

Orbit/Spectrum International Regulatory Framework Challenges in the 21st century



ITSO/ITU/CTU WORKSHOP ON SATELLITE COMMUNICATIONS
PORT OF SPAIN, TRINIDAD, 14th - 18th SEPTEMBER, 2015

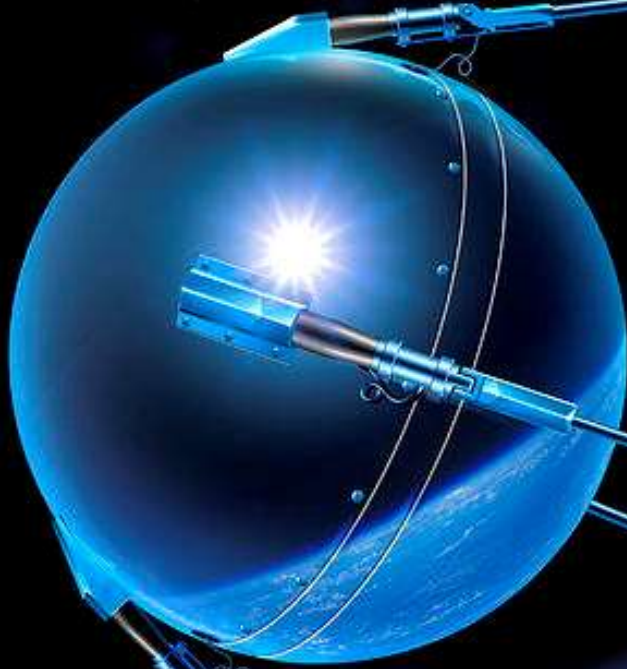


Presentation by:

ITU (International Telecommunication Union)
BR / Space Services Department
Dongsik KIM

1957.... 1965

development of
communication
satellites



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

...2014



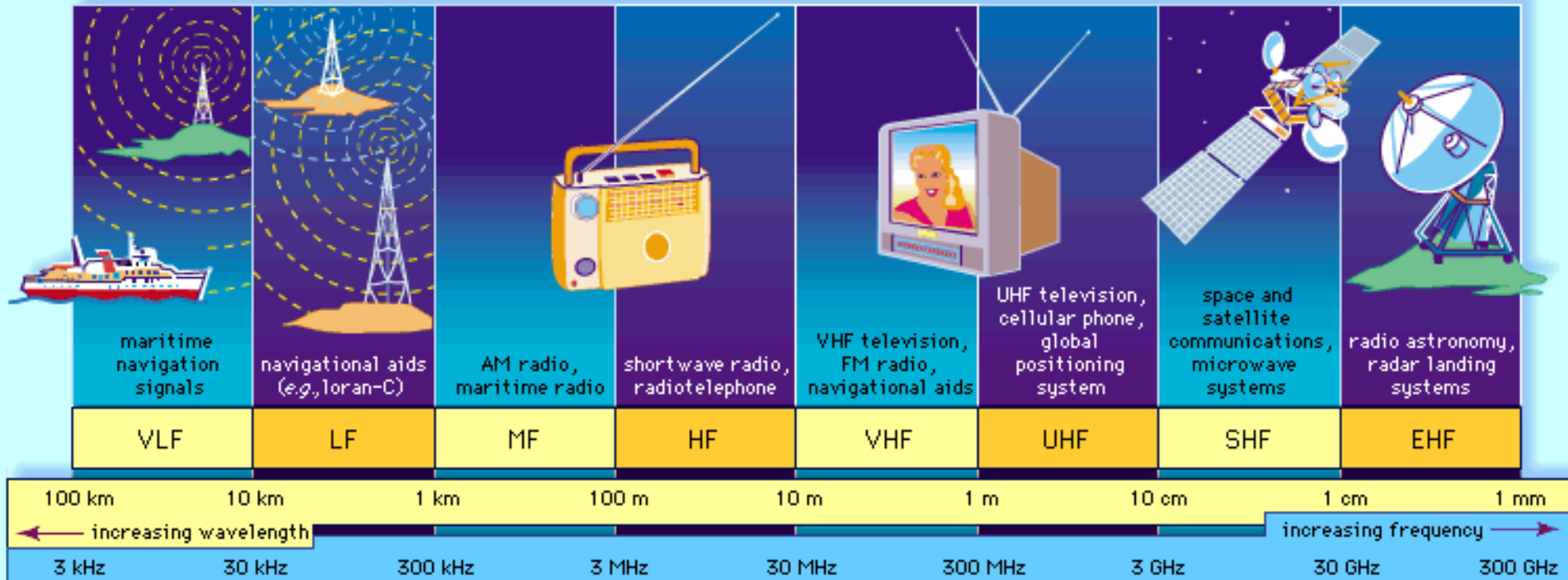
...2015



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.

Frequency spectrum

Limited natural resource



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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

**HIGHLY-ELLIPTICAL
ORBIT**

**MEDIUM-EARTH
ORBIT**

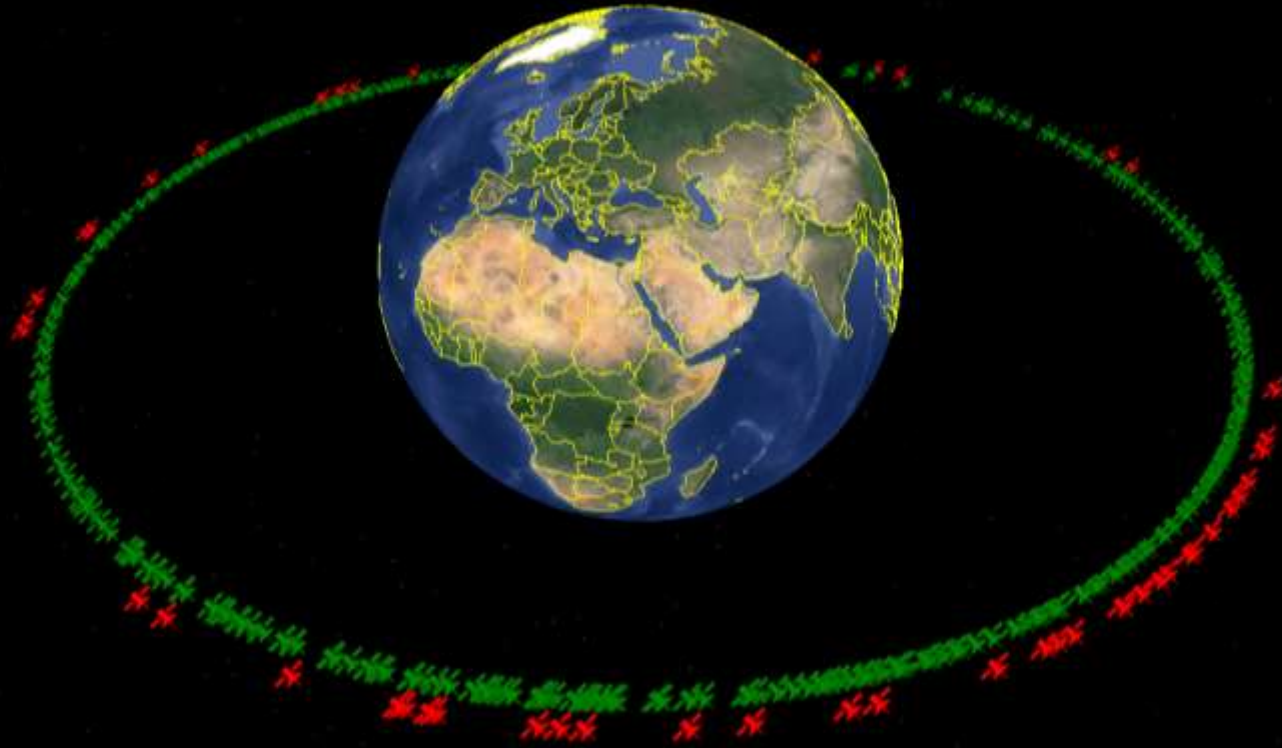
**GEOSTATIONARY
ORBIT**

LOW-EARTH-ORBIT



Sub-orbital flight

Geostationary Satellite Orbit resource

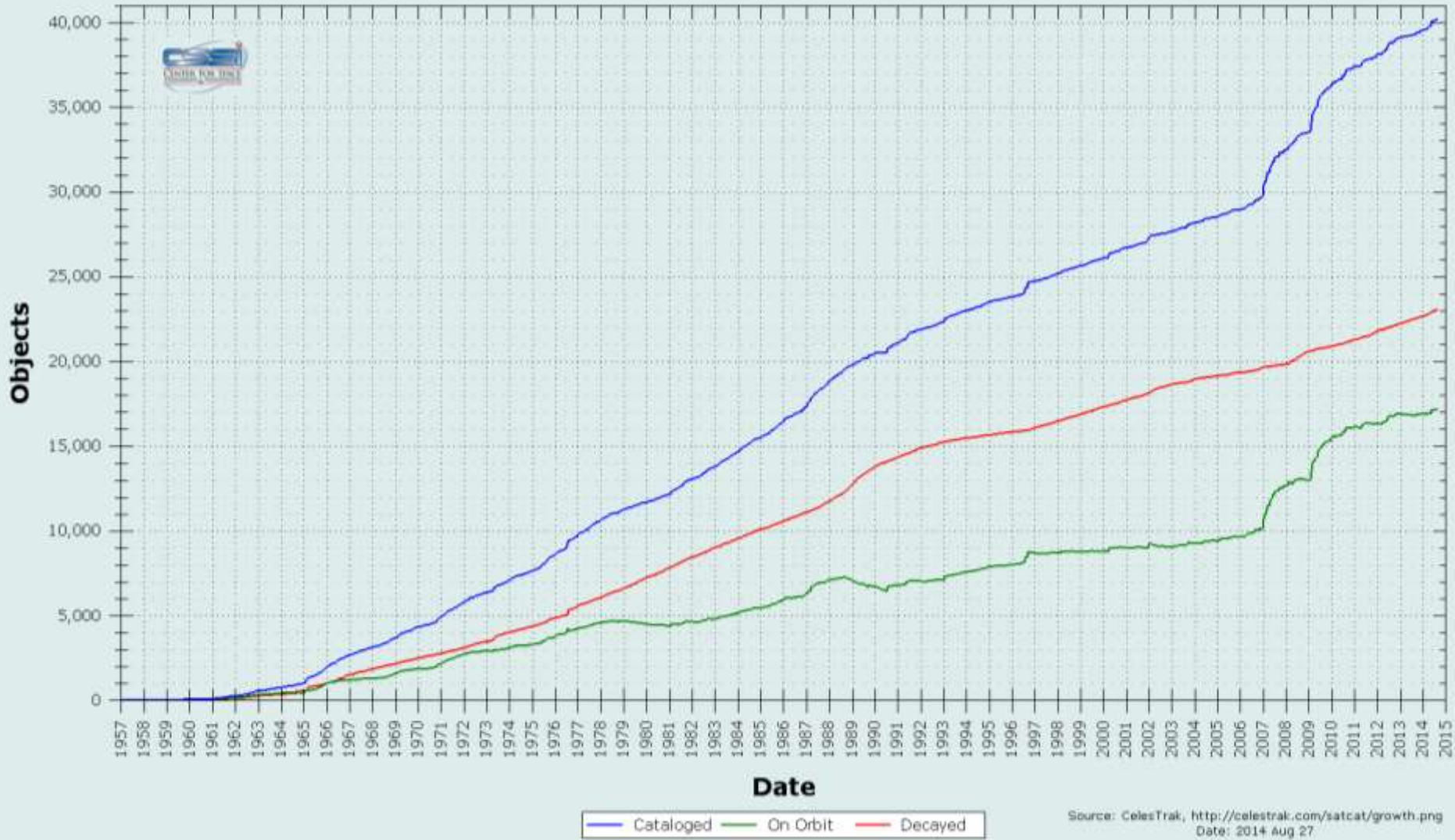


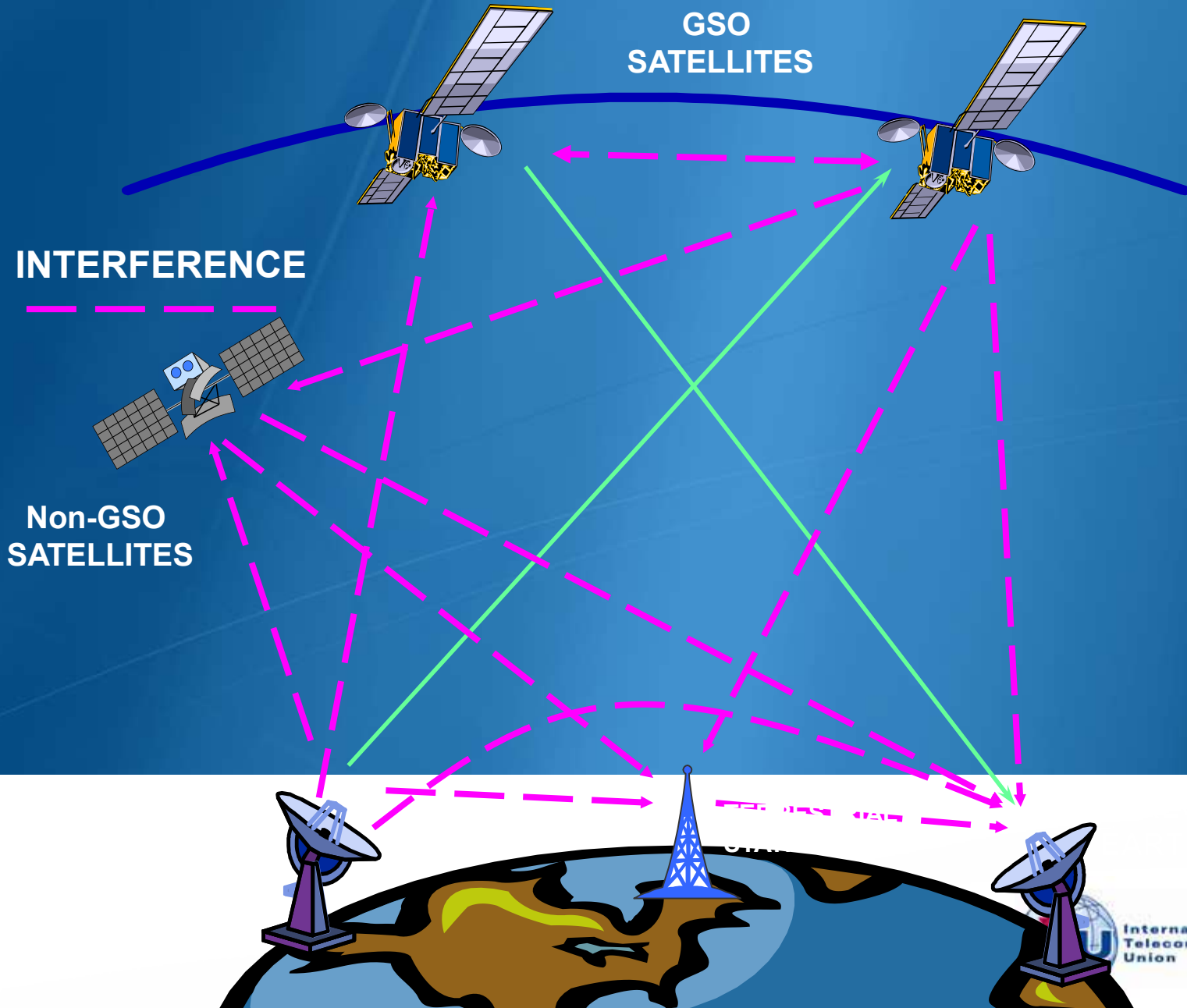
US Dept of State Geographer
© 2013 Google
© 2009 GeoBasis-DE/BKG
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

Google earth

Eye alt 17559.15 mi

Nowadays...







1963

Extraordinary Administrative Radio
Conference to allocate frequency bands for



Since 1906...

Today more
than 1000
pages

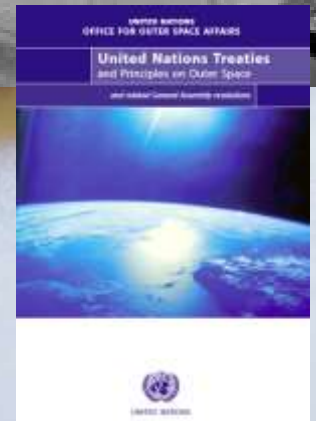
Legal Framework for Spectrum Access/Use





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

Legal Framework for Spectrum Access/Use

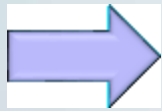
United Nations Outer Space Treaty 1967

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



Legal Framework for Spectrum Access/Use

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



- Updated every 3-4 years by World Radiocommunication Conferences, WRCs
- Rules of Procedure and Radio Regulations Board

33 Agenda items (Successfully addressed without a vote)

First ITU paperless World conference in 6 Languages

Participants: 3042

Countries: 165

Companies: 101



International Legal Framework for Space Services

UN Outer Space instruments (on space objects)

- free “exploration and use”
under international law

OST Art. I

States

Art. VI

- “responsibility” & “licensing”

Art. VIII - “jurisdiction & control”

States

Registration OOSA

Art. VIII

States

“liable” for **damage**

Art. VII

ITU Instruments (on radio frequencies)

- **Equitable** access and **rational** use
of spectrum **CS Art. 44**
under international law

States

- must **license** transmitting radio
stations **RR Art. 18**

- shall **not cause harmful interference**
RR Art. 15

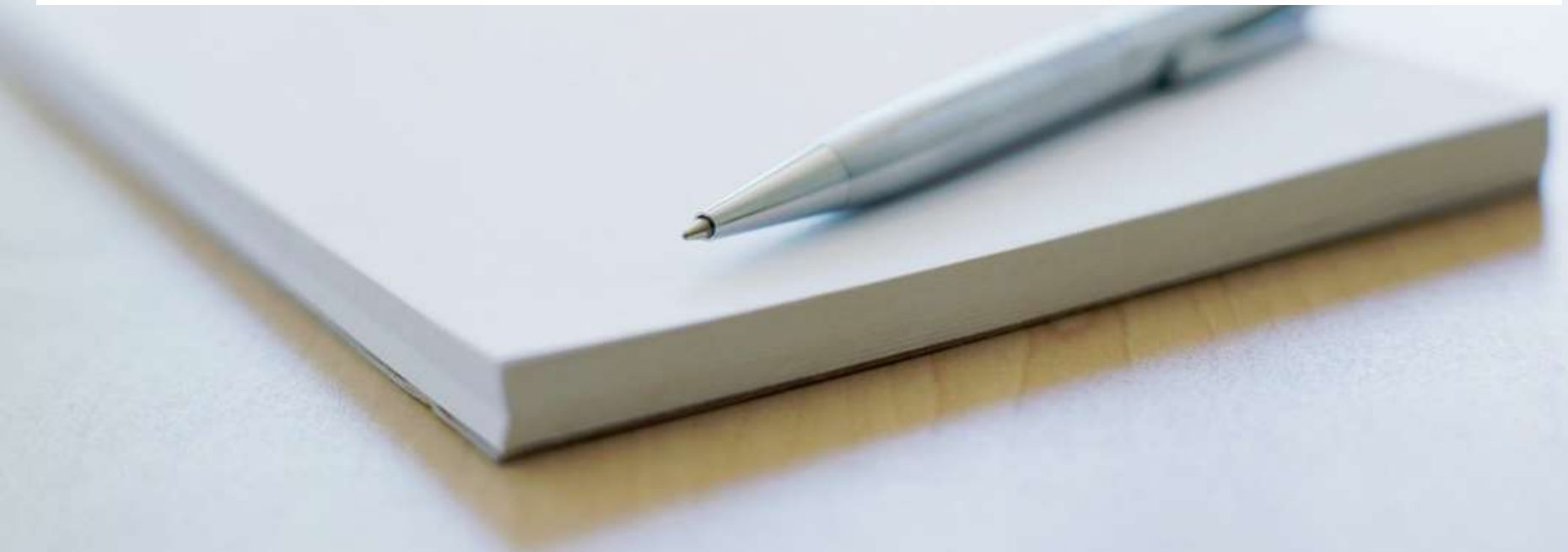
API_CR/C_MIFR

RR Art. 9, 11

No liability clauses

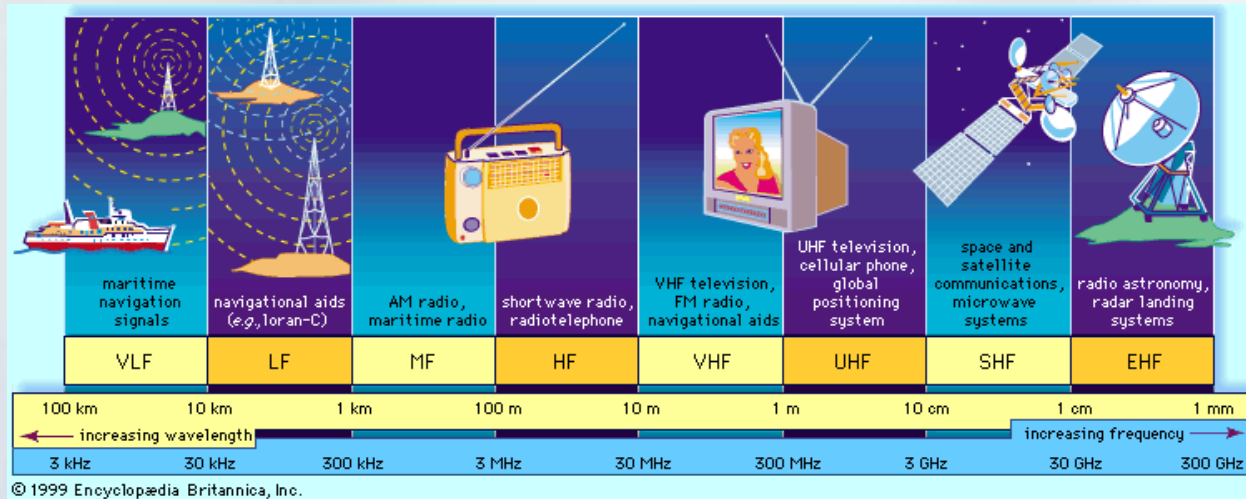


Regulation of radio spectrum and satellite orbit in practice



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

Satellite Frequencies and Services

C-band

Ku-band

Earth station antenna diameter



Small

Large

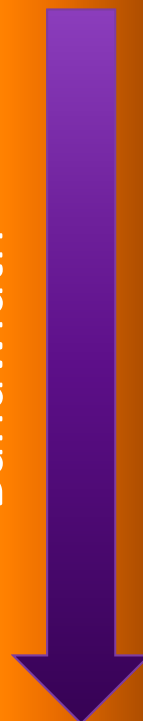
Rain fade



High

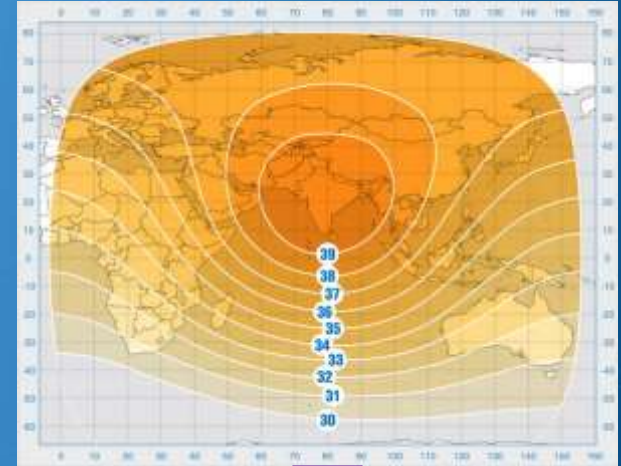
Low

Bandwidth



High

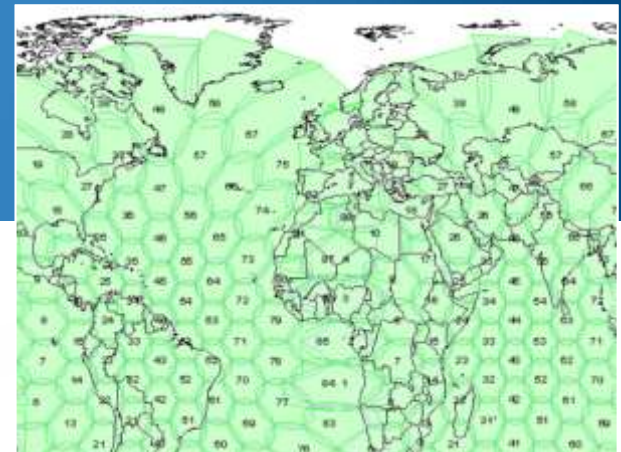
Low



Large beams



Spot beams





International Regulations

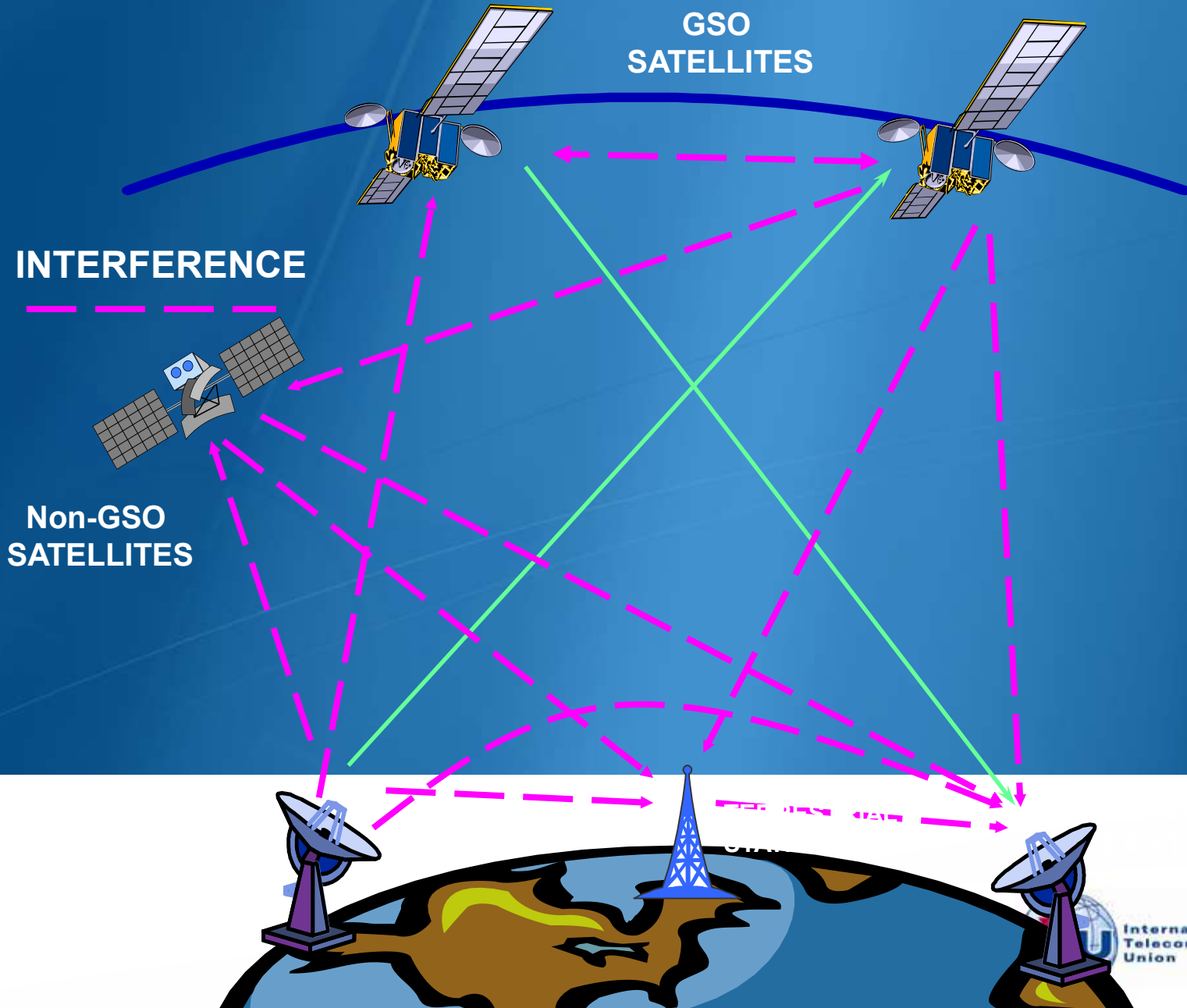
Equitable access
Rational, efficient,
economical use
Operation without harmful
interference

Satellites

Wide coverage
crossing national
borders
Facilitate connectivity

Orbit/Spectrum

Limited
Global/Natural/Public
resource



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 - 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

First come, first served for actual requirements

**Rational, Efficient,
Economical Use**

Planning Approach

Plan for future use

Equitable Access

International Description

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

**Advanced
Publication
Information**

Start the
clock
(7 years to
bring into
use)

**Valid up to
2 years**

Coordination

Obligatory
negotiation
(Goal:
interference
-free
operation)

(3 ~ 6 years)

Notification

Recording in
Master
Register
(international
recognition)

(Bringing into
use)

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

Consequences:

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

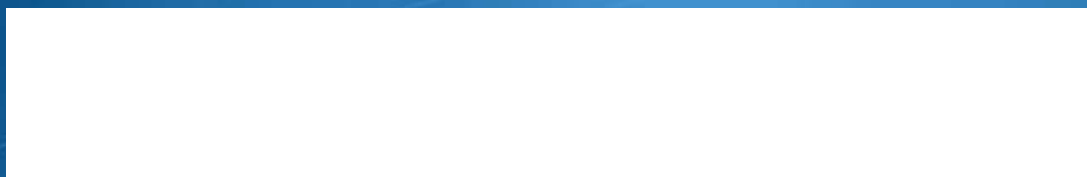
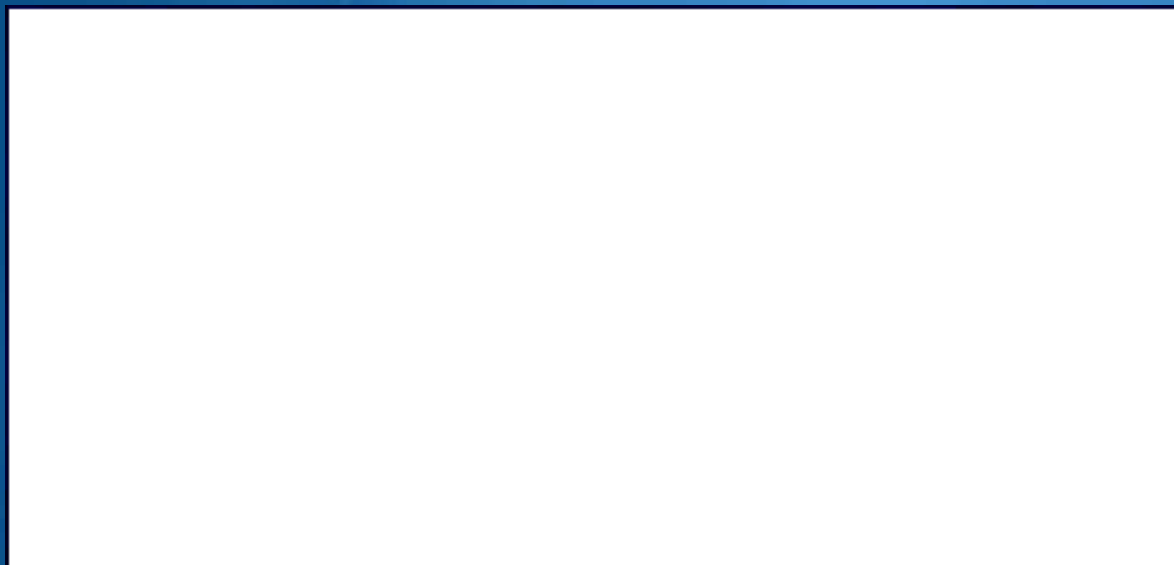
Spectrum/orbit resource:

Scarcity due to thousands of filings



Radio Regulations - Procedure

Article 44



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

Plenipotentiary Conference 2014

RESOLUTION 86 (Rev. Marrakesh, 2002)

NOC Resolution 86 (Rev. Marrakesh, 2002) *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 the ITU Council

to consider and review any proposed **cooperation agreements on the use of satellite monitoring facilities** consistent with the objectives of this resolution ...

instructs the Director of the Radiocommunication Bureau

1 **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** ...

2 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 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!