

 1.6

## Radio Spectrum

The importance of spectrum to the electronic communications sector is evidenced by the soaring number of mobile service subscribers, the huge numbers of viewers and listeners to television and radio and the relatively new and mushrooming phenomenon of Wi-Fi and WiMAX radio access – all of which place demands on the radio spectrum. The transition to digital broadcasting adds a new dimension to the radio spectrum agenda.

In the modern era, spectrum has been subject to detailed regulation for national security and emergency services purposes, as well as to manage spectrum as a scarce resource and minimize the risks of harmful interference between spectrum users. The notion of spectrum scarcity has increasingly led administrations to more efficiently manage spectrum through various mechanisms, such as spectrum trading, reallocation of spectrum to more valuable uses and in-band sharing. In-band sharing is a flexible spectrum management policy in which several licensees are permitted to offer different applications and/or technologies over the same spectrum bands, provided they do not cause harmful interference to any other lawful users. Since spectrum management involves cross-border agreements and harmonization, the spectrum agenda necessarily entails international coordination, where the ITU plays a particular role.

The central issues for spectrum management are allocation (where choices are made between competing uses) and price. Spectrum can be used for many applications where more than one application can work on any given frequency; where some applications can work on a range of different frequencies; and where different applications require varying amounts of spectrum.

Under traditional radio spectrum management, decisions have been made regarding allocations of radio spectrum among competing applications or services for the range of frequencies available. These decisions have often taken place in a two-staged manner. First, frequencies are allocated to particular applications (often according to international agreements), then within those applications certain operators are assigned particular frequencies (often on a first-come, first-served basis) and are charged fees. There is a relationship between fees that can be charged for spectrum usage and revenues that can be earned from services of operators. These choices and prices should provide the maximum net benefit. Issues arise where new technologies offer higher value opportunities for frequencies already allocated to operators or applications. Allocating resources among competing uses is traditionally the realm of economics and markets, but decisions have been made to a large extent administratively, in order to take account of public-interest policies.

Spectrum-related technology is moving much faster than spectrum-related regulation in the context of demand for spectrum growing at an accelerated rate. Once regarded as a particularly scarce resource (another rationale for detailed regulation) the switch from analogue to digital broadcasting will produce a “spectrum dividend.”<sup>\*</sup> Equally, new compression techniques and the use of very short range spectrum are enhancing the availability of spectrum. It is clear that radio spectrum is becoming more valuable with the development of convergence and the expanding range of services that can be delivered via radio spectrum. Consequently there is a requirement to use radio spectrum efficiently.

Currently, there are certain inefficiencies in the radio spectrum arena. These are caused by the inertia and legacies of licensees and certain spectrum management practices that can limit spectrum availability and impede innovation. Very often the public sector is a major holder of radio spectrum. For instance, in the United Kingdom the public sector accounts for nearly half the spectrum below 15 GHz, with the UK Ministry of Defence the largest user. Often, public sector holders of radio spectrum do not use it in the most efficient ways, and in some cases “warehouse” the spectrum, which led to Ofcom issuing a decision in 2008 requiring the public sector to more efficiently use spectrum.<sup>\*</sup> The decision also permits government agencies to sell their unused spectrum to the private sector.

Markets and price mechanisms are generally associated with efficient allocation of scarce resources and may be used to cover the administrative costs of spectrum management; maximizing the economic benefit of the spectrum resource for the public; and ensuring that those operators that benefit pay for the use of spectrum. Often in the second stage, frequencies are assigned to particular operators by market means, and auctions are very common in the issuance of mobile licenses. Some of these licenses have subsequently been traded in mergers and acquisitions. Increasingly, financial incentives are being introduced to encourage users to economize the spectrum they occupy. Measures are also being introduced to allow for the reuse of assigned spectrum that is not fully utilized.

As **Module 5** of the Toolkit explains, four radio spectrum management models have been developed and implemented:

- The traditional “command-and-control” model, which is regarded by some as best suited to fulfilling public interest policies. The model can also provide for the harmonization of spectrum use leading to the development of economies of scale and falling costs for equipment manufacturers and customers
- A “market-based property rights” model involving exclusive usage rights and spectrum trading and pricing. The market-based model should stimulate further technological change in spectrum-based applications and usage, which may not lead to the same degree of harmonization and falling costs of production of equipment.
- The “commons” or “unlicensed” model where, on a shared basis, spectrum is available to all users who comply with certain pre-determined technical limits (e.g., total transmission power/output limits) and equipment certification requirements of mitigation techniques to guard against interference. This “open” model is generally flexible regarding usage rights of “white spaces”, lowers access barriers to radio spectrum usage, and effectively decentralizes radio spectrum allocation to users. As a consequence, the commons approach allows quicker new market entry. In combination, decentralization, rapid market entry, and flexibility can encourage technological developments for spectrum-efficient applications like Wi-Fi. The drawback of the commons model is that it can stimulate overuse of spectrum rather than the efficient use of alternative resources.
- More recently, an “easement” model has been developed and implemented, which relies on intelligent or smart technologies. These technologies allow for spectrum sharing. They enable unlicensed users of devices to operate in the same frequencies on a secondary basis as licensed users who hold exclusive rights to use spectrum. The model draws on both the market-based and commons approaches. It is clear that the easement model can only function where the spectrum in question is not used intensively.

There is always a tension between harmonizing spectrum uses, thereby generating economies of scale and lower costs, and permitting wider uses of any particular band of frequencies and thereby stimulating innovation. The past has largely been characterized by harmonization, while the future is more likely to encourage innovation. Equally, there is a tension in the command-and-control model with the requirements for technological and service neutrality associated with the converged environment.

The ICT sector has witnessed the evolution of spectrum management policy from pure command and control to include increasing contributions from the other three models. It is clear that no single model can be applied in all circumstances. It is also clear that many operators would prefer greater flexibility in using the spectrum they already hold. As discussed in the Toolkit, the challenge for regulators is to achieve a balance between these models that best suits their circumstances. Wireless is clearly the most popular technology in developing countries, and therefore, spectrum management is very high on the regulatory agenda.

\* Ofcom, Spectrum Framework Review for the Public Sector (2008) at .

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