infoDev ITU International Telecommunication Union ICT REGULATION TOOLKIT

Radio Spectrum Management

Executive Level Training for Regulators and Policy-Makers
Hotel Kowloon Shangri-la, Hong Kong, China
December 2-3, 2006

Creating a Regulatory Framework for New Technologies: Changes to Spectrum Management Practices

Adrian M. Foster
McLean Foster & Co.

Agenda

- What are the latest technology trends in radio spectrum management?
- How do these trends affect Traditional Approaches?
- What are Trends In Reform?
- How will ICT development be affected?

McLean Foster & Co.
Spectrum Management, Telecom and Energy Regulatory Management Consultants

Intro - What is Spectrum Management?

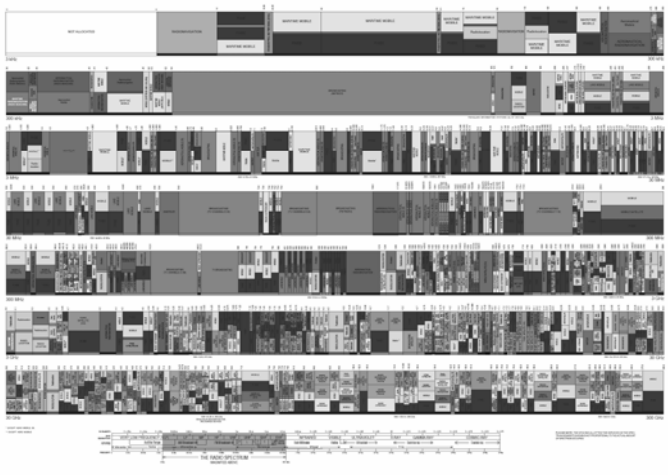
- Spectrum Management:
  - is a combination of administrative & technical procedures to ensure the efficient operation of radiocommunications without causing interference; and,
  - ensures interference-free access to as many users & as many uses as possible;
  - often provides an economic return to the government.

See: www.ictregulationtoolkit.org Radio Spectrum Management: Section I Spectrum Overview

McLean Foster & Co.
Spectrum Management, Telecom and Energy Regulatory Management Consultants

3

Frequency Allocations



McLean Foster & Co.
Spectrum Management, Telecom and Energy Regulatory Management Consultants

4

What are some of the Issues?

- Scarcity due to real congestion, inefficient use, underutilization and artificial scarcity.
- Rigidity and failure to incorporate innovation.
- Control and use of the spectrum lies with the regulator – not the licensee.
- Economic costs due to inefficient use claimed to be enormous.

5

Key Drivers of Change

- The most important driver of change is increased demand. There are several causal factors:
  - Tastes, wealth, globalization of services.
- Technology advances are needed since most “prime spectrum” has already been assigned. Important enablers include:
  - Digitization, Internet Protocol, Packet-Switching, Advances in Radio and Wireless Technologies.

6

Technology Enablers

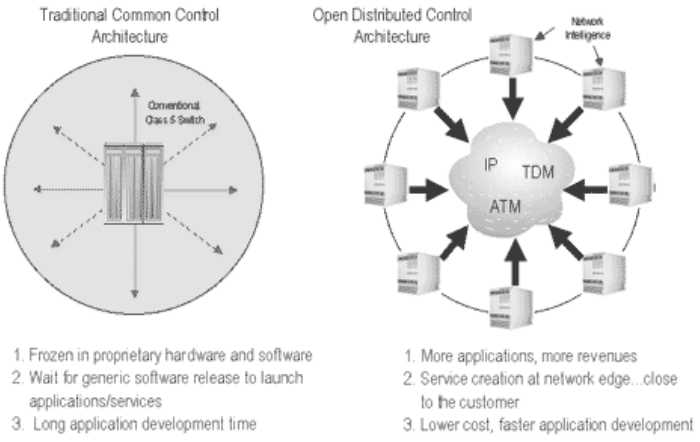
- More use of digital technologies increases the potential throughput of information;
  - Digital signaling techniques are more robust and resistant to interference.
- Next generation network infrastructures based on IP, Packet-Switching, Softswitch and Edge Technologies.
- Broadband Wireless Access and Convergence.

See: www.ictregulationtoolkit.org New Technologies and Impact on Regulation

McLean Foster & Co.
Spectrum Management, Telecom and Energy Regulatory Management Consultants

7

NGN Architecture



1. Frozen in proprietary hardware and software
2. Wait for generic software release to launch applications/services
3. Long application development time

1. More applications, more revenues
2. Service creation at network edge…close to the customer
3. Lower cost, faster application development

Source: IEC.org

McLean Foster & Co.
Spectrum Management, Telecom and Energy Regulatory Management Consultants

8

Technology Enablers

- Development of software –defined radios (SDR). SDR enables more flexible spectrum allocation since these radio systems potentially use spectrum more intensively and are more tolerant of interference.
- New Radio Techniques including modulation and compression techniques resulting in widening of spectrum range and increased data capacity. Increased access to higher spectrum ranges can mitigate scarcity of spectrum resource.

See: www.ictregulationtoolkit.org New Technologies and Impact on Regulation

9

WiFi

- WiFi (sometimes written Wi-fi, WiFi, Wifi, wifi) is a trademark for sets of product compatibility standards based on the IEEE 802.11:
  - WiFi is used primarily for wireless local area networks (WLANs) to allow mobile devices, such as laptop computers and personal digital assistants to connect to local area networks;
  - Can be used for Internet access and wireless VoIP phones;
- Operates at higher frequencies than WANs and uses 20 MHz channels.
  - Uses the ISM or Unlicensd Bands. Eg. ITU Radio Regulation 5.150 Region 2 includes the following bands:
    - 902-928 MHz (centre frequency 915 MHz), 2400-2500 MHz (centre frequency 2450 MHz), 5725-5875 MHz (centre frequency 5800 MHz), and 24-24.25 GHz (centre frequency 24.125 GHz).
- Unlicensed does not mean unregulated. Use of unlicensed bands puts limitations on emissions (Tx power).

See: www.ictregulationtoolkit.org Radio Spectrum Management: Section II Spectrum Use Standards

10

WiMAX

- WiMAX is the popular name of the wireless metropolitan-area network – a WAN technology. WiMAX, with a range of up to 31 miles, is primarily aimed at making broadband network access widely available without the expense of stringing wires (as in cable-access broadband) or the distance limitations of Digital Subscriber Line.
- WIMAX is based on the IEEE 802.16 standard and for certification of products and technologies operates in various frequency bands including the 1.9 GHz. 2.1 GHz, 2.3 GHz, 2.5 GHz, and 3.5 GHz.
  - Uses narrower channels typically 5MHz. for Wideband CDMA and 1.25 MHz for CDMA2000. (Lower frequency bands are congested).
- Applications include microwave backhaul, fixed-wireless access and mobile access.

See: www.ictregulationtoolkit.org Radio Spectrum Management: Section II Spectrum Use Standards

Implications of Market Changes and Convergence, IP and Packet Switching Technology

- Rapid Rate of Innovation:
  - Restrictions on use becomes more difficult to maintain in an environment where services are developing rapidly:
    - For instance 3G and in particular 4G may support broadcasting services. Convergence will therefore support the above mentioned relaxation of license conditions.

Implications of Market Changes and Convergence, IP and Packet Switching Technology

- Effectiveness of Technology-based Solutions is improving. As this happens, radio technical considerations become less important for the allocation of spectrum.
- Blurring of Service Distinctions:
  - As the demand for services changes, it may be desirable (for example) to switch some services to higher frequencies and reform/refarm the spectrum for better-suited new services, resulting in one of biggest challenges facing spectrum regulators: the reallocation of spectrum.
    - It is often difficult to reallocate these frequencies for a different use when frequencies have been used for one purpose, perhaps for decades;
    - Note: global uniform spectrum allocations have benefited consumers due to manufacturing economies of scale sooner.

Traditional Approach – Slowing ICT Development

- Criticisms include:
  - Excessive rigidity creates scarcity - “administrative scarcity”;
  - Technology and service innovation are being stifled;
  - Disincentives for inefficient use of the resource are not sufficient;
  - Erects barriers to other beneficial transactions.

Response using improvements to the Administrative Approach

- Station versus System Licensing
- Delicensing – licence exempt
- Increased Sharing of Spectrum
- Encourage Technical Efficiency:
  - Smart antennas, S/W Defined Radio;
  - Extending the Upper Limit of the Useful Range.
- "Band Clearing"/Reallocation

Impact on Spectrum Regulation

- Generally, the goal is to improve access to spectrum by giving users greater flexibility in its use. Several ways to do this:
  - Implement a new paradigm for interference protection;
  - Implement new methods for assigning spectrum rights.
- Spectrum policy must evolve towards more flexibility and market oriented models to increase opportunities for efficient spectrum use.

Response using improvements to the Market-based Approach

- Use of genuine market mechanisms and forces in the management and licensing of spectrum:
  - Flexibility of use/unified licensing;
  - Spectrum trading and secondary markets:
    - With Property-rights, exclusive right clearly defined;
    - Examples – Australia, Guatemala, and New Zealand and, partially, the U.S.

See: www.ictregulationtoolkit.org Radio Spectrum Management: Section 1.5.2 Market Methods and Section 3.2.1 Methods for Assigning Frequencies

17

Response using improvements to the Market-based Approach

- Auctions: switching from administrative reviews (beauty contests) followed by an administrative decision, to auction in itself does not fundamentally change the spectrum regulatory regime:
  - Licenses specifying the technological apparatus and services to be provided, tie the winner of an auction down as effectively as those firms granted a licence by any other administrative means.
- The key differences for market-based assignment using auctions are that:
  - Auctions assign the licence/spectrum to the firm which bids the most which may in certain conditions be the most efficient firm;
  - Competitive auctions cause any expected excess profits from providing the service to go to the Government, rather than the operator as would be the case if the operator were chosen via a competitive hearing.

See: www.ictregulationtoolkit.org Radio Spectrum Management: Section 1.5.2 Market Methods and Section 3.2.1 Methods for Assigning Frequencies

18

Unlicensed or Spectrum Commons Approach

- No exclusive rights – anyone can use certain blocks of spectrum subject only to certain basic rules (e.g., maximum power) and for any lawful purpose using any technology:
  - Examples of commons approach include amateur radio service.

19

What methods to chose?

The major decision for regulators is where to settle between administrative and market methods in spectrum licensing?
▪ Arguments in favour of administrative methods are: • A high level of control; • 'Safer' in terms of avoiding interference; • Re-allocation of spectrum among radio services can be easier – by order. ▪ Arguments in favour of market methods include: • More flexibility; • Decisions are delegated to those with the best knowledge; • Work speedily to make adjustments in spectrum use within defined criteria.

20

In Practice – Striking a balance

- Regulators should look for the right balance among the three methods of administrative assignment, use of markets and commons.
- The choice will be based on such things as:
  - the general scarcity of spectrum in various parts of the country and in various portions of the spectrum;
  - the human and financial resources available to the regulator;
  - the various types of use – commercial or public service;
  - and opportunities for innovation and commerce.

Discussion and Questions