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Space Infrastructure Foundation is a 501(c)(3) whose purposes embrace the concept of space based capabilities benefiting humanity. Our technical approach is open, voluntary consensus standards based. We view the US space industry as a global industry leader.

SIF Comments are included in attachment 1
A possible global space architecture as presented to the ISO Subcommittee for Space Systems a Operations is included in attachment 2
A draft of the top level international standard for manned spaceflight is included in attachment 3

Space Infrastructure Foundaton Comments on Export Administration Regulations: Control of Spacecraft Systems and Related Items the President Determines No Longer Warrant Control Under the United States Munitions List

Perspective:

From a commercial development viewpoint ITAR is seen as an intentional regulation of certain technical capabilities with relation to arms. In other words (commerce type language) ITAR is in place to impose a non-tariff barrier to trade on arms

- On US companies seeking international business
- On foreign organizations seeking US goods or services.

This ITAR barrier imposition may be warranted but cost must be analyzed. Space capabilities are viewed by arms regulators as arms capabilities. This perspective is only partially correct and is applied under current ITAR in a burdensome manner for general space providers and users.

From a commerce viewpoint there is a clear and compelling need to open global space markets for US companies.

- A key enabler to opening markets is the existence of open standards to overcome/limit non-tariff barriers to trade
- Development of open standards requires[1]
    - An architecture for the (space) enterprise
    - Establishment of common terms and definitions

Reason for a change in ITAR

The US position in the global space marketplace is being eroded over time due in large part to ITAR constraints.

Points for considerations

[1] REMARKS OF MATTHEW H. MURRAY, Deputy Assistant Secretary of Commerce for Europe/ Eurasia, World Trade Center Moscow, U.S.-Russia Standards and Conformity Assessment Forum 30 May 2013 (http://wto.wtcmoscow.ru/en/novosti/1020)

Global comment 1): Regulation of "technology" as a general term is not possible as it is not measurable. Regulation of specific technologies may be possible (e.g., Space-qualified FPGAs). This problem is pervasive through ITAR as it exists today. A good description of terms and definitions will go a long way to eliminating the use of non-measurable barriers to trade. Other terms needing definition are "military or intelligence missions" and "high performance parameters". This problem is promulgated into the Appendix 2 of the draft package.

Global comment 2: DoD be required to determine SECs in language compatible with an open space enterprise architecture (or an equivalent) reviewed and accepted by consensus by US open space standards development participants[2].

Global comment 3: Manned spaceflight is attached very broadly. Suggest referenced to international space standards such as ISO 17763 or others. Create exceptions related to safety for commercial flight related to commercial operations in national controlled airspace. By this logic ITAR and CCL would not control manned spaceflight technology but FAA/AST regulation (including standards) would. FAA/AST, as assigned by Congress, is working with US industry to determine regulatory structure for commercial manned spaceflight.

Specific Comments (by exception)

1) Appendix 1, Category XV :
    a. Paragraph (a)(4): As stated this constraint is too broad. For example: existing efforts to launch commercial or disaster response CubeSats off the ISS fit this constraint. Recommend limiting the criteria, or if this is not possible, eliminate this item from the USML Cat XV.
    b. Paragraph (a)(9): As stated this Position, navigation and Timing (PNT) constraint is too broad. There are currently five (5) GNSS systems in existence or advanced stages of development, all utilizing the basic technology of GPS. That cat is out of the bag. Recommend clarifying the requirement to specify a timing constraint, as both positional information and navigational information are based on timing solutions. Additional clarification of PNT constraints may be stated as any mathematical combination leading to a real time resolution better than XX centimeters.
    c. Paragraph (a)(11): As stated this constraint is too broad. It is inconsistent by Public law to constrain the FAA from constraining commercial manned spaceflight activities prior to 2015, yet impose ITAR additions in the same time frame. ISO (draft) standard 17763 (attached to e-mail) outlines specific areas in discussion in the international community on manned spaceflight standards. It is very specific. Any constraint on the USML Cat XV list should go to at least the same level as ISO 17763 level III of detail inclusion. If DoD and DoS cannot do that they are showing an insufficient level of expertise in this topic area.

[2] No added regulation or authority is needed to meet this requirement. The NTTAA requires USG participation in use and development of open standards. Current efforts include architecture development to aide standards strategy.

d. Paragraph (e) (2): As stated this constraint is too broad. There is a theoretical limit to ground resolution at specific apertures. What is the ground resolution theoretical limit? Specify that. For example, ground resolution better than 1 m might be constrained, but less than 1m is not. Base calculation on the mathematical theoretical limit.
e. Paragraph (e)(5): As stated this constraint is too broad. Same comment as for (e)(2). It might make sense to add a time factor such as "resolution at XX meters within YY seconds".
f. Paragraph (e)(11): Move to the CCL.
g. Paragraph (e)(13): Restate this criteria in language consistent with comments (e)(2) and (e)(5). Do not constrain the technology, constrain the degree of capability.
h. Notes 2: Note 2 main body, Note2 and Note 3: It is not clear if space qualified applies only to heritage items or improvements over heritage items (e.g., using statistical process control). Strictly applying the constraint to heritage only is OK, but statistical improvements can only occur in a commercial context and should not be constrained under USML. They may properly be constrained under CCL.

2) Appendix 2, Proposed CCL ECCN 9X515: This section needs to be rewritten using the same criteria established to rewrite the USML. It is written in the language of the current USML with a different format. Therefore it is inconsistent with the draft USML in Appendix 1.

Discussion of SC14 Strategy Implementation
- Strategy Framework-

For SC14 Heads of Delegation

ISO TC20/SC14
May 2013

Analysis and Presentation by
Frederick A. Slane
US Head of Delegation
Space Infrastructure Foundation

2013 Topics:

Framework Description and View Analysis

2012 Topics:

Issues

Removing Gaps

Organization

Are There Gaps?

- In ISO space standards we do not address gaps ...there is a need to discuss open issues

- Examples might include how SC14 serves (or does not serve) external customers explicitly. Currently we assume we are serving external customers but we have no metrics to show this is the case.

Enterprise View Definitions

OV – Operational View

Describe interaction between organizations or people

SV – Systems View

Describes systems and their interaction

SerV – Services View

Describes services and their interaction

Note: All organizations produce a system or a service, or a combination of both

SC14 Strategic Objectives

Objectives:

Provide service terrestrial applications including

- satellite communications
  - for education and health
  - for logistical support
  - others
- disaster management
  - Earth Remote Sensing
  - environmental surveillance and protection, including protection against infectious diseases
  - management of natural resources (e.g., energy and water)
  - intelligent roads
  - sustainable development in mountainous areas
  - maritime surveillance (against piracy, border security, supply chain safety)
- global navigation (centimeter scale)
- tourism

Provide service non-terrestrial applications including

- space-to-space communications
- space disaster management
  - orbital debris mitigation
  - orbital debris management
- Remote Sensing
  - scientific investigation
- exploration
- space surveillance (against orbital traffic, natural objects)
- space navigation (? scale)

NODE: AV	TITLE: Transnational Space Architecture	NO.: 1

SC14 Strategic Objectives (cont)

Provide service space-based functions including

- space transportation (launch and propulsion) using
  - chemical
  - electrical
  - hybrid
  - mini- and micro-systems
- ground support
  - launch facilities
  - general or use specific receiving stations (see terrestrial applications above)

Provide systems (goods) to achieve terrestrial applications (as listed) and non-terrestrial applications (as listed)

- spacecraft
  - unmanned orbiting systems
  - manned orbiting systems
  - unmanned exploration systems
  - manned exploration systems
- launch systems
- ground systems

Provide operational interactions to allow organizational components to achieve terrestrial applications (as listed) and non-terrestrial applications (as listed)

- spacecraft operators
- launch providers
- launch vehicle providers
- upper stage providers
- orbital transfer vehicle operators
- etc.
- ground segment operators
- launch facility operators
- launch range operators

Consideration of lifecycle (design, manufacturing/fabrication, integration, test, operations and disposal) of all of the above is an explicit consideration.

NODE: AV	TITLE: TSA Objectives (continued1)	NO.: 2

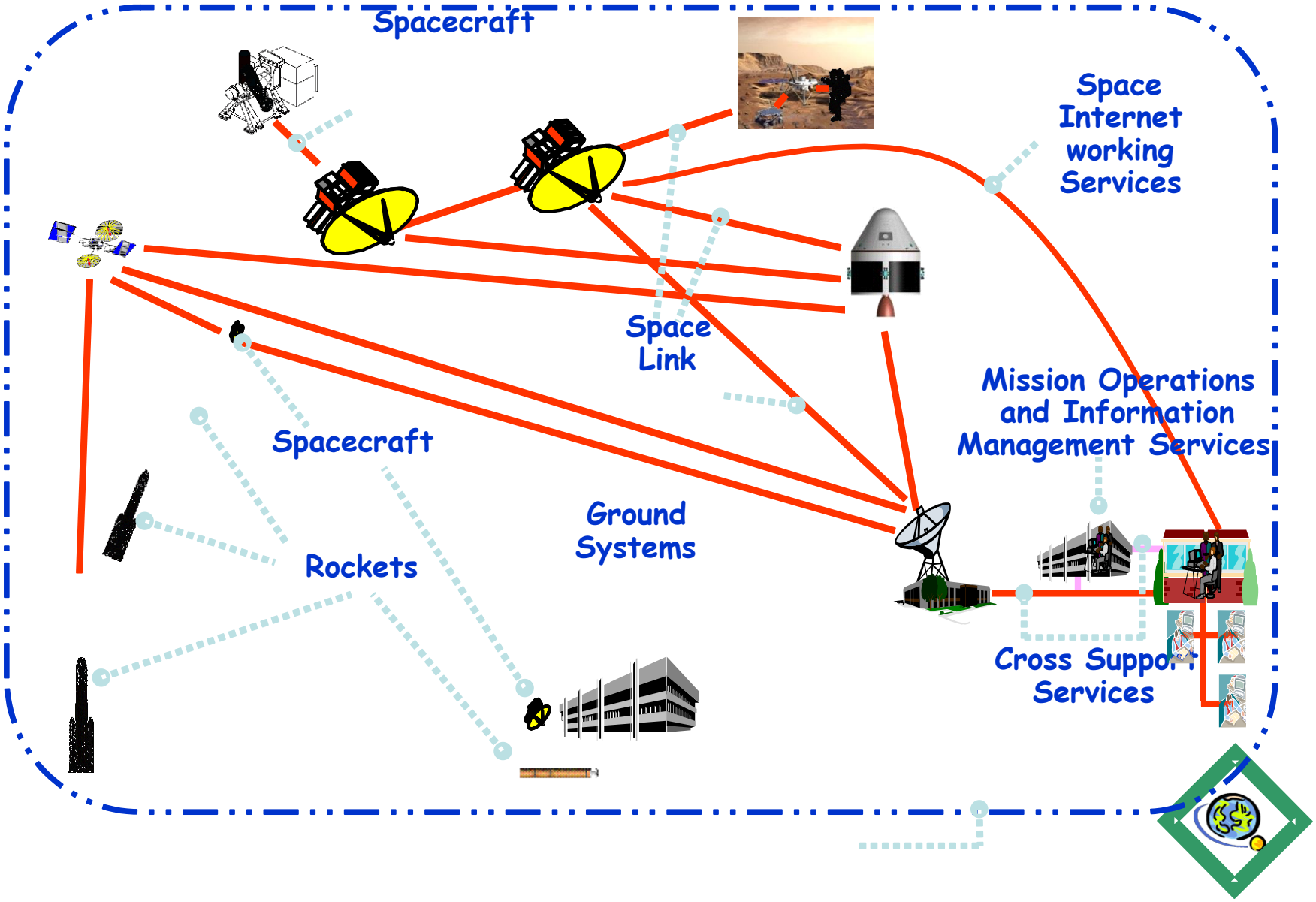
SC14 Strategic Capabilities

Derived Capabilities include:
Uplink, downlink, distribute, collect and process data and information at terrestrial nodes
Uplink, downlink, distribute, collect and process data and information at orbiting and planetary nodes
Control positions in time and space for orbiting and planetary nodes
Transport systems to operational locations

NODE: AV	TITLE: TSA Capabilities	NO.: 3

The Space Framework

(Common view with CCSDS and SC13)



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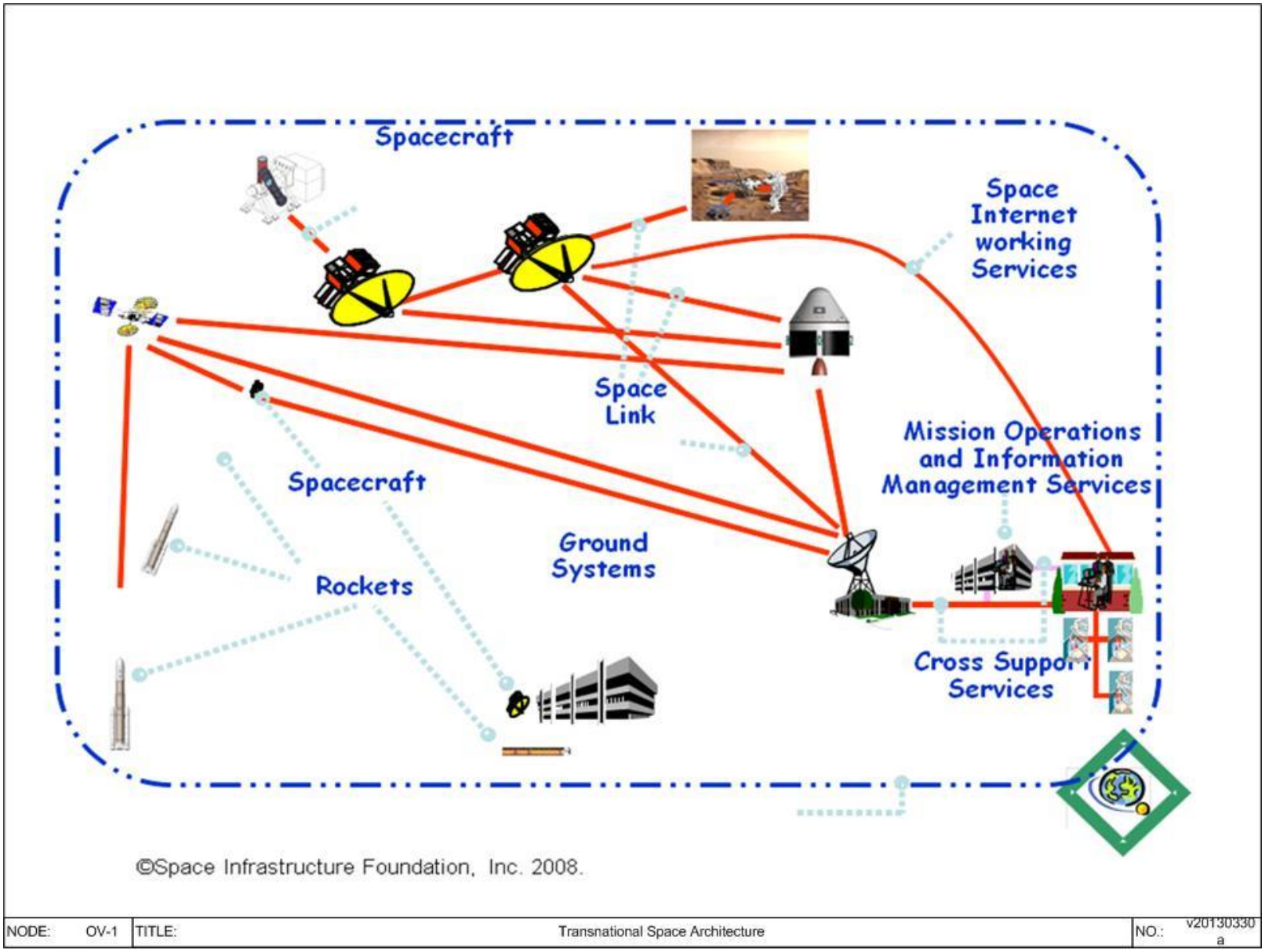
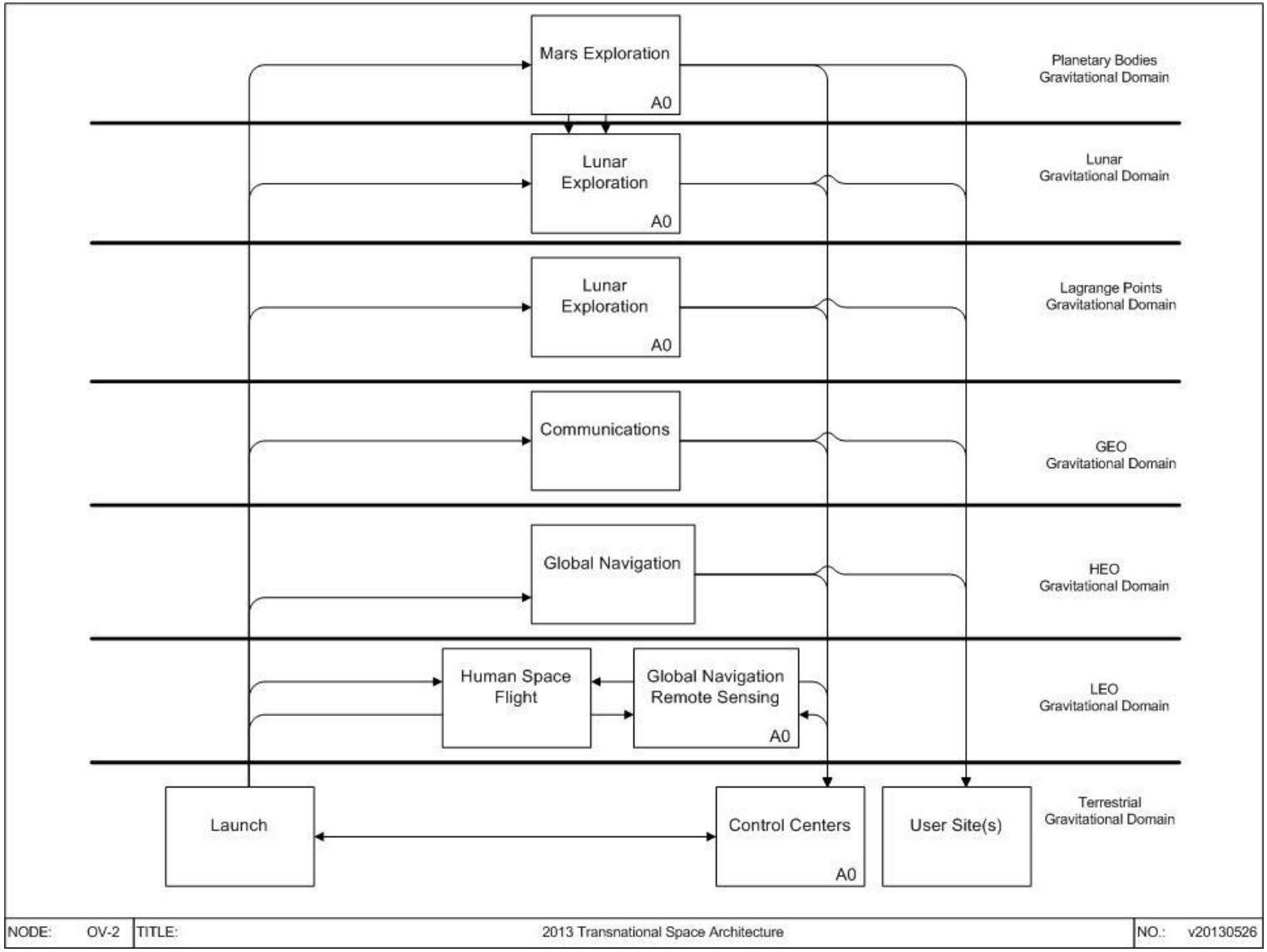
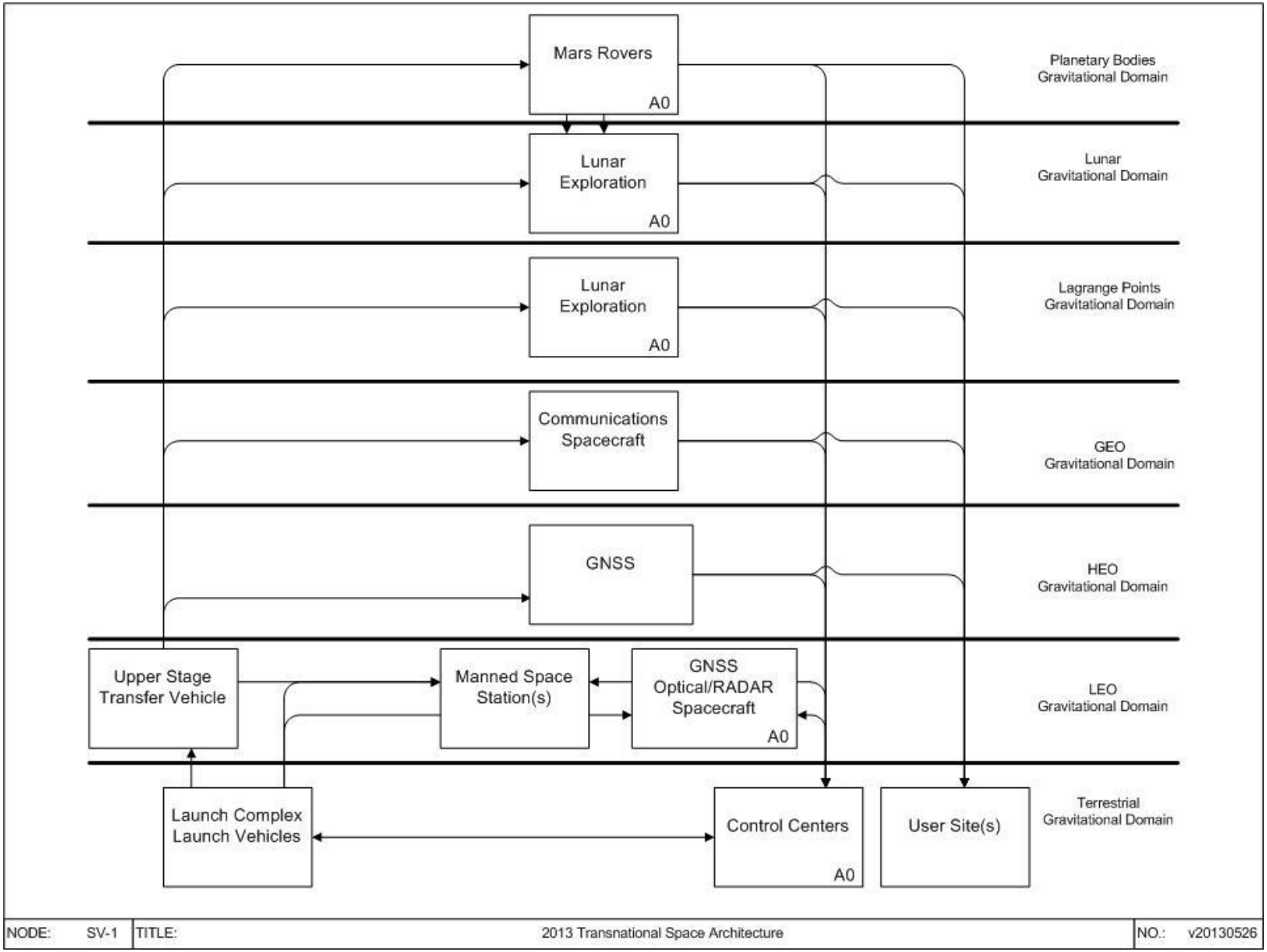
SC14 Strategic Framework as an Operational View Graphic



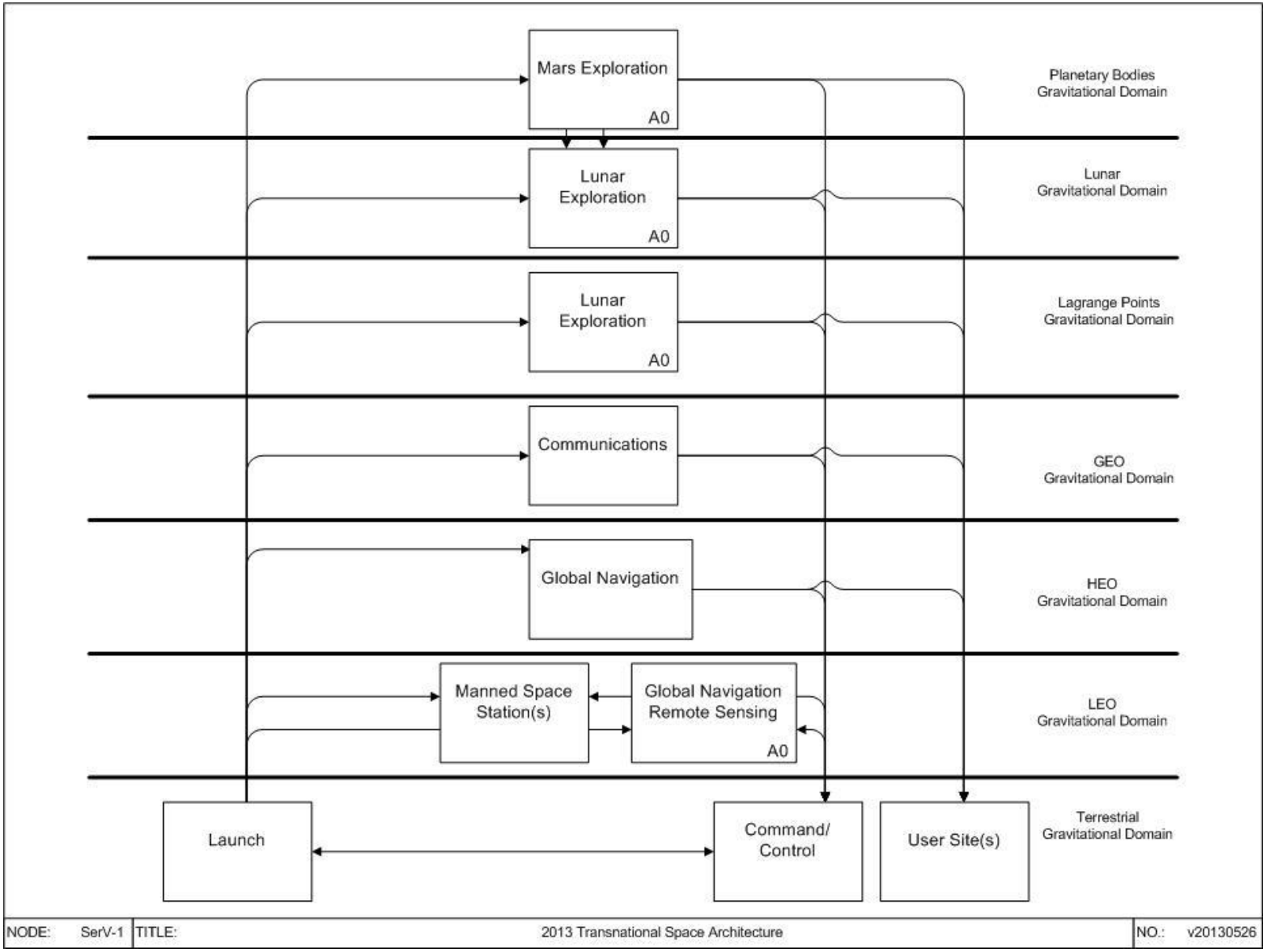
SC14 Strategic Framework as an Operational View Block Diagram



Systems View Block Diagram



Services View Block Diagram



Technical (Standards) View (13 of approximately 300 standards)

Number	Name	View	Location
10785	Space systems — Bellows — Design and operation	SV-1	SC design
10786	Space Systems — Structural components and assemblies	SV-1	SC design
11221	Space systems — Space solar panels — Spacecraft charging induced electrostatic discharge test methods	SV-1	SC design
14302	Space systems — Electromagnetic compatibility requirements	SV-1	SC design
14621	Space systems — Electrical, electronic, and electromagnetic (EEE) parts — Control program requirements	OV-2	SC design
14621	Space systems — Electrical, electronic, and electromagnetic (EEE) parts — Parts management	OV-2	SC design
14622	Space systems — Structural design — Loads and induced environment	SV-1	SC design
14623	Space systems — Pressure vessels and pressurized structures — Design and operation	SV-1	SC design, operation
14953	Space systems — Structural design — Determination of loading levels for a static qualification test of launch vehicles	SV-1	LV design
14954	Space systems — Exchange of mathematical models for dynamic and static analysis	OV-2	SC design
15387	Space systems — Single-junction solar cells — Measurements and calibration procedures	SV-1	SC design
16126	Space Systems — Assessment of survivability of unmanned spacecraft against space debris and meteoroid impacts to ensure successful post-mission disposal	SV-1	Control operations
16127	Space systems — Prevention of break-up of unmanned spacecraft	SV-1	Control operations

Possible Analysis: View Type

View Type	Number
OV-2	97
SV-1	48
SerV-1	38
Total SC14 Standards	183

What does this tell us about how we service the SC14 objectives?

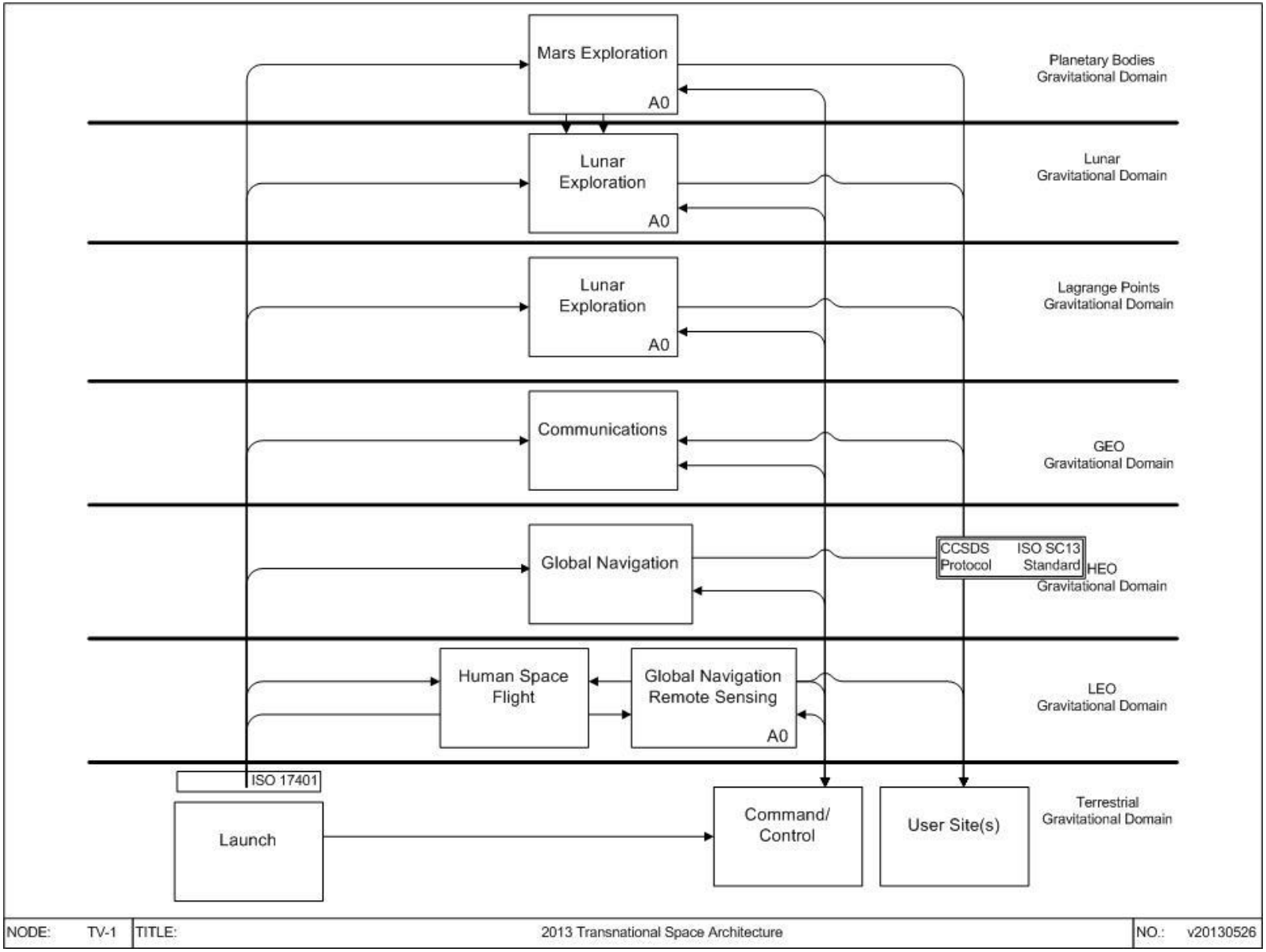
Summary

SC14 HODs have worked to establish a strategy for space systems and operations standards development. This work needs periodic review to stay relevant.

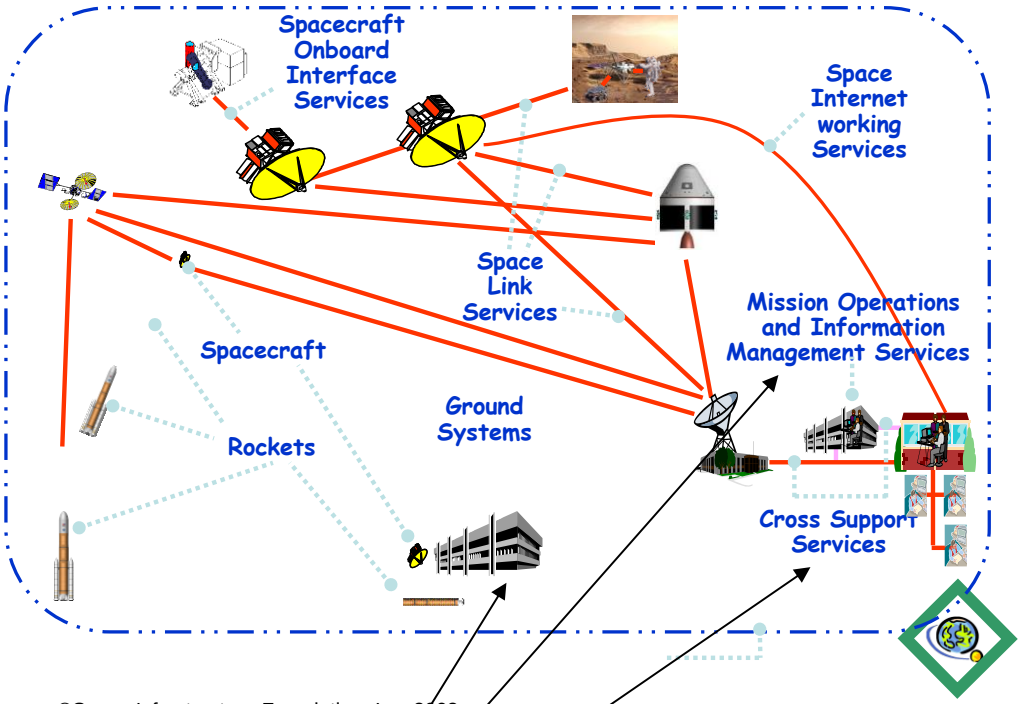
The strategy can guide SC14 work program and organization. This presentation is intended to enhance understanding and facilitate decision making by SC14 leadership. Enterprise Architecture framework methodology is used to initiate detailed understanding of gaps and overlaps in actual ISO space standards. Today we looked at analysis by View type.

Backup

Technical (Standards) View



Organizational Interactions



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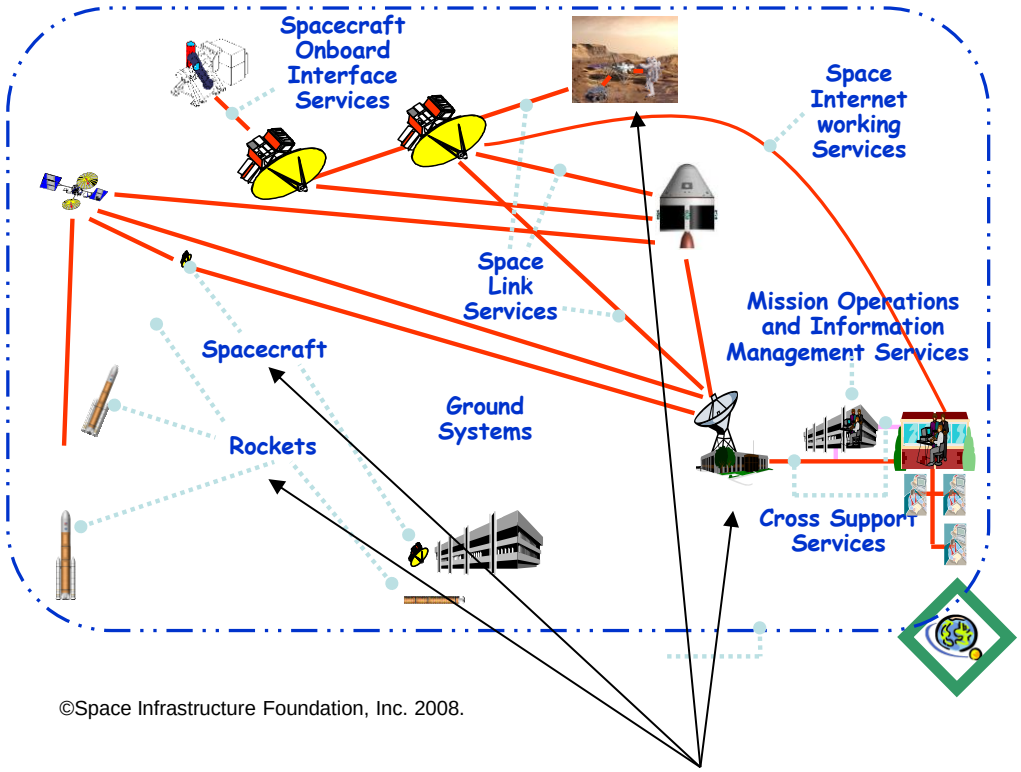
WGs 3 and 5 and the ODWG include coverage of some internal space organizational interactions (operations, program management and debris self-regulation)

Systems*



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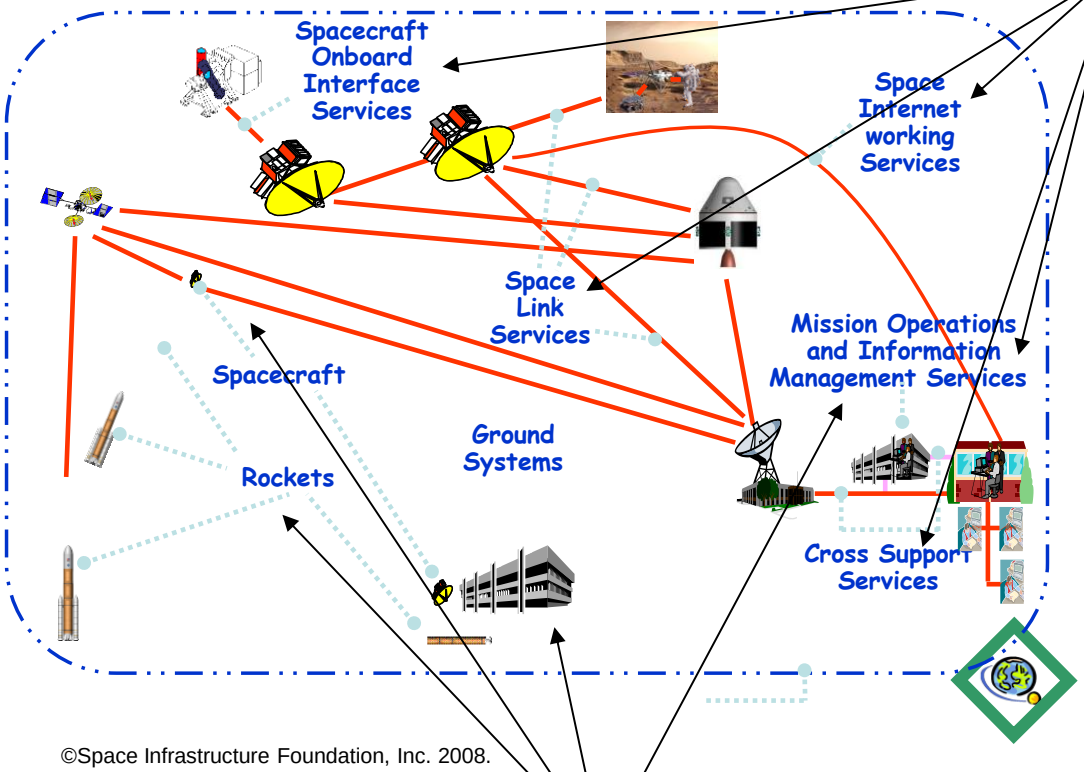
WGs 1, 2, 3 and 6
Include coverage of
Some internal
space systems

* Products include Goods and/or Services. The Systems outlined here are synonymous to Goods.

Services



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CCSDS/SC13 includes coverage of space data and communications protocols and interfaces, some of which support SC14 efforts

SC14 WGs 2, 3 and 4 include coverage of some internal Internal space service areas that require or compliment CCSDS/SC13 efforts

There are space mission services where SC14 and CCSDS have interface and touchpoints for topics of common interest and collaboration. Generally, in these areas,

- CCSDS covers standards regarding data and comm interoperability
- SC14 covers standards regarding systems and operations interoperability (e.g., processes, materials)

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Committee identification: ISO/TC 20/SC 14/WG 6

Secretariat: XXXX

Space systems — Human-life activity support systems and equipment integration in space flight

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A.2 Second level 1
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References ..... Error! Bookmark not defined.

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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ISO nnn-n was prepared by Technical Committee ISO/TC 20, *"Aircraft and space vehicles"*, Subcommittee SC 14, *"Space systems and operation".*

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0 Introduction

This is a first level standard in a set of documents regarding human-life activity support systems and equipment integration in space flight.

This standard, along with second and third level standards, form a complex three-level international standard entitled «Space systems. Human-life activity support systems and equipment integration in space flight».

The second level covers standards on several issues and is entitled: Techno-medical requirements for spacecraft crew habitation environment - Requirements for life activity support of a human in spacesuit and other requirements

The third level covers standards on separate tasks, with specific requirements mentioned in second level documents.

NOTE: detailed data regarding this first level standard are presented in Annex A.

0.1 Basis for standard development

The experience from RSC Energia, Russia allied organizations, and the authors themselves was summarized in order to develop this proposed standard regarding the development and operation of Salyut LSS, Mir, and ISS space stations. In addition, the experience of joint operations with NASA in the Mir-Shuttle and Mir-NASA international programs, as well as the experience of operation with international partners during the Mir and ISS space stations operation was taken into account.

Russian standards, USA standards and joint international normative documents were used to develop this first level standard, in human life activity support during space flight.

0.2 Purpose

The purpose of this standard is to develop a common approach and unified requirements for comfort and safe life conditions of a human in space flight. Maintenance of these conditions is required for human life support systems and equipment in space flight.

Unified standards encompass comfort and safe life of the crew in nominal flights and off-nominal situations associated with living conditions. Such standards increase crew efficiency and support their health.

Difficulties in manufacturing support systems and equipment are eased under international integration projects if such unified requirements , are applied.

0.3 Tasks

The tasks of a first level standard include:

- definition of requirements for development of ecological habitability in limited pressurized volumes,

- definition of second and third level standards, the requirements of which shall support human life activity in space vehicle conditions.

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Space systems — Human - Life activity support systems and equipment integration in space flight

1 Scope

This first level standard is the main standard among several others regarding human-life activity support systems and equipment integration in space flight.

This standard, along with second and third level standards, form a complex three-level international standard entitled «Space systems. Human-life activity support systems and equipment integration in space flight».

It is applicable to tripulated programs in all manned space objects, including space systems, space stations, lunar and planetary bases, as well as extravehicular activity. It covers all phases for developing a manned space object, such as design, production, tests, operation, and maintenance.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
Human habitation environment in space systems
Human habitation environment in space systems is a complex issue that involves material, energy and information flow, as well as elements formed in SS habitable compartments. Such elements are derived from life activity processes, human social-labor processes, space factors, space mobility, and hardware functioning processes. The hardware is designed to arrange humans' interaction with the habitation environment in order to provide specified conditions for human life activity in space flights.

3.2
Human living conditions in SC
Human living conditions are a complex of human habitation environment parameters in SC, providing health maintenance, human safety and keeping of his ability to work at a level needed to execute the planned work program

3.3
Techno-medical requirements for human habitation environments
Techno-medical requirements in space systems are a complex of biomedical, hygiene/sanitary, ergonomic and design issues. Those requirements take into account physiological and social-psychological human needs in the process of hardware development and operation in order to guarantee specified living conditions aboard space systems.

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4 Symbols (and abbreviated terms)

SS space station

5 Application of the standard in space programs

Upon implementation of space programs, integration with human life activity shall be considered at all levels – from individual components to full integration.

5.1 Standard applicability

All requirements stated in this standard, unless otherwise specified, shall be applicable to all phases of the flight program.

5.2 Specific program guidelines

Each manned space program shall establish its specific guidelines for development of this standard. These guidelines shall be verifiable.

5.3 Monitoring of the flight program compliance according to the standard

Each manned space program shall be subjected to permanent monitoring to verify compliance with the standard, including design, development, tests, and operation.

5.4 Verification of program requirements

Each manned space program shall be verified for requirements in accordance with this standard.

6 General

6.1 Matter terrestrial cycle

During terrestrial life activity a human consumes oxygen, water and some other products from the biosphere, which regulate life activity. Oxidation reaction products are released to the environment as carbon dioxide and liquid and solid waste products. In terrestrial conditions these products are processed by bacteria, plants, animals, which restore them to oxygen, water, foodstuff and other parent substances, completing a closed cycle of matter.

Completion of such biological cycle aboard modern space systems is not feasible due to low energy efficiency for natural processes, their unreliability in small volumes, inadequate level of system readiness, and equipment heavy mass.

6.2 Human life activity support in space flights

Human life activity support in space flights is provided through the employment of pressurized modules in which an artificial habitation environment is assured throughout flight.

Under space flight conditions all circulation functions are solved based on special physico-chemical methods for substance regeneration, which are performed by life activity support systems and equipment.

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6.3 Human habitation environment during long-term space missions

For this standard, the concept of space object habitability is based on human physiological and hygiene requirements. The tasks for life activity support systems/equipment are to provide required physico-chemical environmental parameters, to guarantee amount and quality of consumed products (oxygen, water, food), and to dispose of waste products for the specified time period.

When applying requirements of biologically adequate habitation environments to human life activity support systems and equipment, formation of an appropriate environment is required, which shall be suitable to support current organism life activity, in addition to normal evolution of future generations. Biological adequacy of the habitation environment can be achieved through biological mechanisms similar to natural ecosystems. Among such systems, there should be biological sections providing cycle of matter. At this moment, only time-limited human habitability is assured, since biogenic components of the habitation environment are not taken into account (native habitation environment components include a great amount of organic substances released by plant and soil organisms, Humans inhale air rather than oxygen. In addition, natural water is a complex multicomponent product).

The task of biologically adequate human habitation environment will be solved at the several stages of a program evolution. For this purpose this standard will be updated and ammended.

7 Basic provisions

This standard applies to:

- manned space vehicles, space systems, habitable compartments of orbital transportation vehicles, on-orbit complexes, space stations with long-term human presence, up to 3 years;

- unmanned space vehicles designed for operation jointly with space systems as regards to control of hygiene and sanitary conditions, as well as toxicological safety;

- research and experimental equipment installed in crew compartments, as well as materials, hardware and systems. A permit is necessary to employ these items in crew compartments of space systems, considering sanitation, microbiological and toxicological parameters.

7.1 Validity of general techno-medical requirements

General techno-medical requirements are defined regarding habitation environments for crew compartments within independently functioning space systems, in long-duration missions (up to 3 years), considering intermittent human presence.

7.2 Assurance of habitation environment

The space system habitation environment is provided for a category of people whose health status and physical fitness meet relevant medical requirements. Such conditions are previously defined in documents stating medical examination procedures and fitness validation for human candidates to complete the program.

7.3 General techno-medical requirements

General techno-medical requirements are defined with regards to safety assurance of human stay in the space system habitation environment. Many issues are involved such as health conditions, efficiency and fitness of professional activity throughout the space flight and after its completion.

The requirements include norms, procedures, actions, limiting indicators for environmental parameters, as well as correction methods for human status. These methods shall compensate for inadequate efficiency during evaluation of human needs, which is done in the developing phase of the habitation environment.

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7.4 Requirement Compliance

The achievement of requirements shall be controlled during hardware tests and operation in order to assure that the human habitation environment in a space system is in accordance with design and maintenance documentation (flight data file).

7.5 Supply and maintenance of a habitation environment

The habitation environment in space systems shall be provided and maintained at the specified level for human life activity support systems and equipment, as well as ground and onboard equipment. Techno-medical procedures for space flight assurance shall be considered depending on configuration and structure of a space system.

7.6 Assurance of conditions for human life activity support

Complexity and parameter values listed in the standard shall provide conditions for human life activity support in all modes and at all stages of space flight, including:

- human life support conditions;

- human professional activity conditions aboard manned space systems;

- assurance of human protection in space systems, considering space environment factors and motion of space systems;

- human medical provisions;

- human life activity support conditions in emergency situations;

- human life activity support conditions during extravehicular activity.

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Annex A
(normative)

A concept of three-level structure of the international standard «SS — Human – life activity support systems and equipment integration in space flight»

A.1 General

This first level standard is the main standard among several others regarding human-life activity support systems and equipment integration in space flight.

This standard, along with second and third level standards, form a complex three-level international standard entitled «Space systems. Human-life activity support systems and equipment integration in space flight».

It is applicable to tripulated programs in all manned space objects, including space systems, space stations, lunar and planetary bases, as well as extravehicular activity. It covers all phases for developing a manned space object, such as design, production, tests, operation, and maintenance.

A.2 Second level

The second level covers standards on separate problems within «Space systems. Human–life activity support systems and equipment integration in space flight»:

- Techno-medical requirements for crew habitation environment in space systems.
- Requirements for life activity support of a human in spacesuit.
- Requirements for human working activity in space flight.
- Requirements for human rest in space flight.
- Requirements for pressurized volume architecture.
- Requirements for human medical provision.
- Requirements for physical factors during space flight.
- Requirements for human life activity support during emergencies.
- Other requirements.

A.3 Third level

The third level covers standards dealing with separate tasks and specific requirements, which are mentioned in second level standards.

EXAMPLE: The standard «Techno-medical requirements for spacecraft crew habitation environment» includes the following three standards «Requirements for atmosphere quality assurance by chemical impurity »; «Requirements for water supply», and «Requirements for provision of heat-humidity conditions», among others.

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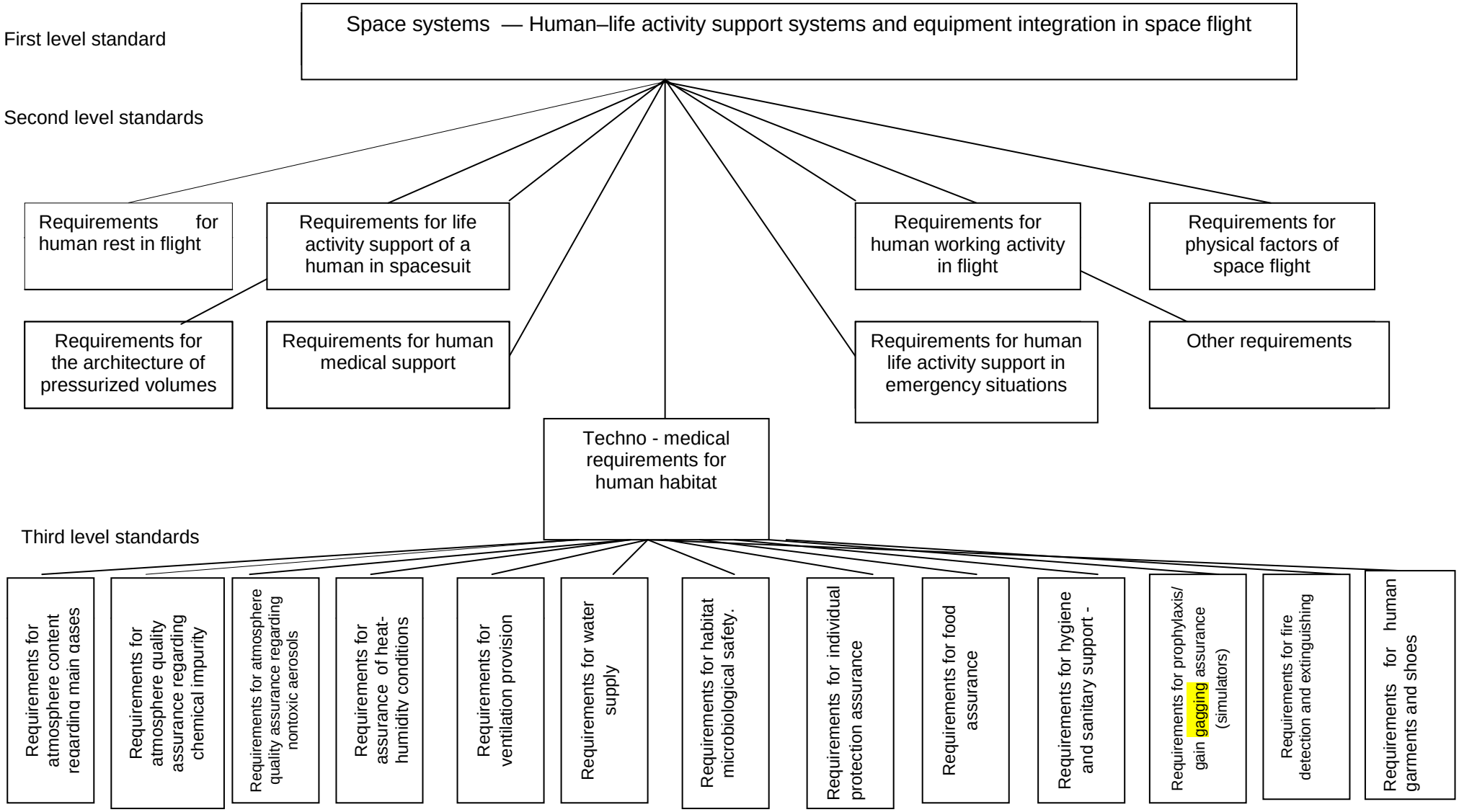

Figure 1 — Structure concept of a three-level international standard «SS. Human–life activity support systems and equipment integration in space flight »

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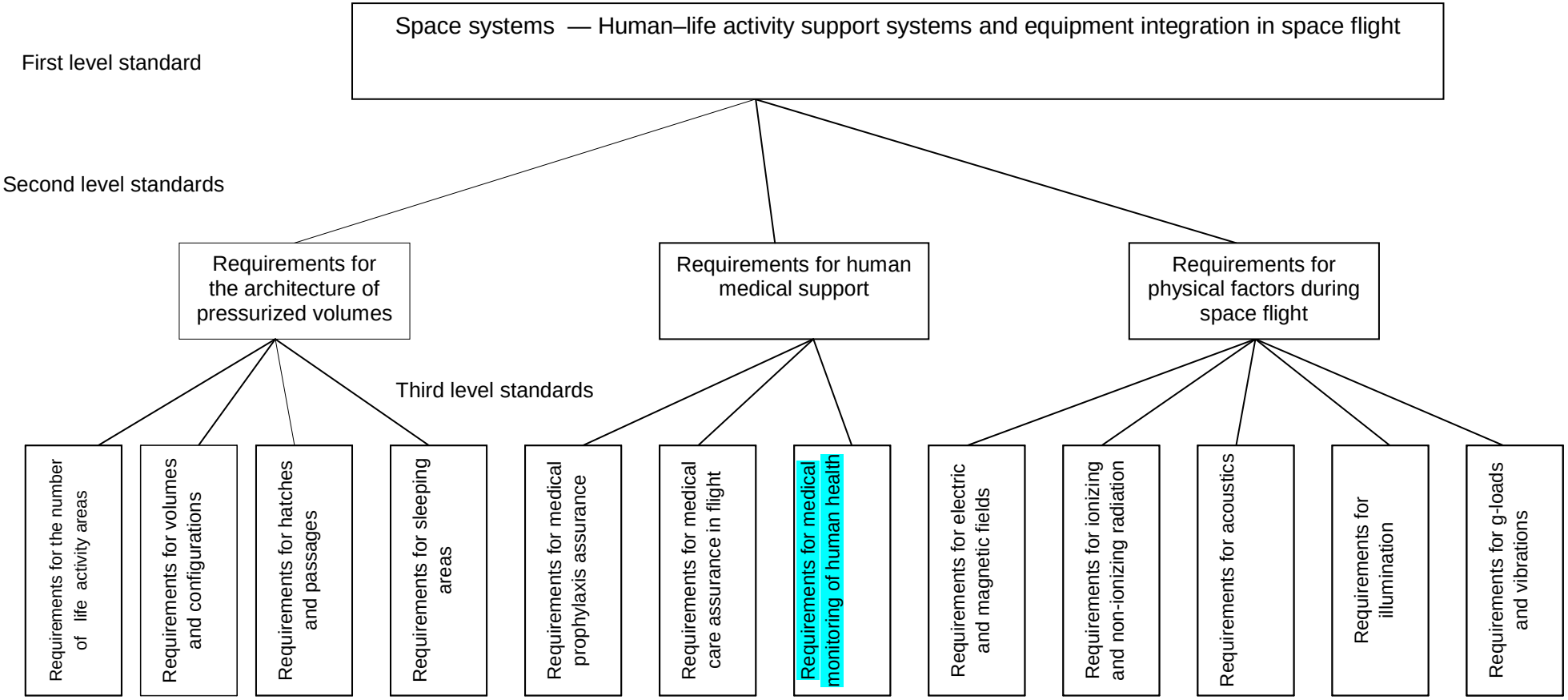

Figure 2 — Structure concept of a three-level international standard «SS. Human–life activity support systems and equipment integration in space flight » (continuation)

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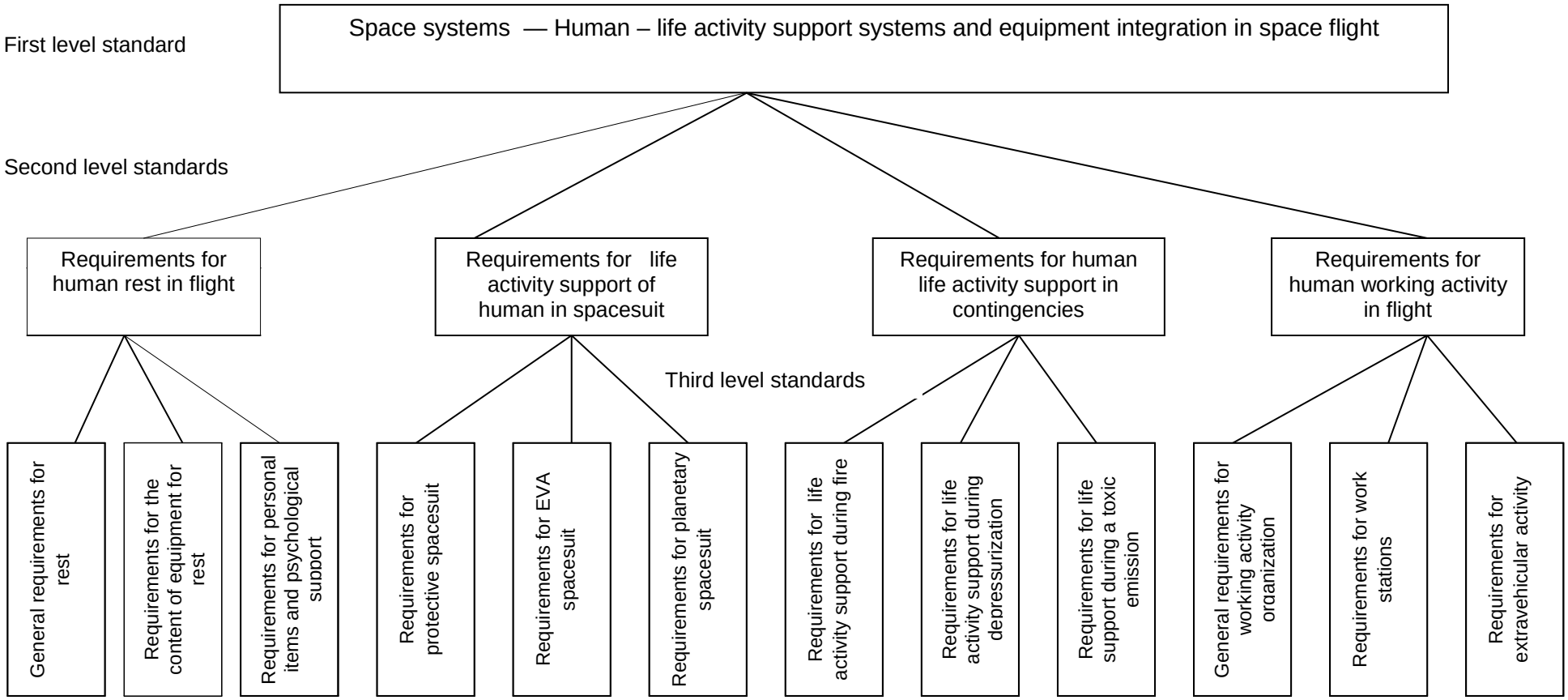

Figure 3 — Structure concept of a three-level international standard «SS. Human–life activity support systems and equipment integration in space flight » (continuation)

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