Frequency Management and Space Traffic Management

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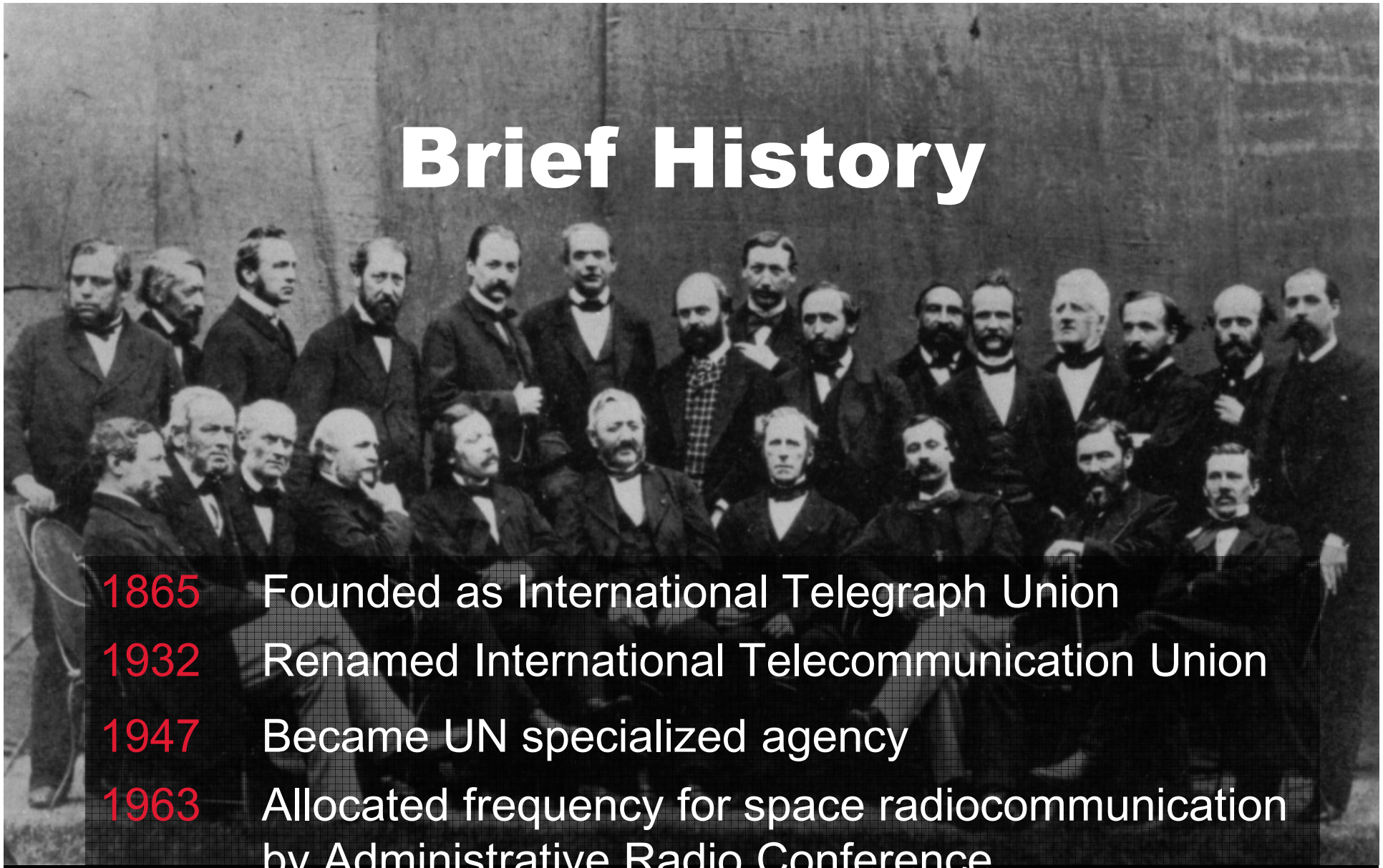
Space Law Symposium 2015



Brief History

1865	Founded as International Telegraph Union
1932	Renamed International Telecommunication Union
1947	Became UN specialized agency
1963	Allocated frequency for space radiocommunication by Administrative Radio Conference
2015	Celebrates 150th anniversary

About ITU

- Based in Geneva, Switzerland
- 12 regional and area offices around the world
- Membership of 193 countries and 700+ private-sector entities and academic institutions
- 3 Bureaus (Radiocommunication, Standardization, Development)

Mission

"To ensure rational, equitable, efficient and economical use of the radio frequency spectrum by all radiocommunication services - including those using the geostationary satellite orbit or other satellite orbits - and to carry out studies on radiocommunication matters"

Satellite Communication

Corporate networks

Maritime communication

VSAT

Aviation Security

Telemedicine

E-learning

Disaster Relief

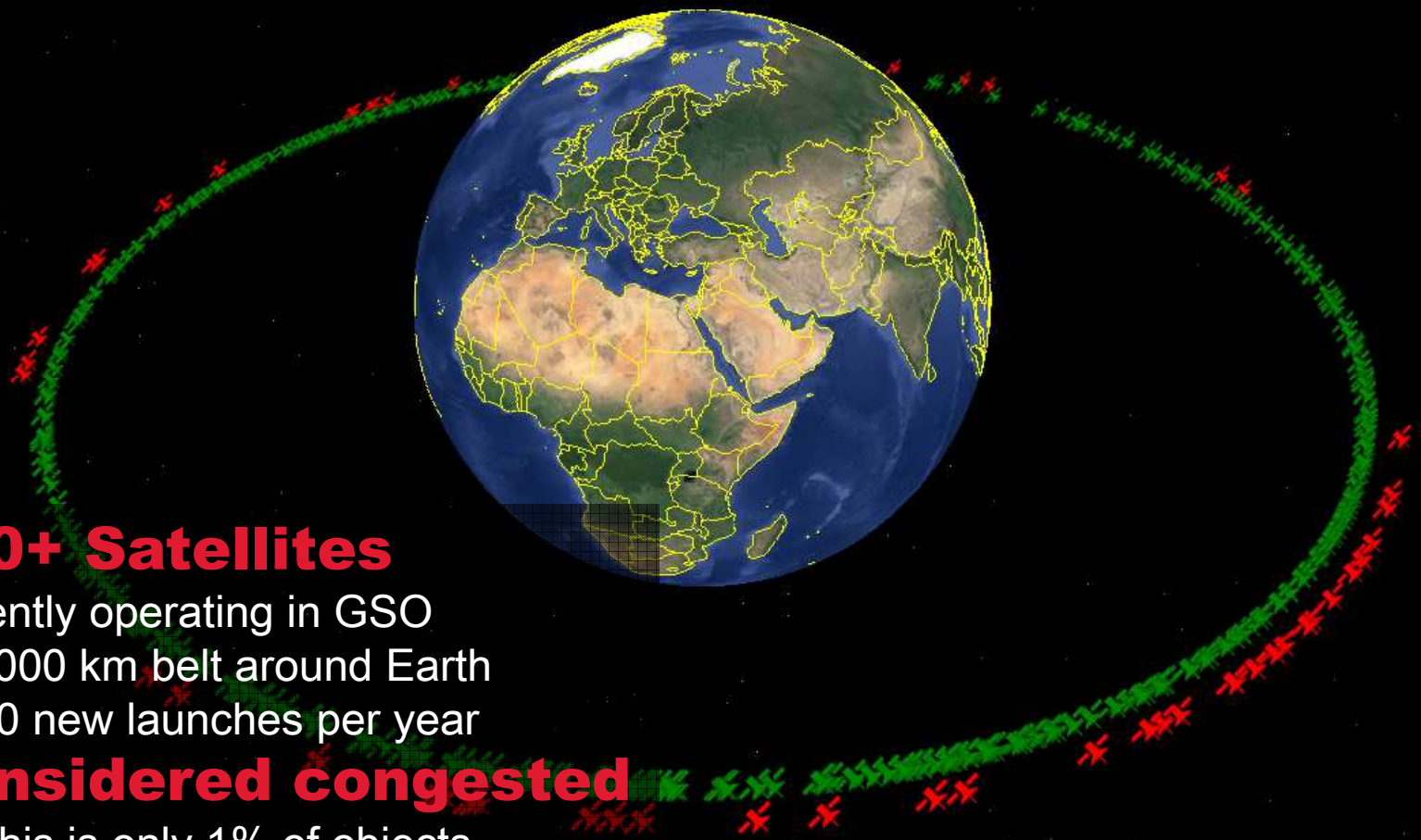
Internet

SNG

DTH

TT&C

Geostationary Satellite Orbit resource



410+ Satellites

currently operating in GSO

265 000 km belt around Earth

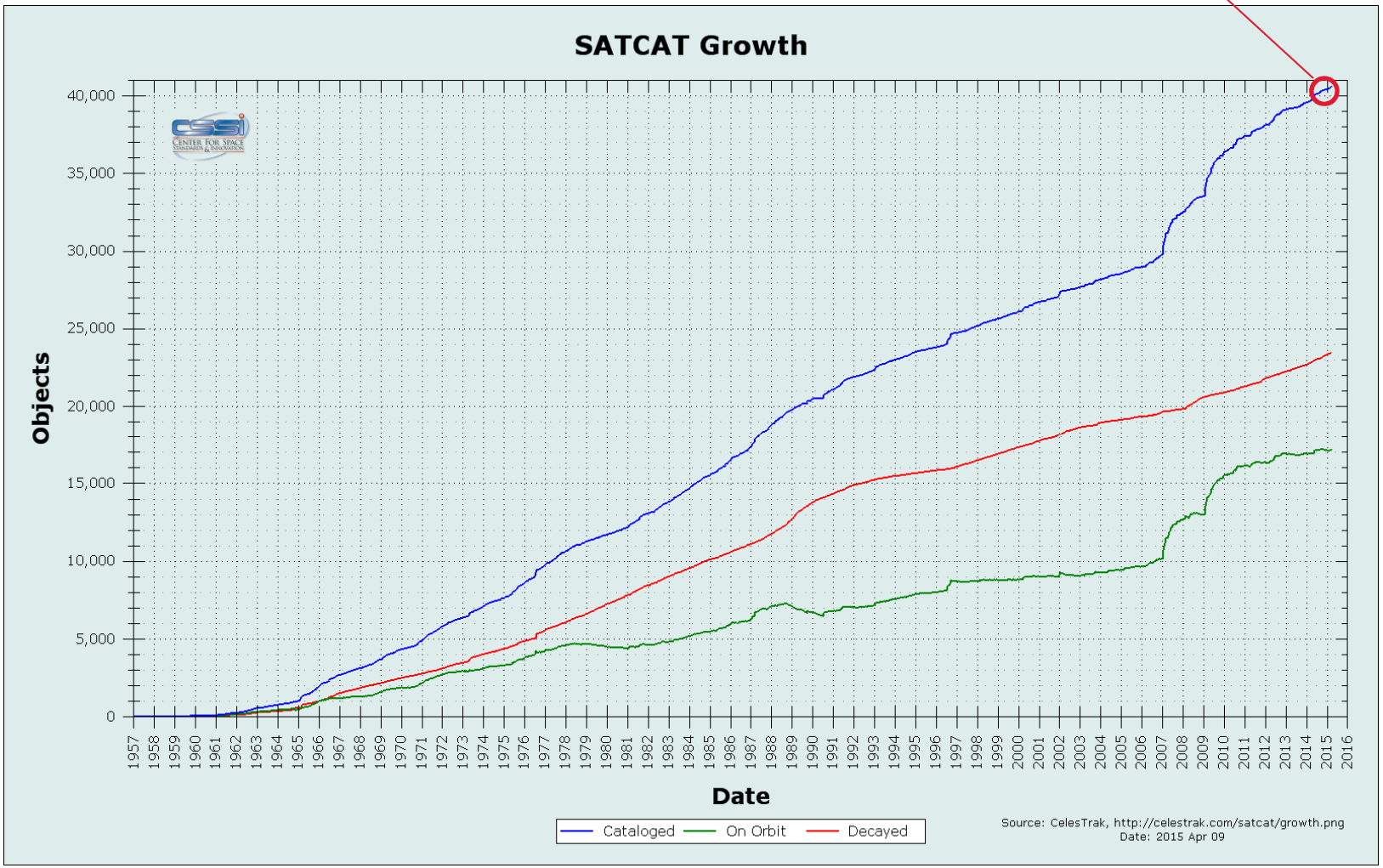
25-30 new launches per year

Considered congested

But this is only 1% of objects catalogued

Source: Norad Data of 15.02.2015

40,000 objects and growing



New/Upcoming Satellite Projects

O3b	**12 MEO Satellites**
OneWeb	**700 LEO Satellites**
SpaceX	**4000 LEO Satellites**
LeoSat	**140 LEO Satellites**

Source: OneWeb Ltd

STM Concept

"Space Traffic Management provides an approach to enter into, operate in and return from space, safe from any interference"

Satellite

Tracking

To determine the orbit, velocity or instantaneous position of spacecraft

For orbit control (transfer orbit, station keeping, fleet management and maneuvering, End Of Life) Surveillance and safety functions

Earth Station

Satellite

Telemetry

For maintenance of spacecraft by monitoring its condition and payload using measured data:

- Temperature
- Magnetic field for instantaneous attitude or rotation speed
- Moving units measurement
- Inertial measurements for attitude and station keeping
- Measurements in relation to Earth, Sun, stars
- Current, voltages
- Condition of components
- Acknowledgement of reception and execution of command

To ensure proper operational conditions, optimizing the spacecraft and payload mission facilities and analysing unforeseen situations

Earth Station

Satellite

Telecommand

For modifying the operation of the spacecraft and its payload

Also, to ensure immediate cessation of radio emissions, whenever required under the provisions of Radio Regulations (RR No. 22.1) such as elimination of harmful interference under RR Nos. 8.5 and 11.42

Earth Station

Space Operation Service

Tracking, Telemetry and Telecommand are Space Operation functions

Failure or improper use of Space Operation functions could lead to loss or degradation of service, reduced operational lifetime of satellite, harmful interference, potential for collisions, debris generation

Definition

Article 1 of Radio Regulations

1.23	**Space Operation**	… service concerned exclusively with the operation of spacecraft, in particular space tracking, space telemetry and space telecommand. …
1.133	**Space Telemetry**	… transmission from a space station of results of measurements made in a spacecraft, including those relating to the functioning of the spacecraft.
1.135	**Space Telecommand**	… transmission of signals to a space station to initiate, modify or terminate functions of equipment on an associated space object, including the space station.
1.136	**Space Tracking**	Determination of the orbit, velocity or instantaneous position of an object in space by means of radiodetermination, … for the purpose of following the movement of the object.

Frequency Allocation

Article 5 of Radio Regulations

Specific bands allocated to Space Operation Services	137-137.825, 148-149.9, 267-272 (Secondary), 272-273, 400.15-401 (Secondary), 401-402, 449.75-450.25, 1 427-1 429, 1 525-1 530, 1 530-1 535, 2 025-2 110, 2 200-2 290 MHz
or	
Within the main service in which the space station is operating	E.g. fixed-satellite service (FSS), broadcasting-satellite service (BSS), mobile-satellite service (MSS)

Frequency Selection

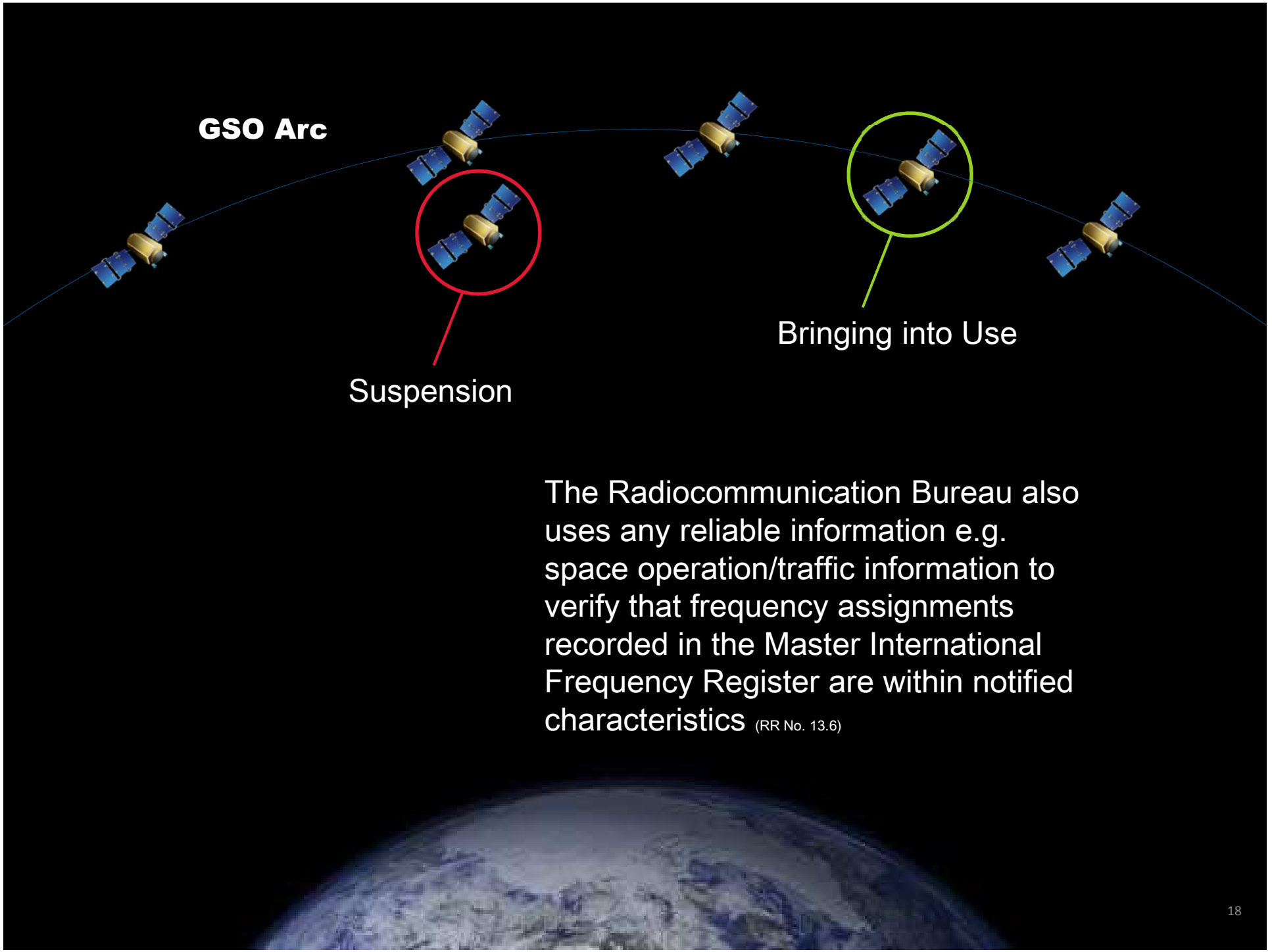
- Preferred bands of frequencies Space Operation are between 1 and 8 GHz
- As an exception, bands above 10 GHz are technically suitable for use for Space Operations during re-entry of satellites into Earth's atmosphere
- To ensure greatest reliability and flexibility during routine, launch or other critical phases

Source: Rec. ITU-R SA.363-5

Study Group within ITU

- Working Party 7B (ITU-R Study Group 7) is responsible group for the subject of transmission and reception of telecommand, tracking and telemetry data for space operation, space research, Earth exploration-satellite, and meteorological satellite services
- It studies communication systems for use with manned and unmanned spacecraft, communication links between planetary bodies and the use of data relay satellites
- Next meeting: 20 May 2015

Source: www.itu.int/en/ITU-R/study-groups/rsg7/rwp7b/



The Radiocommunication Bureau also uses any reliable information e.g. space operation/traffic information to verify that frequency assignments recorded in the Master International Frequency Register are within notified characteristics (RR No. 13.6)

Conclusion

- STM is an essential concept to promote rational, equitable, efficient and economical use of the radio frequency spectrum by all radiocommunication services
- Space Operation functions are critical for proper management of the satellite, especially when orbits are becoming more congested, to maintain its intended service free from harmful interference during its lifetime

ITU-R Resources (Free)

ITU Radio Regulations (2012)
http://www.itu.int/pub/R-REG-RR-2012

ITU Rules of Procedures
http://www.itu.int/pub/R-REG-ROP/en

ITU-R Recommendations
http://www.itu.int/publ/R-REC/en

Preface (Space Services)
http://www.itu.int/ITU-R/go/space-preface/en

Space Services Website
http://www.itu.int/ITU-R/go/space/en

World Radiocommunication Conference (WRC-15)
http://www.itu.int/en/ITU-R/conferences/wrc/2015/Pages/default.aspx

Thank you

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