GSOA
GLOBAL SATELLITE OPERATORS ASSOCIATION

Agenda Item 9
RR 21.5

WRC-23 Agenda Item 9 RR21.5

Overview

This issue was defined at WRC-19, in document 550:

"ITU R is invited to study, as a matter of urgency, the applicability of the limit specified in No. 21.5 of the Radio Regulations to IMT stations, that use an antenna that consists of an array of active elements, with a view to recommend ways for its possible replacement or revision for such stations, as well as any necessary updates to Table 21-2 related to terrestrial and space services sharing frequency bands. Furthermore, the ITU-R is invited to study, as a matter of urgency, verification of No. 21.5 regarding the notification of IMT stations that use an antenna that consists of an array of active elements, as appropriate."

This issue should be addressed at WRC-23 on the basis of the Director's Report (WRC-23 Agenda Item 9).

The purpose of the power limits in RR 21.5 is to cap the agregrate interference generated by fixed and mobile stations (including IMT) onto satellite receivers in space. The limit applies to certain frequency bands, listed in ITU RR Table 21-2, allocated to the fixed or mobile services and shared on a primary basis with allocations to satellite uplink services (Earth-to-space). If the limit is not respected, excessive interference could prevent the operation of satellites.

Background

Provision 21.5 of the ITU RR is as follows:

> **The power delivered by a transmiter to the antenna of a station in the fixed or mobile services shall not exceed +13 dBW in frequency bands between 1 GHz and 10 GHz, or +10 dBW in frequency bands above 10 GHz, except as cited in No. 21.5A.** (WRC-2000)

The studies conducted by the ITU-R before WRC-19 indicated that the aggregate interference from IMT systems using the 26 GHz and other mmWave bands would not exceed the satellite protection requirements. However the IMT community is seeking to deploy base stations with higher power than assumed in those ITU-R studies. As IMT systems in these bands start to be deployed, their characteristics have to be properly controlled to ensure that satellite sytems remain protected.

There are no other provisions in ITU RR that would adequately protect satellite receivers from the aggregate interference from IMT systems. The EIRP limit in RR 21.3 is 55 dBW, which does not adequately protect satellite receivers[1].

The recent introduction of Advanced Antenna Systems (AAS) into 5G mobile systems introduces ambiguity in how to interpret the "power delivered by a transmitter to the antenna of a station" when applying RR 21.5. AAS antennas use an array of radiating elements sending the same signal from each element, but adjusted in phase and sometimes in power, to create a narrow beam that is steered towards the user equipment. Some argue that each radiating element is one "antenna", so the RR 21.5 limit would apply to each radiating element separately. Others argue that the RR 21.5 limit applies to the antenna as a whole, and the "Total Radiated Power" (TRP)[2] is an effective parameter equivalent to the "power delivered by the transmitter to the antenna."

One example illustrates the potential impact of the first interpretation, i.e. the limit applies to each radiating element. The ITU-R studies for 26 GHz assumed that IMT base stations have a radiated power per antenna element of -23 dBW (7 dBm). Compared with the RR 21.5 limit of +10 dBW, IMT could thus operate with increased power by 33 dB

1 The typical EIRP of a VSAT earth station is around 50 dBW. The IMT interfering power just compliant with RR 21.3 would therefore be 5 dB greater than such a VSAT signal. Other VSATs in LEO FSS systems operate with EIRP lower than 50 dBW, hence IMT would interfere with satellites even more.

2 The TRP is defined as the integral of the power transmitted from all antenna elements in different directions over the entire radiation sphere. The parameter is already used in the ITU RR to apply a limit on IMT base station unwanted emissions, in Resolution 750 (Rev.WRC-19).

in apparent compliance with RR 21.5. This huge increase in IMT base station power - by a factor of 2,000 times more - would cause severe harmful interference to satellite receivers using the same band.

The second interpretation, based on the use of TRP and same limit of +10 dBW, would provide just adequate protection to satellite uplinks in the 26 GHz band, and even give margin for the mobile industry to design new, higher power antennas.

The same problem occurs in any frequency band where AAS antennas are envisaged. AAS antennas can be used in any band allocated to the mobile service, whether the band is identified for IMT in ITU RR or not. The use of AAS antennas has also been proposed for fixed service systems. Hence the RR 21.5 power limit should apply to the TRP of AAS antennas in all frequency bands in ITU RR Table 21-2.

The current RR 21.5 limit applies to the power of the emission, irrespective of the signal bandwidth. Yet, the power spectral density is the relevant parameter to measure interference to satellites. If the bandwidth of an IMT base station is halved (while making no other changes), the power spectral density doubles, increasing the interference impact. Hence it is necessary to properly take account of the bandwidths of the IMT signals using AAS antennas.

Key Points

- The ITU RR frequently need to be adjusted to keep up to date with new technologies. The introduction of IMT AAS antennas has created an ambiguity that needs to be urgently addressed. Applying to all fixed and mobile systems, including IMT stations, RR. 21.5 has to achieve its objective: to limit the interference to satellite uplinks.
- Different interpretations of RR 21.5 could lead to very large increases in interference into satellite receivers, which may, in the long term, threaten the existence of satellite sytems in some frequency bands.
- A solution is available, based on the use of the TRP parameter, that would provide just adequate protection to satellite uplinks, without undue constraints on current or new IMT system deployment.

GSOA Position

GSOA recommends the following actions:

1. **The ITU Director should issue guidance (e.g. in a Rule of Procedure) to administrations on how to define the "power delivered by the transmitter to the antenna" for AAS antennas in ITU RR RR 21.5, based on the TRP of the entire antenna array of active elements.**
2. **The definition of the "power delivered by the transmitter to the antenna" for AAS antennas should be clarified in ITU RR, through additions to RR 21. This should apply to all fixed and mobile services, including IMT stations, and in all frequency bands included in Table 21-2.**
3. **ITU RR Table 21-2 should be updated with the addition of satellite uplink bands that are shared on a primary basis with the fixed or mobile services, including the following ones:**
   - FSS allocations in 24.65-25.25 GHz (Region 1), 24.75-25.25 GHz (Region 2), 42.5-43.5 GHz, 47.2-50.2 GHz, 50.4-51.4 GHz and 81-86 GHz.
   - MSS allocations in 43.5-47 GHz, 66-71 GHz, and 81-84 GHz.
4. **The TRP parameter should also be used for these additional bands. The limit in RR 21.5 (currently +10 dBW) needs to be reviewed to ensure that it continues to provide adequate protection to satellite uplinks.**

The actions in item 1 should occur as with no delay, before WRC-23, since IMT or other mobile stations using AAS antennas are already being deployed. The actions in item 2 could occur during WRC-23. The actions in items 3 and 4 can occur after WRC-23, based on a new agenda item for a future WRC.

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