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SPECTRUM EFFICIENCY AT 6 GHZ – WHAT TO CONSIDER

One of telecoms regulators' key objectives is to make efficient use of spectrum. But how should they assess spectrum efficiency?

This primer is a high-level summary of how to evaluate the spectrum efficiency of licence-exempt Wi-Fi 6E (i.e., Wi-Fi 6 operating at 6 GHz) versus licensed IMT in the same spectrum. It draws on a PIP analysis that finds that Wi-Fi 6 and 5G NR have a similar peak spectrum efficiency in terms of the volume of data that is transferred each second for each Hertz of spectrum frequency.

That's because these modern wireless systems both rely on the same underlying radio technologies (e.g. OFDMA and MIMO). The actual real-life performance of Wi-Fi and 5G NR depends mostly on network configurations, network topology and functions, rather than the underlying technology.

Consider the area served

However, if you take a broader view of spectrum efficiency – by considering the area of operation of the network – Wi-Fi is far more efficient than 5G NR. In the absence of a coordination mechanism, the area served by a network is also the area denied to other potential users of the spectrum being employed.

In the case of the 6 GHz band, it is particularly important to consider the area served, as low power Wi-Fi has limited range and, therefore, won't interfere with existing services, such as fixed or fixed satellite services. By contrast, some regulators take the view that, based on their national assessment, 5G cannot share with incumbent services – unless the 5G deployments are restricted to very low power base stations.

Two recent studies that have concluded that 5G can share the 6 GHz band with incumbent services appear to assume very limited deployment of 5G – perhaps one tri-sector outdoor base station every 500 to 600 km^2. If that is a correct assumption, then the spectral efficiency of 5G in the 6 GHz band will be very small (taking into account the area metric).

Other spectrum efficiency metrics might include power efficiency or energy used. If power efficiency is used, then an indoor-to-indoor service, such as low power Wi-Fi, achieves much greater performance than an outdoor-to-indoor service, such as a conventional public IMT network. This is because building attenuation adds 30 dB to the link budget, while also consuming more device battery power.

Given the choice, network operators will select the technology (and accompanying regulatory framework) that best meets their requirements and the expectations of their users. They may, for example, obtain a much higher quality of service by deploying many affordable access points, rather than a few expensive ones.

Consider the bigger picture

For regulators, local spectrum efficiency does not translate into overall efficient use of spectrum. Network topology (e.g. indoor deployment), affordability of equipment and ease of deployment can all improve the efficient use of spectrum, much more significantly than the local peak spectrum efficiency of a given technology. Wi-Fi 6E equipment is already widely available and easy to deploy.

Another key consideration is how a new service interacts with neighbouring or incumbent services in the band. If it cannot coexist, then, the opportunity cost of the impossibility of coexistence (e.g. the cost of clearance) shall be quantified and pondered against the benefits that the new service would bring.

EU regulators should ensure that there is spectrum available to support public wide area networks (e.g., in 3400-3800 MHz), local licensed private networks (e.g. in 3800-4200 MHz) and licence-exempt radio local area networks (e.g. in the 5925-7125 MHz), as all three topologies correspond to different market needs.

When considering efficient spectrum use, bear in mind that Wi-Fi delivers the majority of the wireless traffic and will continue to be the main Internet access technology for the foreseeable future.

For a more technical analysis of the spectrum efficiency of licence-exempt Wi-Fi 6E versus licensed IMT, please see this paper.