need state of the art EEE Components for their implementation: "Mission Enablers"
- Classical Space components development plans and qualification schemes have shown their limits already for a long time - Usage of COTS components is already a reality for the following reasons:
 - ✓ Performance
 - ✓ Availability
 - ✓ Cost of Ownership
 - ✓ Lead times

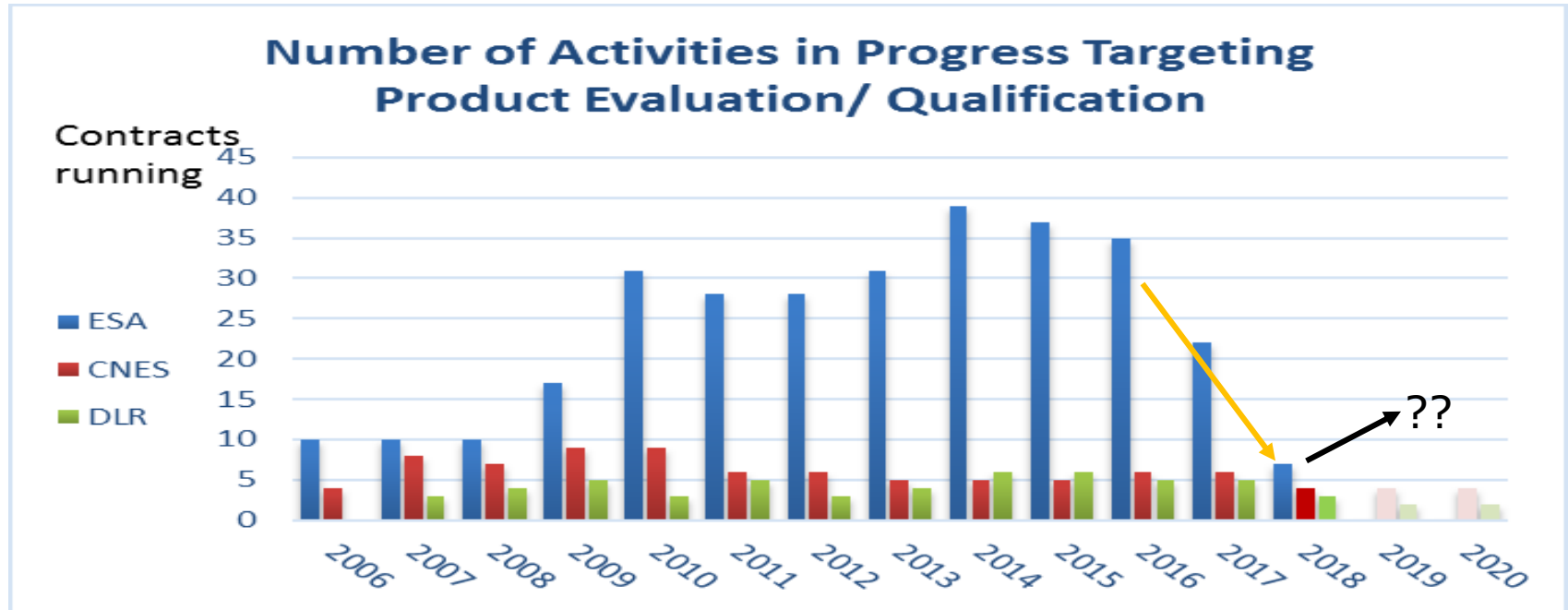
Estimate 20% EEE components in ESA satellites are COTS

No longer a decision if COTS components are needed, but more, how to use them in an appropriate manner according to the mission profile in terms of:

Safety, Reliability and Availability



European Component Initiative



Technology Opportunity



1990's

2018



ESA's Approach on COTS



ESA COTS Steering Committee Mandate:

"Bring together all ESA stake holders related to COTS based development, COTS end users, testing facilities and standards/specification entities in order to manage the evolution of the use of COTS in an coordinated manner in ESA's current and future programmes, and in support to industrial requests".

- Map the needs and the current landscape
- Define the vision and means to manage the challenges of COTS utilisation
- Collaborate with Industry, institutes and space agencies and operators
- Assess the impact of the future COTS policies
- Establish a consolidated action plan for utilisation of COTS in future missions

Timescale : approx. 12- 16 months

Space Environment

- Radiation-Single Event Effects
- Radiation-Total dose
- Vibration
- Outgassing
- Thermal

**ADAPT TESTING TO THE
NEW MARKETS**

Manufacturing & Procurement

- Short product lifetime/ runs
- Limited traceability in the supply chain
- Counterfeit components
- Limited / No after sales support for Space applications
- Variable reliability across production runs
- Assembly and packaging (RoHs & PEMs)

**ADAPT PA/QA
APPROACH**

Narrowing the Scope of COTS



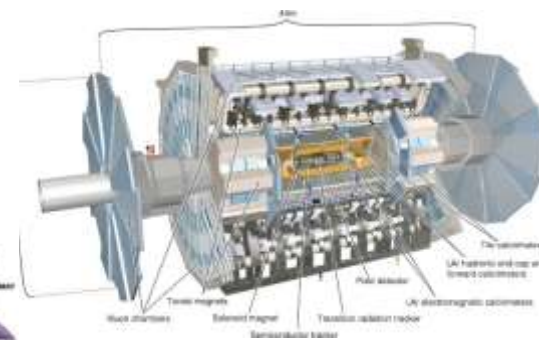
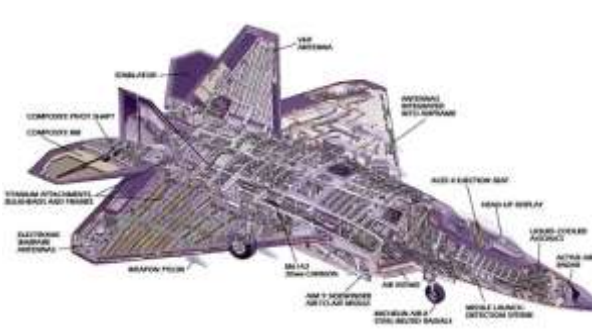
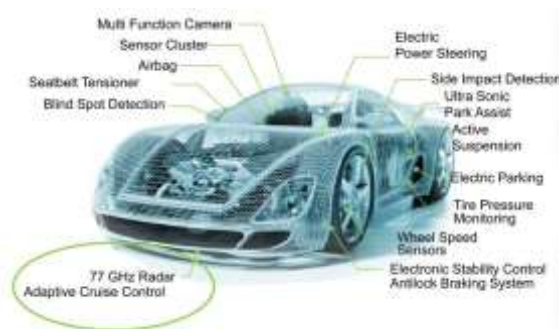
COTS Definition :

“Commercial electronic component readily available and not manufactured, inspected or tested in accordance with military or space standards” (Ref: ECSS-S-ST-00-01C)

“Part neither designed, nor manufactured with reference to military or space standards” (Ref: ECSS-Q-ST-60C)

i.e. Millions of EEE COTS parts !!!

As the selection and evaluation costs of components w.r.t to reliability and radiation assurance aspects are high, a refined selection concept has to be defined:



Large Hadron Collider

Hi-rel, Automotive safety critical, Aeronautical, Medical, Nuclear?



System

- Establishing Mission Classifications
- Redefining Mission Success Criteria
- Sub-System Redundancy
- Design Mitigation, Fault Tree Analysis



Testing/ Screening

- Updating ECSS Q-ST-60-13
- Establish Board Level Testing
- Tailored RHA/Environment approach
- Utilizing Statistical Process Controls from the Manufacturing Process



Technical

- Trusted Supply Chain for "COTS+ "?
- Guidelines for Plastic/Non Hermetic packages
- COTS Reliability Database as a tool for the New Best Practices
- Reference Design Test Boards
- Risk Mitigation for Pure Tin Assemblies



"We look at the reliability from the system perspective. At any given time, an arbitrary satellite may be turned off."

"Will you launch more?"

Very much so. Just to cover for those ones that will not perform perfectly or will fail at launch."

*Rafal Modrzewski,
ICEYE chief executive
Spacenews 22/5/2018*

Low cost or Low criticality Missions

We already know how to deal with COTS for ESA main stream cornerstone missions. (**ECSS-ST-Q-60-13 Class1**).

- **Less clear : low cost missions or low criticality missions**
- A new classification system is necessary to understand how COTS components may be used for these types of missions
- how to assess the COTS suitability for these missions.

General consensus from the ESA COTS Working groups: "there is a need for a **guideline document** on the use of EEE COTS and COTS+ at ESA ":

- Broadening the definition of COTS to include EEE assemblies/modules;
- Classification of ESA missions and modules, based on risk classes with measurable environmental/mission parameters (e.g. orbit, lifetime, re-launch possibility etc);
- Defining New test methodologies at component level and at module level.
- Mapping the ESCC-Q-60-13 Class 1-3, against mission classifications
- Tailoring rules/ guidelines for the PA requirements for the different mission classes.

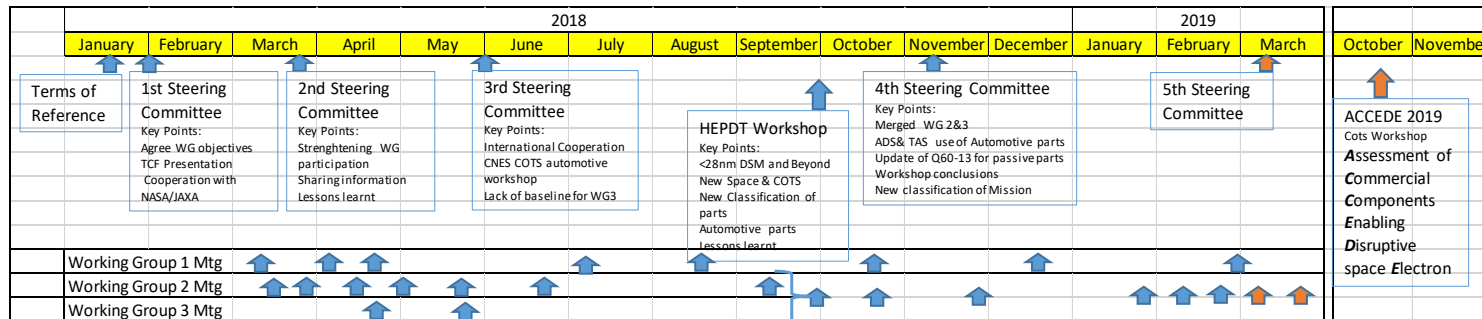


Risk Classification for NASA Payloads (GPR 8705.4)	
EEE parts	Class A
	Class B
	Class C
	Class D
	Ground Systems (GS)
	7120.8 class
	Do No Harm
	Hosted payload Class

ECSS Component classes	
EEE parts	Class 1
	Class 2
	Class 3
	COTS
	COTS +
	EP

		-----Informative area-----				-----Normative area-----	
Mission reference	Type		<u>"Low cost - experimental" mission.</u>		<u>"Robust" mission with high quality / reliability needs.</u>	<u>"Hi Rel certified" mission</u>	
	Cost		Low	Low/medium	Medium/High		
	Lifetime		few weeks/months	> 1 year	> 3 Year		
	Reliability		low to medium	High	high		
	Radiation	SEE	negligible due to lifetime	Relevant	relevant		
	Example		ESEO, Cubesat in LEO, 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	Type		<u>Non Essential</u>	<u>Essential</u>	<u>Non Essential</u>	<u>Essential</u>
Radiation		TiD	Minor	Minor	Medium	Medium	Medium to high
(Minimum) Risk class							Q ₀
(quality standard, guidelines or procedures to be followed)			Q ₄ (TBD)	Q ₃ (TBD)	Q ₂ (TBD)	Q ₁ (TBD)	According to ECSS-Q-ST-60-13C*, ECSS-Q-ST-60C ** extended to passives

ESA's Timeline on COTS Timescale : 12+ Months (starting Feb 2018)



ESA COTS Steering Committee and Working Groups

- Kick off Feb 2018.
- Composition: All Programme directorates are involved. (VERY IMPORTANT)

Expected output:

Interim report to the ESA Executive Board with

- set of recommendations for the use of COTS in future Agency programmes/"new space",
- a roadmap/ required next steps to achieve the above (Q2 2019).

COTS Workshop: ACCEDE (2019)

Assessment of **C**ommercial **C**omponents **E**nabling **D**isruptive space **E**lectronics

Seville (ES): 2-4 October 2019 (2.5 days) - Preliminary programme:

- **Needs and Requirements of End Users**
 - Eutelsat, EU,EDA, Hispasat.....
- **Space Agencies Strategies towards use of COTS**
 - ESA, CNES, DLR, NASA, JAXA.....
- **Satellite integrators /Equipment manufacturers**
 - Airbus, TAS, OHB,
- **Component manufacturers approach**
 - Microchip, Texas instruments.....
- **Technology Concerns**
 - Tin whiskers , lead free, Cu wire ...
- **Risk Management**
 - Reliability prediction , Derating.....
- **Requirements and Specification Systems**



ACCEDE
COTS2019

SEVILLE - SPAIN 2-4 OCTOBER

Assessment of Commercial Components
Enabling Disruptive space Electronics



This workshop is focusing on all aspects related to the usage of Commercial of the Shelf (COTS) Electrical, Electronic and Electromechanical (EEE) parts in space applications. Although the main goal is to address specific needs of "New Space" programs such as constellations and/or nano & small satellites, the workshop will cover also the needs of more classical space missions.

www.altertechnology-group.com
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***Thank you for your
attention !***

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