



ITU Symposium and Workshop on small satellite regulation and communication systems

The ITU - Challenges in the 21st century related to SMALL SATELLITES



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A photograph of the Sputnik 1 satellite in orbit above Earth. The satellite is a spherical metal ball with several external antennas protruding from its surface. The Earth's blue and white horizon is visible in the background against the blackness of space.

1957....

development of
communication
satellites

Sputnik 1 was the first artificial Earth “**SMALL**” satellite launched on 4th October 1957 with external radio antennas to broadcast radio pulses. It was a 58 cm diameter, 83 kg polished metal sphere with a 1 W transmitter on 20.005 and 40.002 MHz.

Analysis of the radio signals was used to gather information about the electron density of the ionosphere. Temp and pressure were encoded in the duration of radio beeps.

...**2016**



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.



Why Small Satellites ?

“Faster, Cheaper, Better, Smaller”

- **Faster** to build/launch (**<1 year**)
- **Cheaper** to build/launch (**10's of k\$**)
- **Easy** modular & standardised (**CubeSats**)
- **Smaller** latest technology (**lighter and efficient**)

Also promotes:

Technology transfer, Collaboration, Education, Earth Science,
Testing innovative technologies, ...

But this comes with drawbacks



Drawbacks!

No regulatory definition for small satellites in the ITU RR only geostationary (GSO) and non-GSO satellites

- **Limited Launching opportunities**
 - > mission delays
- **No/Little Orbit Control**
 - > higher collision risks
- **Small/Unreliable Power Source**
 - > large & costly ground stations
- **Limited Lifetime**
 - > low reliability of electronics
- **Limited Mission Types**
 - > commercially unsustainable
- **Limited Regulatory Certainty**
 - > Lengthy time for Space Activity License



ITU Legal Framework for Spectrum Access/Use



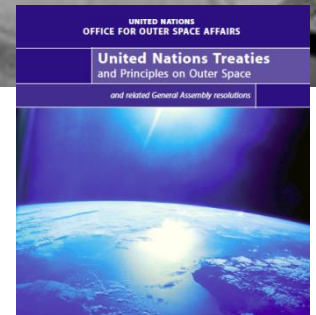


1963

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

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





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





WRC-15



- WRC-15 Outcomes and Achievements
<http://www.itu.int/go/wrc-15>

➤ The ***only*** ITU conference authorized to modify the ITU Radio Regulations
(a legal binding document = an **obligation** for the ITU member states to follow it)



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





Propagation of Radio waves

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

Interference

- 
- *Possible* between radio stations of *different countries* and/or different services
 - This risk is ***high*** in Space Radiocommunications

Radio Regulations

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



Radio Regulations - Mechanisms

Control of Interference

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





WHAT NEEDS TO BE NOTIFIED ?

Any frequency assignments of transmitting and receiving earth and space stations ***shall be notified*** to the Bureau (No.11.2) if:

- Capable of causing harmful interference; or
- Used for international radiocommunication; or
- Subject to coordination procedure of Article 9; or
- Seeking to obtain international recognition; or
- Non conforming assignment under No. 8.4 seeking to be recorded into **MIFR** for information purposes only

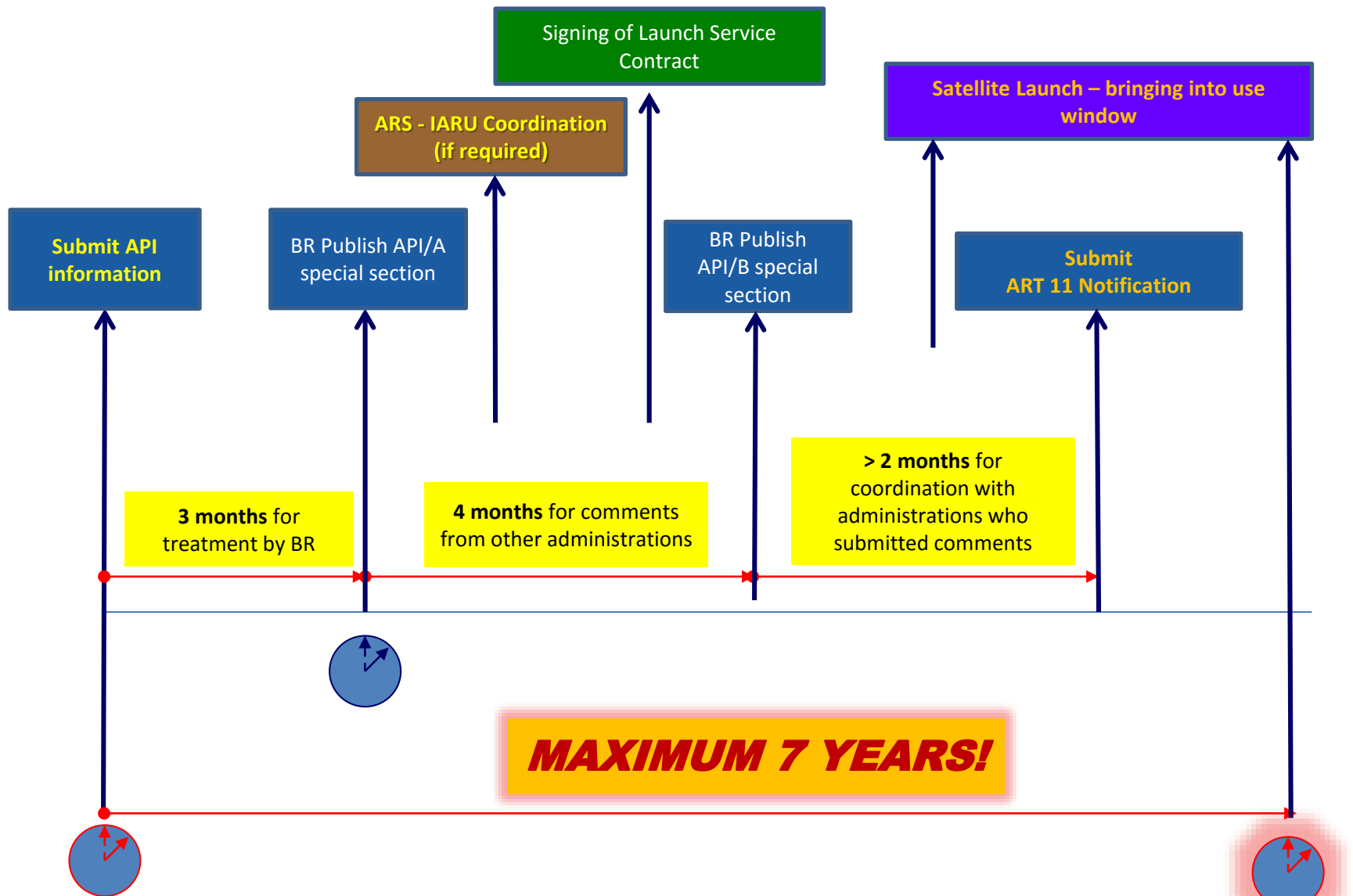


WHEN TO INITIATE THE NOTIFICATION PROCEDURE ?

- No. 9.1 of the RR stipulates that **before initiating any action under Article 11 (Notification)** in respect of frequency assignments for a satellite network, *an administration shall send to the Bureau* a general description of the network for **API** publication *not earlier than seven years* and preferably *not later than two years* before the planned *date of bringing into use (DBiU)* of the satellite network or system
 - API phase is *obligatory*
 - Starts the ***“regulatory clock” for notification***



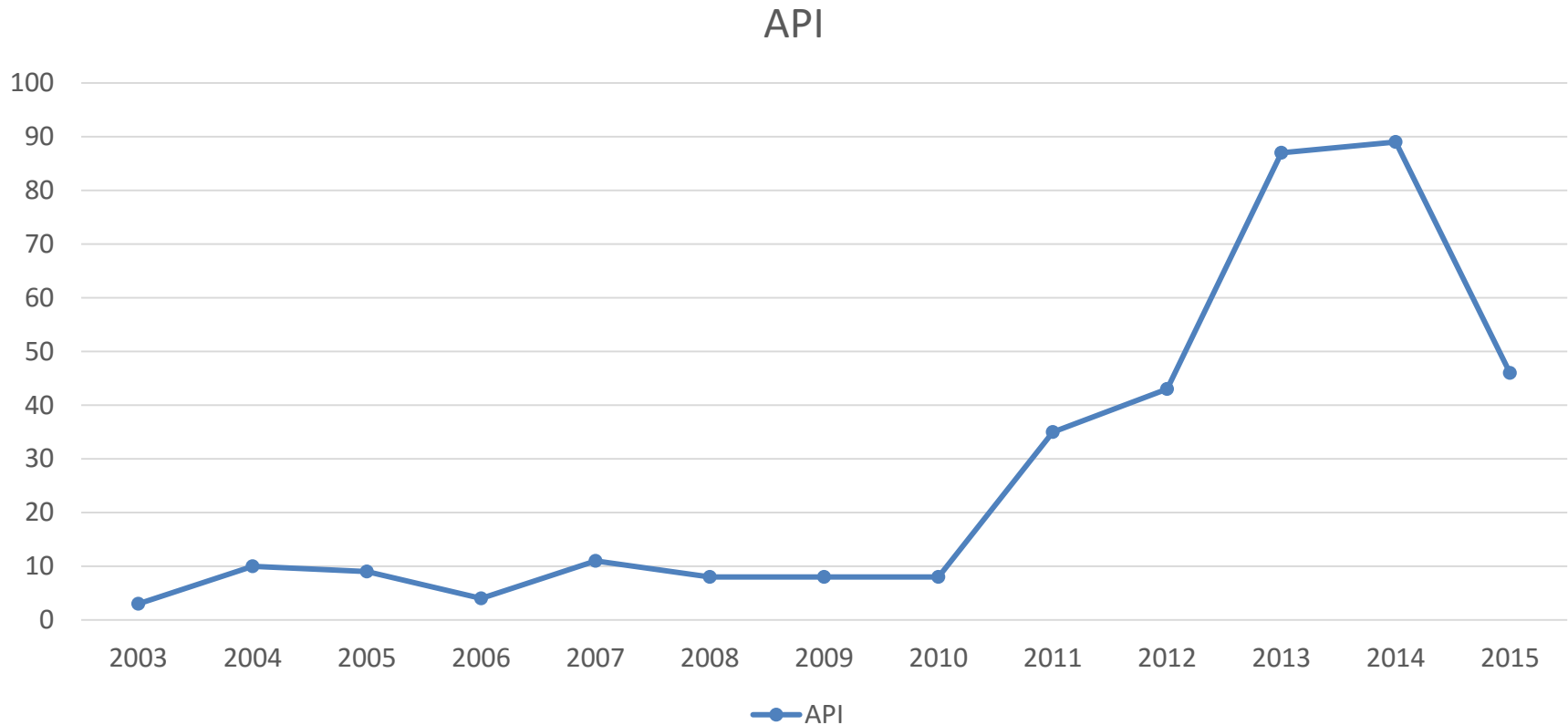
WHEN TO INITIATE THE NOTIFICATION PROCEDURE?





Small satellite ITU API *submissions*

Year	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
small sat API	3	10	9	4	11	8	8	8	35	43	87	89	46





Preliminary Agenda WRC-18

Resolution 757 (WRC-12)

Regulatory aspects for nano- and picosatellites

*resolves to invite **WRC-18***

to consider *whether modifications to the regulatory procedures for notifying satellite networks are needed* to facilitate the deployment and operation of nano- and pico satellites,

and *to take the appropriate actions*





Small satellite definition

no regulatory definition for small satellites
in the ITU RR
(only geostationary (GSO) and non-GSO satellites)

Resolution 757
(WRC-12)

Regulatory aspects for
nanosatellites and
picosatellites

Question **ITU-R 254/7**

Characteristics and
spectrum requirements of
satellite systems using
nano and picosatellites



Small satellite characteristics?

ITU-R Question 254/7

Characteristics and spectrum requirements of satellite systems using nano and pico satellites

- **The ITU-R WP7B finished study Question 254/7**
 - Report ITU-R **SA.2312** Characteristics, definitions and spectrum requirements of nanosatellites and picosatellites, as well as systems composed of such satellites
 - Report ITU-R **SA.2348** Current practice and procedures for notifying space networks currently applicable to nanosatellites and picosatellites

For more info see **ITU-R WP7B** studies:

<http://www.itu.int/en/ITU-R/study-groups/>



WRC-15 Decision

- **SUP RES-757 (WRC-12)** Consider *whether modifications to the regulatory procedures for notifying satellite networks are needed to facilitate the deployment and operation* of small (nano- and pico) satellites...
- **WRC-15 – decision**
- **NO need for any special regulatory procedures** to *facilitate the deployment and operation of nano- and pico satellites*



Free on-line ITU-R help & documents

➤ ***Space service web page:***

<http://www.itu.int/ITU-R/go/space/en>

➤ ***NEW ITU Radio Regulations @ 2016:***

<http://www.itu.int/pub/R-REG-RR/>

➤ ***Support to Amateur Satellite service:***

<http://www.itu.int/en/ITU-R/space/Pages/SupportAmateur.aspx>

➤ ***ITU-R Recommendations:***

<http://www.itu.int/publ/R-REC/en>



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**THANK YOU VERY
MUCH !**

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