**UNITED STATES OF AMERICA**

DRAFT PROPOSALS FOR THE WORK OF THE CONFERENCE

**Agenda Item 1.15**

**Agenda Item 1.15**:*to consider identification of frequency bands for use by administrations for the land-mobile and fixed services applications operating in the frequency range 275-450 GHz, in accordance with Resolution 767 (WRC-15)*

**Background Information:** This document provides information related to WRC-19 Agenda Item1.15, and a proposal to allow sharing of parts of 275-450 GHz on an interference-free basis between Fixed Service stations and passive uses of this band which are given protection under the terms of No. **5.565.**

It is anticipated that the United States of America may submit at a later date additional proposals including proposals for future Conferences. The proposals herein should not considered to be mutually exclusive to other possible proposals for uses of this band that also address the protection of passive services in alternative ways.

At present, there are no international allocations for radiocommunications services above 275 GHz in the Radio Regulations (RR’s). However, footnote No. **5.565** does make identifications for radio astronomy, earth exploration-satellite (passive) and space research (passive) services. Recent advances in microwave technology make possible the use of this spectrum by active services for communications and related uses. Consistent with No. **5.565**, frequencies for fixed and land mobile use could be utilized above 275 GHz, provided “all practicable steps” are taken to protect passive services.

Report ITU-R RA.2189 “Sharing between the radio astronomy service and active services in the frequency range 275-3 000 GHz” indicates that the radio astronomy service can share with terrestrial systems due to propagation conditions and power limitations of current active services technologies. The space research service (passive) and the Earth exploration-satellite service (passive) may also be able to share frequencies with the active services.

This document proposes an initial very conservative sharing regime.

While optical fiber is generally the least expensive terrestrial communications medium in terms of equipment cost per Gb/s-km, there are some applications where fixed radio systems of comparable bandwidth have unique advantages. In some locations, *e.g.*  highly urbanized areas, optical fiber has very high installation costs which greatly exceeds component costs. Optical fiber can not be installed quickly in certain place for special events and may not be economical for short-term events at a given location. Optical fiber has a time latency greater than radio systems due to the index of refraction of the fiber material which results in a group velocity about 25% less than in radio systems. While for many applications this latency is insignificant, for some applications it is an issue. Finally, in case of disaster, especially earthquakes with ground rupture along a fault, fiber optics systems cannot be restored quickly and temporary radio systems with comparable capacity would be beneficial in restoring communications networks for both land line service and mobile service.

The 275-450 GHz has very different physics than the lower bands which have been the focus of the Radio Regulations in the past. The small wavelengths involved, approximate a millimeter, permit modest size antennas to have very narrow beamwidths although sidelobes will still exist as with any physical antenna of finite dimension. At these frequencies, the propagation loss for long distances is not dominated by free space path loss or multipath path loss of the form ~(distance)-n where 2<n<4 as in terrestrial systems at lower frequencies but by absorptive path losses of the form ~e- α x distance , where as described in Recommendation ITU-R P.676, α is a function of atmospheric pressure(height) and moisture content. This latter exponential loss decreases more rapidly with distance than the losses associated with free space and usual multipath propagation.

In particular, for path losses from terrestrial Fixed Service transmitters to space research service (passive) and the Earth exploration-satellite service (passive) satellites in nongeostationary orbits (NGSO), the losses can be very large and vary significantly with both frequency and elevation angle of the fixed service transmit antenna. For some frequency/ elevation angle pairs, the losses can exceed 1000 dB.

While not explicitly mentioned in this agenda item, there is a family of non-communications technologies often called "terahertz spectroscopy" that are presently commercially available in this band. This technology uses radio power to sense and analyze materials. Generally, this use is indoors with powers in the milliwatt range, bandwidths in the tens or 100s of GHz and usable ranges in the centimeter range. There is no record of this technology having adverse impact on any passive use of the band.

To achieve these same objectives, the United States proposes an initial very conservative sharing scheme for the 275-450 GHz which is not to be to the exclusion of other sharing approaches which achieve the goals of No. **5.565.**

**Proposal:**

While the bands enumerated in No. **5.565** for passive use completely cover the 275-450 GHz under consideration in Agenda Item 1.15, Report ITU-R RA.2189 concludes that "Sharing between radio astronomy and active services in the range 275-3 000 GHz is not problematic." Thus, frequencies identified for Earth exploration-satellite service (passive) and space research service use can be used for terrestrial services regardless of whether they are identified for radio astronomy use, provided that suitable out-of-band emission limits are used and guard bands are adopted to reflect the realistic limitation of passive system to reject adjacent band power. These frequencies are: 286-296 GHz, 306-313 GHz, 356-361 GHz, 365-369 GHz, 392-297GHz, 399-409 GHz, 411-416 GHz, and 434-439 GHz.

Taking 500 dB path loss from a terrestrial fixed source to an NGSO passive satellite at a height of 817 km as an adequate protection level, the following bands and maximum elevation angles can be used subject to the limitations of No. **5.565:**

|  |  |
| --- | --- |
| **Band**  **(GHz)** | **Maximum Elevation Angle (Degrees)** |
| 315-475 | 1 |
| 365-450 | 5 |
| 435-450 | 10 |

Because the protection of passive satellites depends critically on the elevation angle of the Fixed service transmitter antenna, administrations must license all use of the bands with antenna elevation angle restrictions and take reasonable steps to verify compliance of users.

Nothing in the Resolution should be interpreted as preventing administrations from authorizing short range non-communications uses of this spectrum such as terahertz spectroscopy on a non-interference basis to the passive uses identified in No. **5.565.**

**Reasons**:

The bands identified above will provide spectrum for new high-speed terrestrial radio systems that can be used for productivity in places where optical fiber is not economical due to high installation costs and also can be used for rapid restoration of broadband terrestrial networks that have been damaged in a disaster. The bands and parameters have been selected to meet the existing passive service protection goals of No. **5.565.**