DRAFT

Spectrum Management

An IEEE European Public Policy
Position Statement

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Based on the viewpoints and arguments in this policy paper, the IEEE EPPC WG on ICT recommends:

- ITU/WARC should amend their usage allocation schemes to consider much wider frequency bands per usage domain, subject to specific audited coding and modulation schemes, which promote innovation and value creation.
- Governments should strive to support the 3D principle and add transmitted power, location, and time constraints to balance conflicting interests; they should also, in some areas, encourage sharing between licensees seeking the same rights.
- Governments, assisted by industry, should reinforce spectrum monitoring; in addition, when monitoring radio spectrum, they should enhance their capabilities in assessing new/forthcoming coding and modulation techniques at the measurement level.
- Legal provisions set by regulators and parliaments should encourage a broader societal value-based allocation, while ensuring dependability, resilience, safety, and security.

Technical Statement

The electromagnetic spectrum is the cornerstone of many of the current and coming technological advances in the foreseeable future. It is, and will be, the foundation for broadband mobile connectivity, microwave technology and instrumentation, radar technology, TV, emergency communications, drone communication and data transfer, intelligent transport systems, control of critical infrastructures and utilities, and internet-of-things (IoT) backbone and edge connectivity.

Contrary to popular belief and discussions in the public domain, while physically limited, the usage of spectrum is not scarce, since some frequency bands are not efficiently used. Under UN and ITU rules, usage of electromagnetic spectrum is a national sovereign issue, subject to international treaties and agreements, due to the over-border propagation. Analyst reports, allocation tables, and national inventory reports often claim that the spectrum is fully utilized and the old technologies must be decommissioned to make way for new technologies and business models. The lengthy discussion of the so-called “digital dividend” (referring to the radio spectrum released in the process of migration from analog to digital television) is a prime example of this. Looking at the frequency allocation table from almost any nation, states assigned frequency allocations of 95% [i][ii] in the prime real estate spectrum are between 30 MHz and 3 GHz. Of course, many sharing opportunities exist above 3GHz as prime spectrum will continue to move to higher frequencies.

However, even in some of the most congested areas such as megacity centers, it is rare to have a frequency band occupancy higher than 10-35%, as measured in the same frequency range by the method in ITU-R SM.2256.1 (i.e. that the frequency band is only being used 10-35% of the time [iii] [iv]). ITU-R SM2256.1 addresses spectrum occupancy measurements and evaluation. It also highlights that most measurement values are very different, with both 0 % and 70 % being possible values (dependent on frequency, time of day, location, channel properties, detection threshold, etc...). Given some of these parameters, average values of 0 % to 32 % by frequency intervals in the range of 180-2700 MHz are seen in [v]. This yields an indicative overall average occupancy of 11%. Similarly, in 3 different locations in France, the overall utilization in the band 400 MHz-3 GHz was found to be 6.5%, 10.7% and 7.7% [vi]. It is, therefore, reasonable to assume that the average occupancy over a 24-hour cycle and that frequency range, for 5 dB over an average signal, to be in the 10-35 % range with a very high probability. This underlines the discrepancy between the existing frequency allocation tables and the actual frequency occupancy [vii]. Therefore, a new approach and view on the spectrum is needed. This should be based on three considerations: 3D allocation, value-based allocation, and spectrum sharing. In this aspect, it is necessary to point out that it is essential that the efforts for European harmonization is continued in this aspect of spectrum management.

3D – A New Approach to Spectrum Management

The new approach can be referenced as 3D, where three dimensions are expanding the single existing dimension of frequency, with two new dimensions: time and geographical position. While the concept is not new, it is only recently that technology has provided the tools to implement it fully. By creating a dynamic frequency allocation, the specific frequency band is no longer limited to being auctioned to a single user for an entire country, but can be shared between multiple operators at different points in time and at various locations. For instance, some broadband mobile channels used in the city are not utilized in rural areas and can be used by farmers for video transmission using low-cost license exempt or geographically limited license wireless networks in those areas. Similarly, the low utilization during night time in the city of mobile broadband [viii][ix], can be used by smart meters for firmware upgrades. First implementations in the European Union (EU) are already taking place through a collaboration involving ETSI, CEPT and the Commission [x], and could be further expanded by the use of experimental licenses in a few dedicated frequency bands.

It should be pointed out, however, that there will always be some specific licensed and unlicensed frequency bands that, by international agreements or due to national sovereign decisions, may not be opened to 3D spectrum management.

Value-Based Allocation

For many years, the spectrum has been driven by nations to create spectrum auctions that license the spectrum to specific operators for a specific use, such as television transmission or cellular networks. As such, traditional industries have accumulated large revenues from substantial financial investment. For the spectrum, it is critical to consider the availability as it impacts emerging technologies. Drones and IoT developers are waiting for a commitment of technology and spectrum to develop their own products, where long-term operational stability can be ensured. A recent report [xi] concluded that there will be a shortfall of 500 MHz of spectrum in urban areas by 2021 and a total of over 4000 MHz by 2026 if there are no further spectrum efficiency gains. This should be considered in contrast to other recommendations of the same report that no additional spectrum is required for WiFi, smart meters and PMSE, and no need for additional spectrum for aeronautical, maritime, road and rail transport over and above that are already identified. Thus, when considering the use of a piece of spectrum, it is important not just to consider the short-term financial gains of auctions and the interference levels between services sharing instantaneously and in a localized way the same frequency, but to consider the total societal value generation by enabling innovation and novel applications, private use value, private external value and broader social value[xii], while also protecting safety and security services such as air traffic control, police, defense and others. Adoption of this concept will rely heavily on obtaining worldwide consensus on quantifying spectrum occupancy.

Use It or Lose it Becomes Share it or Lose It

An old discourse in the spectrum management debate has been the term “use it or lose it”. This has been based on the fact that some institutions, technical areas and organizations, have been allocated spectrum that are rarely used. Therefore, those in need of spectrum have argued that frequency bands with low utilization should be used or transferred to others. As technology has advanced, new coding or modulation schemes now offer the possibility of using spectrum only in certain geographical propagation areas or at certain times, without interference to permanent services and without decrease of the quality of these services for the primary users. As an example, frequencies used by naval radars [xiii] are often allocated nationwide, but due to the nature of naval radars, they are located near the coast. Thus, devices located far away from the coast (i.e. cellular network backhaul) can use the same frequencies. Similarly, by using an online database [xiv][xv][xvi] a usage flag by a radio can be set for a certain area, such that nearby devices do not try to communicate during that period. A more typical case where this capability would be relevant is the TV white space coexistence technology [xvii]. One way of sharing frequencies is by also creating adaptive requirements to the transmitted power and the duty cycle (i.e. ratio between when the radio is transmitting and not transmitting.) Many smart power meters are currently being installed all over Europe on low bandwidth networks, due to duty cycle limitations. In yet another instance, software updates can be simplified (i.e. for the installation of a security patch by allowing a 100% duty cycle, but with only a very low transmitted power (i.e. -70 dBm), it is possible to perform such an update in the same frequency band without the risk of interference to other devices.) However, all the new uses of spectrum result in the need for more detailed and continuous spectrum monitoring by a neutral party, with reporting of any interference cases to be notified and included in the spectrum allocation table.

This statement was developed by the IEEE European Public Policy Committee Working Group on ICT and represents the considered judgment of a broad group of European IEEE members with expertise in the subject field. IEEE has nearly 60,000 members in Europe. The positions taken in this statement do not necessarily reflect the views of IEEE or its other organizational units.

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