Proposal for Spectrum for 60 GHz towards NFAP 2016

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Executive Summary

This document discusses the challenge posed by the exponentially increasing data requirement in the urban areas of the country and proposes wireless system operating in 54-67 GHz spectrum (commonly known as 60 GHz band) as a wireless broadband solution. The status of 60 GHz band world-wide has also been presented to draw a comparison with its status in India. A confluence of several factors makes 60 GHz or V-band very attractive for license exempt broadband services. First, the 7 GHz of spectrum from 57 to 64 GHz offers massive capacity compared to the existing broadband spectrum. Silicon technology innovations combined with global momentum behind the IEEE 802.11ad or WiGig standard **[1]** that also operates in V-band, is making available very low cost semiconductors and system solutions. Finally, the large bandwidth available in 60 GHz band allows for wide channelization (e.g. 2.16 GHz in 802.11ad) and hence supports high-speed links with 10 Gbps and higher data rates. This document also provides recommendations in the spectrum allocation of 60 GHz band towards the National Frequency Allocation Plan (NFAP) India 2016.

1. Background

As the demand for data is growing in the urban regions, availability of high speed Internet has become a major challenge for the service providers. While such broadband access can be provided through dense deployment of 2.4/5 GHz WiFi hotspots, lack of affordable backhaul due to non-availability of ubiquitous fibre has led to extensive research and development in alternate technologies for backhaul. The frequency range of 54-67 GHz commonly known as the 60 GHz band offers one such solution which can cater to high bandwidth requirements for short range communications. The most remarkable features of the 60 GHz band are its 7 GHz wide spectrum, narrow transmit beam and high attenuation due to oxygen absorption and rain.

Wireless access system in the 60 GHz band has been developed through a series of amendments in IEEE 802.11 protocols **[2]**. The IEEE 802.11ad is an amendment to the 802.11 standard to achieve higher throughput in 60GHz band by modifying its Physical (PHY) and Media Access Control (MAC) layer. WiGig specifications were released in 2011, which allow devices to communicate wirelessly at multi-gigabit speeds and deliver high definition content without using wires for shorter distances.

Although 60GHz signal cannot penetrate through walls, the beam forming built into WiGig system enables the propagation of signal through reflections from deterministic reflectors such as wall, glass and metal surfaces. Modern wireless signal processing techniques such as beam-steering, null-steering and micro-route, can be used for interference mitigation. The unique signal absorbing characteristics of 60 GHz band simplifies network planning and enables implementation of frequency reuse in a dense network.

2. Spectrum Allocation for 60 GHz Band Worldwide

Considering the challenges of dense urban Internet connectivity, many countries have worked towards license-exempt operations of 60 GHz band.

Since 2008, the overwhelming trend has been for countries to update 60 GHz regulations and make the band available on a license exempt basis **[3] [4] [5]**. These countries include:

Country	**Year of updating 60 GHz regulation**
Brazil	2008
Austria	2009
United Kingdom	2010
Canada	2010
Switzerland	2011
Spain	2011
Germany	2012
Singapore	2013
Belgium	2014
Australia	2014
New Zealand	2014
Poland	2014
Sweden	2014
Malaysia	2015
South Africa	2015
Philippines	2016

This is in addition to the existing countries United States **[5]**, China and South Korea with license exempt status.

FCC had commissioned rules for unlicensed operations of 57-64 GHz band in 1990's and later in 2013, it "*…increased the power permitted for outdoor operations between fixed points using highly directional antennas, and tied the maximum power permitted to the precision of the antenna beam which determines its potential for causing interference to other users, including to indoor low-power networks…*" **[1]**. In 2016, the FCC reaffirmed the importance of the 57-64 GHz band and further allocated 7 GHz immediately adjacent to the original allocation from 64-71 GHz. The rules created 14 GHz (57-71 GHz) of continuous, unlicensed spectrum to "…encourage the development of very high-speed wireless links with higher connectivity, bandwidth and throughput between small cell sites to support spectral efficiency in existing communications systems as well as in future 5G systems...." **[6]**.

In Europe, the 59-66 GHz band has been allocated for mobile services in general and CEPT Recommendation T/R 22-03 provisionally designates the frequency band 59-62 GHz band for Radio Local Area Network (RLAN). Additionally, broadband mobile systems and road transport informatics (vehicle-to-road and vehicle-to-vehicle communications) can utilise frequency bands 62-63 GHz and 63-64 GHz. Furthermore, bands 58.2-59 GHz and 64-65 GHz may be used for Radio Astronomy observations **[7]**. CEPT ECC Recommendation (09)01 recommends that the use of point-to-point fixed service (FS) systems in the whole or part of the 57-64 GHz band may be provided **[8]**. Similarly, CEPT ECC RECOMMENDATION (05)02 recommends that the use of FS in the 64-66 GHz band be limited to point-to-point systems **[9]**.

3.1 International Telecommunication Union-Radio communication (ITU-R)

Recommendation ITU-R M.2003, recommends multiple gigabit wireless systems in frequencies around 60 GHz, some of which may also be used to provide fixed Broadband Wireless Access (BWA) **[10]**. In developing this recommendation, ITU has considered that MGWS are widely used for fixed, semi-fixed (transportable) and portable computer equipment for a variety of broadband applications, and that many administrations permit MGWS, including RLAN devices to operate in the 60 GHz frequency range on a license-exempt basis. This Recommendation further recognizes that both consumers and manufacturers will benefit from global harmonization of the 60 GHz spectrum for MGWS.

Noting that several standards provide options for MGWS implementation, the Recommendation states that the MGWS standards and their system characteristics contained in Annex 1 of M.2003-1 should be used. These include the internationally developed IEEE Standards 802.11ad-2012 and 802.15.3c-2009. Apart from IEEE 802.11ad, the following two ETSI standards are also relevant for this proposal-

- ETSI EN 302 567 V1.2.1 (2012-01) Broadband Radio Access Networks (BRAN); 60 GHz Multiple-Gigabit WAS/RLAN Systems; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive **[11]**.

- ETSI EN 302 217-3 V2.2.1 (2014-04) Fixed Radio Systems; Characteristics and requirements for point-to-point equipment and antennas; Part 3: Equipment operating in frequency bands where both frequency coordinated or uncoordinated deployment might be applied; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive, Annex UBa: 57 GHz to 66 GHz for point-to-point fixed wireless systems **[12]**.

3. Spectrum Allocation for 60 GHz in India

4.1 Need for review of current allocation

The 60 GHz band is indicative of the spectrum range from 57 GHz to 64 GHz. The current frequency allocation for RLAN in 24.0 –24.25 GHz is as per IND78 and the current frequency allocations in 60 GHz band is as per IND80 of the National Frequency Allocation Plan (NFAP-2011) **[13]**, which are as follows:

IND78:Use of low power telecom systems and devices including Radio Local Area Networks (RLAN) and traffic safety applications in the frequency band 24.0 –24.25 GHz using a maximum Effective Isotropic Radiated Power of 2Watts with spectrum spread of 50 MHz or higher may be considered on non-interference, non-protection and non- exclusive basis.

IND80: Requirements of high capacity dense network may be considered in the frequency bands 31.8-33.4, 37-40 GHz, 40.5-43.5, 51.4-52.6 GHz, 55.78-59 GHz and 64-66 GHz. Requirements of Deep Space Research (Space-to-Earth) in the band 31.8-32.3 GHz and protection of the same may be considered at a few locations. Requirements of inter-satellite link in the band 32.3-33.0 GHz may be considered.

The following are a few observations on the above allocation which point towards the need for re-visiting the same.

- The frequency band from 59-64 GHz is not mentioned in India Remarks.
- There is no regulation imposed on indoor/outdoor maximum Effective Isotropic Radiated Power (EIRP).

4.2 Recommendations

We propose to permit license-exempt operations in the 60 GHz band with flexible channel bandwidth for Wireless Access Systems (WAS) and Radio Local Area Networks (RLAN). V-band seems a suitable solution for the data needs in India considering the following factors.

- On account of unique characteristic of 60 GHz band to mitigate interference with high signal attenuation in the presence of oxygen and water vapour, Telecom Regulatory Authority of India (TRAI) has recommended "*…V-band (57-64GHz) should be delicensed for indoor and outdoor based access applications like WiFi hotspots etc."* **[14]**.

- To maintain the compatibility with international standards, there should be flexibility in the usage and channel bandwidth of the 60 GHz spectrum. This will boost the development of inexpensive equipment and hence proper utilization of the spectrum.

4.3 Proposal for revision of IND78 and IND81 of NFAP 2011

Considering the necessity of wider spectrum for IEEE 802.11ad systems and its role in urban broadband wireless especially in our country, we propose that millimetre wave technology operations in 57-64 GHz may be considered for both outdoor and indoor requirements with maximum transmit power of 10 W for outdoor fixed RLAN, mobile and indoor WAS/RLAN respectively and to meet the operational needs outlined in the **Recommendations** section of this document, it is proposed to modify remarks **IND78** and **IND80** for 60 GHz band as follows:

IND78: Use of low power telecom systems and devices including Radio Local Area Networks (RLAN) and traffic safety applications in the frequency band 24.0 –24.25 GHz using a maximum Effective Isotropic Radiated Power of 2Watts with spectrum spread of 50 MHz or higher may be considered on non-interference, non protection and non- exclusive basis. Use of low power wireless access systems including Radio Local Area Networks (RLAN) in the frequency band 59-64 GHz using a maximum Effective Isotropic Radiated Power of 43 dBm (20 Watts (with 20 mW (13 dBm) of transmit power and 30 dBi antenna gain) for outdoor and indoor purposes with spectrum spread of 2.1 GHz or higher may be considered on non-interference, non-protection, non- exclusive and license-exempt basis.

IND80: Requirements of high capacity dense network may be considered in the frequency bands 31.8-33.4, 37-40 GHz, 40.5-43.5, 51.4-52.6 GHz, 55.78-59 GHz, 59-64 GHz and 64-66 GHz. Requirements of Deep Space Research (Space-to-Earth) in the band 31.8-32.3 GHz and protection of the same may be considered at a few locations. Requirements of inter-satellite link in the band 32.3-33.0 GHz may be considered.

The updated IND78 and IND80 are therefore suggested as-

IND78:Use of low power telecom systems and devices including Radio Local Area Networks (RLAN) and traffic safety applications in the frequency band 24.0 –24.25 GHz using a maximum Effective Isotropic Radiated Power of 2 Watts with spectrum spread of 50 MHz or higher may be considered on non-interference, non protection and non- exclusive basis. Use of low power wireless access systems including Radio Local Area Networks (RLAN) in the frequency band 59-64 GHz using a maximum Effective Isotropic Radiated Power of 43 dBm (20 Watts) (with 20 mW (13 dBm) of transmit power and 30 dBi antenna gain) for outdoor and indoor purposes with spectrum spread of 2.1 GHz or higher may be considered on non-interference, non-protection, non- exclusive and license-exempt basis..

IND80: Requirements of high capacity dense network may be considered in the frequency bands 31.8-33.4, 37-40 GHz, 40.5-43.5, 51.4-52.6 GHz, 55.78-59 GHz, 59-64 GHz and 64-66 GHz. Requirements of Deep Space Research (Space-to-Earth) in the band 31.8-32.3 GHz and protection of the same may be considered at a few locations. Requirements of inter-satellite link in the band 32.3-33.0 GHz may be considered.

4. References

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[3] http://www.gov.za/sites/www.gov.za/files/39180_gen895.pdf

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