

ORBIT/SPECTRUM INTERNATIONAL REGULATORY FRAMEWORK

Challenges in the 21st century

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Global Space Industry in 2015 \$ 335.3 billion



Source: SSIR 2016 Tauri Group

Global Impact and Usage



Satellite Radio



Corporate networks



Maritime communication



Earth Observation



National Security & Defense



E-learning



Agriculture



Cellular Backhaul



Telemedicine



Aviation Security



SNG



VSAT



Internet



Disaster Relief



Global Flight Tracking



DTH



Satnav





1957 .. 1965
Development of
communication satellites

© Д. ван Раменсвады



TELSTAR

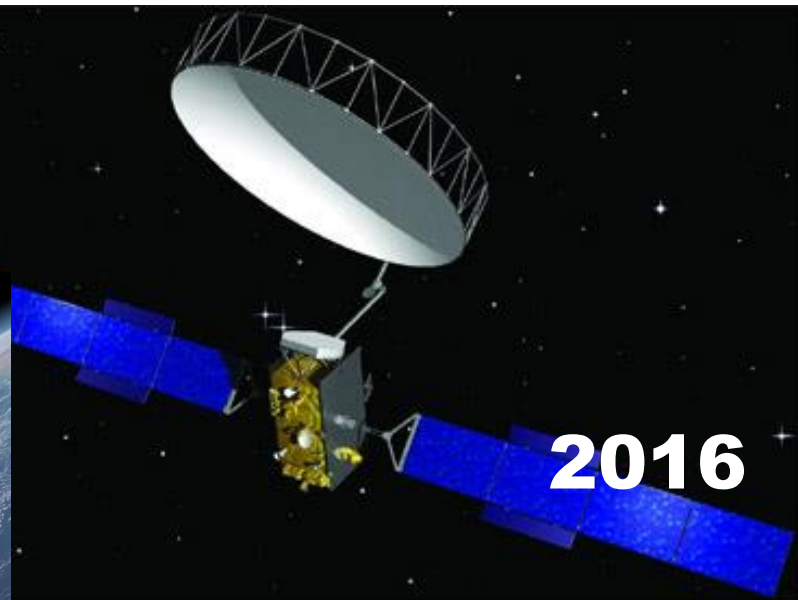
First television pictures,
telephone calls, and fax
images, and provided the first
live transatlantic television feed

SPUTNIK 1 (Спúтник-1)

First artificial Earth satellite launched on
4th October 1957 with
external radio antennas to broadcast
radio pulses



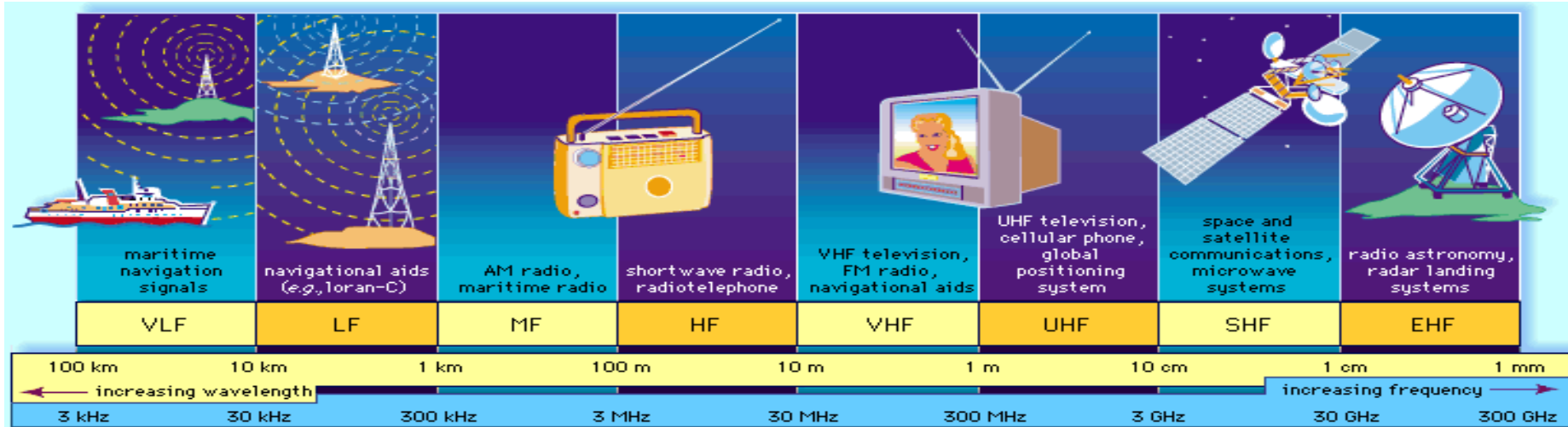
2016



2016

FREQUENCY SPECTRUM

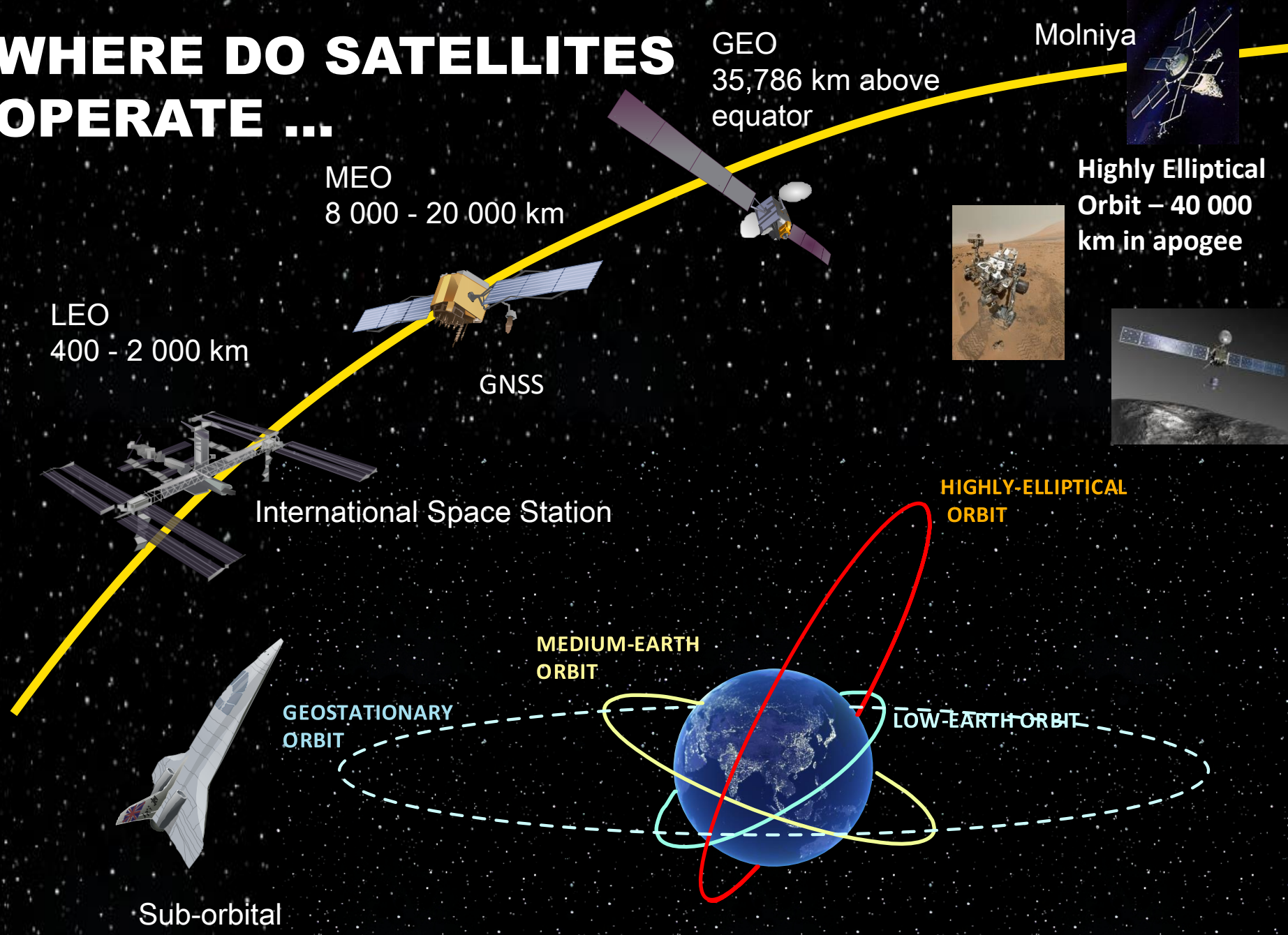
Limited natural resource



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1.467 GHz to 1.492 GHz	1.518 GHz to 1.675 GHz	1.97 GHz to 2.69 GHz	3.4 GHz to 7.025 GHz	10.7 GHz to 14.5 GHz	17.3 GHz to 30 GHz
Satellite Audio Broadcasting to fixed and mobile units	Civilian Mobile-Satellite Services (two-way)	Satellite television & radio broadcasting to mobiles + two-way mobile services	Fixed-Satellite television, & data services (including broadcasting)	Fixed-Satellite television & data services (including broadcasting)	Fixed-Satellite television & data services (including broadcasting)

WHERE DO SATELLITES OPERATE ...



LEO
400 - 2 000 km

MEO
8 000 - 20 000 km

GEO
35,786 km above equator

Molniya

Highly Elliptical Orbit – 40 000 km in apogee

GNSS

International Space Station

HIGHLY-ELLIPTICAL ORBIT

MEDIUM-EARTH ORBIT

GEOSTATIONARY ORBIT

LOW-EARTH ORBIT

Sub-orbital

GEOSTATIONARY SATELLITE ORBIT RESOURCE



265 000 km belt around Earth
36 000 km above Equator

Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat
Image IBCAO

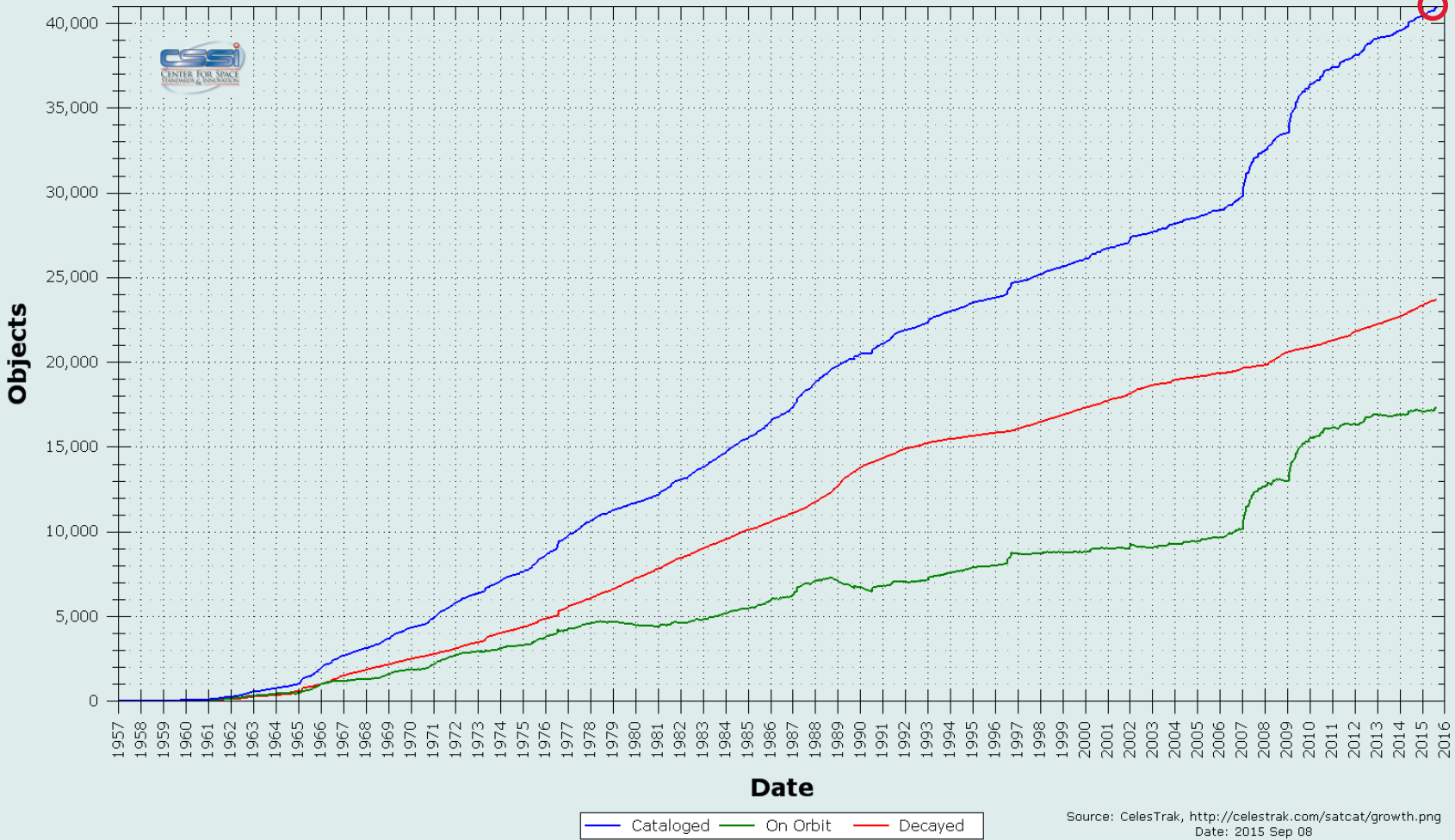
.. YET CONGESTED

Google earth

40°15'51.80" N 96°30'01.41" E eye alt 33599.81 km

40,000 objects and growing

SATCAT Growth



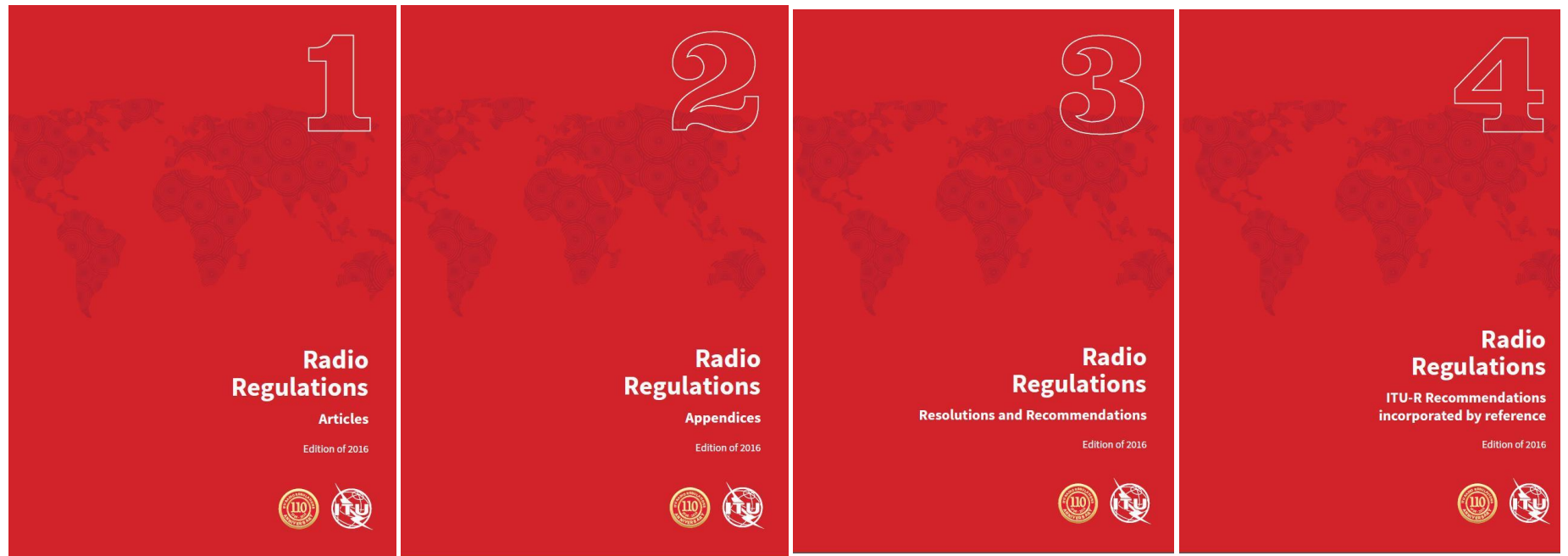
Space debris

- Inter-Agency Debris Coordination Committee (IADC) Statement on Large Constellations of Satellites in Low Earth Orbit
- Whenever possible spacecraft or orbital stages that are terminating their operational phases in orbits that pass through the LEO region, or have the potential to interfere with the LEO region, should be de-orbited (direct re-entry is preferred) or where appropriate maneuvered into an orbit with a reduced lifetime.



1963

Extraordinary Administrative Radio Conference to allocate frequency bands for space radiocommunication purposes



TODAY

More than 2000 pages of Radio Regulations

The Sustainable Development Goals



The Sustainable Development Goals

- In 2015, the United Nations adopted 17 Sustainable Development Goals (SDGs) as part of the Agenda 2030 to achieve a better future for all.
- These goals apply to all countries, whether developing or developed.
- Radiocommunications, including satellites have a key supporting role in achieving each and everyone of these 17 SDGs.

INTERNATIONAL TREATIES

1967 “Outer Space Treaty”

Treaty on Principles Governing the Activities of States in Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies

1968 “Rescue Agreement”

Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space

1972 “Liability Convention”

Convention on International Liability for Damage Caused by Space Objects

1975 “Registration Convention”

Convention on Registration of Objects Launched into Outer Space

1979 “Moon Treaty”

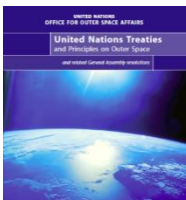
Agreement Governing the Activities of States on the Moon and Other Celestial Bodies

**ITU Constitution/Convention of 1982 listed under other agreements
ITU is recognized as the specialized agency responsible for
telecommunication issues**

UN OUTER SPACE TREATY (1967)



- Outer space free for exploitation and use by all states in conformity with international regulations
- States retain jurisdiction and control over objects launched into outer space
- States shall be liable for damage caused by their space objects



ITU RECOGNIZED AS SPECIALIZED AGENCY RESPONSIBLE FOR



- Principles of use of orbit/spectrum
- Allocation of frequency bands
- Procedures, Plans, operational measures
- Instruments (Constitution, Convention, Radio Regulations, Rules of Procedures, Recommendations)

Role of ITU in radiocommunications

- Developing and updating international regulations on the use of orbit /spectrum
- Applying these regulations
- Developing and adopting standards and best practices on the use of orbit/spectrum
- Disseminating information on these regulations, standards and best practices

ITU CONSTITUTION (Art.1)

ITU shall **effect allocation of bands** of the radio-frequency spectrum, the allotment of radio frequencies and the **registration of radiofrequency assignments** and, for space services, of **any associated orbital position** in the geostationary-satellite orbit or of any associated characteristics of satellites in other orbits, in order to **avoid harmful interference** between radio stations of different countries



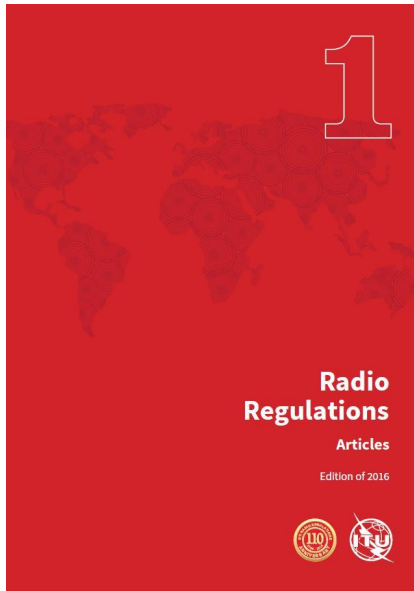
ITU Constitution

(Art.44)

Radio frequencies &
satellite orbits are limited
natural resources

Rational, Efficient,
Economical Use

Equitable Access



RADIO REGULATIONS

- Intergovernmental Treaty governing the use of spectrum/orbit resources by administrations
- Define the rights and obligations of Member States in respect of the use of these resources
- Recording of a frequency assignment in the Master Register (MIFR) provides international recognition



RADIO REGULATIONS

- Updated every 3-4 years by World Radiocommunication Conference (WRC)
- Complemented by Rules of Procedure, revised by Radio Regulations Board (RRB)



1. Harmonize global spectrum to create economies of scale, roaming and interoperability

3. Creating certainty requires consensus: time, efforts and patience

PURPOSE

2. Create regulatory certainty for a multi-trillion dollars industry playing an increasingly important role in the development of our societies



UN

Outer Space instruments
on space objects

Free “exploration & use” under
international law

States
Responsibility & licensing
Jurisdiction & control

States
Registration OOSA

States
Liable for damage



ITU

Instruments
on radio frequencies

Equitable access & rational use of
spectrum under international law

States
Must license trans. radio stations
Shall not cause harmful interf.

States
API...CR/C...MIFR

No liability clause

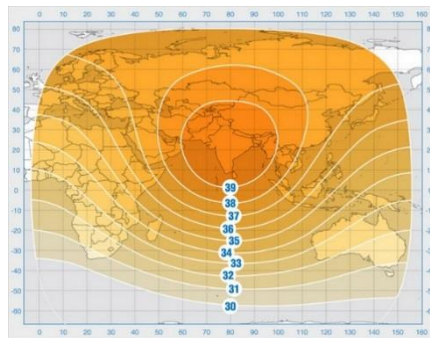
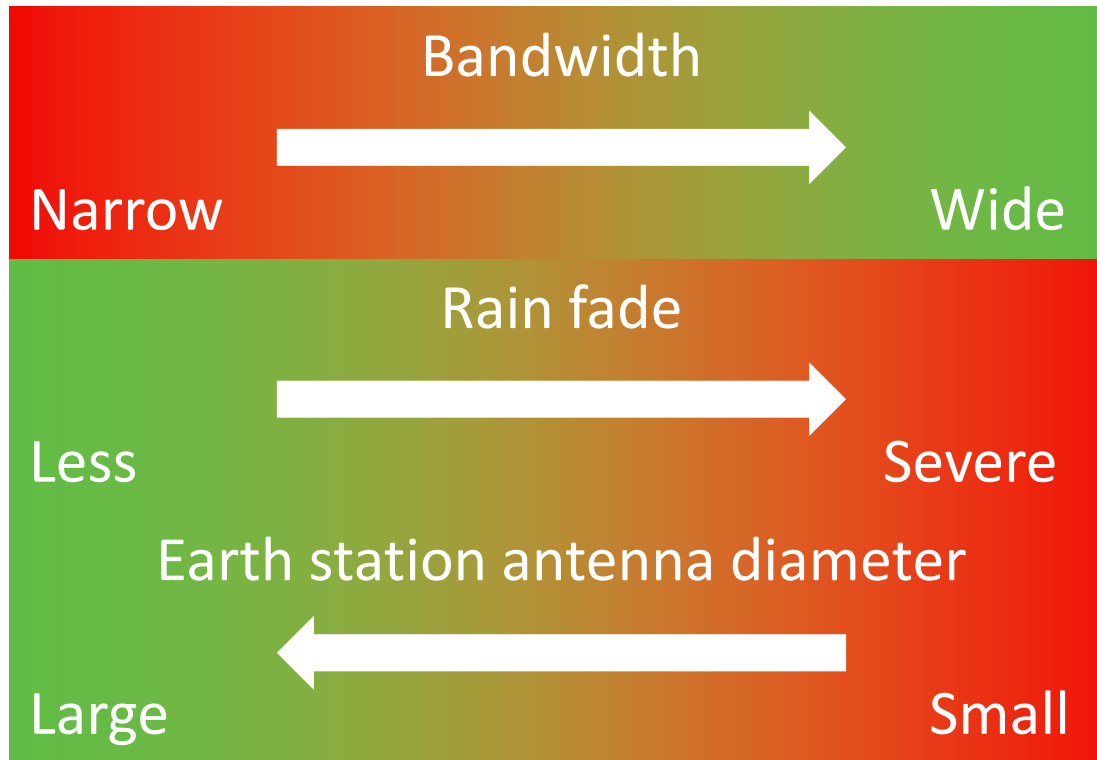
Satellite Frequencies and Services

L-band	1.0-2.0 GHz	Mobile Satellite Service (MSS) Radionavigation Satellite Service
S-band	2-4 GHz	Radars, MSS, Broadcasting Satellite Space Research
C-band	3.4-7 GHz	Fixed Satellite Service (FSS), VSATs Direct-To-Home (DTH)
X-band	7-10 GHz	Radars, Satellite Imaging Space Research
Ku-band	10-15 GHz	FSS, VSAT Broadcasting Satellite, MSS
Ka-band	17.7 - 21.2, 27.5 – 31 GHz	FSS “broadband”, inter-satellite links, MSS

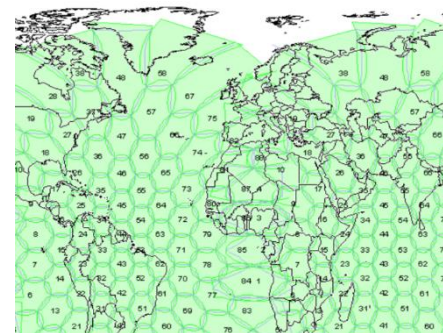
C-Band

Ku-band

Ka-band



Large Beams



Spot beams

INTERNATIONAL REGULATIONS

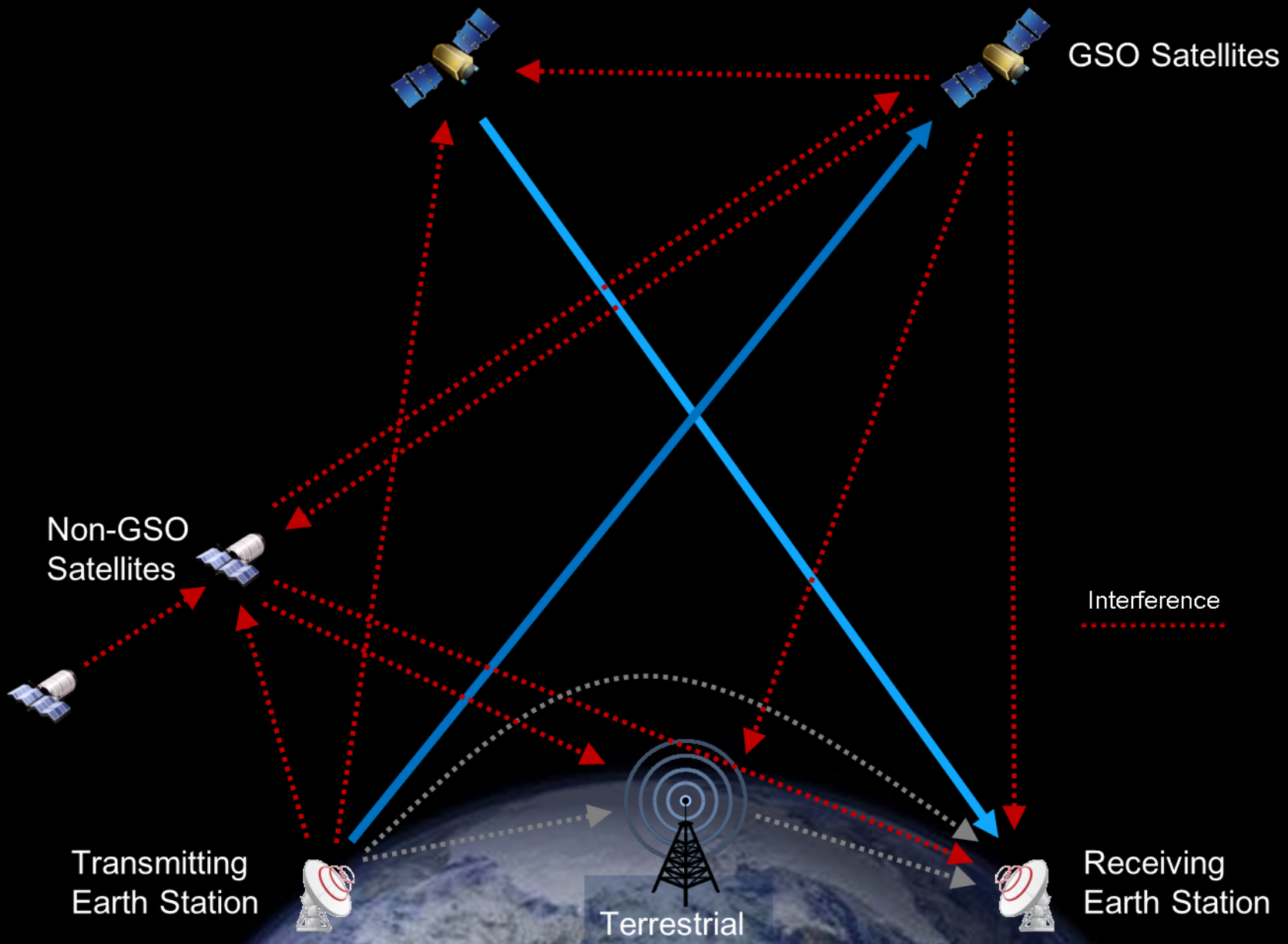
Equitable access
Rational, efficient,
economical use
Operation without
harmful interference

SATELLITES

Wide coverage
Cross national borders
Facilitate connectivity

ORBIT/ SPECTRUM

Limited
Global/Natural/Public
resource



PROPAGATION OF RADIO



Laws of physics
Radio waves do not stop at national borders

INTERFERENCE



Possible between radio stations of different countries
High risk in Space Radiocommunications

RADIO REGULATIONS



One of its main purposes:
Interference-free operation of Radiocommunications

CONTROL OF INTERFERENCE



RADIO REGULATIONS

ALLOCATION

Frequency separation of stations of different services

COORDINATION

between Administrations to ensure interference-free operations conditions

POWER LIMITS

PFD to protect TERR services / EIRP to protect SPACE services / EPFD to protect GSO from Non-GSO

RECORDING

In the Master International Frequency Register (MIFR)
International recognition

MONITORING

International monitoring system



Launch Vehicle

COMMON GOAL

Access to spectrum/orbit resources
Ensure rational, equitable, efficient, economical use
Interference-free operation

SHARING ORBIT/SPECTRUM RESOURCE

1. COORDINATION APPROACH

- First come, first served
- Rational, Efficient, Economical Use
- Rights acquired through coordination with administrations concerning actual usage
- Efficient spectrum/orbit management
- Dense/irregular orbital distribution of space stations

2. PLANNING APPROACH

- Plan for future use
- Equitable Access
- Congestion of GSO
- Frequency/orbital position plans
- For future use by all countries
- Predetermined orbital position & frequency spectrum



International Recognition
Registration in **MIFR**

RR9-1
ARTICLE 9
Procedure for effecting coordination with or obtaining agreement of other administrations^{1, 2, 3, 4, 5, 6, 7, 8, 8bis} (WRC-12)
Section I – Administrative

RR11-1
ARTICLE 11
Notification and recording of frequency assignments^{1, 2, 3, 4, 5, 6, 7, 8bis} (WRC-12)

1

Radio Regulations

Articles

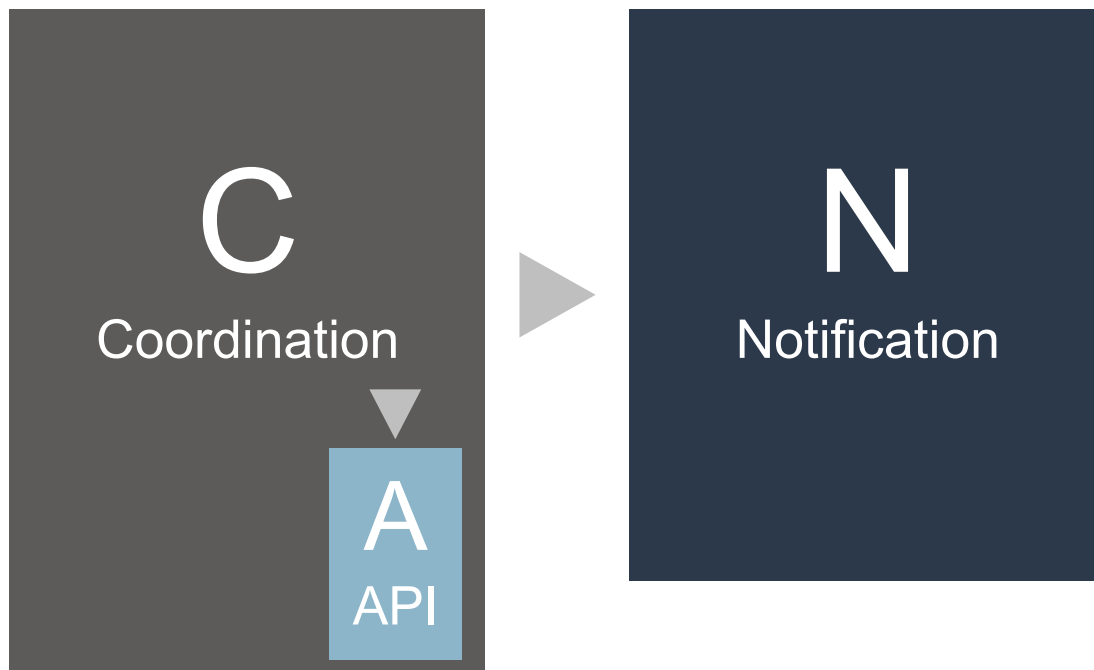
Edition of 2016



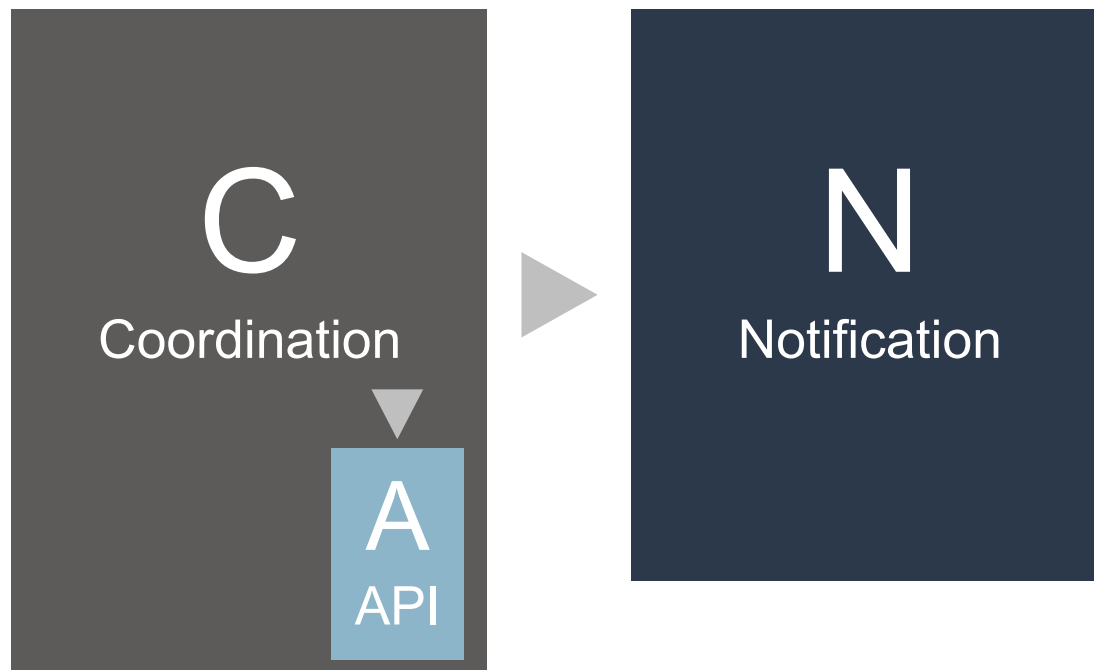
NON-PLANNED PROCEDURES

Articles 9 and 11

Non-planned Procedures (GSO & non-GSO) subject to coordination (Articles 9 & 11)

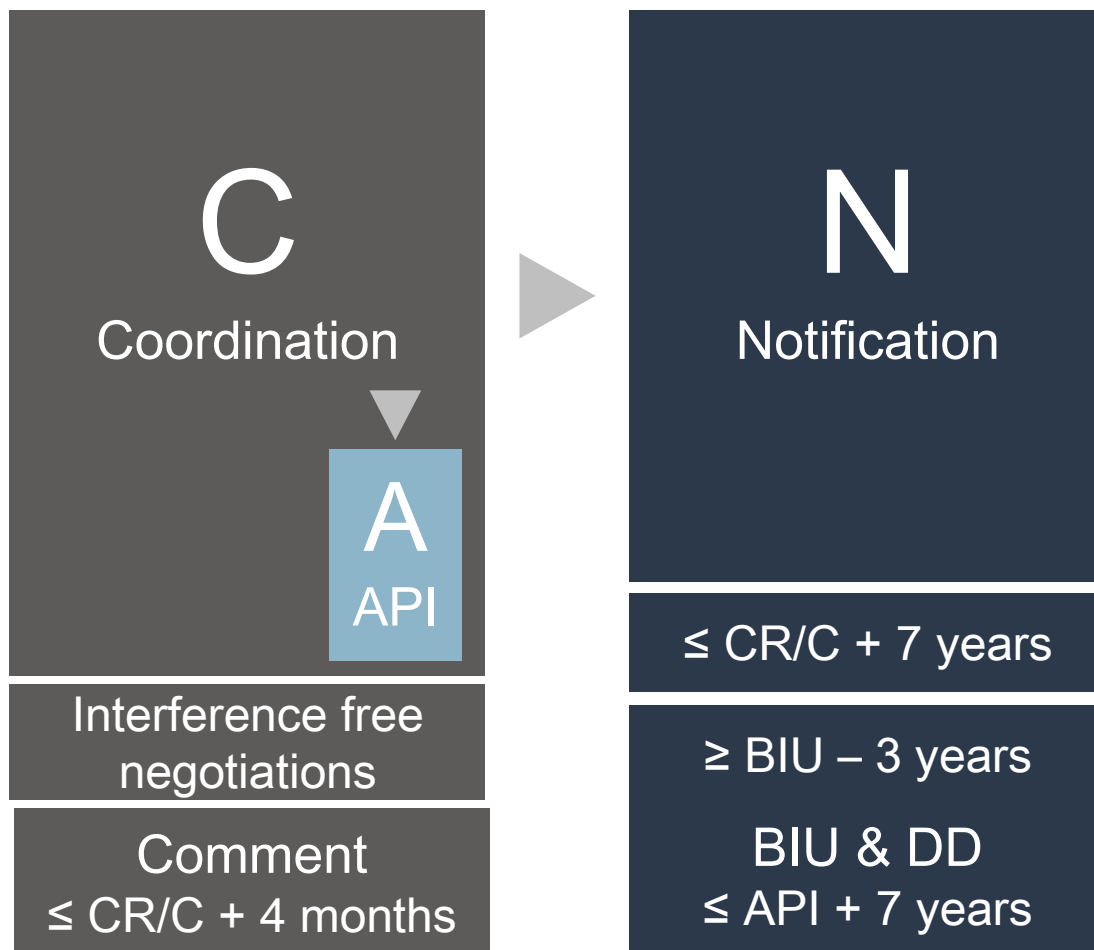


Non-planned Procedures (GSO&non-GSO) subject to coordination (Articles 9 & 11)



7 years

Non-planned Procedures (GSO&non-GSO) subject to coordination (Articles 9 & 11)



APPENDIX 30 (REV.WRC-12)*

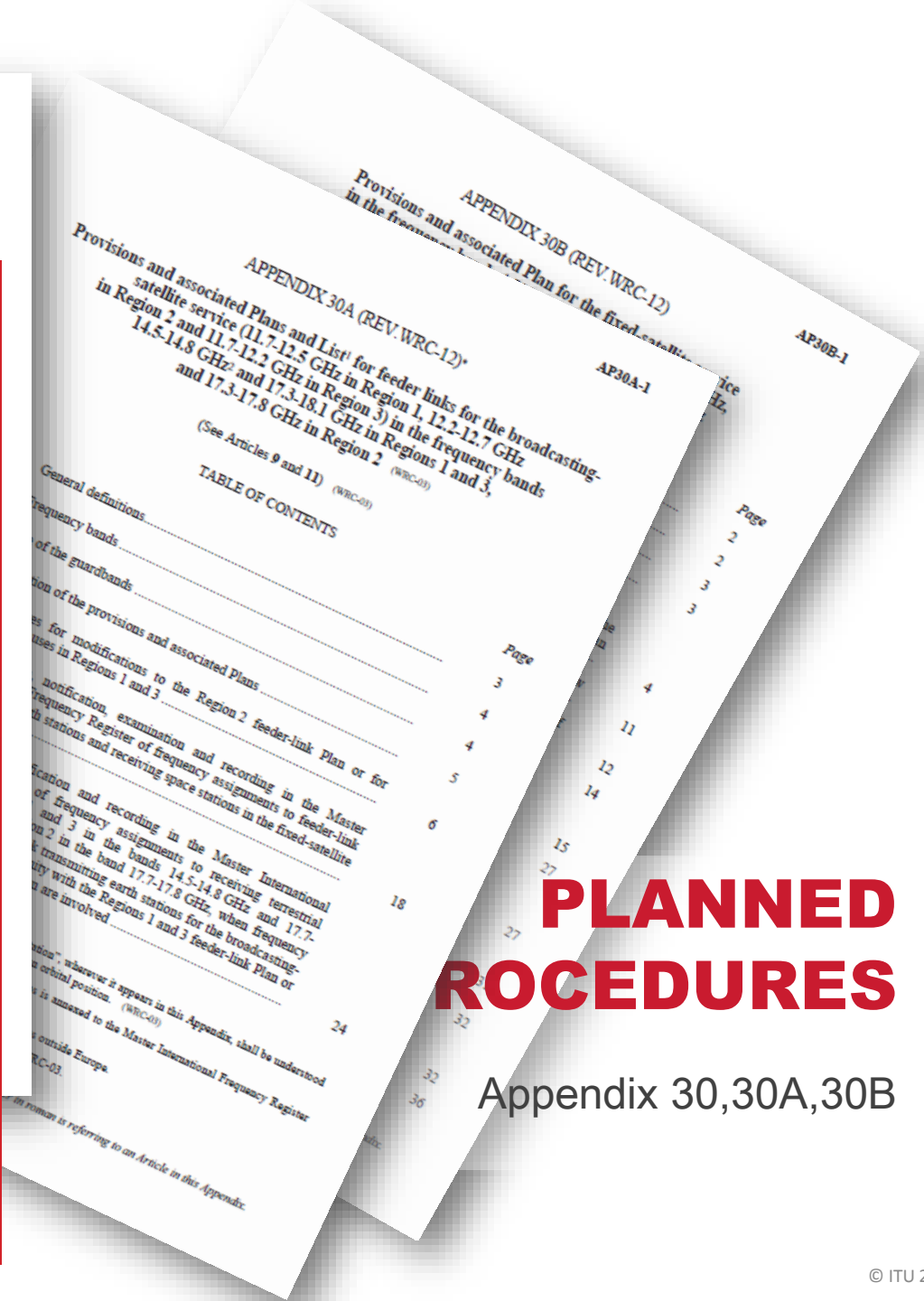
Provisions for all services and associated Plans and List¹ for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2). (WRC-03)

1

Radio Regulations

Articles

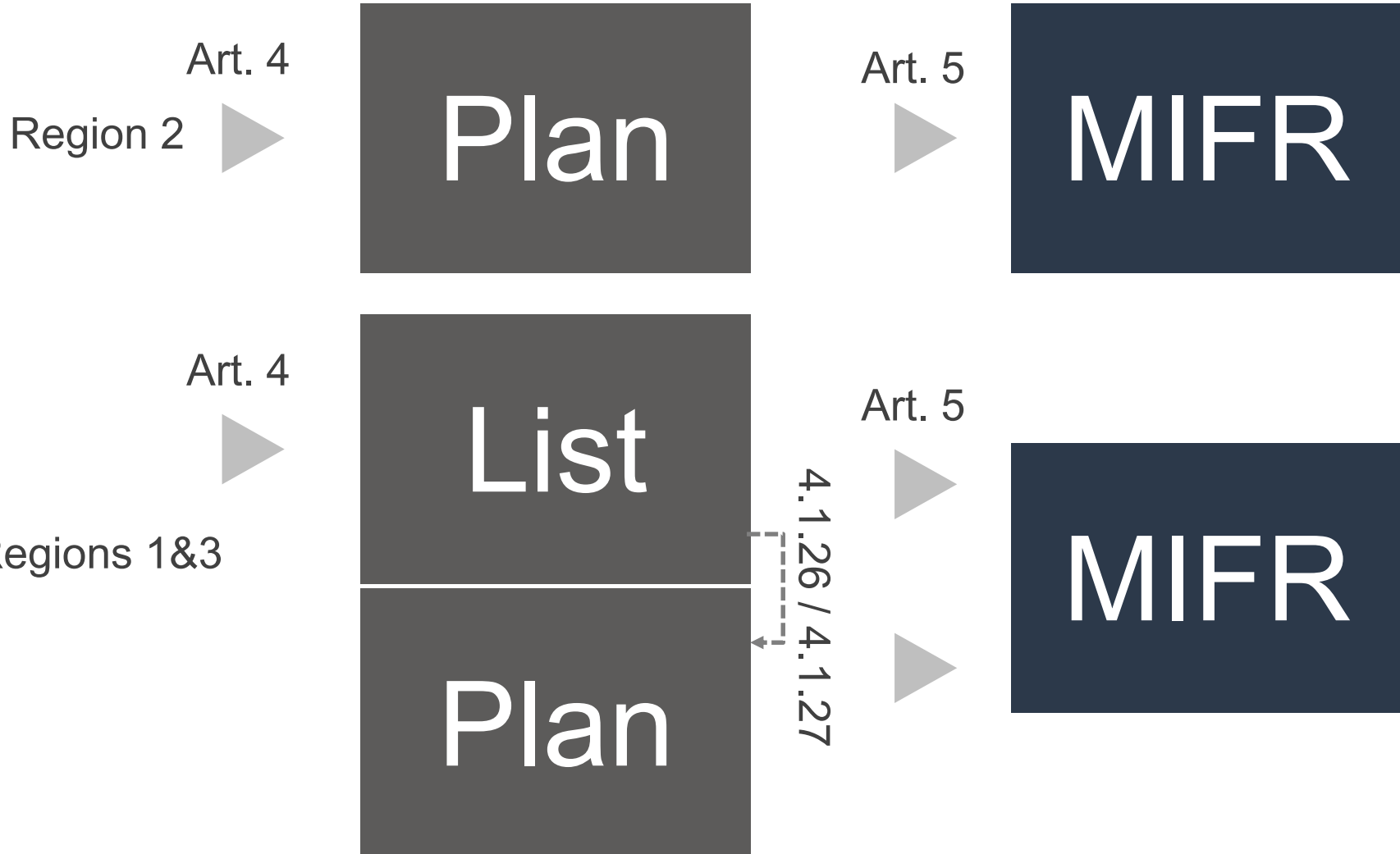
Edition of 2016



PLANNED PROCEDURES

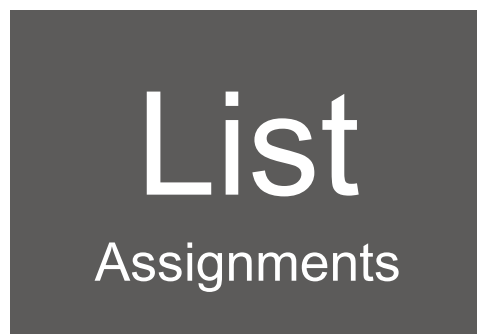
Appendix 30,30A,30B

BSS Planned Procedures (GSO) (Appendix 30/30A)



FSS Planned Procedures (GSO) (Appendix 30B)

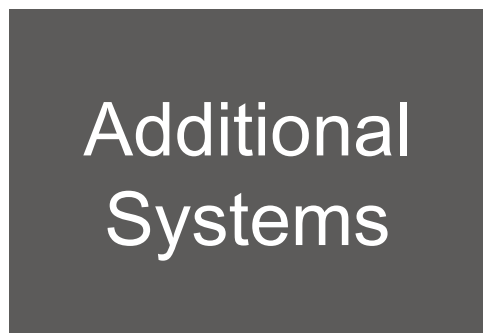
Art. 7



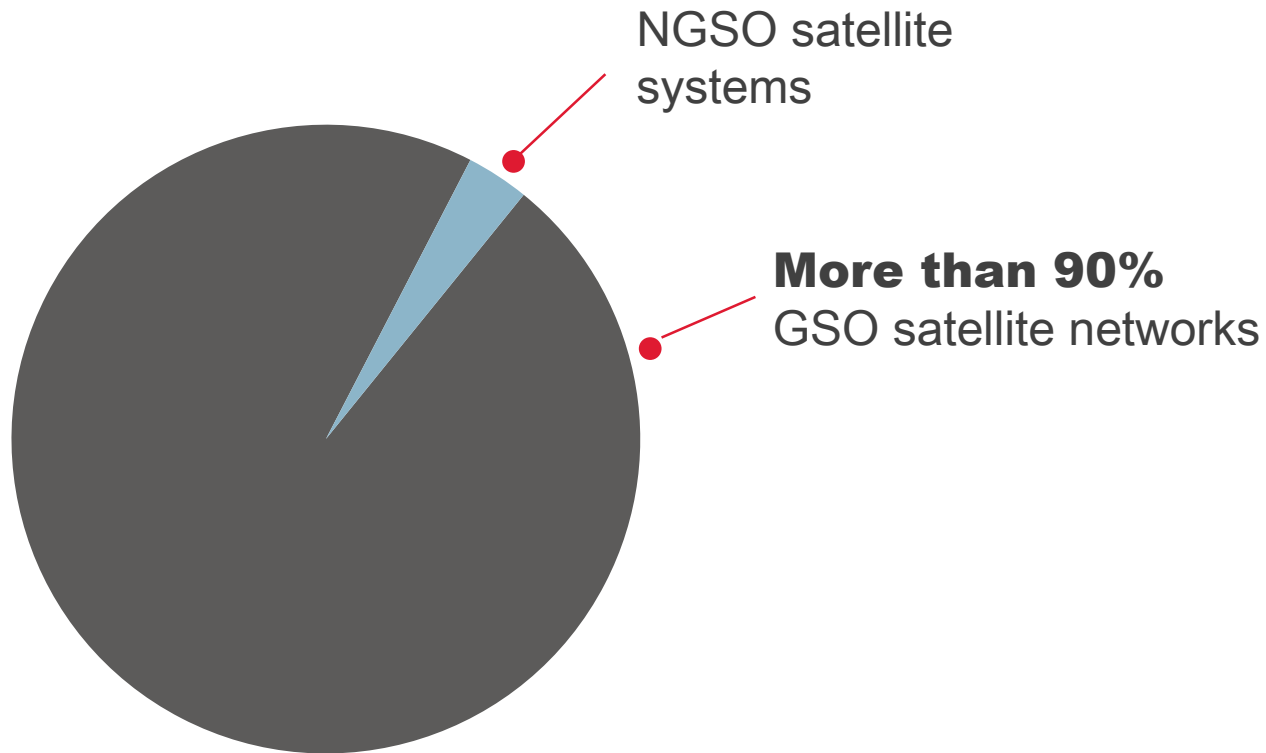
Art. 8



Art. 6



GSO vs NGSO SATELLITE NETWORKS



Source: Satellite networks in coordination stage, SRS database of 21.02.2014

INTERNATIONAL REGULATIONS

Lengthy & complex procedures
Lack of incentive to review underused spectrum/orbital positions

CONSEQUENCE

Difficulty to coordinate
Multiple filings
Operation without coordination
Fait-accomplis approach
Fictitious recorded assignments

ORBIT/ SPECTRUM

Scarcity due to thousands of filings

ITU Constitution

(Art.44)

Radio frequencies &
satellite orbits are limited
natural resources

Rational, Efficient,
Economical Use

Equitable Access



Opportunity to resolve
interference before
operation

Prevents loss of
investment, customers &
revenue by minimizing
unusable capacity due to
interference

PLENIPOTENTIARY CONFERENCE 2014

RESOLUTION 86 (REV. MARRAKESH, 2002)

NOC Advance publication, coordination, notification and recording procedures for frequency assignments pertaining to satellite networks

RESOLUTION 186 (BUSAN, 2014)

Strengthening the role of ITU with regard to transparency and confidence-building measures in outer space activities

RESOLUTION 186 (BUSAN, 2014)

invites ITU Council

to consider and review any proposed **cooperation agreements on the use of satellite monitoring facilities**

instructs BR Director

to promote access to information, upon request by administrations concerned, **related to satellite-monitoring facilities**, in order to address cases of harmful interference in accordance with Article 15 of the Radio Regulations, through cooperation agreements

to continue taking action to **maintain a database** on cases of harmful interference, reported in accordance with relevant provisions of the Radio Regulations and in consultation with Member States concerned

invites Member States and Sector Members

to participate in the activities related to the implementation of this resolution

KEY POINTS

- Natural limited resources to be shared and regulated: orbit & radiofrequency spectrum
- Legal framework: UN Outer Space Treaty, ITU CS/CV, RR, RoP, Recs
- ITU CS/Arts. 44 & 45:
 - To avoid harmful interference
 - To ensure efficient, rational, equitable economical use
- Radio Regulations: Allocation, registration, interference free operation
- Radio Regulations constantly being improved

FREE ONLINE ACCESS

- The ITU Constitution
 - <http://www.itu.int/pub/S-CONF-PLEN-2015>
- World Radiocommunication Conference (WRC)
 - <http://www.itu.int/ITU-R/go/wrc/en>
- ITU-Radio Regulations @ 2015
 - <http://www.itu.int/pub/R-REG-RR-2015>
- ITU-R Recommendations
 - <http://www.itu.int/publ/R-REC/en>
- Preface to the BR IFIC (Space services)
 - <http://www.itu.int/ITU-R/go/space-preface/en>

“With a concerted effort, we can **reduce**, and to the extent possible **remove**, all **obstacles** impeding the development and bringing into operation of new satellite networks”

“Think carefully about how we can continue to use and improve satellite access to help **connect the unconnected**, and make the world a better and a fairer place for all”

MERCI

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