IEEE Wireless Communications, Vol. *19*, No. 4, p. 6 (August 2012)
Spectrum Policy and Regulatory Issues

On Moving the Upper "Frontier" of Commercial Wireless Use

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International spectrum allocations of the International Telecommunications Union (ITU) now go to an upper limit of 275 GHz. The upper limit of actual production commercial equipment appears to be in the 80 GHz range in the millimeterwaves or "mmW" region (30-300 GHz). While these upper frequencies have been often associated with fixed and satellite uses, the emergence of IEEE 802.11ad/WiGig mobile standards at 60 GHz[1] and interest in broadband mobile applications above 100 GHz shows that many different uses may now be possible.

The initiation last year of the new *IEEE Transactions on Terahertz Science and Technology* [2]shows that basic technology is moving on somewhat independent of lagging pectrum regulation. In addition, a technical highlight of the 2008 Beijing Olympics - ignored by the general press - was the use of 120 GHz point-to-point terrestrial links for high definition video distribution from venues to a central site[3] and showed the potential for commercial spectrum use in presently virgin upper spectrum.

However, commercialization of such technology generally requires private investment for product development and rational investors may be reluctant to invest in technology that lacks the regulatory pathway to production and sales and raises unusual uncertainties not associated with less regulated technologies. While much of the speculation on use of these upper frequencies has been on fixed links connecting buildings or mobile base stations, there also has been discussion on using such higher frequencies for very high speed downlinks to mobile users in small cells. Thus there are a variety of possible uses for such high frequencies.

In the US the author played a key role in moving the upper frontier of normal regulation from 40 GHz in 2 steps to the present 95 GHz upper limit in the 1994 – 2003 time frame. But perhaps the time has come for the technical community and regulatory community to start a dialogue on the next step on moving the frontier.

Many of the concepts of spectrum management were developed when the spectrum under consideration was at much lower bands with very different physical characteristics. At mmW frequencies atmospheric absorption from oxygen and water molecules can be significant but vary according to frequency due to molecular resonances. The small wave lengths at these frequencies also allows small narrow beam antennas that are just not feasible at lower bands. Finally, present device technology severely limits practical powers available in these bands, especially for mobile devices. As a result the concerns about intersystem interference are much less than those in bands that were first utilized at the formative stages of spectrum

policy. The alternative to traditional licensing may be attractive in many applications. In the US, unlicensed operations is allowed at 57-64 GHz and a very simplified "licensing light" scheme is permitted in the 70/80/90 GHz area[4].

Readers not familiar with mmW spectrum management may not be aware of the complex mixture in these bands of active spectrum allocations and passive allocations, *e.g.* radio astronomy and remote sensing. This pattern dates back to the 1979 World Administrative Radio Conference (WARC-79) where the scientific community successfully requested allocations in these bands that were of virtually no commercial interest at the time. A significant fraction of the bands between 95 and 275 GHz either have only passive allocations or coprimary passive allocations where active users are obligated to seek coordination with passive users in the band. While the terms of ITU Radio Regulation 4.4 allows national regulators to vary from these international allocations and only allow limited types of users in a given band if it does not affect adversely other countries, national regulators generally comply with such ITU allocations.

However in the past 2 years there have been changes in the trend of ITU policy in this area. In 2010 ITU-R concluded[5] that "(c)ertain characteristics of the frequency range 275-3 000 GHz combine to reduce the likelihood of interference between the radio astronomy service and active services in this range." The 2012 World radio Conference (WRC-12) declined to make new passive allocations above 275 GHz stating "(t)he use of the range 275-1 000 GHz by the passive services does not preclude use of this range by active services[6]."

In the US, the passive communities use the National Research Council's Committee on Radio Frequencies (CORF) as a forum to review spectrum policy issues. CORF has done an excellent job both documenting the spectrums needs of the passive communities[7] and exploring innovative approaches to possible sharing of spectrum between passive and active users[8] for mutual benefit. In particular, the 2010 CORF report recognized the promise of "cooperative spectrum usage" with dynamic spectrum assignments as a potential sharing mechanism although the details have yet to be developed.

Moving the frontier of commercial spectrum use above 95 GHz will require a dialogue between potential active spectrum user and the passive spectrum use communities. Such a dialogue could be to the mutual advantage of both communities in recognizing their interests in these bands and he sharing that is possible due to the nature of technology and propagation at the upper end of the spectrum. Let's hope that the dialogue begins soon.

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[1] Wireless Gigabit Alliance, WiGig White Paper: Defining the Future of Multi-Gigabit Wireless Communications, 2010

(http://wirelessgigabitalliance.org/?getfile=1510)
[2] http://www.mtt.org/terahertz.html#philo

[3] A. Hirata *et al.,* Transmission Trial of Television Broadcast Materials Using 120-GHz-band Wireless Link, *NTT Technical Review*, Vol. *7* No. 3 (Mar. 2009) (*https://www.ntt-review.jp/archive/ntttechnical.php?contents=ntr200903sf3.pdf&mode=show_pdf*)
[4] http://www.comsearch.com/applications/link7090/index.jsp
[5] ITU-R, Report ITU-R RA.2189
(http://www.itu.int/dms_pub/itu-r/opb/rep/R-REP-RA.2189-2010-PDF-E.pdf)
[6] ITU Radio Regulations, foot note 5.565 (WRC-12 revision)
[7] Committee on Scientific Use of the Radio Spectrum; Committee on Radio Frequencies; National Research Council. *Handbook of Frequency Allocations and Spectrum Protection for Scientific Uses*, 2007 (http://www.nap.edu/catalog.php?record_id=12800)
[8] Committee on Scientific Use of the Radio Spectrum; Committee on Radio Frequencies; National Research Council. *Spectrum Management for Science in the 21st Century*, 2010 (http://www.nap.edu/catalog.php?record_id=12800

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