ITU Regional Training Workshop on "Spectrum Management: Strategic Planning and Policies for Wireless Innovation"

Spectrum Policies for Wireless Innovation – Allocations and Assignment and Spectrum Caps

Place: Algiers

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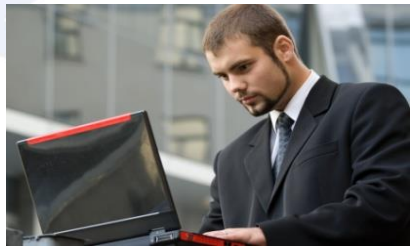
Session Objectives

- In this session we briefly benchmark “conventional” allocation processes in several countries.
- The use of unlicensed spectrum and dynamic spectrum access are reviewed along with negotiated access.

STUDENTS



Session Topics

- Key Features of Traditional Allocation and Assignment Processes
- Spectrum Allocation Benchmarking
- Unlicensed Spectrum, Dynamic Spectrum Access and Negotiated Access
- Spectrum Caps

Overview

- Allocating and assigning spectrum for various uses and users is a powerful regulatory tool with significant implications.
- Imposing or limiting restrictions on uses and users has a direct impact on spectrum access and efficiency.
- Knowing where and where not to impose restrictions requires information, building consensus and where consensus is lacking, the means to smooth out differences by way of an adjustment process such as compensation or arbitration.
- Consultation should be included at all important stages.

Spectrum Value and Scarcity

- Key stakeholders – government, industry and consumers increasingly embrace the view that spectrum has significant value in economic terms, as an input to, broadly speaking the production of telecommunications services and especially mobile and broadband services. It is not hard to see why.
- Spectrum shortfalls are predicted and NRA's are setting targets to secure additional spectrum to meet expected future needs.

- **It took fixed line telephony more than 125 years to reach 1 billion lines.**
- **Mobile connections grew from 1 to 3 billion in less than six.**
- **There are 6.3B mobile subscribers as of 2012 and of these over 1B are mobile broadband.**
- **9 of the top 10 growth markets are in the developing world.**

Source: Author

Traditional Framework

The traditional framework is highly prescriptive and often requires very detailed regulatory oversight.

For example, it may prescribe the applications that can use spectrum (e.g., mobile services, terrestrial point-to-point links, etc.), the technology to be used, power levels, localization and height of the transmission masts, as well as bandwidth.

Key Features of Traditional Allocation and Assignment Processes

- The traditional framework is highly prescriptive and often requires very detailed regulatory oversight.
  - For example, it may prescribe the applications that can use spectrum (e.g., mobile services, terrestrial point-to-point links, etc.), the technology to be used, power levels, localization and height of the transmission masts, as well as bandwidth.
- Liberalization and the use of market-based mechanisms is intended to remove, or at least reduce, these restrictions.
- However, specific restrictions are necessary to avoid harmful interference, while other requirements are necessary to satisfy international agreements.
- Formulating policies and reforming regulations to reflect a more liberalized environment should be a prerequisite before steps are taken to improve allocation and assignment processes since an increased emphasis on a more liberalized approach to spectrum use and spectrum licensing significantly influences how the improved process will unfold.

Forecasting and Analysis of Demand and Supply

- The regulators included in the benchmarking review have made it a practice to continuously assess the demand for spectrum and supply including the perspectives of users and operators on their needs and responses to new and existing services to better understand future requirements. How this is done varies.
- Ofcom conducts formalized broad studies of ICT sector focusing on telecommunication and broadcast services. As well, government departments are required to provide credible studies of future spectrum requirements taking into account the use of advanced more efficient technologies.
- The FCC conducts extensive analysis of future spectrum requirements in order to develop strategies for foundation technologies such as broadband. The NTIA conducts analysis and prepares forecasts of future spectrum requirements for aeronautical, public safety, and security/defense requirements. The FCC and NTIA are required by law to collaborate on spectrum planning.

Band Planning

- While forecasting and analysis of spectrum demand and supply are being conducted by benchmark regulators in various forms, band planning by these regulators of priority bands for services such as broadband, broadcast, cellular, fixed links, public safety and security and satellite is a consistent focus.
- New allocations for fixed and mobile services (both terrestrial and space) have been decided upon at WRCs, benefiting cellular and broadband networks and assigned new services to digital dividend spectrum (allocated is for services, assigned for licenses) , and re-allocated the digital dividend spectrum to new services, then assigned it using…..
- Band planning involves analysis of market-structure and resulting competition, new technologies and services and the demand for new services, and input from existing and new users.

Consultation

- Consultation is essential to every aspect of spectrum management including changes to national allocations, demand and supply forecasting, band planning in addition to developing spectrum policies and technical standards. The impracticalities of consulting with individual spectrum users can be overcome by conducting effective consultations and allowing associations or bodies representing groups of users to contribute to the process.
- It is important that the spectrum regulator's proposals be made public to facilitate consultation on important spectrum management issues. Typically several options may be presented for public comment and is helpful to allow for exchanges between the regulator and interested parties
- Irrespective of the methods for obtaining input, minimal guidelines to allow for contributions should be set such as allowing for a deadline by which comments.

Spectrum Management Systems

- The ability to plan, allocate and assign on an efficient, timely and accurate basis depends entirely upon the existence of adequate, sufficient, and accurate data for existing licences, occupancy, location, usage, stations and equipment maintained in the national frequency register. It is essential that the national register is complete and that all frequency assignments and licences are recorded with appropriate security over access and disclosure.

- The spectrum manager can then properly perform their responsibilities for planning, authorizing, engineer and monitoring spectrum use by using adequate, accurate and complete data in combination with an automated integrated spectrum management system

Spectrum Allocation Process Benchmarking

Australia

- Spectrum is managed by the Australia Communications and Media Authority (ACMA). The underlying legislation is the Radiocommunication Act 1992 which provides the ACMA with objectives for spectrum management which can be summarized as public benefit, access and flexibility.
- The Australia Radiocommunication Act's main provisions cover:
  - a comprehensive system of licensing radio frequency emissions under three broad licence types (spectrum, apparatus and class licences to be clarified below);
  - market-based assignment of licences (including by auction, predetermined or negotiated price) sitting side by side with traditional administrative assignment of licences;
  - rules and processes for making spectrum plans and band plans;
  - a system of registration of licences with the register to be available to the public;
  - processes for setting standards and technical regulation and device labelling;
  - procedures for review of ACMA decisions; and
  - Provisions relating to charging for the use of spectrum

Spectrum Assignment Process Benchmarking

Australia

- The step by step process on how to acquire spectrum found here: HTTP://www.acma.gov.au/WEB/STANDARD/pc=PC_300171
- An applicant applies directly to ACMA for assigned bands directly on Australian Radio frequency Spectrum Plan. Authorizations are granted on a first-come, first-served basis unless it is determined demand exceeds supply in which case the ACMA may then proceed to making assignment through an auction.
- ACMA will negotiate pricing according to market value. Licenses typically last up to 15 years.

Spectrum Allocation Process Benchmarking

France

France has a complex spectrum management regulatory framework in that there are nine agencies and departments which have some role in the oversight, licensing and use of radio spectrum. The main agencies and departments are:

- Telecommunications Regulatory Authority - ARCEP
- National Agency of Frequencies - ANFR
- French Broadcasting Authority - CSA
- Ministry of Defence
- Ministry of the Interior
- Civil Aviation Authority
- Ports Authority
- Meteorology Administration

Spectrum Allocation Process Benchmarking

- The ANFR coordinates all terrestrial services to prevent interference with neighboring countries and optimize the use of the spectrum. This coordination is regulated by agreements established at the ITU Regions and / or multilaterally. These agreements outline the rights negotiated for each signatory government as well as the procedure for the change, if any. These rights exist in various forms: frequency and / or codes preferential allotments, depending on frequency assignments and countries. They can be packaged in technical and administratively by other agreements.
- Advisory Committees
  - A framework of advisory committees is in place to assist ANFR in meeting its obligations for planning and management of radio spectrum and its use. The committees serve to:
    - Allow discussions amongst ministries and administrative authorities, with the participation of economic stakeholders (operators, manufacturers);
    - Assess supply and demand for spectrum over the planning period;
    - Establish consensus between the various spectrum users before decision is taken at the national or international level.

Spectrum Allocation Process Benchmarking

- ARCEP is an independent administrative authority that was created on 5 January 1997, under the name of ART – (Autoritéde Régulation de Télécommunications), or Telecommunications Regulatory Authority – to accompany the French telecommunications sector as it was opened up to competition, and to regulate the markets created in the process.
- The legislative provisions that define ARCEP's role and status are contained in the French Postal and electronic communications code or CPCE (Code des postes et des communications électroniques). Furthermore the CPCE gives the National Frequency Agency, (ANFR) (Agence Nationale des fréquences) – a public State administration – a central role in managing radio frequencies, in tandem with the authorizing users to use radio frequencies . ARCEP works especially closely with ANFR. An ARCEP representative has a seat on the ANFR Board of Directors, and therefore takes part in its operation.

Spectrum Allocation Process Benchmarking

United States

- FCC and NTIA Spectrum management in the United States up until recently, as elsewhere in the world, was organized along the lines of the traditional approach with a focus on frequency allocations, allotments and assignments. Administrative processes were used extensively in making allocation decisions in the public interest; the FCC takes into account:
  - public needs and benefits;
  - technical considerations;
  - apparatus limitations
- The centralized administrative approach to allocating spectrum to specific radio services and to assigning spectrum to specific users resulted, in particular, in prolonged delays in some services, most notably cellular mobile telephony services.

UNLICENSED SPECTRUM, DYNAMIC SPECTRUM ACCESS AND NEGOTIATED ACCESS

Allocation and Licensing Regimes

- There are two fundamental types of allocation and licensing regimes:
  - Licence-based access regime – based on the economic characterisation of spectrum as a simple resource, rival in consumption, in which a user will need to obtain a licence through a regulatory award or market-based negotiation. Efficient allocation amongst users could be further assured through the development of system of tradable property rights or,
  - Rule-based access regime – in which the satisfaction of certain conditions, such as limited transmit power levels, checking with an online database and/or payment of an access fee permits spectrum access

Spectrum User Rights

- In practice, tradable spectrum licences have not nearly fulfilled the hopes of their proponents.
- First, the standard process of enabling access for new applications to clear bands of existing users and grant new licences persists. However, this process is increasingly costly and time-consuming and provides no guarantee that new white spaces will not be created
- Next, activity has been slow and volumes low, with the large majority of ‘trades’ simply representing the transfer of company ownership.
- Finally, and perhaps and quite disappointingly, tradable spectrum rights have not led to the innovation.

Unlicensed Spectrum

- A significant occurrence in wireless communication has been the growth and success of licence-exempt technologies.
- Wideband licence-exempt usage was first authorised in 1985 by the FCC in the Industrial Scientific and Medical (ISM) spectrum bands at 900 MHz and 2.4 GHz. These bands were chosen for licence-exempt usage because they were inundated by radiation from microwave ovens and medical and industrial equipment, and so were thought to be 'junk spectrum' unsuitable for communications usage.
- There are powerful arguments against expanding the number of unlicensed bands:
  - Restrictions imposed internationally on the use of spectrum by the ITU, CEPT and EU to ensure harmonization;
  - Radio waves do not observe national boundaries.
  - Licence exempt spectrum generally is not appropriate for emergency communications or other services which require high levels of reliability / availability
  - Economies of scale needed for equipment development and production.

Dynamic Spectrum Access

- The promise of 'Dynamic Spectrum Access (DSA) is to enable access to and use of these vast untapped spectrum resources. Initially most efforts at DSA have been focussed on devices that could sense the spectrum around them and automatically choose quiet channels.
- A more recent approach is to use geo-location databases where devices contact a central database which informs them of the permitted frequencies and operating conditions at their location.
- There are a number of advantages of DSA:
  - First, it avoids the costs of clearing spectrum.
  - Second, it allows regulators unprecedented ability to maximise the efficient usage of spectrum.
- Disadvantages are:
  - mid and long term non-tenure entails high risk to any business case (the pioneer curse: triggering a golden rush, new players, incoming primary players, band reallocation, etc.)

Negotiated Access

- Recently, effort has commenced into determining negotiated access processes using rules-based Dynamic Spectrum Access technologies.
- Two challenges are studied in establishing a process to support either monetary or resource exchanges used by participants in the spectrum negotiation:
  - Asymmetrical information – typically one of the participants has an advantage in knowing details about sites, power, performance, costs, etc.
  - Dynamic multi-period negotiation – the agreement necessarily covers multiple time periods and changing circumstances.

Licence Based vs. Rules Based

- Current debate on whether to use Licensed-based (exclusive rights) Spectrum Access or Rules-Based Spectrum Access. The debate centres on a number of issues:
  - Quality of Service degradation
  - Tragedy of the Commons
  - Underutilized spectrum hoarding
  - Lack of innovation
  - Loss of spectrum value
- The debate continues.

Spectrum Caps

- Spectrum caps: ex-ante means to implement competition policy in mobile communications markets to help ensure that no single mobile operator, or a very small number, can acquire all or almost all spectrum on offer either at the time of initial spectrum awards or in subsequent mergers of, or deals between operators.
- To prevent creation of positions of large holdings of a scarce resource, i.e. spectrum, exploited anti-competitively so as to cause market failures with deleterious effects for customers and overall economic welfare. There are other means to ensure entry into the mobile market by multiple operators, such as issuing multiple separate licences and setting aside spectrum for entrants in individual spectrum auctions.
- The choice by NRA's in using either spectrum caps, set-asides, or other means such as licences depends on the stage of market evolution and competition.
  - In early stages of the cellular (primarily voice traffic) market evolution, spectrum caps were used to assist entry and prevent dominant players from overtaking the market. These were subsequently relaxed and in the intervening period set-asides were used to aid new entrants into the market at later stages usually when newly available bands were being auctioned off.

Spectrum Caps

Characteristics of Spectrum Caps	
Hard Spectrum Cap	A “hard” cap or absolute limit on the amount of spectrum any one operator can hold.
Soft Spectrum Cap	A “soft” cap, i.e. if exceeded other conditions may be applied to the spectrum licence, such as a different initial licence period.
Specific Band Spectrum Cap	A band-specific only spectrum cap with no reference to other spectrum holdings .
Multi-band Spectrum Cap	A spectrum cap that considers spectrum holdings across other spectrum bands - may be cumulative only and/or include cumulative and band-specific elements.
Durable Spectrum Cap	Durable caps set at the time of the award – and applicable to subsequent spectrum trades and acquisitions.

Spectrum caps to promote competition and efficient use

Average Spectrum Holdings and Spectrum Caps in Selected Countries - 2008

Country/Region	Spectrum Holdings per Operator in MHz
EU Average	92.6 MHz
United Kingdom	82.2 MHz
Germany	65 MHz
USA – 3 operators	87. MHz

Source: Mobile Demand, Competition and Spectrum Caps, A.D. Little 2010

More Recent Spectrum Caps: 700, 800, 900, 2500 MHz Bands

Country, Regulator and Frequency Band	Cap	Maximum spectrum permitted
United Kingdom, Ofcom - 800 MHz and 2.6 GHz Auction	cap on spectrum awarded and cap on total spectrum holdings by operator	maximum of 2x27.5 MHz of sub-1 GHz spectrum and 2x105 MHz of mobile spectrum in total (2x132.5 MHz).
Republic of Ireland, ComReg – 800, 900 and 1800 MHz Band Auction	Cap for 1800 MHz band to avoid one operator acquiring rights to entire 1800 MHz band, which would adversely affect downstream competition	Existing cap for spectrum below 1.0 GHz of 2x20 MHz confirmed. Combined limit of 2 x 50 MHz on total spectrum any one bidder could be awarded in the joint auction
United States	Not recently used spectrum caps to promote competition. However, US Department of Justice decision denying AT& T and T-Mobile merger in 2011 noted the combined would be detrimental to completion	

Spectrum Caps

Republic of Ireland, *ComReg – 800, 900 and 1800 MHz Band Auction*

- ComReg set a spectrum cap for the 1800 MHz band given the reason that if a single bidder (whether an incumbent or an entrant) were to acquire the rights to the entire 1800 MHz band this would potentially adversely affect downstream competition in the longer term. Therefore it was important to place a limit on the amount of 1800 MHz spectrum that any one bidder can obtain in the competition.
- ComReg's view in setting a spectrum cap for the 1800 MHz band determined that:
  - A multi-band combined spectrum cap was appropriate including the spectrum cap previously set for spectrum below 1.0 GHz of 2x20 MHz.
  - ComReg set a combined limit of 2 x 50 MHz on the total amount of spectrum any one bidder could be awarded in the joint auction striking a balance between providing sufficient 1800 MHz spectrum to allow an operator to provide a differentiated high bandwidth service, while also ensuring that 2 x 25 MHz of 1800 MHz spectrum is available to other bidders if one bidder was to be awarded the maximum permitted under this cap.

Source: ComReg, Inclusion of the 1800 MHz band in the 800 and 900 MHz Auction, Document 10/105, December 15, 2010.

Thank you