

## **Spectrum (517 words)**

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The assignment and management of electromagnetic frequency spectrum (spectrum), once an esoteric subject, has today become one of the most important issues of public policy on ICTs. It has become the most essential input to the provision of electronic connectivity to the public.

**Technical features:** Spectrum is a peculiar kind of natural resource, in that its use requires human action in the form of generating electromagnetic energy and imposing patterns containing information upon that energy. Scarcity, hitherto considered a central characteristic, arises from information becoming noise because of interactions. With recent rapid advances in radio engineering such as spread spectrum and software radio, scarcity is becoming less central.

**Economics of spectrum:** Wireless in various forms is emerging as the dominant technology in developing-economy local-access networks because of easy deployment, low capital requirements and lower costs made possible by large-scale manufacturing. For mobile access, spectrum is essential, particularly in bands for which cheap equipment is manufactured. It is also indispensable for thin backhaul networks. Originally, spectrum was assigned administratively with fees set outside the market. As its value increased and it defined the level of competition in markets, its flaws in ensuring efficiency and reducing possibilities of corruption became evident. Various assignment procedures, ranging from “beauty contests,” where proposals are compared using marking schemes, to auctions, became popular. Auctions, when designed to optimize yields, generated massive revenues for government. In many cases, they created quasi-private property rights, wherein the right to alienate still required government consent. In some cases, that right was part of the bundle of rights purchased, subject to the spectrum being used for services that fell within the class of services decided on by the International Telecommunication Union (ITU).

**Refarming:** Because spectrum applications of spectrum developed over time, the overall assignments did not fit a master plan. However, the ITU set in place pragmatic allotment plans, different for the three main regions in the world, within which national administrations assigned frequencies in ways that would minimize interference. As new technologies emerge and new markets are developed, it is not always possible to use “greenfield” bands, but instead to reassign existing bands. This is like the periodic redevelopment of urban land, wherein “low-value” land is cleared and reassigned for “high-value” uses. Within the exclusive-use, private-property paradigm, the solution is relatively simple. The beneficiaries of refarming compensate those who bear the costs. However, a mechanism for compensating holders of exclusive rights to frequencies when the beneficiaries are non-exclusive users as would be the case if the cleared frequencies are to constitute a “commons.” Absent refarming, the anticipated nirvana of regulation-free commons bands will not emerge except in greenfield bands.

**Regulatory issues:** Those who supply connectivity services, especially in the developing world, cannot do without spectrum. In addition, current and potential users have incentives to restrict competitive entry. Scarcity leads to the concentration of discretion among politicians and officials, leading to an environment conducive to rent seeking. One of the highest regulatory priorities is the creation of an environment that allows optimal use of spectrum in the context of rapidly changing technology without the pall of rent seeking.

## Additional Information

### Studies

- Cramton P. (2002). Spectrum Auctions. In Cave, M., Majumdar, S. and Vogelsang, I. (eds.), *Handbook of Telecommunications Economics*, Amsterdam: Elsevier Science B.V.
- Goswami, D. (2008). Wifi: The Network Fix. In Samarajiva, R. & Zainudeen, A. (eds.), *ICT infrastructure in emerging Asia: Policy and regulatory roadblocks*, New Delhi & Ottawa: Sage and IDRC.
- Gruber, H. (2001). Endogenous Sunk Costs in the Market for Mobile Telecommunications: The Role of Licence Fees, *The Economic and Social Review*, 33 (1): 55-64
- Prat, A., & Valletti T. M. (2001). Spectrum auctions versus beauty contests: costs and benefits. *Rivista di politica economica*, 91: 59-109,
- Samarajiva, R. (2007). Preconditions for effective deployment of wireless technologies for development in the Asia-Pacific, *Information Technology and International Development*, 3(2): 57-71.

### Websites

- <http://www.ictregulationtoolkit.org/en/index.html>
- <http://www.itu.int/ITU-R/index.asp?category=information&rlink=rhome&lang=en> – webpage of the ITU Radiocommunications Sector (ITU-R)
- <http://www.ntia.doc.gov/osmhome/osmhome.html> - Office of Spectrum Management (OSM), National Telecommunications and Information Administration (NTIA), responsible for managing the US Federal Government's use of radio frequency

### Online news

- US auctions 700 MHz spectrum reclaimed from broadcasters:  
[http://www.nytimes.com/2008/01/22/business/22spectrum.html?\\_r=1&th&emc=th&oref=slogin](http://www.nytimes.com/2008/01/22/business/22spectrum.html?_r=1&th&emc=th&oref=slogin)

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