Orbit Spectrum-International Regulatory Framework

Presented by :

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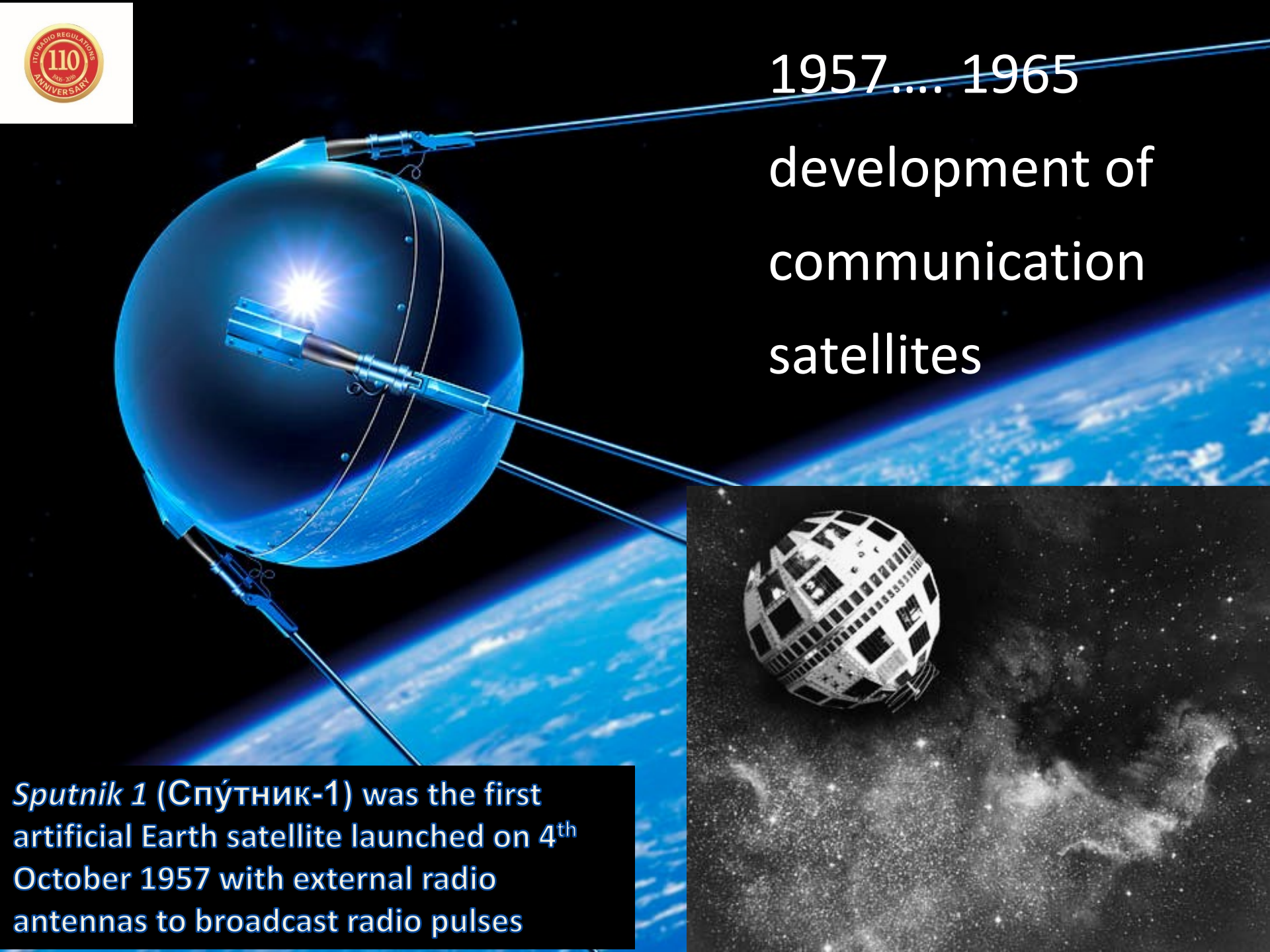
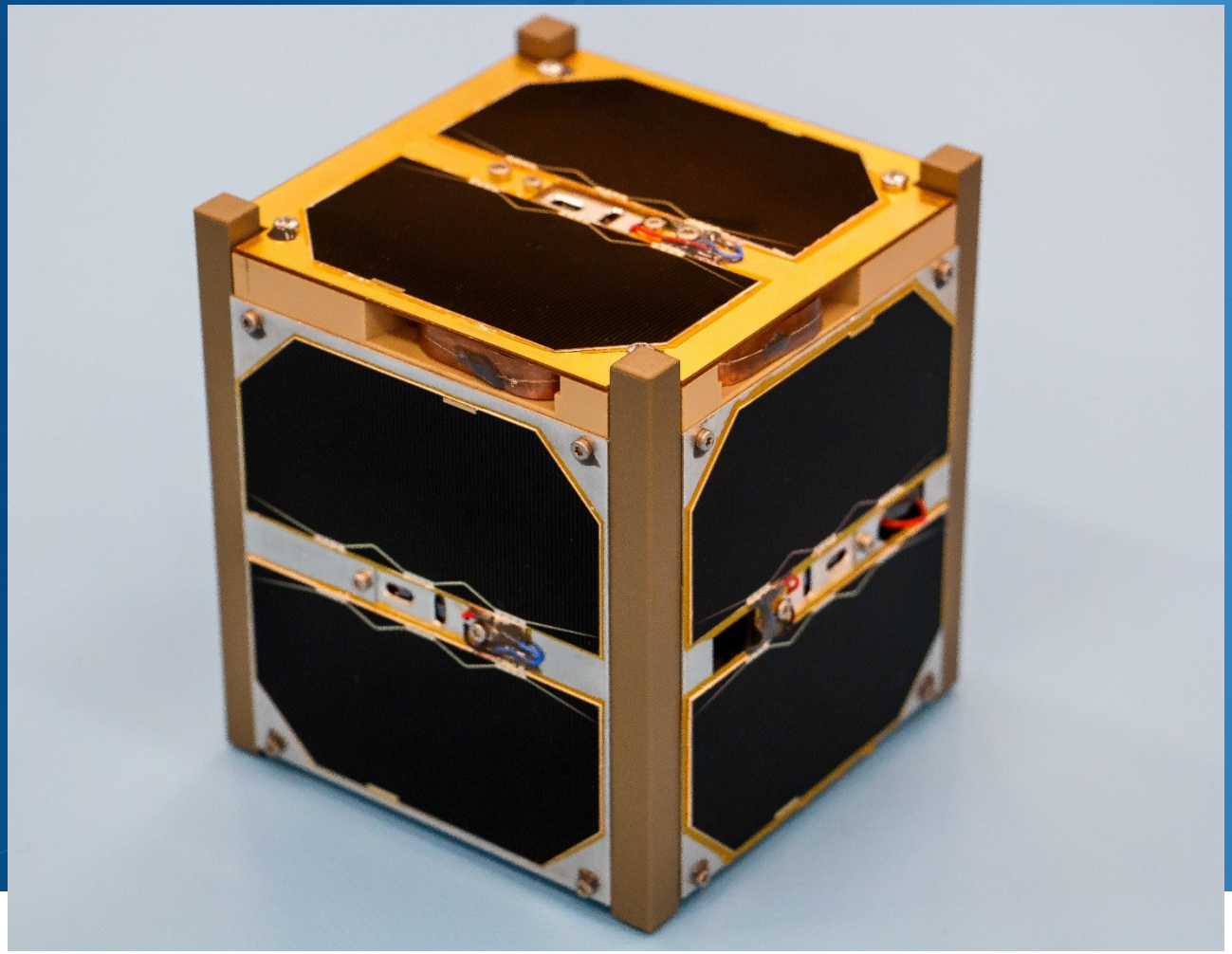
1957.... 1965 development of communication satellites



Sputnik 1 (Спу́тник-1) was the first artificial Earth satellite launched on 4th October 1957 with external radio antennas to broadcast radio pulses

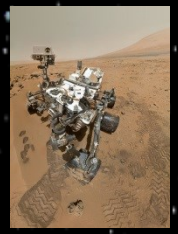
…2014

…2015



A “standard 1U" CubeSat has a volume of one liter - 10 cm cube and a mass of 1 kg, orbiting at 300-600 km circular orbit, 1W transmitter on 145 or 435 MHz amateur-satellite service band. It’s used for academic education, research and technology validation applications but also for complex science and governmental use.

Source:



Geostationary Orbit
35,786 km above
the Earth's equator

Highly Elliptical
Orbit – 40 000 km
in apogee

Medium Earth
Orbit
8 000 - 20 000 km

Molniya

Low Earth Orbit
400 - 2 000 km

International Space Station

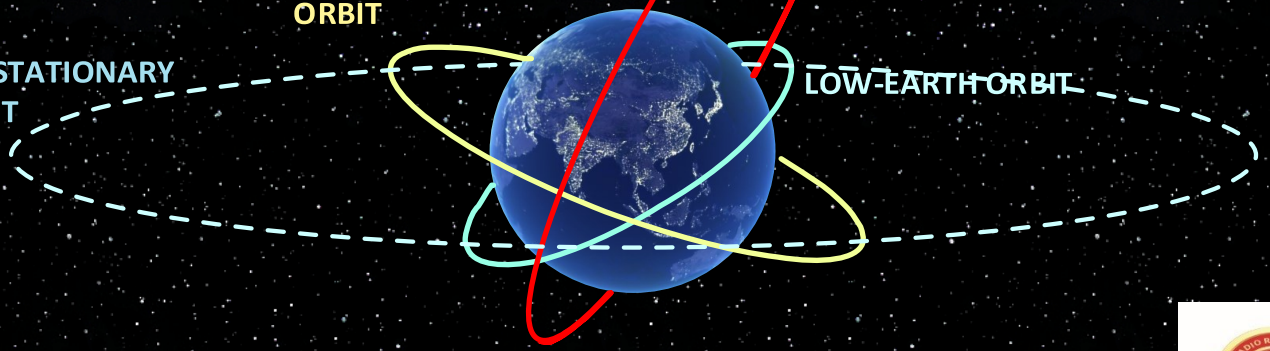
Sub-orbital flight

HIGHLY-ELLIPTICAL
ORBIT

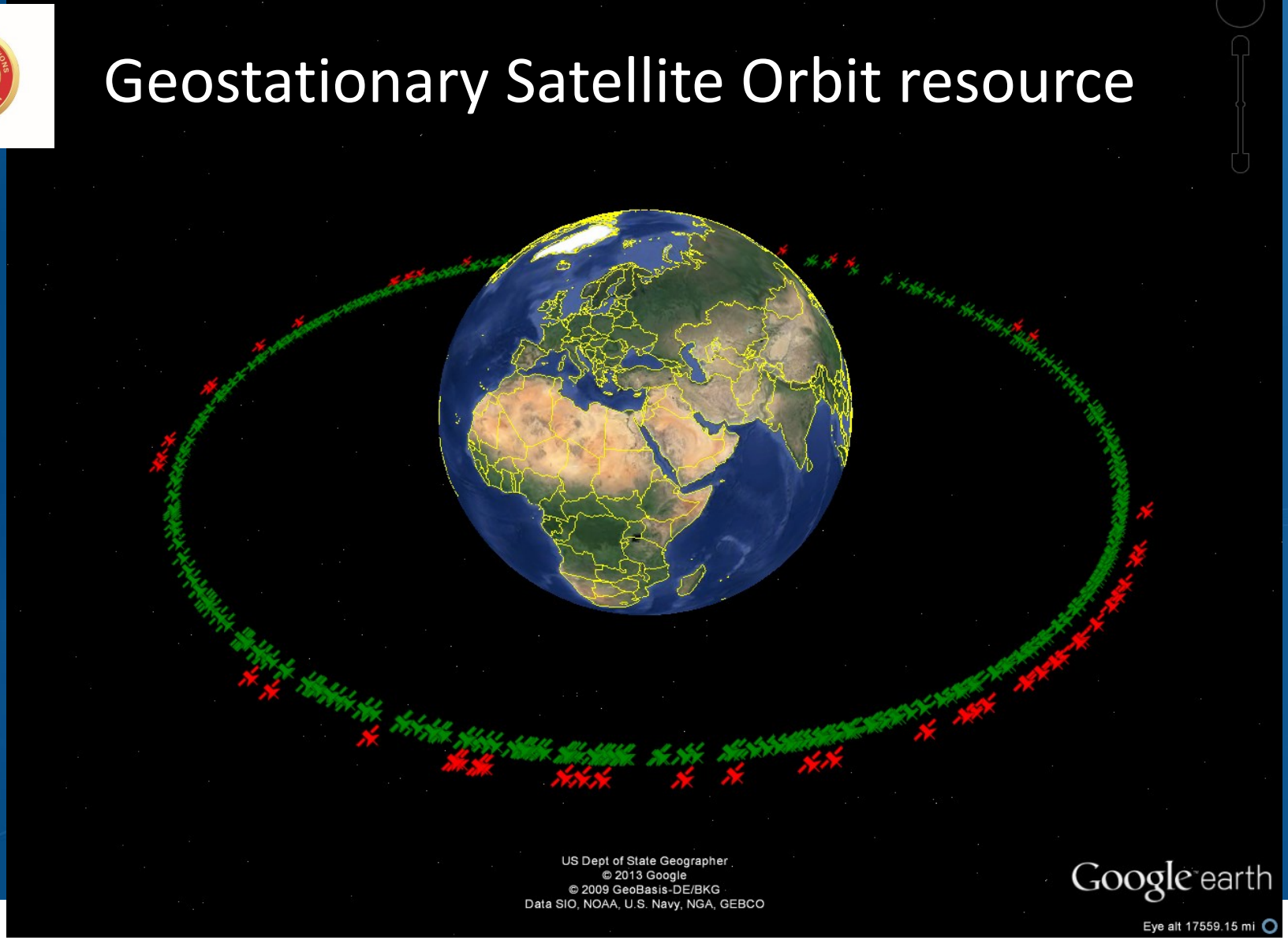
MEDIUM-EARTH
ORBIT

GEOSTATIONARY
ORBIT

LOW-EARTH ORBIT



Geostationary Satellite Orbit resource



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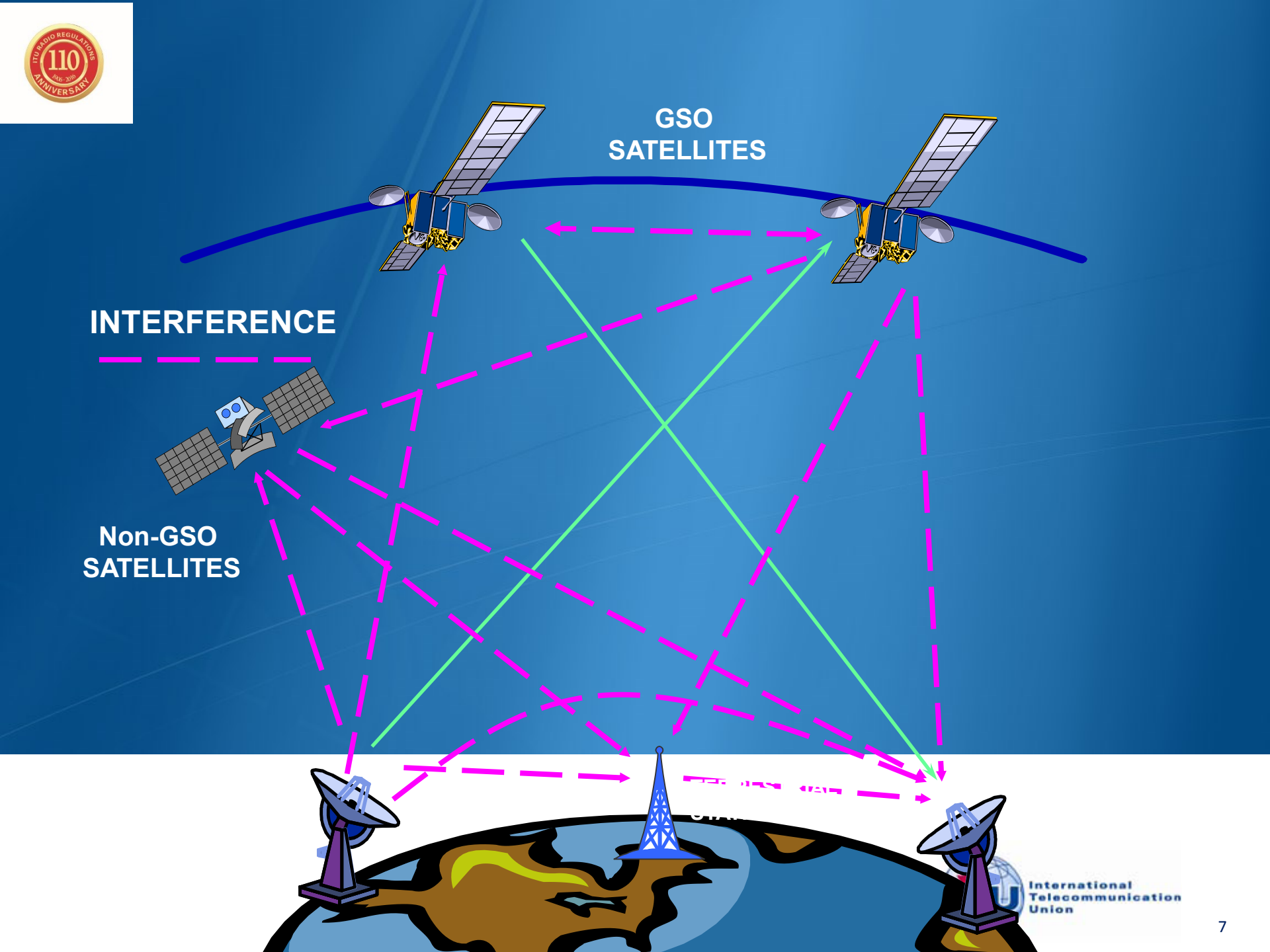
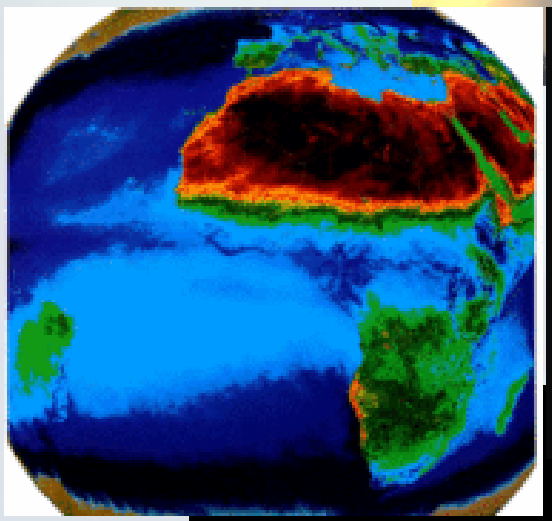
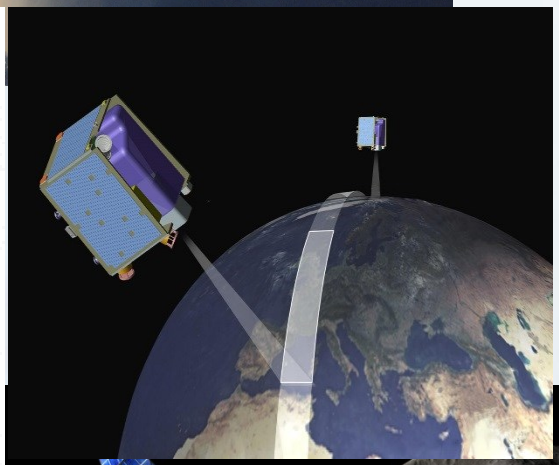


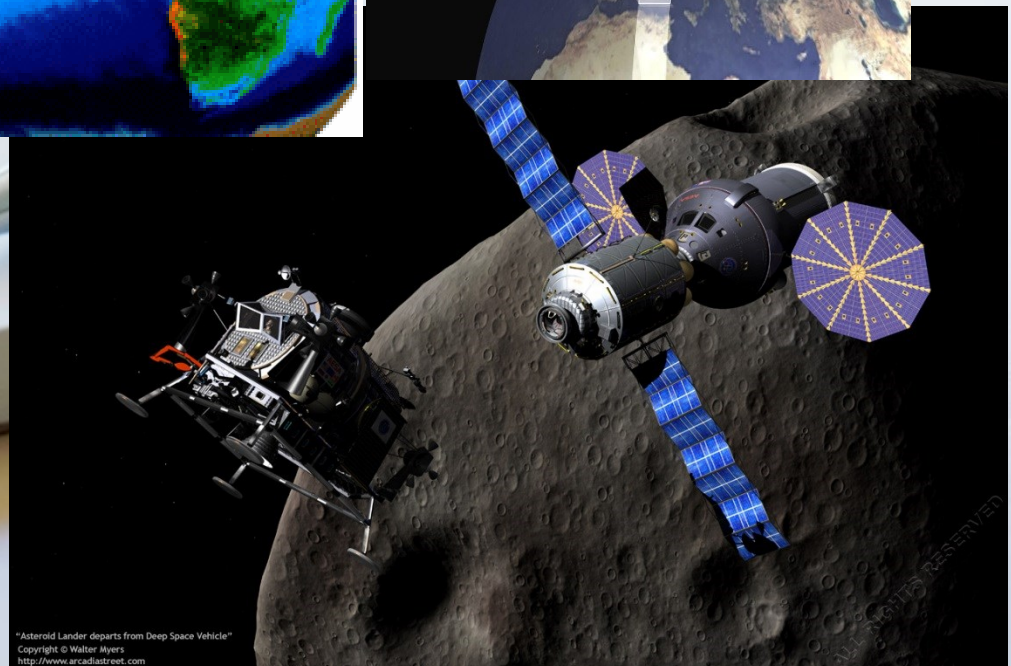
International Telecommunication Union

Space Activities

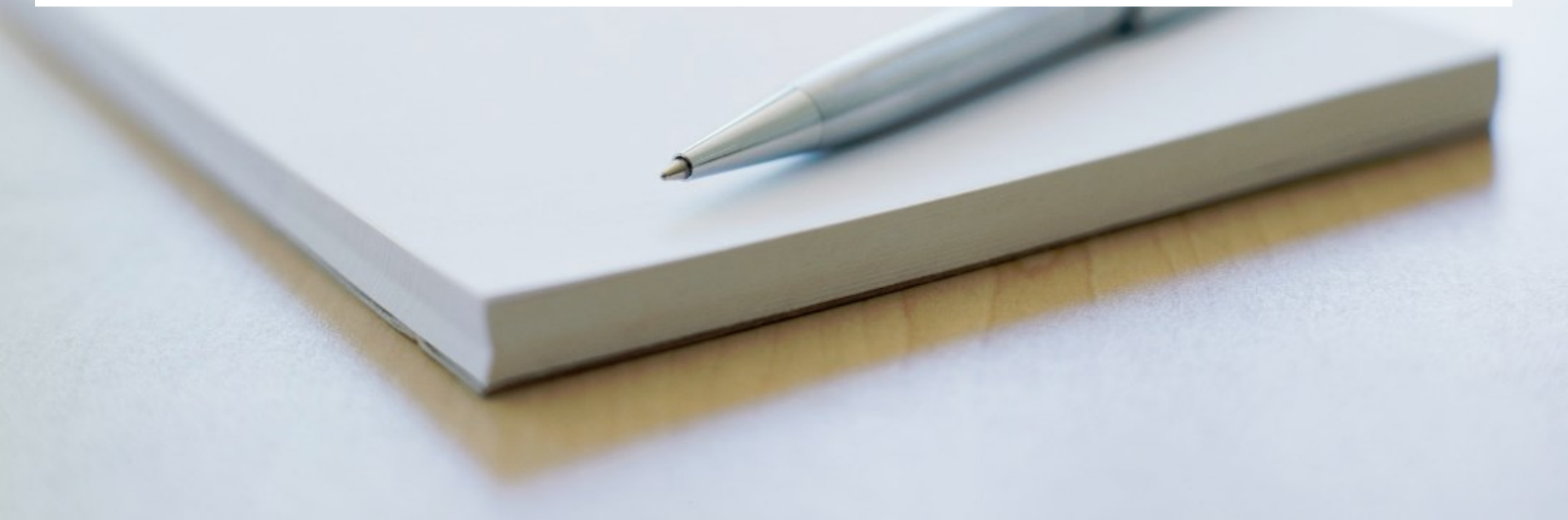
- Science
- Meteorology
- Earth Observation
- Navigation
- Astronomy
- Exploration
- Exploitation
- Transport
- ……







Legal Framework for Spectrum Access/Use



Two Categories of Issues

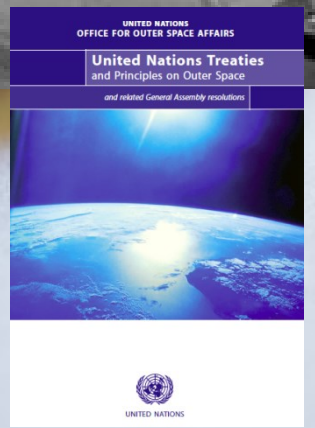
Objects in Space

Orbits & Spectrum

International Telecommunication Union

United Nations 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 they have launched into outer space
- States shall be liable for damage caused by their space objects



United Nations Outer Space Treaty 1967

1. Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies - 1967

2. The Agreement Governing the Activities of States on the Moon and Other Celestial Bodies - 1984

3. The Agreement on the Rescue of Astronauts - 1968

4. The Convention on International Liability for Damage Caused by Space Objects (States retain jurisdiction and control over objects they launch into outer space) - 1972

5 The Convention on Registration of Objects Launched into Outer Space – 1976

ITU – CS/CV of 1982 is listed under other agreements and ITU is recognized as the specialized agency responsible for telecommunication issues

UN Register

UN-OOSA (Office for Outer Space Affairs) maintain a public Register:

- Name of launching States(s)
- Designator or registration number
- Date & territory/location of launch
- Basic orbital parameters (apogee, perigee, period, inclination…)
- General function of the space object

Legal Framework for Spectrum Access/Use

ITU is recognized as the specialized agency responsible for:

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

Legal Framework for Spectrum Access/Use

United Nations Outer Space Treaty 1967
ITU Constitution – Article 44

In *using frequency bands* for radio services, Member States shall bear in mind that *radio frequencies* and *any associated orbits*, including the geostationary-satellite orbit, *are limited natural resources* and that they must be used *rationally*, *efficiently* and *economically* in conformity with the provisions of the Radio Regulations…

Legal Framework for Spectrum Access/Use

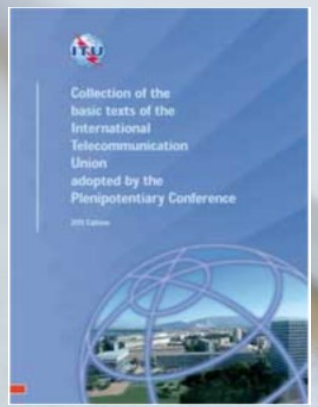
United Nations Outer Space Treaty (1967)

↓

ITU Constitution, Article 44

↓

Radio frequencies & satellite orbits are limited natural resources



↓

Rational, Efficient, Economical Use

↓

Equitable Access

ITU Constitution – Article 44

Objectives:

- ***To avoid harmful interference***
- To establish global standards and associated material to assure the necessary required performance, interoperability and quality
- To ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum and satellite-orbit resources

Legal Framework for Spectrum Access/Use

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

International Legal Framework for Space Services

UN
Outer Space instruments
(*on space objects*)

ITU
Instruments
(*on radio frequencies*)

- free "exploration and use" *under international law*

OST Art. I

⇨

- **Equitable** access and **rational** use of spectrum *under international law*

CS Art. 44

Art. VI **States**

- "responsibility" & "licensing"

Art. VIII - "jurisdiction & control"

⇨

States

- must **license** transmitting radio stations

RR Art. 18

- shall **not cause harmful interference**

RR Art. 15

States

Registration OOSA

Art. VIII

⇨

API_CR/C_MIFR

RR Art. 9, 11

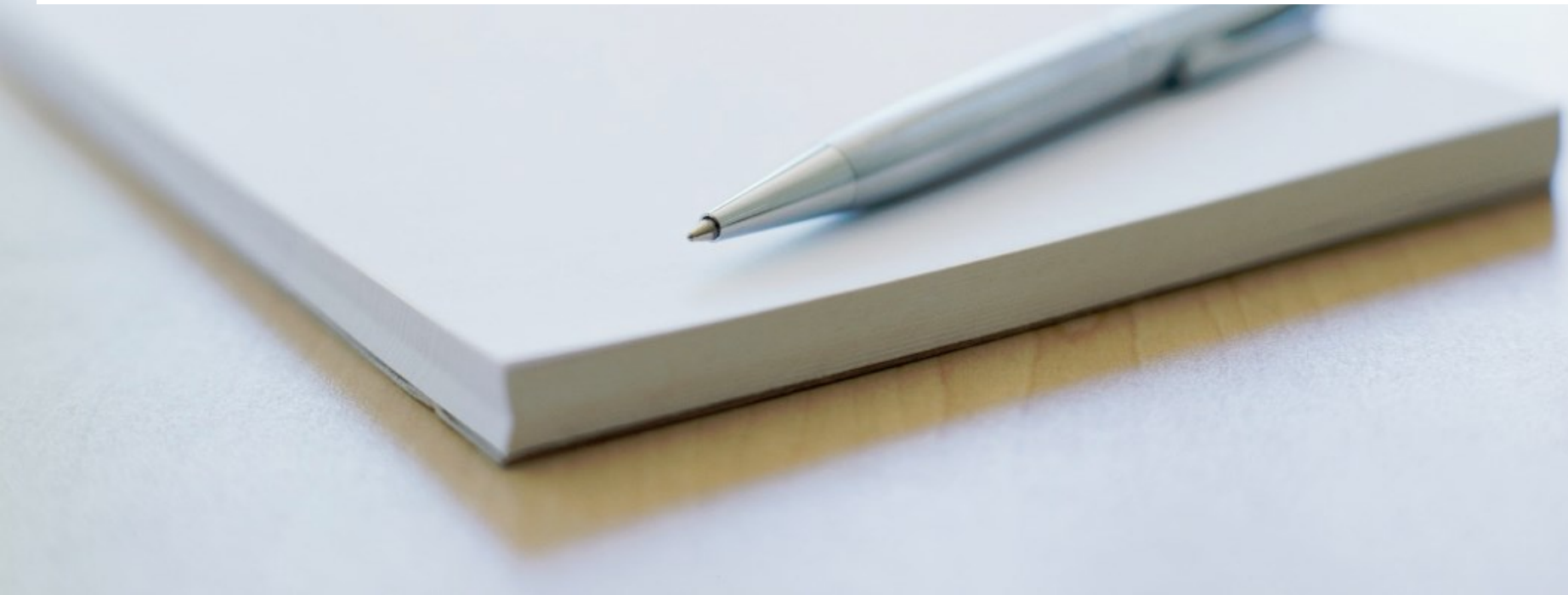
Art. VII States

"liable" for **damage**

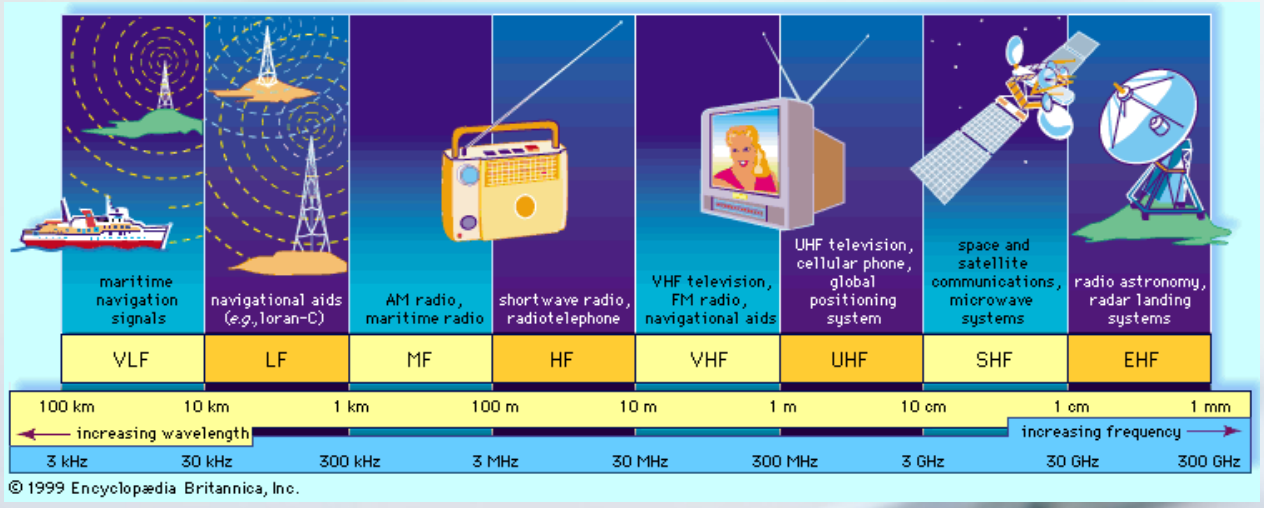
⇨

No liability clauses

Regulation of radio spectrum and satellite orbit in practice



Radio Regulations
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

International Regulations

Equitable access

Rational, efficient, economical use

Operation without harmful interference

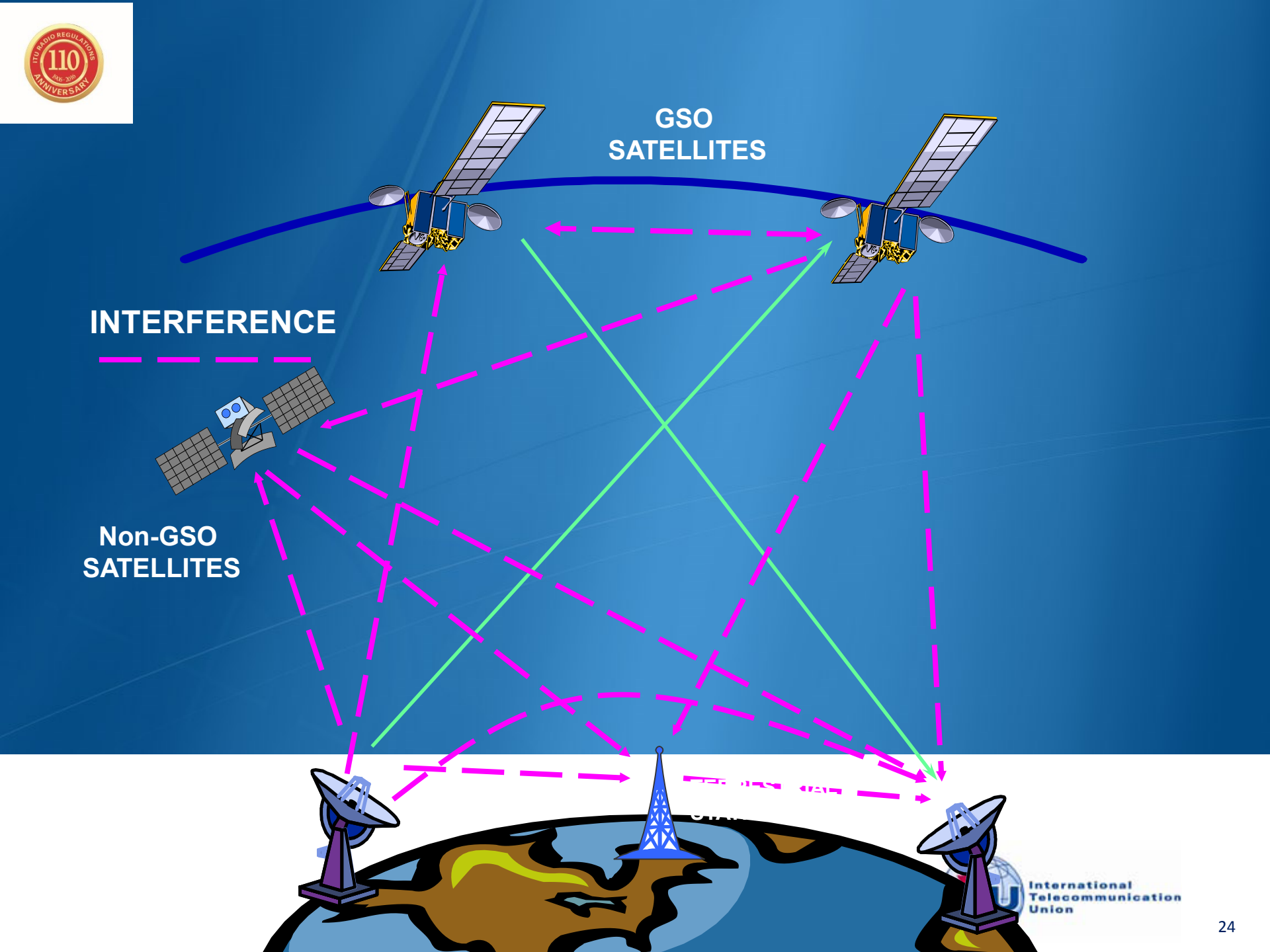
Satellites

Wide coverage crossing national borders

Facilitate connectivity

Orbit/Spectrum

Limited Global/Natural/Public resource


GSO
SATELLITES
INTERFERENCE
Non-GSO
SATELLITES

Propagation of Radio waves

- Laws of physics
- Radio waves do not stop at national borders

Interference

- possible between radio stations of different countries
- This risk is high in Space Radiocommunications

Radio Regulations (RR)

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

Radio Regulations

Procedure

- Efficient use of spectrum
- Equitable access
- Opportunity to resolve interference before operation
- Prevents loss of investment, customers & revenue by minimizing

Article 15- Interference

Infringement of the Constitution or Radio Regulations

- **No.15.1:** All stations are ***forbidden*** to carry out ***unnecessary transmissions***, or the transmissions of ***superfluous signals***, or the transmission of ***false or misleading signals*** or the transmission of ***signals without identification***.
- The station which is causing harmful interference ***shall immediatly eliminate*** this harmful interference
- This assumes a legal link between the transmit station and the administration under the jurisdiction of which it is placed:

Article 18- Licences

No.18.1: No transmitting station may be established or operated by a private person or by any enterprise without a licence issued in an appropriate form and in conformity with the provisions of these Regulations by or on behalf of the goverment of the country to which the station in question is subject.

Radio Regulations - Mechanisms

To ensure equitable access and control interference by

ALLOCATION

Frequency separation of stations of different services

POWER LIMITS

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

MONITORING

International monitoring system

COORDINATION

between Administrations to ensure interference-free operations conditions

RECORDING

In the Master International Frequency Register (MIFR)

International recognition

Radio Regulations

- Two mechanisms for sharing the orbit/spectrum resource:

Coordination Approach	Planning Approach
First come, first served for actual requirements	Plan for future use
Rational, Efficient, Economical Use	**Equitable Access**

International Recognition

MIFR

Radio Regulations

Rational, Efficient, Economical Use

Coordination Approach

First come, first served for actual requirements

- Rights acquired through **coordination** with administrations concerning **actual usage**
- Efficient spectrum / orbit management
- Dense/irregular orbital distribution of space stations

Coordination Approach

First come, first served for actual requirements

API/Coordination

negotiation (Goal: interference-free operation)

API to be submitted only for networks not subject to coordination (WRC-15)

Notification

Recording in Master Register (international recognition)

(Bringing into use within 7 years from first submission)

Radio Regulations

Equitable Access

Planning Approach

Plan for future use

- Congestion of the GSO
- Frequency / orbital position plans
- Guarantee for equitable access to the spectrum / orbital resources
  - Spectrum set aside for future use by all countries
  - Predetermined orbital position & frequency spectrum

International regulatory framework:
Lengthy & complex procedures
Lack of incentive to review underused spectrum/orbital positions

Spectrum/orbit resource:
Scarcity due to thousands of filings

Consequences:
Difficulty to complete coordination
Multiple-filing submissions
Operation without prior coordination
Fait-accompli approach
Fictitious recorded assignments

What to do?

- To introduce new milestones in Res 49
- To notify more realistic parameters at the notification/recording stage
- To charge fees for data in the MIFR
- To review satellite service/application definitions
- to introduce more deterrent enforcement mechanisms (…monitoring)
- to improve procedures?

Goal:

- To ensure rational, equitable, efficient and economical use of the radio frequency spectrum
- To ensure compliance of orbit/spectrum use with RR
- To develop procedures that facilitate access to the resources
- To guarantee interference-free satellite network operation…

Radio Regulations - Procedure

Article 44

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

Key elements to remember

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

Key ITU documents free on-line downloads

- **The ITU Constitution:**
  http://www.itu.int/pub/S-CONF-PLEN-2011
- **ITU Radio Regulations @ 2012:**
  http://www.itu.int/pub/R-REG-RR-2012
- **ITU-R Recommendations:**
  http://www.itu.int/publ/R-REC/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"

Thank you for your attention!

See you at WRS-2016 (12-17 December 2016)