Introduction to the ECSS standardisation system

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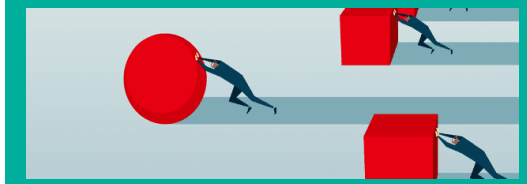
1 → Understanding the ECSS standardisation system

The need for space standards

Competitiveness

Standards have an important economic and social role for enabling our industry to remain competitive on the market and to conquer new markets.



Efficiency

Standards contribute to making the development, manufacturing and supply of products and services more efficient, reliable, safer, and cleaner.

Trade facilitation

Standards allow trading between organizations to progress easier and fairer.

Knowledge transfer

Standards aid in transferring knowledge and enhancing engineering capabilities to smaller or developing organizations.

Education

Standards participate to the education of today's and future engineers when conforming to standards is secured, thus, for instance, avoiding designers *reinventing the wheel*.

Myths about standards*

Myth

Standards stifle innovation

Fact

Standards stimulate advanced technology by adopting, adapting, developing and solidifying innovations with exposure to a wider community

When an innovative technology is rapidly brought to the standards community, it is vetted with a larger user base, facilitating widespread adoption of innovative technology.

This reduces the risk of new technology with “more eyes on the problem”.

Myth

Standards delay implementation

Fact

Not if the innovation is brought into the standards process early. Delays result from reluctance to standardise, not from standardisation

This spreads the cost of technology development over a larger user base.

This enables joint missions, for cost sharing and increased capabilities.

This improves operations, with familiar interfaces and more options for contingency recovery.

* adapted from CCSDS Overview, August 2014 - https://cwe.ccsds.org/cmc/docs/CCSDS%20Overview%20Charts/CCSDS%20Overview.pptx?Web=1

Why was ECSS created?

back in the early 1990s...

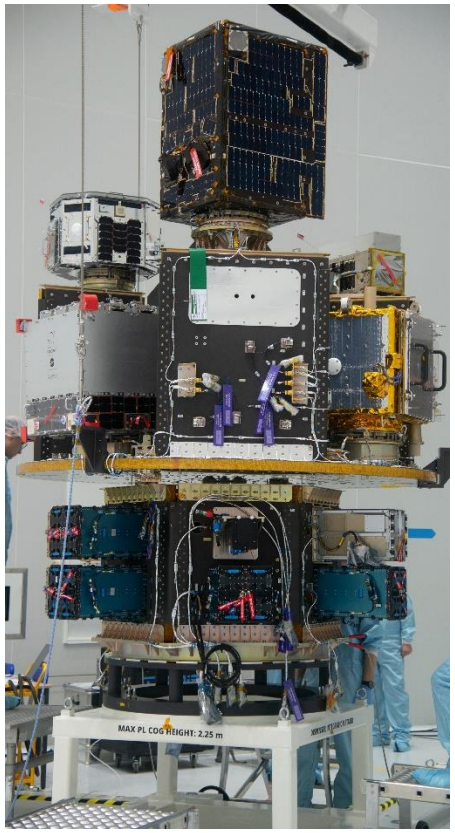
- each customer had its own set of standards (eg NASA, US MIL, industry best practices)
- European space industry had to meet different requirements for each customer
- very expensive...

→ need to develop a common standardization system

→ ECSS is that common system

→ one pool of standards for all customers

European Cooperation for Space Standardization (ECSS)



AIRBUS

arianeGROUP

OHB

ThalesAlenia Space
a Thales / Leonardo company

... and many smaller companies

ECSS purpose

- develop and maintain a single set of consistent space standards
- recognized and applied for use by the entire European Space Community
- the European way of procuring space systems
- standards made applicable by the project contract

ECSS way of working

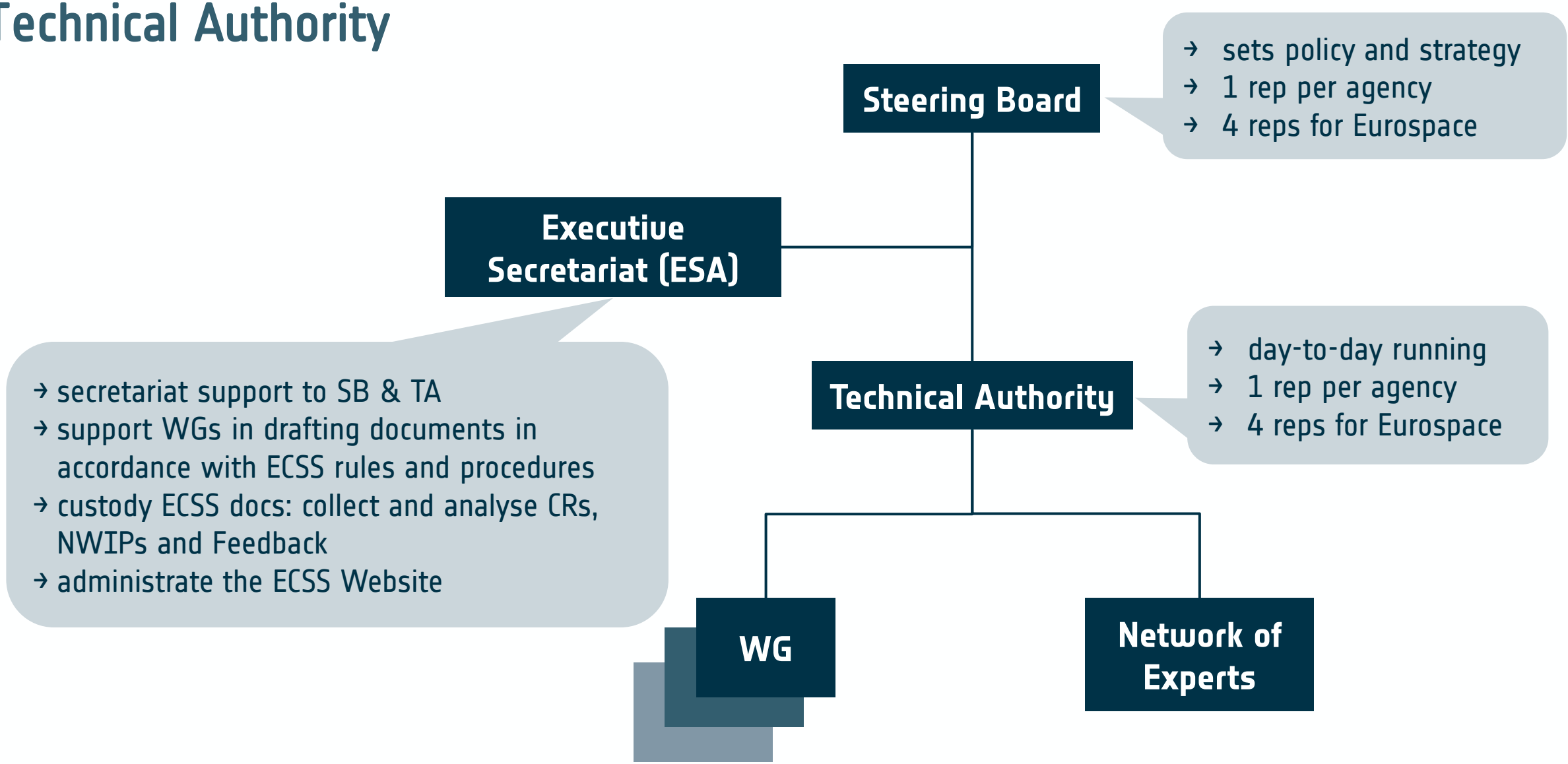
- capitalises on more than 40 years of experience in space projects
- developed through a partnership between the European Space Agency, National Space Agencies, and the European Space Industry
- liaison with European Committee for Standardization ensures all ECSS standards become European Norms

ECSS

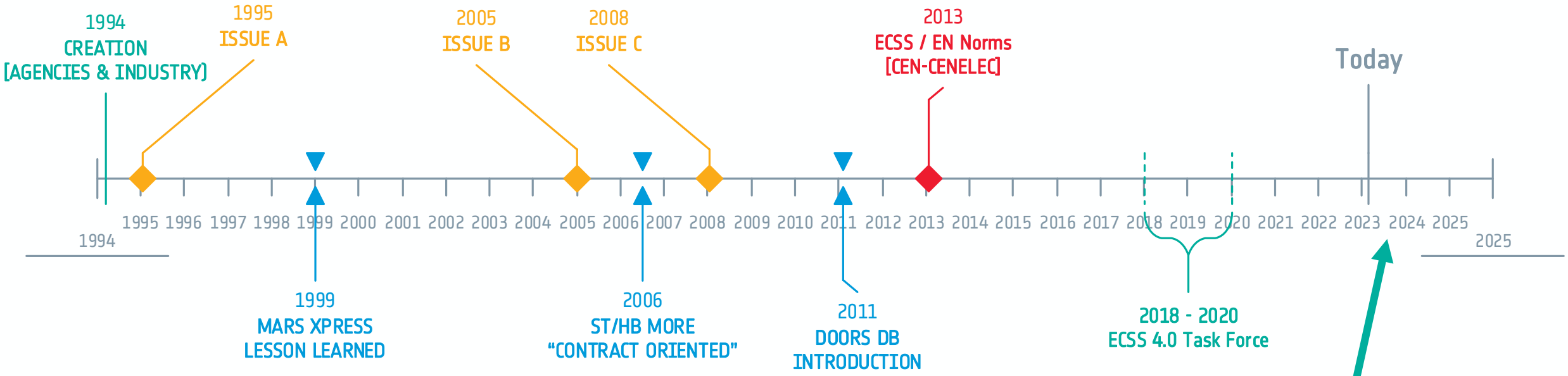
esa + ASD-EUROSPACE The Space group in ASD

agenzia spaziale italiana · cnes CENTRE NATIONAL D'ÉTUDES SPATIALES · DLR · Netherlands Space Office · Norsk Romsenter Norwegian Space Agency · UK SPACE AGENCY

ECSS has two high level bodies: the Steering Board and the Technical Authority



ECSS evolution



Coherent set of documents: 136 STandards - 57 HandBooks

- ECSS system is fully operational
- Application of ESA approved standards (ESA Admin/IPOL(2007)/11)
- Lesson Learned + feedback → Change Request process

- Simplify
  - Allow better usability
  - Adapt to New Space
- Involve new actors
  - New Space
  - SMEs
- Filter according to project
- Master Database

ECSS in numbers

>29000 ECSS requirements

- **>18000** engineering requirements
- **>500** project management requirements
- **>9000** product assurance requirements
- **83** sustainability requirements

>300
Working Groups since 1994

29 years
ECSS started in 1994
28 years since the first ECSS standard was published

136 active standards

57 active handbooks

>20
active WG for new standards, including:
- machine learning qualification for space projects
- management branch simplification
- magnetic cleanliness
- software security
- COTS

134
ECSS standards adopted as European Norms by CEN

57
ECSS handbooks adopted as Technical Reports by CEN

7
Requests to translate ECSS standards:
- Japan
- Belarus
- China
- Ukraine
- Kazakhstan
- Poland
- Russia

>1100 training course attendees since 2017

>40% training course attendees from SMEs

>50 ESA space projects using ECSS standards

ECSS and the commitment of its members

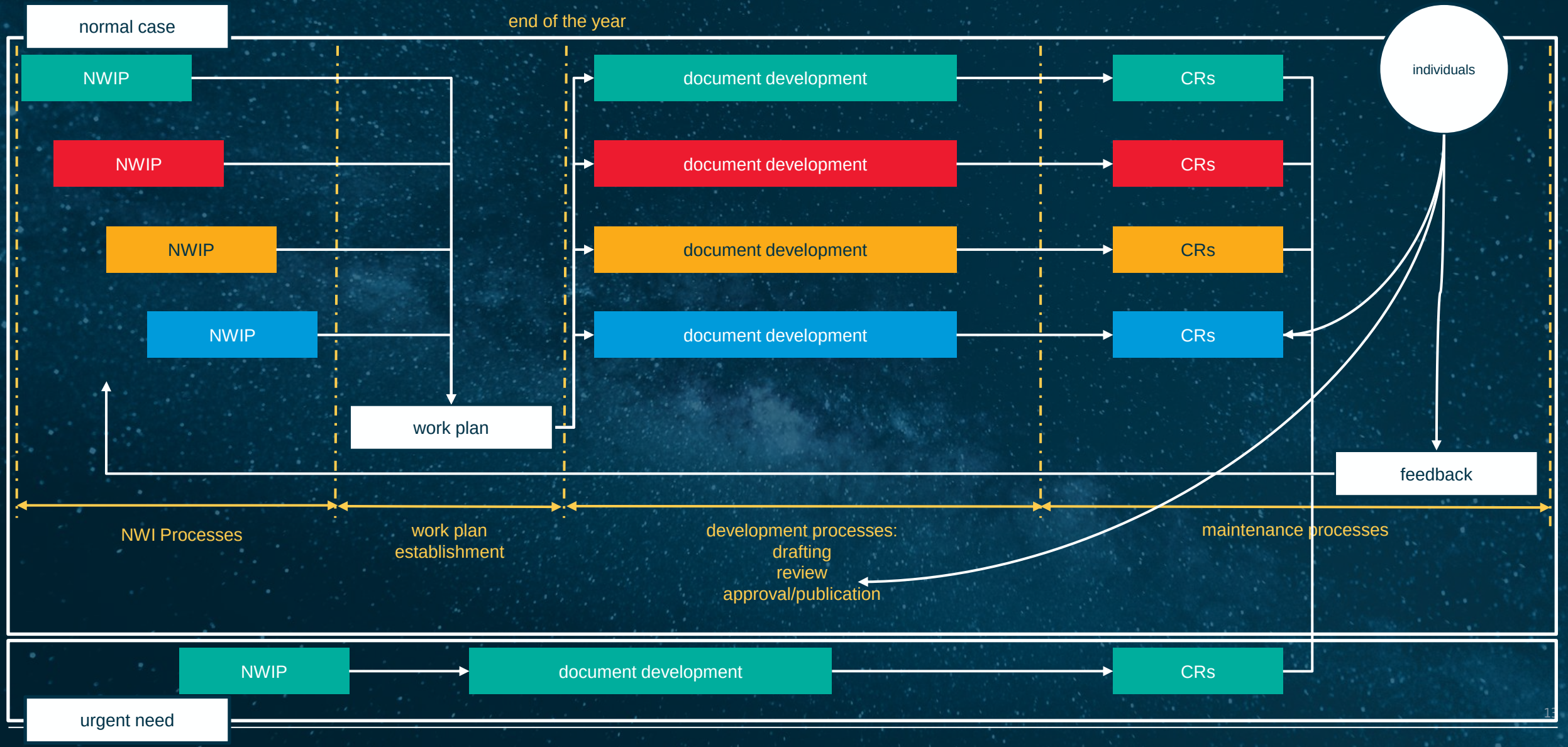
How can you contribute to the development of standards?

Contribute in the development of ECSS documents by:

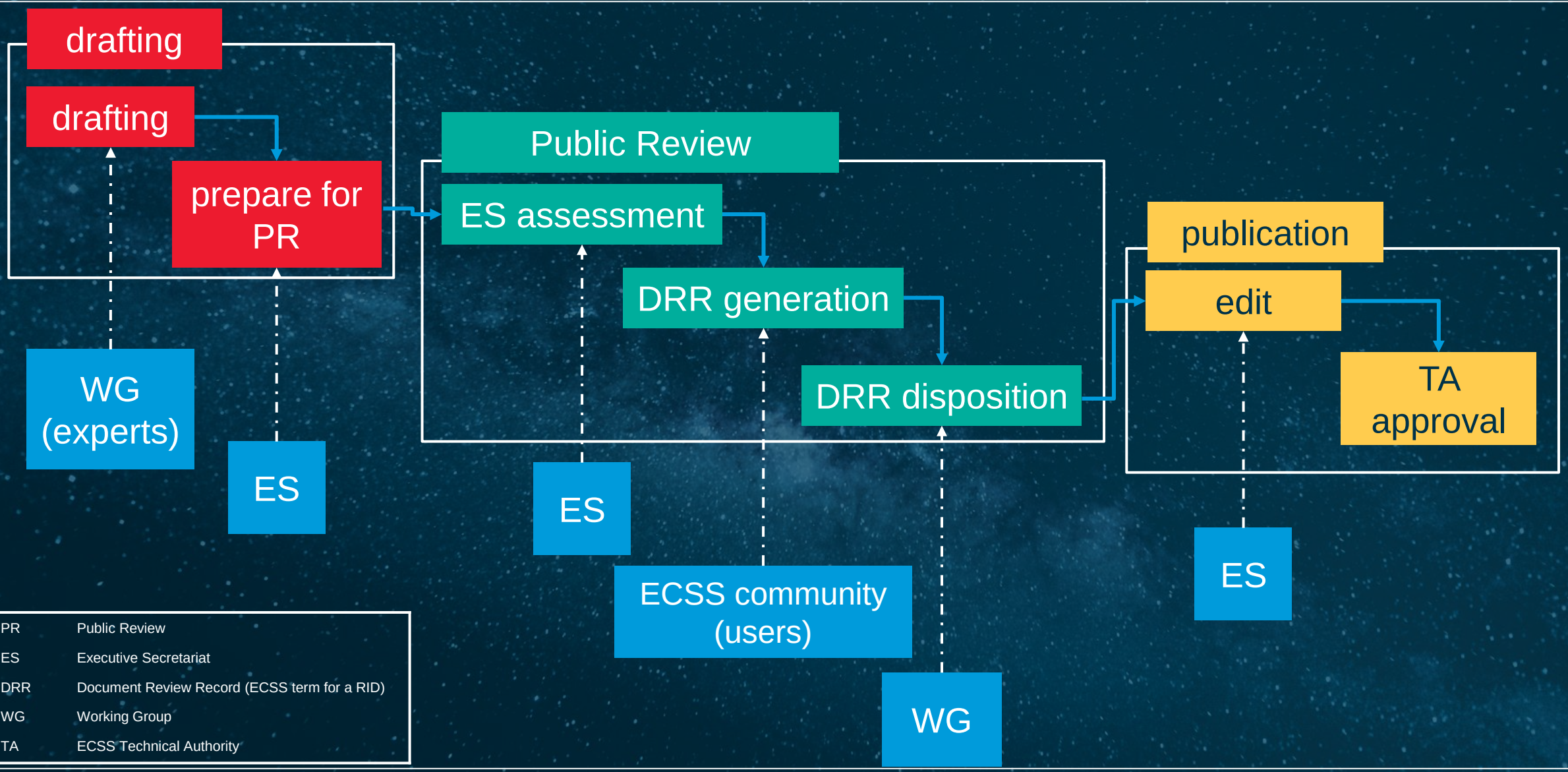
- → Participating in the ECSS governing bodies
- → Contributing to the development of docs by appointing experts to WGs
- → Providing comments to the docs under development, during their review
- → Providing CRs as needed, and contributing to the feedback process

ECSS members are committed to use the ECSS standards for their Space projects and programmes

ECSS document lifecycle



ECSS documents production lifecycle



PR	Public Review
ES	Executive Secretariat
DRR	Document Review Record (ECSS term for a RID)
WG	Working Group
TA	ECSS Technical Authority

ECSS policies

certification	ECSS **neither provides nor recognizes any certification process** of suppliers or of products according to ECSS requirements, by any party. Nothing prevents that individual ECSS members can certify against ECSS on their own behalf.
training	ECSS **promotes** usage of the ECSS system in European space projects and beyond through information and, as far as practical, through the **training of potential users**. In addition, **ECSS does not endorse** the development of third party training courses related to the ECSS system.
translation of documents	ECSS documents are **only written in English**. ECSS members may translate them into another language, but the translations do not become part of the ECSS system, are not maintained by ECSS and cannot be sold.
copyright and use	ESA holds ECSS copyrights on behalf of the ECSS members. No ECSS document may be reproduced without the explicit consent of ESA. However, this **consent is granted to ECSS members** for their own use and for their (sub)contractors.

ECSS interfaces with other Standards Development Organisations

ECSS avoids the developing documents, if an existing or planned document on the subject from other SDOs is considered suitable for ECSS use

document suitable as is	**No additional action needed** (it will be cross-referenced By ECSS docs)
usable, but needs some modifications for full suitability	**adopted via an Adoption Note**, which lists one by one all the clauses/paragraphs/requirements: → To be deleted → To be modified (and then including the modified text) → To be added (and then including the added text)

external documents may be adopted as standards or handbooks

ECSS interfaces with other Standards Development Organisations

3 options for ECSS participation in development activities in other SDOs

1. ECSS decides not to participate at all in the development, and when the document is published, apply the adoption policy explained in the previous slide.
The risk is that if the final product is not suitable, ECSS will have to generate its own document.

2. ECSS does not contribute directly to the drafting, but it comments the document during the Public Review and monitor the dispositions and implementation.
This permits certain control on the final product, but it does not ensure that it will meet the ECSS needs.

3. ECSS decides to fully cooperate with the other SDO in the complete development of the document, by providing experts to the WG and producing comments during the PR.

} formal or informal agreement with the other SDO needed

General ECSS **objectives** for cooperation with other SDOs:

- Ensure that, where international consensus and recognition is essential in order to allow **global interoperability** and/or common policies and treaties, standards are developed in conjunction with the appropriate SDO [at international level ISO/TC20/SC14]
- **Avoid duplication and conflicts** between standards that are planned to be used for space application by the European and international community
- Take into account **inputs & feedback**, in an agreed format, from all stakeholders, in particular liaison SDOs like ISO, in the preparation / maintenance / evolution of ECSS standards

ECSS interfaces with other Standards Development Organisations

ECSS has agreements in place with other SDOs

liaison	No collaborative activities, only mutual visibility.	
ad-hoc cooperation	Performed in accordance with an SB mandate to the TA of limited scope	Cooperation with CCSDS, only for those CCSDS documents considered of ECSS interest
formal agreement	Signed by both organizations. The SB will sign on behalf of ECSS: → mutual recognition → formal cooperation	Mutual recognition with ISO and formal cooperation with CEN

Presently ad-hoc ECSS cooperation with ISO exists for:

- → Space Debris series of standards
- → Solar panels and cells (ISO 11221, 15386, and 23038)

CEN/CENELEC – ECSS MoU was signed in May 2013:

- → Transfer and maintenance of existing ECSS standards as European Norms (EN)
- → ECSS involvement in the development of new EN standards for space

Consultative Committee for Space Data Systems (CCSDS)

Consultative Committee for Space Data Systems

www.ccsds.org

CCSDS is a multi-national forum

- 11 Member Agencies
- 26 Observer Agencies
- 133 Commercial Associates & 13 Liaisons
- forum for the **development of communications & data systems standards** for spaceflight.
- goal is to **enhance governmental & commercial interoperability & cross-support**, while also **reducing risk, development time & project costs**

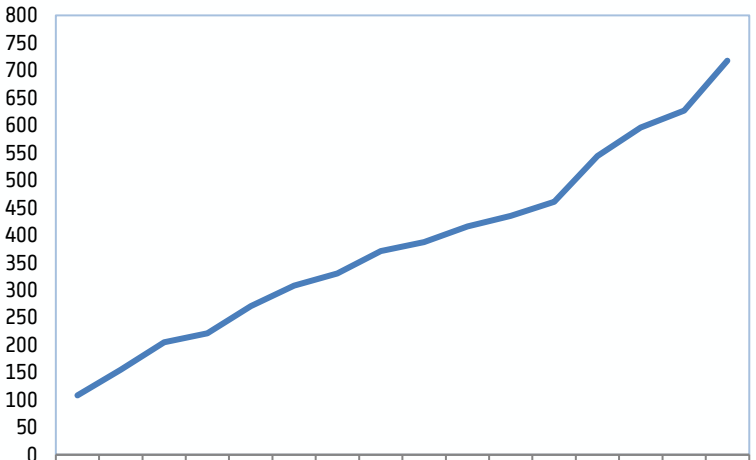
>1200 missions are using CCSDS standards :

https://public.ccsds.org/implementations/missions.aspx

> 143 COTS CCSDS-compliant hardware

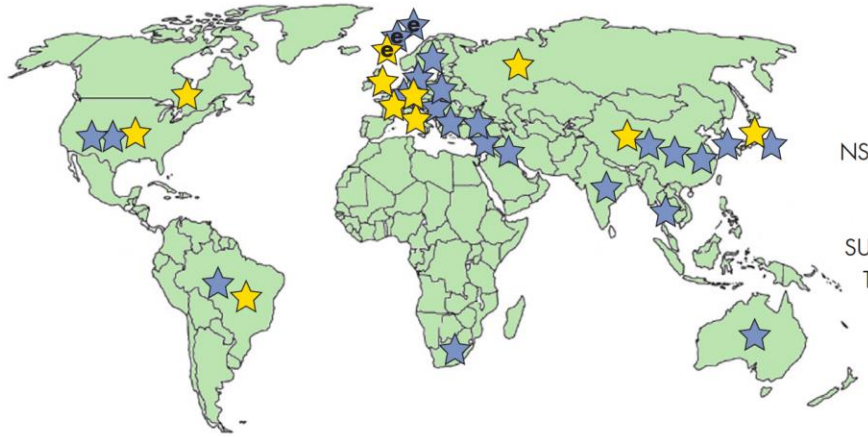
Also functions as an ISO Committee
TC20/SC13 - Space Data & Info Transfer Systems

missions using CCSDS standards (1999-2014)



	99	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Cumulative Missions	108	155	205	221	271	308	330	371	387	416	435	461	544	596	627	718

MEMBER AGENCIES	OBSERVER AGENCIES
ASI/Italy	ASA/Austria
CNES/France	BFSPO/Belgium
CNSA/China	CAS/China
CSA/Canada	CAST/China
DLR/Germany	CLTC/China
ESA/Europe	CSIR/South Africa
FSA/Russia	CSIRO/Australia
INPE/Brazil	DCTA/Brazil
JAXA/Japan	DNSC/Denmark
NASA/USA	EUMETSAT/Europe
UKSA/UK	EUTELSAT/Europe
	GISTDA/Thailand
	HNSC/Greece
	IKI/Russia
	ISRO/India
	KARI/Korea
	KFKI/Hungary
	MOC/Israel
	NCST/USA
	NICT/Japan
	NOAA/USA
	NSARK/Kazakhstan
	NSPO/Taipei
	SSC/Sweden
	SUPARCO/Pakistan
	TsNIIMash/Russia
	TUBITAK/Turkey
	USGS/USA



European Space Components Coordination (ESCC)

ESCC
European Space Components Coordination

Executive task

- **ESCC Executive,** provided by the Space Agencies participating in ESCC, is primarily responsible to:
  - **provide** an organisation for the custody and management of the ESCC Specification System
  - **manage** the related tasks of evaluation and qualification of components
  - **manage** the related tasks of certification of components and component manufacturers

Harmonisation task

- 2002; agreement between **Space Agencies**, **European Space Industry** and **European Component Manufacturers** (component user/providers) to cooperate in the field of EEE parts for application in Space Programmes
- Harmonisation tasks are performed under the auspices of the **Space Components Steering Board (SCSB)** supported by the **Policy and Standards Working Group (PSWG)** and the **Components Technology Board (CTB)**

ESCC publications

- **ESCC Specifications** for EEE components
- ESCC Qualified Parts List **(QPL)**
- ESCC Qualified Manufacturer List **(QML)**
- ESCC Hybrid Process Capability Approval List **(HPCL)**
- ESCC European Preferred Parts List **(EPPL)**
- ESCC Executive Public notices

European Committee for Standardisation (CEN)

- CEN is an EU/EC-endorsed standardisation body (together with CENELEC and ETSI)
- Members are national standardisation bodies (eg DIN), mainly from Europe (dark blue in the map), with a few partner organisations in other countries (light blue in the map)
- In essence, a European analogue of ISO (CENELEC is the analogue of IEC)
- CEN and CENELEC operate Joint Technical Committees in areas of common interest
- CEN/CENELEC received an EC mandate (M469) for Space standardisation in 2011, leading to the establishment of **JTC5** ***Space*** and the MoU with ECSS
- National projects are usually legally-required to use CEN standards

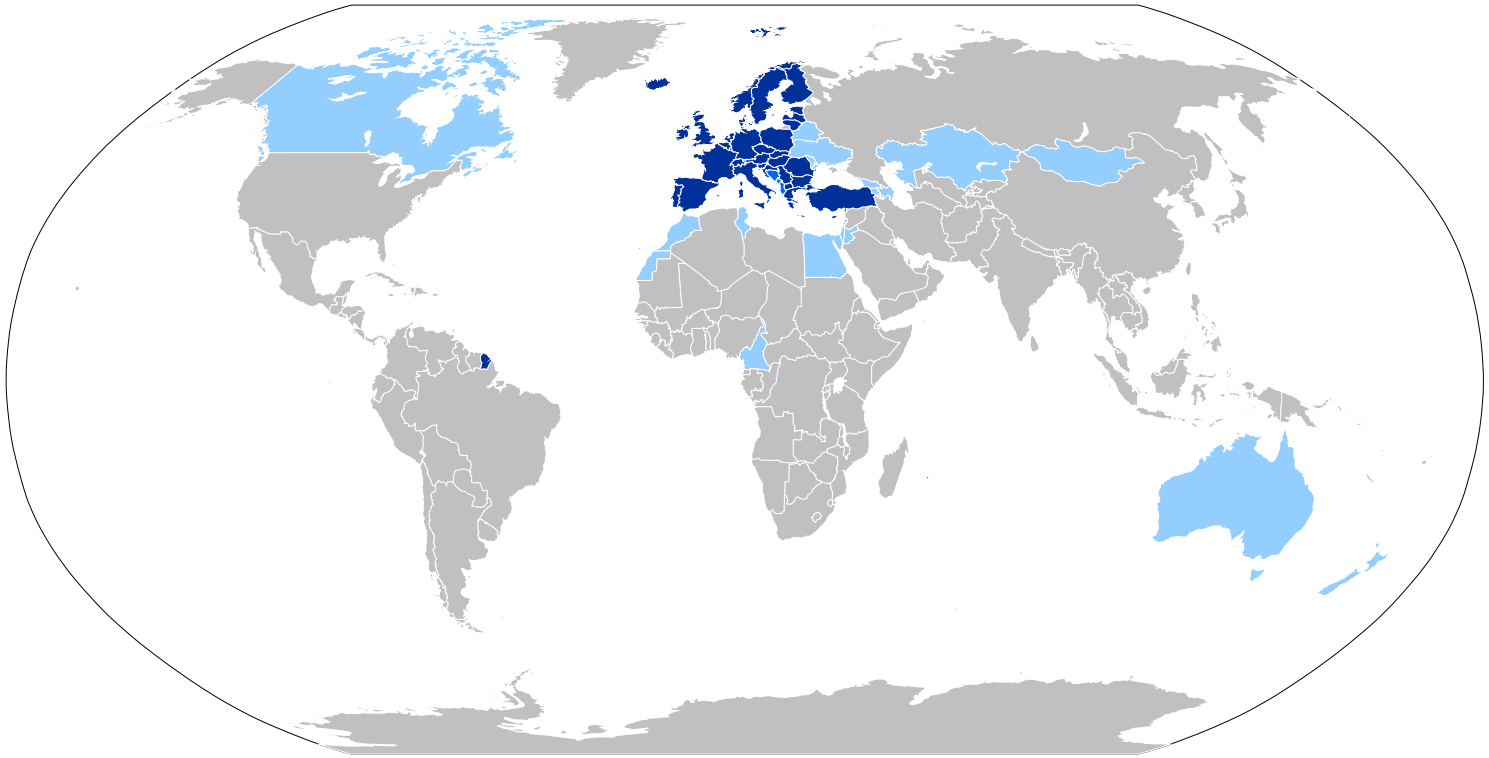


*image by Getsnoopy from Wikipedia

CEN standards are not freely-available

Space SDO comparison

organisation	ECSS	Consultative Committee for Space Data Systems (CCSDS)	ESCC European Space Components Coordination
geographical scope	Europe	worldwide	Europe
membership	space agencies and industry	space agencies	space agencies and industry
business scope	standardisation	standardisation	standardisation and component/manufacturer certification
standardisation scope	space standardisation (project management, engineering, product assurance, sustainability)	space communications and data handling (to enable interoperability)	EEE space components (addressed to component manufacturers)
website	ecss.nl	ccsds.org	spacecomponents.org escies.org
ESA point of contact	TEC-QES	TEC-ED OPS-GD	TEC-QES

2 → The ECSS standardisation documentation model

ECSS document types

standards

- → normative documents
- → for direct use in invitations to tender and business agreements
- → content limited to verifiable requirements – state what to do, not how to do it

handbooks

- → non-normative documents
- → provide guidelines and/or a collection of data

technical memoranda

- → non-normative documents
- → provide useful information to the space community
- → content not yet mature for a standard or handbook

Characteristics of an ECSS standard

express **what** to do, not how

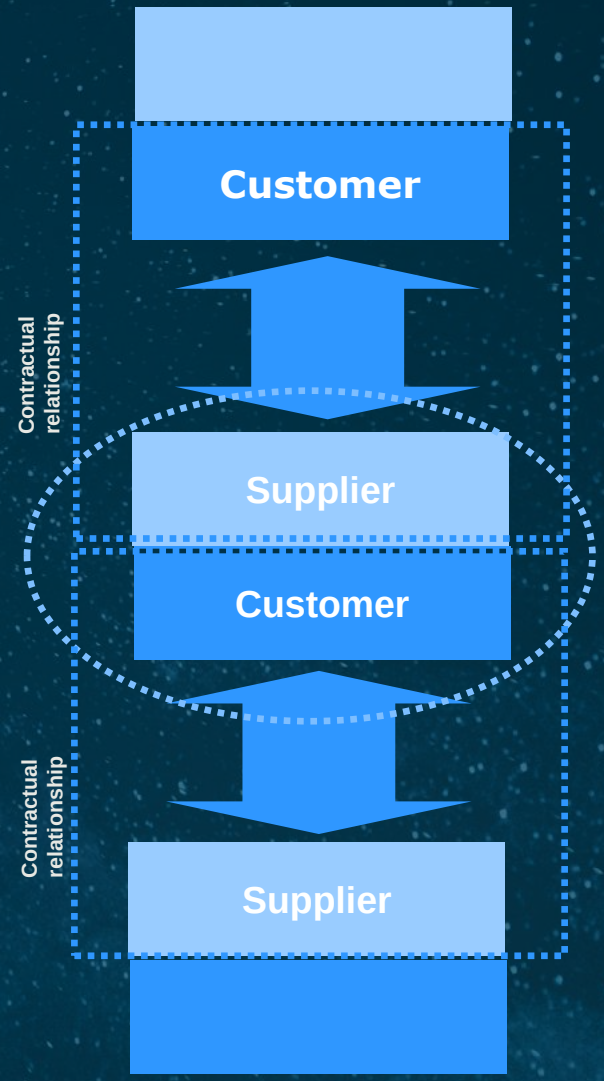
→ the procedural aspects not normally covered
→ procedural aspects should go in handbooks

express what to do in terms of regulatory provisions

→ requirements
→ recommendations
→ permissions

provisions focused on a contractual relationship

→ contractual model defined in ECSS-S-00



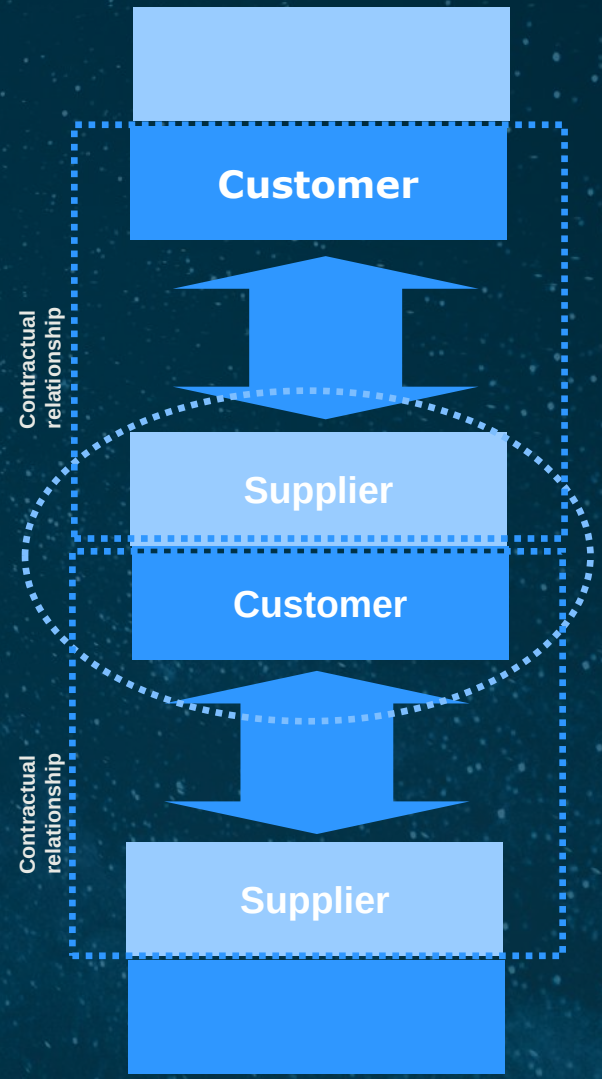
Focus on contractual relationship

Customer	organization or person that receives a product* as part of a business agreement
Supplier	organization or person that provides a product* as part of a business agreement

*the term product covers: services, software, hardware, documentation, and processed materials

Business agreement	legally binding agreement, for the supply of products, between two or more actors in the customer-supplier chain

- → Contracts
- → Memoranda of understanding
- → Inter-governmental agreements
- → Inter-agency agreements
- → Partnerships
- → Bartering agreements
- → Purchase orders



ECSS documentation structure

S-Branch
standardisation system description

- define the system of standardisation documents
- specifies how to use it in Space projects

branches

disciplines

M-Branch space project management	Q-Branch space product assurance	E-Branch space engineering	U-Branch space sustainability
M-10 project phases and implementation	Q-10 product assurance management	E-10 system engineering	U-10 space debris mitigation
M-40 configuration and information management	Q-20 quality assurance	E-20 electric, electronic, and optics	U-20 planetary protection
M-60 cost and schedule management	Q-30 dependability	E-30 mechanical	
M-70 integrated logistic support (ILS)	Q-40 safety	E-40 software engineering	
M-80 risk management	Q-60 EEE components	E-50 communications	
	Q-70 materials, mechanical parts and processes (MMP&P)	E-60 control engineering	
	Q-80 software product assurance	E-70 ground systems and operations (GSO)	

Denomination of ECSS documents

$$ECSS - \{S, M, Q, E, U\} - \{ST, AS, HB, AH, TM\} - \langle number \rangle \langle version \rangle$$

branch
S – ECSS system
M – Management
Q – Product Assurance
U – Sustainability

document type
ST – Standard
AS – Adopted Standard
HB – Handbook
AH – Adopted Handbook
TM – Technical Memorandum

number
- one group of two digits to identify those documents with more generic requirements
- two groups of two digits to identify those with more specific requirements
- the difference is not to indicate higher relevance of some standards with respect to others

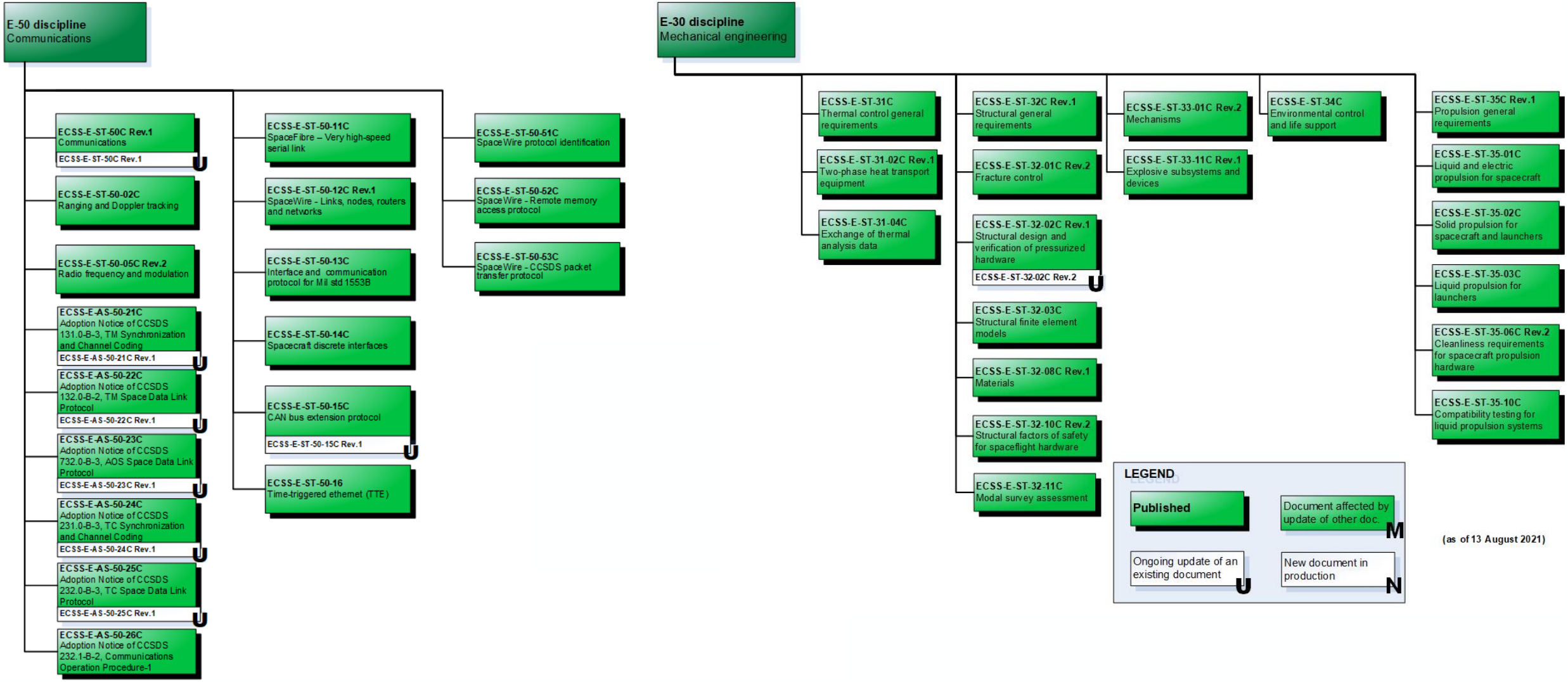
version
- a letter from A onwards, representing the issue
- may include also a Rev index, from 1 onwards

Example:
S-ST-00C
ECSS System (standard)

E-ST-50C
Communications
(standard)
↓
E-ST-50-05C
Radio frequency and modulation
(standard)

E-HB-50A
Communications
(handbook)

Example of ECSS standards' denomination



ECSS is a consistent and coherent set of standards
ECSS standards shall NOT be used in isolation

- ECSS was started with the aims to develop a single coherent set of space standards, either adopted from other SDOs or developed by ECSS itself, for the use of the entire Space community.
- This implies that **repetition and overlapping among standards should be avoided**.
  If an existing part of a document needs to be addressed in a second one, it is not repeated but a reference to the first one should be done.

There are two types of references in ECSS documents

Normative references	references from a normative statement (e.g. a requirement), incorporating as part of such a requirement a part of other document; they exist ONLY in standards, and are listed in Normative references
Informative references	references from a non-normative (i.e. informative) statement; they may exist in standards, handbooks, and TMs; in standards, they are listed in *Bibliography;* in HBs & TMs, are listed in *References*

Example: standards applicable to a software project

Software is specifically covered by the following two ECSS standards

ECSS-E-ST-40C	*Software*	ECSS-Q-ST-80C Rev.1	*Software product assurance*

These two standards are not enough to run a space contract, even if the project only includes software. Other documents may need to be included

ECSS M-ST-10	*Project planning and implementation*	for e.g. the definition of the project phases
ECSS-M-ST-10-01	*Organization and conduct of reviews*	
ECSS-M-ST-40	*Documentation and configuration management*	for e.g. the SW configuration control
ECSS-E-ST-10	*System Engineering*	for e.g. DDF, DJF, Technical Specification
ECSS-E-ST-10-02	*Verification*	
ECSS-Q-ST-10-09	*Non-conformance control system*	
ECSS-Q-ST-30	*Dependability*	for e.g. criticality definition
ECSS-Q-ST-40	*Safety*	

Characteristics of ECSS standards and requirements

- intended for direct use in *business agreements:*
  - specific legal langue **not** used
  - language used aims to **avoid variations in interpretation**
  - clearly state the obligations of each actor (customer/supplier)

- this leads to **5 golden rules**:
  1. clear identification of what is part of the obligations of the contract (ie normative) and what is guidance/informative and not part of the contract
  2. clear physical separation between obligations and informative/guidance material
  3. clear identification (by a **unique** reference number) of individual normative provisions
  4. are requirements are clear, unambiguous, and **verifiable**
  5. all normative cross-references (internal and external) are to the appropriate paragraphs

1. Clear identification of what is really part of the obligations of the contract and what is only guidance and therefore is not part of the contract

part of the obligations of the contract = normative statements in the standard

There are three types of normative statements in ECSS standards

Requirements	shall/shall not
Recommendations	should/should not
Permissions	may/need not

2. Clear physical separation between obligations and guidance material

In ECSS a combination of all the following approaches is used:

informative clauses	Guidance material is covered in a specific clause(s). Normally Clause 4 is used to explain the principles. It is also usual that the first sub-clause of each main clause is used to introduce the subject.
informative annexes	For a unit of guidance/informative material, informative annexes can also be used.
notes to requirements	For small pieces of information related to a specific requirement, NOTES to such a requirement are used.

3. Clear identification (by an unique identifier) of individual normative provisions

In ECSS, each requirement, recommendation and permission is individually tagged with an identifier:

- → for an easy and unambiguous **tailoring**
- → for an efficient control of the **verification** process

5.2.2 Provisions

5.2.2.1 Power subsystem

ECSS-E-ST-20_0020089

a. The power subsystem of a spacecraft shall be able to generate, store, condition, distribute and monitor the electrical power used by the spacecraft throughout all mission phases in the presence of all environments actually encountered.

NOTE For passivation, refer to ECSS-U-AS-10.

5.2.2.2 Engineering process

ECSS-E-ST-20_0020090

a. An analysis of power demand versus power available shall be performed, including average peak power, for all phases of the mission.

requirement 5.2.2.1a

4. All the requirements are clear, unambiguous, feasible, and verifiable

Writing verifiable requirements has proved to be sometimes a challenge at the time of writing the standard. However, ECSS consider that this is a MUST for any ECSS standard.

5.5.3.2 Software unit testing

a. The supplier shall develop and document the test procedures and data for testing each software unit.

EXPECTED OUTPUT: The following outputs are expected:

a. Software component design document and code (update) [DDF, SDD, source code; CDR];

b. Software unit test plan (update) [DJF, SUITP; CDR].

b. The supplier shall test each software unit ensuring that it satisfies its requirements and document the test results.

EXPECTED OUTPUT: The following outputs are expected:

a. Software component design document and code (update) [DDF, SDD, source code; CDR];

b. Software unit test reports [DJF, - ; CDR].

verified by customer review of the Software Unit Test Plan

5. All normative cross-references (internal or external) are to the appropriate paragraphs

Cross-references don't make mandatory a complete document, when only some paragraphs are applicable

ECSS-E-ST-20_0020109

e. The solar array design shall be such that charging phenomena do not degrade the performance of the solar array below the ones specified in 5.5.2a and 5.5.2c and meeting the requirements specified in clauses 7.1 and 7.2 of ECSS-E-ST-20-06.

NOTE Good practices in accordance with the present state of the art (maximum current of 0,6 A) are to:

- limit the differential voltage in between cells to 30 V (this relates to a factor of 2,3 margin with respect to Table 7-1 from ECSS-E-ST-20-06) in all conditions if the minimum accepted gap between adjacent non-directly connected cells is 0,5 mm;
- implement string blocking diodes;
- have a coverglass extending beyond the solar cell limits.

normative reference to two clauses/sections of another standard

Structure of an ECSS standard

- ❑ change log, ToC, *[introduction]*
1. **Scope**
   clear and concise identification of the coverage and applicability of the standard
2. **Normative reference**
   listing **only** documents referenced from requirements
3. **Terms, definitions, and abbreviations**
4. *[Principles and/or background]*
   containing **only** informative/guidance material
5. **Requirements**
   containing the normative provisions
   it may contain some NOTES and a few guidance sub-clauses with only guidance material
6. *[More requirements]*
n. *[Pre-tailoring (per product type and project phase)]*
   only mandatory if the standard is subject to pre-tailoring

- ❑ *[Annexes]*
  Normative annexes (DRDs) – always first
  Informative annexes
- ❑ **Bibliography**
  lists documents references from informative/guidance text

mandatory clauses
[optional caluses/sections]

normative reference = reference to another standard explicitly done from a requirement

- references done from informative text go in the bibliography
- if a document is not mentioned in the normative clauses of the standard it **shall not** be listed in normative references, irrespective of its importance – it shall go in bibliography

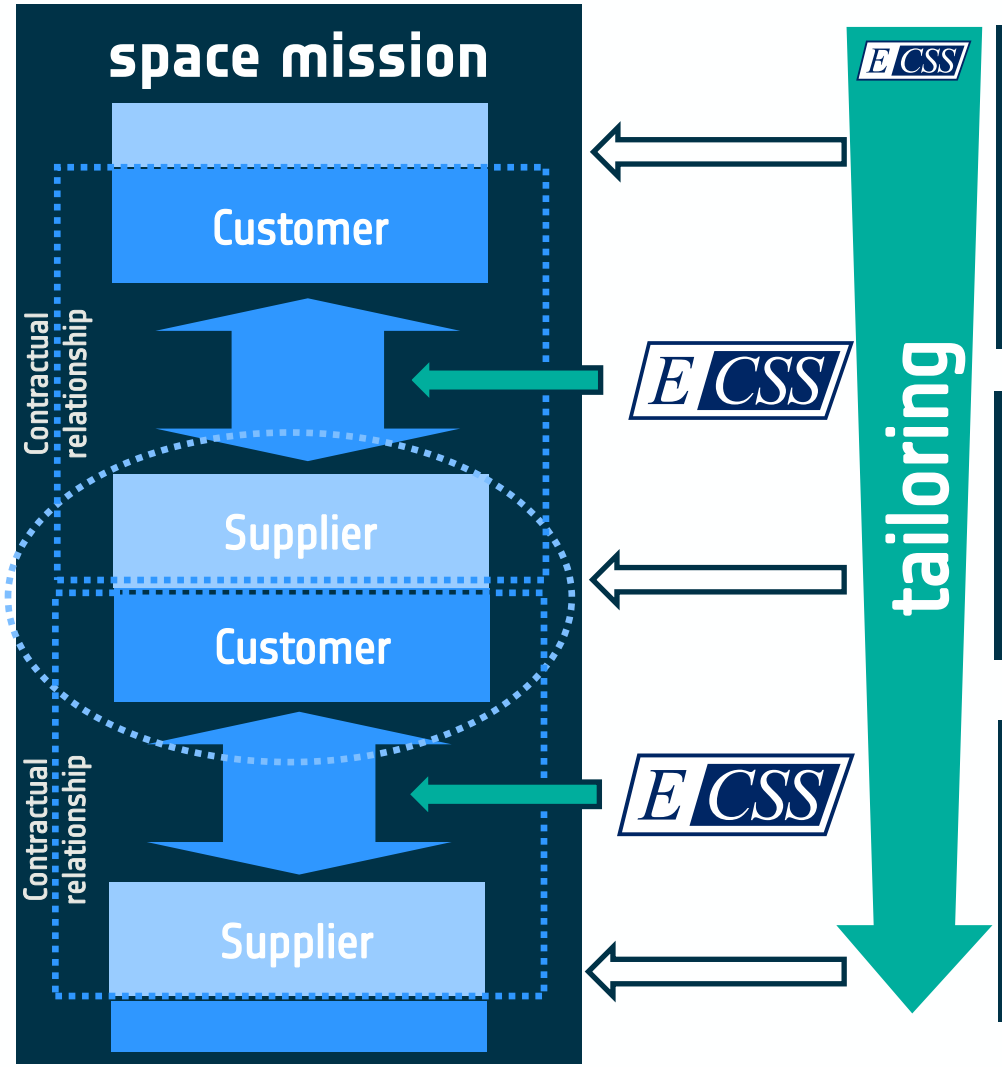
DRD = Document Requirements Definition

- normative annexes → they are requirements
- specify the content of a deliverable document
- do not specify the format, only the information to be provided
- always referenced from a requirements specifying who, when, and how often the document shall be provided – the DRD only specifies the content

3 → Application of ECSS standards in space projects

ECSS is the cornerstone of space project procurement in Europe

Tailoring – ECSS standards are made applicable at each level of the customer-supplier chain by adapting them to the specificities of the project, at this level



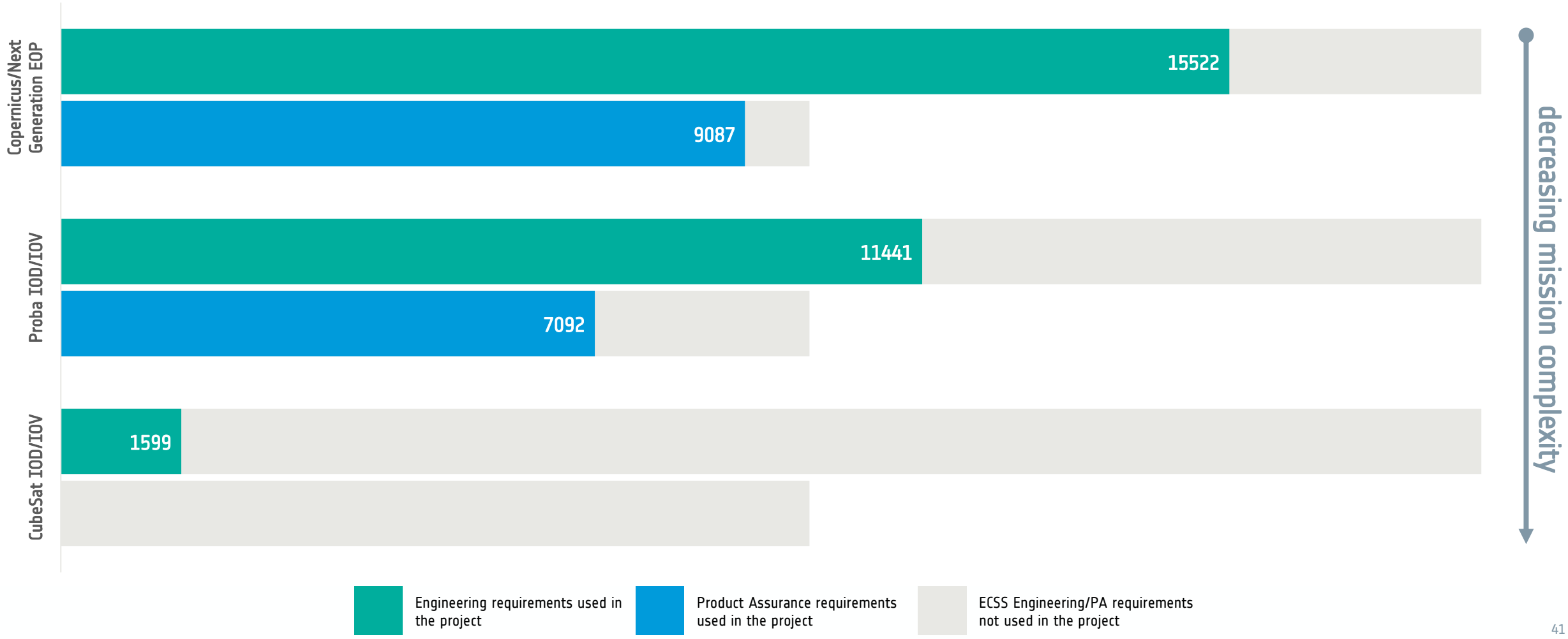
top-level space mission customers

first-level suppliers (large integrators)

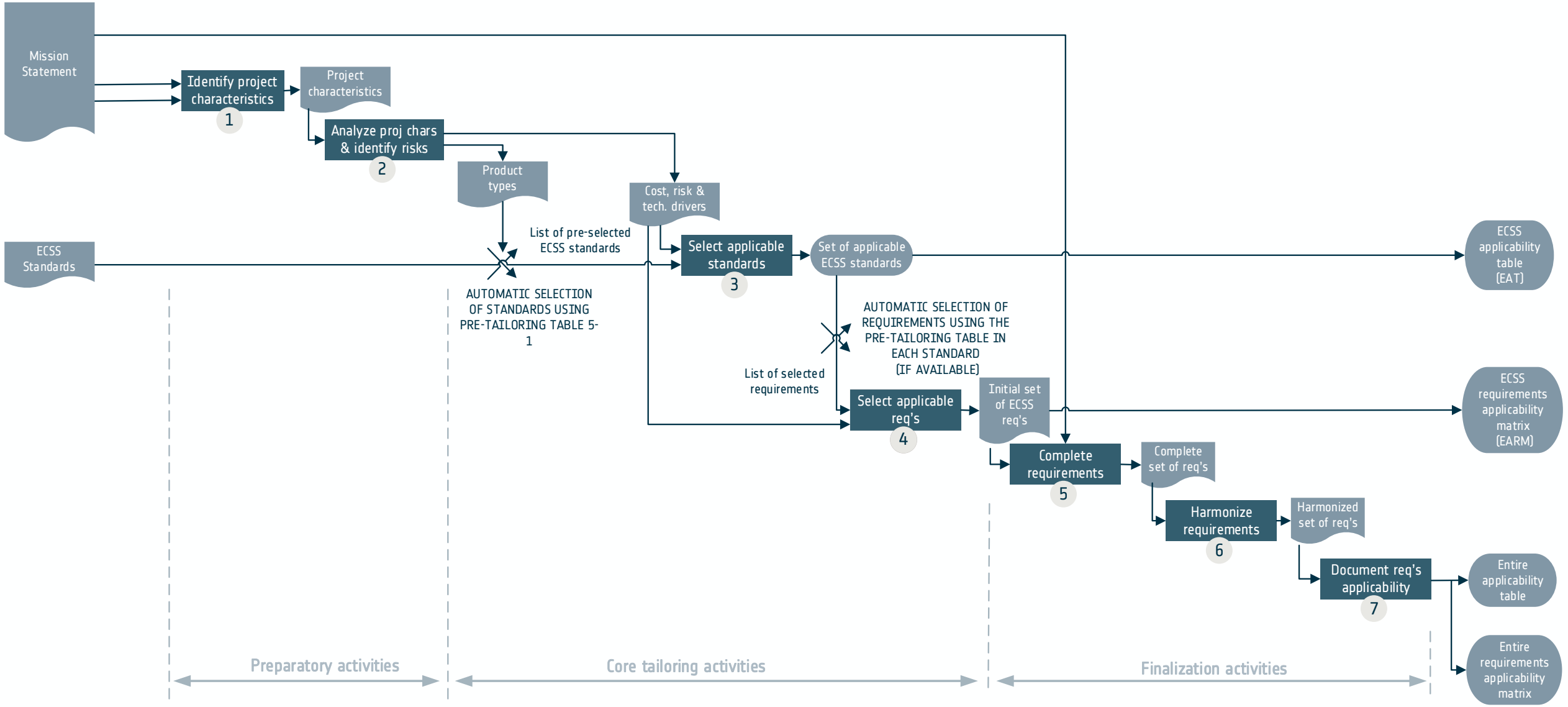
space system/subsystem/component suppliers
(includes SMEs, research institutes, and academia)

Number of ECSS requirements used in projects decreases with decreasing mission complexity

Large projects (e.g. Copernicus) use most ECSS requirements, especially for PA



The tailoring process



The ECSS applicability table (EAT)

ECSS Applicability table (EAT)

Project/Programme:
Contract information:
Originator:

Mission type:
Issue date:
Event generation:

Standard	Applicability (A / T / >> /NA)	Justification (including justification of the use of other standard instead of)

A: Standard fully applicable without tailoring
M: Standard applicable with tailoring. For each of these standards, the generation of a EARM is expected.
>> See meaning in #5.2.1a and Table 5-1. Standard applicable at a lower level of product and to be tailored by the customer of this lower level
NA Standard not applicable at all

The ECSS Applicability Requirement Matrix (EARM)

ECSS Applicability requirement matrix (EARM)

Project/Programme:
Issue date:
Event generation:
Product type:

Contract information:
Originator:
Standard reference:

THE COMPLETE SET OF REQUIREMENTS IN THE STANDARDS IN THE EAT ARE APPLICABLE, WITH THE MODIFICATIONS STATED IN COLUMNS 2 TO 6 OF THIS EARM					
1. ECSS Standard	2. ECSS Req. identifier	3. Org. Req. identifier	4. Applicability (M/D/N)	5 Modified or New requirement (Full text)	6. Justification (Only in case of M, D or N in column 4)

NOTE: Column 3 is provided to give the users the capability of using their own requirement identification system, in parallel with the identification of the requirement in the applicable standard (Column 2).	M: Requirement applicable with Modification D: Requirement Deleted, not applicable N: New requirement (requirement added)

Pre-tailoring and tailoring

Pre-tailoring

a **pre-cooked list of standards**, and a **pre-cooked list of requirements** in every standard subject to pre-tailoring **(published at the time of producing the standard*)**

Tailoring

done specifically by every project **by the project itself**

**pre-tailoring matrices are present is standards published after 2015 and subject to pre-tailoring*

- → Tailoring of the whole set of requirements for a specific application has demonstrated to be a non-trivial very heavy task.
- → It is however acknowledged that a number of requirements may not be meaningful for specific type of project or for specific phases of a project.
- → It was therefore considered of ECSS interest to identify possible *types of products* and establish the associated applicability of standards/requirements. This view is shared by all ECSS Space Agencies, and considered of crucial importance by Eurospace.
- → The impact of pre-tailoring is that **it will reduce dramatically the *Baseline for tailoring*** (input to steps 3 and 4 in the general tailoring process).
  It will NOT eliminate the need of the final tailoring by the customer.

The three types of ECSS pre-tailoring

Category C	Category I	Category E
Complete	**Implicit**	**Explicit**
The standard needs no pre-tailoring, because it is applicable as a whole to a particular type of product, during a given phase	The standard has been built such that the pre-tailoring is implicit to its structure	The pre-tailoring of the document is included (per product type and per project phase), in explicit tables within the document
Example: ECSS-Q-ST-70-03C *Black-anodizing of metals with inorganic dyes*	Example: ECSS-E-ST-10-02 *Testing*	Example: ECSS-E-ST-10C Rev. 1 *System engineering general requirements*
if black-anodizing is used, then the standard is applicable	clauses are organized as *Testing for space segment equipment*, *Testing for space segment element*, *Pre-launch testing.*	pre-tailoring matrices (e.g. for different product types, segments, etc) are contained in the standard

Example of a pre-tailoring matrix

Input for Step 4 – tailoring of the set of requirements (**per standard**)

Table in each standard needing **explicit** pre-tailoring (category E) – **example** from **ECSS-E-ST-10C Rev. 1**

Table 7-2: Pre-tailoring matrix per "Space product types"

ECSS req. #	Space system	Space segment element and sub-system	Space segment equipment	Launch segment element and sub-system	Launch segment equipment	Ground segment element and sub-system	Ground segment equipment	Ground support equipment	Software	Comments
5.1a	X	X[1]	//[2]	//[2]	-	-	-	-	-	[1] applicable at element level: for subsystem level - see [2] [2] applicability should be defined/tailored at each level for next lower level, depending on product heritage, engineering complexity and industrialization context.
5.1c	X	X[1]	-	//[2]	-	-	-	-	-	[1] applicable at element level: for subsystem level - see [2] [2] applicability should be defined/tailored at each level for next lower level, depending on product heritage, engineering complexity and industrialization context.
5.1d	X	X[1]	//[2]	//[2]	-	-	-	-	-	[1] applicable at element level: for subsystem level - see [2] [2] applicability should be defined/tailored at each level for next lower level, depending on product heritage, engineering complexity and industrialization context.
5.2.1a	X	X	X	X	-	-	-	-	-	

Pre-tailoring matrix

Input for step 3 – tailoring of the **list of standards** – Pre-tailoring table attached to **ECSS-S-ST-00-02C DRAFT1**

			Space segment		Launch segment		Ground segment				
Standards	Title	Space system	Element & sub-system	Equipment	Element & sub-system	Equipment	Element & sub-system	Equipment	Ground Support Equipment	Software	Comments
[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
ECSS-S-ST-00	Description, implementation & general requirement	X	X	X	X	X	X	X	X	X	
ECSS-S-ST-00-01	Glossary of terms	X	X	X	X	X	X	X	X	X	
ECSS-M-ST-10	Project planning and implementation	X	X	X	X	X	X	X	X	X	
ECSS-M-ST-10-01	Organization and conduct of reviews	X	X	X	X	X	X	X	X	X	
ECSS-M-ST-40	Configuration and information management	X	X	X	X	X	X	X	X	X	
ECSS-M-ST-60	Cost and schedule management	X	X	X	X	X	X	X	X	X	
ECSS-M-70	Integrated logistic support	X	X	X	X	X	X	X	X	X	
ECSS-M-ST-80	Risk management	X	X	X	X	X	X	X	X	X	
ECSS-Q-ST-10	Product assurance management	X	X	X	X	X	X	X	-	X (1)	(1) for SW as referred to by ECSS-Q-ST-80
ECSS-Q-ST-10-04	Critical item control	X	X	X	X	X	X	X	-	X (1)	(1) for SW as referred to by ECSS-Q-ST-80
...											
ECSS-E-ST-70-11	Space segment operability	X	X	X	-	-	-	-	-	-	
ECSS-E-ST-70-31	Ground systems and operations - Monitoring and control data definition	X	X	X	-	-	X	X	X	-	
ECSS-E-ST-70-32	Test and operations procedure language	X	X	-	-	-	X	-	-	-	
ECSS-E-ST-70-41	Telemetry & telecommand packet utilization	X	X	X	-	-	X	X	X	-	applicable only to products managing packet TM or TC with CCSDS format
ECSS-U-AS-10	Adoption Notice of ISO 24113: Space systems – Space debris mitigation requirements	X	X	X	X	X	-	-	-	-	
ECSS-U-ST-20	Planetary protection	X	X	X	X	X	X	X	X	X	

Providing ECSS feedback

ECSS relies on feedback provided by ECSS members and users to update documents and/or processes

Potential outputs of the feedback process are:

1. **Change Requests** (CR) to existing standards
2. **New Work Item Proposals** (NWIP) (add/modify/split/group standards)
3. TA recommendation to improve overall ECSS system (eg improve Website, add/remove discipline/branch, standard cancelation, etc)

→ Feedback from ECSS user (which includes Space Agencies and Eurospace) is required by ECSS-S-ST-00C Rev. 1 *System description and implementation* (→ **it is a requirement on the *users***)

→ The **feedback process** is defined in ECSS-D-00B *ECSS organization and processes* (→ **it is a process for *developers***)

ECSS DOORS database

- DOORs is a commercial SW from IBM for requirement management
- It is designed for management of requirements during their lifecycle, including flowing down to (sub)contractors
- The tool, customized for Space requirement management purposes, and the database with all the ECSS standards version C (or later), is available under request to ESA.
- The application and the database with all ECSS (standards and requirements) in version C or later, is available under request to ESA.
- Advantages:
  - Powerful. It permits full requirement configuration control, at all levels in the customer-supplier chain, including full traceability to the original requirements.
- Disadvantages:
  - It needs a license → not usable universally.
  - Expensive, both the license and in terms of learning time
- ECSS has produce a DOORS database of all ECSS requirements
- Now this database is approved by the ECSS SB and available

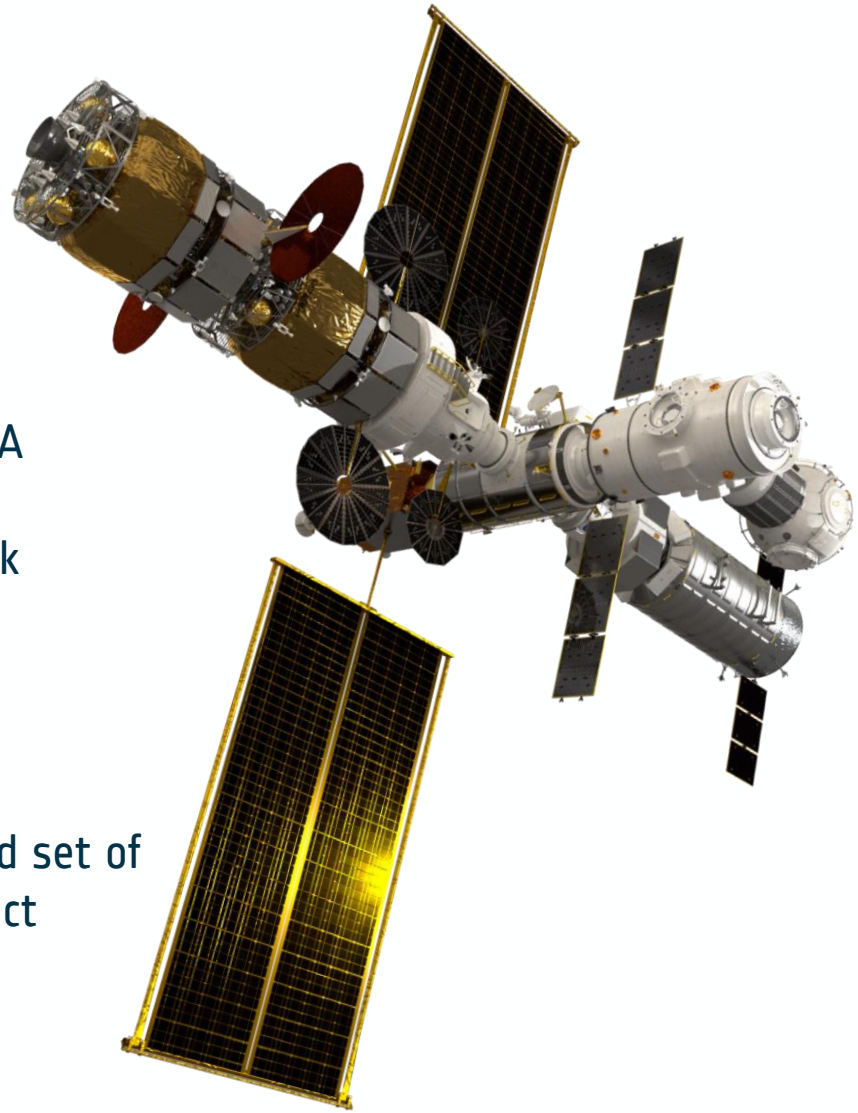
ECSS Evolution

ECSS 4.0 and simplification

- stakeholders to identify core & non-core requirements to address the commercialisation needs and the New Space market
- approach to be complemented by the ESA mission classification to tailor the requirements according to the project risk profile

ECSS Master Database

- simplifies the application of a pre-defined set of requirements for a specific mission/project
- improves usability of ECSS standards
- adapts faster to new requirements



Mission classification

- framework to define the appropriate requirements tailored to the profile of the mission
- new structured framework for ESA & MS to manage programmatic risks
- systematic approach for optimising resources in accordance with mission objectives
- framework to develop novel project implementation strategies
- basis for the introduction of novel elements (eg COTS) aiming at reducing development time and cost

→ standardization will support a more dynamic space market in Europe

ESA Mission Classification

HIGH requirements LOW

LOW probability of failure HIGH

Scope – ESA procurement

- one-off missions (crewed or not)
- recurring operational spacecraft
- IOD/IOV missions
- CubeSats

→ mega-constellations not addressed

	Class type	I	II	III	IV	V
weighted scoring criteria	Criticality to Agency strategy	Extremely high criticality	High criticality	Medium criticality	Low criticality	Educational purposes
	Mission objectives	Extremely high priority	High priority	Medium priority	Low priority	Educational purposes
	Cost	> 700 M€	200 – 700 M€	50 – 200 M€	1 – 50 M€	< 1 M€
	Mission lifetime	> 10 years	5 – 10 years	2 – 5 years	3 months – 2 years	< 3 months
	Mission complexity	High	High to medium	Medium	Medium to low	Low

Pre-tailoring of ECSS requirements

- completed for product assurance standards
- on-going for engineering standards
- security and safety not subject to tailoring

weighted average score in the 5 criteria determines the mission class (I to V)

units/payloads can have a lower class

4 → Dissemination of ECSS information

ECSS website (ecss.nl)

ECSS | European Cooperation for Space Standardization

Search website | Sign in

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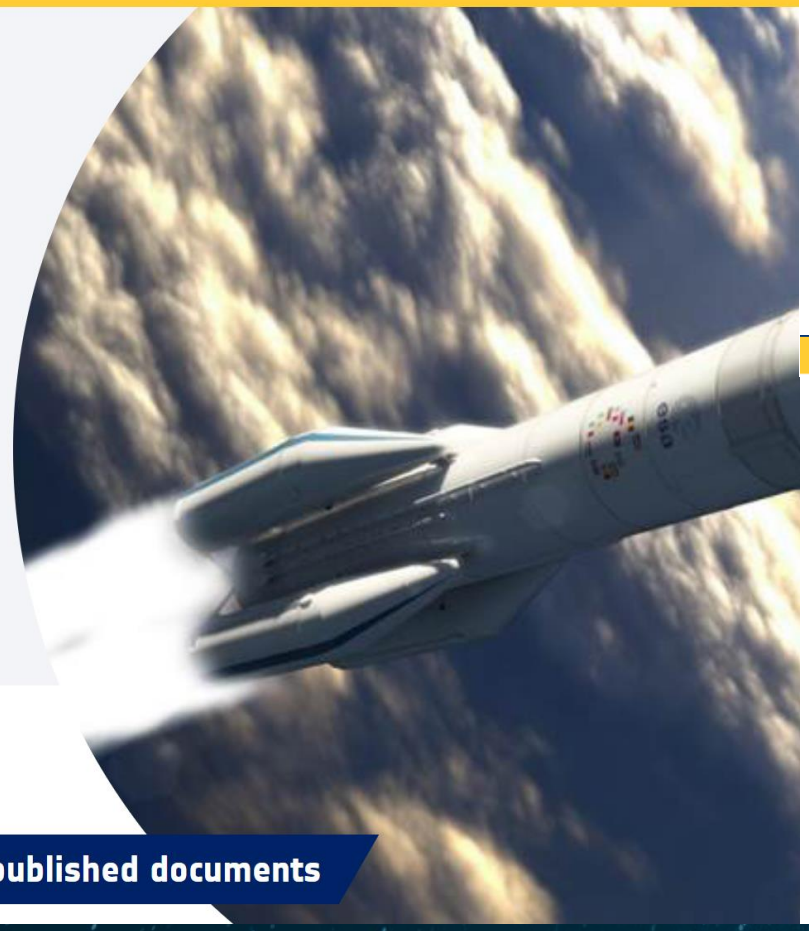
The European Cooperation for Space Standardization is an initiative established to develop a coherent, single set of user-friendly standards for use in all European space activities.



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- Active Engineering standards
- Active Management standards
- Active Product Assurance standards
- Active Sustainability standards
- ECSS General and System documents

Active Standards

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- ECSS training material downloads
- Recordings of ECSS Training held by ESA in 2017
- Recordings of ECSS Training held by ESA in 2019

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- Any deficiency identified in the Training Material shall be reported to the ECSS secretariat;
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Creating an ECSS account and logging in

go to ecss.nl and click on the ***Sign in / Register*** button

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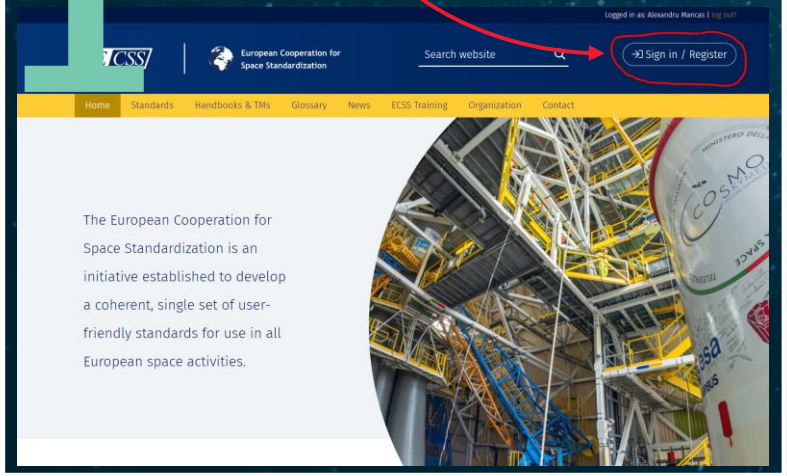

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if you have an account: click on the ***ECSS*** button

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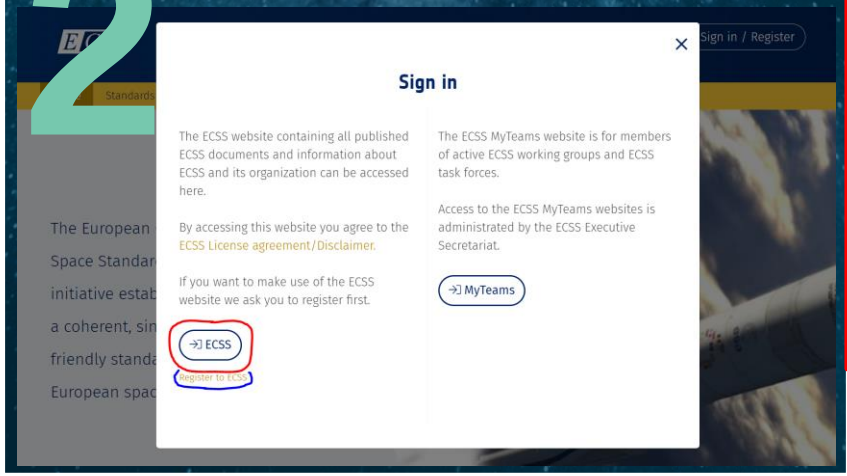

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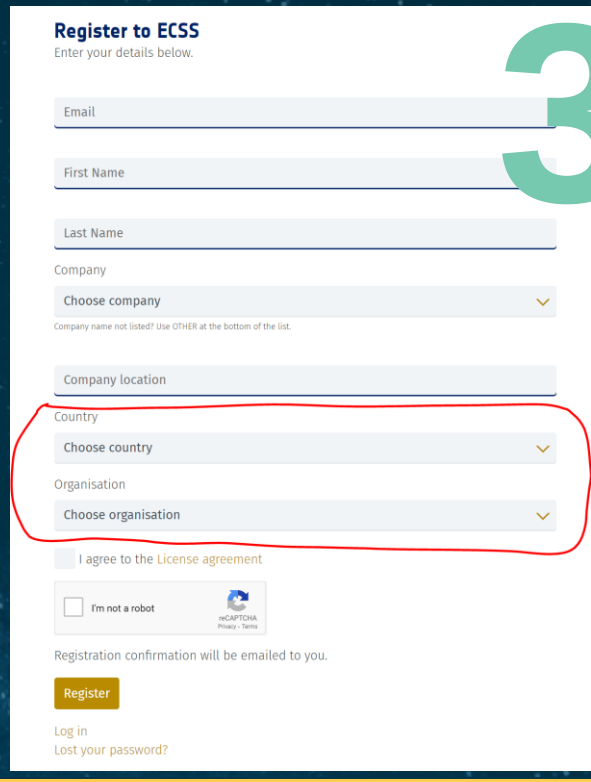

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- Active Standards
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- Documents For Developers
- Document Production Status
- DOORS Database Download
- ECSS Applicability Requirement Matrix (EARM)
- ECSS Support Material
- Online Change Request Form
- ECSS Change Request Form (Excel File)

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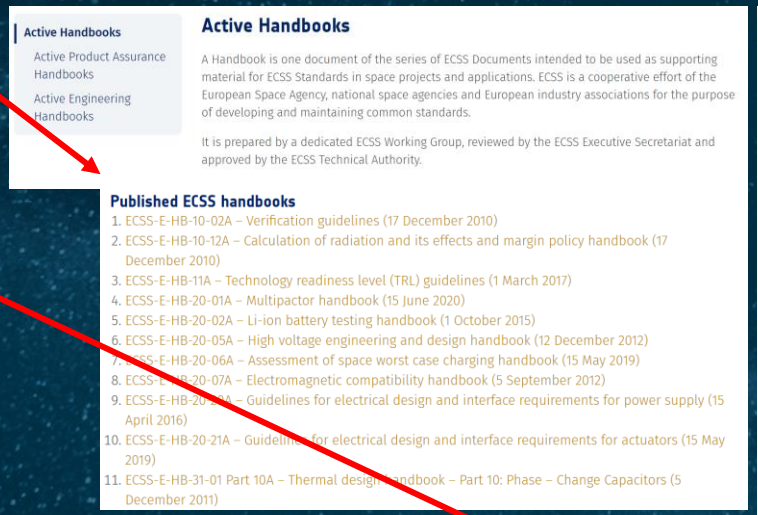
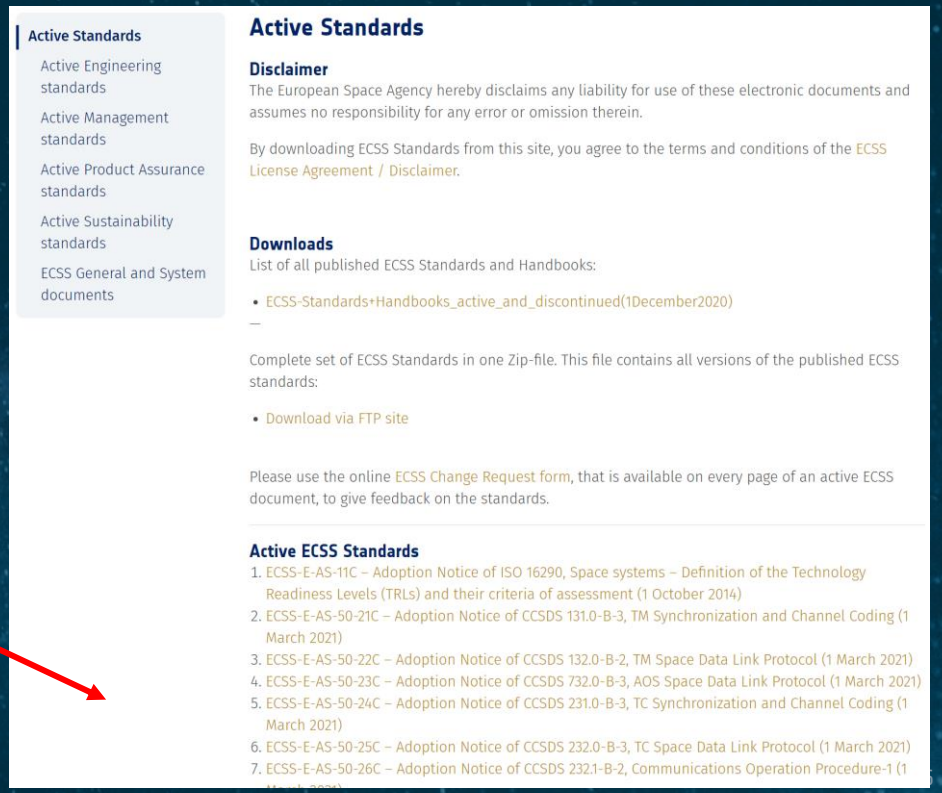
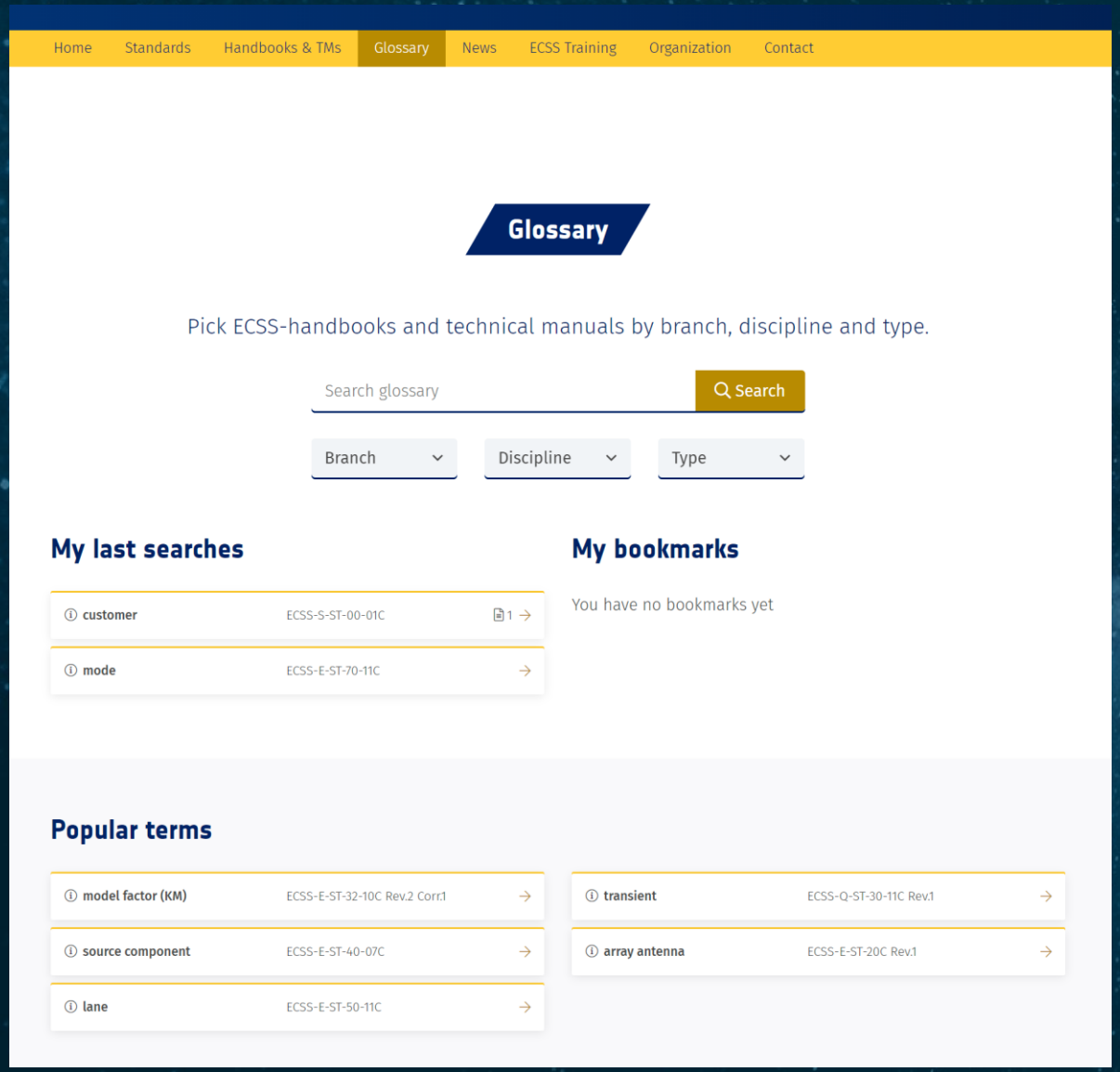
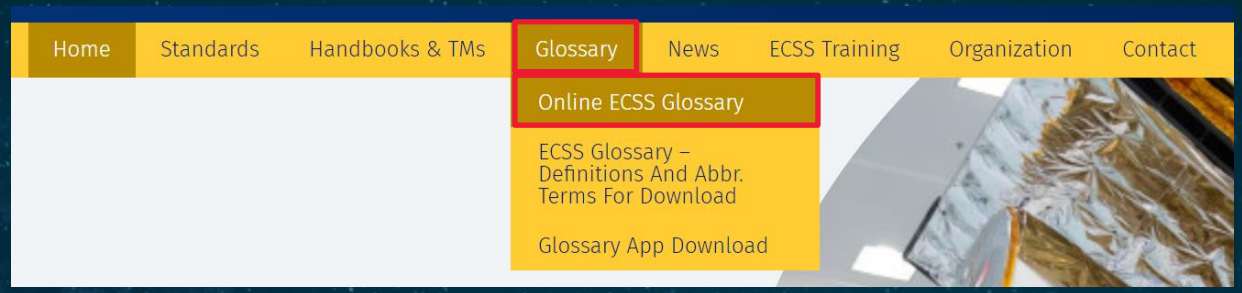




The ECSS Glossary of terms

https://ecss.nl/glossary/





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Read More

What is CCSDS?

The Consultative Committee for Space Data Systems (CCSDS) is a multi-national forum for the development of communications & data systems standards for spaceflight.

Leading space communications experts from 28 nations collaborate in developing the most well-engineered space communications & data handling standards in the world.

The goal to enhance governmental & commercial interoperability & cross-support, while also reducing risk, development time & project costs.

More than 1000 space missions have chosen to fly with CCSDS-developed standards.

New to CCSDS

Frequently asked questions about CCSDS

Materials that provide a quick overview of CCSDS's current activities

Finding and Using CCSDS Standards

Access the CCSDS library of publications

The Space Assigned Numbers Authority (SANA) is the registrar function for the protocol registries created under CCSDS.

Working Within CCSDS

View CCSDS documents currently under review and find information on submitting RIDs.

Collaborative Work Environment Visitors: Enter the CWE area to view public documents in the CCSDS working groups. Request a CWE ID to fully engage in the technical teams.

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) is the executive management oversight grou
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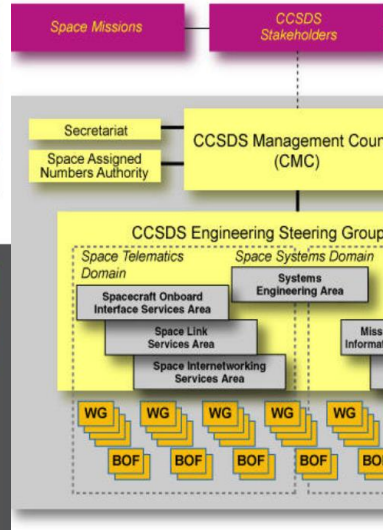

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Locate CCSDS Documents by Book Color, CCSDS Area, or by using the Interactive Space Data System Reference Model (see below). To better understand the CCSDS Standards Development Process click here.

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- Magenta: Recommended Practices
- Green: Informational Reports
- Orange: Experimental
- Yellow: Record
- Silver: Historical
- All Active Publications

Publications Sorted by CCSDS Area

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- Space Link Services

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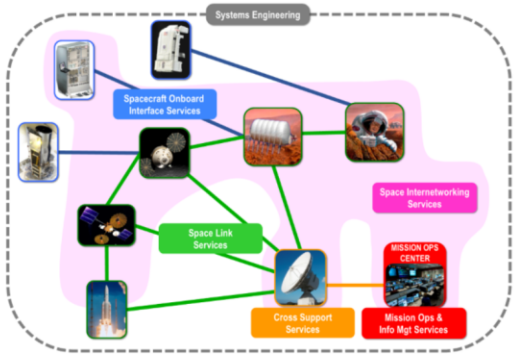
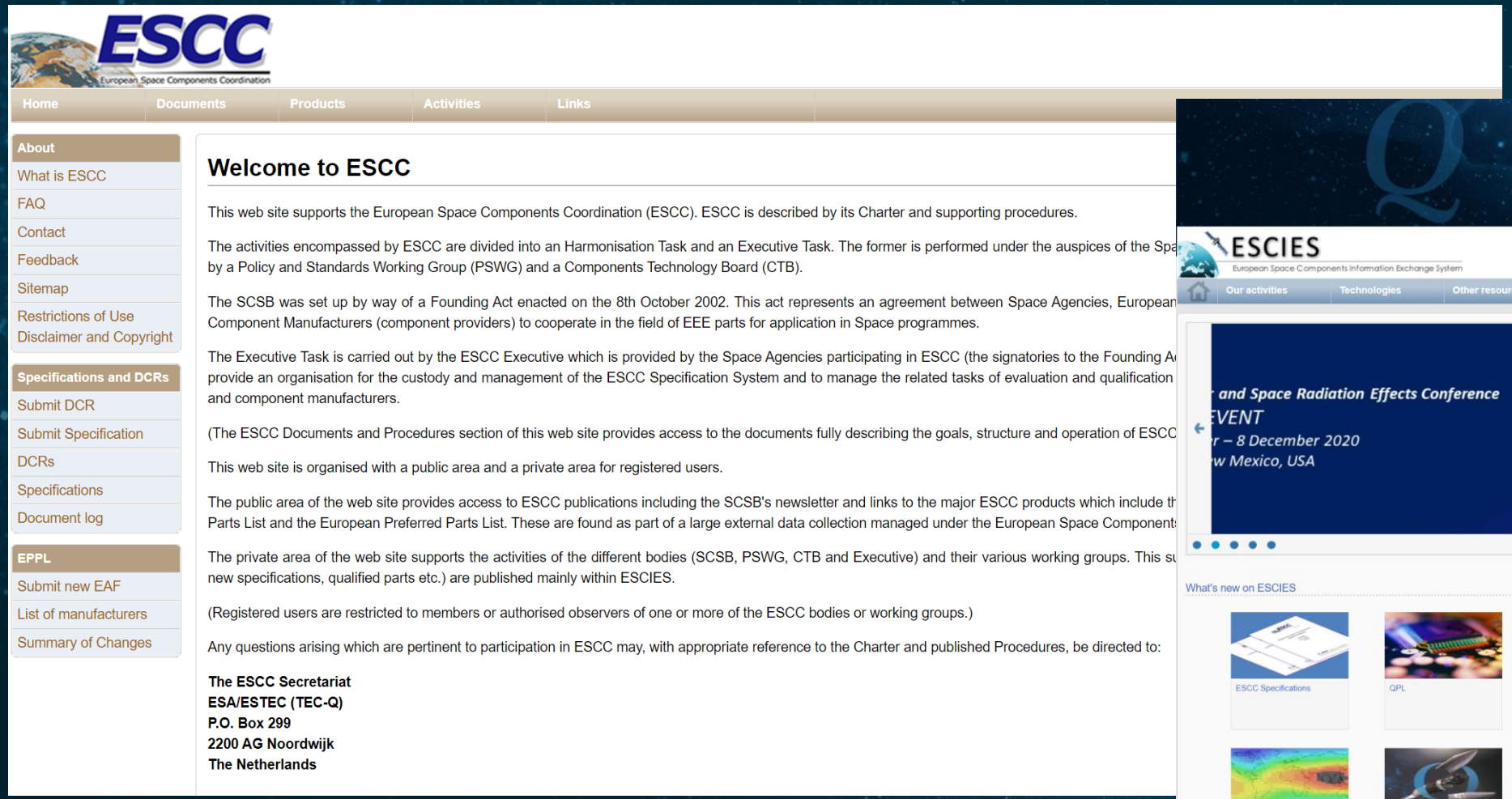
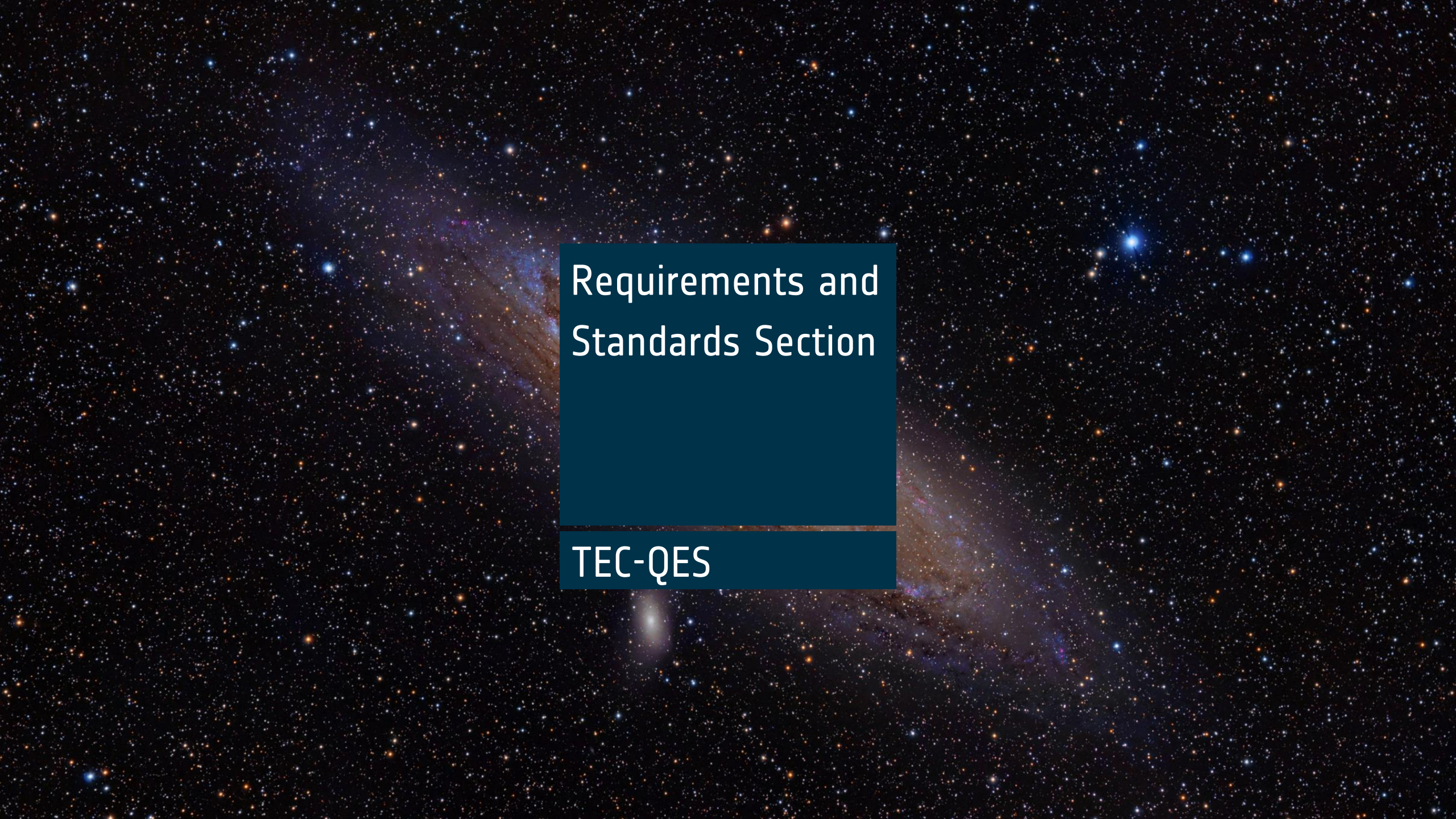


ESCC (escies.org and spacecomponents.org)

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