Version 1.0 - November 2013

STANDARDS ANALYSIS
SPACE SECTOR
Luxembourg

ILNAS
Institut luxembourgeois de la normalisation, de l'accréditation, de la sécurité et qualité des produits et services

ANEC
AGENCE POUR LA NORMALISATION ET L'ÉCONOMIE DE LA CONNAISSANCE

Executive summary

The survey and analysis of European and international standards in the space sector has been initiated by the *Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et services* (ILNAS). Realized in the frame of the implementation of the national standardization strategy 2010-2020, this work is conducted by ILNAS in order to develop an information and exchange network for space-related standardization knowledge in the Grand Duchy of Luxembourg.

Conducted in several steps, this survey is basically built on a standards watch that allows the identification of standardization technical committees related to the space sector at the European and international levels. Detailed information concerning the most interesting formal standardization technical committees (about 35) is provided in the present report. Then, in order to induce stakeholder interest, the national market of the space sector has been characterized through the definition of 4 categories for which potential interests and opportunities to participate in the standardization process (*via* ILNAS) have been identified.

Conceived as a practical tool, this report is evolving and should be used to quickly identify issues and interests for the national stakeholders of the space sector. The present report constitutes the first version of this analysis which will continue to be updated on a regularly basis according to the market interest.

Foreword

The *Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et services* (ILNAS) is an administration under the supervision of the Minister of the Economy and Foreign Trade in Luxembourg. It was created based on the law of May 20th, 2008 and started its operations on June 1st, 2008.

For reasons of complementarity, effectiveness and transparency as well as for purposes of administrative simplification, ILNAS is in charge of several administrative and technical legal missions that were previously the responsibility of different public structures. These assignments have been strengthened and new tasks are now assigned to ILNAS. ILNAS thus corresponds to a network of skills for competitiveness and consumer protection.

To promote standardization in Luxembourg, ILNAS has drawn up a national standardization strategy[1], which was approved by the Minister of the Economy and Foreign Trade on June 10th, 2010.

This national standardization strategy, directly related to the 2020 strategy of the European Union, is primarily based on the following guiding principle: "Setting standards means setting the market."
The goals of the standardization strategy are:

- to better support the national economy in terms of competitiveness, visibility, and performance;
- to promote a homogeneous standardization culture at the national level;
- to improve the international position of the Grand Duchy of Luxembourg in standardization organizations;
- to launch an innovative and federative way for the national standardization process.

Thus, the act of participating in the standardization process does not only allow for future standards to be anticipated but also allows the market to be guided by meeting its interests at any level. This strategy, including its operational objectives that are regularly updated, will be implemented through a sector-based economic approach and where national needs are identified.

To give new impetus to standardization in Luxembourg, this strategy is based on the five pillars hereafter mentioned:

- a sector-based standards approach as a support for the national economy,
- innovation and research development in the frame of standardization,
- a sector-based development of ILNAS, Luxembourg's national standards body,
- standardization training and public awareness,
- the creation and development of the Economic Interest Grouping "*Agence pour la Normalisation et l'Économie de la Connaissance*" (ANEC).

The national standardization strategy 2010-2020 has been updated by ILNAS in January 2013 and approved by the Minister of the Economy and Foreign Trade (the initial strategy remains the reference framework). Covering the period 2013-2020, this update[2] focuses on four major development axes related to:

- the creation of standards-related education at national level,
- the (inter-) sectoral standardization approach,
- the strengthening of research activities,

[1] http://www.ilnas.public.lu/fr/publications/normalisation/etudes-nationales/ilnas-strategie-normalisation-2010-2020.pdf
[2] http://www.ilnas.public.lu/fr/publications/normalisation/etudes-nationales/luxembourg-standardization-strategy-2013-2020.pdf

- the development of products and services in the field of standardization.

Beginning in October 2010, ILNAS has been helped by ANEC in implementing this strategy. The role of ANEC is to support the development of standardization activities at a national level and to promote the benefits of participating in standardization. Its mission is to create awareness, training and monitoring in the field of standardization and applied research in order to support the competitiveness of companies in Luxembourg. Thus, ILNAS, with the help of ANEC, can effectively contribute to the economic diversification policy pursued by the government in the expertise niches of tomorrow.

In this context, ILNAS commissioned ANEC to complete the task of a survey and analysis of European and international standards of the space sector.

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1. INTRODUCTION

Many of the systems and services that are today essential for our well-being and security depend directly or indirectly on space. Without being aware, people rely on space technologies when they use their mobile phones, make financial transactions, take an airplane, watch the weather forecast or look for the nearest restaurant using their cars' navigation system. Space has become part of our daily lives.[3]

Europe's space industry is a driver for growth and innovation and a highly strategic sector, helping us face both societal challenges and create innovative technologies and services. Existing space programs Galileo and EGNOS are expected to generate economic and social benefits worth around 60-90 billion euros over the next 20 years.

Initiated by ILNAS, the standards analysis described in this document constitutes indeed a sector-based "snapshot" for fostering and strengthening the national space sector in its involvement in standardization work. Based on the detailed information provided, the aim is to involve national stakeholders in a global approach to standardization in this sector in the Grand Duchy of Luxembourg in order to support the sector in terms of competitiveness, visibility and performance, while enhancing the international recognition of the Grand Duchy of Luxembourg at the standards level.

The survey and analysis of European and international standards related to space sector have been realized in several steps listed hereafter:

- execution of a standards watch of the targeted sector (inventory of standards – both published and under development – at the European and international levels; identification and description of technical standardization committees);
- targeting the national market of the related sector by identifying national stakeholders (public and private);
- definition of logical links between the national market, the different stakeholders and the results of the standards watch;
- preparation of a final report of analysis and opportunities.

The report structure follows the same execution sequence. After introductory chapters dedicated to standardization in general (**Chapter 2**) and the context of the space sector (**Chapter 3**), the method applied for the standards analysis is described in **Chapter 4**.

Chapters 5, 6 and 7 then present the main results of the standards analysis, the description of the national market and the interests in standardization for national stakeholders. In order to bring the national stakeholders of the space sector into an active approach to standardization, logical links were established between the national market and the standards watch results. Thus, these chapters offer an overview of the different subsectors identified for the space sector. In the second step, the potential interests to take part in the standardization process are then highlighted for all stakeholder categories characterizing the national market.

The same potential interests for different stakeholder categories constitute opportunities for the sector as a whole. **Chapter 8** presents them in order to engage not only an individual but also a general perspective about the benefits of standardization.
Considering the results of the standards watch as relevant information, the appendix is dedicated to a detailed presentation of each standardization technical committee identified at the European and international levels. Through this form, the information is directly available for someone seeking to estimate his or her interest for a specific technical committee.

[3] http://europa.eu/rapid/press-release_MEMO-13-146_en.htm

Finally, the conclusion points out the main purpose of this standards analysis, which is to provide useful information to the national stakeholders in order to involve them later in the standardization process.

Note: In accordance with the ILNAS policy on participation in standardization technical committees, the term "standardization technical committee" is in this report a generic term that covers also the "technical committees", "subcommittees", "working groups", etc.

2. STANDARDIZATION

2.1. DEFINITIONS

❖ ILNAS:

This acronym designates the "*Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et services*". ILNAS, an administration under the authority of the Minister of the Economy and Foreign Trade, was created by the law of May 20th, 2008, and began its activities on June 1st, 2008.

❖ OLN:

This acronym designates the "*Organisme luxembourgeois de normalisation*", an ILNAS department and which, according to the law of May 20th, 2008, fulfills the ILNAS missions as a national standardization organization. A national standards body recognized at national level is eligible to be a national member of the corresponding international and European standards organizations.

❖ ANEC:

This acronym designates the "*Agence pour la Normalisation et l'Économie de la Connaissance*". Created in October 2010, the role of ANEC is to implement the national standardization strategy established by ILNAS in order to support the development of standardization activities at a national level and to promote the benefits of participating in the standardization process.

❖ STANDARDIZATION:

Standardization is a voluntary, consensus-driven activity, carried out by and for the interested parties themselves, based on openness and transparency, within independent and recognized standards organizations, leading to the adoption of standards with which compliance is voluntary.[4] It is the activity of establishing with regard to actual or potential problems, provision for common and repeated use, aimed at the achievement of the optimum degree of order in a given context.[5]

❖ STANDARD:

A standard is a document established by consensus and approved by a recognized body and that provides applicable guidelines for activities. Standards are for common and repeated used rules, guidelines or characteristics for products or related processes and production methods for which compliance is not mandatory.[5] They have a national, regional or international concern. Standards are created by bringing together all interested parties, such as manufacturers, consumers and regulators of a particular material, product, process or service. All parties benefit from standardization. Several categories of standards exist: core standards, standards of analysis and testing, standards of specifications, methodological standards, etc.

[4] Official Journal of the European Communities 2000/C141/01
[5] Based on the definition proposed in the standard EN 45020:2006: Standardization and related activities – General vocabulary

❖ STANDARDS BODY:

A standards body can be defined as a standardizing body recognized at the national, regional or international level that has as its principal function the preparation, approval or adoption of standards that are made available to the public.[6]
In this report, a distinction has been made between formal standards bodies (e.g. CEN or ISO) and non-formal standards bodies (e.g. HL7 or DICOM).

❖ STANDARDIZATION TECHNICAL COMITTEE:

A technical decision-making body with a precise title, scope and work program, within a European and/or international standardization organism, essentially to manage the preparation of deliverables as standards in accordance with an agreed upon business plan.[7]

❖ CEN WORKSHOP AGREEMENT:

A CEN Workshop Agreement (CWA) is a standardization document, developed in a CEN Workshop. The latter is open to the direct participation of anyone with an interest in the development of the agreement. There is no geographical limit on participation and hence participants may be from outside of Europe. The development of a CWA is fast and flexible. It does not have the status of a European standard, and there is no obligation for the national standards bodies to adopt it as national standards.[8]

❖ NATIONAL MIRROR COMMITTEE:

A national mirror committee is a national structure to European or international standardization technical committees, ensuring, for example, the formulation of coherent national positions as a first round of consensus finding.[9]

2.2. STANDARDIZATION OBJECTIVES

Standardization is an efficient economical tool offering the possibility to pursue various objectives, such as:

- management of the diversity;
- convenience of use;
- compatibility;
- interchangeability;
- health;
- security;
- environmental protection;
- product protection;
- mutual understanding;
- economic performance;
- trade;
- etc.

[6] Based on the definition proposed in the standard EN 45020:2006: Standardization and related activities – General vocabulary
[7] Based on the information available on the CEN website/BOSS
[8] Based on the information available on the CEN website/CEN Workshop Agreements
[9] Based on the information available on the CEN website/Glossary

The standardization principles are:

- **voluntary**: standardization is open to all and is based on voluntary involvement of all the actors of the market;
- **consensus**: a standard is approved by consensus; all the positions of all the participants are taken into account (manufacturers, vendors and users, consumer groups, testing laboratories, governments, engineering professions, research organizations, etc.);
- **industry wide**: a standard is developed to offer global solutions to satisfy industries and customers all around the world.

2.3. STANDARDIZATION LANDSCAPE

In Europe, the 3 recognized European Standards Organizations (ESO) are:

- the European Committee for Standardization (**CEN**),
- the European Committee for Electrotechnical Standardization (**CENELEC**),
- the European Telecommunications Standards Institute (**ETSI**).

At the international level, the 2 recognized Standards Organizations are:

- the International Organization for Standardization (**ISO**),
- the International Electrotechnical Commission (**IEC**).

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

- CENELEC and IEC are specialized in electrotechnical standards;
- ETSI is focused on telecommunications standards;
- CEN and ISO are in charge of the other types of standards in the other sectors.

Table I presents the main characteristics of the European and international standards bodies.

Table I: Characteristics of European and international standards organizations[10]

European and International Standards Bodies		Date of creation	Number of Members	Number of published standards
ISO	International Organization for Standardization	1946	164	19 573
IEC	International Electrotechnical Commission	1906	82	6 971
CEN	European Committee for Standardization	1961	33	14 885
CENELEC	European Committee for Electrotechnical Standardization	1973	33	6 763
ETSI	European Telecommunications Standards Institute	1988	759[11] (62 countries)	32 570

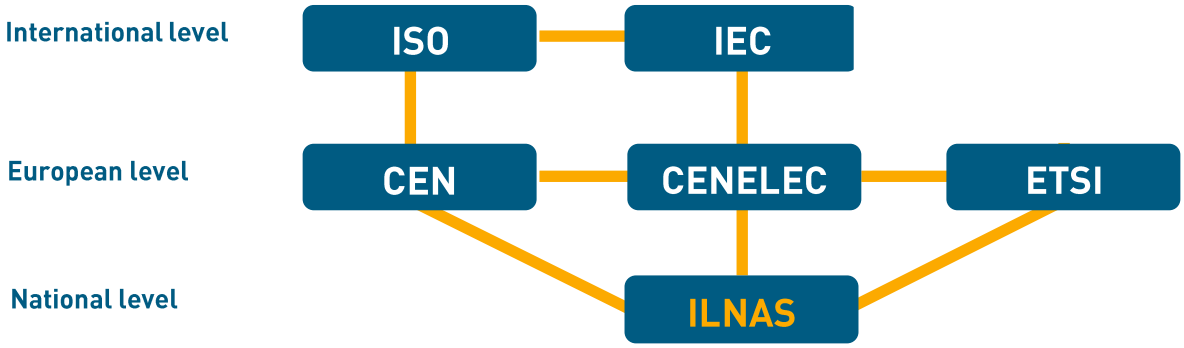
[10] Source: Websites of organizations – October 2013

[11] ETSI has a specific way of working compared to the other recognized organizations, as it works through the direct participation of industry stakeholders.

From a national perspective, one or several standardization bodies protect national interests from within the European and international standardization organizations. In Luxembourg, ILNAS – the only official national standards organization – is a member of the European and international standards organizations CEN, CENELEC, ISO, IEC and ETSI.

Several bridges exist between the national, European and international standardization bodies in order to facilitate the collaboration and coordination of the standardization work on the different fields (Figure 1).

Figure 1: Interactions between the standardization organizations



A strong collaboration exists between the European and international standards bodies. To increase transparency in the work and avoid the duplication of standards, the **Vienna Agreement** was concluded in 1991 between ISO and CEN. This agreement 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);
- notifications of the standardization documents for approval between the two organizations.

Similarly, the **Dresden Agreement** was concluded in 1996 between IEC and CENELEC with the aim of developing intensive consultations in the electrotechnical field. This agreement is based on 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);
- ballots for documents made in parallel at IEC and CENELEC.

Under both agreements, approximately 55% of all European standards ratified by CEN, and about 70% of those ratified by CENELEC, are now technically equivalent or identical to ISO or IEC standards; in that respect, the European and international organizations do not duplicate work.

Agreements also exist between the standards bodies to facilitate their cooperation. The two conventions established between ISO and IEC allow the creation of joint technical committees. Similarly, the cooperation between CEN and CENELEC aims to create a European standardization system that is open, flexible and dynamic.

2.4. STANDARDS DEVELOPMENT

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 studies the draft and prepares the standard draft;
- **public inquiry and approval**: the standard draft goes into public consultation and is subject to approval in a second step;
- **publication**: the ratified standard is published by the standards body.

At each stage, a validation of all participating members of the standardization technical committee is required. This is done automatically as a vote; however, the rules of the vote differ between the European and international levels as outlined in Table II below.

Table II: Voting rules at European and international levels

Organization	Members	Method of adopting standards	Integration into the collections of national standards
International ISO and IEC	National bodies from countries members of ISO (164) and IEC (82)	1 country = 1 voice	Voluntary
European CEN and CENELEC	National bodies from the EU and EFTA[12]countries (33)	Weighted Vote (Treaty of Nice)	Required: countries must eliminate conflicting provisions from their collections

The weighted vote is defined by the Treaty of Nice, which was signed in 2001 by the EU Member States and fixes the distribution of the voices for the European Union Council as show in Table III.

Table III: Distribution of the weighted votes throughout the European Member States[13]

Countries	Weighting of votes
France, Germany, Italy, Turkey, United Kingdom	**29**
Poland, Spain	**27**
Romania	**14**
Netherlands	**13**
Belgium, Czech Republic, Greece, Hungary, Portugal	**12**
Austria, Bulgaria, Sweden, Switzerland	**10**
Croatia, Denmark, Finland, Ireland, Lithuania, Norway, Slovakia	**7**
Cyprus, Estonia, Former Yugoslav Republic of Macedonia, Latvia, Luxembourg, Slovenia	**4**
Iceland, Malta	**3**

[12] EFTA: "European Free Trade Association" whose current members are Norway, Switzerland, Iceland and Liechtenstein
[13] Source: Internal regulation CEN/CENELEC – Part 2 – Annex D (2013)

Another particularity at the European level is that the European standards approved 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 the national level in an average of six months. The new European standard then takes the status of national standard.

3. CONTEXT AND DEFINITION OF THE SPACE SECTOR

3.1. GENERAL CONTEXT OF THE SPACE SECTOR

At an international level, if the space sector is recognized as a key strategic sector since a long time, these last years the number of public and private stakeholders involved in space activities has strongly increased. Space technologies have taken a large place in our everyday life and became essential. Weather forecasting, global communications or air traffic management are good examples of usual activities directly based on satellite technology. This sector is considered as an international motor of economic growth. The Organization for Economic Co-operation and Development (OECD) estimates that revenues derived from the wide diversity of space-related products and services amounted to 165 billion dollars in 2009[14].

Various types of space applications exist on the market and can be encompassed into 3 main fields. The **telecommunications market**, that is currently the most important and the most dynamic market for space applications. It includes fixed telecommunications services (voice, data or multimedia); broadcasting (TV and radio services or internet content); mobile services (data, voice or internet). The second market is dedicated to **earth observation** that helps to measure and monitor the climate and environment, and to map resources. This field is extending to a growing number of domains, including agriculture, resource management, exploration, mapping and planning, hazard monitoring and disaster assessment as well as security and defense. Finally, there is the **positioning and navigation** market where satellites are used for localization and navigation purposes.

At a European level, the space sector is also identified as a strategic sector. By employing more than 31 000 highly-qualified persons, it generated an annual turnover of 5.4 billion euros in 2010. The European space market is in constant development as with the space services. Following the same trend, OECD forecasts a deep increase of the market of the commercial data of Earth observation for 2017 (around 3 billion dollars).[15]

Conscious of this key role, the European Union (EU), through the Lisbon Treaty entered into force on December 1st, 2009, gave a legal grounding to develop policies on the space exploration and exploitation. Indeed, the Article 189 of this treaty gives to the EU a mandate to take action in this field, including through the implementation of a European space program. The European Commission (EC) is in charge of developing, in close collaboration with the European Space Agency (ESA) and Member States, a space industrial policy. In addition, the space sector is identified as a priority area for the Europe 2020 strategy and as one of 10 key actions in the "Integrated industrial policy for the globalisation era" published by the EC.

The European Commission's Space Research and Development activities are coordinated within the framework of the overall European Space Policy. In April 2011, the European Commission released a communication entitled "Towards a space strategy for the European Union that benefits its citizens". The priorities set out for the implementation of the future European Space Policy have been jointly developed by the European Commission and the European Space Agency and reflect the resolutions of the Space Council.

[14] OECD, The space economy at a glance – 2011: http://www.oecd.org/sti/futures/space/48301203.pdf
[15] European GNSS Agency: http://www.gsa.europa.eu/news/eu-exhibition-show-how-space-impacts-all-our-lives

In detail, these priorities had as objectives to:

- Pursue the European satellite navigation programs Galileo and EGNOS,
- Implement the European Earth Monitoring Program designed to monitor the land, ocean, atmosphere, air quality and climate change, as well as to aid in emergency response and security,
- Setting up a European Space Situation Awareness to protect space infrastructures against space debris, solar radiation and asteroids,
- Identify and support actions at EU level in the field of space exploration,
- Maintain the space industrial policy developed in close collaboration with the European Space Agency and Member States,
- Support R&D to increase European technological non dependence and ensure that innovation in this field will be of benefit to non-space sectors and citizens,
- Strengthen the partnerships with EU Member States and the European Space Agency (ESA).

In order to support research and development, a specific FP7 call dedicated to the space sector was published on July 10th, 2010: the sixth call for proposals under the Space theme of FP7 with a budget of 126 million euros. In this call, the focus is on research topics in climate change, critical technologies, Earth analogue R&D preparing for space exploration missions, space weather, and space debris and collision threats.

The implementation of the European Space Policy requires the effective coordination of the space activities of the European Union, the European Space Agency and EU member states, together with other national and transnational agencies.

The European Space Agency (ESA) was created in 1975 and is located in Paris. It is an international organization dedicated to the space sector with 20 Member States (Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland and the United Kingdom). Hungary, Estonia and Slovenia are "European Cooperating States" when Canada takes part in some projects under a Cooperation agreement as associated member.
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 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.

The European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) is an intergovernmental organization created in 1986 through an international convention. Currently, 27 Member States are part of this organization (Austria, Belgium, Croatia, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, the Netherlands, Norway, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Turkey, and the United Kingdom) and 4 other countries signed cooperation agreements (Bulgaria, Iceland, Lithuania and Serbia).[16]
EUMETSAT's primary goal is to establish, maintain and exploit European systems of operational meteorological satellites. EUMETSAT is in charge of the delivering of weather and climate-related satellite data, images and products– 24 hours a day, 365 days a year. This information is supplied to the National Meteorological Services of the Member and Cooperating States, as well as other users world-wide. EUMETSAT is also responsible for the launch and operation of the satellites and for

[16] http://www.eumetsat.int/website/home/AboutUs/WhoWeAre/MemberStates/index.html

delivering satellite data to end-users as well as contributing to the operational monitoring of climate and the detection of global climate changes.
At a national level, even if the Grand Duchy of Luxembourg does not have any national space agency, the space sector is seen as a driven sector for the national economy and a motor for the development of innovation. The government of Luxembourg developed a national action plan concerning space technologies and sciences to develop innovative applications, products and services with high added value especially in the domains of Telecommunications as satellite infrastructures, Earth Observation, Navigation & Technology.

The national plan to develop the space sector involves 4 major strategic steps[17]:

- **Diversify**, offer new market opportunities and ensure sustainable economic activities: The short lifecycles of products and services in the context of dynamic and competitive international markets require public policies that foster innovation and diversification;
- **Promote** local experience and know-how in telecommunications and media: Electronic communication services are a key sector for the country. To remain competitive, new applications and innovative services can be promoted such as "hosting services", safety, natural risk management, etc.;
- **Reinforce** companies' and organizations' competitive position: In an extremely competitive international environment, research will be encouraged to identify and occupy niches which have not been taken by major European space players;
- **Develop** Luxembourg's space sector skills and join international networks: Projects at a national level are carried out to better position Luxembourg in the space sector. They include international collaborations, training programs and the development of research activities at the University of Luxembourg and at the public research centers.

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.

Luxembourg pursued its involvement in the space sector when it became an official Member State of the European Space Agency in 2005. This membership is seen as the occasion to develop opportunities for the national actors and confirms also the commitment of the government to promote Luxembourg as a hub for innovative projects in advanced technologies. Luxembourg participates actively to some ESA programs. Since 2000, Luxembourg is engaged in the TIA Advanced Research in Telecommunications Systems (ARTES) program. It enables European and Canadian industry to explore, through R&D activities, innovative concepts to produce leading-edge satcom products and services. The Earth observations or satellite navigation are also other interesting topics where Luxembourg dedicated some of its budget engaged in ESA.

Following the same objective, the Ministry for Higher Education and Research has developed a national space policy presented in 2008 during the ESA Council.
The "*Plan d'action national en matière de sciences et technologies spatiales*" has as main strategic objectives to:

- contribute to the diversification and sustainability of economic activities in Luxembourg,
- consolidate and enhance existing skills in the field of telecommunications and media as well as ground systems,
- extend skills in the space sector,
- give an international dimension to the activities through an access to international networks.

[17] Luxembourg: A gateway to space, http://www.mesr.public.lu/recherche/esa/gateway_to_space/Ministere_brochure_ville.pdf

The Luxembourg government set up in 2008 a special measure called LuxLAUNCH to support industry and research organizations in identifying new opportunities and better integrating the international network of European actors in the space sector. LuxLAUNCH is realizing preparatory studies to help industry and research organizations to position themselves in the space market. It is focusing on specific topics as the fields of satellite telecommunications, satellite navigation and Earth observation.
In order to stick as close as possible to the needs of the national stakeholders, LuxLAUNCH organizes every year a Call for Ideas. The next one will be open in March 2014. Based on the introduced ideas, a pre-selection is done by a panel of evaluators. Then, the selected companies are invited to provide a complete proposal. After a final assessment of this proposal, a supplier is selected and a contract is negotiated to realize the studies. Once per year, a workshop is finally organized to present the study results.

Finally, Luxembourg reinforces its position in favor of the development of the space sector by sending a strong political message through the fact of being the head the Council of Ministers of ESA. Indeed, Luxembourg, in partnership with Switzerland, chairs the ESA Council for the period 2012-2015.[18]

[18] The Federal Authorities of the Swiss Confederation: http://www.admin.ch/aktuell/00089/?lang=en&msg-id=42554

3.2. STANDARDS CONTEXT OF THE SPACE SECTOR

The space sector is a sector where the international cooperation and collaboration is of primary importance. The International Space Station 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.

Under 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 schedule and 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 a smooth interface of systems.

Conscious of this specific context and issues, international and European initiatives have been developed in order to support the development of standards dedicated to the space sector.

The Consultative Committee for Space Data Systems (CCSDS), created in 1982, is an initiative of the major space agencies of the world to provide a multi-national forum for discussion of common problems in the development communications and data systems standards for the space sector. Composed of 11 member agencies, 28 observer agencies, and over 150 industrial associates[19], its main objective is to provide recommendations for data- and information- systems standards in order to promote interoperability and cross support among cooperating space agencies, while also reducing risk, development time and project costs.
In 1990, CCSDS started to collaborate with the International Standards Organization (ISO). Under this cooperation agreement, a specific ISO subcommittee was created, ISO/TC 20/SC 13 "Space Data and Information Transfer Systems".

The Object Management Group (OMG) is an international, open membership, not-for-profit computer industry consortium with a specific task force dedicated to the space sector: the OMG Space Domain Task Force. This task force encompasses space professionals willing to increase the 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,
- Encourage the development and use of CORBA based space, satellite and ground system domain software components, thereby growing the object technology market,
- Encourage the use of UML to describe the architectures of the systems,
- Encourage continued space industry member participation leverage existing OMG specifications.

Created in 1984, the Committee on Earth Observation Satellites (CEOS) is an international coordinating mechanism, coordinating international civil space borne missions designed to observe and study planet Earth. Comprising 30 members (most of which are space agencies) and 23

[19] CCSDS participation figures: http://public.ccsds.org/participation/default.aspx , 2013

associates[20] (associated national and international organizations), CEOS 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. This committee was created 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. This group recognized the multidisciplinary nature of satellite Earth observation and the value of coordination across all proposed missions.

Digital Geospatial Information Working Group (DGIWG) is a multi-national body responsible for geospatial standardization for the defense organizations of member nations. It supports, among others, the requirements identified to address a specific set of operational scenarios, as for example the 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).

At a European level, in 1977, the European Space Agency (ESA) realized the importance of software standards for the proper conduct of complex or critical space software projects and established the Board for Software Standardisation and Control (BSSC). This board released in 1984 a set of software engineering standards (PSS-05 series).

In June 1994, the ESA Council adopted a resolution that transferred the existing system of ESA space standards to a new set of standards prepared by the European Cooperation for Space Standardization (ECSS).[21] The creation of this European space community was based on the fact that there was no uniform system of space standards and requirements in Europe. This initiative was established to develop a coherent, single set of user-friendly standards for use in all European space activities. The partners jointly undertook the development of the system, designed to meet the main objective of providing a single coherent set of standards for use in all European space activities and particularly projects.

Aware of the importance of developing space standards, the European Space Agency (ESA) actively supports the ECSS activities. During the development process of ECSS standards, the ESA Requirement and Standard division acts as the ECSS central secretariat and in this function provides technical support during the drafting process of new standards and during the subsequent review process and also administrative support. ESA also supports ECSS by preparing training material in order to train potential users in applying ECSS standards in space projects, or tailor these standards for their specific needs. Finally, 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.

In 1994, National Space Agencies and space industry stakeholders joined ESA on the Space Component Ad-Hoc Committee (SCAHC). The goal was to establish a series of recommendations to develop a close partnership between national agencies and industry in the space sector. The objectives of these recommendations are to achieve a European policy, to improve competitiveness, to establish concepts for cooperation and information exchange, to ensure the availability of advanced and strategic components and to identify appropriate resources needed for the implementation of the recommendations. A final report was presented in 1996 containing the 10 recommendations that were endorsed by ESA's Industrial Policy Committee and by all the national bodies of the SCAHC membership.

[20] CEOS organization figures:
http://www.ceos.org/index.php?option=com_content&view=category&layout=blog&id=30&Itemid=76, 2013
[21] http://www.esa.int/esapub/bulletin/bullet111/chapter21_bul111.pdf, 2012

Based on the Recommendation R6 of the Space Components Ad Hoc Committee (SCAHC), the European Space Components Information Exchange System (ESCIES) was established to propose an information exchange system on component data with access available to all European users. ESCIES 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.

In addition, in October 2002, the European Space Components Coordination (ESCC) was created between ESA and representatives of National Space Agencies, industry (through Eurospace) and European component manufacturers. 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).

Finally, it is important to mention the European Mandates related to the space sector that were issued these last years by the European Commission (EC). These mandates are the mechanism by which the EC and the EFTA Secretariat request the European Standards Organizations to develop and adopt European standards in support of European policies and legislation.

Regarding the space sector, the European Commission issued in June 2007 the mandate M/415 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. The CEN created a working group, CEN/BT/WG 202 "Space", to work on this mandate. A report was prepared covering the 2 first stages of the work: a feasibility study and the development of a comprehensive standardization work program[22].

To pursue this initiative, in 2011, the European Commission issued another mandate, the mandate M/496 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/TC 5 "Space". Its mission is to actually respond to mandate 496.

In Luxembourg, based on the national standardization strategy[23], ILNAS launched several actions in order to promote standardization and to extend the participation to technical committees either at the European or international level. However, up to now, only one national delegate, currently registered among the Luxembourg's national standards body, ILNAS, can be considered as working in the space sector. This delegate is Mr. Thomas WREDE, from SES, and he is actively participating in 2 technical committees related to the space sector:

CLC/TC 206 Consumer equipment for entertainment and information and related sub-systems,
CLC/TC 209 Cable networks for television signals, sound signals and interactive services.

3.3. DEFINITION OF THE SPACE SECTOR

A common definition for the space sector is that this sector "includes all actors involved in the systematic application of engineering and scientific disciplines to the exploration and utilization of outer space, an area which extends beyond the earth's atmosphere". If this definition is useful to

[22] http://wiki.services.eoportal.org/tiki-download_wiki_attachment.php?attId=88
[23] http://www.ilnas.public.lu/fr/publications/normalisation/etudes-nationales/luxembourg-standardization-strategy-2013-2020.pdf

distinguish aeronautics and space activities, however because of the recent developments and innovations of the sector, it started to be limited and too restrictive[24].

NASA uses a broader definition and talks about space economy instead of space sector. For them, it encompasses a 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[25].

The Organisation for Economic Co-operation and Development (OECD)[26] defines the space sector as a sector including public and private actors involved in the provision of space-enabled products and services. They are part of a long value-adding chain that starts upstream with the manufacturers of space hardware and ranges downstream to the providers of space-enabled products (as GPS-based car navigation systems) and services (e.g. weather forecast satellite services) to final users.

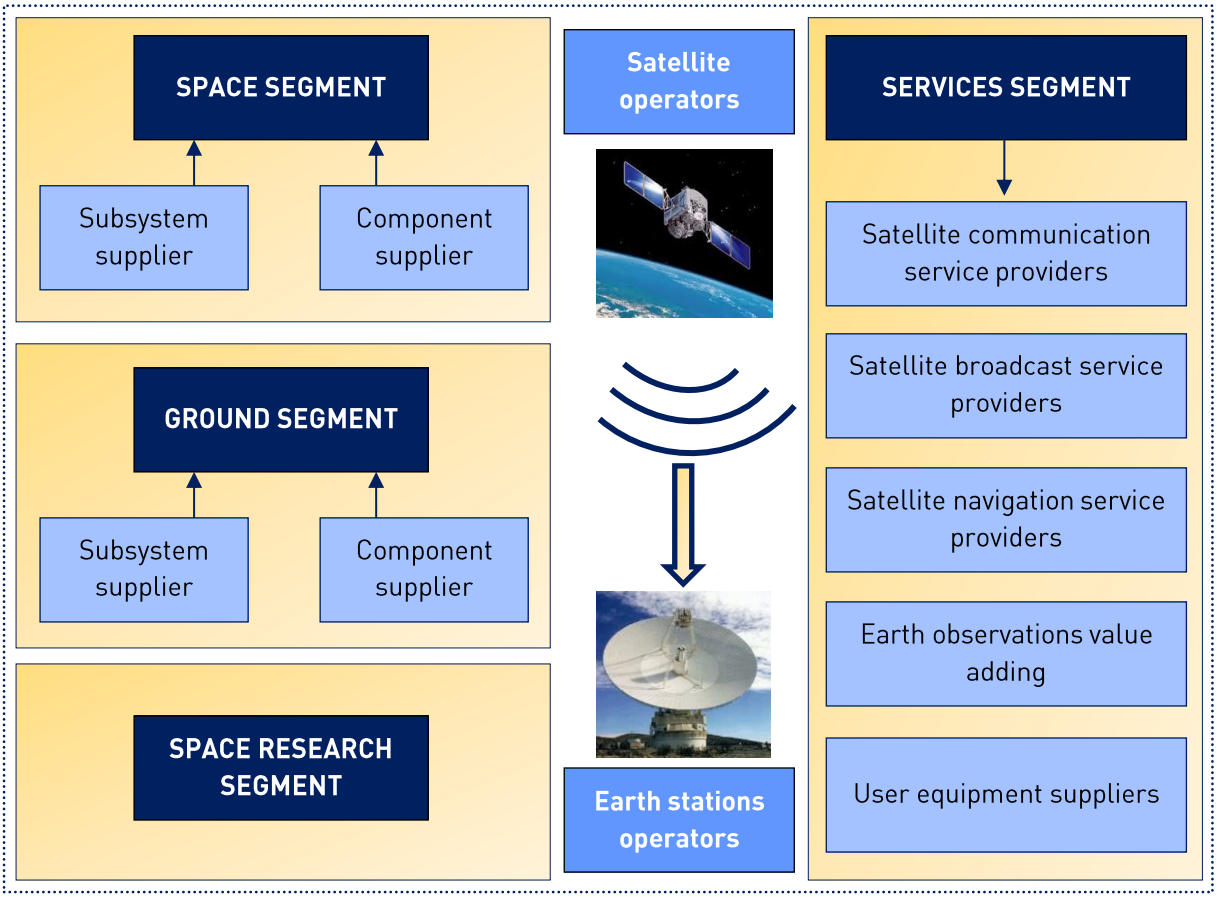
Based on the categorization used by the Luxembourg Space Cluster, the space sector can be divided into 4 different segments:

- **Space segment** with R&D, engineering services, manufacturing, testing, integration and launch of platforms (satellites, spacecraft and robotic systems), complete systems, subsystems, and components & materials,
- **Ground segment** encompassing R&D, manufacturing, testing, and integration of facilities on Earth for controlling space-based systems and satellites, for linking satellites to operational terrestrial networks and for processing satellite-derived data,
- **Services segment** with all the development and/or provision of services and value-added products and technologies that are derived from the use of space systems and/or data, and the provision of consulting and engineering services,
- **Space Research** segment containing the research related to non-commercial space activities.

Figure 2 illustrates these different segments describing the space sector.

[24] OECD Handbook on Measuring the Space Economy, OECD, March 2012
[25] Extracted from an article published by NASA, Space economies and economics, J. Foust, September 24th, 2007 http://www.thespacereview.com/article/962/1
[26] OECD, The Commercialisation of Space and the Development of Space Infrastructure, link: http://www.oecd.org/futures/space/thecommercialisationofspaceandthedevelopmentofspaceinfrastructure.htm (last visit: October 2013).

Figure 2: Space sector segments

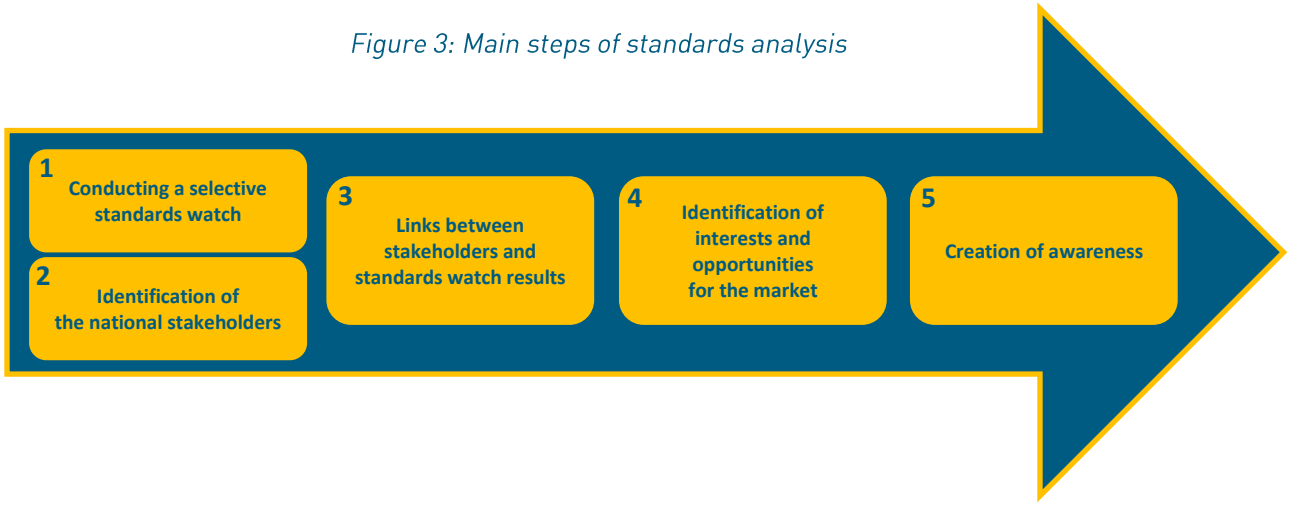


Based on the UK Space Agency: The Size and Health of the UK Space Industry - A Report for the UK Space Agency Executive Summary, October 2012, link: http://www.bis.gov.uk/assets/ukspaceagency/docs/industry/size-and-health-report-oct-2012.pdf and on the Luxembourg Space Cluster website.

4. METHODOLOGY OF THE STANDARDS ANALYSIS

In order to meet the national standardization strategy issues described in the previous chapter, a standards analysis was carried out and is presented in this report. Different steps were followed and are illustrated by Figure 3 below.

Figure 3: Main steps of standards analysis



4.1. SELECTIVE STANDARDS WATCH

A standards watch was carried out in order to identify the standardization technical committees of potential interests for the national stakeholders in the space sector. These technical committees are either from formal standards bodies (for example, CEN, CENELEC, ISO or IEC) or managed from non-formal standards bodies (e.g. ITU, CCSDS or NAS).
The different stages processed to carry out the watch analysis can be described as below.

- **Stage 1: Identification of the standardization technical committees in relation with the space sector**

The objective of this stage is to identify the standardization technical committees in relation to the space sector. The method used consists of identifying the sources of information available, applying the relevant research criteria and recording interesting and useful data. As mentioned before, the search focused not only on formal standards bodies but was opened to non-formal standards bodies. In addition, to facilitate the view and the understanding of the watch results, the space sector was divided into subsectors and the standardization technical committees identified were classified according these subsectors.

- **Stage 2: Selection of the most active standardization technical committees in terms of being current, dynamic and strategic**

This stage gives a selective character to the standards watch in the space sector. The purpose is to keep only the standardization technical committees that could be of potential interest for future national delegates willing to contribute to the standardization and also to be in line with the news and developments of the sector.

- **Stage 3: Presentation of the results**

In the Appendix, tables are available in order to present each selected technical committee through a simple and quick view. These tables give more information on each selected committee.

4.2. STAKEHOLDERS OF THE NATIONAL SPACE SECTOR

In parallel to the standards watch, the identification of national private and public stakeholders representing the entire space sector in Luxembourg was conducted. This national panorama of the space sector proposes a view of the situation based on the experience and expertise of the ILNAS. It reflects the situation at a certain moment from a certain point of view and is not intended to be exhaustive but tries to be as complete as possible. If necessary, it would be adjusted following the comments received after the release of this report.

The overall national stakeholders of the space sector have been reviewed. Based on the available information (documentation, internet websites, conferences, etc.), the analysis was carried out by seeking to identify the maximum number of relationships, connections and interactions between the different national stakeholders. The main sources used were the Luxembourg Space Cluster website and the GLAE website.

Then, according to their activities and objectives, they were allocated to different categories in order to draw a full and complete picture of this sector in Luxembourg. This proposed categorization was designed to facilitate the standards analysis. By grouping the different stakeholders into categories, it should facilitate the analysis, as stakeholders of a same category should have similar potential interests in participating to standardization activities. Then, connections between the space subsectors and the categories of stakeholders should be simplified.

4.3. INTERESTS AND OPPORTUNITIES FOR THE NATIONAL MARKET

After compiling the selected technical committees in relation to the space sector into subsectors and categorized the different stakeholders, an analysis of the potential interests for the national stakeholders to participate to the standardization work was carried on.

This step consists in identifying, for each stakeholder category, the potential interests to follow and participate in the standardization technical committees. In practice, it links a category of stakeholders with space subsectors as they were defined in the initial stage of the selective standards watch according to their potential interests.

❖ Stage 1: Definition of the potential interests for stakeholders

As detailed in Table IV, the potential interests defined were the following:

Table IV: Potential interests for the stakeholders

◆**Information**	Thanks to the participation to a standardization technical committee, the stakeholders are informed about the last standardization developments relating to their activities, thus allowing them to identify potential future impacts and to anticipate the consequences.
■ **Performance**	Through participation in standardization activities within a technical committee, stakeholders contribute to the increase of their performance in particular: Development of new competencies due to contact with other professionals and experts of the sector (networking); Information on the directions taken by other states or other entities (benchmarking); Translation of the innovations into future rules (knowledge codification); Anticipation of the obligation to comply with European regulatory requirements.

❖ **Services**	The follow-up of standards developments offers in some cases the opportunity for stakeholders to develop new services in line with their activities.
☐ **Projects**	Research projects directly linked to standardization or involving standards in order to codify the acquired knowledge are regularly launched. Stakeholders can access useful information in the framework of a future call for tenders and benefit from specific support to get involved into projects.
O Training	Thanks to the knowledge of standards and process, stakeholders have solid and reliable elements to update, improve or develop training in the space sector.
$ Investments	Stakeholders could have an interest in investing in a new technology or concept.

❖ Stage 2: Matrix of the potential interests and the space subsectors

Then, a matrix was realized to cross the space subsectors, classifying the selected standardization committees, with the potential interests of the national stakeholders. The main objective of this approach is to establish a relationship between a specific stakeholder category and some space subsectors. This link is made by suggesting potential interests specific to each stakeholder category according to particular subsectors.

This information could be interesting for them in order, for example, to increase their competitiveness or to facilitate their European and international exchanges.

❖ Stage 3: Definition of the opportunities for the national market

Finally, from this relationship between the stakeholder categories and the technical committee subsectors, opportunities for the national market have been identified. These opportunities are based on the potential interests common to all stakeholder categories. However, when interesting, some opportunities could also be dedicated to only a specific category of stakeholders.

These opportunities should be seen by the national market as a series of proposals in order to go further and to engage future actions to take advantage of the standardization.

5. RESULTS OF THE STANDARDS WATCH

The standards watch of the space sector has primary identified 65 standardization technical committees (European and international). However, by applying selection criteria, **35 technical committees** were identified as potentially interesting.

In the framework of the standards watch and in particular in order to establish links between the national market of the space sector and the watch work results, the technical committees were classified into **4 subsectors**, as shown in Table V.

Table V: Definition of the space subsectors

Subsector 1 - Aerospace equipment and infrastructure	This sector corresponds to equipment, material, structures directly related to the space and ground activities. It encompasses the activities related to R&D, engineering services, manufacturing, testing, integration and launch of platforms (satellites, spacecraft and robotic systems), integration of facilities on Earth for controlling space-based systems and satellites, for linking satellites to operational terrestrial networks and for processing satellite-derived data, complete systems, subsystems and components & materials.
Subsector 2 - Earth observation technologies	This sector corresponds to the Earth observation technologies that are developed and used to collect information about planet Earth's physical, chemical and biological systems. It is used to monitor and assess the status and changes of the environment. In recent years, Earth observation domain has become more sophisticated and was used to develop various applications.
Subsector 3 - Telecommunications & Broadcasting	This sector encompasses the telecommunications and communications products, services and infrastructure based on the satellite broadcasting technology. It contains for example the telephone, TV, radio networks, Internet or also the data networks.
Subsector 4 – Space related technologies	This subsector encompasses the activities linked to the space related technologies. This covers for example the services and value-added products and technologies that are derived from the use of space systems and/or data, and the provision of consulting and engineering services.

Following these subsectors categorizing the space sector, the selected technical committees were classified. Table VI lists the 35 selected standardization technical committees related to the space sector according to the 4 subsectors. In addition, in order to have access to more detail information, tables are available in the Appendix, in which detailed information on each selected standardization technical committee is available.

Table VI: Technical committees selected according to space subsectors

SUBSECTOR	ORIGINE*	TECHNICAL COMMITTEE (TC)
AEROSPACE EQUIPMENT & INFRASTRUCTURE	EU	CEN/ASD-STAN - Aerospace
	EU	CEN/SS T02 - Aerospace
	EU	CLC/TC 107X - Process management for avionics
	EU	IEC/TC 107 - Process management for avionics
	EU	CEN/CLC/TC 5 - Space
	EU	ECSS - European Cooperation for Space Standardization Standards
	INT	ISO/TC 20 - Aircraft and space vehicles
	INT	ISO/TC 20/SC 1 - Aerospace electrical requirements
	INT	ISO/TC 20/SC 13 - Space data and information transfer systems
	INT	ISO/TC 20/SC 14 - Space systems and operations
	INT	NAS - National Aerospace Standards
	INT	CCSDS - Consultative Committee for Space Data Systems Standards
EARTH OBSERVATION TECHNOLOGIES	EU	ETSI/TC SES - Satellite Earth Stations & Systems
	INT	ISO/TC 211 - Geographic information/Geomatics
	INT	ISO/TC 23/SC 19 - Agriculture electronics
TELECOMMU-NICATIONS & BROADCASTING	EU	CLC/SR 80 - Maritime navigation and radiocommunication equipment and systems
	EU	CLC/TC 206 - Consumer equipment for entertainment and information and related sub-systems
	EU	CLC/TC 209 - Cable networks for television signals, sound signals and interactive services
	EU	EBU/ETSI/CENELEC JTC BROADCAST - Joint Technical Committee on Broadcast
	INT	IEC/CISPR - International special committee on radio interference
	INT	IEC/TC 100 - Audio, video and multimedia systems and equipment
	INT	IEC/TC 103 - Transmitting equipment for radiocommunication
	INT	IEC/TC 108 - Safety of electronic equipment within the field of audio/video, information technology and communication technology
	INT	ITU/ICG-SAT - ICG on Satellite Matters
	INT	ITU-R/SG 6 - Broadcasting service
	INT	ITU/ITU-R/WP 4B - Working Party 4B (WP 4B) - Systems, air interfaces, performance and availability objectives for FSS, BSS and MSS, including IP-based applications and satellite news gathering
	INT	ITU/ITU-T/SG - 13 Future networks including cloud computing, mobile and next-generation networks
	INT	ITU/ITU-T/SG 16 - Multimedia
SPACE RELATED TECHNOLOGIES	EU	ESCIES - European Space Components Information Exchange System

SUBSECTOR	ORIGINE*	TECHNICAL COMMITTEE (TC)
	INT	ISO/JTC 1/SC 2 - Coded character sets
	INT	ISO/JTC 1/SC 23 - Digitally Recorded Media for Information Interchange and Storage
	INT	ISO/JTC 1/SC 24 - Computer graphics, image processing and environmental data representation
	INT	ISO/JTC 1/SC 27 - IT Security techniques
	INT	ISO/JTC 1/SC 29 - Coding of audio, picture, multimedia and hypermedia information
	INT	ISO/TC 184 - Automation systems & integration

** **EU**: European origin and **INT**: International origin*
***In Red**: National delegate registered for this technical committee among the Luxembourg's national standards body (ILNAS).*

In summary, the 35 selected technical committees, potentially interesting for the space sector, are distributed as noted in Table VII below.

Table VII: Distribution of the selected technical committees in the space sector

Subsector	European TC	International TC	Total
Subsector 1 - Aerospace equipment and infrastructure	6	6	**12**
Subsector 2 - Earth observation technologies	1	2	**3**
Subsector 3 - Telecommunications & Broadcasting	4	9	**13**
Subsector 4 - Space related technologies	1	6	**7**
Total	**12**	**23**	**35**

More information on each technical committee identified is available in the Appendix.

6. DESCRIPTION OF THE NATIONAL MARKET

If the first step was to select potentially interesting technical committees in the space sector and to categorize them into subsectors, the next step proposes a description of the national market. Mainly based on the overview proposed on the website of Luxembourg Space Capabilities, a national panorama of the stakeholders of the space sector was established[27]. Other sources were also used in order to complete this source of information.

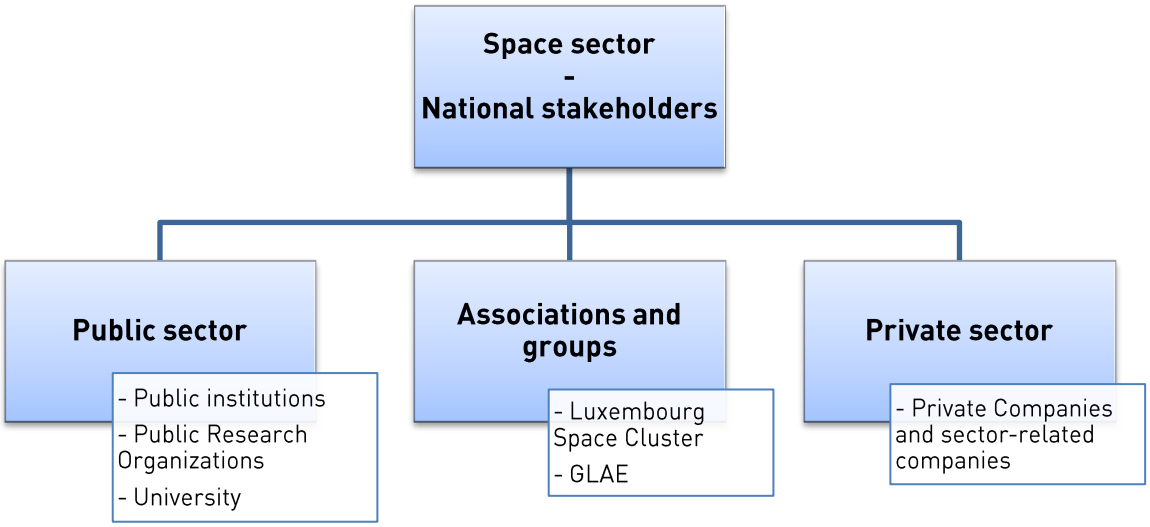
This panorama reflects the situation at a certain moment from a certain point of view and is not intended to be exhaustive.

Stakeholders involved in the space sector are either working in public institutions or in privates companies. The following components can be distinguished:

- R&D centers, laboratories, universities, either public or private establishments often playing a role in basic research and science,
- Manufacturers specialized in satellites, launchers or in the ground segment,
- Operators including satellite signal providers or digital contents providers,
- Services providers working with the ground equipment and devices developers for example.

Figure 4 presents a summary of the different groups of stakeholders identified during the review who are acting in this specific sector in Luxembourg.

Figure 4: Illustration of the categories of space sector's national stakeholders



The different categories of stakeholders are described in detail in the following paragraphs of the report.

[27] Luxembourg Space Capabilities - Update 2013:
http://www.spacecluster.lu/content/download/11657/106078/version/1/file/space-capabilities-2013.pdf

6.1. PUBLIC INSTITUTIONS

Official bodies and public institutions play a key role in the space economy as developers, investors, owners, operators, regulators and customers for much of the space infrastructure.

In Luxembourg, the general policy on research, development and innovation is generally defined and implemented by 3 Ministries: the Ministry of Higher Education and Research, the Ministry for Economy and Foreign Trade and the Ministry of the Small and Medium sized Businesses and Tourism.

Regarding the space sector, the Ministry for Higher Education and Research is in charge of relations with the European Space Agency. This Ministry is managing the financial, political and programming aspects related to ESA activities and, on the basis of industry and public research capabilities and objectives, opens program lines and supports the set-up of specific projects.

The "Research and Innovation" department of the Ministry for Higher Education and Research ensure the definition, the coordination as well as the implementation of policies related to the national action plan in space and aeronautical sciences and technologies.

Luxinnovation GIE, the national agency for innovation and research, is the Luxembourg National Contact Point for ESA. The agency provides information to companies and research organizations on how ESA operates and on the different research programs that exist. It also offers advice and support to national stakeholders willing to work with ESA.

6.2. PUBLIC RESEARCH ORGANIZATIONS

This category of stakeholders encompasses 3 organizations involved in the research and development segment of the space sector:

- The CRP Gabriel Lippmann,
- The CRP Henri Tudor,
- The University of Luxembourg.

As a public establishment devoted to applied scientific research and technological development, the *Centre de Recherche Public Gabriel Lippmann* carries on activities of research center related to the space sector. Two departments are directly concerned:

Environment and Agro-Biotechnologies department - EVA

In the space sector, EVA is mainly active in the use of Earth Observation (EO) data for environmental and risk management applications. The research unit "Geohydrosystems and land use management" runs research in hydrological processes studies, hydrological and hydraulic modelling, natural hazard assessment and the application of remote sensing technologies in environmental studies. The Geomatics platform integrates science and technology from several disciplines for acquisition, modelling, analysis, and management of spatially referenced data. Major research activities include imaging spectrometry, development of retrieval algorithms for bio-geophysical and bio-geochemical parameters in different environmental application areas and the assimilation of spatial information retrieved from remote sensing data into hydrological, ecological and atmosphere models.

Science and materials analysis department - SAM

The SAM department is a reference laboratory in the fields of:

- Characterization of materials, surfaces and interfaces down to nanometer scale;
- Innovative surface treatments, to treat and functionalize surfaces and deposit thin layers with optimized chemical, thermal, mechanical and physical properties;
- Nanomaterial: production of innovative nanostructured materials with a very fine control of the composition, structure and architecture down to the atomic scale;
- Development of scientific instruments using ultra-vacuum techniques, electrostatic optics and plasma physics, allowing developing unique analytical instruments and custom-designed surface treatment techniques that can be transferred directly to industry.

SAM gives its partners access to ultra-specialized technical platforms, and brings them the expertise of a multiple-discipline team of specialists in materials science. It provides a wide range of services to assist its customers, in all their materials and surfaces R&D projects and technological development work, as well as helping them with their day-to-day problems concerning materials.

The *CRP Henri Tudor* is a public research establishment supporting innovation in Luxembourg. The activities of research center related to the space sector are found in two specific departments:

The Advanced materials technologies department - AMS

AMS is in charge of developing research, development and innovation activities in the field of materials science, and it does so by focusing on two areas:

- The conception and design of advanced materials based on polymer composites,
- The applied modeling and simulation of materials, structures and industrial processes.

The aim is to develop new applications or modifications for identified materials/systems by increasing the scientific understanding of the relationships between architectures/structures and properties, and their impact on performance, by constructively combining the experimentation and numerical modeling phases.

The Service Science & Innovation department - SSI

SSI focuses its activities towards information and communication technologies and business organization and management. Its main goal is to increase the impact of ICT on the economic and societal development of Luxembourg and its Grande Region.

The SSI is an interdisciplinary center dedicated based on numerous skills for optimal R&D realizations on Software architectures, Securised communication networks, Engineering, Quality & Management of ICT-based services, Research, analysis and management of information, Free and Open Source Software.

Specific departments and units of the University of Luxembourg work on space related research projects.

The Geophysics Laboratory focuses on climate, sea level variability and geodynamics. The primary goals include obtaining reliable geodetic measurements of environmental change and assessing the influence of human and natural factors in those changes. To do so, the group has developed a patented differential free-fall gradiometer part of our activities in scientific metrology, advanced high-accuracy Global Navigation Satellite Systems (GNSS) techniques, provided interpretation of time variable gravity from space and improved the modeling of environmental effects on geodetic observations.

The Research Unit in Engineering Science is an interdisciplinary group active in the classical domains of civil, electrical and mechanical engineering. Among its various research activities a particular emphasis is given to numerical simulation in order to reduce the required experimental effort, but the validation of the models will remain an essential asset.

The Interdisciplinary Centre for Security, Reliability and Trust (SnT) aims to become a European centre of excellence and innovation for secure, reliable, and trustworthy ICT (Information and Communication Technologies) systems and services. Research activities are carried out through interdisciplinary research platforms targeting key areas of strategic importance for the region. The SnT research activities in Satellite Systems includes: Applications and Services, Satellite Hybrid Networks, Transmission and Reception Technologies, Legal and Regulatory Challenges.

These 3 previous organizations are active in the **Research segment**

6.3. GLAE

The *"Groupement luxembourgeois de l'aéronautique et de l'espace"* (GLAE) is a non-profit organization created in February 2005, following the Grand Duchy of Luxembourg's adhesion to Eurepan Space Agency. The GLAE members are Luxembourg based companies active in the space sector: DKE Aerospace Lux S.à.r.l., Entreprise des Postes et Télécommunications, EURO-COMPOSITES S.A., GRADEL S.A., GT Satellite Systems S.A., HITEC Luxembourg S.A., LUXSPACE S.à.r.l., Nokia Siemens Networks S.A., Saturne Technology S.à.r.l., SES ASTRA S.A., SOLELEC S.A., TELINDUS S.A..

Constituted within the Luxembourg Federation of Employers (FEDIL), the objective of GLAE is to create link between its members active in the space sector, advising them and defending their shared professional, economic and social interests at a national and international level.

GLAE is a partner of the government for addressing all questions in relation to initiatives taken by the authorities in the frame of ESA programs and the establishment of a space policy in Luxembourg. It offers to its members the opportunity to create collaborations at the national and European level for both private and public sector.

GLAE A.s.b.l. - Groupement Luxembourgeois de l'Aéronautique et de l'Espace

President: Yves Elsen
7, rue Alcide de Gasperi L-1013 Luxembourg - Kirchberg
Phone: (+352) 43 53 66 – Fax: (+352) 43 23 28
Website: www.glae.lu
E-mail: glae@fedil.lu

6.4. LUXEMBOURG SPACE CLUSTER

The Luxembourg Space Cluster is a platform dedicated to the space sector to support and develop the exchanges between specialized private companies and public research organizations. This network has as aim to create and develop synergies and new partnerships at the national and international level through collaborative Research, Development and Innovation projects.

Membership of the Luxembourg Space Cluster is open to companies, public research and other organizations that are active in the field of Space Technologies and located in Luxembourg.

Based on the main interests of the national market, the Luxembourg Space Cluster focuses on the following thematic areas: Space Telecommunications, Global Navigation Satellite System and Location based Applications, Earth Observation, Maritime Security and Safety, Space related Technologies.

The main objectives of the Luxembourg Space Cluster are to:

- empower the development of the space sector in Luxembourg,
- increase and encourage the uptake of new technologies,
- promote the technological capabilities of private companies and public research in Luxembourg and thereby enhancing their national and international visibility,
- facilitate collaboration between public and private research actors on the national and international level,
- identify new market possibilities.

Luxembourg Space Cluster

Manager: Patricia Conti
7, rue Alcide de Gasperi L-1013 Luxembourg - Kirchberg
Phone: (+352) 43 62 63 – Fax: (+352) 43 81 20
Website: www.spacecluster.lu
E-mail: patricia.conti@spacecluster.lu

The Luxembourg Space Cluster and the GLAE work in close collaboration and share common objectives. They are both representing the Luxembourg Space Industry by encompassing private companies and other public organizations active in the aeronautic and space sector.

6.5. PRIVATE COMPANIES

Since 1985, the establishment of SES, a pioneer in satellite telecommunications services, many space-related companies have settled in Luxembourg. This is the result of an active national development policy, supporting research and development and seeking to diversify and expand its national market through innovative sectors as the space sector.

This chapter gives a general overview of the main private stakeholders that have some of their activities dedicated to the space sector. Aware that other private companies could also have a potential interest in developing business in the space sector, this is of course a non-exhaustive list. However, this analysis tried to identify companies that demonstrated a clear interest in the space sector through for example being a member to the Luxembourg Space Cluster or the GLAE.

Note: The main source to prepare the panorama of the national privates companies acting in the space sector in Luxembourg was the website called Luxembourg Space Capabilities. This website lists and details capabilities of the national stakeholders in order to encourage collaboration and partnerships with the international space community.

Cybercultus was created in 1999. It proposes innovative digital content solutions to the TV entertainment industry and the multimedia cultural and tourism sectors. It invented an innovative technology with the RAMO "Reactive and Adaptive Multimedia Objects" semantic layer that insulates content producers from the technical complexity of interactive and user immersive applications.

Cybercultus works with industries and organizations in Europe and develops partnerships with public and private actors specialized in social / immersive applications (for TV programs, cultural heritage, travel portals) and in GIS technologies (for spatial and temporal mapping of cultural and tourism geo-localised multimedia assets).

Active in the following space sector segments: **Service segment**

Cybercultus

CEO: Farid Meinköhn
25, rue du Quartier, L-4289 Esch-sur-Alzette
Phone: (+352) 265 456 54 – Fax: (+352) 265 456 24
Website: www.cybercultus.com
E-mail: farid@cybercultus.com

Established since 2007 in Luxembourg, DKE Aerospace is expert in space applications and services through engineering and consulting services. It offers expertise and resources for system design and development and integration and test work, especially related to space ground infrastructure and space applications.

Active in the following space sector segments: **Ground segment** and **Service segment**

DKE Aerospace

CEO: Klaus Enßlin
11, rue Pierre Werner, L-6832 Betzdorf
Phone: (+352) 270 779 20 – Fax: (+352) 270 779 79
Website: www.dke-aerospace.com
E-mail: bg@dke-aerospace.com

EmTroniX provides, since 2001, technological expertise, engineering design, prototyping and production services in advanced electronics and embedded software to customers involved in technological sectors such as Space.

Among other activities, they actively participated in the development of the first Luxemburgish S-AIS receiver embarked on both LEO satellites and the ISS.

Active in the following space sector segments: **Space segment** and **Ground segment**

EmTroniX

CEO: Cédric Lorant and Henri Du Faux
150, rue de Niederkorn, L-4991 Sanem
Phone: (+352) 26 58 17 50 – Fax: (+352) 26 58 17 51
Website: www.emtronix.lu
E-mail: cedric.lorant@emtronix.lu

The EC-Group is active in the field of advanced and demanding composites products. It offers technical solutions based on advanced composites adapted to the needs of aeronautic and space customers. Expert in its domain, EC-Group possesses several qualifications and accreditations for its products as with the Airbus Group, Boeing D1-4426, BAC 5317, EASA 21 Part G, ISO 9001 & SAE AS 9100, NADCAP, IRIS.

Active in the following space sector segments: **Space segment** and **Ground segment**

Euro-Composites Group

CEO: Rolf Mathias Alter
B.P. 24, Zone Industrielle, 6401 Echternach
Phone: (+352) 72 94 63-1 – Fax: (+352) 72 94 60
Website: www.euro-composites.com
E-mail: walter@euro-composites.com

Created in 2004, e-Xstream engineering provides simulation software and engineering services focused on advanced material modeling. It develops a nonlinear multi-scale material and structure modeling platform that fasten the development of optimal composite materials and parts (DIGIMAT). It is used by material suppliers and end users to accurately predict the nonlinear micromechanical behavior of complex multiphase composites materials and structures used across the industries acting among others, in the space sector.

Active in the following space sector segments: **Space segment** and **Ground segment**

e-Xstream engineering

CEO: Roger Assaker
Z.A.E. Robert Steichen, 5, Rue Bommel, L-4940 Hautcharage
Phone: (+352) 26 17 66 07 – Fax: (+352) 26 17 66 12
Website: www.e-xstream.com
E-mail: info@e-Xstream.com

Established in Luxembourg since 2007, GeoVille is specialized in remote sensing and GIS applications. It offers value-added geographic information and environmental services in the land domain, providing the bridge from technical knowhow in merging geospatial explicit data with statistics to supporting the analysis of what this information means for the environment. It provides solutions for efficient and optimized spatial data management and analysis.

GeoVille has well established quality and environmental management systems, whose compliance with ISO standards 9001:2008 (certified by Quality Austria, a member of the International Certification Network).

Active in the following space sector segments: **Service segment**

Geoville

CEO: Stefan Kleeschulte
3, Z.I Bombicht, L-6947 Niederanven
Phone: (+352) 26 71 41 35 – Fax: (+352) 26 71 45 54
Website: www.geoville.com
E-mail: kleeschulte@geoville.com

GRADEL was founded in 1965 and develops several activities covering among others the space sector. In the space domain, it provides mechanical engineering and manufacturing solutions, including Mechanical Ground Support Equipments (MGSEs), mechanical parts of satellites and studies for ESA.

Active in the following space sector segments: **Space segment** and **Ground segment**

GRADEL sàrl

CEO: Claude Maack
38, route de Luxembourg, L-8440 Steinfort
Phone: (+352) 39 00 44 1 – Fax: (+352) 39 00 44 79
Website: www.gradel.lu
E-mail: c.maack@gradel.lu

Established in Luxembourg since 1986, HITEC Luxembourg developed its business activities in innovative fields as the space sector. It offers high technology solutions as satellite ground segment technology as well as innovative satellite based products and ICT services to support public safety services in case of crisis or disasters. The company offers a range of Limited Motion (LM) and Full Motion (FM) high end antenna systems. HITEC Luxembourg's experience in satellite ground segment technology allows the company to take part in large international projects like VINASAT and the European Galileo project. The company is ISO 9001 certified for engineering, analysis, consulting, manufacturing, maintenance and sales of systems in mechanics, electronics, physical measuring techniques as well as information and communication technologies.

Active in the following space sector segments: **Ground segment** and **Service segment**

HITEC Luxembourg

Founder: Yves Elsen
5, rue de l'Église, L-1458 Luxembourg
Phone: (+352) 49 84 78-1 – Fax: (+352) 40 13 03
Website: www.hitec.lu
E-mail: info@hitec.lu

IMVIO developed an innovative solution called iPAYMO based on global navigation satellites systems such as GPS, adapted to operational business needs. This is a generic authentication platform services provided in a single turn-key solution which is easy to use and simple to implement. These solutions focus on improving security, usability and privacy for mobile devices.

The IPAYMO's technologies were refined during its incubation as part of the ESA Technology and Transfer Programme with the assistance of industry, research centers and universities.

Active in the following space sector segments: **Service segment**

IMVIO

CEO: Robert A. Carter
84, rue de Beggen, L-1220 Luxembourg
Phone: (+352) 26 008 082 – Fax: (+352) 66 008 081
Website: www.ipaymo.com
E-mail: robert@ipaymo.com

Created in 2007, itrust consulting is specialized in secure information systems. It performs consulting services, audit, design and implementation of security solutions protecting its clients against data divulgation, data manipulations, and service unavailability. Research domains of the company are not limited to network security as it also works on securing localization data and protecting critical infrastructures. Like this, itrust participates to ESA projects as Galileo or EGNOS.

Active in the following space sector segments: **Ground segment** and **Service segment**

itrust consulting

CEO: Carlo Harpes
18 Steekaul, L-6831 Berbourg
Phone: (+352) 26 176 212 – Fax: (+352) 26 710 978
Website: www.itrust.lu
E-mail: info@itrust.lu

Created in 2008, Lion Systems is specialized in building and customizing high performance optical measuring systems based on innovative technologies.

Active in the following space sector segments: **Space segment** and **Service segment**

Lion Systems S.A.

CEO: Guido Becker and Marc Schmiz
Rue du Commerce, Bat. Ecostart 2, L-3895 Foetz
Phone: (+352) 26 37 60-1 – Fax: (+352) 26 17 68 21
Website: www.lionsystems.lu
E-mail: info@lionsystems.lu

LuxSpace provides since 2004, know-how, expertise as well as products and services to the European and global institutional and industrial market in the fields of space and defense system engineering and application development. It focuses on space systems and subsystem design, specification, procurement, manufacturing, integration and test, and quality assurance and also on space applications and service development and operation with focus on Earth Observation & Telecommunication Applications & Services.

Since 2008, LuxSpace is ISO 9001 certified.

Active in the following space sector segments: **Space segment**, **Ground segment** and **Service segment**

LUXSPACE

CEO: Jochen Harms
SES Business Center, 9 rue Pierre Werner, L-6815 Betzdorf
Phone: (+352) 267 890 40 00 – Fax: (+352) 267 890 40 49
Website: www.luxspace.lu
E-mail: info@luxspace.lu

Since its creation in 2000, M-PLIFY focuses on the development of applications as procedure based bidirectional reminder, alerting and messaging applications.

Active in the following space sector segments: **Ground segment** and **Service segment**

M-PLIFY

CEO: Izidor Ciglar
21, rue Glesener, L-1631 Luxembourg
Phone: (+352) 26 18 46 1 – Fax: (+352) 26 18 46 46
Website: www.m-plify.com
E-mail: contact@alarmtilt.com

Post Luxembourg (formerly P&T Luxembourg) is a Luxembourg's leading telecommunications and information services company. It was founded in 1842, and has operated as a public enterprise since 1992.

Post Luxembourg is the incumbent telecom operator of the Grand-Duchy of Luxembourg and as such serves all segments of the community and all ranges of society, from residential to large corporate customers, offering both fixed and mobile services. The Post group comprises 14 sub-companies offering a wide range of innovative and valuable solutions.

Active in the following space sector segments: **Ground segment** and **Service segment**

Post

CEO: Claude Strasser
8a, avenue Monterey, L-2020 Luxembourg
Phone: (+352) 4765-1 – Fax: (+352) 4751 10
Website: www.post.lu
E-mail: contact.group@post.lu

SES is a world-leading satellite operator with a fleet of 50 geostationary satellites. Established since 1985 in Luxembourg, it provides satellite communications services to broadcasters, content and internet service providers, mobile and fixed network operators and business and governmental organizations worldwide. It offers a large portfolio of broadcast and broadband solutions for customers and provides internet access and network services to governments, large corporations, small- to medium-sized enterprises and individual households. Its entity, ASTRA TechCom provides operational services, technical consultancy and high-tech products as well as integrated solutions to the satellite industry around the world and is certified ISO 9001:2008.

Active in the following space sector segments: **Space segment**, **Ground segment** and **Service segment**

SES

CEO: Romain Bausch
Château de Betzdorf, L-6815 Betzdorf
Phone: (+352) 710 725 1 – Fax: (+352) 710 725 575
Website: www.ses.com
E-mail: info@ses-astra.com

SMALUX is a manufacturing company producing solid bars of castings made of aluminum, tool steel, titanium, stainless steel, duplex steel, non-ferrous metal, composites materials or plastics. Created in 2010, it develops high-precision products as for example for the space industry, to meet specific requirements and optimum solution to its customers.

Active in the following space sector segments: **Space segment** and **Ground segment**

SMALUX

CEO: Jean-Manuel Santos
Z.A.E. Robert Steichen, 5 rue Bommel, L-4940 Hautcharage
Phone: (+352) 26 50 33 15 – Fax: (+352) 26 50 15 33
Website: www.smalux.lu
E-mail: jm.santos@smalux.lu

SOLELEC provides support for complex and major projects in electrical engineering, from design to commissioning. SOLELEC designs and manufactures electrical installations (Mv-Lv-Electronics Systems) for building and industry and electrical cabinets for distribution and control systems. Regarding the space sector, SOLELEC provides assistance and ground electrical services for launch site as for the Space Centre in French Guyana.

Active in the following space sector segments: **Ground segment** and **Service segment**

SOLELEC

CEO: Bernard Carlier
371, route de Belval, L-4024 Esch-sur-Alzette
Phone: (+352) 31 48 10 – Fax: (+352) 31 48 11
Website: www.solelec-gdfsuez.lu
E-mail: info@cofelysolelec-gdfsuez.lu

Telindus Luxembourg is the ICT branch of the Belgacom Group in Luxembourg. Since 1978, it provides solutions to a variety of private and public-sector companies. Its expertise domains include enterprise networks and connectivity, datacenters, security, collaboration, applications and mobility. Since the beginning of the year 2009, the company has the operator status.

In the space domain, Telindus positions itself in the activities related to security, virtualization, routing and switching.

Active in the following space sector segments: **Ground segment** and **Service segment**

Telindus

CEO: Gerard Hoffmann
81-83, route d'Arlon, L-8009 Strassen
Phone: (+352) 450 915-1 – Fax: (+352) 450 911
Website: www.telindus.lu
E-mail: contact@telindus.lu

Created in 1998, GT Satellite Systems S.A. (GTSS) provides fixed satellite services as well as media and direct-to-home services. It is part of a group encompassing two main subsidiaries, GT Satellite Systems S.A. (GTSS) and "GeoTelecommunications", LLC (GT). Its core markets are located in Russia and in the CIS. In addition to the Fixed Satellite Services, the Group started Media activities in 2006.

Active in the following space sector segments: **Space segment** and **Service segment**

GT Satellite Systems S.A.

8, rue Heinrich Heine, L-1720 Luxembourg
Phone: (+352) 46 42 10 10 – Fax: (+352) 46 42 10 42
Website: www.gtssgroup.com
E-mail: post@cfg.lu

Created in 1902, Air Liquide is an international group located in 72 different countries. It is established in Luxembourg since 1931. Air Liquide focuses its space-related activities on the definition, conception and production of embedded cryogenic equipment, as well as on the processing and analysis of flights.

Active in the following space sector segments: **Space segment**

Air Liquide Luxembourg

CEO: Diederick Luijten
Zoning PED - BP20, L-4801 Rodange
Phone: (+352) 50 62 63 1 – Fax: (+352) 50 62 63 218
Website: www.airliquide.lu
Email: jean-claude.puco@airliquide.com

Digitaria International, created in 2012, is an IT Global Service Company having, in the broadest sense, any interest whatsoever in electronic media and the development of satellite technology. The aim of Digitaria is to be predominantly active in the communications area via satellites and to invest, directly or indirectly, in other companies that are actively involved in the dynamic industry of satellite communication and multimedia applications.

Active in the following space sector segments: **Space segment**

Digitaria International

CEO: Jean-Martin Stoffel
31, bvd Grande-Duchesse Charlotte, L-1331 Luxembourg
Phone: (+352) 26 44 19 93 – Fax: (+352) 26 44 19 94
Website: www.digitaria-international.com
Email: info@digitaria-international.com

Created in 2012, The Elwing Company designs, manufactures and commercializes Electric Propulsion (EP) systems for satellites and spacecrafts. The systems are designed to fulfill the propulsion needs of most spacecraft operators and manufacturers in the United States and throughout the world.

Active in the following space sector segments: **Space segment**

The Elwing Compagny

CEO: Gregory Emsellem
30 Dernier Sol, L-2543 Luxembourg
Phone: (+352) 20 88 04 71
Website: www.elwingcorp.com
Email: contact-europe@elwingcorp.com

OTHER PRIVATE COMPANIES IDENTIFIED AS BEING RELATED TO SPACE SECTOR

Nokia Siemens Networks S.A.

Country Director: Filip Rommelaere
15 Z.I. Breedewues, L-1259 Senningerbergg
Phone: (+352) 26 34 09 41 – Fax: (+352) 26 34 09 48
Website: http://lu.nsn.com

Saturne Technology Sàrl

CEO: Grzymlas Walter
Zone Industrielle Rolach, L-5280 Sandweiler
Phone: (+352) 26 17 94 1 – Fax: (+352) 26 55 28 97
Website: www.saturne-technology.com

Green Vision Systems Environmental Lux Sàrl

CEO: Danny S. Moshe
11 Avenue Guillaume, L-1651 Luxembourg
Phone: (+352) 268 0511
Website: infoeurope@greenvs-lux.com
E-mail: www.greenvs.com

7. POTENTIAL INTERESTS IN STANDARDIZATION FOR NATIONAL STAKEHOLDERS

The following matrix (Figure 5), encompassing the overall categories of stakeholders, provides a clear picture of all potential interests shared between the national stakeholders. This matrix intends to help in proposing opportunities for the market by identifying the common interests of the national market.

Figure 5: Global matrix

Space Stakeholders	Subsector 1 Aerospace equipment and infrastructure	Subsector 2 Earth observation technologies	Subsector 3 Telecommu-nications & Broadcasting	Subsector 4 Space related technologies
Public Institutions	◆	◆	◆	◆
Public Research Organizations - University	◆❖◘	◆❖◘	◆❖◘	◆❖◘
Associations & Groups (GLAE and Space Cluster)	◆	◆	◆	◆
Private Companies	◆◘	◆◘	◆■❖◘$	◆■❖◘$

◆Information ■ Performance ❖ Services ◘ Projects $ Investments

Public Institutions and Association & Groups should be interested in following all the subsectors for information purposes. Maintaining a good level of information on all the subsectors characterizing the space sector should be of interest for them.

Public Research Organizations and University should share the same interests. They should have an obvious interest in following all the subsectors in order to collect general information. Research activities, in order to be efficient, have to go with knowledge watch in order to remain as close as possible to state of the art research. Following the standardization activities of the space subsectors could also constitute an interest for them in terms of projects as, by following relevant technical committees, it could lead to collaboration or partnerships, for example. In line with the aspects of networking and partnership through projects, it could also constitute an interest for them in terms of developing new services.

Private sector should have interest in following all the space subsectors for information and project purposes depending on their activities. The collection of information in general, as well as the development of new projects, should constitute a main issue for them.
According to the current activities of the private companies present in Luxembourg, it could be of particular interest for them to follow the Telecommunications & Broadcasting and Space related technologies sectors in terms of performance and services. This could allow them to improve their networking through collaborations and also to improve the quality of the services already implemented or maybe to develop new services. The same observation could be done in terms of investment, as private companies could potentially be interested in investing in any promising sectors. Participating in standardization activities in selected technical committees could allow for the identification of these opportunities.

Based on these observations, it appears that the majority of stakeholders share some common interests. For these common interests, therefore, opportunities for the market can be identified and proposed for discussion.

8. OPPORTUNITIES FOR THE NATIONAL MARKET

The main aim of this analysis is to increase the participation of the national stakeholders in the standardization activities. Previous steps of the standards analysis have permitted the identification and selection of standardization technical committees and, through a link with the different stakeholder categories involved in the space sector in Luxembourg, to point out potential interests for the national players to follow standardization activities. Then, thanks to the potential interests identified for each stakeholder category, opportunities for the national market dedicated to the space sector can be identified and recommended in this report. Indeed, based on common interests shared between different categories of stakeholders, opportunities for future developments in order to give an answer to these identified needs can be proposed.

Of course, the opportunities that are listed below are only proposals. They would be therefore submitted for comment to the national stakeholders of the space sector.

❖ Creating a national forum dedicated to standards developments

Based on the common interest identified for all the stakeholder categories in terms of need of information, the creation of a national platform dedicated to the space sector could be an interesting initiative. This "Space Standardization Forum", conducted by ILNAS, could be the place for the respective stakeholders to collect, share, and exchange information and knowledge related to the space sector in terms of standards development.
It could be an interesting opportunity to create a group encompassing members that would like to follow in more detail information related to the standardization work realized in the space sector. ILNAS, helped by ANEC, would conduct this forum and when possible would transmit pertinent and useful information to the members.
This platform could share some activities with the Luxembourg Space Cluster, a national initiative already in place to facilitate the exchange between players acting in the Space sector.

❖ Supporting national delegates involved in standardization

In being the Luxembourg's national standards body, one of the missions of ILNAS is to provide support to national delegates and to coordinate the activities of the different committees at the national level. These duties are of primary importance and well stated in the national standardization strategy[28] through the following objectives:

- Ensure the sector-based economic approach of the "*Organisme Luxembourgeois de Normalisation*" (pillar III),
- Provide support to technical committees and delegates in standardization (role of the GIE ANEC) (pillar V).

Thus, a result expected from this standards analysis focusing on the space sector is to raise awareness and increase the participation of the Luxembourg stakeholders in standardization technical committees, either at a European or an international level.

[28] http://www.ilnas.public.lu/fr/publications/normalisation/etudes-nationales/ilnas-strategie-normalisation-2010-2020.pdf

❖ Providing services in relation to standards evolutions

Services in relation to standards and their development could be proposed to the space sector. It could be, for example, a standards' watch focusing on a specific subsector or a thematic search associating regulatory requirements and standardization duties.

The identification of services to be developed that potentially answer to the expectations of the national stakeholders of the sector would be realized according to the comments received after the release of this standards analysis report.

❖ Following research projects involving standardization

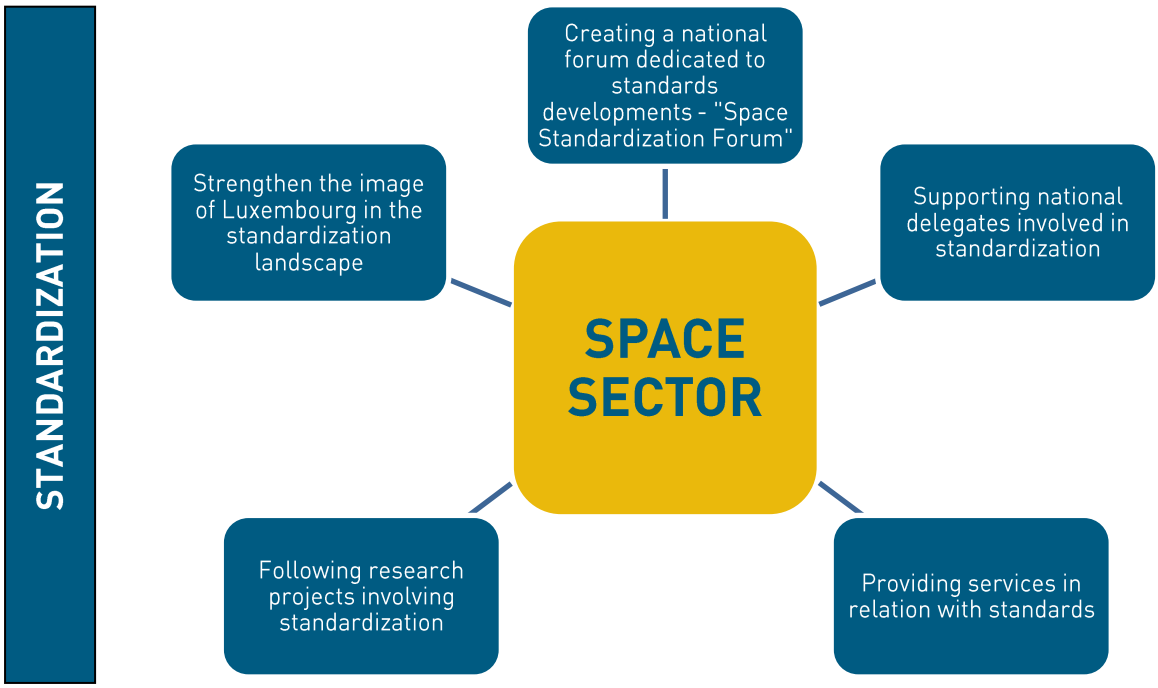
It might be extremely worthwhile for researchers carrying out projects to participate in standardization work. It would help researchers in preparation and project activities, in the codification of the state of the art. Taking into account standards when conducting projects ensures the compliance of the project results with regulatory requirements, and it can also enhance the interoperability, comparability, and compatibility of the project results with what already exists.

❖ Strengthen the image of Luxembourg in the standardization landscape

Through an enhancement of the participation in the standardization work and the implementation of the opportunities listed above, Luxembourg should strengthen its presence in the standardization field and significantly improve its image at the European and international levels.

To summarize, opportunities identified for the national market related to the standardization activities of the space sector are illustrated in Figure 6.

Figure 6: Opportunities for the national market



As long as the stakeholders of the sector wish to seize these opportunities, ILNAS, supported by ANEC, will provide an active contribution and support.

In being Luxembourg's national standards body, ILNAS offers the possibilities to national stakeholders to follow specific standardization works of technical committees, either at the European or international level. ILNAS supports interested persons in their participation in standardization activities through appropriate information and training. Therefore, resources from ILNAS and ANEC are specifically dedicated to these aspects and are able to efficiently support and inform the future national delegates.

9. CONCLUSION

The space sector is largely recognized as a key strategic sector. These last years have seen the increase of the number of public and private stakeholders involved in space activities especially, in the space services domain. Identified as a priority area in the Europe 2020 strategy, a European space program has been released in February 2013. The European Commission worked in close collaboration with the European Space Agency and Member States to develop and implement a space industrial policy.[29] This policy proposes actions to increase industry's skills levels, to support research and innovation, to ensure the EU's independence in space, to make finance and investment more readily available, and to reshape the EU's legislative framework to make it a driver for the industry's competitiveness.

At a national level, the space sector is also seen as a driven sector for the national economy and a motor for the development of innovation. The government of Luxembourg implemented a national action plan concerning space technologies to develop innovative applications, products and services with high added value. Luxembourg strengthened its commitments in favor of the development of the space sector by becoming an official Member State of the European Space Agency in 2005, and more recently, through its co-chair, with Switzerland, of the Council of Ministers of ESA, for the period 2012-2015.

However, if a strong support is provided at national, European and international level to the space sector, a main key of success 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. Under this context, it is then 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 in a reliable and cost-effective manner. Based on these issues, standardization activities constitute a key element to strengthen the European and national space sector strategy.

This standards analysis realized by ILNAS with the support of ANEC, has as main objectives to, primarily, inform the national stakeholders of the space sector of the standards developments and, secondly, to raise their awareness of the potential benefits that they could obtain in following and participating in standardization.

However, more than a simple presentation of a standardization panorama of the space sector, this standards analysis should be seen as a starting point for further discussions and involvement. As stated, the main aim of this analysis is to raise awareness of the national stakeholders of the space related issues for participating in standardization and to perceive this matter as interesting and efficient economic leverage. As participation in standardization is a voluntary process, a clear understanding of these concerns by the national stakeholders is of primary importance in order to master the challenges linked with standardization in the space sector and to engage an individual process to participate.

[29] http://ec.europa.eu/enterprise/policies/space/policy/jobs-growth/industrial-policy/index_en.htm

10. APPENDIX

10.1. ACRONYM LIST

Acronym	Title
AMES	Advanced materials technologies department
ANEC	*Agence pour la Normalisation et l'Économie de la Connaissance*
ARTES	TIA Advanced Research in Telecommunications Systems
BT	Technical Board
BSSC	Board for Software Standardisation and Control
CCSDS	Consultative Committee for Space Data Systems
CEN	European Committee for Standardization
CENELEC (or CLC)	European Committee for Electrotechnical Standardization
CORBA	Common Object Request Broker Architecture
CTB	Components Technology Board
EC	European Commission
ECSS	European Cooperation for Space Standardization
EFTA	European Free Trade Association
EGNOS	European Geostationary Navigation Overlay Service
EO	Earth Observation
EPPL	European Preferred Parts List
ESA	European Space Agency
ESCC	European Space Components Coordination
ESCIES	European Space Components Information Exchange System
ESSB	ESA Standardization Steering Board
ETSI	European Telecommunications Standards Institute
EU	European Union
EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
FEDIL	Luxembourg Federation of Employers
FP7	Seventh Framework Programme
GLAE	*Groupement luxembourgeois de l'aéronautique et de l'espace*
GNSS	Global Navigation Satellite Systems
ICT	Information and Communications Technology
IEC	International Electrotechnical Commission
ILNAS	*Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et services*
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JTC	Joint Technical Committee
JWG	Joint Working Group
MT	Maintenance Team
NAS	National Aerospace Standards

Acronym	Title
NATO	North Atlantic Treaty Organization
OECD	Organisation for Economic Co-operation and Development
OLN	*Organisme Luxembourgeois de Normalisation*
PT	Project Team
QPL	Qualified Parts List
R&D	Research and Development
RTTE	Radio and Telecommunications Terminal Equipment
SAM	Science and materials analysis department
SB	Standards Body
SC	Subcommittee
SCAHC	Space Component Ad-Hoc Committee
SnT	Interdisciplinary Centre for Security, Reliability and Trust
SSI	Service Science & Innovation department
TC	Technical Committee
WG	Working Group

10.2. SUBSECTOR 1 - AEROSPACE EQUIPMENT & INFRASTRUCTURE

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
CEN/ASD-STAN	Aerospace	1973	The ASD-STAN committee develops specifications for aerospace applications, mainly in the field of engineering materials and components and submits the drafts to CEN for adoption as European Standards. ASD-STAN is a nonprofit making Association and membership is open internationally to all Aerospace Associations, companies, consortia, airlines and authorities. It is well recognized as the European body for the development of global aerospace standards by the International Aerospace Quality Group (IAQG). Cooperation between the CEN and the Aerospace and Defence Industries Association of Europe – Standardization (ASD-STAN) starts in 1973.	2151	465	ASD-STAN/D 1 General ASD-STAN/D 2 Electrical ASD-STAN/D 3 Mechanical ASD-STAN/D 4 Materials ASD-STAN/D 6 Quality ASD-STAN/D 7 E-Standards ASD-STAN/D 8 Customer & Product Support ASD-STAN/D 9 Environment ASD-STAN/D 10 Space
CEN/SS T02	Aerospace	na	na	45	none	na
CLC/TC 107X	Process management for avionics	2011	The CLC/TC 107X works in close collaboration with the IEC/TC 107. It develops 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 TC 107X 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/TC 107X is to ensure that the specific European requirements will adequately be reflected in IEC/TC 107.	3	1	na

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
IEC/TC 107	Process management for avionics	2011	The IEC/TC 107 works in close collaboration with the CLC/TC 107X. It develops process management standards on systems and equipment used in the field of avionics. Avionics includes electronics used in commercial, civil and military aerospace applications.	17	8	WG 1 Aerospace and defence 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 PT 62396 Accommodation of atmospheric radiation effects via single event effects within avionics electronic equipment MT 1 Revision of IEC TS 62239 Ed. 1 MT 2 Use of semiconductor devices outside manufacturers' specified temperature range
CEN/CLC/TC 5	Space	na	The mission of this joint Technical Committee between CEN and CENELEC is to actually respond to Mandate 496. Foreseen is that the Technical Committee will gather the expertise from all the major European space stakeholders, and in particular from the European Cooperation for Space Standardization (ECSS). This TC 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, in as much 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). It is also important and necessary that it coordinates its work with relevant technical bodies in ETSI as much as possible. It should in particular develop European Standards that are needed to support the implementation of EU-level space projects, such as Galileo or GMES.	na	99	WG 1 Navigation and positioning receivers for road applications WG 2 Space Situational Awareness Monitoring WG 3 Earth observation WG 4 Payload Interfaces for Launchers WG 5 Planetary Protection

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
ISO/TC 20	Aircraft and space vehicles	1947	The ISO/TC 20 works on 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.	585	88	TC 20/SC 1 Aerospace electrical requirements TC 20/SC 4 Aerospace fastener systems TC 20/SC 6 Standard atmosphere TC 20/SC 8 Aerospace terminology TC 20/SC 9 Air cargo and ground equipment TC 20/SC 10 Aerospace fluid systems and components TC 20/SC 13 Space data and information transfer systems TC 20/SC 14 Space systems and operations
ISO/TC 20/SC 1	Aerospace electrical requirements	na	The ISO/TC 20/SC1 is a subcommittee of ISO/TC 20 "Aircraft and space vehicles". It is specialized on the standardization of the electrical equipments for construction and operation of aircraft and space vehicles as well as equipment used in the servicing and maintenance of these vehicles.	58	na	TC 20/SC 1/WG 1 Aerospace vehicle interconnection installation practices TC 20/SC 1/WG 3 Solid state remote power controllers - Performance requirements and Hybrid remote power controller - Performance requirements TC 20/SC 1/WG 5 Aircraft electric cables - General requirements TC 20/SC 1/WG 8 Heat shrinkable products TC 20/SC 1/WG 10 Databus systems TC 20/SC 1/WG 13 Characteristics of aircraft electrical systems (Revision of ISO 1540) TC 20/SC 1/WG 15 LED power light

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
ISO/TC 20/SC 13	Space data and information transfer systems	na	The ISO/TC 20/SC13 is a subcommittee of ISO/TC 20 "Aircraft and space vehicles". This subcommittee covers the following topics: Spacecraft onboard interface services, Space link services, System engineering, Space internetworking, Cross border support services and Mission operations & information management services.	64	na	ISO/TC 20/SC 13/WG 1 Systems engineering ISO/TC 20/SC 13/WG 2 Mission operations and information management ISO/TC 20/SC 13/WG 3 Cross support services ISO/TC 20/SC 13/WG 4 Spacecraft onboard interface services ISO/TC 20/SC 13/WG 5 Space link services ISO/TC 20/SC 13/WG 6 Space internetworking services
ISO/TC 20/SC 14	Space systems and operations	1992	The ISO/TC 20/SC14 is a subcommittee of ISO/TC 20 "Aircraft and space vehicles". This subcommittee covers the following topics: Space debris, Interface integration & test, Operations & ground support, Materials & processes, Environment (natural & induced), Programme management, Design, engineering & production.	123	na	ISO/TC 20/SC 14/WG 1 Design engineering and production ISO/TC 20/SC 14/WG 2 Interfaces, integration and test ISO/TC 20/SC 14/WG 3 Operations and ground support ISO/TC 20/SC 14/WG 4 Space environment (natural and artificial) ISO/TC 20/SC 14/WG 5 Space System Program Management and Quality ISO/TC 20/SC 14/WG 6 Materials and processes ISO/TC 20/SC 14/WG 7 Orbital Debris Working Group
NAS	NAS - National Aerospace Standards	na	The National Aerospace Standards (NAS) are produced by the Aerospace Industries Association (AIA). These standards 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. AIA comprises leading manufacturers and suppliers of civil, military, and business aircraft, helicopters, unmanned aircraft systems, space systems, aircraft engines, missiles, materiel, and related components, equipment, services, and information technology. In addition to all types of screws, nuts, and rivets, NAS define high pressure hose, electrical connectors, splices and terminations, rod end bearings, and many other types of hardware and components.	Over 500 MIL-spec's to NAS exists up to now.	na	na

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
CCSDS	CCSDS - Consultative Committee for Space Data Systems Standards	1982	The Consultative Committee for Space Data Systems (CCSDS) is an international voluntary consensus organization of space agencies and industrial associates interested in mutually developing standard data handling techniques to support space research, including space science and applications. CCSDS Recommended Standards (Blue Books) define specific interfaces, technical capabilities or protocols, or provide prescriptive and/or normative definitions of interfaces, protocols, or other controlling standards such as encoding approaches. Standards must be complete, unambiguous and at a sufficient level of technical detail that they can be directly implemented and used for space mission interoperability and cross support. Standards must say very clearly, "this is how you must build something if you want it to be compliant".	53 Recommended Standards 28 Recommended Practices	7 under review	A CCSDS Member Agency is a governmental or quasi-governmental organization that fully participates in all CCSDS activities and provides a commensurate level of support. Only one agency representing a given country or multinational organization may participate as a Member Agency of the CCSDS. Each CCSDS Agency must formally appoint its delegates to the CCSDS technical Working Groups which that Agency supports. The CCSDS Engineering Group (CESG) is composed of 6 areas. Within these areas there are Working Groups (WG), Birds of a Feather (BOF), and Special Interest Groups (SIG) that collaborate. (details available here: http://cwe.ccsds.org/default.aspx).
ECSS	ECSS - European Cooperation for Space Standardization	1997	The European Cooperation for Space Standardization (ECSS) is an initiative established to develop a coherent, single set of user-friendly standards for use in all European space activities.	261	na	ECSS is supported by several agencies and companies. The work is done by several ECSS Working Groups, the three ECSS Panels (Engineering, Management and Product Assurance), the ECSS Executive and the ECSS Steering Board.

10.3. SUBSECTOR 2 – EARTH OBSERVATION TECHNOLOGIES

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
ETSI/TC SES	Satellite Earth Stations & Systems	na	This TC has in the scope of its standardization activities all types of satellite communication services and applications (including mobile and broadcasting), 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.	na	na	There is several working groups in this technical committee: Working groups dealing with Harmonized standards (R&TTE Directive) as Earth stations on board vessels and trains (MAR ESV) or harmonisation (HARM); Working groups dealing with specific systems Broadband Satellite Multimedia (BSM), GEO Mobile Radio Interface (GMR), Satellite Component of IMT 2000 (S-UMTS) Satellite Digital Radio (SDR); other Working group as European Commission activity support (ECAS).
ISO/TC 211	Geographic information/ Geomatics	1994	The ISO/TC 211 works on standardization in the field of digital geographic information. 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.	66	23	TC 211/WG 4 Geospatial services TC 211/WG 6 Imagery TC 211/WG 7 Information communities TC 211/WG 9 Information management TC 211/WG 10 Ubiquitous public access
ISO/TC 23/SC 19	Agriculture electronics	2004	The ISO/TC 23 field of application includes production machines and equipment required for farming and forestry as well as for gardening. The specific subcommittee SC 19 is especially dedicated to "Agriculture electronics" in order to integrate electronics on tractors, machines and implements and of other aspects such as those related to the use of electricity.	41	12	TC 23/SC 19/WG 1 Mobile equipment TC 23/SC 19/WG 3 Identification TC 23/SC 19/WG 5 Wireless communication in agriculture TC 23/SC 19/WG 7 Testing procedures for positioning and guidance systems in agriculture TC 23/SC 19/WG 8 Revision of ISO 25119-1 to -4

10.4. SUBSECTOR 3 – TELECOMMUNICATIONS & BROADCASTING

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
CLC/SR 80	Maritime navigation and radiocommuni-cation equipment and systems	na	This TC based its standardization activities on the maritime navigation and radiocommunication equipment and systems. These activities have to take into account the European Directive 2004/108/EC of the European Parliament and of the Council of 15 December 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility and repealing Directive 89/336/EEC.	43	3	na
CLC/TC 206*	Consumer equipment for entertainment and information and related sub-systems	na	The scope of the CLC/TC 206 is to develop standards for audio, video and multimedia sub-systems and equipment for consumer use. This includes: - receiving equipment for satellite, terrestrial and cable broadcasting services including associated data, - imaging, recording and reproducing equipment and components, - interfaces and interconnections between equipment, - user interfaces, - infrared systems and equipment, - methods of measurement, - harmonization of relevant IEC standards.	0	2	na

** National delegate registered for this technical committee among the Luxembourg's national standards body (ILNAS).*

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
CLC/TC 209*	Cable networks for television signals, sound signals and interactive services	na	The scope of the CLC/TC 209 is to develop harmonised 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 as well as of any coaxial, balanced and optical cables and accessories thereof is excluded.	31	11	WG 01 Safety requirements WG 02 EMC for equipment and cable networks WG 03 Equipment for coaxial cable networks WG 05 Equipment and systems for optical cable networks WG 07 System performance WG 08 Ad-hoc WG « SAT » - Satellite systems and equipment WG CAG Chairman's advisory group
EBU/ETSI/CENELEC JTC BROADCAST	Joint Technical Committee on Broadcast	na	The joint ETSI/EBU/CENELEC technical committee, JTC Broadcast, co-ordinates the drafting of standards for broadcast systems (emission-reception combination) for television, radio, data and other services via satellite, cable and terrestrial transmitters. The Committee works with the other specialist groups as necessary.	20	na	Technical activities as Digital Video Broadcasting (DVB) and Multimedia Home Platform (MHP), Digital Audio Broadcasting (DAB); Analogue TV: Programme Delivery Control (PDC), Wide-Screen Signaling (WSS), Electronic Programme Guide (EPG), Teletext, NICAM, PAL/SECAM ghosting; Analogue RADIO: DAta Radio Channel (DARC) and VHF FM Sound Broadcasting Transmitters

** National delegate registered for this technical committee among the Luxembourg's national standards body (ILNAS).*

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
IEC/CISPR	CISPR - International special committee on radio interference	na	The IEC/CISPR works in the standardization in the field of electromagnetic compatibility (EMC) including: 1) Protection of radio reception in the range 9 kHz to 400 GHz from interference caused by operation of electrical or electronic appliances and systems in the electromagnetic environment; 2) Measurement instrumentation, facilities, methods and statistical analysis for the measurement of disturbance; 3) Limits for radio disturbances caused by electrical or electronic appliances and systems; 4) Requirements for the immunity of electrical appliances, multimedia equipment, information technology equipment and sound and television broadcast receiving installations from interference; 5) Liaison with IEC Technical Committees that maintain basic standards that apply the prescriptions of methods of measurement of such immunity. Test levels for such immunity tests will be set by CISPR in relevant product standards; 6) The consideration jointly with other IEC and ISO committees of the emission and immunity requirements for devices and products where their standards cover EMC requirements which do not match to the respective requirements in CISPR standards; 7) Taking into account the impact of safety issues on disturbance suppression and immunity of electrical equipment.	na	na	Subcommittees: CIS/A Radio-interference measurements and statistical methods CIS/B Interference relating to industrial, scientific and medical radio-frequency apparatus, to other (heavy) industrial equipment, to overhead power lines, to high voltage equipment and to electric traction CIS/D Electromagnetic disturbances related to electric/electronic equipment on vehicles and internal combustion engine powered devices CIS/F Interference relating to household appliances tools, lighting equipment and similar apparatus CIS/H Limits for the protection of radio services CIS/I Electromagnetic compatibility of information technology equipment, multimedia equipment and receivers CIS/S Steering Committee of CISPR Joint Task Forces: JTF MU Joint Task Force TC 77/CISPR on Measurement Uncertainty Managed by TC 77

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
IEC/TC 100	Audio, video and multimedia systems and equipment	na	The IEC/TC 100 is active in preparing international publications in the field of audio, video and multimedia systems and equipment. These publications mainly include specification of the performance, methods of measurement for consumer and professional equipment and their application in systems and its interoperability with other systems or equipment. Note: Multimedia is the integration of any form of audio, video, graphics, data and telecommunication and integration includes the production, storage, processing, transmission, display and reproduction of such information.	395	67	TA 1 Terminals for audio, video and data services and contents; TA 2 Colour measurement and management; TA 4 Digital system interfaces and protocols; TA 5 Cable networks for television signals, sound signals and interactive services; TA 6 Storage media, data structures, equipment and systems; TA 8 Multimedia home server systems; TA 9 Audio, video and multimedia applications for end-user network; TA 10 Multimedia e-publishing and e-book technologies; TA 11 Quality for audio, video and multimedia systems; TA 12 AV energy efficiency and smart grid applications; TA 13 Environment for AV and multimedia equipment; TA 14 Interfaces and methods of measurement for personal computing equipment PT 0 Wireless power transmission; PT 4 Project team for General Meeting; PT 100-6 Smart Television (TA1); PT 100-7 Ambient Assisted living (AAL); PT 62045 Multimedia Security - Guideline for privacy protection of equipment and systems in use and disused; PT 62458 Sound System Equipment - Electroacoustical Transducers - Measurement of Large Signal Parameters; PT 62459 Sound System Equipment - Electroacoustical Transducers - Dynamic Measurement of Suspension Parts; PT 62481 Digital living network alliance (DLNA) home networked device interoperability guidelines - Part 5: Device Profiles; PT 62574 Audio, video and multimedia systems - General channel assignment of multi-channel audio (TC 100); PT 62608 Multimedia systems and equipment - Multimedia home network configuration - Basic reference model; PT 62731 Text-to Speach Functionality for Television - General Requirements; PT 62767 Air Interface Protocol for local multilingual Broadcasting; PT 62760 Audio reproduction method for normalized loudness level

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
IEC/TC 103	Transmitting equipment for radiocommuni-cation	1996	The scope of the IEC/TC 103 is the standardization of transmitting equipment for radiocommunications purposes and electronic devices employing similar techniques. The standardization work deals with methods of measurement, safety requirements and transmitter control and interconnection.	33	6	WG 3 Methods of measurement and TV transamitters WG 6 Radio on fibre transmitter MT 60215 Safety requirements for radio transmitting equipment
IEC/TC 108	Safety of electronic equipment within the field of audio/video, information technology and communication technology	2001	Standardization activities of the IEC/TC 108 is in the field of safety for audio/video and similar technology, information technology and communication technology equipment. Additionally, it prepares requirements for methods of measurement of energy efficiency of information technology and communication technology equipment (consideration of energy efficiency includes power conservation). Horizontal safety function: Methods of measuring touch current and protective conductor current (IEC 60990). This includes, for various types of equipment, methods of measurement of touch current with regard to physiological effects and of protective conductor current for installation purposes. The methods of measurement consider both normal conditions and certain fault conditions. Safety of equipment electrically connected to a telecommunication network (IEC 62151). Group safety function: Audio, video and similar electronic equipment.	28	4	WG 5 Maintenance and proposals for IEC 60990 WG HBSDT Hazard based standard development team for IEC 62368-1 and IEC 62368-2 TR Maintenance Teams: MT 1 Maintenance of IEC 60065 and IEC 62441 TS MT 2 Maintenance of IEC 60950-1, IEC 60950-21, IEC 60950-22, IEC 60950-23, IEC 62102 TR and IEC 62151 and IEC 62367 TS

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
ITU/ICG-SAT	ICG on Satellite Matters	na	This inter-Sector Coordination Group on Satellite Matters of ITU works on: - Performance and availability of satellite networks, - Interconnection of stallite networks including GMPCS with public switched networks, - Routing, signalling, numbering, protocols, - IP over satellite, - Multimedia services and systems, - Satellite terminal portability, - Convergence, - Secure time stamping.	na	na	na
ITU/ITU-R/SG 6	Broadcasting service	na	The ITU/ITU-R/SG 6 is working on radiocommunication broadcasting, including vision, sound, multimedia and data services principally intended for delivery to the general public. Broadcasting makes use of point-to-everywhere information delivery to widely available consumer receivers. When return channel capacity is required (e.g. for access control, interactivity, etc.), broadcasting typically uses an asymmetrical distribution infrastructure that allows high capacity information delivery to the public with lower capacity return link to the service provider. This includes production and distribution of programmes (vision, sound, multimedia, data, etc.) as well as contribution circuits among studios, information gathering circuits (ENG, SNG, etc.), primary distribution to delivery nodes, and secondary distribution to consumers. The Study Group, recognizing that radiocommunication broadcasting extends from the production of programmes to their delivery to the general public, as detailed above, studies those aspects related to production and radiocommunication, including the international exchange of programmes as well as the overall quality of service.	na	na	Working Party 6A (WP 6A) - Terrestrial broadcasting delivery Working Party 6B (WP 6B) - Broadcast service assembly and access Working Party 6C (WP 6C) - Programme production and quality assessment Joint Task Group 4-5-6-7 (JTG 4-5-6-7) - WRC-15 Agenda items 1.1 and 1.2

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
ITU/ITU-R/WP 4B	Working Party 4B (WP 4B) - Systems, air interfaces, performance and availability objectives for FSS, BSS and MSS, including IP-based applications and satellite news gathering	1997	This Working Party of ITU works on the systems, air interfaces, performance and availability objectives for FSS, BSS and MSS, including IP-based applications and satellite news gathering.	na	na	na
ITU/ITU-T/SG 13	Future networks including cloud computing, mobile and next-generation networks	na	This ITU study group works on standardization of the future networks including mobile and NGN. NGN refers to the move from circuit switched to packet based networks that many operators worldwide are undertaking. This will mean reduced CAPEX and OPEX costs for service providers who will in turn be able to offer a richer variety of services.	na	na	WP 1/13 NGN-e and IMT WP 2/13 Cloud Computing and Common Capabilities WP 3/13 SDN and Networks of Future
ITU/ITU-T/SG 16	Multimedia		Study Group 16 leads the ITU-T work on multimedia (MM) coding, terminals, systems and applications, including the coordination of the studies among the various ITU-T SGs. It is also the lead study group for ubiquitous applications ("e-everything", such as e-health and e-business), and for telecommunication/ICT accessibility for persons with disabilities. SG16 is active in all aspects of MM standardization, including terminals, architecture, protocols, security, mobility, interworking and quality of service. It focuses its studies on telepresence and conferencing systems; IPTV; directory services; speech, audio and visual coding; PSTN modems and interfaces; facsimile terminals; ICT accessibility, etc.	na	na	WP 1/16 Multimedia systems WP 2/16 Multimedia services and accessibility WP 3/16 Media coding and signal processing

10.5. SUBSECTOR 4 – SPACE RELATED TECHNOLOGIES

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
ISO/JTC 1/SC 2	Coded character sets	1961	The subcommittee SC2 of the ISO/JTC1 focuses its standardization activities on the graphic character sets and their characteristics, including string ordering, associated control functions, their coded representation for information interchange and code, extension techniques. This scope excludes the audio and picture coding.	52	4	JTC 1/SC 2/WG 2 Universal coded character set
ISO/JTC 1/SC 23	Digitally Recorded Media for Information Interchange and Storage	na	The ISO/JTC 1/SC 23 carries on standardization activities in the field of removable digital storage media other than hard disks utilizing optical and /or magnetic recording technology for digital information interchange. It includes algorithms for the lossless compression of data and volume and file structure.	142	1	JTC 1/SC 23/WG 6 iVDR Cartridge JTC 1/SC 23/WG 7 Joint between ISO/IEC JTC 1/SC 23, ISO/TC 42, and ISO/TC 171/SC 1
ISO/JTC 1/SC 24	Computer graphics, image processing and environmental data representation	na	The ISO/JTC 1/SC 24 carries standardization activities on interfaces for information technology based applications relating to computer graphics, image processing, virtual reality, environmental data representation and interaction with, and visual presentation of, information. It includes the following related areas: Modelling and simulation, related reference models; application program interfaces; functional specifications; representation models; interchange formats, encodings and their specifications, including metafiles; device interfaces; testing methods; registration procedures; presentation and support for creation of multimedia and hypermedia documents. It excludes from the scope: Character and image coding; coding of multimedia and hypermedia document interchange formats, JTC 1 work in user system interfaces and document presentation; ISO TC 207 work on ISO14000 environment management, ISO TC211 work on geographic information and geomatics; and software environments as described by ISO/IEC JTC 1 SC22.	80	9	JTC 1/SC 24/WG 6 Augmented reality continuum presentation and interchange JTC 1/SC 24/WG 7 Image processing and interchange JTC 1/SC 24/WG 8 Environmental representation JTC 1/SC 24/WG 9 Augmented reality continuum concepts and reference model

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
ISO/JTC 1/SC 27	IT Security techniques	na	The development of standards for the protection of information and ICT. This includes generic methods, techniques and guidelines to address both security and privacy aspects, such as Security requirements capture methodology; Management of information and ICT security; in particular information security management systems (ISMS), security processes, security controls and services; Cryptographic and other security mechanisms, including but not limited to mechanisms for protecting the accountability, availability, integrity and confidentiality of information; Security management support documentation including terminology, guidelines as well as procedures for the registration of security components; Security aspects of identity management, biometrics and privacy; Conformance assessment, accreditation and auditing requirements in the area of information security; Security evaluation criteria and methodology. SC 27 engages in active liaison and collaboration with appropriate bodies to ensure the proper development and application of SC 27 standards and technical reports in relevant areas.	125	66	JTC 1/SC 27/SWG-T Transversal items JTC 1/SC 27/WG 1 Information security management systems JTC 1/SC 27/WG 2 Cryptography and security mechanisms JTC 1/SC 27/WG 3 Security evaluation, testing and specification JTC 1/SC 27/WG 4 Security controls and services JTC 1/SC 27/WG 5 Identity management and privacy technologies
ISO/JTC 1/SC 29	Coding of audio, picture, multimedia and hypermedia information	na	The ISO/JTC1/SC29 works on the standardization of coded representation of audio, picture, multimedia and hypermedia information and sets of compression and control functions for use with such information, such as: Audio information, Bi-level and Limited Bits-per-pixel Still Pictures, Digital Continuous-tone Still Pictures, Computer Graphic Images, Moving Pictures and Associated Audio, Multimedia and Hypermedia Information for Real-time Final Form Interchange, Audio Visual Interactive Script ware. It excludes from its scope the Character Coding domain.	475	59	JTC 1/SC 29/WG 1 Coding of still pictures JTC 1/SC 29/WG 11 Coding of moving pictures and audio

Technical Committee (TC) Reference	Technical Committee (TC) Title	Creation Date	Scope	Standards		Structure
				published	under development	
ISO/TC 184	Automation systems & integration	1983	The ISO/TC 184 has its standardization activities in the field of automation systems and their integration for design, sourcing, manufacturing and delivery, support, maintenance and disposal of products and their associated services. Areas of standardization include information systems, robotics for fixed and mobile robots in industrial and specific non-industrial environments, automation and control software and integration technologies. These standards may utilize other standards and technologies beyond the scope of TC 184, such as machines, equipment, information technologies, multi-media capabilities, and multi-modal communication networks. Standards in the following areas are excluded from the scope of this TC: Electrical and electronic equipment as dealt with by IEC/TC 44; PLCs for general application as dealt with by IEC/TC 65; Multi-media capabilities as dealt with by IEC/TC 100.	753	286	TC 184/AG Advisory group TC 184/WG 6 OGI TC 184/SC 1 Physical device control TC 184/SC 2 Robots and robotic devices TC 184/SC 4 Industrial data TC 184/SC 5 Interoperability, integration, and architectures for enterprise systems and automation applications
ESCIES	European Space Components Information Exchange System (ESCIES)	na	The European Space Components Information Exchange System (ESCIES) is a repository for EEE parts information hosted by ESA, on behalf of the Space Components Steering Board, as part of the European Space Components Coordination.	43	na	- Component Standards - Component Quality Assurance: Reliability, Alerts, and Problem Notifications, Non-conformances, Lessons Learned - Component Radiation Data - Component Evaluation - Component Manufacturers and Suppliers Data - Previous Component Usage

11. CONTACTS

ILNAS
Institut Luxembourgeois de la Normalisation, de l'Accréditation, de la Sécurité et qualité des produits et services – Organisme luxembourgeois de normalisation
1, avenue du Swing
L-4367 Belvaux
Phone: (+352) 247 743 40
E-mail: normalisation@ilnas.etat.lu

ANEC GIE
Agence pour la Normalisation et l'Économie de la Connaissance
1, avenue du Swing
L-4367 Belvaux
Phone: (+352) 247 743 70
E-mail: anec@ilnas.etat.lu

CONTACT:

ILNAS & ANEC

Southlane Tower I

1, avenue du Swing • L-4367 Belvaux

Tel.: (+352) 24 77 43 -70 • Fax : (+352) 24 79 43 -70

E-mail : anec@ilnas.etat.lu

www.ilnas.lu