ORBIT/SPECTRUM INTERNATIONAL REGULATORY FRAMEWORK

Challenges in the 21st century

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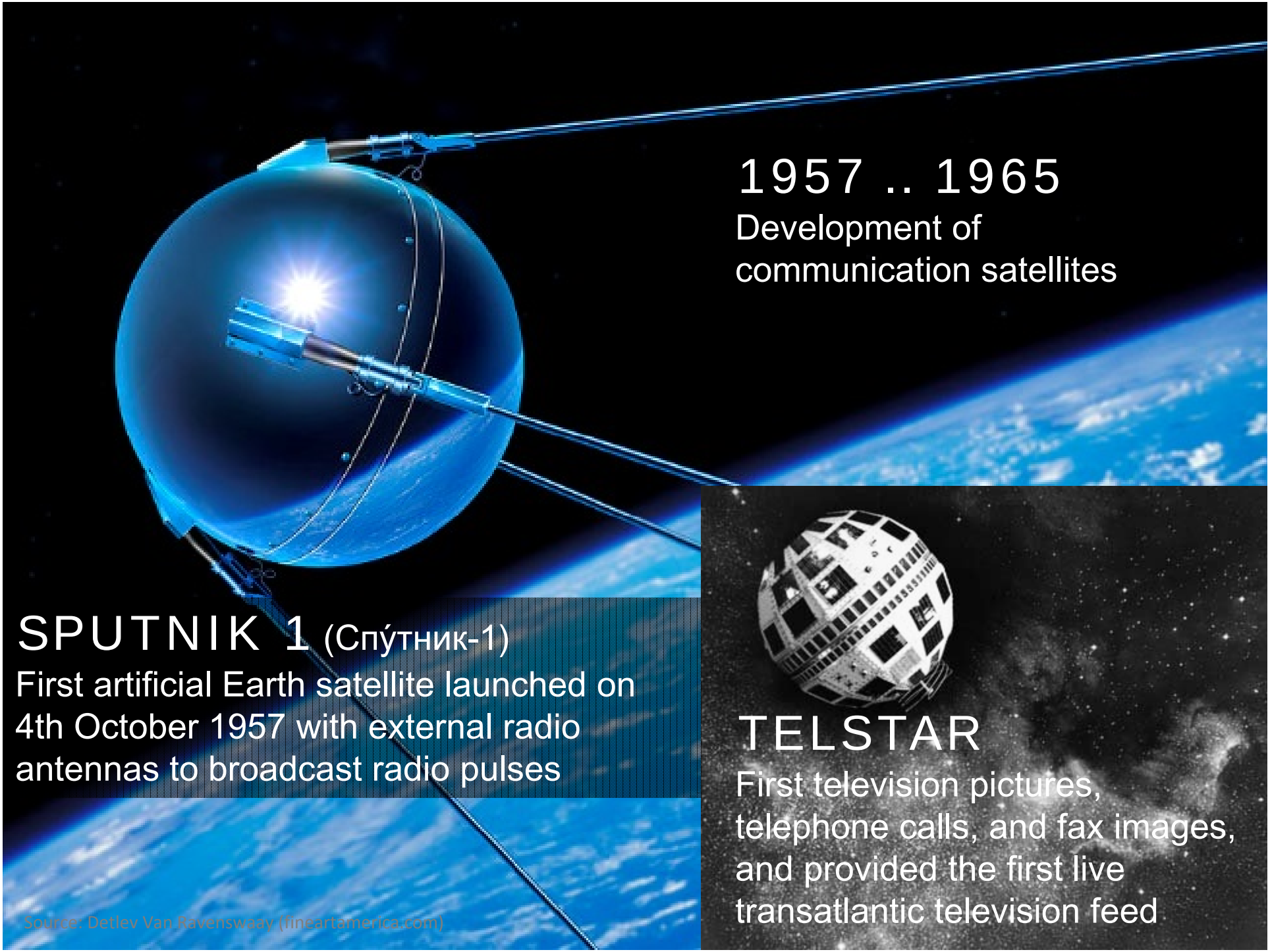
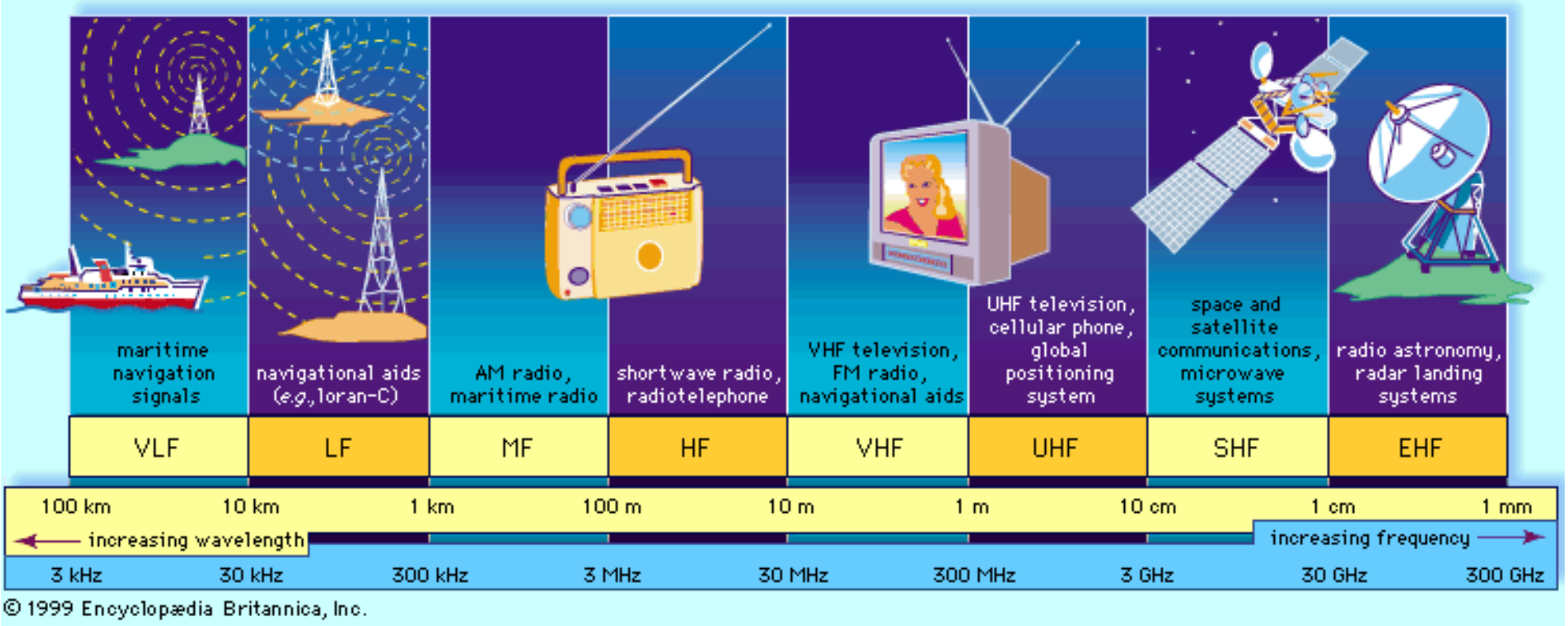
ITU International Satellite Symposium 2015


1957 .. 1965
Development of
communication satellites
SPUTNIK 1 (Спу́тник-1)
First artificial Earth satellite launched on
4th October 1957 with external radio
antennas to broadcast radio pulses
TELSTAR
First television pictures,
telephone calls, and fax images,
and provided the first live
transatlantic television feed
Source: Detlev Van Ravenswaay (fineartamerica.com)

Source: Inmarsat Global Xpress

FREQUENCY SPECTRUM

Limited natural resource



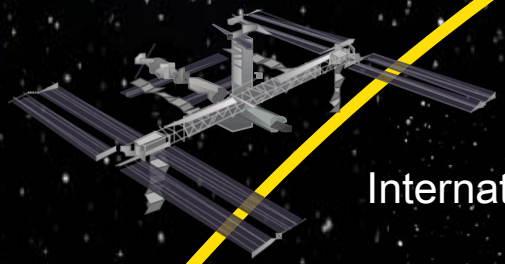
WHERE DO SATELLITES OPERATE ...

GEO
35,786 km above equator

Molniya

MEO
8 000 - 20 000 km

LEO
400 - 2 000 km



International Space Station

HIGHLY-ELLIPTICAL ORBIT

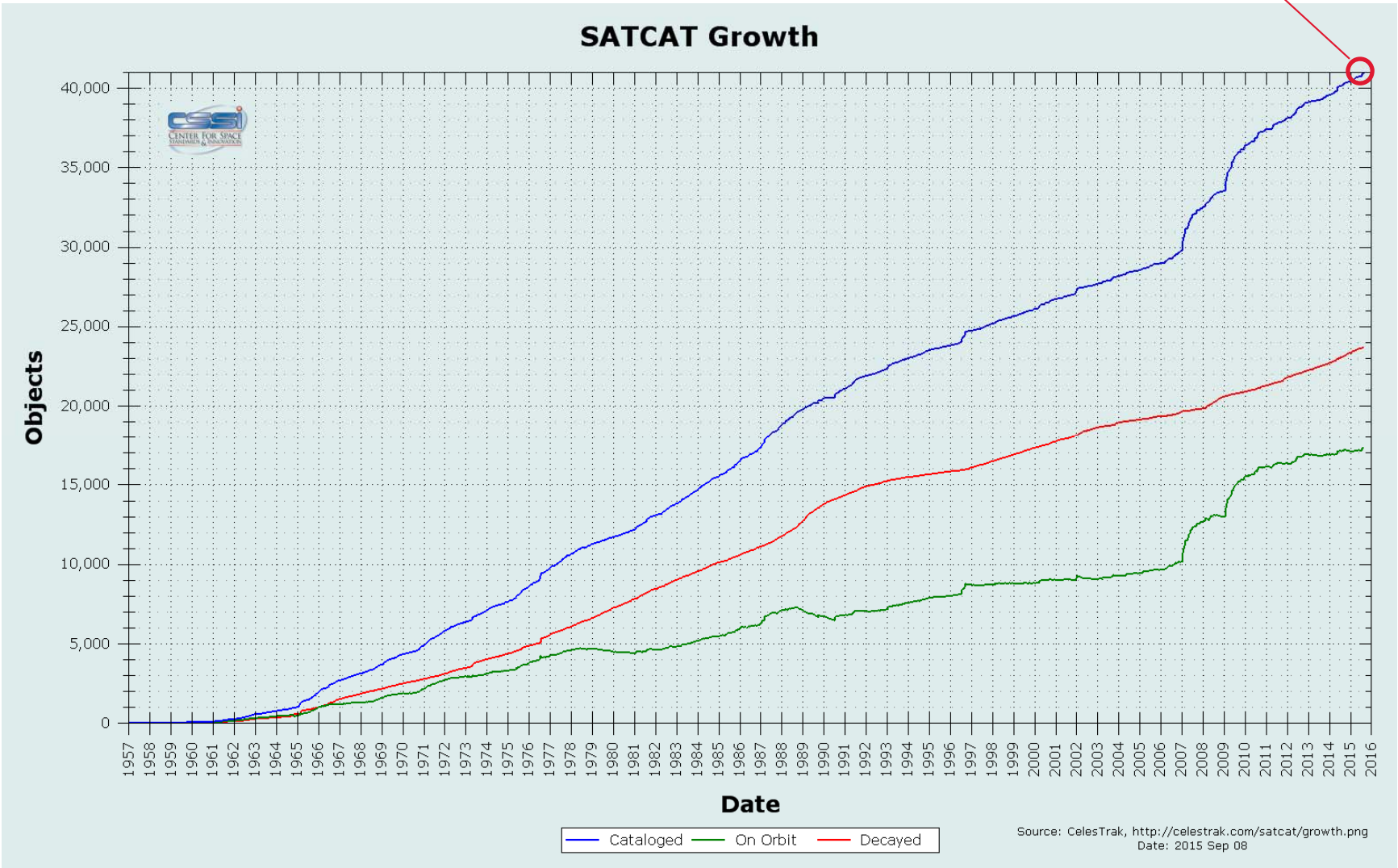
MEDIUM-EARTH ORBIT

GEOSTATIONARY ORBIT

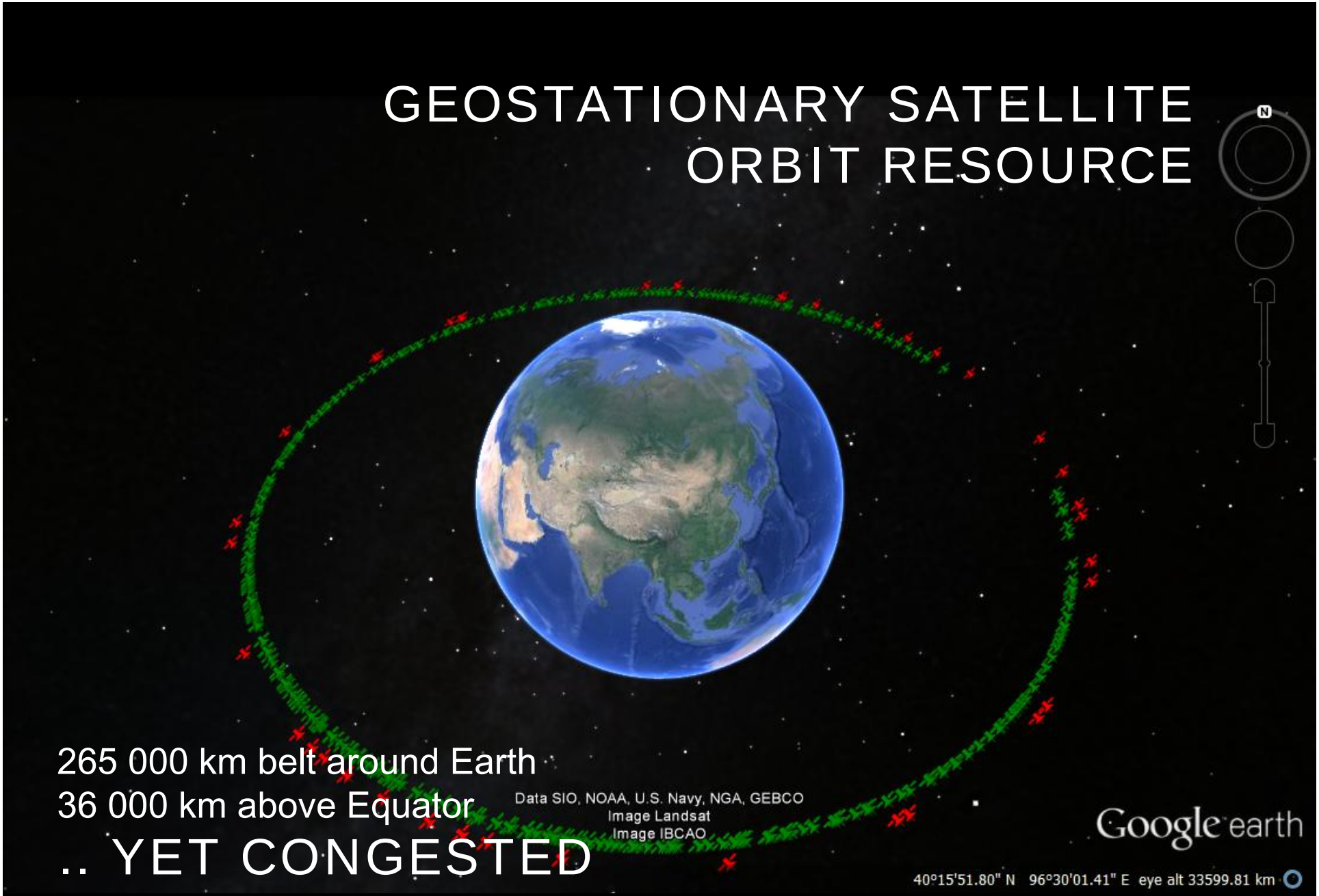
LOW-EARTH ORBIT

Sub-orbital

40,000 objects
and growing



GEOSTATIONARY SATELLITE ORBIT RESOURCE



265 000 km belt around Earth

36 000 km above Equator

.. YET CONGESTED

Source: TLE data dated 10.08.2015

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)

ITU CONSTITUTION (Art.1)

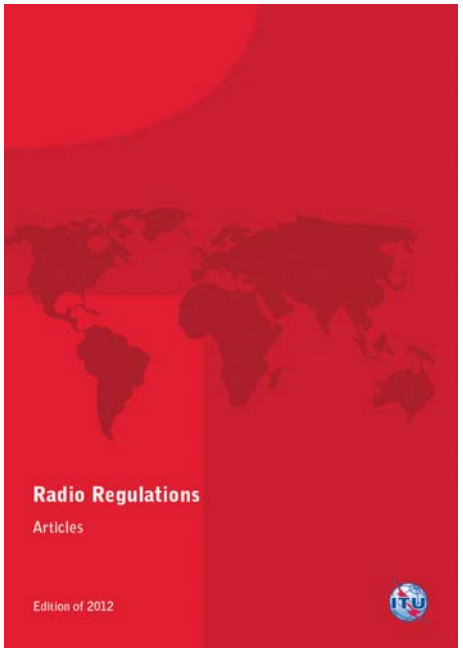
"ITU shall effect allocation of bands of the radio-frequency spectrum, the allotment of radio frequencies and the registration of radiofrequency assignments and, for space services, of any associated orbital position in the geostationary-satellite orbit or of any associated characteristics of satellites 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 resouces

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

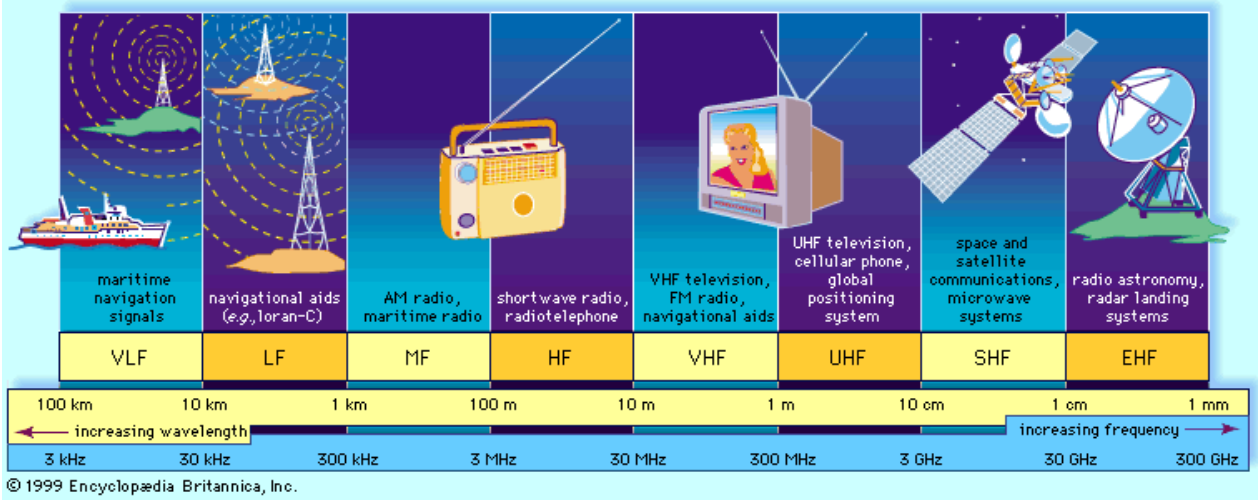
RADIO REGULATIONS

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

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 Liable for damage	▶	No liability clause

REGULATION OF RADIO SPECTRUM AND SATELLITE ORBIT IN PRACTICE

ALLOCATION OF SPECTRUM



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)

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

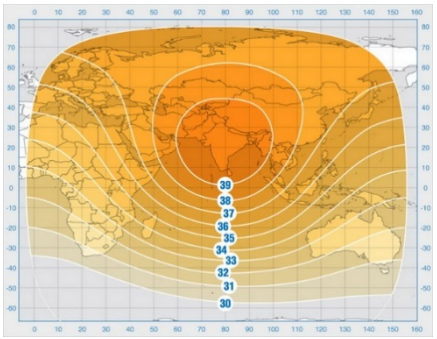
Narrow → Wide

Rain fade

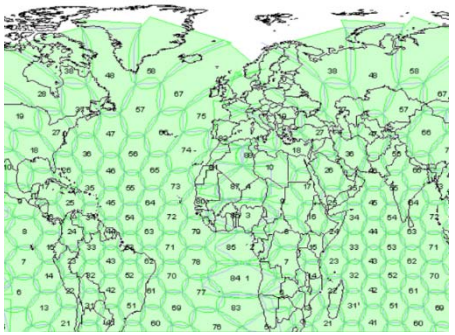
Less → Severe

Earth station antenna diameter

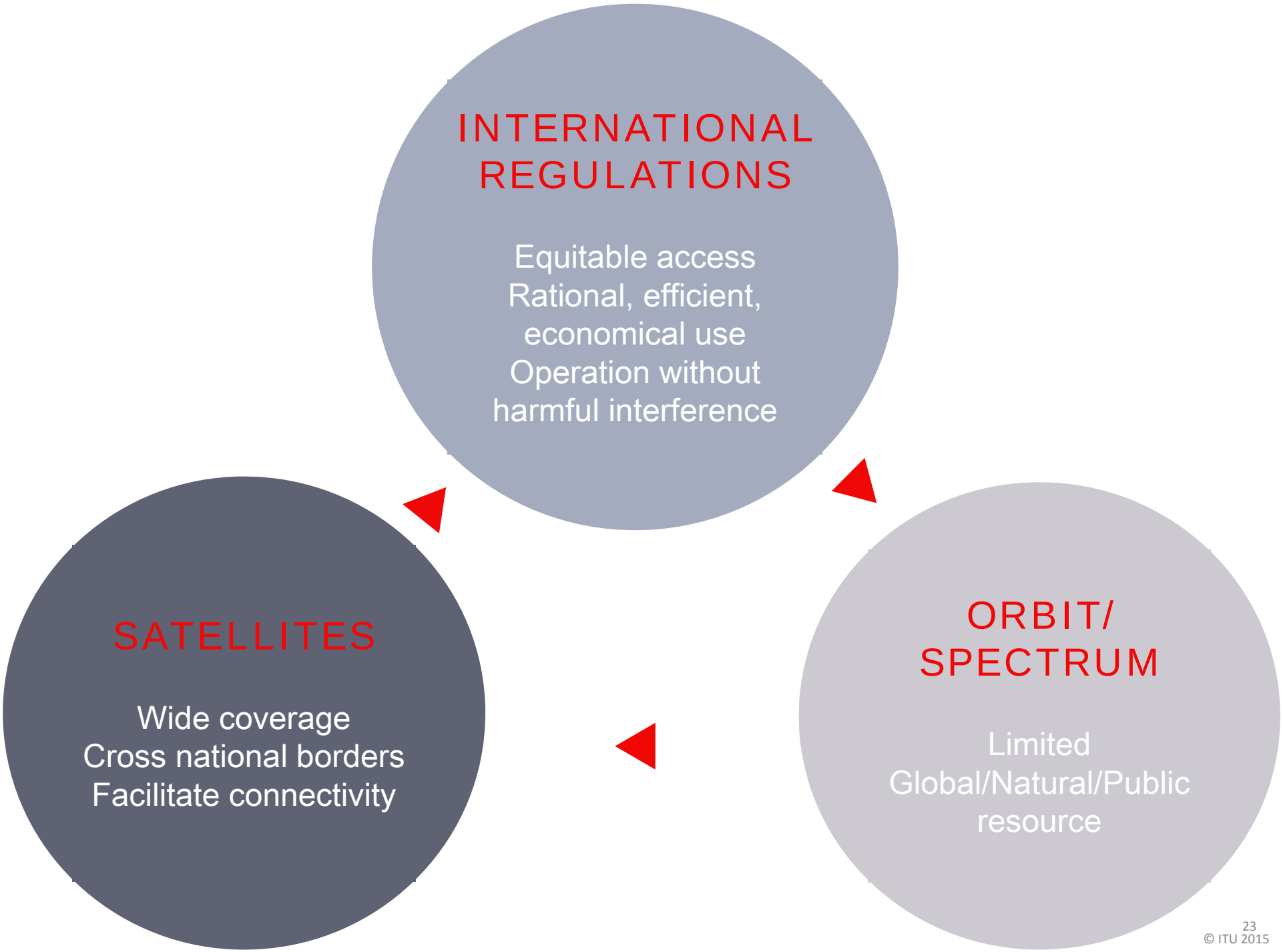
Large ← Small

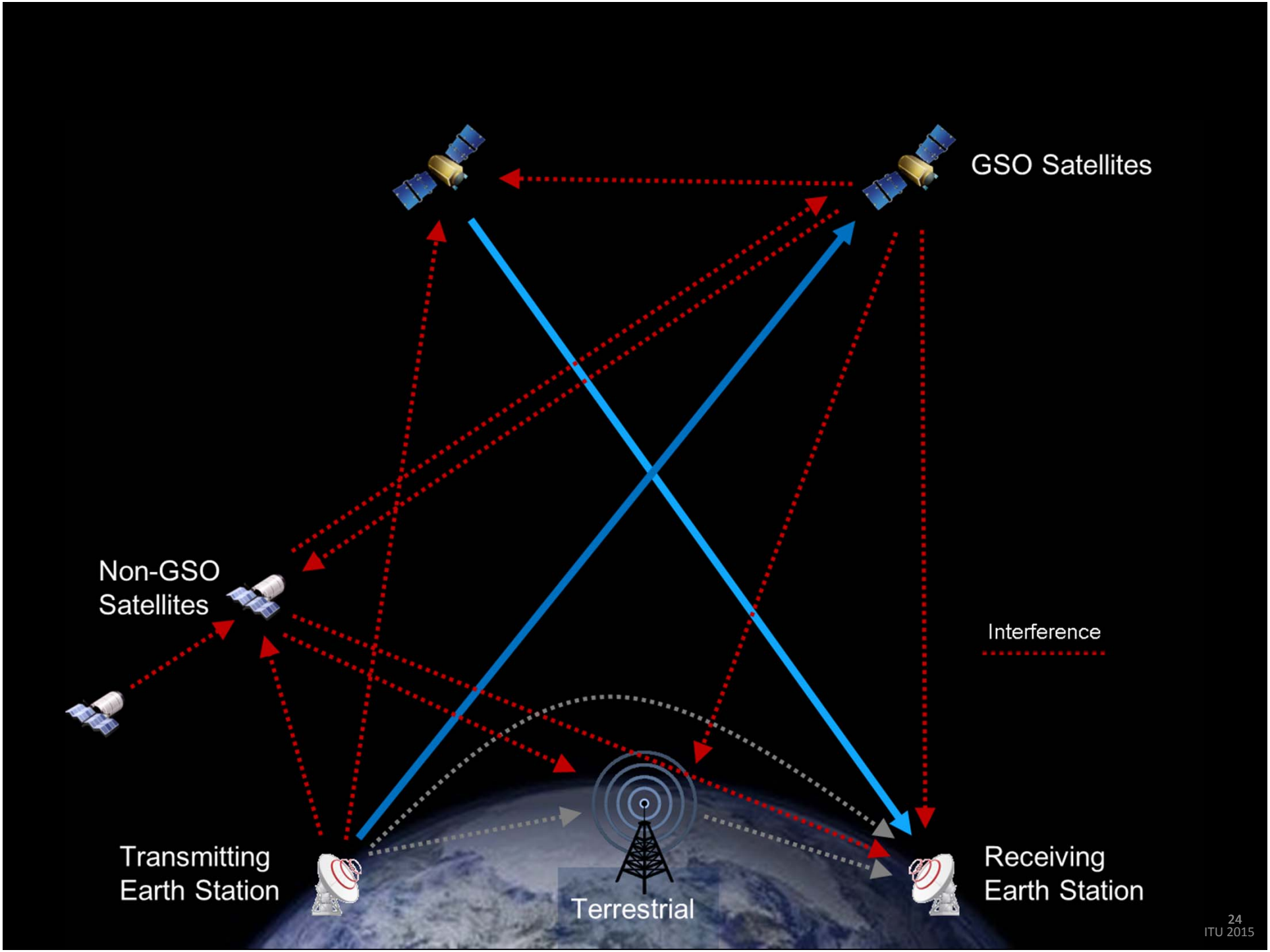


Large Beams



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

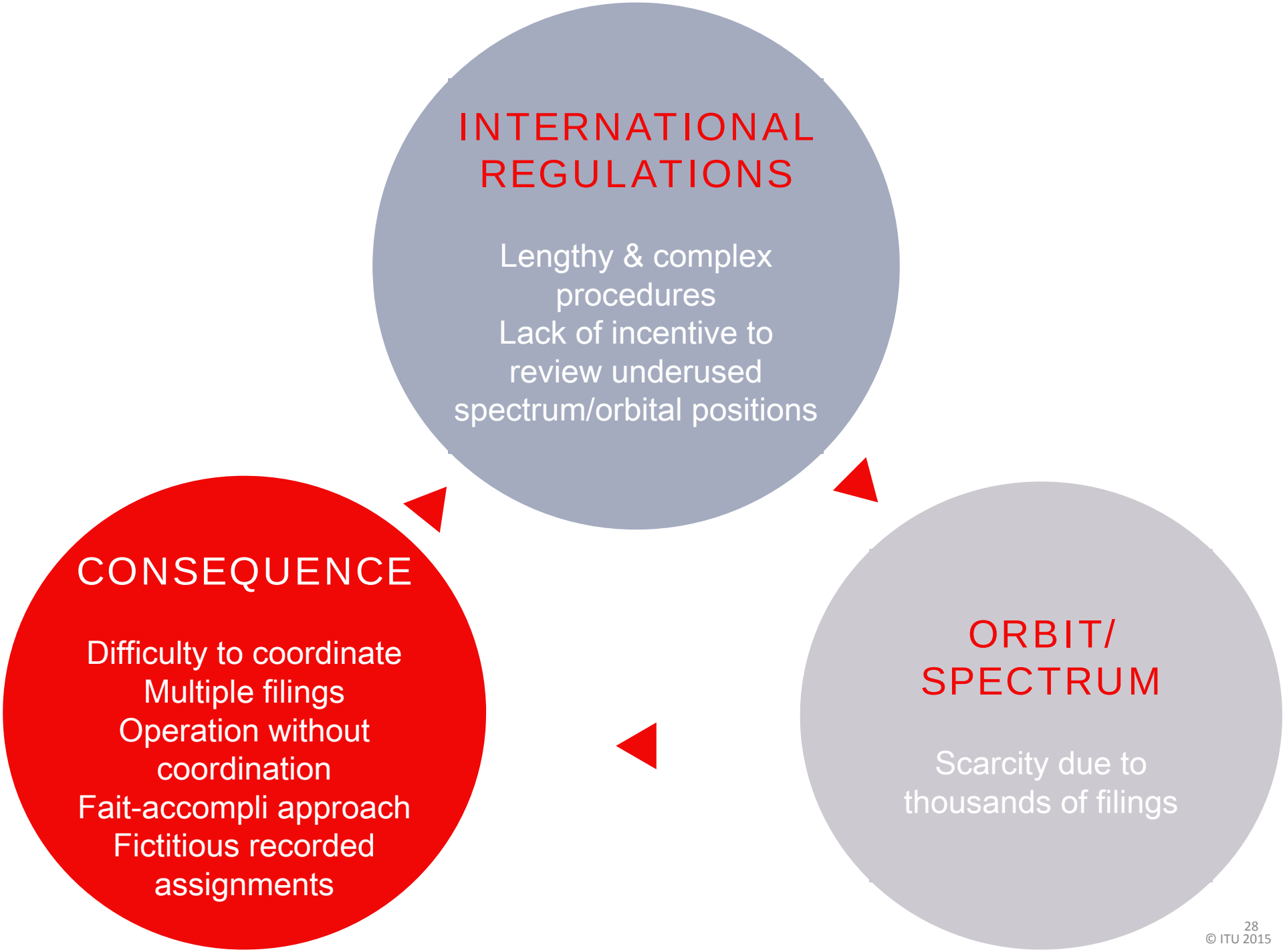
SHARING ORBIT/SPECTRUM RESOURCE

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 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 resouces

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

"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"

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