STANDARDS ANALYSIS

AEROSPACE SECTOR

LUXEMBOURG

Version 6.0 · July 2024
ISSN: 2738-9499

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Institut Luxembourgeois de la
Normalisation, de l'Accréditation, de la
Sécurité et qualité des produits et services

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FOREWORD

Technical standardization and standards play an important role in the support of economic development. Nowadays, almost every professional sector relies on standards to perform its daily activities and provide services in an efficient manner, and the space sector is no exception.

Standards can provide, for example, good practices for services and product development, governance, quality assessment, safety, trustworthiness, etc. Standards are therefore considered as a source of benefits in all sectors of the economy, and this is particularly true for the space sector where international cooperation is commonplace and facilitated by their use.

Indeed, the active participation of Luxembourg as a Member State of the European Space Agency (ESA) followed by the creation of Luxembourg Space Agency (LSA) opened the door to new partnerships in Europe and internationally. The Grand Duchy of Luxembourg aims to seize this opportunity to further develop the space sector, whose development has already been promoted for several years through various actions, especially in the field of space resources exploration and utilization.

The Ministry of the Economy plays an important role in the development of the space sector in Luxembourg. It has notably published, with LSA, the 2020-2024 National Action Plan for Space Science and Technology[1].

The *Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et services* (ILNAS), an administration under the supervision of the Minister of the Economy, fully supports this development through the 2020-2030 Luxembourg Standardization Strategy[2], where the Aerospace sector was identified as one of the key strategic sectors along with the Information and Communication Technology (ICT) and construction sectors.

Directly linked to this strategy, ILNAS has drawn up the 2021-2025 Policy on Aerospace Technical Standardization[3]. The motivation of this standards analysis lays within the three lead projects of this policy:

- Promoting aerospace technical standardization to the market;
- Reinforcing the valorization and the involvement regarding aerospace technical standardization;
- Supporting and strengthening education about standardization and the related research activities.

This new standards analysis is intended to serve as a practical tool to discover the latest standardization developments in space-related technologies, with the ultimate objectives to offer national stakeholders guidance for applying these standards, for a potential future involvement in the standards development process, and allow them to benefit from the services provided by ILNAS at the national level regarding technical standardization.

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[1] https://space-agency.public.lu/dam-assets/publications/2020/Luxembourg-space-action-plan-ENG-final-kw.pdf

[2] https://portail-qualite.public.lu/dam-assets/publications/normalisation/2020/strategie-normative-luxembourgeoise-2020-2030.pdf

[3] https://portail-qualite.public.lu/content/dam/qualite/publications/normalisation/2021/Policy-on-aerospace-technical-standardization-2021-2025.pdf

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INTRODUCTION

Consistently growing in Luxembourg since 1985, the space industry drives growth and innovation. This document aims to provide national stakeholders with knowledge on a tool to support their space-related activities: technical standardization.

Nowadays, technological evolution is greatly impacting all businesses, and space activities is no exception. Direct consequences on this domain are the origination of new development perspectives which are driving the current activities and will determine the economic and scientific orientation of the space industry in a short-, mid- and long- term. Some of them are already under investigation, like space-tourism, deep-space exploration and space resources utilization.

These new activities will help to achieve common international goals, but give raise to new challenges. One of the most important issues to address is the harmonization of operations. So far the cooperation between different space organizations has been successful, as demonstrated by the International Space Station, but new emerging risks (lunar occupation and resources utilization, traffic management to avoid collision, space-debris, etc.) require new ways of collaboration, such as uniform directives, for example. This need of common language is also exalted by the change of space development paradigm which means fast design, private stakeholders driving projects and large partnership for single mission, causing higher risks of failure. In this frame, technical standardization is a tool that can reduces the risk and increase efficiency with the benefits of bringing satisfaction and output quality to end-users.

Furthermore, technical standardization constitutes an incubator to foster innovation and the uptake of new services or products. It notably offers an access to technologies and knowledge that supports market entry, an opportunity to benefit from a network of thousands of experts and an aid in complying with regulation and certifications. Standards also create trust in innovative solutions and ensure their interoperability in order to facilitate their acceptance on the market.

This standards analysis was carried out in the frame of the 2021-2025 Policy on Aerospace Technical Standardization. It should be noted that in line with the national strategy for the economic development of the space sector [1] initiated by the government of Luxembourg, this edition of the aerospace standards analysis will only focus on the “space” domain, excluding aeronautics applications. The main objectives of this document are to increase the market’s knowledge on space-related technical standardization and to facilitate its involvement within the associated activities.

To this end, this document is organized as follows. In Chapter 1, after providing a brief definition of the space sector, this document first introduces this sector’s current general context, before focusing on the European and national levels. Technical standardization is then presented in Chapter 2, in a general way, and in relation to the space sector. After these two chapters providing background information, Chapter 3 presents several ways to get involved in technical standardization in the space sector, one of them being to become a national delegate. The benefits of involvement are also emphasized. Finally, aware of these benefits, the reader will be able to use the space sector standards watch from Chapter 4 to spot relevant technical committees[4] for involvement, according to his/her interest. Indeed, this standards watch presents all technical committees from recognized standardization organizations relevant to space-related applications.

It should be borne in mind that the information contained in this document may only be valid at the time of writing. This standards analysis is a sector-based “snapshot” of the space sector; it is planned to update it on a regular basis.

[4] In this document, the term “standardization technical committee” is generic and covers “technical committee”, “subcommittee”, working group”, etc.

1 Space Sector

1.1 Definition

The space sector is often defined in regard to the space economy or the space industry. In short, it is "the economic sector providing goods and services related to space" [2]. The National Aeronautics and Space Administration (NASA) defines the space economy as "the full range of activities and the use of resources that create and provide value and benefits to human beings in the course of exploring, understanding and utilizing space" [3].

Based on the categorization used by Luxembourg Space Agency (LSA), the space sector can be divided into three identifiable segments [4]:

- **The space segment**: manufacturing of satellite and instrument structures, system integration of micro-satellites, electric propulsion for satellites, robotic payloads, in-space manufacturing, composites, Radio Frequency (RF) payloads, Field Programmable Gate Array (FPGA);
- **The ground segment**: ground stations development, mechanical and electrical ground support equipment, communication networks, operations;
- **The service segment**: teleport services, satellite-based media and telecommunications services, risk management services, data analytics, environmental applications and services, aeronautical information services, analytics platform.

1.2 General context

1.2.1 Evolution

The use of space started to thrive with technological breakthroughs towards the end of World War II. Then, the Cold War and its space race led to the broad usage of satellites for military and commercial purposes, as well as launching the trend for space exploration. Since then, space has been considered a key strategic sector.

The 1967 "Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies", commonly referred to as the "Outer Space Treaty", laid the basis of international space law, banned nuclear weapons from space, and forbade any government to claim any celestial body such as the Moon. This basis was strengthened in the European Union (EU) through Article 189 of the Lisbon Treaty (2009), providing a legal ground to develop policies on space exploration and exploitation, and giving to the EU a mandate to take action in this field, such as through the implementation of a European space program unifying and coordinating European efforts.

Nowadays, space technology and services have become part of our everyday life, and we rely on them when using telephone and car navigation systems, watching satellite TV, checking the weather forecast and withdrawing money. Satellites also provide critical data in case of natural disasters [5]. Moreover, items developed for use by astronauts in space now improve lives on Earth: memory foam, scratch-resistant sunglasses, cordless vacuums, and so on.

More recently, space has been open to private industry. Although definitions may vary, this new (private) space sector is commonly referred to as "NewSpace". The major characteristic [6] of the NewSpace era is the shift from a space industry exclusively funded by governments (and therefore taxpayers' money), to one in which an increasing role is played by independent private sector actors.

1.2.2 Economic overview

The space sector is considered to be an international motor of economic growth. In Europe, the sector experienced a steady growth of sales in the past decade, supporting a similar trend in employment growth [7].

The Space Foundation estimates that the annual global commercial revenues from the space sector are of $337 billion in 2019 [8] , $357 billion in 2020 [9] and $362 billion in 2021 [10]. Most of this revenue was generated through commercial satellite services. Accordingly, we can identify three active development areas with direct economic repercussions: Telecommunications, Earth observation and Satellite navigation.

While these areas of business are dominated by giants of the industry, the start-up economy in the space sector is not left out: from 2009 to 2018, a total of $18 billion was invested in space start-ups [11].

Moreover, following the steadily rising demand, new promising developments are expected to increase the share of the space sector in the global economy in the decade to come. These developments cover, among other topics, Earth Observation, Telecommunication, Space debris, Traffic Management, In-Orbit servicing and Space resources. All these activities are aligned with the sustainability objective set by National Space Strategy of Luxembourg 2023-2027 [12]. In addition to this national common thread, Cybersecurity, Space tourism, Small satellite launch services and Information and Communication Technology (ICT) are topics which are currently gaining interest from the different actors of space domain.

Active development areas

For decades, the space sector has relied on strong economic areas of Telecommunications, Earth observation and Satellite navigation. These areas are in perpetual evolution and contribute to active economic development of the Space sector. Below is an overview of these economic areas, covering both private and public sector initiatives.

Telecommunications

It is currently the most important and the most dynamic market for space applications, it includes remote communication (voice, video or data), broadcasting (TV, radio) and internet access. The European Defence Agency "GovSatCom" project [13], created in 2017 and involving 26 participating countries in Europe (including Luxembourg), provides a reliable, secure and cost-effective service of governmental satellite communications. It also aims to demonstrate the benefits of a "Pooling and Sharing" collaborative model (a form of defense cooperation [14]).

Earth observation

The increase in the number of satellites and in image resolution in this sector now allows a broad range of activities. Weather forecasting supports economic growth, as our highly developed economies and many areas of our modern lives are highly weather sensitive. Among other things, Earth observation also helps save lives at sea, improves response time when facing natural and man-made disasters, helps farmers to better manage their crops, protects marine activities from piracy, provides food security, helps monitor natural resources, and reduces poverty [15].

The European program Copernicus [16], created in 2014, aims to provide Europe with a set of approximately 20 satellites dedicated to Earth observation, called the Sentinel satellites. These satellites are specifically designed to meet the needs of the Copernicus services and their users. The Copernicus program offers six kinds of services: Atmosphere, Marine, Land, Climate Change, Security and Emergency.

More recently, in response to the COVID-19 pandemic, NASA, the Japanese Aerospace Exploration Agency (JAXA) and the European Space Agency (ESA) have joined forces to create a satellite data dashboard[5] that shows the environmental and economic effects of the pandemic.

In the Global Assessment Report (GAR) 2022 Concept note of the UN Office for Disaster Risk Reduction, decision makers everywhere agree that they need more reliable data and statistics. The use of Earth observation should be the key to support them and increase the accuracy of data and statistics. [17].

Satellite navigation

The use of satellite navigation has become part of our everyday life. To date, there are four Global Navigation Satellite Systems (GNSSs): the Global Positioning System (GPS) from the United States (US), the Global Navigation Satellite System (GLONASS) from Russia, the BeiDou Navigation Satellite System (BDS) from China and Galileo from the EU.

Some regional (and not global) navigation satellite systems also exist, such as the European Geostationary Navigation Overlay Service (EGNOS) for Europe, or the local satellite positioning reference system of Luxembourg named “Satellite Positioning System Luxembourg” [18] (SPSLux). These regional systems improve the performance (accuracy and reliability) of GNSS by applying real time corrections to the GNSS data. Other regional satellite navigation systems like the Indian Regional Navigation Satellite System (IRNSS) are trending towards global navigation systems [19].

Promising development areas

As international and national space industries are thriving, new areas of business are emerging, along with new opportunities. Below is a non-exhaustive selection of some of the promising development areas in the space sector.

Earth Observation for Sustainable Development Goals

Earth Observation activities are already used to serve economic growth, like agriculture, or to help people (during conflict or extreme weather conditions). However, with the current climatic change challenges, Earth Observation can support Sustainable Development Goals (SDG) defined by United Nations[6] by using satellites images as input for algorithm or Artificial Intelligence (AI) in order to provide useful output as water stress level or air quality, for instance. Following this context, ESA Digital Twin Earth (DTE) Challenge [20] seeks to stimulate applications which combine AI and Big Data from Copernicus Sentinels and other Earth observation data to provide forecasting on the impact of climate change and respond to societal challenges. The ESA DTE Challenge aims to increase the exposure and understanding of Earth observation data combined with AI and Machine Learning, IoT, Cloud Computing and Data Analytics in order to answer to challenges and target addressed by Green Deal.

From a national standpoint, LSA Data Center[7] actively supports the development of the downstream sector by facilitating the access to space data, since data collected through space infrastructure are becoming more and more critical for various applications. LSA Data Center is the Luxembourg entry

[5] https://eodashboard.org/
[6] https://sdgs.un.org/goals
[7] https://www.collgs.lu/

point to data products of the Copernicus Sentinel constellation, and provides the users with a real time updated geo-catalogue where they can select the needed products for download.

Space Traffic management and collision avoidance

Since 1957, more than 15430 artificial satellite have been delivered into Earth's orbit and currently more than 7700 artificial satellites are still active [21]. Status of non-operational satellites can be classified in two ways: either they are still orbiting, or they have been destroyed due to unexpected collisions or explosion caused by system failure (for example, battery explosion [22]) causing clouds of debris in orbit. Currently, a number of 1 million of space debris (bigger than 1cm; including decommissioned satellites) has been estimated by ESA statistical models [23].

From these previous observations, several risks can be clearly identified: collisions between active satellites, collision between active satellites and space debris and collision between space debris. Moreover, these event probabilities will be increased in the next decade [24], due to the forecasted presence of 20000 additional satellites in orbit.

In the past, only voluntary and non-binding good practices have been used to tackle these risks, but with the increase of artificial satellite in Earth's orbit, a formal way to operate is needed. Although ESA is setting up several concepts and capabilities (Space Surveillance and Tracking, Space Traffic Coordination and Space Traffic Coordination and Management), currently no regulation is available and the different countries and unions pushed to set a common understanding in order to undertake these growing danger. More recently, communication has been made towards European Commission and Council at the date of 15th February 2022, promoting an international and global agreement on these topics [25]. This communication has been highlighted in December 2022, with the opinion of the European Economic and Social Committee on these needs in regulation and standardization [26].

As starting point of these challenges, three concepts have been defined: traffic management, debris monitoring and debris management.

Active monitoring of debris orbit and active satellite is made in order to prevent collisions by sometimes requesting a change of satellites attitude. Some orbital maneuvers already have been performed in order to prevent collisions. Each maneuver reduces the active satellite's life expectancy, since it consumes fuel normally used to maintain its orbit, therefore shortening the time before the satellite will become debris itself [27].

Besides the economic interest behind reducing these one-time corrections, the management of space debris should also prevent the risk of rendering certain orbits totally unusable: in a worst case scenario, debris collisions will induce even more debris, self-generating collisions in a cascading way, in a fashion called the Kessler syndrome. This scenario could have dramatic socio-economic impacts, preventing access to services like Earth observation, satellite communications and navigation, among other things [27].

This explains why many companies are already working on this issue, taking advantage of this emerging business of space debris surveillance, tracking and removal. ESA signed an €86 million contract with a consortium led by a Swiss start-up in order to remove one of its space debris by 2025. This service will be the first of its kind, and includes advanced guidance, navigation and control systems, and vision-based Artificial Intelligence (AI) [28].

At the roots of the above solution, ESA started in 2016 e.Deorbit project with the same initial goals. However, these objectives have been broadened in 2018 with the On-Orbit servicing concept [29]: to extend satellite lifetime of retiring out-of-power or broken satellites, an extra satellite (also called Mission Extension Vehicle) can perform maintenance tasks, as repairs or refuels of the primary one. This kind of actions have been successfully performed with MEV-1 and MEV-2 vehicles which serviced satellites in February 2020 and April 2021, respectively. Nowadays, these activities are foreseen as key-solution for space sustainability.

From standardization stand-point, the different organizations are also trying to solve the Space Debris issues. The International Organization for Standardization (ISO) published several international standards, giving guidelines to reduce the growth of space debris[8,9].

Space resources

The US and Luxembourg both took strong actions to develop the field of space resources, especially through the establishment of a dedicated legal framework. Luxembourg also already provided support to promising space resources start-ups [30].

Space resources are not meant to be used primarily for terrestrial needs, but are closely connected to space exploration and inhabitation: basic material for additive manufacturing but also water could be collected directly in space, instead of having to be carried all the way up from Earth. A good example is Artemis program [31] [32]: led by NASA and in partnership with ESA, this 3 phases-mission aims to explore the Moon in 2025 by humans with the goals of creating a Base Camp on the surface and utilizing the Lunar resources to trigger new economies [33]. Therefore, space resources hold a high potential for future development: their usage will be key to the future of space exploration.

Aware of this future type of economy and part of the SpaceResources.lu initiative, European Space Resources Innovation Centre (ESRIC) has been created in late 2020 in Luxembourg. This center aims to become an internationally recognized center for the use of space resources and for space exploration, with the support of ESA and LSA.

The activities of ESRIC are based on four main pillars:

- Space resources research and development;
- Support for economic activities;
- Knowledge management;
- Community management.

While research covers the full value chain, the focus is put on advancing knowledge and technologies for extracting oxygen from lunar regolith.

Cybersecurity

Human's activities are highly relying on space systems and any loss can have critical consequences. During decades, these mission failure risks have been associated to the environmental conditions of space and counter measures have been implemented accordingly (redundancy, qualified components, etc.). But today, a new source of risk is considered: cyberattacks.

In the last century, wars took the shape of physical (World War II) or intellectual (Cold War) conflicts, but today - and even more in the future -, battle will take place on the technological areas. For example, in February 2022, cyberattacks towards ViaSat's and Starlink's telecommunication and Internet service providers happened, causing services interruption [34]. In May 2023, Thales Alenia Space (under ESA's supervision), took control from satellite and modified spacecraft attitude [35]. Although not directly harmful for Human being, these attacks showed only few possibilities by exploiting vulnerabilities of satellites.

[8] ISO 24113:2023, Space systems - Space debris mitigation requirements
[9] ISO 23312:2022, Space systems - Detailed space debris mitigation requirements for spacecraft

In the future, attacks will even more be present: the virtuous circle created by the regular launches and small satellite developments is currently orienting the development and design solutions towards common computer and communication technologies, which could lead to more regular attacks. Aware of these threats, and to manage associated risks, ESA is currently focusing some of its activities on cybersecurity, by setting up capabilities like Cyber-Security Operations Centre (C-SOC) which will cover all security aspect of its infrastructure, in order to protect European citizens from any cyberattacks and subsequent effects. This entity will be fully operational by end 2024 [36].

Information and Communication Technology (ICT)

The space and ICT sectors are closely related since they both often benefit from the advances made in the other sector. The increasing availability of space information (through satellite-as-a-service for example) is fostering innovation in combining space and ICT to improve life on Earth.

Navigation and tracking systems powered by satellite navigation services assist the development of the Internet of Things (IoT), especially in transportation networks. Intelligent Transport Systems (ITS) help increase safety and reliability through the optimization of people and goods transportation. Other domains like healthcare informatics (for fitness trackers) or drone delivery systems also benefit both from GNSS and IoT.

ESA's ARTES 4.0 program [37] also aims to use space to accelerate the connectivity revolution through three main projects: Space for 5G, Optical Communications ScyLight (secure and laser communication technology), and Space Systems for Safety and Security (4S). Some of the new initiatives of the ARTES 4.0 program cover the topics of a responsible use of space, in-orbit assembly, and Very Low Earth Orbit (VLEO).

Space tourism

An opportunity rising with today's safer spaceflights and with the availability of space travel at a lower cost is that of space tourism, which consists in space traveling for recreational purposes. To date, three types of space tourism are considered: sub-orbital, orbital, and lunar.

While there are currently less than 18 official space tourism missions, some companies like Virgin Galactic, Blue Origin or SpaceX are working on sending several people per year to space. Many people are ready to spend millions in order to realize their dream of flying to space.

In 2019, NASA announced that from 2020 they will allow private astronauts to stay in the International Space Station (ISS) for $35,000 per night, for up to 30 days [38]. Several missions are already planning to take advantage of that offer. For example, a crew of four private astronauts including three customers went to the ISS through Axiom Space between April 8th 2022 and April 25th 2022 [39] with a Dragon spacecraft.

1.2.3 Science and exploration

The space sector is not limited to commercial or military usage: for 2024, 8.1% of ESA's budget is dedicated to science and exploration missions [40]. The ISS was also created for that purpose, and is currently used for space research. The Station is supposed to be deorbited in 2031 [41] emphasizing the interest of the scientific community to the space activities.

At higher level and in the context of planetary defense, NASA's DART [42] and ESA's Hera [43] missions confirmed countries willingness of scientific research: in December 2022, DART mission impacted Dimorphos, the orbiting Moonlet in a binary asteroid system, showing the capacity of deflecting asteroid [44]. Complementary mission from ESA, Hera will be launch in October 2024 with several scientific objectives including the following ones [45]:

- Establishing a first comprehensive characterization of a binary near-Earth asteroid (NEA)
- Probing the subsurface and interior properties of and asteroid,
- Studying the surface geophysics of two objects of different size and surface gravity
- Obtaining the first in-situ characterizations of an asteroid
- Investigating the crater formed by the impact of DART mission.

Already mentioned, NASA's program Artemis [31] aims to land astronauts on the Moon again with objectives which are not only limited to the resources utilization but also science. Indeed, the final phase of Artemis mission will have the purpose to understand the planetary processes, to interpret the impact history of the Earth-Moon system and to reveal the record of the ancient Sun [46] by executing several types of measurements. Additionally, Artemis will be a step towards Mars exploration by collecting useful information for extending the space trips to deep exploration.

At national level, Luxembourg is among the eight original signatory countries of the Artemis Accords, an international agreement promoting the peaceful exploration of space, especially Lunar and Martian exploration. The agreement is based on the founding principles of the Outer Space Treaty of 1967 [32]. So far, 19 countries have signed these agreements.

1.3 European context

1.3.1 Political guidance and funding

The European Commission instigates and implements EU policies, such as the space policy, to provide socio-economic benefits to the EU citizens.

The EC is in particular responsible for the implementation of the new EU Space Programme Regulation, laying down the objectives, budget and rules of the Programme for the 2021-2027 period. This Regulation also establishes the European Union Agency for the Space Programme (EUSPA). In February 2022, the EC propose two new initiatives to boost the Space Traffic management and space-based secure connectivity [47] which led in March 2023 to the publication to the "*Regulation (EU) 2023/588 of the European Parliament and of the Council of 15 March 2023 establishing the Union Secure Connectivity Programme for the period 2023-2027*"The EC is also responsible for the European funding programs, such as the Horizon Europe program, running from 2021 to 2027, with a total budget of €86.1 billion, including an envelope of €13,5 billion for the Cluster '*Digital, industry and space'* [48].

Additionally, following the State of the Union given by President of the European Commission Ursula von der Leyen, the initiative of setting-up an EU Space Law has been mentioned. Initially planned to be published during the first quarter of 2024, the document will be finally released by end of 2024 and will aim to provide a common framework for security, safety, and sustainability in space by setting up rules for space traffic management, for instance.

1.3.2 The European Space Agency (ESA)

ESA defines itself as "Europe's gateway to space". It was created in 1975 and has its headquarters located in Paris. ESA is an intergovernmental organization dedicated to the space sector with 22 Member States [49]: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom[10]. Slovenia and Latvia are Associated Members.

[10] The UK's membership of ESA is not affected by leaving the EU as ESA is not an EU organization. However, it will no longer participate in some of the EU programs, such as Galileo or EGNOS.

Canada takes part in some projects under a Cooperation agreement, just as Bulgaria, Croatia, Cyprus, Lithuania, Malta and Slovakia.

Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and to the world. Through its governing body, the Council, ESA provides basic policy guidelines to draw up a European space program. Each Member State is represented on the Council and has one vote, regardless of its size or financial contribution. Canada also sits on the Council.

The ESA Agenda 2025[11] is a document that defines the priorities and goals of the Agency. Five specific targets (in no particular order) have been defined in that context:

- Strengthen ESA-EU relations;
- Boost green and digital commercialisation;
- Develop space for safety and security;
- Address critical programme challenges;
- Complete the ESA transformation.

1.3.3 Other entities[12]

Several other important players are shaping the space industry in Europe. The following entities are some of the main contributors from the EU:

- The European Union Agency for the Space Programme (EUSPA) was launched on May 12, 2021. It embraces the scope of the former European GNSS Agency (GSA), which was especially responsible for Galileo and EGNOS operations and service provision (EGNOS is a Satellite-Based Augmentation System (SBAS) used to improve performance for GNSS services). EUSPA also endorses additional responsibilities such as Security Accreditation by the Security Accreditation Board (SAB) for all the components of the Space Programme, and the possibility to carry out the market development and users' coordination potentially for all the components of the Space Programme;
- The European Defence Agency (EDA) is an intergovernmental agency. It falls under the authority of the Council of the EU, to which it reports and from which it receives guidelines. The EDA supports EU member states in space-based military operations, and ensures a secured access to satellite telecommunications and navigation;
- The European Union Satellite Centre (SatCen) is an agency from the EU supporting the decision making and actions of the EU in the field of Common Foreign and Security Policy. It provides the EU with products and services such as satellite imagery, resulting from the exploitation of relevant space assets and data;
- The European Telecommunications Satellite Organization (EUTELSAT IGO) is an intergovernmental organization with currently 49 member states. Its mission is to maintain the rights to use radio frequencies and orbital locations which were assigned collectively to its member states by the International Telecommunication Union (ITU) and to oversee the operations of Eutelsat S.A. so as to ensure that the company complies with the EUTELSAT Amended Convention;
- The European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) is an intergovernmental organization with currently 30 member states. EUMETSAT's primary goal is to establish, maintain and exploit European systems of operational meteorological satellites. The organization is responsible for providing satellite data, images and products related to weather and climate;

11 https://download.esa.int/docs/ESA_Agenda_2025_final.pdf

12 Non-exhaustive list. Information based on the organizations' websites.

- The European Space Policy Institute (ESPI) is an independent institute created following an initiative of ESA. Through various services, publications and events, ESPI provides recommendations, policy options and forward vision as to how Europe's engagement in space can bring maximum benefit to society;
- ASD-Eurospace is the trade association of the European space sector. It is a not-for-profit organization founded in 1961, with currently 44 European companies as members. ASD-Eurospace is the professional association of the European space industry. As such, it is the reference body for consultation and dialogue within the industry and with European institutions. The main focus of ASD-Eurospace is space policy and strategy. The association regularly publishes recommendations based on the identification of issues affecting the industry as a whole.
- SME4SPACE is a not-for-profit organization that aims to express the viewpoint of space Small and Medium-sized Enterprises (SMEs) in a coordinated way, and to facilitate their access to space activities in general and to ESA and EU programs in particular. SME4SPACE was launched in 2007.

1.4 National context

In just three decades, Luxembourg's space industry emerged from nothing to be on the verge of becoming the center of space business in Europe.

1.4.1 Milestones

Creation of the *Société Européenne des Satellites*

Historically, the interest of Luxembourg for the space sector starts in 1985 where the potential of the satellite telecommunications market was fully understood and initiated the creation of the *Société Européenne des Satellites* (SES). This was the starting point for the economic development of the national space sector. SES is now one of the world's largest commercial satellite service providers.

Member of ESA and national space program

Luxembourg pursued its involvement in the space sector when it became an official Member State of the European Space Agency in 2005, and is today the member with the highest annual contribution per capita to the Agency [50].

Primarily active through the ESA Telecommunications Programme and then through its national space program LuxIMPULSE, launched in 2009, Luxembourg provided funding to help companies established in Luxembourg bring innovative ideas to the market.

SpaceResources.lu initiative

In 2016, Luxembourg became the first European country and the second country in the world (after the US in 2015) to offer a legal framework for the exploration and use of space resources. The SpaceResources.lu initiative's goal is "to ensure that space resources explored under its jurisdiction serve a peaceful purpose, are gathered and used in a sustainable manner compatible with international law and for the benefit of humankind" [51].

Moreover, while the 1967 Outer Space Treaty lacked of clarity regarding ownership of the material found in space, this initiative provides companies with a legal framework that secures property rights for space resources.

Following this, the Grand Duchy also actively engaged in related discussion with the UN COPUOS and strongly contributes to the work of the International Hague Space Resources Governance Working Group.

Creation of Luxembourg Space Agency (LSA)

LSA was created in 2018, and is now responsible for deploying a national civil space strategy, which is based on four pillars [1]:

- Expertise: knowledge and experience to create new space industries;
- Innovation: nurturing entrepreneurial space research and business;
- Skills: building a talent pool for a new economy;
- Funding: financing the future space economy.

The Agency promotes the commercial space sector in Luxembourg by providing support to the space industry, fostering new and existing businesses, developing human resources, offering access to financial solutions and supporting academic learning and research.

LSA also drives the SpaceResources.lu initiative, and manages the LuxIMPULSE national space program.

Recent evolutions of the legal framework

The more recent Law of 15 December 2020 on Space Activities further supports the development of space activities carried out by private space players in Luxembourg, by offering a “clear legal framework for the authorization and supervision of space activities allowing the management of risks related to space activities and state liability” [52].

In accordance with this Law, Luxembourg ratified the Convention on Registration of Objects Launched into Outer Space (commonly known as the Registration Convention) on January 27, 2021. This convention aims to enhance the existing registry of launchings with details about the orbit of each space object.

Current space policy and partnership

Since Luxembourg became a member of ESA, it has regularly been editing a National Action Plan for Space Science and Technology. This document defines the national space policy and the strategic objectives in this sector. It presents the previous accomplishments and submits proposals for future projects. The current version is valid for the 2020-2024 period [53]. Complementary, National Space Strategy 2023-2027 has been released in December 2022 [12]. The objective of the strategy is to pursue the effort made for the development of the Luxembourg space sector as a vector of diversification and perpetuation of the Luxembourg economy, but also as a major contributor to the sustainability of activities on Earth and by privileging a responsible approach of activities in Space.

The 2023-2027 strategy has four main components:

- the sustainability of economic activities;
- the sustainability of activities on Earth;
- the sustainability of activities in Space;
- sustainable use of space resources.

It is also important to highlight Luxembourg's first Spatial Defense Strategy, announced in February 2022, aimed at strengthening national defense and contributing to the overall effort in terms of security and defense. [54]

In recent years, Luxembourg has increased its partnerships with other countries. In October 2021, Luxembourg signed a Memorandum of Understanding (MoU) with Italy [55] and with France [56]. Then in November 2022, a MoU with South Korea has been signed [57] and in June 2024, a MoU with Japan has also been agreed [58]. These MoUs strengthen the links between countries on space and allow in-depth knowledge sharing in order to carry out joint projects.

1.4.2 The space sector for economic development

LSA is a business-oriented agency, and contrary to most national space agencies, will not directly develop its own space missions, but will focus on business development and creation of economic value and jobs, as well as facilitate access to ESA programs for national stakeholders. With the 2020-2024 National Action Plan for Space Science and Technology, Luxembourg contributes to compulsory and optional ESA programs for up to €130.51 million, in addition to its own national program budget of €80 million [53]. In October 2021, ESRIC launches the first global start-up support program dedicated to space resources [59] and have started a collaboration with Airbus Defence and Space on lunar resources extraction technologies. [60].

From a national standpoint, between 2018 and 2020, the number of jobs in the space sector increased by 50%, and the number of space-related businesses doubled: LSA now counts around 80 space-related businesses and research bodies in Luxembourg [61].

Today, the contribution of the space sector to the nation's Gross Domestic Product (GDP) is amongst the highest in Europe [4].

1.4.3 Education in the space sector

In line with the third pillar of the SpaceResources.lu strategy, which aims to “promote long-term development by supporting public research and education”, the Grand Duchy also developed education in the space sector. First, with the establishment of the “Interdisciplinary Space Master” (ISM) in 2018 in partnership with LSA, complementing the already existing “Master in Space, Communication and Media Law”. Secondly, with the creation in 2018 of a European Space Education Resources Office (ESERO) in Luxembourg, an educative platform for primary and secondary schools in Europe, with 16 national offices among ESA members [53].

2 Technical Standardization and Standards

Standardization corresponds to the definition of voluntary technical or quality specifications with which current or future products, production processes or services may comply.

Standardization is organized by and for the stakeholders concerned based on national representation (CEN, CENELEC, ISO and IEC) and direct participation (ETSI and ITU-T), and is founded on the principles recognized by the World Trade Organization (WTO) in the field of standardization, namely coherence, transparency, openness, consensus, voluntary application, independence from special interests and efficiency [62].

In accordance with these founding principles, it is important that all relevant interested parties, including public authorities and small and medium-sized enterprises, are appropriately involved in the national, European and international standardization process [63].

Technical standards provide an effective economic tool for achieving various objectives, such as the attainment of a certain level of quality, mutual understanding, reduction of costs, elimination of waste, improvement of efficiency, achievement of compatibility between products and components or access to knowledge about technologies [64].

The application of the fundamental principles stated by the WTO throughout the development of technical standards also guarantees the legitimacy of these documents. In addition, technical standards play an important role for innovation.

Indeed, as pointed out by the European Commission in its communication Europe 2020 Flagship Initiative [65], these technical standards “enable dissemination of knowledge, interoperability between new products and services and provide a platform for further innovation”. It is all the more relevant in the current context, in which the world tends to become increasingly digitalized and connected.

Finally, as reminded in the EC’s recent communication “An EU Strategy on Standardisation – Setting global standards in support of a resilient, green and digital EU single market” [66], technical standardization is a core component in the EU’s competitiveness not just at the European level, but at the international one as well. As the space sector is also a key sector in the technological sovereignty of the EU, the commission follows closely the standards on the management of space traffic. In the long term, thanks to an action plan bringing together the civil, defense and space industries, the commission wants to become a source of proposals for new international standards.

2.1 Standardization organizations and principles

2.1.1 Standardization Definition

As stated in the Regulation (EU) N°1025/2012 on European standardization [63], and according to the WTO [62], standardization is based on founding principles, which are observed by the formal standards bodies for the development of international standards:

Transparency
All essential information regarding current work programs, as well as on proposals for standards, guides and recommendations under consideration and on the results should be made easily accessible to all interested parties.

Openness

Membership of an international standards body should be open on a non-discriminatory basis to relevant bodies.

Impartiality and Consensus

All relevant bodies should be provided with meaningful opportunities to contribute to the elaboration of an international standard so that the standard development process will not give privilege to, or favor the interests of, a particular supplier, country or region. Consensus procedures should be established that seek to take into account the views of all parties concerned and to reconcile any conflicting arguments.

Effectiveness and Relevance

International standards need to be relevant and to effectively respond to regulatory and market needs, as well as scientific and technological developments in various countries. They should not distort the global market, have adverse effects on fair competition, or stifle innovation and technological development. In addition, they should not give preference to the characteristics or requirements of specific countries or regions when different needs or interests exist in other countries or regions. Whenever possible, international standards should be performance-based rather than based on design or descriptive characteristics.

Coherence

In order to avoid the development of conflicting international standards, it is important that international standards bodies avoid duplication of, or overlap with, the work of other international standards bodies. In this respect, cooperation and coordination with other relevant international bodies is essential.

Development dimension

Constraints on developing countries, in particular, to effectively participate in standards development, should be taken into consideration in the standards development process. Tangible ways of facilitating developing countries participation in international standards development should be sought.

2.1.2 Standardization organizations

In Europe, the three recognized European Standardization Organizations (ESOs), as stated in Regulation (EU) No 1025/2012 [63], are:

- European Committee for Standardization (CEN);
- European Committee for Electrotechnical Standardization (CENELEC);
- European Telecommunications Standards Institute (ETSI).

All countries from the European Union (through their official representative), as well as the United Kingdom, the Republic of North Macedonia, Serbia, Turkey, Iceland, Norway and Switzerland are by default members of the recognized ESO and their technical committees.

At the international level, the three recognized standardization organizations are:

- International Organization for Standardization (ISO);
- International Electrotechnical Commission (IEC);
- International Telecommunication Union’s Telecommunication Standardization Sector (ITU-T).

Regarding the international standardization organizations, countries (through their official representative) become members upon request, either as observing members (O-members) or as participating members (P-members).

This standardization frame allows cooperation between standardization organizations at the same level, or at different levels but on the same topics:

- CENELEC and IEC are specialized in electrotechnical standards;
- ETSI and ITU-T are focused on telecommunications standards;
- CEN and ISO are in charge of standards in all other sectors.

At national levels, one or several national standards bodies protect the interests of the country within each of the European and international standardization organizations (e.g.: in Germany, on the one hand DIN is the member of ISO and CEN, and on the other hand DKE is member of IEC, CENELEC and ETSI).

In Luxembourg, ILNAS – the only official national standards body – is member of the European and international standardization organizations CEN, CENELEC, ETSI, ISO, IEC and ITU-T.

Figure 1 highlights the several bridges that exist between the national, European and international standardization organizations in order to facilitate the collaboration and coordination of standardization work in the different fields.

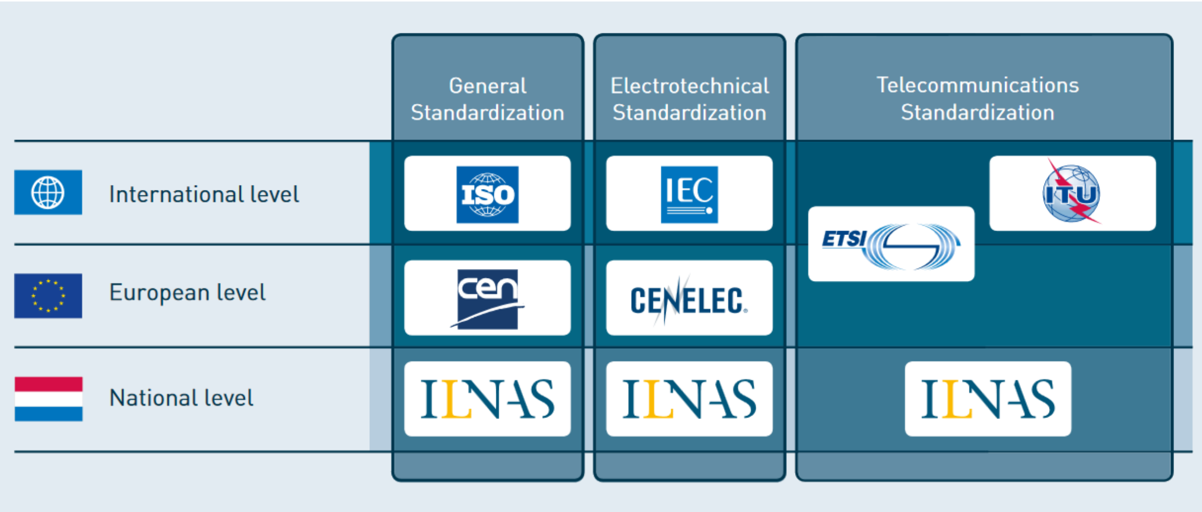

Figure 1: Interactions between the Standardization Organizations

A strong collaboration exists between the European and international standardization organizations. Indeed, in order to ensure transparency in the work and avoid the duplication of standards, several agreements have been signed between European and international standardization organizations.

In 1991, ISO and CEN signed the Vienna Agreement, which is based on the following guiding principles:

- Primacy of international standards and implementation of ISO Standards at European level (EN ISO);
- Work at European level (CEN), if there is no interest at international level (ISO);
- When a given project undergoes parallel development, procedures are in place ensuring standardization documents of common interest are approved by both (ISO and CEN) organizations.

Similarly, CENELEC and IEC signed the Dresden Agreement in 1996 with the aim of developing intensive consultations in the electrotechnical field. This agreement has been replaced by the Frankfurt

Agreement in 2016 with the aim to simplify the parallel voting processes, and increase the traceability of international standards adopted in Europe thanks to a new referencing system. It is intended to achieve the following guiding principles:

- Development of all new standardization projects by IEC (as much as possible);
- Work at European level (CENELEC), if there is no interest at international level (IEC);
- When a given project undergoes parallel development, ballots for relevant standardization documents are organized simultaneously at both (IEC and CENELEC) organizations.

Under both agreements, 34% of all European standards ratified by CEN, as well as 74% of those ratified by CENELEC, are respectively identical to ISO or IEC standards. Another 19% of those ratified by CENELEC are based on IEC standard [67]. In that respect, the European and international organizations do not duplicate work.

Similarly, ITU-T and ETSI have agreed on a MoU in 2000, lastly renewed in 2016 [68], that paves the way for European regional standards, developed by ETSI, to be recognized internationally.

Agreements also exist between the standards organizations to facilitate their cooperation. For example, ISO and IEC have the possibility to sign conventions to create Joint Technical Committees (JTCs) or Joint Project Committees (JPCs) when an area of work overlaps the two organizations (e.g.: ISO/IEC JTC 1 for the Information Technology domain).

ISO, IEC and ITU have also established the World Standards Cooperation (WSC) in 2001, a high-level collaboration system intending to strengthen and advance the voluntary consensus-based international standards system and to resolve issues related to the technical cooperation between the three organizations [69].

Similarly, a cooperation agreement [70]has been established between CEN, CENELEC and ETSI in order to facilitate cooperation and collaboration between the three ESOs, and to share their expertise of standards-making, particularly in the light of new technologies, mandated work and areas of common interest

2.1.3 Standards development process

Developing a standard is characterized by four main steps:

- Proposal: following an identified need, a party proposes a preliminary draft;
- Study and preparation: a working group prepares the standard draft;
- Public enquiry and approval: the standard draft goes into public consultation and is subject to approval;
- Publication: the ratified standard is published by the standardization organization.

At each stage, a validation of all participating members of the standardization technical committee is required. This is done through a vote, whose rules vary between the European and international levels as outlined in Table 1.

Organization	Members	Method of adopting standards	Integration into the collections of national standards
International ISO and IEC	National bodies from countries members of ISO and IEC	1 country = 1 voice	Voluntary
European CEN and CENELEC	National bodies complying with membership requirements of CEN and CENELEC [71]	Weighted Vote	Required: countries must eliminate conflicting documents from their collections

Table 1: Voting rules at European and international levels

At the European level, the weighted vote is defined by internal regulations from the CEN/CENELEC [70] (which are applicable since July 2023), which fixes the distribution of the voices for the CEN/CENELEC national members.

Another particularity at the European level is that the approved European standards shall be implemented identically in both technical content and presentation, with no restrictions for application by each national member.

This implies enforcing the new standard through publication and withdrawing all conflicting standards already in place at national level, on average, in six months. The new European standard then takes the status of national standard.

In the Grand Duchy of Luxembourg, the list of new national standards is regularly published by ILNAS in the Official Journal of the Grand Duchy of Luxembourg[13].

[13] http://legilux.public.lu/

2.2 Space technical standardization

2.2.1 The need for standards

In the space sector, international cooperation and collaboration is of primary importance. The ISS is a good illustration. This large scientific cooperative program gathers resources and expertise from all over the world through national space agencies and various contractors.

In this context, it is important for space industries, national governments, users or suppliers to support and to adopt the use of standards in order to facilitate this international collaboration through the integration of products and services. Space missions and satellites have challenging performance and lifetime requirements. The technology is becoming more sophisticated with more and more reliance on on-board intelligence and autonomy while costs have to be reduced. These issues impose a strict approach to the engineering of the space and ground segments. Finally, especially in the space sector, standards are developed to facilitate the interoperability of products, to reduce the technical barriers between the different stakeholders and to facilitate the interface of systems. Figure 2 illustrates how standardization supports the development of the space sector.

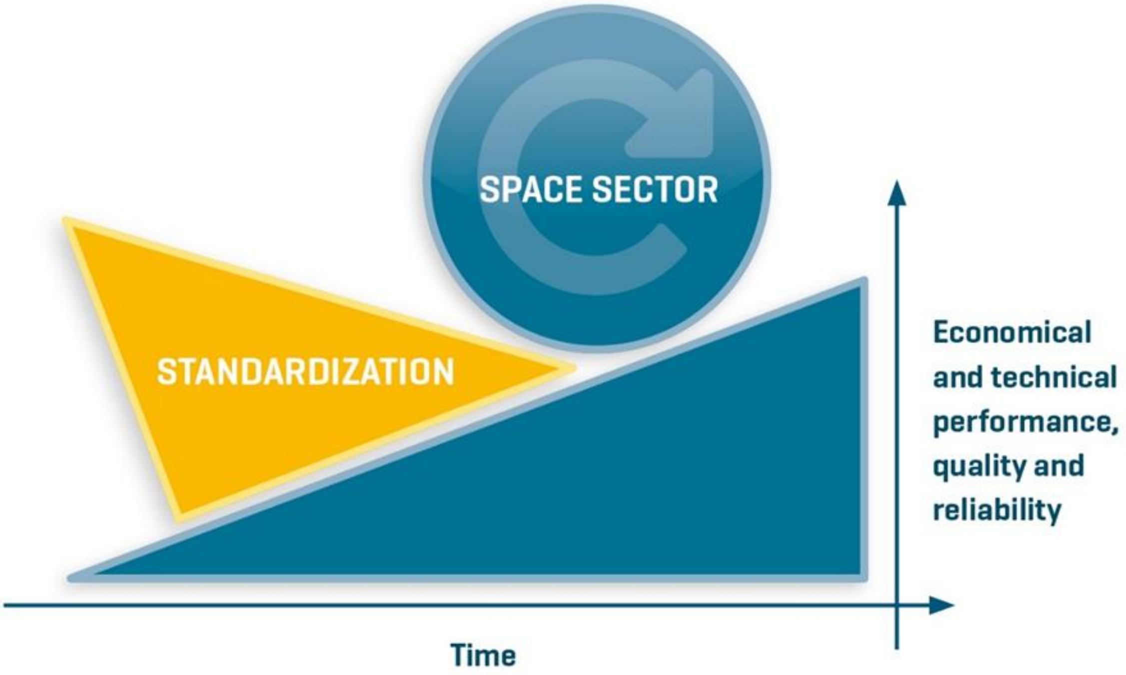

Figure 2: Standardization as a support for the space sector development

2.2.2 Upstream and downstream standards

Standards in the space sector can be divided into two main categories: the upstream and the downstream standards. The upstream sector encompasses everything from design and manufacturing of space components, to the launch and operation of the associated systems and products. The downstream sector utilizes all the information received back down for practical applications (GNSS, Earth observation, etc.) through daily operations of space infrastructure.

While the upstream sector is growing, especially thanks to the NewSpace context, the downstream activities still account for most of the revenue generated [72]. However, the downstream sector is also the one that received the least attention regarding standards development. The industry already partnered with standardization organizations to analyze the NewSpace context with regard to standardization and identify possible required evolutions [73].

Figure 3 combines this division between upstream and downstream activities with the categorization of the space sector from LSA (presented in Section 1.1).

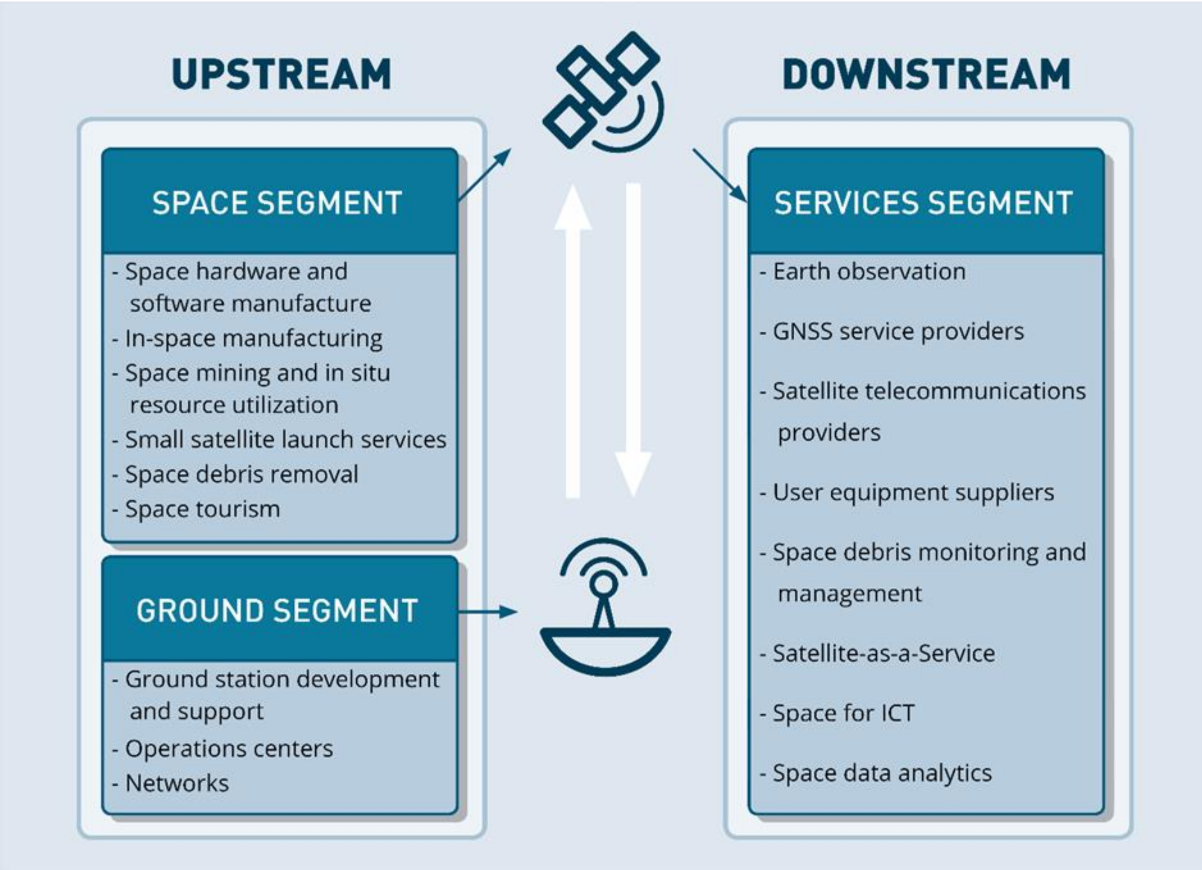

Figure 3: Space sector segments

2.2.3 International activities

International Organization for Standardization (ISO)

ISO is the world's dominant developer and publisher of International Standards in terms of scope. It has around 24,600 standards published and got around 800 technical committees and subcommittee [74]. ISO is in charge of developing International Standards for all industry sectors.

Within its technical committee (TC) 20 “Aircraft and space vehicles”, ISO holds two subcommittees (SC) directly related to space: SC 13 “Space data and information transfer systems”, and SC 14 “Space systems and operations”.

International Electrotechnical Commission (IEC)

The IEC prepares and publishes International Standards for all electrical, electronic and related technologies – collectively known as “electrotechnology“.

Some IEC committees provide standards relevant for various space-related applications, especially regarding satellite telecommunications.

International Telecommunication Union (ITU)

The ITU is an “intergovernmental public-private partnership organization” which brings together experts from around the world to develop international standards known as ITU Recommendations. The ITU is also responsible for allocating global radio spectrum and satellite orbits.

The Radiocommunication sector of ITU (ITU-R) holds a Space Services Department (SSD) and six Study Groups (SGs) dedicated to radiocommunication.

The Telecommunication Standardization sector of ITU (ITU-T) holds 11 dedicated study groups.

Both ITU-R and ITU-T provide standards (Recommendations) relevant for satellite telecommunications.

Other entities[14]

Aerospace Industries Association[15] (AIA)

The National Aerospace Standards (NAS) are produced by the AIA, through the National Aerospace Standards Committee (NASC). The AIA was created in 1919 and is composed of 170 Full Members and 162 Associate Members.

NAS provide engineers, designers and others working for manufacturers and suppliers of aerospace and national defense systems with information designed to ensure product quality and safety. The NASC is especially responsible for the creation and maintenance of part standards for aerospace parts and components, such as screws, nuts, rivets, high pressure hose, electrical connectors, splices and terminations, rod end bearings, and many other types of hardware and components.

The AIA holds the secretariat of ISO/TC 20 “Aircraft and Space Vehicles”, and its subcommittee SC 16 “Unmanned Aircraft Systems”.

[14] Non-exhaustive list, in alphabetical order. Information based on the organizations’ websites.
[15] https://www.aia-aerospace.org/committee/national-aerospace-standards-committee/

American Institute of Aeronautics and Astronautics[16] (AIAA)

Created in 1963, the AIAA is a renowned aerospace publisher. The AIAA also contributes to standards development in the following topics:

- Aeronautics;
- Modeling, Simulation and Testing;
- Space Systems and Vehicles.

Each of these topics can be subdivided. As for the Space Systems and Vehicles, the subtopics are:

- Spacecraft Architecture;
- Space Systems;
- Space Operations;
- Launch Vehicles;
- Space Power and Propulsion;
- Safety.

In addition to standards, the AIAA also produces recommended practices and guides. Individual involvement in the standardization process is possible through the AIAA Committees on Standards. Nearly 30,000 individuals are already involved globally within the AIAA.

American Society of Civil Engineers[17] (ASCE)

The Aerospace Division was established by the ASCE in 1971 to apply emerging and advanced aerospace technologies to civil engineering practice. It encourages dual technology development and promotes transfer of technologies and know-how in various civil engineering disciplines between terrestrial and extraterrestrial applications and development, and between civil and other engineering and science areas. It also aims to provide a common platform to exchange this knowledge.

The Aerospace Division holds the following technical committees:

- Advanced materials and structures;
- Dynamics and controls;
- Regolith operations, mobility and robotics;
- Space engineering and construction.

These technical committees are promoting the use of civil engineering principles in aerospace engineering through the development of dedicated standards and publications. Space resources usage is one of the many applications that can directly benefit from this transfer of technology.

American Society of Mechanical Engineers[18] (ASME)

Founded in 1880, ASME is a nonprofit professional organization that enables collaboration, knowledge sharing and skill development across all engineering disciplines. ASME especially provides standards on various engineering disciplines. More than 90,000 individual members take part in ASME activities.

The ASME holds an Aerospace Division, as well as an Aerospace and Advanced Engineering Drawing Standards committee (AED). This committee develops advanced practices unique to aerospace and other industries. It also develops and maintains standards.

16 https://www.aiaa.org/
17 https://www.asce.org/aerospace-engineering/aerospace-division/
18 https://community.asme.org/aerospace_division/default.aspx

ASTM International[19]

Formerly known as the American Society for Testing and Materials (ASTM), ASTM International was founded in 1902. It develops and publishes voluntary consensus technical standards for a wide range of materials, products, systems, and services.

Among its technical committees, two are relevant for space-related applications: “Space Simulation and Application of Space Technology” (E21) and “Aerospace and Aircraft” (F07).

With more than 30,000 members, participation in the standardization process through the dedicated technical committees is open to anyone on a voluntary basis.

Committee on Earth Observation Satellites[20] (CEOS)

Created in 1984 in response to a recommendation from the Economic Summit of Industrialized Nations Working Group on Growth, Technology, and Employment’s Panel of Experts on Satellite Remote Sensing, CEOS is an international mechanism, coordinating international civil space-borne missions designed to observe and study the Earth. Comprising 34 Members (most of which are space agencies) and 27 Associate Members (national and international organizations), it is recognized as the major international forum for the coordination of Earth observation satellite programs and for interaction of these programs with users of satellite data worldwide. CEOS publishes its best practices and guidelines through its five working groups:

- Capacity Building & Data Democracy;
- Climate;
- Calibration & Validation;
- Disasters;
- Information Systems & Services.

Consultative Committee for Space Data Systems[21] (CCSDS)

The CCSDS, created in 1982, is an initiative from the major space agencies of the world to provide a multinational forum for discussion of common problems in the development and operation of data systems for the space sector. Composed of 11 Member Agencies, 32 Observer Agencies, and 119 industrial Associates, its main objective is to provide standards for data and information systems in order to promote interoperability and cross-support among cooperating space agencies, while also reducing risk, development time, and project costs.

The CCSDS membership has a dual role, functioning as the CCSDS standards body and as the ISO TC 20/SC 13 standards body, since completed CCSDS standards can be processed and approved as ISO Standards. CCSDS publications include standards but also recommended practices, informative documents, drafts, and others. This work is split between the six following areas:

- Systems engineering;
- Mission Operations and Information Management;
- Cross Support Services;
- Spacecraft Onboard Interface Services;
- Space Link Services;
- Space Internetworking Services.

19 https://www.astm.org/
20 https://ceos.org/
21 https://public.ccsds.org/default.aspx

Defence Geospatial Information Working Group[22] (DGIWG)

The DGIWG is a multinational body responsible for geospatial standardization for the defense organizations of the current 22 member nations. Established in 1983, it supports, among other things, the requirements identified to address a specific set of operational scenarios, as for instance the North Atlantic Treaty Organization (NATO) requirements. The DGIWG geospatial standards are built upon the generic and abstract standards for geographic information defined by the International Organization for Standardization (ISO/TC 211). DGIWG standards are developed within five projects:

- Vector Data;
- Imagery and Gridded Data;
- Metadata;
- Portrayal;
- Geospatial Web Services.

Institute of Electrical and Electronics Engineers Standards Association[23] (IEEE SA)

The IEEE SA, founded in 1980, is developing standards in a broad range of technologies that drive the functionality, capabilities, and interoperability of products and services. Some of the topics addressed are aerospace electronics, antennas and propagation, and wireless communications.

Inter-Agency Space Debris Coordination Committee[24] (IADC)

IADC is an international governmental forum for the worldwide coordination of activities related to the issues of man-made and natural debris in space. The main purpose of the IADC is to facilitate cooperation and data exchange on space debris among its members in order to reduce related problems. There are currently 13 members, including ESA. IADC is composed of one Steering Group and four Working Groups:

- WG1: Measurement;
- WG2: Environment and database;
- WG3: Protection;
- WG4: Mitigation.

International Aerospace Quality Group[25] (IAQG)

The IAQG is an international nonprofit association created in 1998. It aims to establish methods to share best practices in the aviation, space and defense industry. The association has 27 Full Members, 32 Associate Members, and 21 Affiliate Members. All members are companies from the industry.

The IAQG publishes standards through SAE International and ASD-STAN. It also hosts a Space Forum, which aims to “identify the needs of the space industry and institutional customers, and leverage opportunities to address such needs within IAQG.”

Object Management Group[26] (OMG)

OMG is an international, open membership, not-for-profit computer industry consortium created in 1989, currently gathering 252 Members (from private entities, universities or governments), with a specific task force dedicated to the space sector: the OMG Space Domain Task Force. This task force

[22] https://www.dgiwg.org/
[23] https://standards.ieee.org/
[24] https://www.iadc-home.org/
[25] https://iaqg.org/
[26] https://www.omg.org/space/

encompasses space professionals willing to increase interoperability, to reduce costs, schedule, and risk for space applications through the development of space standards. The Space Task Force's goals are to:

- Clarify space, satellite and ground system requirements;
- Provide a transparent space standards development environment open to participation by all;
- Encourage the development and use of Model-Driven specifications that allow future-proofing of space systems;
- Encourage continued space industry member participation to leverage existing OMG specifications.

Open Geospatial Consortium[27] (OGC)

The OGC is an international consortium composed of more than 500 businesses, government agencies, research organizations, and universities. Created in 1994, OGC creates royalty-free, publicly available, open geospatial standards. The OGC has a close relationship with ISO/TC 211 "Geographic Information/Geomatics".

SAE International[28]

Founded in 1905, SAE International was previously known as the Society of Automotive Engineers (SAE). SAE International is a global association of more than 130,000 engineers and related technical experts in the aerospace, automotive and commercial vehicle industries. The association's core competencies are life-long learning and voluntary consensus standards development. Participation is possible through a membership or through volunteering.

SAE International has been a leading provider of aerospace standards through its Aerospace committee. With more than 22,000 aerospace standards (AS) and aerospace materials specifications (AMS) available, SAE standards are recognized and used globally by manufacturers and suppliers throughout the aerospace industry. They cover the full spectrum of processes and technologies in the aerospace industry.

United States - Department of Defense[29]

Although not a standardization organism, United Stated – Department of Defense contributes to military standardization through its Defense Standardization Program. This program is known to issue MIL-STD, initially foreseen for military purposes but sometimes used for space development activities.

Contribution to standard development within Defense Standardization Program is only limited to several company and their scope is defined by United States - Department of Defense.

Currently, more than 28,000 active standards are available and cover a large panel of topics, and dedicated aircraft specifications can be transposed for space applications.

[27] https://www.ogc.org/
[28] http://en.sae.org/standards/aerospace/
[29] https://www.dsp.dla.mil/

2.2.4 European activities

European guidelines for standards development

Regarding the European space sector, the EC issued in June 2007 the mandate M/415[30] to CEN, CENELEC and ETSI for the development of a work program for European Standards for the Space industry. This mandate was an element of the European Space Program and thus supposed to help paving the way to integrate the variety of existing space systems in Europe into a European infrastructure. CEN created a working group, CEN/BT/WG 202 "Space", to work on this mandate. A report was prepared covering the first two stages of the work: a feasibility study and the development of a comprehensive standardization work program.

To pursue this initiative, in 2011, the EC issued another mandate, the mandate M/496[31] to CEN, CENELEC and ETSI, in order to develop European Standards for the space industry. To this end, a new joint technical committee was created between CEN and CENELEC: CEN/CLC/JTC 5 "Space". ETSI responded through the existing ETSI/TC SES "Satellite Earth Stations and Systems". Their mission is to respond to mandate M/496 by developing and adopting European standards in support of European policies and legislation. With this mandate, CEN/CLC/JTC 5 and the European Cooperation for Space Standardization (ECSS) have agreed on a collaboration in their standards work and, as an early result, JTC 5 accepted and adopted many existing ECSS standards. Together with the CEN/ASD-STAN Aerospace, this multifold collaboration, including ETSI/TC SES, gathers the major standards development bodies in Europe backed by the EC.

Moreover, a 2018 EC proposal for establishing the space program references the need for standardization and certification, especially regarding the Galileo, EGNOS, and GovSatcom initiatives [75]. In the new strategy, EC express its will to become source of proposal for international standards. It will benefit ongoing European projects and lead the EU towards technological sovereignty.

European Committee for Standardization (CEN) and European Committee for Electrotechnical Standardization (CENELEC)

CEN and CENELEC are two official ESOs closely collaborating through a common CEN-CENELEC Management Centre since 2010.

The creation of the joint technical committee CEN/CLC/JTC 5 following the acceptance of mandate M/496 of the European Commission also prevents an overlap in standardization work related to space, and provides for the topics not covered in any other European technical body (such as ECSS or ETSI). CEN/CLC/JTC 5 "Space" has become the center of European space standardization, with the creation of five working groups (WG 4 has been disbanded in 2014, WG3 and WG5 have been disbanded in 2021) directly responsible for the development of European standards needed for the implementation of EU-level space projects:

- WG 1: Navigation and positioning receivers for road applications
- WG 2: Space Situational Awareness Monitoring
- WG 6: Upstream standards
- WG 7: Future activities in space standardization
- WG 8: SBAS receivers performances for Maritime applications

Another significant European technical committee on space standardization is ASD-STAN. ASD-STAN has been recognized as an Associated Body to CEN in 1986. It covers various topics of the aerospace

[30] https://ec.europa.eu/growth/tools-databases/mandates/index.cfm?fuseaction=search.detail&id=375
[31] https://ec.europa.eu/growth/tools-databases/mandates//index.cfm?fuseaction=search.detail&id=499

industry. Its goal is to promote the harmonization of aerospace standards in Europe, and pay attention to these areas where improved standardization can result in reduced costs to manufacturers.

ASD-STAN transfers all of its projected European Standards (ENs) to CEN for publication and is in close collaboration with the ECSS following a three-party agreement. This however excludes standards related to parts and materials or standards which are common in space and aeronautics, and these constitute the majority of the standards produced by ASD-STAN. ASD-STAN is currently divided in 10 “domains” [76]:

- D 1: Program Management and System Engineering
- D 2: Electrical
- D 3: Mechanical
- D 4: Material (Metallic & Non-Metallic)
- D 5: Autonomous Flying
- D 6: Quality and safety management
- D 7: Digital Projects
- D 8: Propulsion Systems
- D 9: Environment
- D 12: Cabin

European Telecommunications Standards Institute (ETSI)

ETSI is an independent, not-for-profit, standardization organization in the field of information and communications. Along with CEN and CENELEC, ETSI is an official ESO.

Through its technical committee “Satellite Earth Stations and Systems” (ETSI/TC SES), ETSI provides standards for satellite telecommunications and navigation applications. Other ETSI technical committees are also related to space, such as the ETSI/TC ERM “Electromagnetic compatibility and Radio spectrum Matters”, and the EBU/CLC/ETSI JTC Broadcast, which mainly deals with satellite broadcasting systems.

Other entities[32]

European Broadcasting Union[33] (EBU)

The EBU was created in 1950 and gathers public broadcasting organizations, mainly from Europe but also from all over the world. The EBU aims to create a sustainable environment for public service media. It develops recommendations related to media services, and takes part in the joint technical committee EBU/CLC/ETSI JTC Broadcast.

European Cooperation for Space Standardization[34] (ECSS)

Created in 1993, and mostly composed of national space agencies, the ECSS develops standards distributed among four disciplines:

- Space project management (M-branch);
- Space product assurance (Q-branch);
- Space engineering (E-branch);
- Space sustainability (U-branch).

[32] Non-exhaustive list, in alphabetical order. Information based on the organizations’ websites.
[33] https://www.ebu.ch/home
[34] https://ecss.nl/

In 2013, the ECSS and CEN-CENELEC signed a MoU for the transfer of the ECSS standards to European Standards (ENs) [77].

The ESA Requirement and Standard division acts as the ECSS central secretariat, and through the ESA Standardization Steering Board (ESSB), a list of standards approved for application by ESA space projects and based on published ECSS standards is maintained. To promote the wider usage of ECSS standards, the published documents are made freely available worldwide.

European Space Components Coordination[35] (ESCC)

In October 2002, the ESCC was created between ESA and representatives of National Space Agencies, industry (through ASD-Eurospace) and European component manufacturers. The ESCC is focusing on electrical, electronic and electro-mechanical components. This European partnership operates under the Space Components Steering Board (SCSB), supported by a Policy and Standards Working Group (PSWG) and a Components Technology Board (CTB).

Major outputs of ESCC are the European Preferred Parts List (EPPL), the ESCC Specification System and the ESCC Qualified Parts List (QPL).

European Space Components Information Exchange System[36] (ESCIES)

Based on the Recommendation R6 of the Space Components Ad Hoc Committee (SCAHC) [78], ESCIES was established to propose an information exchange system on component data with access available to all European users. ESCIES is a repository for Electrical, Electronic and Electromechanical (EEE) parts information hosted by ESA, on behalf of the Space Components Steering Board, as part of the ESCC, and it aims to systematically collect and make available data and documentation produced in Europe in the frame of studies, evaluations, procurement and quality assurance activities related to space components to the European space community.

ESCIES also provides the European space sector with several recommended lists published by the ESCC: the Qualified Parts List (QPL), the Qualified Manufacturer List (QML), the Hybrid Process Capability Approval List (HPCL), and the European Preferred Parts List (EPPL).

35 https://spacecomponents.org/
36 https://escies.org/

3 OPPORTUNITIES FOR THE NATIONAL MARKET

The common ground provided by technical standardization is essential in the space sector as external cooperation is almost always involved. Technical standardization is meant to facilitate this cooperation and to reduce technical barriers between the different stakeholders by promoting interoperability and the use of common interfaces.

This chapter will present the benefits and means of involving in standardization.

3.1 Technical standardization benefits

3.1.1 Standards usage

From a business point of view, displaying standards compliance can provide customers with guarantee in terms of quality, efficiency and effectiveness.

Moreover, by applying standards, a company can raise its credibility among clients and partners. In a high-stakes industry like the space sector, this factor plays an even more crucial role when doing business. Mission success rates are often of primary importance, and by applying standards, the risks are minimized. Additionally, if a failure should happen, implementing all state-of-the-art standards can justify choices and help mitigate liability in the event of a legal process or trial.

Standards are essential not only to the development of the space sector, but also to support its interoperability with other sectors, such as the ICT sector for example.

As an example of the standards available for the space sector, ILNAS published a video presenting the main standards contributing to the mitigation of space debris[37]. It offers the opportunity to better understand the interest of standardization in the space sector, as well as the different ways to consult, purchase, or participate in the development of these standards.

In addition, giving the large amount of standards available to the market, ILNAS offers a standards watch service to help stakeholders in the identification of standards relevant to their business and to keep up-to-date standardization information for their projects.

3.1.2 Standards development

Beyond the sole use of standards, involvement in the technical standardization development process can provide an edge over the competition, both nationally and internationally.

Thanks to the participation in a standardization technical committee, stakeholders can develop new competencies through networking, since technical committees gather experts on a specific topic. Additionally, information on the directions taken by other states or other entities is easily accessible.

Stakeholders are also informed about the last standardization developments related to their activities, thus allowing them to identify potential future impacts and to anticipate the associated consequences. An example would be the possibility to anticipate the obligation to comply with European regulatory requirements.

[37] https://www.youtube.com/watch?v=e-iQ5mSnpml

Companies strongly involved in standardization can even influence the standards development in favor of their business strategy, products or services.

Finally, being a national delegate in technical standardization allows the delegate to represent Luxembourg's space industry internationally as well as increase his/her own company's visibility.

3.2 Becoming a national delegate in standardization

The space sector standards watch (Chapter 4) of this standards analysis will point out standardization technical committees of potential interest for national stakeholders.

In Luxembourg, registration in technical committees from ISO, IEC, CEN or CENELEC is free of charge, and can be done by contacting ILNAS[38].

To summarize, participating in standardization technical committees offers a broad set of opportunities and benefits, such as:

- Giving your opinion during the standardization process (comments and positions of vote on the draft standards);
- Valuing your know-how and good practices;
- Accessing draft standards;
- Anticipating future evolutions of space standardization;
- Collaborating with strategic partners and international experts;
- Enhancing the visibility of your organization at national and international level;
- Identifying development opportunities;
- Making your organization competitive in the market.

Indeed, this registration allows national stakeholders to become members of a technical committee on national standards, or of a national mirror committee of a European (CEN, CENELEC) or international (ISO, IEC) standardization committee, as illustrated in Figure 4.

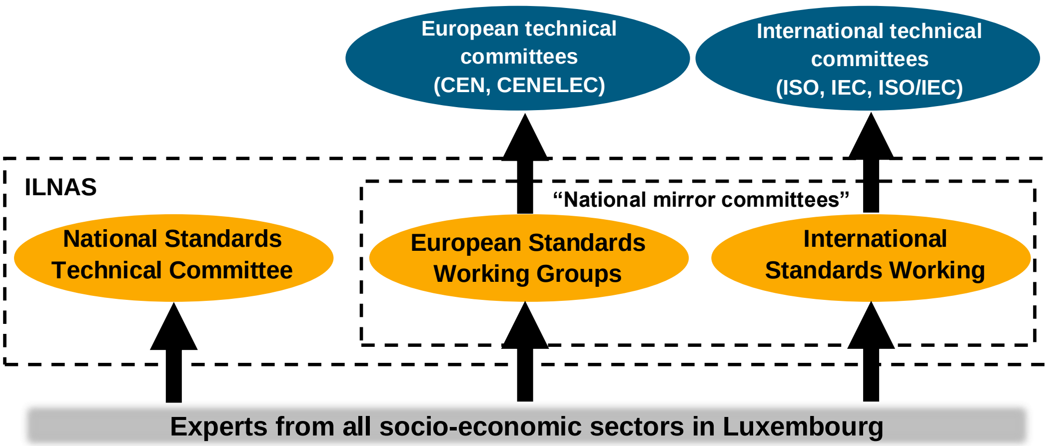

Figure 4: Organization of the participation of national delegates in technical standardization in Luxembourg

[38] https://portail-qualite.public.lu/fr/normes-normalisation/participer-normalisation/experts-normalisation.html

3.3 Free consultation of standards

ILNAS offers the possibility to consult its entire standards' database (including more than 200,000 normative documents from ILNAS, DIN, CEN, CENELEC, ETSI, ISO and IEC) free of charge through reading stations located in various places in Luxembourg[39].

This service allows, for example, interested organizations or individuals to consult a standard before its purchase. The ILNAS e-Shop[40] then offers the possibility to buy the relevant standards in electronic format at competitive prices.

3.4 Comment standards under public enquiry

ILNAS proposes, through its e-Shop, the opportunity to submit comments on the standards under public enquiry. Every interested national stakeholder can propose changes to the draft standard, regardless of whether such stakeholders are officially registered in the technical committee responsible for the development of this standard.

3.5 Propose new standards projects

National stakeholders can propose new standardization projects both at international and national levels through ILNAS. The national standards body offers its support to ensure the good implementation of the process and the project's compliance with the related rules and legislation.

This opportunity can allow national stakeholders to take a leading role in the standardization of a specific domain and to benefit from the definition of the future market rules.

39 https://portail-qualite.public.lu/fr/normes-normalisation/achat-consultation-normes.html
40 https://ilnas.services-publics.lu/ecnor/home.action

4 SPACE SECTOR STANDARDS WATCH

4.1 Purpose and methodology

The objective of this standards analysis is to facilitate the involvement of the national stakeholders of the space sector in the technical standardization process.

To this end, this chapter presents a list of standardization technical committees of potential interest for business and research applications in the space sector. These committees have been selected from European and International standards bodies.

The topics covered by the selected technical committees try to match the space-related activities of the national stakeholders. These activities were identified thanks to Luxembourg Space Agency's Space Directory 2022[41]. Have been excluded from this standards watch the technical committees with no direct link to space-related activities. However, several technical committees dedicated to the aerospace domain, i.e. aeronautics and astronautics, have been included since they are relevant to both disciplines.

Considering the wide field of applications of space-related activities and the inhomogeneous relevance of the technical committees to these activities, this chapter is divided into five sections, classifying the different committees:

1. Solely dedicated to the space sector, with a wide range of applications (Section 4.2.1)
2. Telecommunications (Section 4.2.2)
3. Earth observation (Section 4.2.3)
4. Technical areas (mechanical, electrical, etc.) (Section 4.2.4)
5. Systems engineering, Quality, Safety and Management processes (Section 4.2.5)

The committees listed in the first section may deal with topics also addressed in the other sections, but with a focus on space applications, whereas the other sections often include more general information about their category.

Space activities are often closely related to ICT applications. While a direct link cannot always be established between the two sectors, therefore not justifying their inclusion in this standards watch, they often work side by side. For further information, a Standards Analysis of the ICT sector[42] is published regularly by ILNAS with the support of ANEC GIE.

[41] https://space-agency.public.lu/en/expertise/space-directory.html

[42] https://portail-qualite.public.lu/fr/normes-normalisation/secteurs/tic.html

4.2 Space sector standardization technical committees

4.2.1 Solely dedicated to the space sector, with a wide range of applications

This section includes technical committees working solely on topics of the space sector. They cover a broad range of activities.

ISO/TC 20/SC 13 Space data and information transfer systems			
GENERAL INFORMATION			
Creation date	1990	**Secretariat**	ANSI (United States)
Chairperson	Mr Kiyohisa Suzuki	**Committee Manager**	Mr. Sami Asmar
Scope	Standardization for spacecraft missions, ground based radio science, and space and ground tracking networks.		
Structure	N/A		
Webpage	https://www.iso.org/committee/46612.html		
STANDARDIZATION WORK			
Published standards	86	**Projects**	4
INTERNATIONAL MEMBERS			
P-Members	12	**O-Members**	12 (including **Luxembourg**)
COMMENTS			
Standards developed within this Technical Committee cover the following topics: Space Link Extension (SLE), mission operations, voice and audio communications, attitude data and pointing request messages, digital motion imagery, spectral processing transform, spacecraft onboard interface services, delta-DOR quasar catalog update procedure, cross-support service management, and network layer security adaptation profile. Completed CCSDS standards can be processed and approved as ISO Standards within this committee.			

ISO/TC 20/SC 14 Space systems and operations			
GENERAL INFORMATION			
Creation date	1992	**Secretariat**	ANSI (United States)
Chairperson	Mr Frederick Slane	**Committee Manager**	Mr. Nick Tongson
Scope	Standardization of manned and unmanned space vehicles that include management of space programs, design, test, production, launch, maintenance, operation, and disposal of space vehicles, and for the environment in which the space programs operate.		
Structure	AG 1 Chairman's advisory group (CAG) AG 2 Terminology task force AG 3 STRAG - Reference Architecture Advisory Group WG 1 Design engineering and production WG 2 System requirements, verification and validation, interfaces, integration, and test WG 3 Operations and support systems WG 4 Space environment (natural and artificial) WG 5 Space System Program Management and Quality WG 6 Materials and processes WG 7 Orbital Debris Working Group WG 8 Downstream space services and space-based applications		
Webpage	https://www.iso.org/committee/46614.html		
STANDARDIZATION WORK			
Published standards	193	**Projects**	43

INTERNATIONAL MEMBERS			
P-Members	16	**O-Members**	14 (including **Luxembourg**)
COMMENTS			
Current standards under development cover topics such as, separation test methods for spacecraft, safety requirements and compatibility of materials, ground support equipment for use at launch, landing or retrieval sites, avoiding collisions among orbiting objects and traffic coordination, thermal vacuum environmental testing, large constellation design and operations, cybersecurity, project management, small satellite design and testing, mechanical analysis and design, or cosmic ray and solar energetic particle penetration inward the magnetosphere.			

CEN/CLC/JTC 5
Space

GENERAL INFORMATION			
Creation date	1987	**Secretariat**	DIN (Germany)
Chairperson	Mr. Legrand Thierry	**Secretary**	N/A
Scope	This technical committee covers all standardization activities in CEN and CENELEC related to space, including dual use aspects, systems of systems, as well as upstream and downstream applications, inasmuch as these topics are not covered by any other existing technical body in CEN or CENELEC or by the European Cooperation for Space Standardization (ECSS) or ETSI, therefore it is important and necessary that it coordinates its work with relevant technical bodies in ETSI. It develops European Standards that are needed to support the implementation of EU-level space projects.		
Structure	WG 1 Navigation and positioning receivers for road applications WG 2 Space Situational Awareness Monitoring WG 6 Upstream standards WG 7 Future activities in space standardization WG 8 SBAS receivers performances for Maritime applications WG 9 Galileo Timing Receivers		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:887985&cs=17D471F6F920904967AFC18C2BDA2F89F		
STANDARDIZATION WORK			
Published standards	207	**Projects**	14
EUROPEAN MEMBERS			
P-Members	35 (including **Luxembourg**)		17
COMMENTS			
Current standards under development cover topics such as: non-destructive testing, obsolescence management, space data links, communications, space data and information transfer systems, calculation of radiation and its effects, processing and quality assurance requirements, Li-ion battery testing, software, thermal design, contamination and cleanliness control, electromagnetic compatibility, machine learning qualification for space applications, photovoltaic assemblies and components, or manufacturing and control of electrical harness. Completed ECSS standards can be processed and approved as European Standards (ENs) within this committee within WG 6.			

ETSI/TC SES **Satellite Earth Stations and Systems**			
GENERAL INFORMATION			
Creation date	1992		
Chairperson	Mr. Marcovina Marco		
Scope	Standardization related to all types of satellite communication systems, services and applications including fixed, mobile and broadcasting; satellite navigation systems and services; all types of earth stations and earth station equipment, especially the radio frequency interfaces and network and/or user interfaces; and protocols implemented in earth stations and satellite systems.		
Structure	SES HARM R&TTE dir. 99/5/EC and RED dir. 2014/53/EU SES SCN Satellite Communications and Navigation		
Webpage	https://portal.etsi.org/ses		
STANDARDIZATION WORK			
Published standards	570	**Projects**	/
NATIONAL INVOLVEMENT			
National organizations involved	SES S.A. Amazon Web Services- Luxembourg		
COMMENTS			
Current standards under development cover the following topics: land, fixed, mobile, Aircraft and vehicle-Mounted Earth stations, access to radio spectrum, DVB-S2x/RCS2 protocol, Virtualized Network Functions data model for satellite communication systems, and Edge delivery in 5G through satellite multicast, Return Link Encapsulation (RLE) The standards projects cover various frequency bands.			

CEN also lists two workshops (WS) directly related to space applications:

- CEN/WS CORE[43] "Development of a GALILEO enabled label";
- And with CENELEC[44], CEN/CLC/WS 17 "Multi-constellation based services for goods transport and tracing applications".

They each published a document in line with the topic they address.

[43] https://standards.cen.eu/dyn/www/f?p=204:7:0::::FSP_ORG_ID:2238989&cs=188FF5B34136B90BCDC549EBA5227057E
[44] https://standards.cen.eu/dyn/www/f?p=204:7:0::::FSP_ORG_ID:2584849&cs=199B777BEA98127A8575AE3558C4956A1

4.2.2 Telecommunications

This section includes technical committees dealing with telecommunications. This sector has the most dynamic market among the other space activities, and has been the starting point of Luxembourg's space economy development.

ITU/ITU-R/SG 1 Spectrum management			
GENERAL INFORMATION			
Creation date	N/A		
Chairperson	Mr. Wael Sayed		
Scope	Spectrum management principles and techniques, general principles of sharing, spectrum monitoring, long-term strategies for spectrum utilization, economic approaches to national spectrum management, automated techniques and assistance to developing countries in cooperation with the Telecommunication Development Sector.		
Structure	WP 1A Spectrum engineering techniques WP 1B Spectrum management methodologies and economic strategies WP 1C Spectrum monitoring		
Webpage	https://www.itu.int/en/ITU-R/study-groups/rsg1/Pages/default.aspx		
STANDARDIZATION WORK			
Published standards	89	**Projects**	N/A

ITU/ITU-R/SG 3 Radiowave propagation			
GENERAL INFORMATION			
Creation date	N/A		
Chairperson	Ms. Clare Allen		
Scope	Propagation of radio waves in ionized and non-ionized media and the characteristics of radio noise, for the purpose of improving radiocommunication systems.		
Structure	WP 3J Propagation fundamentals WP 3K Point-to-area propagation WP 3L Ionospheric propagation and radio noise WP 3M Point-to-point and Earth-space propagation		
Webpage	https://www.itu.int/en/ITU-R/study-groups/rsg3/Pages/default.aspx		
STANDARDIZATION WORK			
Published standards	86	**Projects**	N/A

ITU/ITU-R/SG 4 Satellite services			
GENERAL INFORMATION			
Creation date	N/A		
Chairperson	Mr. Victor Strelets		
Scope	Systems and networks for the fixed-satellite service, mobile-satellite service, broadcasting-satellite service and radiodetermination-satellite service.		
Structure	WP 4A Efficient orbit/spectrum utilization for FSS and BSS WP 4B Systems, air interfaces, performance and availability objectives for FSS, BSS and MSS, including IP-based applications and satellite news gathering WP 4C Efficient orbit/spectrum utilization for MSS and RDSS		
Webpage	https://www.itu.int/en/ITU-R/study-groups/rsg4/Pages/default.aspx		
STANDARDIZATION WORK			
Published standards	313	**Projects**	N/A

ITU/ITU-R/SG 5
Terrestrial services

GENERAL INFORMATION			
Creation date	N/A		
Chairperson	Mr. Kyujin Wee		
Scope	Systems and networks for fixed, mobile, radiodetermination, amateur and amateur-satellite services.		
Structure	WP 5A Land mobile service above 30 MHz (excluding IMT, including the exact frequency of 30 MHz); wireless access in the fixed service; amateur and amateur-satellite services WP 5B Maritime mobile service including Global Maritime Distress and Safety System (GMDSS); aeronautical mobile service and radiodetermination service WP 5C Fixed wireless systems; HF and other systems below 30 MHz in the fixed and land mobile services WP 5D IMT Systems		
Webpage	https://www.itu.int/en/ITU-R/study-groups/rsg5/Pages/default.aspx		
STANDARDIZATION WORK			
Published standards	369	Projects	N/A

ITU/ITU-R/SG 6
Broadcasting service

GENERAL INFORMATION			
Creation date	N/A		
Chairperson	Mr. Thiago Aguiar Soares		
Scope	Radiocommunication broadcasting, including vision, sound, multimedia and data services principally intended for delivery to the general public.		
Structure	WP 6A Terrestrial broadcasting delivery WP 6B Broadcast service assembly and access WP 6C Programme production and quality assessment TG 6/1 WRC-23 agenda item 1.5		
Webpage	https://www.itu.int/en/ITU-R/study-groups/rsg6/Pages/default.aspx		
STANDARDIZATION WORK			
Published standards	239	Projects	N/A

ITU/ITU-R/SG 7
Science services

GENERAL INFORMATION	
Creation date	N/A
Chairperson	Mr. Markus Dreis
Scope	• Systems for space operation, space research, Earth exploration and meteorology, including the related use of links in the inter-satellite service. • Systems for remote sensing, including passive and active sensing systems, operating on both ground-based and space-based platforms. • Radio astronomy and radar astronomy. • Dissemination, reception and coordination of standard-frequency and time-signal services, including the application of satellite techniques, on a worldwide basis.
Structure	WP 7A Time signals and frequency standard emissions: Systems and applications (terrestrial and satellite) for dissemination of standard time and frequency signals WP 7B Space radiocommunication applications: Systems for transmission/reception of telecommand, tracking and telemetry data for space operation, space research, Earth exploration-satellite, and meteorological satellite services

	WP 7C Remote sensing systems: active and passive remote sensing applications in the Earth exploration-satellite service and systems of the MetAids service, as well as space research sensors, including planetary sensors WP 7D Radio astronomy: radio astronomy and radar astronomy sensors, both Earth-based and space-based, including space very long baseline interferometry (VLBI)		
Webpage	https://www.itu.int/en/ITU-R/study-groups/rsg7/Pages/default.aspx		
STANDARDIZATION WORK			
Published standards	126	**Projects**	N/A

IEC/TC 80
Maritime navigation and radiocommunication equipment and systems

GENERAL INFORMATION			
Creation date	1980	**Secretariat**	BSI (United Kingdom)
Chairperson	Mr. Hannu Antero Peiponen	**Secretary**	Mr. Kim Fisher
Scope	To prepare standards for maritime navigation and radiocommunication equipment and systems making use of electrotechnical, electronic, electroacoustic, electro-optical and data processing techniques.		
Structure	WG 6 Digital interfaces for navigational equipment within a ship WG 15 Automatic identification system (AIS) WG 16 Bridge alert management (BAM) WG 17 Common Maritime Data Structure (CMDS) PT 61108-7 Maritime navigation and radiocommunication equipment and systems - Global navigation satellite systems (GNSS) - Part 7: Satellite Based Augmentation Systems - Receiver Equipment – Performance requirements and method of testing MT 5 Revision of IEC 62288: Presentation of navigation-related information on shipborne navigational displays – General requirements, methods of testing and required test results MT 7 Revision of IEC 61174: Electronic chart display and information system (ECDIS) - Operational and performance requirements, methods of testing and required test results MT 18 Integrated communication system (ICS) MT 19 Global maritime distress and safety system (GMDSS)		
Webpage	https://www.iec.ch/ords/f?p=103:7:205518329579915::::FSP_ORG_ID,FSP_LANG_ID:1271,25		
STANDARDIZATION WORK			
Published standards	90	**Projects**	9
INTERNATIONAL MEMBERS			
P-Members	18	**O-Members**	17

CLC/SR 80
Maritime navigation and radiocommunication equipment and systems

GENERAL INFORMATION			
Creation date	N/A	**Secretariat**	BSI (United Kingdom)
Manager	Legrand Thierry	**Secretary**	N/A
Scope	Standardization for maritime navigation and radiocommunication equipment and systems.		
Structure	N/A		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=305:7:0::::FSP_ORG_ID:1258049		
STANDARDIZATION WORK			
Published standards	52	**Projects**	4
COMMENTS			
This technical committee is the European equivalent of IEC/TC 80.			

IEC/TC 100/TA 1
Terminals for audio, video and data services and contents

GENERAL INFORMATION			
Creation date	N/A	Secretariat	KATS (Korea)
Manager	Mr. Masatake Sakuma	Secretary	Mr. Kwang-Soon Choi
Scope	To develop international standards related to consumer electronics equipment for access and use of audio, video and/or data services and content.		
Structure	MT 60315 Methods of measurement on radio receivers for various classes of emission - Part 4: Receivers for frequency-modulated sound broadcasting emissions MT 62104 Characteristics of DAB receivers MT 62106 Specification of the radio system (RDS) for VHF/FM sound broadcasting in the frequency range from 87,5 to 108,0 MHz MT 62216 Digital terrestrial television receivers for the DVB-T system MT 62360 Baseline Specifications of Satellite and Terrestrial Receivers for ISDB MT 62448 Multimedia systems and equipment - Multimedia e-publishing and e-books - Generic format for e-publishing MT 62455 Internet protocol (IP) and transport stream MT 62605 Multimedia systems and equipment - Multimedia e-publishing and e-books - Interchange format for e-dictionaries MT 62766 Open IPTV Forum (OIPF) Consumer Terminal Function and Network Interfaces for Access to IPTV and Open Internet Multimedia Services - Part 4-1: Protocols		
Webpage	https://www.iec.ch/ords/f?p=103:7:205518329579915::::FSP_ORG_ID,FSP_LANG_ID:1429,25		
STANDARDIZATION WORK			
Published standards	67	Projects	4

IEC/TC 100/TA 5
Cable networks for television signals, sound signals and interactive services

GENERAL INFORMATION			
Creation date	N/A	Secretariat	JISC (Japan)
Manager	Mr. Takumi Matsumoto	Secretary	Mr. Hiroo Tamura
Scope	To develop international standards and other publications relating to cable networks including equipment and associated methods of measurement for headend reception, processing and distribution of television and sound signals and for processing, interfacing and transmitting all kinds of data signals for interactive services using all applicable transmission media. These signals are typically transmitted in networks by frequency-multiplexing techniques. This includes for instance: • Regional and local broadband cable networks; • Extended satellite and terrestrial television distribution systems; • Individual satellite and terrestrial television receiving systems, and all kinds of equipment; systems and installations used in such cable networks, distribution and receiving systems. The extent of this standardization work is from the antennas and/or special signal source inputs to the headend or other interface points to the network up to the terminal input of the customer premises equipment. The standardization work will consider coexistence with users of the RF spectrum in wired and wireless transmission systems. The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals etc.) as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.		
Structure	WG 1 Safety of cable networks WG 2 EMC WG 3 Coaxial equipment WG 4 Headend equipment WG 5 Optical systems and equipment WG 6 Power supply		

	WG 7 Systems WG 8 Satellite reception		
Webpage	https://www.iec.ch/ords/f?p=103:7:205518329579915::::FSP_ORG_ID,FSP_LANG_ID:1433,25		
STANDARDIZATION WORK			
Published standards	31	**Projects**	3

CLC/TC 209
Cable networks for television signals, sound signals and interactive services

GENERAL INFORMATION			
Creation date	N/A	**Secretariat**	DKE (Germany)
Manager	M. Leboucher Yves	**Secretary**	Dipl.-Ing. Thomas Wegmann
Scope	To develop harmonized and other European standards and deliverables relating to cable networks including equipment and associated methods of measurement for headend reception, processing and distribution of television and sound signals and for processing, interfacing and transmitting all kinds of data signals for interactive services using all applicable transmission media. These signals are typically transmitted in networks by frequency-multiplexing techniques. This includes for instance: • Regional and local broadband cable networks; • Extended satellite and terrestrial television distribution systems; • Individual satellite and terrestrial television receiving systems; • And all kinds of equipment, systems and installations used in such cable networks, distribution and receiving systems. The extent of this standardization work is from the antennas and/or special signal source inputs to the headend or other interface points to the network up to the terminal input of the customer premises equipment. The standardization work will consider coexistence with users of the RF spectrum in wired and wireless transmission systems. The standardization of any user terminals (i.e. tuners, receivers, decoders, multimedia terminals etc.) as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.		
Structure	WG 1 Safety requirements WG 2 EMC for equipment and cable networks WG 3 Equipment for coaxial cable networks WG 5 Equipment and systems for optical cable networks WG 7 System performance WG 8 Ad-hoc WG « SAT » - Satellite systems and equipment WG CAG Chairman's advisory group		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=305:7:0::::FSP_ORG_ID:1258287		
STANDARDIZATION WORK			
Published standards	39	**Projects**	3
COMMENTS			
This technical committee is the European equivalent of IEC/TC 100/TA 5.			

ETSI/TC ERM
Electromagnetic compatibility and Radio spectrum Matters

GENERAL INFORMATION	
Creation date	N/A
Chairperson	Mr. Butscheidt Holger
Scope	Responsible for a range of radio product and electromagnetic compatibility (EMC) standards and the overall co-ordination of radio spectrum matters. Since the scope of the Radio Equipment Directive (RED) is broader than the R&TTE Directive, the technical committee develops new Harmonized Standards in areas such as

	radio and TV broadcast receivers, equipment below 9 kHz and radio determination equipment which were not addressed previously. The technical committee liaises with a number of EC groups in which ETSI is an observer, in particular the Expert Group of the Telecommunication Conformity Assessment and Market Surveillance Committee (TCAM), the Radio Spectrum Policy Group (RSPG) and the Radio Spectrum Committee (RSC). It also works closely with the CEPT Electronic Communications Committee (CEPT/ECC), the Radio Equipment Directive Compliance Association (REDCA) and the market surveillance and conformity assessment authorities through ADCO RED (Group of Administrative Co-operation under the RED).		
Structure	TF ES ERM and MSG for harmonized standards for IMT-2000 TG 11 Wideband Data Systems TG 17 PMSE and broadcast equipment/services TG 17 WG 3 ERM Radio Microphones, Cordless Audio and Audio Links TG 28 ERM Generic SRD's TG 30 ERM Wireless Medical Devices TG 34 ERM RF Identification Services TG 37 ERM Intelligent Transport Systems TG AERO Aeronautics TG DMR Digital Mobile Radio TG MARINE ERM Maritime and radio amateur activities TG SRR ERM Automotive and surveillance radar TG UWB Ultra Wide Band WG EMC ERM Electromagnetic Compatibility WG RM ERM Radio Matters		
Webpage	https://portal.etsi.org/erm		
STANDARDIZATION WORK			
NATIONAL INVOLVEMENT			
National organizations involved	Amazon Web Services- Luxembourg FBConsulting S.A.R.L. IEE		
Published standards	9744	**Projects**	122
COMMENTS			
More general information on radio interference can be found within the IEC/CISPR[45] "International special committee on radio interference". Published standards include electromagnetic compatibility for satellite interactive Earth stations, mobile Earth stations, data communications and GNSS receivers.			

EBU/CLC/ETSI JTC Broadcast
Broadcast

GENERAL INFORMATION			
Creation date	1995		
Chairperson	Mr. Arcidiacono Antonio		
Scope	Coordinating the drafting of standards in the field of broadcasting and related fields. The Committee assesses the work performed within organizations such as e.g. DVB, WorldDAB, HbbTV, and is responsible for coordinating the drafting of standards for broadcast systems (emission-reception combination) for television, radio, data and other services via satellite, cable and terrestrial transmitters. It includes interactive TV, terrestrial TV, radio (including hybrid radio), satellite TV, fixed line TV, mobile TV and audio technologies.		
Structure	N/A		
Webpage	https://portal.etsi.org/broadcast		
STANDARDIZATION WORK			
Published standards	728	**Projects**	10

45 https://www.iec.ch/dyn/www/f?p=103:7:::::FSP_ORG_ID:1298

ITU/ITU-T/SG 2
Operational aspects of service provision and telecommunication management

GENERAL INFORMATION	
Creation date	N/A
Chairperson	Mr. Philip Rushton
Scope	Study Group 2 is home to Recommendation ITU-T E.164, the numbering standard which has played a central role in shaping the telecom networks of today. ITU-T E.164 provides the structure and functionality of telephone numbers, and without it we would not be able to communicate internationally. In recent years SG2 has worked on ENUM, an Internet Engineering Task Force (IETF) protocol for entering E.164 numbers into the Internet domain name system (DNS). An equally important product of SG2 is Recommendation ITU-T E.212 which describes a system to identify mobile devices as they move from network to network. International mobile subscriber identity (IMSI) is a critical part of the modern mobile telecoms system, allowing the identification of a roaming mobile terminal in a foreign network and subsequently the querying of the home network for subscription and billing information. As the world's foremost authority on international numbering, SG2 is responsible for the maintenance of ITU's International Numbering Resource (INR) database. The INR database includes repositories of the various numbers and codes overseen by ITU; a mechanism for the exchange of administrative and operational information among administrations and private-sector players; and a channel through which ITU members can report the possible misuse of ITU-T E.164 numbers. Study Group 2 is also responsible for standards on the management of telecom services, networks and equipment. Telecom management systems are a crucial part of the business processes at the heart of service providers' operations. Standards focus on fault, configuration, accounting, performance and security management (FCAPS) interfaces. FCAPS interfaces sit between network elements and management systems and also between two management systems. SG 2 is also home to a group made up of network operators. The service and network operations group (SNOg) aims to ensure that the needs of operations staff are taken into account in the development of standards.
Structure	Q 1 Application of numbering, naming, addressing and identification plans for fixed and mobile telecommunications services Q 2 Routing and interworking plan for current and future networks Q 3 Service and operational aspects of telecommunications, including service definition Q 5 Requirements, priorities and planning for telecommunication/ICT management and operation, administration and maintenance (OAM) Recommendations Q 6 Management architecture and security Q 7 Interface specifications and specification methodology **Regional groups** ARB Regional Group for the Arab Region AMR Regional Group for the Americas AFR Regional Group for the Africa Region **Focus group** AI4NDM ITU-T Focus Group on AI for Natural Disaster Management
Webpage	https://www.itu.int/en/ITU-T/studygroups/2022-2024/02/Pages/default.aspx

STANDARDIZATION WORK			
Published standards	873	**Projects**	67

COMMENTS
Published standards include telecommunication services via satellite and their maintenance.

ITU/ITU-T/SG 3
Tariff and accounting principles and international telecommunication/ICT economic and policy issues

<table>
<tr><th colspan="4">GENERAL INFORMATION</th></tr>
<tr><td>Creation date</td><td colspan="3">N/A</td></tr>
<tr><td>Chairperson</td><td colspan="3">Mr. Ahmed Said</td></tr>
<tr><td>Scope</td><td colspan="3">ITU-T Study Group 3 provides a unique global forum to improve the understanding of the financial and economic aspects associated with the growth of ICT, particularly with respect to the shift to IP-based and NGN/Future Networks and the exponential rise in mobile wireless communications.

ITU-T SG3 is responsible, inter alia, for studying international telecommunication/ICT policy and economic issues and tariff and accounting matters (including costing principles and methodologies), with a view to informing the development of enabling regulatory models and frameworks. SG3 is also tasked with the study of the economic and regulatory impact of the Internet, convergence (services or infrastructure) and new services, such as OTT, on international telecommunication services and networks.</td></tr>
<tr><td>Structure</td><td colspan="3">Q 1 Development of charging and accounting/settlement mechanisms for current and future international telecommunication/ICT services and networks
Q 3 Study of economic and policy factors relevant to the efficient provision of international telecommunication services
Q 4 Regional studies for the development of cost models together with related economic and policy issues
Q 6 International Internet and Fibre Cables connectivity including relevant aspects of Internet protocol (IP) peering, regional traffic exchange points, Fibre Cables optimization, cost of provision of services and impact of Internet protocol version 6 (IPv6) deployment
Q 7 International mobile roaming issues (including charging, accounting and settlement mechanisms and roaming at border areas)
Q 8 Economic aspects of alternative calling procedures in the context of international telecommunications/ICT services and networks
Q 9 Economic and policy aspects of the Internet, convergence (services or infrastructure) and OTTs in the context of international telecommunication/ICT services and networks
Q 10 Competition policy and relevant market definitions related to the economic aspects of international telecommunication services and networks
Q 11 Economic and policy aspects of big data and digital identity in international telecommunications services and networks
Q 12 Economic and policy issues pertaining to international telecommunication/ICT services and networks that enable Mobile Financial Services (MFS)
Regional groups
AFR Regional Group for Africa
AO Regional Group for Asia and Oceania
ARB Regional Group for the Arab Region
EECAT Regional Group for EECAT
EURM Regional Group for Europe and the Mediterranean Basin
LAC Regional Group for Latin America and the Caribbean
Focus groups
FG-CD Focus Group on cost models for affordable data services</td></tr>
<tr><td>Webpage</td><td colspan="3">https://www.itu.int/en/ITU-T/studygroups/2022-2024/03/Pages/default.aspx</td></tr>
<tr><th colspan="4">STANDARDIZATION WORK</th></tr>
<tr><td>Published standards</td><td>147</td><td>Projects</td><td>46</td></tr>
<tr><th colspan="4">COMMENTS</th></tr>
<tr><td colspan="4">Published standards include charging, billing and accounting regarding communications via satellite.</td></tr>
</table>

ITU/ITU-T/SG 11
Signalling requirements, protocols, test specifications and combating counterfeit products

GENERAL INFORMATION	
Creation date	N/A
Chairperson	Mr. Ritu Ranjan Mittar
Scope	SG11 now focuses on improving the security of signalling protocols such as the legacy SS7. The resulting standards address issues including the integration of digital certificates into signalling exchange, supporting trust in digital financial services, for example, as well as the combating of Calling Party Number spoofing and robocalls. SG11's work in this arena is closely coordinated with related work in ITU-T Study Groups 2 (Operational aspects) and 17 (Security). Ongoing SG11 research focuses on remote testing facilities enabled by testbed federations, which allow different test sites and testing laboratories to be connected using virtual environments. This work includes SG11's development of the APIs required to establish such interoperable connections. SG11 also focuses on developing standards on combating counterfeit and stolen telecommunication/ICT devices and counterfeit or tampered telecommunication/ICT software. SG11 leads ITU's work on conformance and interoperability (C&I) testing and is responsible for coordinating ITU's C&I programme. The C&I programme was initiated at the request of ITU's membership in light of the challenges faced by developing countries in improving interoperability. The Conformity Assessment Steering Committee, which works under auspices of SG11, has developed an ITU Testing Laboratories recognition procedure in close collaboration with the International Laboratory Accreditation Cooperation (ILAC). Under this recognition procedure, all laboratories with a scope covering ITU standards that are accredited by ILAC Mutual Recognition Arrangement signatories may be recognized by ITU.
Structure	Q 1 Signalling and protocol architectures for telecommunication networks and guidelines for implementations Q 2 Signalling requirements and protocols for services and applications in telecommunication environments Q 3 Signalling requirements and protocols for emergency telecommunications Q 4 Protocols for control, management and orchestration of network resources Q 5 Signalling requirements and protocols for border network gateway in the context of network virtualization and intelligentization Q 6 Protocols supporting control and management technologies for IMT-2020 network and beyond Q 7 Signalling requirements and protocols for network attachment and edge computing for future networks, IMT-2020 network and beyond Q 8 Protocols supporting distributed content networking, information centric network (ICN) technologies for future networks, IMT-2020 network and beyond Q 12 Testing of internet of things, its applications and identification systems Q 13 Monitoring parameters for protocols used in emerging networks, including cloud/edge computing and software-defined networking/network function virtualization (SDN/NFV) Q 14 Testing of cloud, SDN and NFV Q 15 Combating counterfeit and stolen telecommunication/ICT devices Q 16 Test specifications for protocols, networks and services for emerging technologies, including benchmark testing Q 17 Combating counterfeit or tampered telecommunication/ICT software **Regional groups** EECAT Study group 11 regional group for Eastern Europe, Central Asia and Transcaucasia (EECAT) AFR Study group 11 regional group for Africa **Focus groups** TBFxG Testbeds Federations for IMT-2020 and beyond **Other groups under SG11** CASC Conformity Assessment Steering Committee
Webpage	https://www.itu.int/en/ITU-T/studygroups/2022-2024/11/Pages/default.aspx

STANDARDIZATION WORK			
Published standards	1009	Projects	160

COMMENTS
Published standards include requirements to be met in interfacing the international telex network with maritime satellite systems, the INMARSAT mobile satellite systems, and means to control the number of satellite links in an international telephone connection.

ITU/ITU-T/SG 13
Future networks and emerging network technologies

GENERAL INFORMATION	
Creation date	N/A
Chairperson	Mr. Kazunori Tanikawa
Scope	The international standards (ITU-T Recommendations) developed by ITU-T Study Group 13 (SG13) address the requirements, architectures, functional capabilities and application programming interfaces of converged future networks. Key areas of focus include network softwarization and orchestration, information-centric networking, content-centric networking, and the application of machine learning technologies. It is responsible for studies relating to future computing, including cloud computing and data handling in ICT networks. This work covers network capabilities and technologies to support data utilization, exchange, sharing, and data quality assessment. It also covers computing-aware networking as well as end-to-end awareness, control and management of future computing, including cloud, cloud security and data handling. SG13 studies aspects of fixed, mobile and satellite convergence for multi-access networks, mobility management, and enhances existing ITU-T Recommendations on mobile communications, including the energy-saving aspects. It develops standards for quantum key distribution networks, and related technologies. It further studies the concepts and mechanisms to enable trusted ICT, including framework, requirements, capabilities, architectures and implementation scenarios of trusted network infrastructures and trusted cloud solutions, in coordination with all study groups concerned.
Structure	Q 1 Future Networks: Innovative service scenarios, including environmental and socio-economic aspects Q 2 Next-generation network (NGN) evolution with innovative technologies including software-defined networking (SDN) and network function virtualization (NFV) Q 5 Applying Future Networks and innovation in developing countries Q 6 Networks beyond IMT2020: Quality of service (QoS) mechanisms Q 7 Future Networks: Deep packet inspection and network intelligence Q 16 Future Networks: Trustworthy and Quantum Enhanced Networking and Services Q 17 Future Networks: Requirements and capabilities for computing including cloud computing and data handling Q 18 Future Networks: Functional architecture for computing including cloud computing and data handling Q 19 Future Networks: End-to-end management, governance, and security for computing including cloud computing and data handling Q 20 Networks beyond IMT-2020 and machine learning: Requirements and architecture Q 21 Networks beyond IMT-2020: Network softwarization Q 22 Networks beyond IMT2020: Emerging network technologies Q 23 Networks beyond IMT2020: Fixed, mobile and satellite convergence **Regional groups** AFR Regional group for Africa EECAT Regional group for EECAT **Other groups under SG 13** JCA-IMT2020 Joint Coordination Activity on IMT-2020 JCA-ML Joint Coordination Activity on Machine Learning
Webpage	https://www.itu.int/en/ITU-T/studygroups/2022-2024/13/Pages/default.aspx

STANDARDIZATION WORK			
Published standards	659	Projects	298

COMMENTS
Published standards include integration of satellite and radio systems in synchronous digital hierarchy transport networks and interworking requirements for mobile satellite data transmission systems.

ITU/ITU-T/SG 15 **Networks, technologies and infrastructures for transport, access and home**	
GENERAL INFORMATION	
Creation date	N/A
Chairperson	Mr. Glenn Parsons
Scope	The international standards (ITU-T Recommendations) developed by Study Group 15 detail technical specifications giving shape to global communication infrastructure. The group's standards define technologies and architectures of optical transport networks enabling long-haul global information exchange; fibre- or copper-based access networks through which subscribers connect; and home networks connecting in-premises devices and interfacing with the outside world. This includes the development of standards for the optical transport network, access network and home network infrastructures, systems, equipment, optical fibres and cables and the related installation, maintenance, management, test, instrumentation and measurement techniques, and control plane technologies to enable the evolution toward intelligent transport networks. Particular emphasis is given to providing international standards for a high-capacity (terabit) optical transport network (OTN) infrastructure including the support of IMT-2020 and beyond, and for high-speed (multi-Mbit/s and Gbit/s) network access and home networking. This includes the related work on modelling for network, system and equipment management, transport network architectures and layer interworking.
Structure	Q 1 Coordination of access and home network transport standards Q 2 Optical systems for fibre access networks Q 3 Technologies for in-premises networking and related access applications Q 4 Broadband access over metallic conductors Q 5 Characteristics and test methods of optical fibres and cables, and installation guidance Q 6 Characteristics of optical components, subsystems and systems for optical transport networks Q 7 Connectivity, operation and maintenance of optical physical infrastructures Q 8 Characteristics of optical fibre submarine cable systems Q 10 Interfaces, interworking, OAM, protection and equipment specifications for packet-based transport networks Q 11 Signal structures, interfaces, equipment functions, protection and interworking for optical transport networks Q 12 Transport network architectures Q 13 Network synchronization and time distribution performance Q 14 Management and control of transport systems and equipment
Webpage	https://www.itu.int/en/ITU-T/studygroups/2022-2024/15/Pages/default.aspx

STANDARDIZATION WORK			
Published standards	920	**Projects**	256

COMMENTS
Published standards include maintenance aspects for the maritime satellite telex service, use of global navigation satellite systems to create a referenced network map, and interface between synchronous data networks using an envelope structure and single channel per carrier (SCPC) satellite channels.

More information on standardization related to Radio Frequency (RF) equipment can be found in the technical committees IEC/TC 46[46] "Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories", and IEC/SC 46F[47] and CLC/SR 46F[48] both on "RF and microwave passive components".

46 https://www.iec.ch/dyn/www/f?p=103:7:::::FSP_ORG_ID:1247
47 https://www.iec.ch/dyn/www/f?p=103:7:::::FSP_ORG_ID:1447
48 https://standards.cencenelec.eu/dyn/www/f?p=305:7:0:25:::FSP_ORG_ID,FSP_LANG_ID:1258597

4.2.3 Earth observation

This section contains technical committees related to Earth observation. Dedicated satellites are now commonly used not only for weather forecasting, but also for activities such as crops management or natural disasters support.

ISO/TC 211 Geographic information/Geomatics			
GENERAL INFORMATION			
Creation date	1994	**Secretariat**	SIS (Sweden)
Chairperson	Mr. Peter Parslow	**Committee Manager**	Mr. Mats Åhlin
Scope	Standardization in the field of digital geographic information. Note: This work aims to establish a structured set of standards for information concerning objects or phenomena that are directly or indirectly associated with a location relative to the Earth. These standards may specify, for geographic information, methods, tools and services for data management (including definition and description), acquiring, processing, analyzing, accessing, presenting and transferring such data in digital / electronic form between different users, systems and locations. The work shall link to appropriate standards for information technology and data where possible, and provide a framework for the development of sector-specific applications using geographic data.		
Structure	AG 1 Outreach advisory group AG 2 Advisory group on strategy AG 3 Programme maintenance group (PMG) AG 4 Joint advisory group (JAG) ISO/TC 211 – OGC AG 5 Harmonized model maintenance group (HMMG) AG 6 Group for Ontology Maintenance (GOM) AG 7 Terminology maintenance group (TMG) AG 10 XML maintenance group (XMG) AG 11 Advisory group to support UN-GGIM and other related UN activities AG 12 Control body for the ISO geodetic register AG 13 Land cover and land use AG 14 Registration Maintenance group (RMG) AHG 11 Climate changeCAG 1 Chair's advisory group JWG 11 Joint ISO/TC 211 - ISO/TC 204 WG: GIS-ITS WG 1 Framework and reference model WG 4 Geospatial services WG 6 Imagery WG 7 Information communities WG 9 Information management WG 10 Ubiquitous public access **Joint working groups under the responsibility of another committee:** ISO/TC 59/SC 13/JWG 14 Joint ISO/TC 59/SC 13 - ISO/TC 211 WG: GIS-BIM interoperability		
Webpage	https://www.iso.org/committee/54904.html		
STANDARDIZATION WORK			
Published standards	97	**Projects**	27
INTERNATIONAL MEMBERS			
P-Members	38	**O-Members**	34 (including **Luxembourg**)
COMMENTS			
Any device or product that makes use of location coordinates derived from a GNSS device is likely to follow standards from this technical committee.			

CEN/TC 287 Geographic Information

GENERAL INFORMATION			
Creation date	N/A	Secretariat	BSI (United Kingdom)
Chairperson	Dr. Walker Bob	Secretary	Mr. Starr Christopher
Scope	Standardization in the field of digital geographic information for Europe: The committee will produce a structured framework of standards and guidelines, which specify a methodology to define, describe and transfer geographic data and services. This work will be carried out in close co-operation with ISO/TC 211 in order to avoid duplication of work. The standards will support the consistent use of geographic information throughout Europe in a manner that is compatible with international usage. They will support a spatial data infrastructure at all levels in Europe.		
Structure	N/A		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:6268&cs=1D5368A4F6E101B66AD14AB12AC0FC914		
STANDARDIZATION WORK			
Published standards	59	Projects	26

ISO/TC 172/SC 6 Geodetic and surveying instruments

GENERAL INFORMATION			
Creation date	1981	Secretariat	SNV (Switzerland)
Chairperson	Mr. Hannes Maar	Committee Manager	Ms Tanja Jankovic
Scope	Standardization of terminology, requirements and test methods for geodetic and surveying instruments, their components and accessories.		
Structure	WG 4 Field procedures and ancillary devices WG 5 Terminology		
Webpage	https://www.iso.org/committee/53732.html		
STANDARDIZATION WORK			
Published standards	14	Projects	4
INTERNATIONAL MEMBERS			
P-Members	13	O-Members	10
COMMENTS			
ISO defines GNSS as included in the business environment of this technical committee.			

4.2.4 Technical areas (mechanical, electrical, etc.)

This section includes technical committees covering various technical areas. Often related to aeronautics, these committees are also relevant for space (astronautics) applications.

ASD-STAN Aerospace			
GENERAL INFORMATION			
Creation date	N/A	**Secretariat**	ASD-STAN
Manager	Mr. Thierry Legrand	**Secretary**	N/A
Scope	Promote the harmonization of aerospace standards in Europe, and pay attention to these areas where improved standardization can result in reduced costs to manufacturers.		
Structure	D 1 Program Management and System Engineering D 2 Electrical D 3 Mechanical D 4 Materials D 5 Autonomous Flying D 6 Quality and safety management D 7 Digital Projects D 9 Environment D 10 Space D 11 Board D 12 Cabin		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:6378&cs=19D1C1BC19E61A3F4288F436AE3B14CD4		
STANDARDIZATION WORK			
Published standards	2591	**Projects**	283
COMMENTS			
The ASD-STAN has been recognized as an Associated Body to CEN for Aerospace Standards in 1986.			

ASD-STAN/D02 Aerospace / Electrical			
GENERAL INFORMATION			
Creation date	N/A	**Secretariat**	AFNOR (France)
Manager	N/A	**Secretary**	N/A
Scope	• Prepare sectorial standards and maintain them by using the feedback and the qualifications of the users; • Promote awareness of norms and standards; • Develop an action plan directed by user and/or manufacturer data.		
Structure	WG 01 Electrical Network WG 02 Cables and Stripping Tools WG 03 Elements of Connection (Connectors, Contacts, Rear Accessories, Crimping Tools) WG 04 Relays, Switches, Push-Buttons WG 05 Protection Devices WG 06 Exterior and cockpit lightning (Lamps, LED, etc.) WG 08 Installation Technologies WG 10 Optical Components WG 11 IMA packaging WG 12 MOAA Modular and Open Avionics Architecture		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:837186&cs=1FA9C4A11B884BD9EA21CBC4E2E1802FE		
STANDARDIZATION WORK			
Published standards	886	**Projects**	/

ASD-STAN/D03
Aerospace / Mechanical

GENERAL INFORMATION			
Creation date	N/A	Secretariat	DIN (Germany)
Manager	N/A	Secretary	N/A
Scope	• Standardization of parts and technical requirements for aerospace mechanical systems, (e.g bearings, rods, bushes, vibration isolators), fasteners (e.g. bolts, nuts, screws, washers, high-locks, quick fasteners, rivets), and fluid systems (e.g. couplings & fittings, clamps, flexible hoses, tubes); • Preparation, update, revision of standards and maintain them by users' feedback; • Formulate the opinion of the aerospace sector on standards established by other authorized standardization development organizations; • Promote awareness of norms and standards.		
Structure	WG 01 Parts of Mechanical Systems WG 02 Fasteners WG 03 Fluids Systems WG 06 Coatings for fasteners		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:837197&cs=164BEA1644037C8DF5E8B026F9A93824A		
STANDARDIZATION WORK			
Published standards	607	Projects	/

ASD-STAN/D04
Aerospace / Material (Metallic and Non-Metallic)

GENERAL INFORMATION			
Creation date	N/A	Secretariat	DIN (Germany)
Manager	N/A	Secretary	N/A
Scope	• Coordination of the Domain related sector work; • Coordination between the Domain related sector leaders; • Promoting the development of new innovative European standards for the Aerospace industry.		
Structure	WG 01 Light Alloys WG 03 Steels WG 04 Welding / Brazing WG 05 Test Methods WG 06 Surface Treatments WG 07 Elastomers / Sealants WG 08 Composite WG 11 Super Alloy WG 15 Non-Destructive Testing		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:837201&cs=1964A84B41732696ABAB6F8A467CF66F3		
STANDARDIZATION WORK			
Published standards	600	Projects	/
COMMENTS			
A more general approach of standardization related to composites and reinforcement fibres can be found in the technical committee ISO/TC 61/SC 13 "Composites and reinforcement fibres". The same goes for advanced ceramics with CEN/TC 184 "Advanced technical ceramics".			

ISO/TC 20
Aircraft and space vehicles

GENERAL INFORMATION			
Creation date	1947	Secretariat	ANSI (United States)
Chairperson	Mr. Richard Forselius	Committee Manager	Mr. Christopher Carnahan
Scope	Standardization of materials, components and equipment for construction and operation of aircraft and space vehicles as well as equipment used in the servicing and maintenance of these vehicles.		
Structure	SC 1 Aerospace electrical requirements SC 4 Aerospace fastener system SC 6 Standard atmosphere SC 8 Aerospace terminology SC 9 Air cargo and ground equipment SC 10 Aerospace fluid systems and components SC 13 Space data and information transfer systems SC 14 Space systems and operations SC 16 Unmanned aircraft systems SC 17 Airport infrastructure SC 18 Materials		
Webpage	https://www.iso.org/committee/46484.html		
STANDARDIZATION WORK			
Published standards	682	Projects	83
INTERNATIONAL MEMBERS			
P-Members	17	O-Members	28

ISO/TC 20/SC 1
Aerospace electrical requirements

GENERAL INFORMATION			
Creation date	1983	Secretariat	SAC (China)
Chairperson	Mr Yang YANG	Committee Manager	Ms. Liwen Gao
Scope	ISO/TC20/SC1 engages in the preparation of international standards related to the generation, control and distribution of electrical energy, including associated materials and components, for civil aircraft, and aerospace application.		
Structure	WG 3 Solid state remote power controllers - Performance requirements and Hybrid remote power controller - Performance requirements WG 5 Aircraft electric cables - General requirements WG 9 Aircraft circuit breakers WG 13 Characteristics of aircraft electrical systems (Revision of ISO 1540) WG 15 LED power light		
Webpage	https://www.iso.org/committee/46506.html		
STANDARDIZATION WORK			
Published standards	64	Projects	3
INTERNATIONAL MEMBERS			
P-Members	10	O-Members	12

ISO/TC 20/SC 4 Aerospace fastener systems

GENERAL INFORMATION			
Creation date	1984	Secretariat	DIN (Germany)
Chairperson	Mr. Ralf Schomaker	Committee Manager	Mr. M. Sc Josef Saurer
Scope	Standardization of aerospace-related fastener systems		
Structure	WG 3 Supporting documents		
Webpage	https://www.iso.org/committee/46538.html		
STANDARDIZATION WORK			
Published standards	96	Projects	4
INTERNATIONAL MEMBERS			
P-Members	11	O-Members	9

ISO/TC 20/SC 6 Standard atmosphere

GENERAL INFORMATION			
Creation date	1980	Secretariat	GOST R (Russia)
Chairperson	Mr. Nikita Kuprikov	Committee Manager	Mr. Denis Doronin
Scope	N/A		
Structure	WG 1 Atmosphere from 30 to 120 km		
Webpage	https://www.iso.org/committee/46560.html		
STANDARDIZATION WORK			
Published standards	4	Projects	0
INTERNATIONAL MEMBERS			
P-Members	6	O-Members	11

ISO/TC 20/SC 10 Aerospace fluid systems and components

GENERAL INFORMATION			
Creation date	1980	Secretariat	DIN (Germany)
Chairperson	Mr. Ulrich Müller	Committee Manager	Ms. Dorothée Kretschmar
Scope	Standardization in the field of developing and maintaining standards in the area of aerospace fluid systems and components.		
Structure	WG 1 Joint ISO/TC 20/SC 10 - ISO/TC 131/SC 7 WG: Seals and seal retainers WG 3 Tubing and tube retaining devices WG 6 Couplings for rigid pipe WG 8 Hydraulic fluids and fluid contamination control WG 9 Hydraulic power and actuation equipment WG 14 Hose assemblies		
Webpage	https://www.iso.org/committee/46570.html		
STANDARDIZATION WORK			
Published standards	81	Projects	7
INTERNATIONAL MEMBERS			
P-Members	12	O-Members	12

ISO/TC 20/SC 18 Materials

GENERAL INFORMATION			
Creation date	2016	**Secretariat**	AFNOR (France)
Chairperson	Mr. Dongwei Sun	**Committee Manager**	Mr. Romain Simion
Scope	Standardization of materials and related processes (e.g.: surface treatment/coating, defects in composites...) used by aircraft and engine manufacturers. Attention for duplication, the following ISO/TC for materials exist: ISO/TC 35 Paints and varnishes, ISO/TC 17 Steel, ISO/TC 25 Cast irons and pig irons, ISO/TC 26 Copper and copper alloys, ISO/TC 45 Rubber and rubber products, ISO/TC 79 Light metals and their alloys, ISO/TC 155 Nickel and nickel alloys, ISO/TC 206 Fine ceramics, ISO/TC 61 Plastics. Attention for duplication, the following ISO/TC for processes exist: ISO/TC 44/SC 14 Welding and brazing in aerospace, ISO/TC 107 Metallic and other inorganic coatings, ISO/TC 156 Corrosion of metals and alloys, ISO/TC 244 Industrial furnaces and associated processing equipment, ISO/TC 261 Additive manufacturing.		
Structure	WG 1 Surface treatment		
Webpage	https://www.iso.org/committee/6207117.html		
STANDARDIZATION WORK			
Published standards	6	**Projects**	4
INTERNATIONAL MEMBERS			
P-Members	6	**O-Members**	5

4.2.5 Systems engineering, Quality, Safety and Management processes

This section contains technical committees dealing with systems engineering, quality, and safety and management processes relevant for space applications.

IEC/TC 107 Process management for avionics			
GENERAL INFORMATION			
Creation date	N/A	Secretariat	BSI (United Kingdom)
Chairperson	Mr. Alexandre Barbosa dos Santos	Secretary	Ms. Josephine Vann
Scope	To develop process management standards on systems and equipment used in the field of avionics. Avionics includes electronics used in commercial, civil and military aerospace applications.		
Structure	WG 1 Aerospace and defense electronic systems containing lead-free solder WG 2 Aerospace qualified electronic component (AQEC) WG 3 Counterfeit electronic parts; avoidance, detection, mitigation, and disposition in avionics applications WG 4 Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment WG 5 Management plans MT 2 Components capability – Temperature uprating MT 3 Process management for avionics - Electronic components for aerospace, defence and high performance (ADHP) applications - Part 1: General requirements for high reliability integrated circuits and discrete semiconductors AHG 3 Avionics reliability prediction AHG 4 New electronic technology qualification AHG 6 Cyber Security		
Webpage	https://www.iec.ch/dyn/www/f?p=103:7:::::FSP_ORG_ID:1304		
STANDARDIZATION WORK			
Published standards	29	Projects	1
INTERNATIONAL MEMBERS			
P-Members	9	O-Members	13

CLC/SR 107 Process management for avionics			
GENERAL INFORMATION			
Creation date	2011	Secretariat	DKE (Germany)
Chairperson	N/A	Secretary	N/A
Scope	To develop process management standards on systems, components and equipment used in the field of avionics. Avionics includes electronics used in commercial, civil and military aerospace applications. The work of SR 107 will take into account the special European needs e.g. in the field of ecological and environmental concerns such as disposal or recycling of electronic equipment, including the previous work items of BTTF 91-3 and BTTF 101-3. Furthermore, CLC/SR 107 is to ensure that the specific European requirements will adequately be reflected in IEC/TC 107.		
Structure	N/A		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=305:7:0:25:::FSP_ORG_ID,FSP_LANG_ID:1258481		
STANDARDIZATION WORK			
Published standards	5	Projects	1
COMMENTS			
This committee is the European equivalent of IEC/TC 107.			

ASD-STAN/D01
Aerospace / Program Management and System Engineering

GENERAL INFORMATION			
Creation date	N/A	Secretariat	AFNOR (France)
Manager	N/A	Secretary	Ms. Marina Epis
Scope	The D01 Domain covers processes used to deliver the system and his associated support system required as result of a program. According to this objective, the D01 domain develops program management and systems engineering best practices to reach the goal in an optimize manner. The operational target readership for the program management includes, but not limited, program breakdown structures, development logic with synchronization reviews (project and systems maturity reviews), risks, cost and estimating, configuration and others topics associated to the responsibility of the Program Management Team. The operational target readership for System Engineering technical processes includes, but not limited, expression of needs from stakeholders point of view, definition of the system during the various level of maturity of the design, system security and safety, industrialization practices from the system definition to the production end of life, the relationship with production process, capability of the logistic system to support the system, and how to ensure that the system complies with Qualification and Certification processes. Both Program Management and Systems Engineering practices have strong relationship and shall covers the all life cycle (from the idea to disposal) of the system required.		
Structure	WG 11 System definition and realization WG 12 Programme phasing and planning WG 13 Configuration management WG 14 Risk management WG 15 ILS and Obsolescence Management WG 16 RAMS (Reliability, availability, maintainability and safety)		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:837180&cs=119515BC01D9A504FBA6A2634C1CA15FA		
STANDARDIZATION WORK			
Published standards	29	Projects	/

ASD-STAN/D06
Aerospace / Quality and Safety Management

GENERAL INFORMATION			
Creation date	N/A	Secretariat	AFNOR (France)
Manager	N/A	Secretary	Ms. Marina Epis
Scope	This domain covers the development and maintenance of all quality-related documents in the area of product assurance and quality management, in order to reach the following objectives: • Establish commonality of aviation, space and defence quality systems, “as documented” and “as applied”; • Establish and implement a process of continual improvement to bring initiatives to life (e.g. Industry expectations, lean manufacturing, performance metrics); • Establish methods to share best practices in the aviation, space and defence industry; • Coordinate initiatives and activities with regulatory/government agencies and other industry Stakeholders, aiming at the consideration of respective standards as acceptable means of compliance.		
Structure	WG 01 EAQG European Aerospace Quality Group WG 04 Design Organisation Approval (DOA)		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:837215&cs=10881054EC3A6CA67CCEAEA4B4D714727		
STANDARDIZATION WORK			
Published standards	8	Projects	9

ASD-STAN/D07 **Aerospace / Digital Projects**			
GENERAL INFORMATION			
Creation date	N/A	**Secretariat**	N/A
Manager	N/A	**Secretary**	N/A
Scope	This domain represents interests for the European standardization activities in the field of Information and Data related technologies for aerospace applications. Examples are Archiving, Cybersecurity, Blockchain technologies or health monitoring. It prepares ASD-STAN prEN standards, EN-standardization projects and comments as well as participates in other European and International projects. The Working Group provides interested stakeholders the opportunity to actively work on standardization procedures, contribute their ideas and suggestions and take part in the information exchange between national experts.		
Structure	WG 01 LOng Term Archiving and Retrieval of Digital Technical Product Data (LOTAR) WG 02 Radio Frequency IDentification and connected devices (RFID) WG 03 Prognostics and Health Monitoring (PHM)		
Webpage	https://standards.cencenelec.eu/dyn/www/f?p=205:7:0::::FSP_ORG_ID:837227&cs=11DE33A4DC4A857D0A82E0A19949D3C1E		
STANDARDIZATION WORK			
Published standards	N/A	**Projects**	N/A

ISO/TC 20/SC 8 **Aerospace terminology**			
GENERAL INFORMATION			
Creation date	1988	**Secretariat**	GOST R (Russia)
Chairperson	Ms. Liudmila Rostovtseva	**Committee Manager**	Ms. Irina Kashkovskaya
Scope	Standardization of terminology used in aerospace industry, as well as the terms used for aerospace components and equipment for construction and operation of aircraft and space vehicles and equipment used in the servicing and maintenance of these vehicles.		
Structure	WG 2 Flight dynamics concepts, quantities and symbols		
Webpage	https://www.iso.org/committee/46562.html		
STANDARDIZATION WORK			
Published standards	24	**Projects**	N/A
INTERNATIONAL MEMBERS			
P-Members	10	**O-Members**	8

ISO/TC 44/SC 14
Welding and brazing in aerospace

GENERAL INFORMATION			
Creation date	2015	Secretariat	DIN (GermanyRussia)
Chairperson	Mr. Gregory Trepus	Committee Manager	Mr Till Lehmann
Scope	Standardization in the field of welding, soldering and brazing in aerospace including: • qualification of personnel; • qualification of procedures; • design; • quality requirements for inspection, testing, equipment qualification and ground support equipment.		
Structure	N/A		
Webpage	https://www.iso.org/committee/5695988.html		
STANDARDIZATION WORK			
Published standards	7	Projects	2
INTERNATIONAL MEMBERS			
P-Members	10	O-Members	9

CONCLUSION

Arguably, there is a true ambition of further developing the space sector in Luxembourg, especially in the domain of space resources utilization. In line with the SpaceResources.lu initiative, the creation of ESRIC as well as the recent legal framework evolutions are supporting this trend.

The space sector being recognized as a motor for economic growth and development of innovation, strong support is provided to national stakeholders by the government through the national space agency. The 2020-2024 National Action Plan for Space Science and Technology is one of the key documents driving the development of the space sector in Luxembourg.

Nonetheless, successful activity is still based on the implementation of an efficient cooperation and partnership between the different stakeholders, private or public, involved in the development of space innovations. In addition, the inter-sectorial collaboration grows in importance, with space-ICT developments being a vivid example. On the one hand, evolution in the space sector brought to the existence the hardware, such as satellites or other equipment, involved in the transmission of data related to space and earth observations. On the other hand, without supporting ICT activities in the area of telecommunications, regarding radio waves, communication flows or even cybersecurity, this data transmission would not be possible. While benefiting the progress in both sectors, this collaboration comes with its challenges, such as for example the issues of interoperability.

In this context, it is important for space industries, national governments, users or suppliers to support and to adopt the use of standards in order to facilitate this international and inter-sectorial collaboration through the integration of products and services in a reliable and cost-effective manner.

Moreover, technical standardization is not only giving a first-hand insight into the latest developments, thus supporting innovation, but is also contributing to the harmonization of systems and procedures, opening access to external markets, ensuring constant progress, and building trust.

Standardization activities are therefore a key element to strengthen the European and national space sectors, and to reach long-term sustainability. To summarize, standards contribute to promote and share good practices and techniques available through the market. They ensure the quality, security and performance of products, systems, and services.

Following the national standardization strategy and the related Policy on Aerospace Technical Standardization (2021-2025), ILNAS is providing national stakeholders with relevant information and opportunities regarding technical standardization in the space sector, and aims to raise awareness regarding the potential benefits of involvement in this domain. Accordingly, this standards analysis should have allowed national stakeholders to understand the various benefits from involvement in technical standardization and to identify technical committees of potential interest regarding their activities.

Finally, conforming to the third project of the Policy on Aerospace Technical Standardization, ILNAS has undertaken concrete developments for strengthening education and research activities in the area of technical standardization. In this frame, ILNAS, the University of Luxembourg and the SnT are implementing, since 2021, a research program around aerospace, ICT and construction domains[49].

This standards analysis should be seen as a starting point for further discussions. Therefore, any interested party is invited to use the contact information provided to make additional requests.

[49] https://ilnas-snt.uni.lu/

List of Acronyms

ACRONYM	MEANING
ADCO	Administrative Cooperation
ADHP	Aerospace, Defence and High Performance
AFNOR	*Association Française de Normalisation*
AG	Advisory Group
AHG	Ad Hoc Group
AI	Artificial Intelligence
AIA	Aerospace Industries Association
AIAA	American Institute of Aeronautics and Astronautics
AIS	Automatic Identification System
ANEC	*Agence pour la Normalisation et l'Economie de la Connaissance*
ANSI	American National Standards Institute
AQEC	Aerospace Qualified Electronic Component
ASCE	American Society of Civil Engineers
ASD-STAN	AeroSpace and Defence Industries Association of Europe - Standardization
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
BAM	Bridge alert management
BC4A	Blockchain for Aviation
BDS	BeiDou Navigation Satellite System
BSI	British Standards Institution
BSS	Broadcasting-Satellite Service
CAG	Chairman's Advisory Group
CASC	Conformity Assessment Steering Committee
CCSDS	Consultative Committee for Space Data Systems
CEN	European Committee for Standardization
CENELEC (CLC)	European Committee for Electrotechnical Standardization
CEOS	Committee on Earth Observation Satellites
CEPT	European Conference of Postal and Telecommunications Administrations
CLC	European Committee for Electrotechnical Standardization
CMDS	Common Maritime Data Structure
CNSA	China National Space Administration
COPUOS	Committee on the Peaceful Uses of Outer Space

ACRONYM	MEANING
CTB	Components Technology Board
DAB	Digital Audio Broadcasting
DGIWG	Defence Geospatial Information Working Group
DIN	*Deutsches Institut für Normung*
DKE	*Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE*
DMR	Digital Mobile Radio
DNS	Domain Name System
DOA	Design Organisation Approval
DSN	Distributed Service Network
DTE	Digital Twin Earth
DVB	Digital Video Broadcasting
DVB-T	Digital Video Broadcasting - Terrestrial
EAQG	European Aerospace Quality Group
EBU	European Broadcasting Union
EC	European Commission
ECC	Electronic Communications Committee
ECDIS	Electronic Chart Display and Information System
ECSS	European Cooperation for Space Standardization
EDA	European Defence Agency
EEE	Electrical, Electronic and Electromechanical
EGNOS	European Geostationary Navigation Overlay Service
EMC	Electromagnetic Compatibility
EN	European Standard
EPPL	European Preferred Parts List
ERM	Electromagnetic compatibility and Radio spectrum Matters
ESA	European Space Agency
ESCC	European Space Components Coordination
ESCIES	European Space Components Information Exchange System
ESERO	European Space Education Resources Office
ESO	European Standardization Organization
ESPI	European Space Policy Institute
ESRIC	European Space Resources Innovation Centre
ESSB	ESA Standardization Steering Board
ETSI	European Telecommunications Standards Institute

ACRONYM	MEANING
EU	European Union
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
EUSPA	European Union Agency for the Space Programme
EUTELSAT IGO	European Telecommunications Satellite Organization
FCAPS	Fault, Configuration, Accounting, Performance and Security
FM	Frequency Modulation
FN	Future Network
FPGA	Field Programmable Gate Array
FSS	Fixed-Satellite Service
GDP	Gross Domestic Product
GEO	Geostationary Earth Orbit
GLONASS	Global Navigation Satellite System
GMDSS	Global Maritime Distress and Safety System
GNSS	Global Navigation Satellite System
GOM	Group for Ontology Maintenance
GOST R	Federal Agency on Technical Regulating and Metrology
GPS	Global Positioning System
GSA	European GNSS Agency
HMMG	Harmonized Model Maintenance Group
HN	Home Networking
HPCL	Hybrid Process Capability Approval List
IADC	Inter-Agency Space Debris Coordination Committee
IAQG	International Aerospace Quality Group
ICN	Information Centric Network
ICS	Integrated Communication System
ICT	Information and Communication Technology
IEC	International Electrotechnical Commission
IEEE SA	Institute of Electrical and Electronics Engineers Standards Association
IETF	Internet Engineering Task Force
ILNAS	*Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et Services*
ILS	Integrated Logistics Support
IMSI	International Mobile Subscriber Identity
IMT	International Mobile Telecommunications
IoT	Internet of Things

ACRONYM	MEANING
IP	Internet Protocol
IPTV	Internet Protocol Television
IRNSS	Indian Regional Navigation Satellite System
ISDB	Integrated Service for Digital Broadcast
ISM	Interdisciplinary Space Master
ISO	International Organization for Standardization
ISS	International Space Station
ITS	Intelligent Transport Systems
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union – Radiocommunication sector
ITU-T	International Telecommunication Union – Telecommunication Standardization sector
JAG	Joint Advisory Group
JAXA	Japanese Aerospace Exploration Agency
JISC	Japanese Industrial Standards Committee
JPC	Joint Project Committee
JTC	Joint Technical Committee
JWG	Joint Working Group
KATS	Korea Agency for Technology and Standards
LEO	Low Earth Orbit
LOTAR	LOng Term Archiving and Retrieval
LSA	Luxembourg Space Agency
MFS	Mobile Financial Services
MOAA	Modular and Open Avionics Architecture
MoU	Memorandum of Understanding
MSG	Mobile Standards Group
MSS	Mobile-Satellite Service
MT	Maintenance Team
NAS	National Aerospace Standards
NASA	National Aeronautics and Space Administration
NASC	National Aerospace Standards Committee
NATO	North Atlantic Treaty Organization
NFV	Network Function Virtualization
NGN	Next-Generation Network
OAM	Operation, Administration and Maintenance

ACRONYM	MEANING
OECD	Organization for Economic Co-operation and Development
OGC	Open Geospatial Consortium
OIPF	Open IPTV Forum
OMG	Object Management Group
OTN	Optical Transport Network
OTT	Over-The-Top
PHM	Prognostics and Health Monitoring
PMG	Programme maintenance group
PMSE	Programme Making and Special Events
PSWG	Policy and Standards Working Group
PT	Project Team
QML	Qualified Manufacturer List
QoS	Quality of Service
QPL	Qualified Parts List
RAMS	Reliability, Availability, Maintainability and Safety
RDS	Radio Data System
RDSS	Radio Determination Satellite Service
RED	Radio Equipment Directive
REDCA	Radio Equipment Directive Compliance Association
RF	Radio Frequency
RFID	Radio Frequency IDentification
RSC	Radio Spectrum Committee
RSPG	Radio Spectrum Policy Group
SAC	Standardization Administration of China
SAE	Society of Automotive Engineers
SatCen	European Union Satellite Centre
SAB	Security Accreditation Board
SBAS	Satellite-Based Augmentation System
SC	Subcommittee
SCAHC	Space Components Ad Hoc Committee
SCPC	Single Channel Per Carrier
SCSB	Space Components Steering Board
SDN	Software-Defined Networking
SDG	Sustainable Development Goal

ACRONYM	MEANING
SES	*Société Européenne des Satellites*
SES	Satellite Earth Stations and Systems
SG	Study Group
SIS	Swedish Institute for Standards
SLE	Space Link Extension
SME	Small and Medium-sized Enterprise
SNOg	Service and Network Operations group
SNV	Swiss Association for Standardization
SPSLux	Satellite Positioning System Luxembourg
SR	Reporting Secretariat
SRD	Short Range Devices
SRR	Short Range Radar
SSD	Space Services Department
STM	Space Traffic Management
TC	Technical Committee
TCAM	Telecommunication Conformity Assessment and Market Surveillance Committee
TF	Task Force
TG	Task Group
TMG	Terminology maintenance Group
UK	United Kingdom
UN	United Nations
US	United States
USN	Ubiquitous Sensor Network
UWB	Ultra Wide Band
VHF	Very High Frequency
VLBI	Very Long Baseline Interferometry
VLEO	Very Low Earth Orbit
WG	Working Group
WP	Working Party
WRC	World Radiocommunication Conference
WS	Workshop
WSC	World Standards Cooperation
WTO	World Trade Organization
XMG	XML Maintenance Group

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July 2024 · STANDARDS ANALYSIS · AEROSPACE SECTOR · Version 6.0 · © ILNAS · ISSN: 2738-9499

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