Orbit/Spectrum International Regulatory Framework

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BR Space Services Department

Global Space Industry in 2017

$ 348 billion

Source: SSIR 2018 Tauri Group

Global Impact and Usage

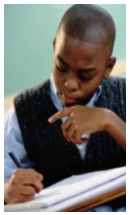
Satellite Radio

Corporate networks

Maritime communication

Earth Observation

National Security & Defense



E-learning

Agriculture

Cellular Backhaul

Telemedicine

Aviation Security

SNG

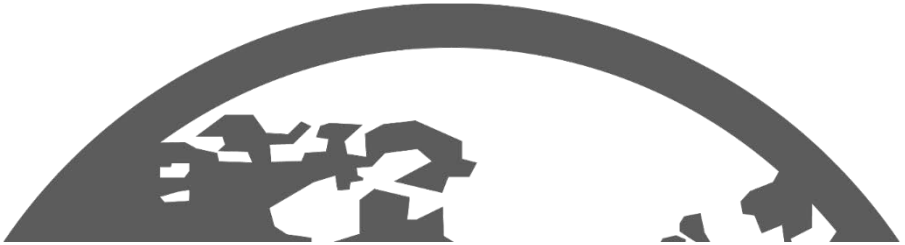
VSAT

Internet

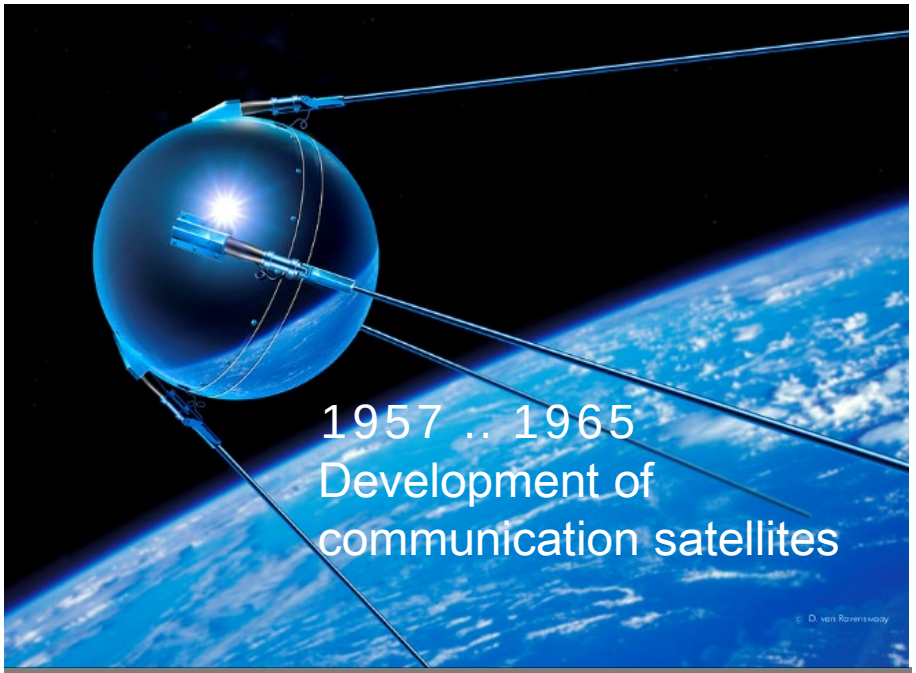
Disaster Relief

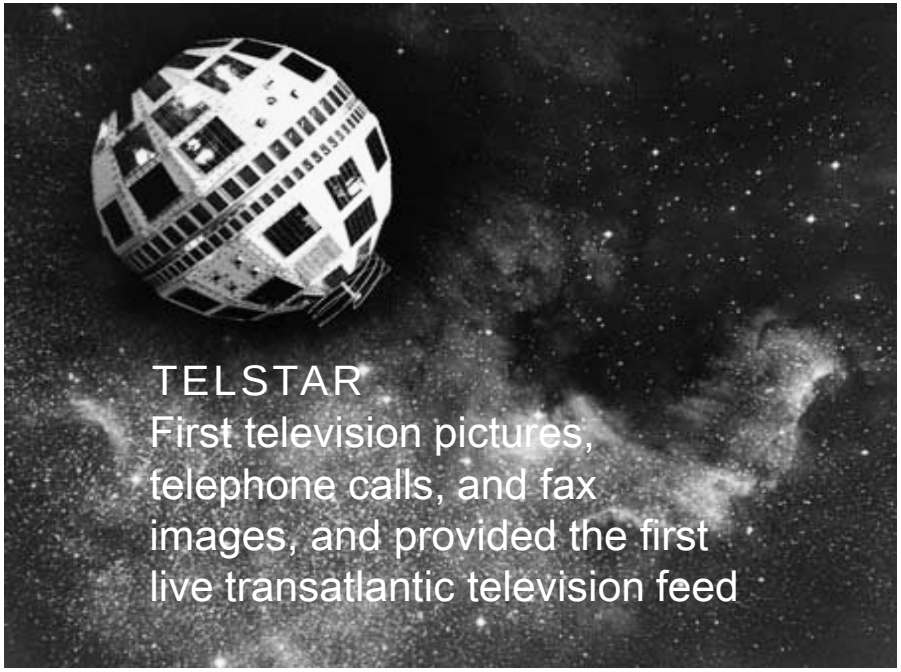
Global Flight Tracking

DTH



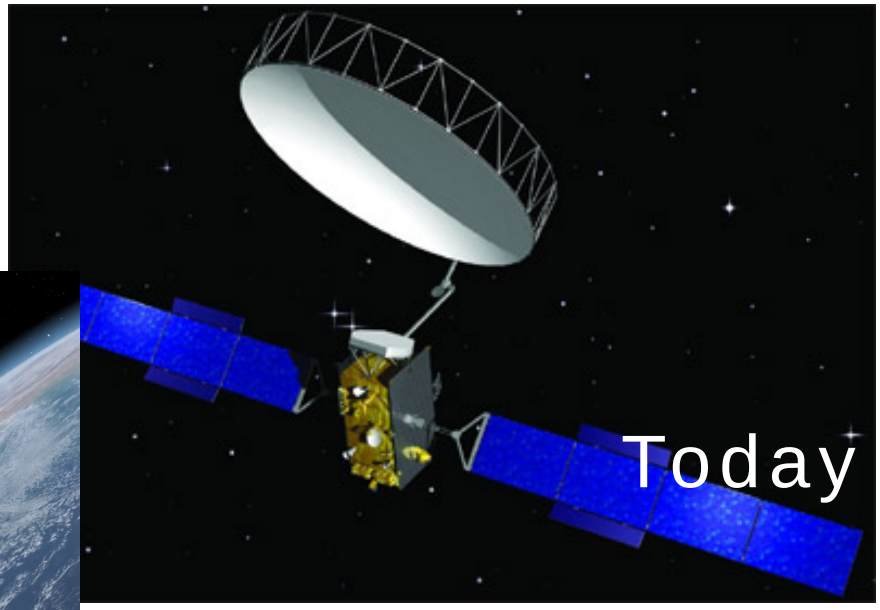
Satnav



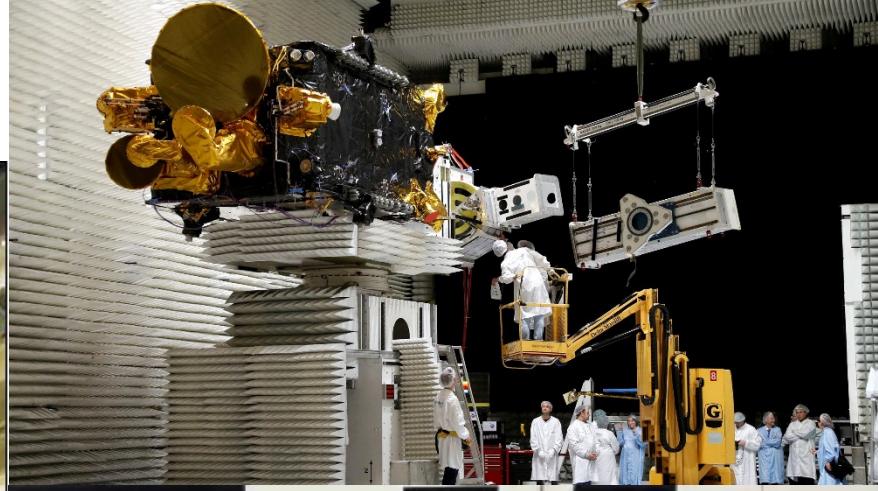


SPUTNIK 1 (Спу́тник-1)

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

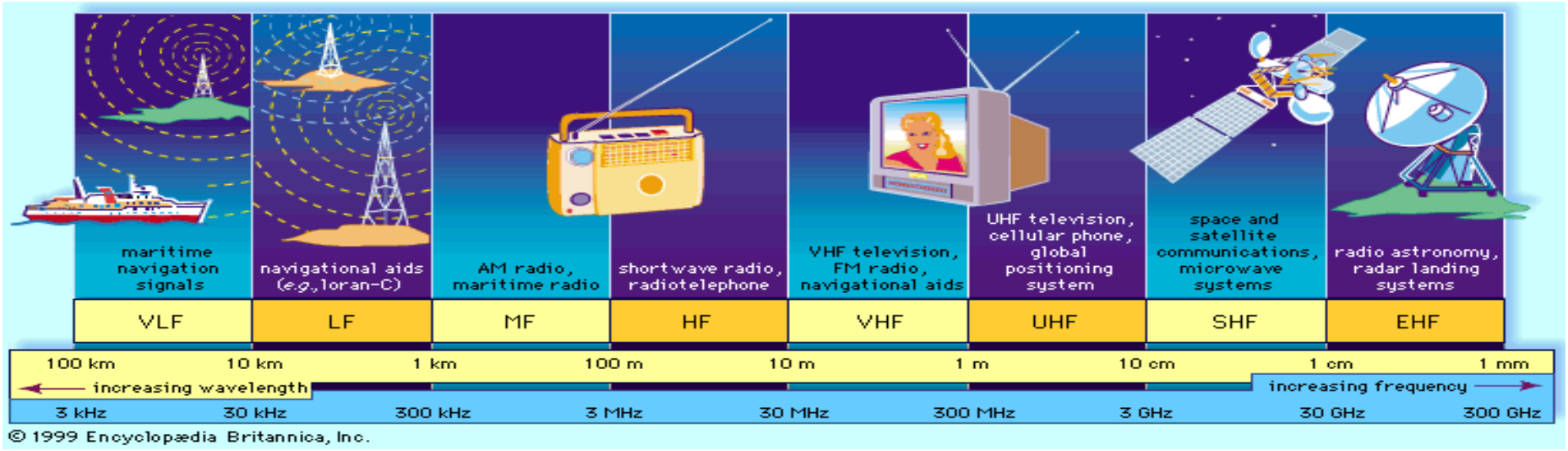


Satellites today…



FREQUENCY SPECTRUM

Limited natural resource



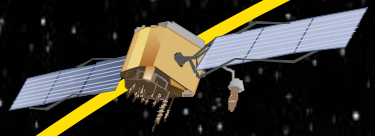
1.467 GHz to 1.492 GHz	1.518 GHz to 1.675 GHz	1.97 GHz to 2.69 GHz	3.4 GHz to 7.025 GHz	10.7 GHz to 14.5 GHz	17.3 GHz to 30 GHz
Satellite Audio Broadcasting to fixed and mobile units	Civilian Mobile-Satellite Services (two-way)	Satellite television & radio broadcasting to mobiles + two-way mobile services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

GEO
35,786 km above equator

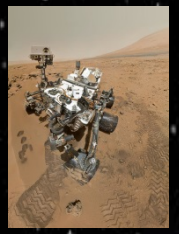
Molniya

MEO
8 000 - 20 000 km

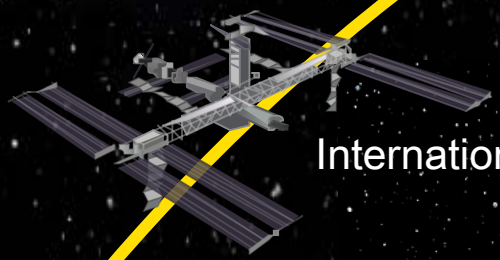


GNSS

Highly Elliptical Orbit – 40 000 km in apogee



LEO
400 - 2 000 km



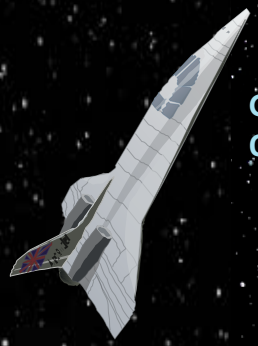
International Space Station

HIGHLY ELLIPTICAL ORBIT

MEDIUM EARTH ORBIT

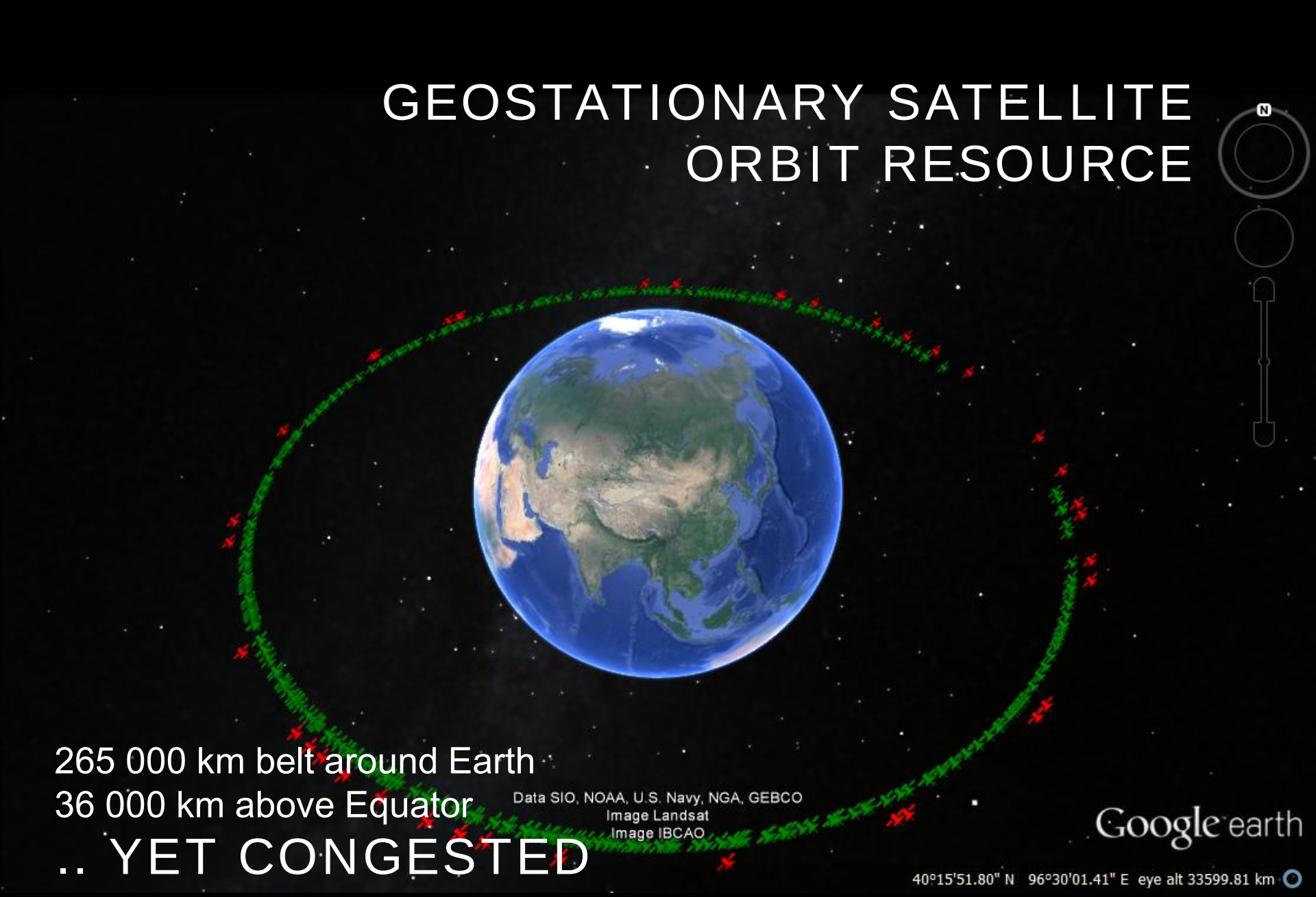
GEOSTATIONARY ORBIT

LOW EARTH ORBIT



Sub-orbital

GEOSTATIONARY SATELLITE ORBIT RESOURCE



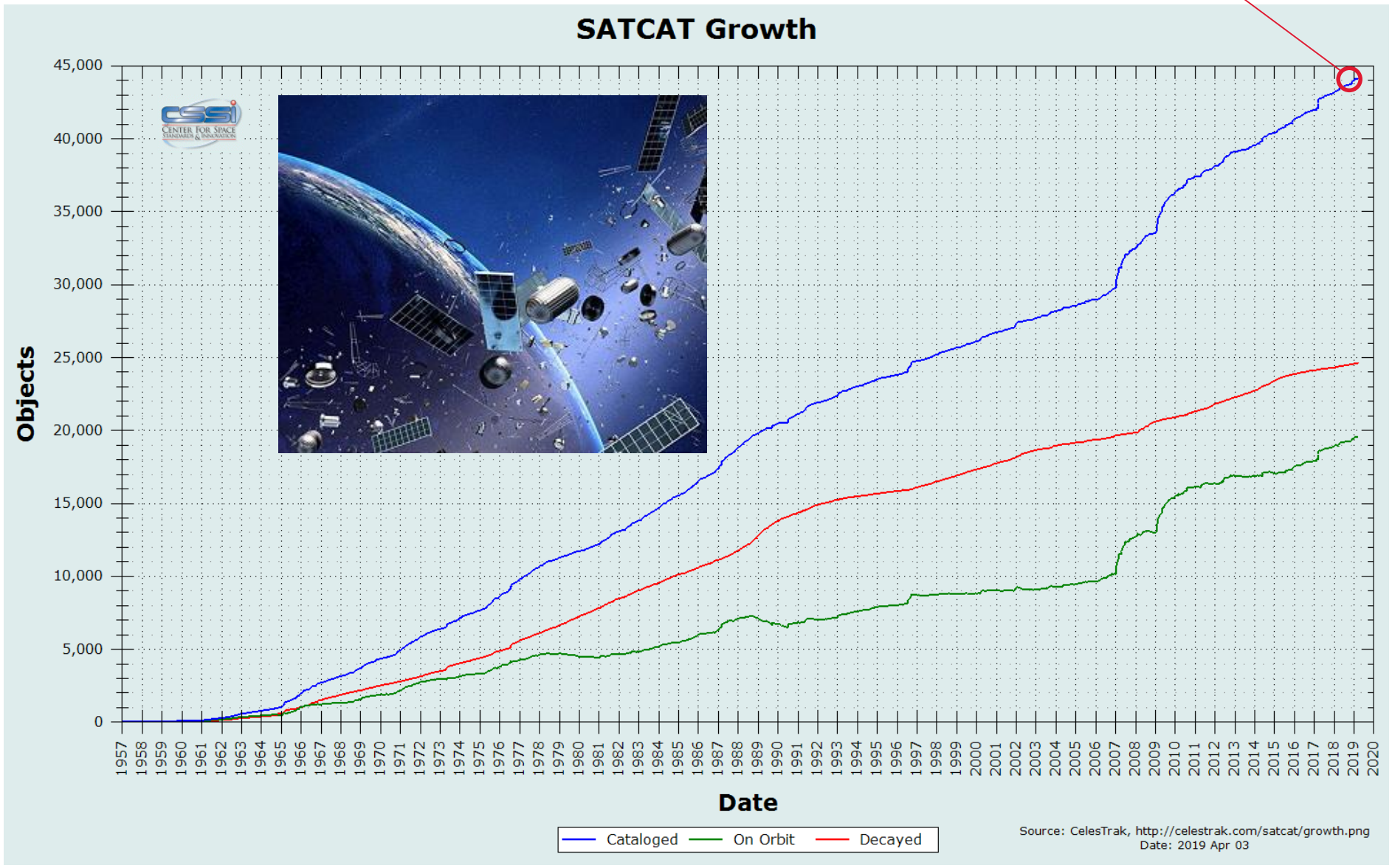
265 000 km belt around Earth

36 000 km above Equator

.. YET CONGESTED

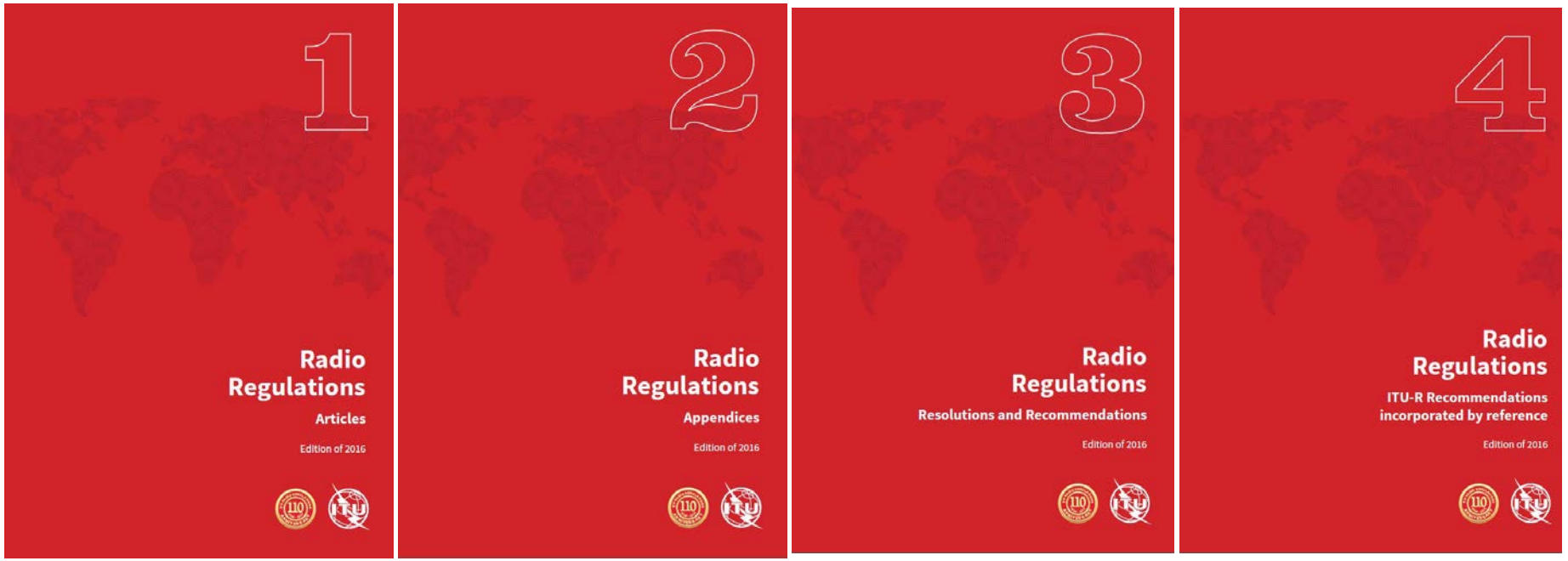
Source: TLE data dated 10.08.2015

45,000 objects and growing



1963

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



TODAY

More than 2000 pages of Radio Regulations

LEGAL FRAMEWORK FOR SPECTRUM ACCESS/USE

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

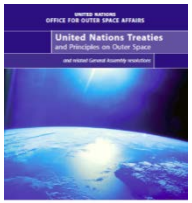
1979 “Moon Treaty”

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

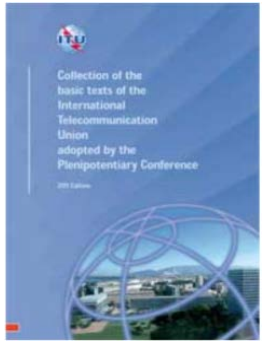
- Principles of use of orbit/spectrum
- Allocation of frequency bands
- Procedures, Plans, operational measures
- Instruments (Constitution, Convention, Radio Regulations, Rules of Procedures, Recommendations)

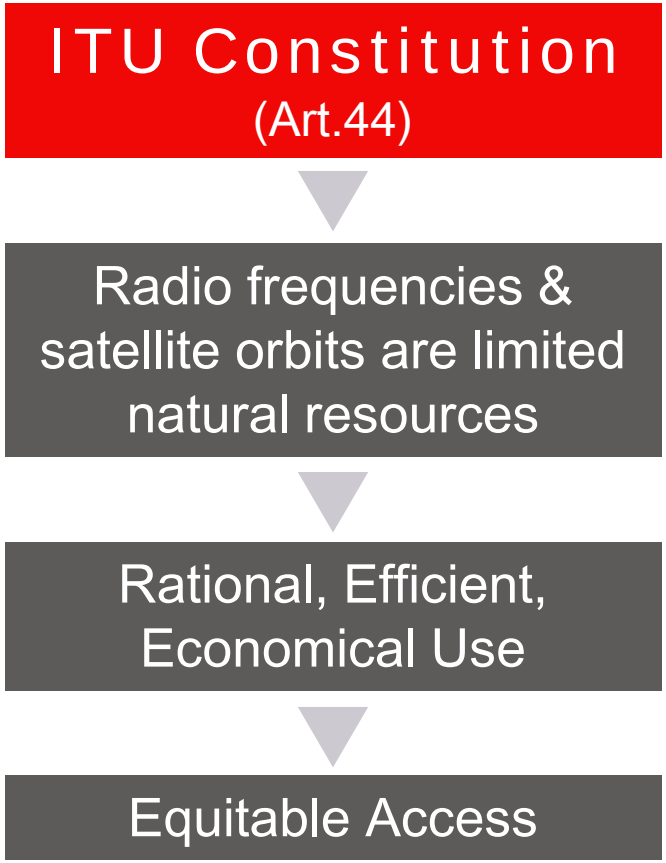
Role of ITU in radiocommunicatons

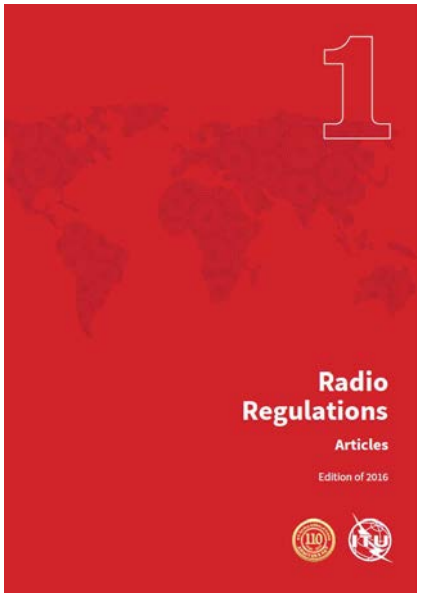
- Developing and updating international regulations on the use of orbit /spectrum
- Applying these regulations
- Developing and adopting standards and best practices on the use of orbit/spectrum
- Disseminating information on these regulations, standards and best practices

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	ITU Instruments on radio frequencies
Free “exploration & use” under international law	Equitable access & rational use of spectrum under international law
States Responsibility & licensing Jurisdiction & control	States Must license trans. radio stations Shall not cause harmful interf.
States Registration OOSA	States API…CR/C…MIFR
States Liable for damage	No liability clause

REGULATION OF RADIO SPECTRUM AND SATELLITE ORBIT IN PRACTICE

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

Bandwidth

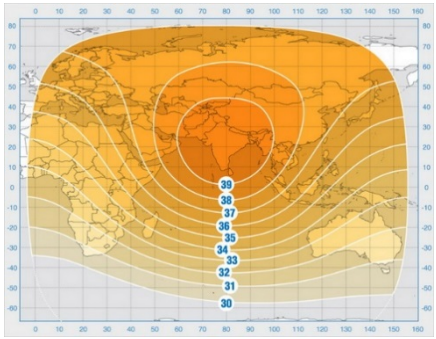
Narrow → Wide

Rain fade

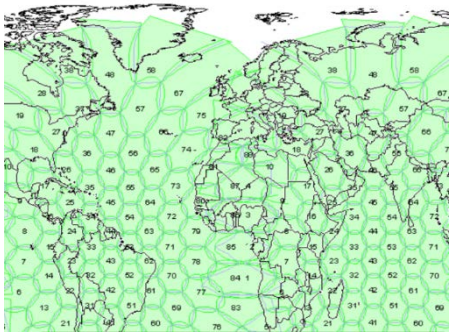
Less → Severe

Earth station antenna diameter

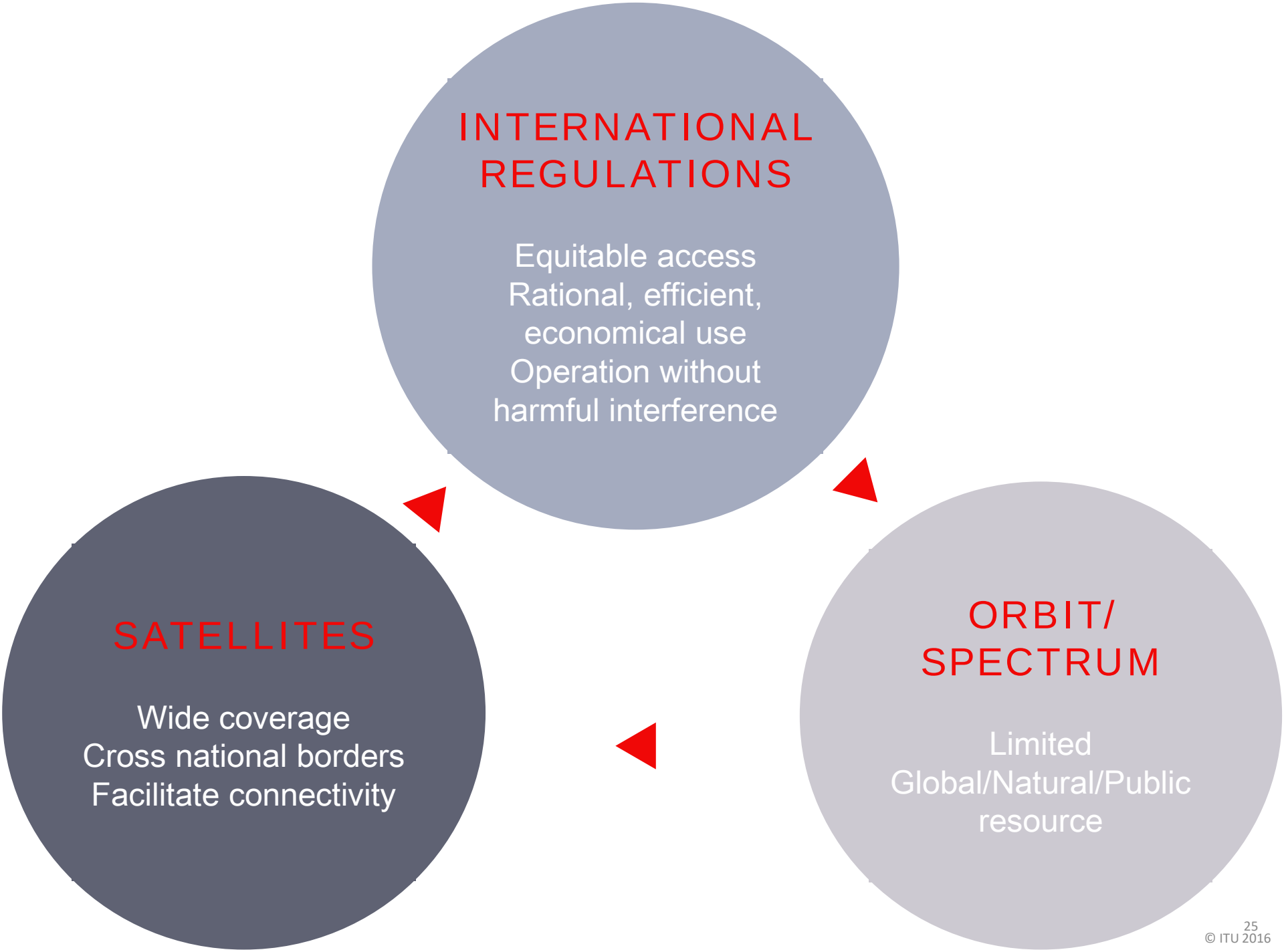
Large ← Small

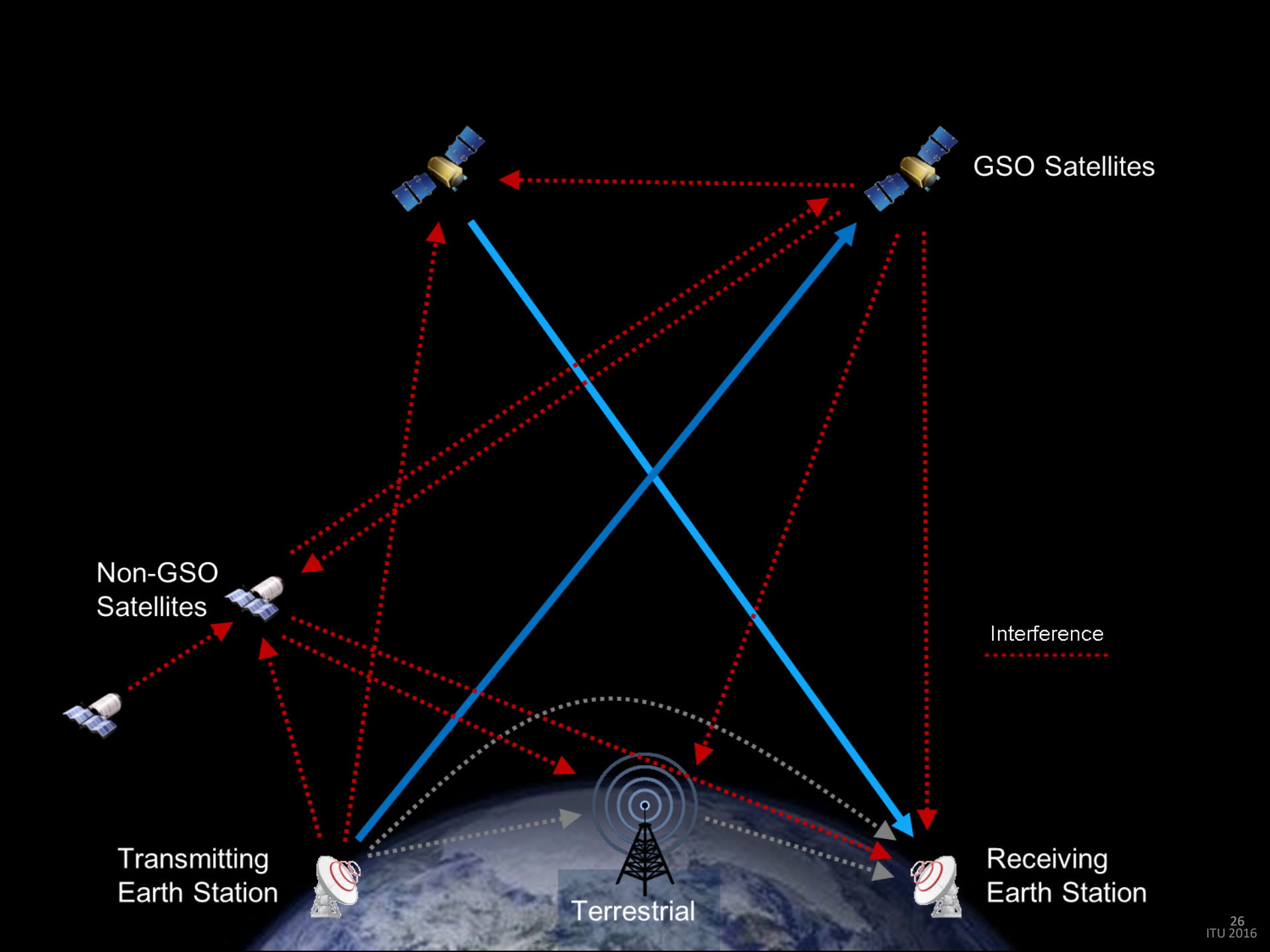


Large Beams



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


GSO Satellites
Non-GSO Satellites
Interference
Transmitting Earth Station
Terrestrial
Receiving Earth Station

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

COMMON GOAL

Access to spectrum/orbit resources

Ensure rational, equitable, efficient, economical use

Interference-free operation

Source: Articles 1, 44, 45 & Res 71 of ITU Constitution & Convention

Photo credit: ESA (for educational purposes)

SHARING ORBIT/SPECTRUM RESOURCE

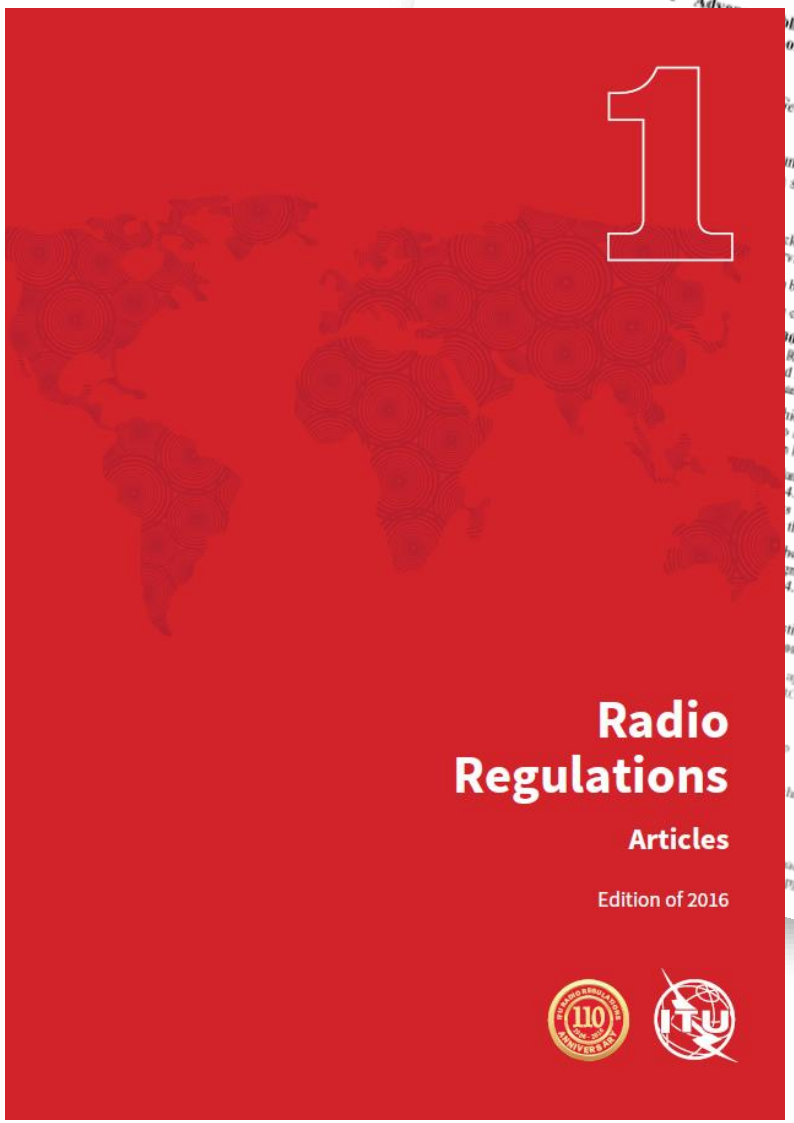
1. COORDINATION APPROACH

- 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

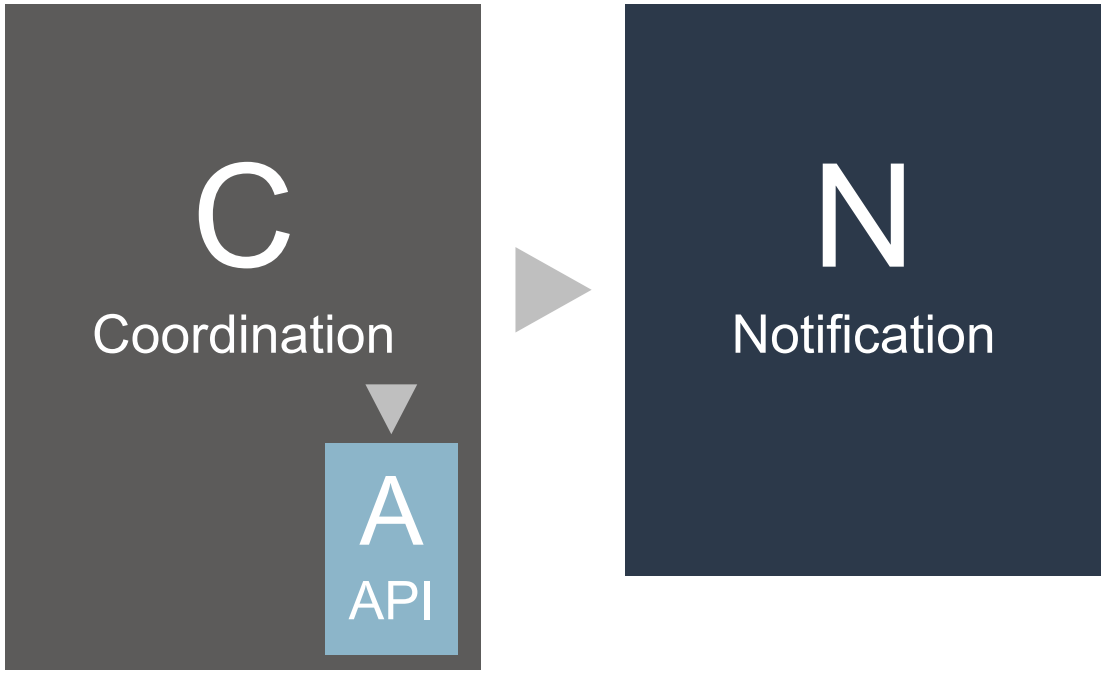
International Recognition
Registration in **MIFR**



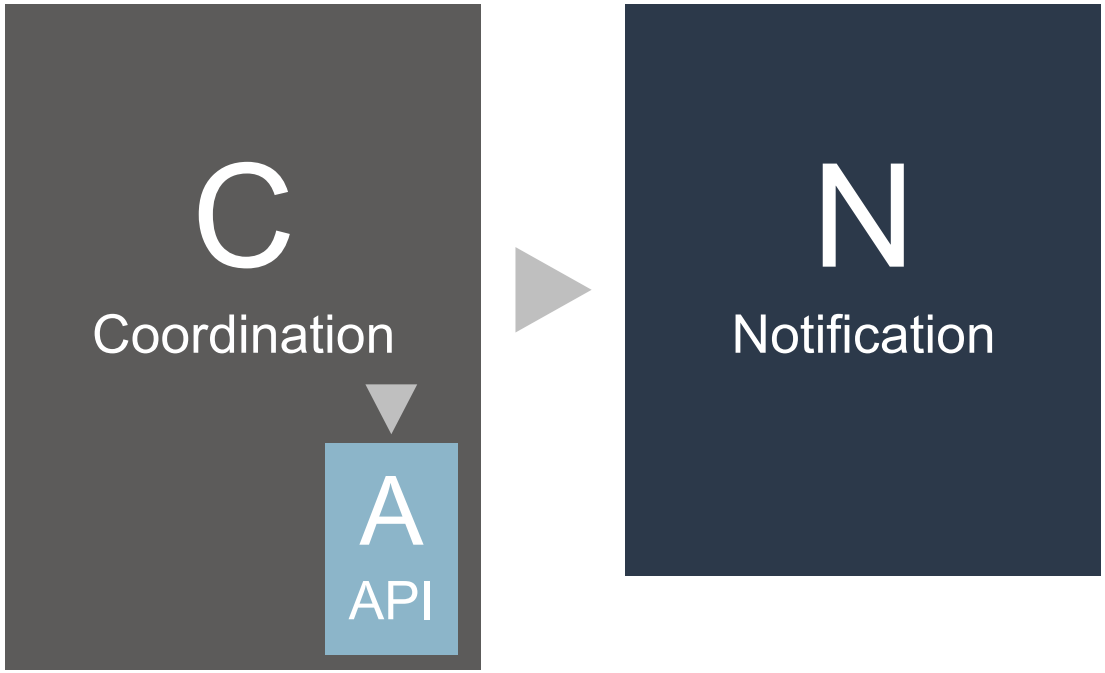
NON-PLANNED PROCEDURES

Articles 9 and 11

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

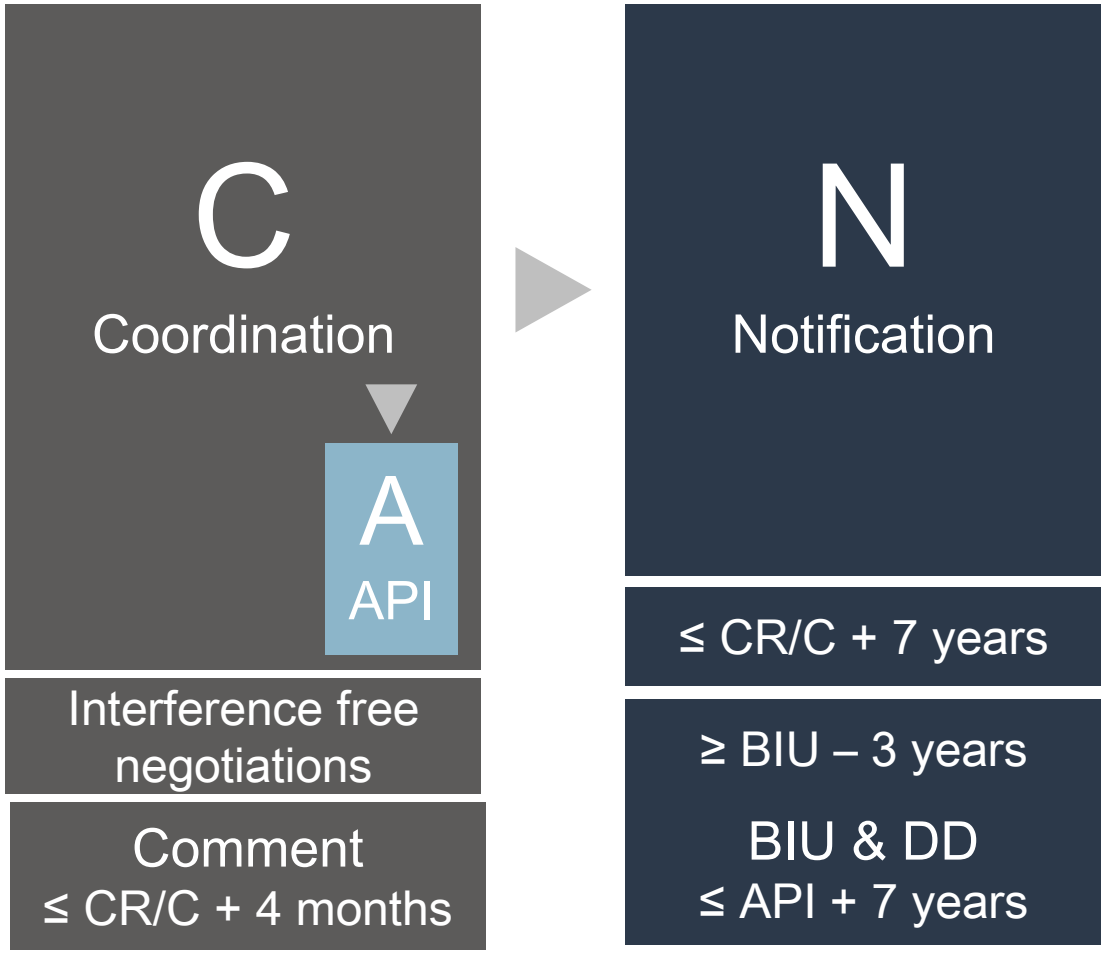


Non-planned Procedures (GSO&non-GSO) subject to coordination (Articles 9 & 11)



7 years

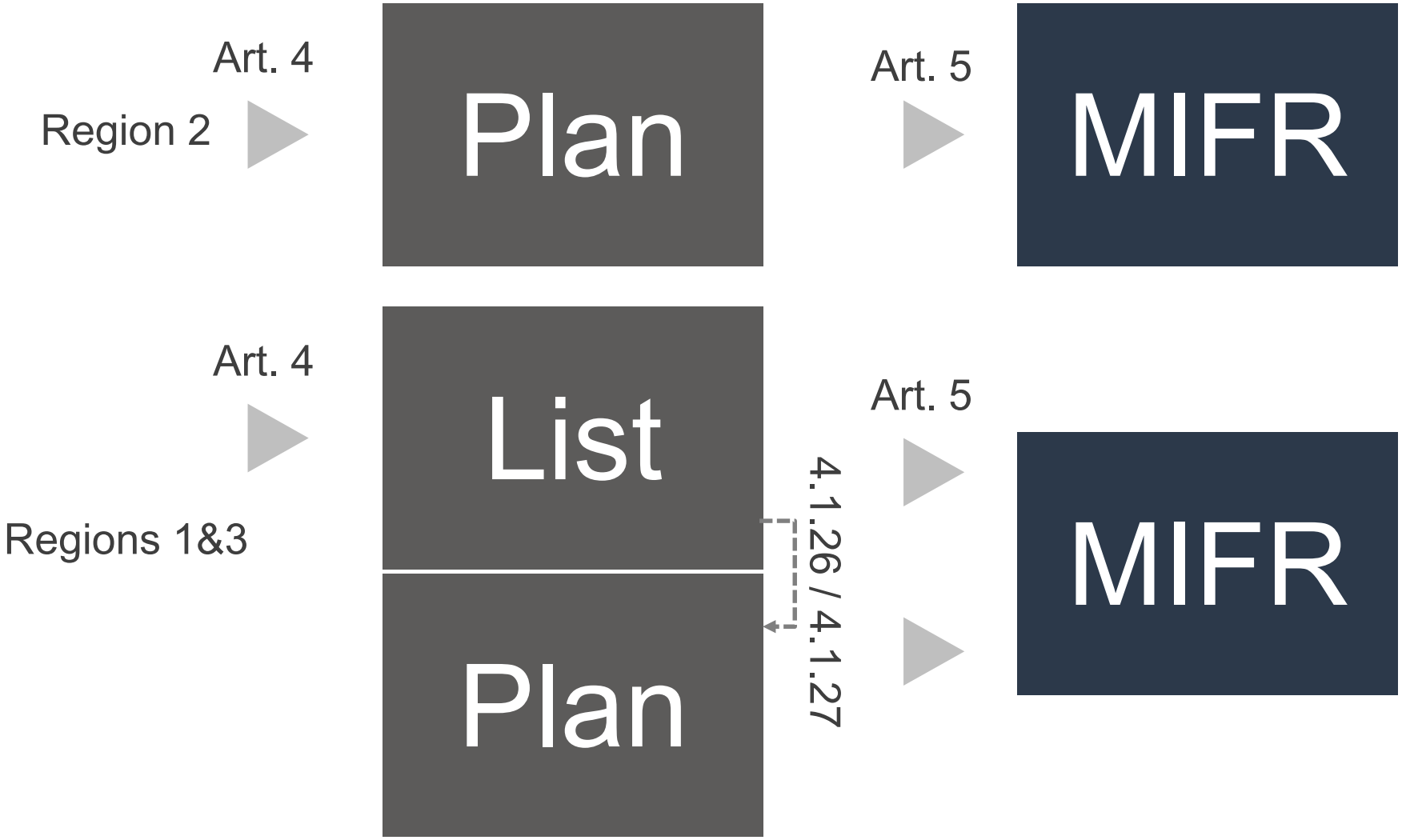
Non-planned Procedures (GSO&non-GSO) subject to coordination (Articles 9 & 11)



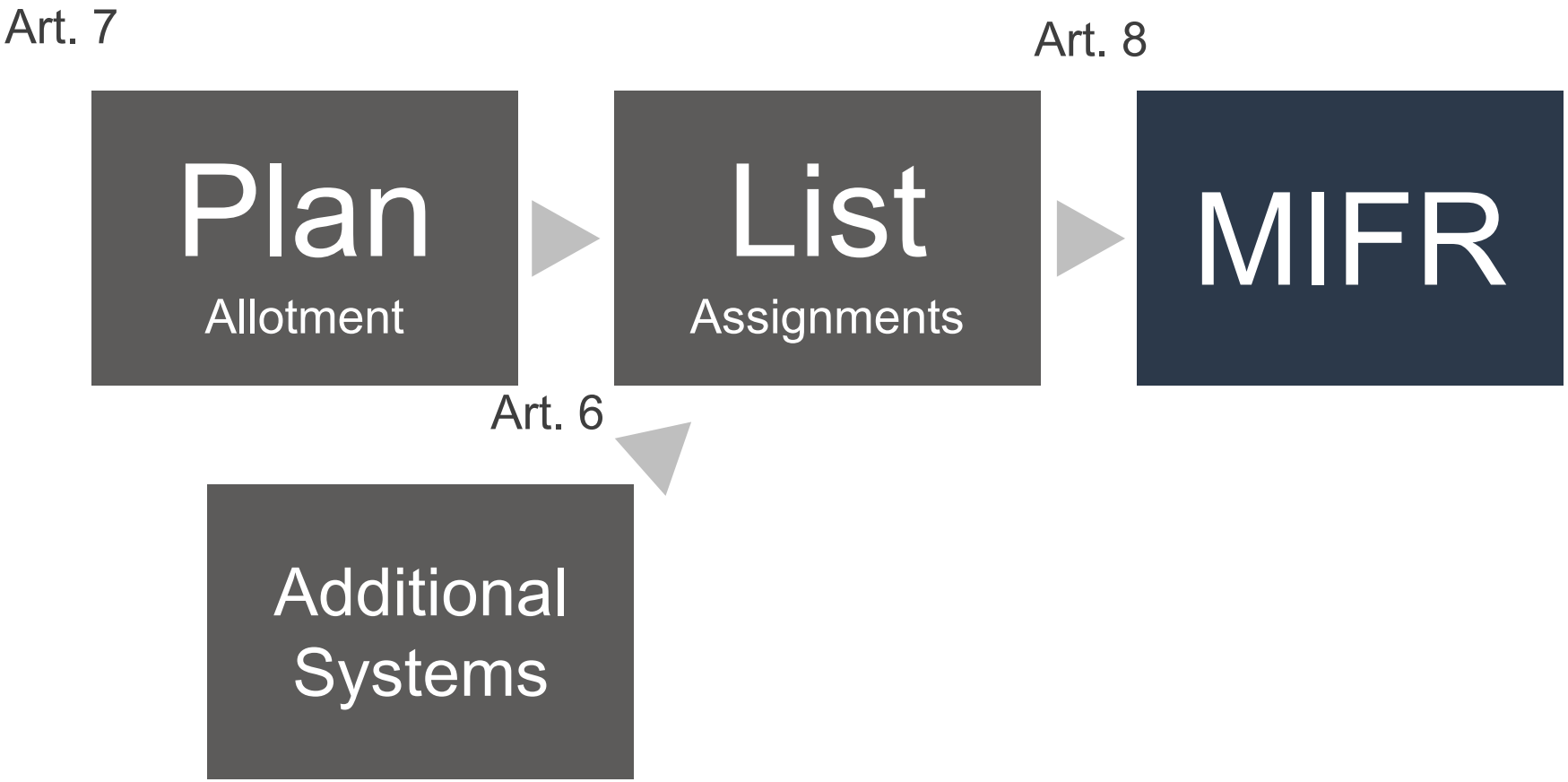
Source: Nos. 9.1, 9.5D, 9.52C, 9.43, 11.44.1, 11.25, 11.44 of Radio Regulations

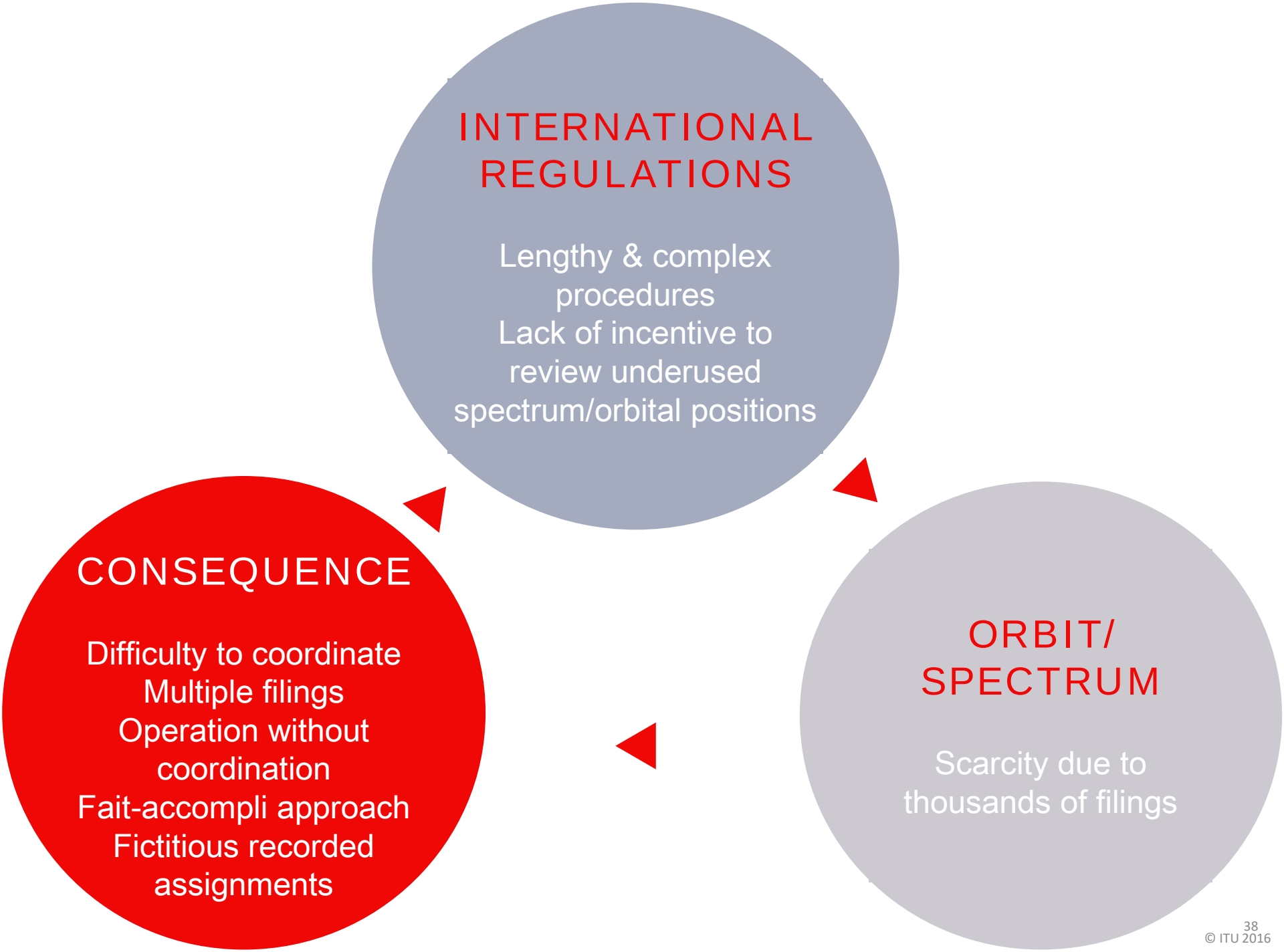

AP30-1
APPENDIX 30 (REV.WRC-12)*
Provisions for all services and associated Plans and List[1] for the broadcasting-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1) and 12.2-12.7 GHz (in Region 2)
1
Radio Regulations
Articles
Edition of 2016
APPENDIX 30A (REV.WRC-12)*
Provisions and associated Plans and List[1] for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz[2] and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2
AP30A-1
(See Articles 9 and 11)
TABLE OF CONTENTS
APPENDIX 30B (REV.WRC-12)
Provisions and associated Plan for the fixed-satellite service in the frequency bands
AP30B-1
Page
PLANNED
ROCEDURES
Appendix 30,30A,30B

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



FSS Planned Procedures (GSO)
(Appendix 30B)




INTERNATIONAL REGULATIONS
Lengthy & complex procedures
Lack of incentive to review underused spectrum/orbital positions
ORBIT/ SPECTRUM
Scarcity due to thousands of filings
CONSEQUENCE
Difficulty to coordinate
Multiple filings
Operation without coordination
Fait-accompli approach
Fictitious recorded assignments

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

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 @ 2016
  - https://www.itu.int/pub/R-REG-RR/en
- 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

Thank you for your attention

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