

SMALL SATELLITE REGULATION
WRC-15 OUTCOME
AND
RESULTS OF THE ITU-R
WP7B STUDIES

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Presentation outline

- ✓ ***WHAT*** is the WRC-15?
- ✓ Is it ***OBLIGATORY*** to follow the ITU RR ?
- ✓ Results of the ITU-R WP7B studies
- ✓ Report ITU-R **SA.2312**
- ✓ Report ITU-R **SA.2348**
- ✓ ***WHAT*** is the status of RES-**757** (WRC-12) - *Regulatory aspects for nanosatellites and picosatellites?*
- ✓ ***New*** RES-**659** (WRC-15) - *Studies to accommodate requirements in the space operation service for non-gso satellites with short duration missions*
- ✓ Small satellite ***problems?***



WRC-15 Outcome?



- 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)



Is there a need for small satellite regulatory relaxation ?

- Small satellite community was interested in relaxation of the RR and easy deployment of their non-GSO small satellites
- **RES 757** (WRC-12) to 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...
 - *invites ITU-R to examine the procedures for notifying space networks and consider possible modifications to enable the deployment and operation of nanosatellites and picosatellites, taking into account the short development time, short mission time and unique orbital characteristics,*
 - *instructs the Director to report to WRC-15 on the results of these studies*

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/>

As described in the Report ITU-R **SA.2312**,
small satellites

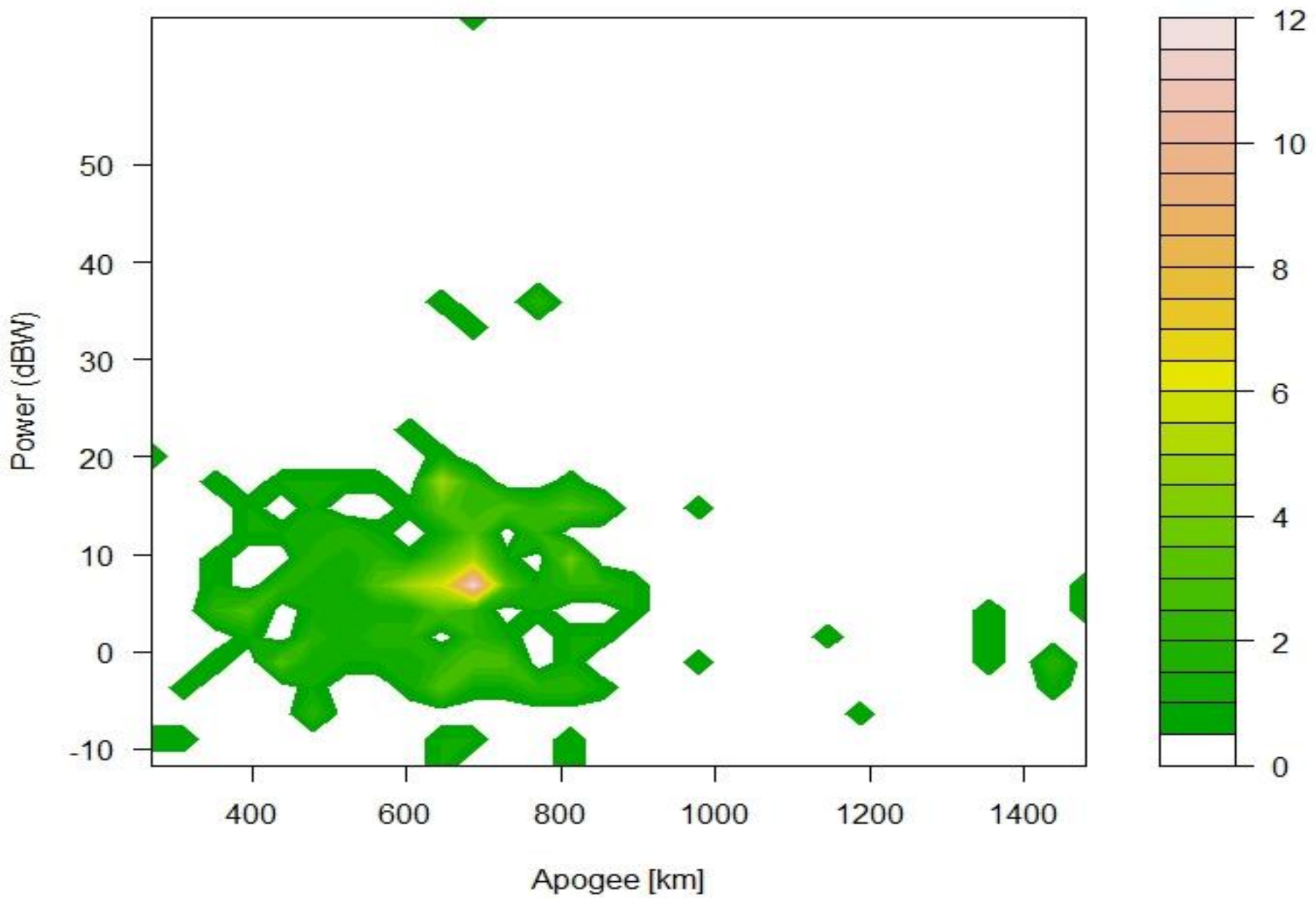
- provide a means for testing emerging technologies
- offer new opportunities for new satellite operators that might not otherwise have considered or been able to afford the use of satellite technologies
- demonstrated in a variety of practical applications, including Earth observation, space astronomy, space physics, maritime and amateur-satellite communications

Depending on specific mission objectives, small satellite missions

- May or may not have particular orbital requirements
- May have a number of potential launch opportunities available, and may thus *not have knowledge of specific orbital characteristics until a launch vehicle is selected*
- Have been launched mostly *as secondary payloads*, meaning that the primary mission for the launch vehicle involves the launch of one or more larger satellites
- *Because of the interest in small satellites, launch/mission developers are now considering whether dedicated small satellite launches and/or launch vehicles would be useful*

Notifications

Maximum pep_max vs. apogee distance



Small satellite TT&C and ground segment

Committed to Connecting the World



- Under No. **22.1** of the RR, *space stations shall be fitted with devices to ensure immediate cessation of their radio emissions by telecommand*
- In order to comply with requirements to control and have the ability to cease transmissions, small satellites have implemented a *passively-safe system* - satellite is active **ONLY** *when in view of an associated earth station*
- Most small satellite missions are utilizing a *single small earth station*
- Recent developments in *networks of cooperative earth stations* have enabled to **receive** telemetry throughout large proportions of the orbit. *In this case the satellite service area shall be declared global*

ITU-R

WP-7B studies

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As described in the Report ITU-R **SA.2348**

- small satellites using frequency assignments, including those operating in the amateur-satellite service, are **required to be notified under RR Article 11**
- *Prior to notification*, in accordance with RR No. **9.1**, notifying ADM is required to send to the Bureau the API not earlier than 7 years and preferably not later than 2 years before the date of bringing into use
- The largest challenges in the current practice of filing small satellites is the **late knowledge of orbital parameters**
- For the API, the declaration of the orbital parameters is mandatory, however administrations may submit for the API the best known orbital parameters and notify under RR ART **11** the final ones
- It is noted also that under RR No. **9.2** only the mod of the reference body or the mod of the direction of transmission for a space station using a non-gso satellite orbit will require the application of the new API procedure

WRC-15 Decision - 1



- **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*

WRC-15 Decision - 2



Resolution 659 (WRC-15)

Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions

- *resolves to invite **WRC-19** (AI 1.7)*
- to consider the results of ITU-R studies and *take necessary action*, as appropriate, provided that the results of the studies referred to in *invites ITU-R* below are complete and agreed by ITU-R study groups,
- *invites ITU-R*
- 1 to study the spectrum requirements for telemetry, tracking and command in the space operation service for the growing number of non-GSO satellites with short duration missions, taking into account RR No. **1.23** (space operation service);
- 2 to assess the suitability of existing allocations to the space operation service in the frequency range below 1 GHz, taking into account *recognizing a)* and current use;
- 3 if studies of the current allocations to the space operations service indicate that requirements cannot be met under *invites ITU-R* 1 and 2, to conduct sharing and compatibility studies, and study mitigation techniques to protect the incumbent services, both in-band as well as in adjacent bands, in order to consider *possible new allocations or an upgrade of the existing allocations to the space operation service within the frequency ranges 150.05-174 MHz and 400.15-420 MHz*

CPM 19-1 Decision

- WRC-19 Agenda Item (AI) **1.7** - *to study the spectrum needs for telemetry, tracking and command in the space operation service for non-GSO satellites with short duration missions, to assess the suitability of existing allocations to the space operation service and, if necessary, to consider new allocations, in accordance with Resolution 659 (WRC-15) is assigned to ITU-R WP7B*
- ITU-R **WP7B** - Space radiocommunication applications:
<http://www.itu.int/en/ITU-R/study-groups/rsg7/rwp7b/>
- **WP 7B** is responsible for the transmission and reception of telecommand, tracking and telemetry data for space operation, space research, Earth exploration-satellite, and meteorological satellite services.
- **WP 7B** studies communication systems for use with manned and unmanned spacecraft, communication links between planetary bodies and the use of data relay satellites

1.1 Technical and operational characteristics of NGSO satellites with short duration missions using existing SOS allocations in the bands below 1 GHz

- Determine planned and potential operational scenarios.
- Determine the technical requirements for the scenarios.

1.2 Technical and operational characteristics of systems operating below 1 GHz and specifically systems within or adjacent to the 150.05-174 MHz and 400.15-420 MHz bands

- Determine the deployment of existing and planned systems both in-band and in adjacent bands.
- Determine the interference sensitivity of those existing and planned systems.

1.3 Determine sharing criteria

- Use the information developed in 1.1 and 1.2 to determine the potential for interference to existing and planned in-band and adjacent band systems.
- Based on the potential for interference, determine appropriate sharing criteria that will protect systems of existing services with existing both in-band and in adjacent bands.

1.4 Examine possible regulatory actions to satisfy the spectrum requirements of section 1.3

2. Development and agreement of the draft CPM text for **CPM-19**



WP 7B 1st meeting April 2016

- Organize work and present draft work plan
- Preliminary determination of the technical and operating characteristics of NGSO satellites with short duration missions using the existing SOS allocations, in the bands below 1 GHz, for TT&C
- Conduct preliminary sharing analyses between NGSO short duration missions using the existing SOS allocations for TT&C and systems of other services in the bands below 1 GHz.
- Liaise to contributing WPs (WP 4A, 4C, 5A, 5B, 5C, 6A, 7C, 7D) and interested WPs (WP 1A, 3M, 4B)

WP 7B 2nd meeting - Fall 2016 – just finished – OCT 2016

- Finalize on the NGSO satellite technical and operating characteristics
- Refine preliminary sharing analyses performed for the 1st meeting
- Liaise to contributing WPs (WP 4A, 4C, 5A, 5B, 5C, 6A, 7C, 7D) and interested WPs (WP 1A, 3M, 4B)

WP 7B 3rd meeting [Spring 2017]

- Continue to refine the preliminary sharing analyses performed for the 2nd meeting and if deemed appropriate conduct sharing analyses between the NGSO short duration missions using the SOS for TT&C and systems of other services within or adjacent to the frequency ranges 150.05-174 MHz and 400.15-420 MHz
- Liaise to contributing and interested WPs

WP 7B 4th meeting [Fall 2017]

- Completion of the WP 7B sharing studies, taking into account responses from the concerned and interested WPs
- Prepare draft CPM text including regulatory considerations
- Final liaison to concerned and interested WPs

WP 7B 5th meeting [Spring 2018]

- Completion of all necessary Reports and Recommendations.
- **Draft CPM-19 text agreed**

Technical and operational characteristics of non-GSO satellites with short duration missions

2.1 Orbital characteristics

Most non-GSO satellites with short duration missions are launched into Low Earth Orbit (LEO). Table 1 provides typical orbital characteristics of these satellites.

TABLE 1

Typical orbital characteristics of non-GSO satellites with short duration missions

Parameter	Appendix 4 identifier	Value
Apogee altitude	A.4.b.4.d	300-1 000 km
Perigee altitude	A.4.b.4.e	300-1 000 km
Angle of inclination of the orbital plane with respect to the Earth's equatorial plane	A.4.b.4.a	50-100 degrees

WRC-19 AI 1.7 – WP7B studies 2



2.2 Technical characteristics specific to the Space to Earth direction

Report ITU-R **SA.2312** provides a number of characteristics related to nanosatellites and picosatellites.

Table 2 provides typical characteristics for non-GSO satellites with short mission duration applicable to the space to Earth direction.

TABLE 2

Typical technical characteristics in the Space to Earth direction

Parameter	Appendix 4 identifier	Value
Bitrate	C.9.a.4.a	Not more than 100 kbit/s
Spectral efficiency	N/A	0.5-2 bit/s/Hz
Necessary bandwidth	C.7	Not more than 200 kHz
Satellite transmit power delivered to antenna	C.8.a.1	1 W
Satellite antenna gain	B.3.a.1	Not more than 3 dBi
Earth station system noise temperature	C.10.d.6	500-1 500 K
Earth station antenna gain	C.10.d.3	14 dBi
C/N objective	C.8.e.1	12 dB
Operational duty cycle during Earth station contact	N/A	75%

2.3 Technical characteristics specific to the Earth to Space direction

Report ITU-R **SA.2312** provides a number of characteristics related to nanosatellites and picosatellites.

Table 3 provides typical characteristics for non-GSO satellites with short mission duration applicable to the Earth to space direction.

TABLE 3

Typical technical characteristics in the Earth to Space direction

Parameter	Appendix 4 identifier	Value
Bitrate	C.9.a.4.a	Not more than 10 kbit/s
Spectral efficiency	N/A	0.5-2 bit/s/Hz
Necessary bandwidth	C.7	Not more than 20 kHz
Earth station transmit power delivered to antenna	C.8.a.1	50 W
Earth station antenna gain	C.10.d.3	14 dBi
Satellite system noise temperature	C.5.a	300-1 000 K
C/N objective	C.8.e.1	20 dB
Operational duty cycle during Earth station contact	N/A	25%

For all contributions related WRC-19 AI 1.7 - **Resolution 659** (WRC-15) - *Studies to accommodate requirements in the space operation service for non-geostationary satellites with short duration missions*

- see ITU-R **WP7B** website (**TIES account required**)
<http://www.itu.int/en/ITU-R/study-groups/rsg7/rwp7b/>

Free on-line ITU-R documents



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

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

➤ **ITU Rules of Procedure**

<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 service web page:***

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

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Questions ?