Spectrum Management: Strategic Planning and Policies for Wireless Innovation

Training summary

Place: Algeria

Date: 1-5 Dec. 2019

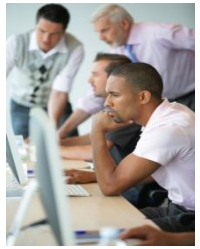
Presenter : Eng. Tamer Sayed

Introduction to Session 1

- We will learn about the international and national frameworks in which policy formulation takes place, the trends and reform initiatives which have influenced policy and the principles and the objectives that guide policy decisions as well as the tools used to capture and evaluate information which goes into the development of spectrum policies.
- One of main products of putting spectrum policy into action are Spectrum Strategic Plans, in various forms.

Session Objectives

- Distinguishing between spectrum policy and strategic planning for spectrum;
- Learning about Spectrum policies development, generally and within spectrum management;
- Learning what are the main influences on policy development and its implementation.



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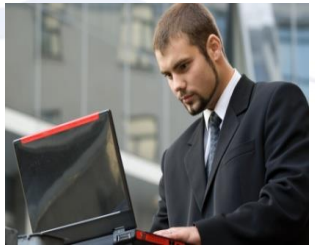


Module Topics

- Spectrum Policies and Strategic Plans
- Spectrum Policy Formulation Framework and Processes, Components and Constituents
- Policy influences - cultural, legal, government traditions).
- Introduction to Planning at the International level
- Introduction to Spectrum Policy and Planning at the national level - who is responsible for Spectrum Policy?
- Key Policy Questions and Planning Examples.

Definition – What is Policy?

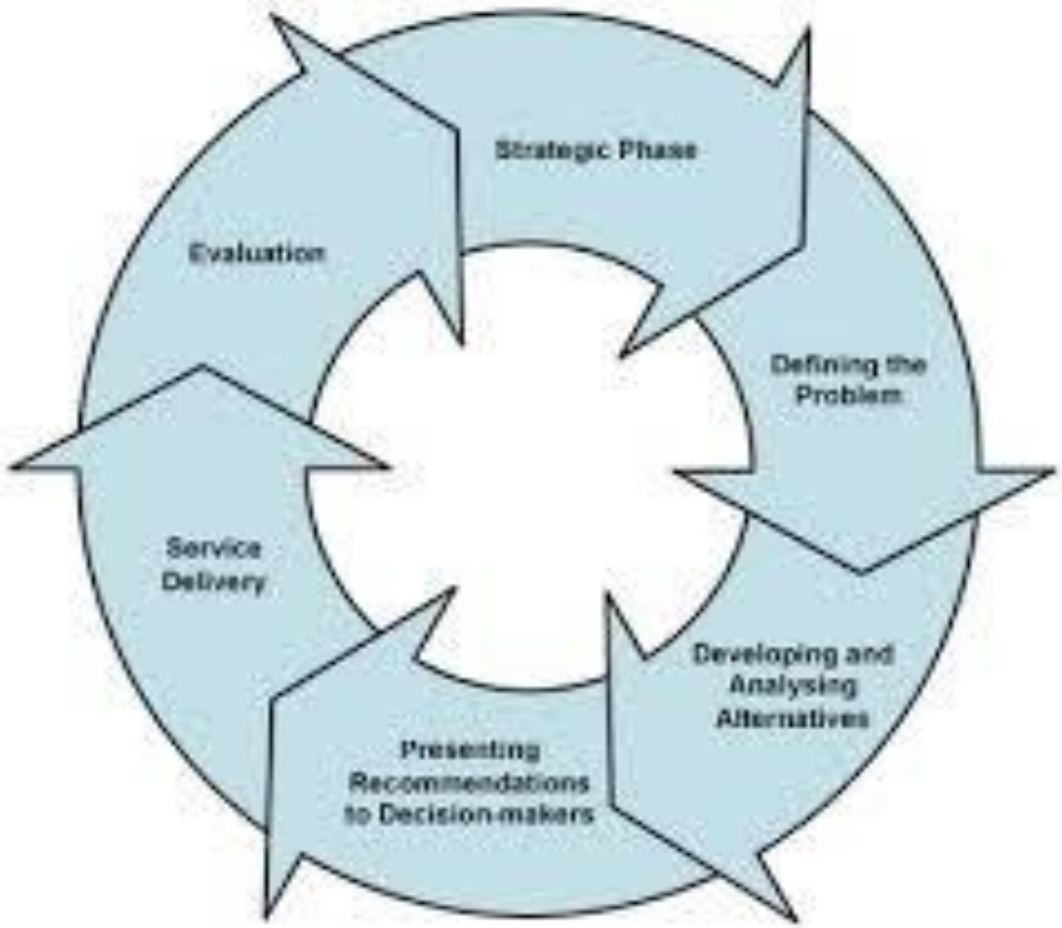
- Policy can be defined as a set of ideas and proposals for action culminating in a government decision.
- To study policy, therefore, is to study how decisions are made.
  - Burch (1979, p108) distinguishes between two main types of government decisions:
    - Rules, regulations and public pronouncements (e.g. Acts of Parliament, Orders in Council)
    - Public expenditure and its distribution

Policy differs from Strategic Planning

Policy Statement: A clear statement of intent which guides and constrains subsequent decision-making and actions (choices), as well can delegate authority and tasks.

Strategic Plan: A plan or plans involving choices about deployment of resources – where, how, when. It is equally important to say what won't be done as will be done.

The Policy Cycle



Diversity in Policies and Plans

- There are widely divergent approaches and outcomes to policy and plans and this applies to Spectrum Policy and Plans, as well.
  - We see this with different allocations for IMT spectrum, the size and use of the digital dividend and timing for digital switchover, uses of auctions, spectrum prices and refarming practices. We will review for a few moments the underlying reasons which are ultimately important when it comes to developing and implementing policy.
- The main reasons are differences in legal systems and resulting legal framework and regulatory design, cultural and social factors

International Framework

- ITU World Radio Conferences
- World Trade Organization – Basic Agreement on Telecommunications
- Treaties, Bilateral Agreements governing management and use such as ITU Radio Regulations, CRASA agreements, Memorandum of Agreements on Coordination and Resource Sharing

National Policy Framework

- Primary Legislation:
  - Usually the Telecommunications Law
  - Sometimes there is Radiocommunications Law
- Secondary Legislation and Regulation:
  - Regulations governing authorizations, compliance, fee schedule, pricing, renewal, penalties.
  - Broadcast, Competition, Foreign Direct Investment, Privacy Legislation.
- Existing Rules of Procedures For resolving Arbitration and Disputes
- Other agencies involved in the licensing process:
  - Ministry of Health for emission standards.
  - Ministry of Commerce and Industry (consumer affaires)
  - Municipalities on land-use and rights of way.

Spectrum Planning – Report ITU-R SM.2015

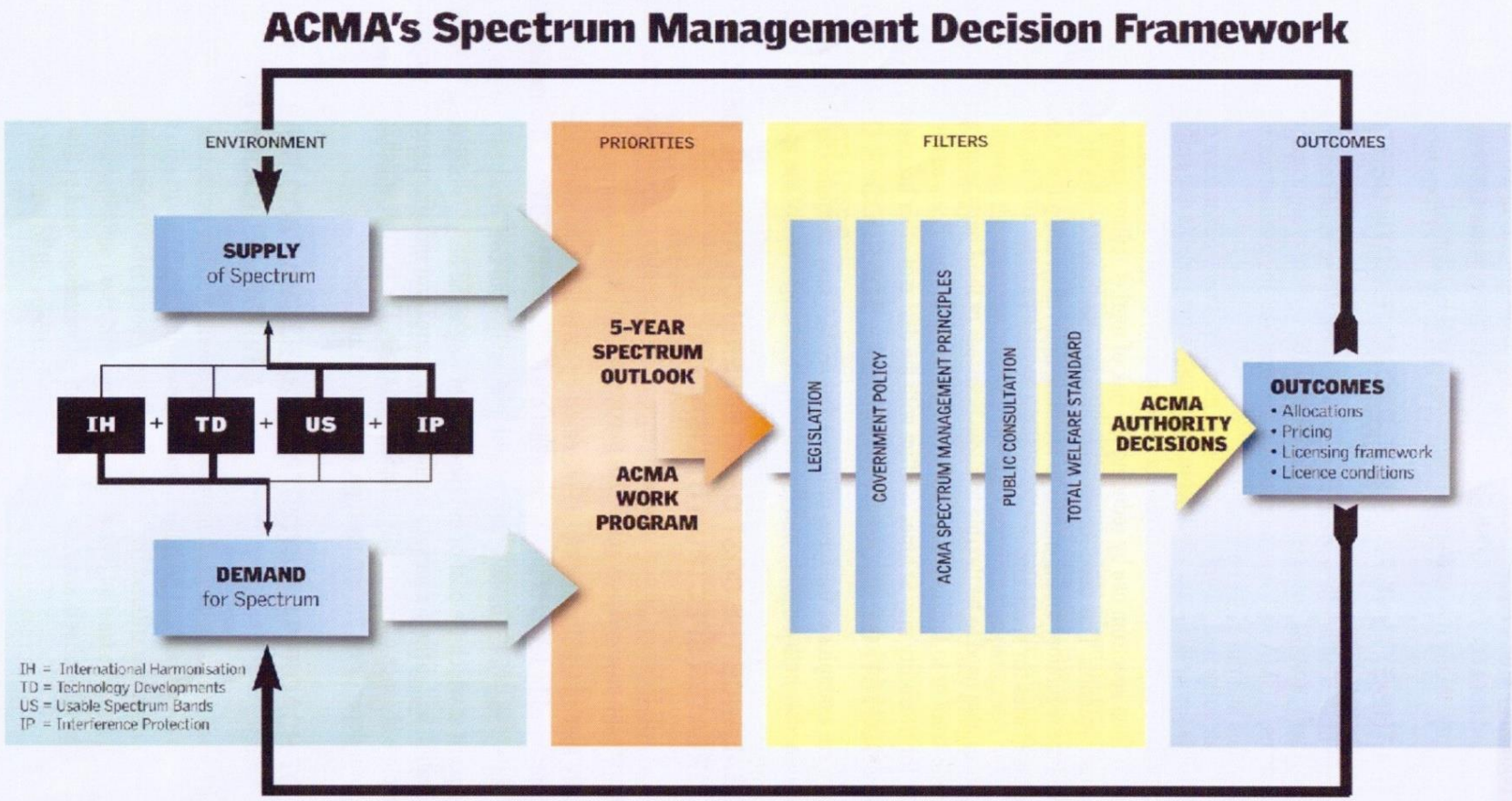
- Methods for Determining National LONG-TERM STRATEGIES for Spectrum Utilization
  - Four Phases are described managed by group within the Spectrum Management Organization responsible for planning:
    - Determining spectrum requirement
    - Determining spectrum availability
    - Considering spectrum planning options – band planning
    - Spectrum planning implementation
  - Spectrum planning is an iterative and consultative process

Spectrum Master Plans

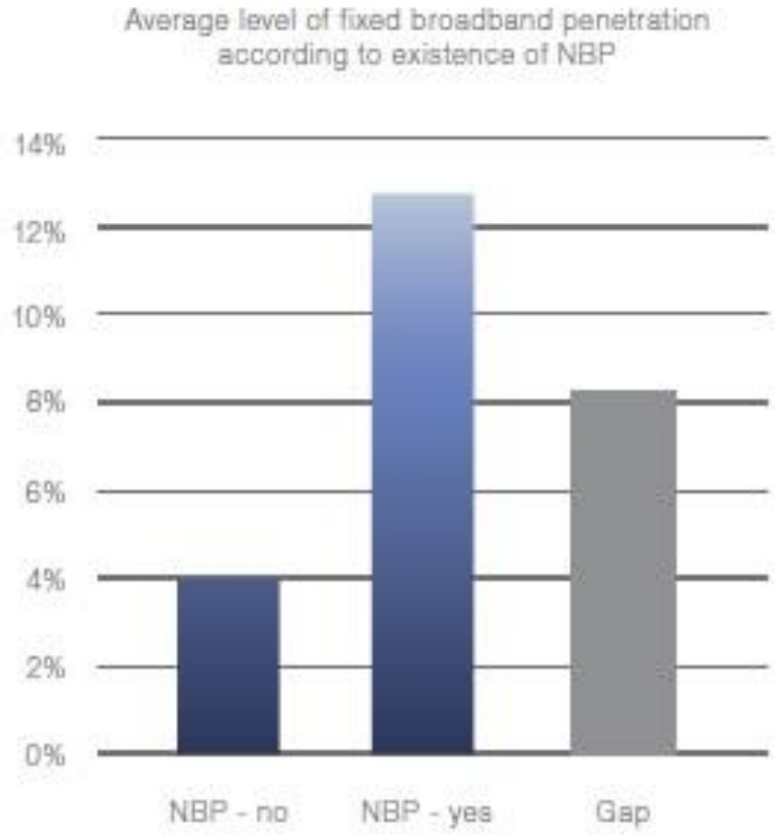
- Regulators in some countries – not many - publish Spectrum Master Plans. One of the first to publish a plan on a continuous basis is Infocomm Development Agency (IDA) in Singapore.
- Others include: the FCC/NTIA, NBTC in Thailand, Ofcom in the UK which publishes two related documents:
  - Telecommunications Market Sector Outlook
  - Spectrum Outlook.
- Master Plans vary in approach:
  - Policy and Strategy oriented
  - Service and band oriented.

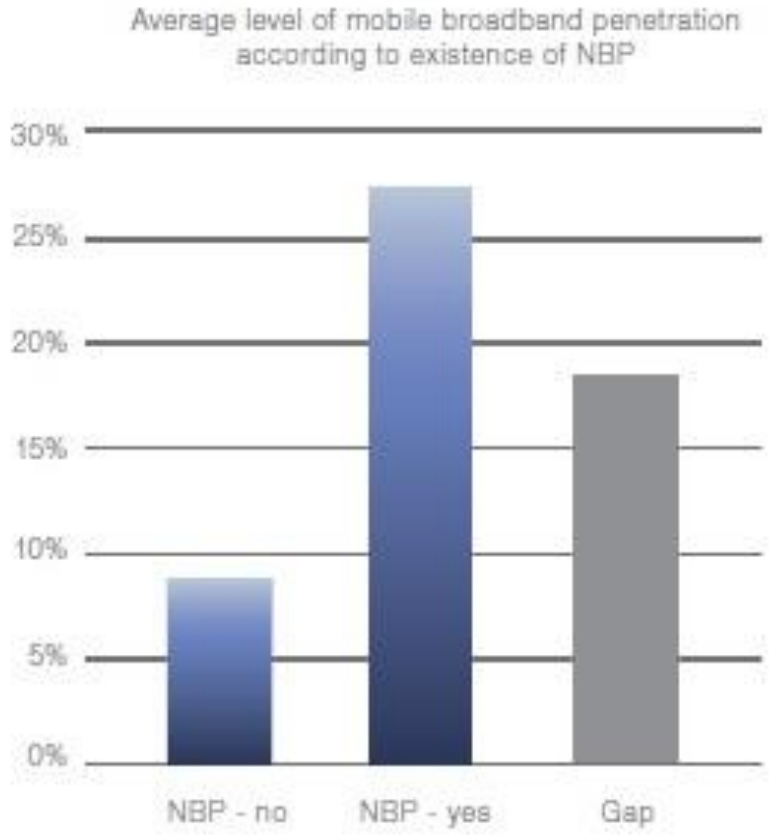
ACMA Decision Making Framework

Figure 1 ACMA Spectrum management decision framework



Positive Impact of Broadband Planning on Penetration





Source: ITU World Telecommunication/ICT Regulatory Database.

Designing Effective Broadband Plans

Liberalization

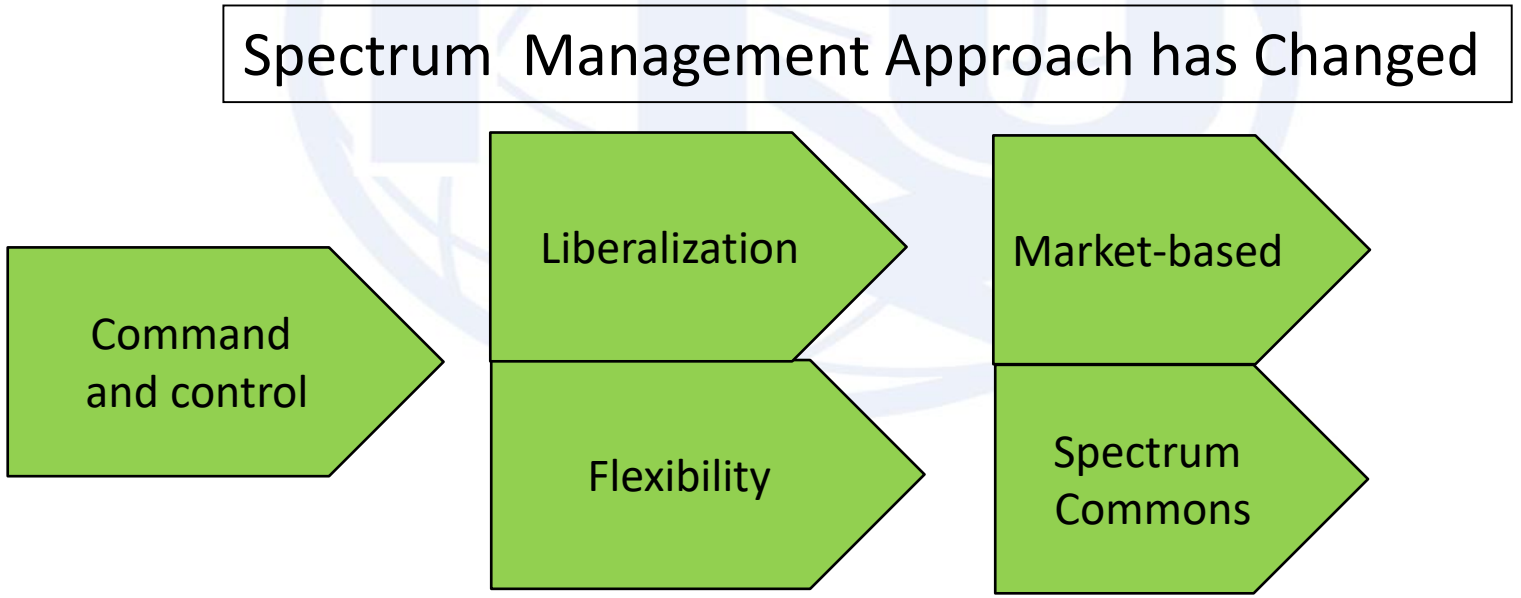
- As discussed in more details in other modules there has been a move away from relying predominantly on the traditional planning and allocation model, most notably in countries where demand for radio spectrum access is rising fast.
- The hallmarks of contemporary spectrum management have become *liberalization* and *flexibility*.
- Liberalization refers to managing spectrum through market-based mechanisms.
- This covers issues ranging from competitive assignments (such as auctions) to secondary trading.
- This approach delegates as much spectrum “management” as possible to participants in the marketplace. Spectrum management agencies in liberalized settings perform the role of “light-handed” regulators.

Flexibility

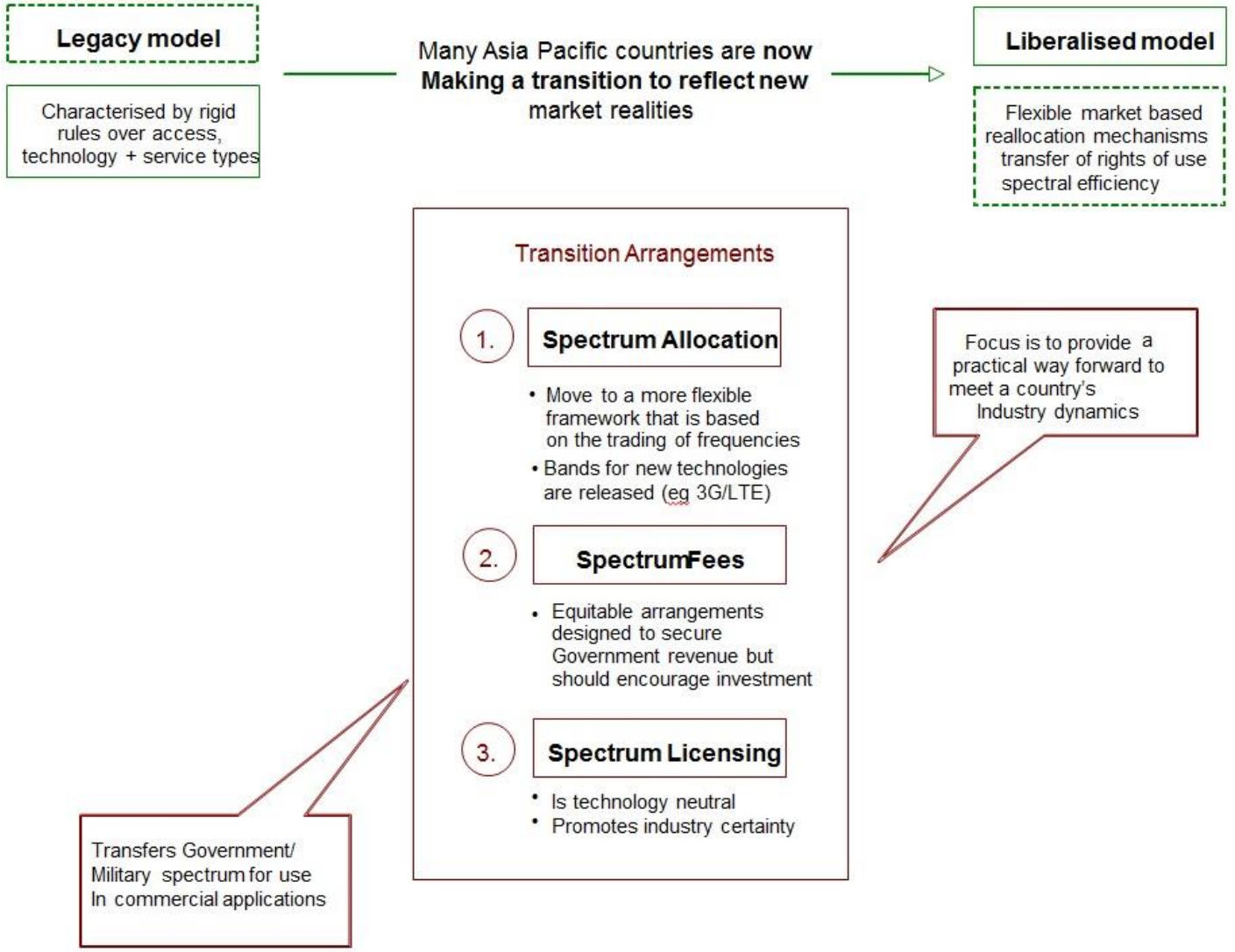
- Flexibility involves relaxing constraints and prescriptions that specify particular uses and technologies for specific spectrum bands. This might mean just setting technical rules to preclude interference, and then letting licensees choose whatever technologies meet those criteria. But it can also mean setting up spectrum "commons" or managed-sharing bands, along with licence-exempt usage.
  - Very few countries have opened up large parts of the spectrum as pure commons bands. But many allow licence-exempt use of certain bands for low-power devices. Several countries have embarked on a path of considerable innovative activity and regulatory actions designed to promote flexibility and unlicensed use.
- The benefits of liberalization are enhanced by greater flexibility, and the benefits of flexibility reach their full potential within a liberalized environment. So liberalization and flexibility are closely intertwined.

Transition to more flexible access and use

- Maximizing consumer value requires more flexible spectrum management
- Technology changes such as Dynamic Spectrum Access will force more flexible approach to allocation and assignment



Transition to market based liberalized spectrum management models



Source: *Windsor Place Consulting, 2010 from Guidelines for the preparation of national wireless broadband master plans for the Asia Pacific region, ITU-R, 2013*

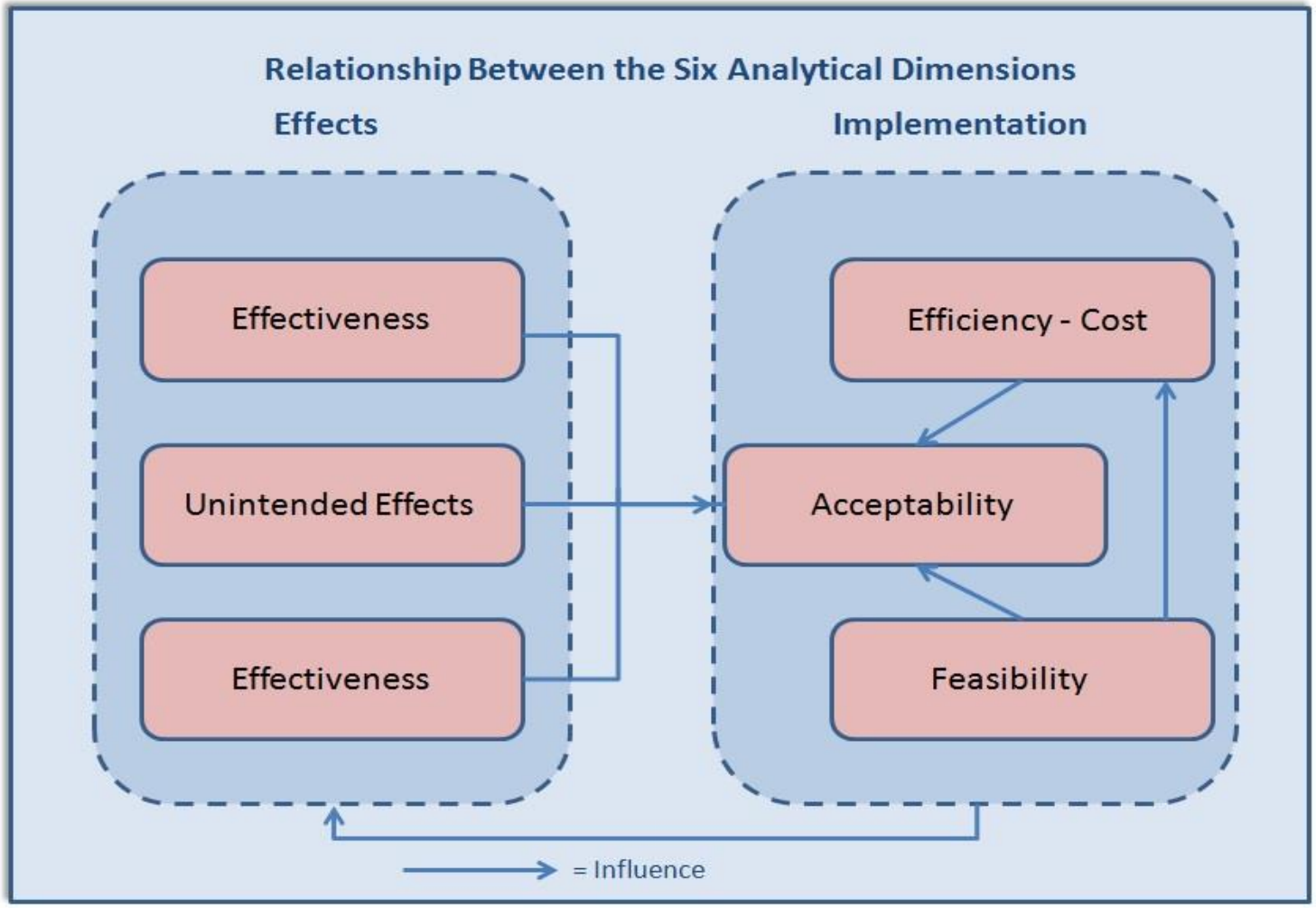
Current Best Practice

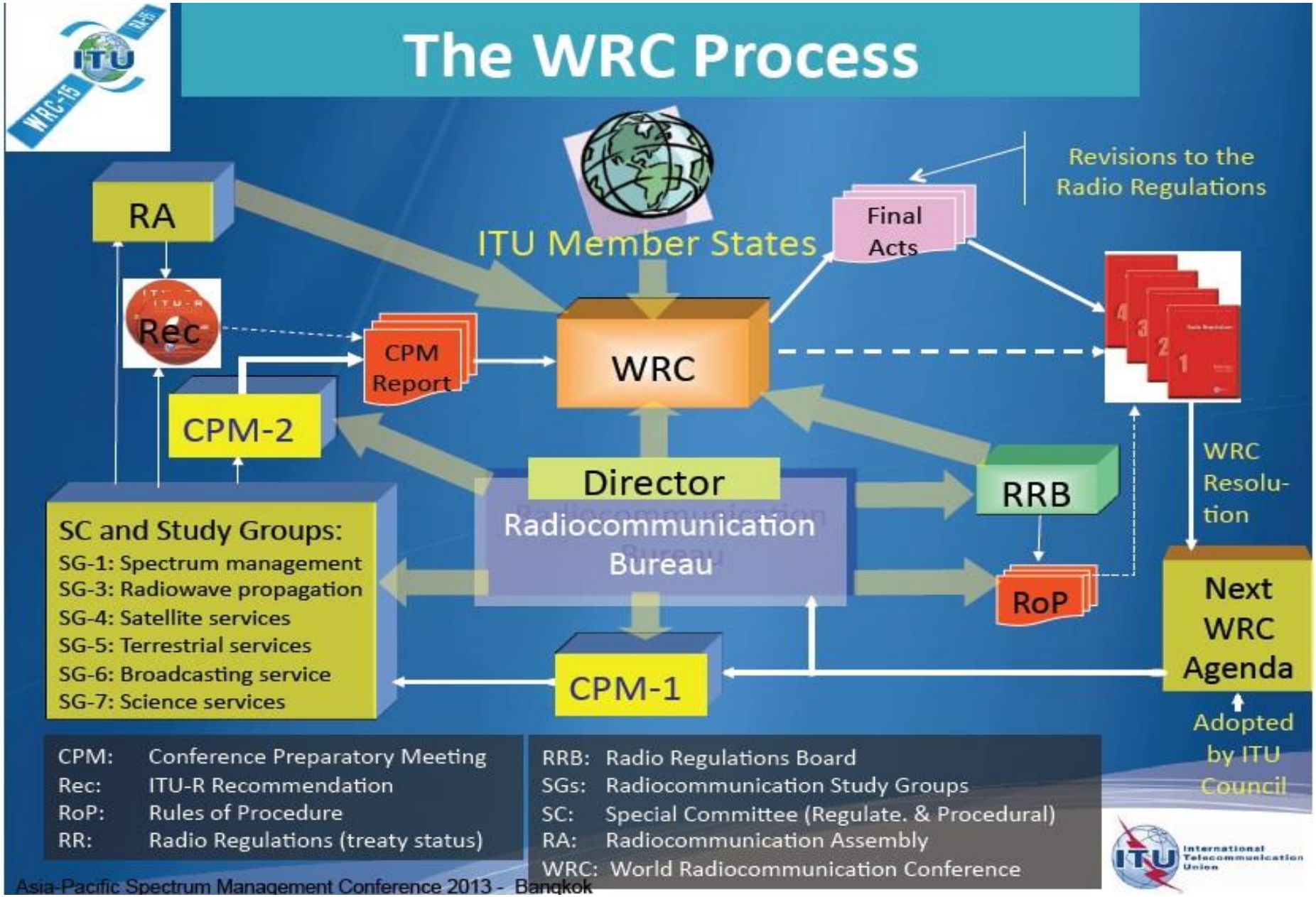
- Most often spectrum policy practices include:
  - Spectrum policy reviews where policies are compared with spectrum policies that have typically been in force for sometime by leading regulators. The comparison may be done to examine similarities, various options, and expected and actual outcomes;
  - Existing policies are reviewed and examined through analysis most often incorporating consultations with determine weaknesses and areas for improvement.
- Ideally the review, analysis and evaluation is evidenced based and includes a thorough and comprehensive examination of issues.
  - Issues related to the implementation of the policy are identified so that the chances of (future) success can be assessed and implementation properly planned.

Suggested Approach – Two Pronged Analysis

	Effectiveness	What effects does the policy have on the target spectrum management goal?
Effects	Unintended effects	What are the unintended effects of this policy?
	Equity	What are the effects of the policy on different groups?
	Efficiency - cost	What are the financial costs of the policy and do benefits outweigh costs?
Implementation	Feasibility	Is the policy technically feasible and within the capabilities of the various actors?
	Acceptability	Do the relevant stakeholders view the policy as acceptable?

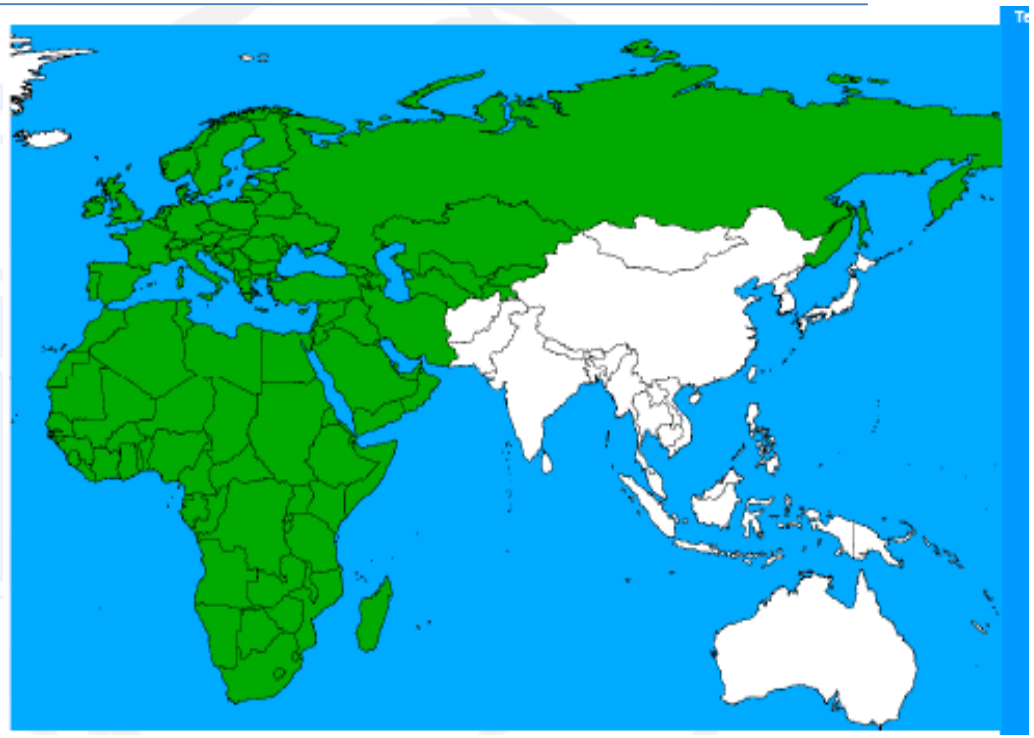
Relationship Between the Six Analytical Dimensions




The WRC Process
RA
Rec
CPM-2
CPM Report
ITU Member States
WRC
Final Acts
Revisions to the Radio Regulations
Director
Radiocommunication Bureau
RRB
RoP
WRC Resolu-tion
Next WRC Agenda
Adopted by ITU Council
CPM-1
SC and Study Groups:
SG-1: Spectrum management
SG-3: Radiowave propagation
SG-4: Satellite services
SG-5: Terrestrial services
SG-6: Broadcasting service
SG-7: Science services
CPM: Conference Preparatory Meeting
Rec: ITU-R Recommendation
RoP: Rules of Procedure
RR: Radio Regulations (treaty status)
RRB: Radio Regulations Board
SGs: Radiocommunication Study Groups
SC: Special Committee (Regulate. & Procedural)
RA: Radiocommunication Assembly
WRC: World Radiocommunication Conference
International Telecommunication Union

Examples of Long Rang Planning Processes

- The Geneva 2006 Frequency Plan (GE06) Agreement - new broadcast frequency plan for Europe, Africa and many parts of Asia. After 17 June 2015 analogue services no longer protected and frequencies can be assigned for transmission of domestic digital services. GE06 digital plan transition period (between 17 June 2006 and 17 June 2015) requires prior agreement of neighbouring countries that may be affected.



DVB-T	Fourth Iteration	Third iteration	Second Iteration	First Iteration
Total	56533	55876	60227	62692
Assigned	55409	52229	51222	46333
% assigned	98.0	93.5	85.0	73.9

Demand Forecast Objectives

- The principal objective of a demand study is to develop a forecast of the future demand for radio spectrum with some or all of the forecasts incorporated into the Spectrum Master Plan and in specific band plans where the goal is to ensure there is sufficient spectrum available to meet demand;
- Demand forecasts are usually developed for several timeframes: short-range (2-3 years), medium range (4-7 years) and long range (8 to 20 years) with particular focus on short range requirements.

Approach using Quantitative and Qualitative Analysis

- For most commercial services the linkage between infrastructure, technology, traffic growth, and spectrum demand is reasonably well understood and has been modelled.
- Non-commercial services are more difficult and lend themselves to qualitative analysis.
  - To help reduce uncertainty several growth scenarios can be developed: low, expected, hyper-growth for example.
- Other services such as mobile radio, aeronautical and maritime, and public safety are not readily forecast able given usually to a lack of reliable data. For these services, forecasts are typically based on qualitative analysis using ITU documents and references, WRC planning efforts, planning activities completed by other regulators.

Qualitative and Quantitative Forecast Models

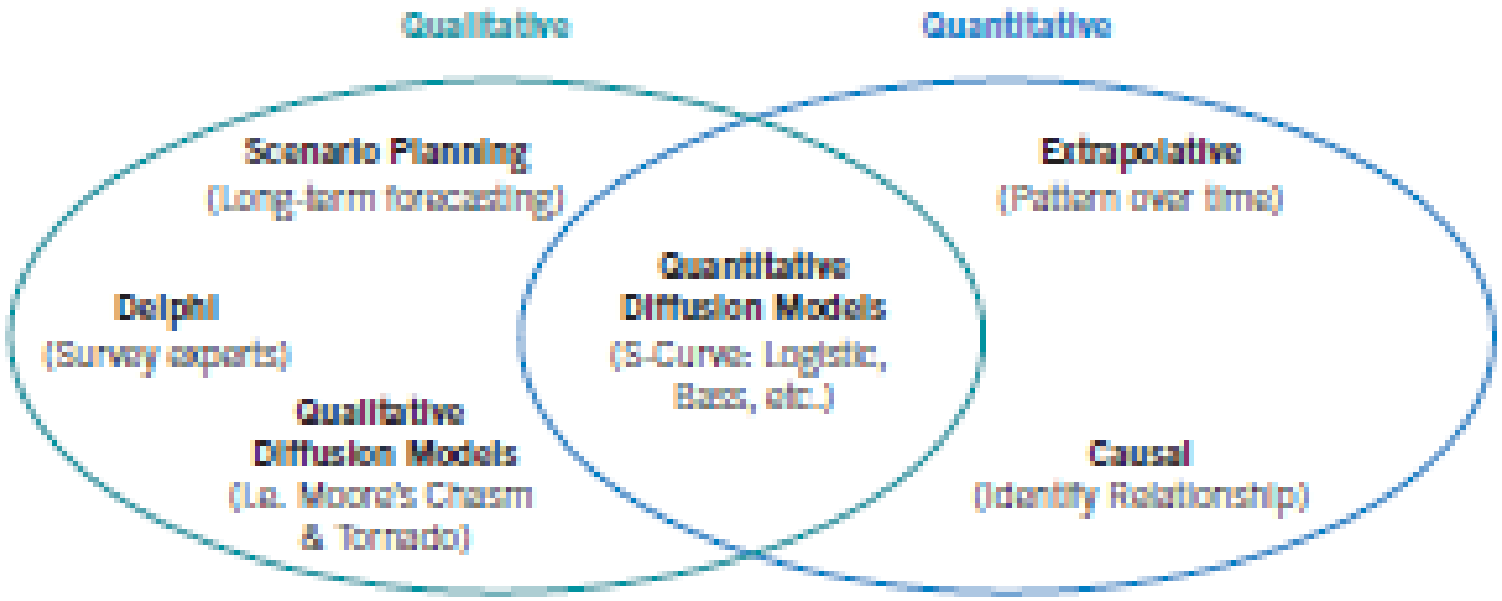


Figure 1. Forecasting techniques

Source: Tellabs Inc.

Session 9 – Stage I Exercise

Note: Stage 2 for the Case Study exercise occurs with Session 14 and builds on the information provided in Session 9.

- The Minister has requested that CommCo prepare a report identifying the issues facing the ICM Sector and which provides advice to the Minister on the necessary steps and required actions to be taken in support of the Five Year Strategic Plan. The report should first appear as an outline addressing the following in point form:
- The brief report should include as a first step and outline of the following:
  - What are the key activities to be undertaken?
  - What information is needed?
  - Who should be involved?
  - What issues can be anticipated?
  - What policies are likely to be needed?

Market-based Spectrum Valuation

- Economic Modelling
  - The objective of economic modelling is to assess spectrum value from the perspective of its contribution to the national economy. This is important because we are interested in increasing economic contribution which translates into increasing value
- Business Case Valuation
  - A business-based valuation model assesses the value of spectrum from a commercial perspective. The objectives of both regulator and operator converge at the point when the spectrum is optimally priced. Estimating the value of spectrum involves analysis of the impact on profits of changes in spectrum fees over the model period. Modelling what happens to estimates of profits across the sector in the case where there are no spectrum fees is revealing and can be analyzed in comparison to current fee levels.
- Opportunity Cost - AIP

Key Features of Benchmarked 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 means removing, or at least reducing, these restrictions. Introducing liberalization and flexibility in parallel facilitates the migration of spectrum to more efficient uses.
  - This boosts efficiency, furthers innovation and makes competition more intense.
- However, in so doing, as always it must be considered that 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 improving 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.

Key Features of Benchmarked Allocation and Assignment Processes

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.

Key Features of Benchmarked Allocation and Assignment Processes

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 have been decided upon at WRC-2000 and WRC-2007 for cellular and broadband services. The benchmarked regulators had already conducted comprehensive planning efforts for digital switch-over and the use of the digital dividend and all of the countries involved have completed digital switch-over and assigned new services to digital dividend spectrum using either auction or competitive bid processes.
- 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.

Key Features of Benchmarked Allocation and Assignment Processes

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.

Key Features of Benchmarked Allocation and Assignment Processes

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

Licensing practices: the changing framework

Service Specific Licensing

All other aspects of VoIP Regulation should be examined in the context of prevalent licensing regime

VoIP and traditional licensing practices

	Fixed Service Licenses	Mobile Service Licenses	Internet / Value Added Service Providers
Market Entry	Restricted / Open	Limited	Generally unlimited
Entry fees	Medium to Low	High (incl. Spectrum)	Low
Annual fees	Yes	Yes	No
Numbering	E.164	E.164	NA
Terminal equipment	Fixed Phone / PC	Mobile phone	PC / IP enabled devices

Technology Neutral Licensing (Spectrum ???)

Service Neutral Licensing

Approach 1: General Authorization e.g. European Union

- A general authorization instead of individual licenses . All electronic communication services and networks will be covered under a general authorization regime, with individual rights-of-use being confined to the assignment of radio frequencies and numbers only.
- A maximum set of conditions to be attached to general authorizations . The Directive introduces a strict separation between:
  - conditions under general law, applicable to all undertakings in all economic sectors;
  - conditions under the general authorization applicable to all telecommunication services and networks; and
  - conditions attached to rights of use for radio frequencies and numbers.

Approach 2: Facilities / Service Based e.g. Singapore

Two classes of licenses in Singapore:

Facilities-based operator. (FBO) licences

- In general, operators that install or operate any kind of network infrastructure require an FBO license. This includes international and domestic wireless transmission or switching facilities; public cellular mobile networks; paging networks; public mobile data and trunked radio services; and local multipoint distribution services. Wireless services are licensed separately, pursuant to spectrum-management policies

Service-based operator. (SBO) licences.

- **Individual SBO licenses** are required for international simple resale; resale of leased circuits; virtual private network services; managed data network services; Internet access; Internet exchange services; mobile virtual networks; and live audio-text services.
- **SBO class licenses** cover simple resale of public switched telephony; international call-back services; Internet-based voice or data services; and international calling card services. Class licensees may offer their services without obtaining a specific authorization, but they are subject to all relevant codes of practice and service-quality standards.

Source: IDA (http://www.ida.gov.sg/)

Approach 3: Converged Licensing e.g. Malaysia

- Network Facility Providers (NFPs), which include owners of satellite earth stations, fibre optic cables, communications lines and exchanges, radio communication and transmission equipment, mobile communication base stations and broadcasting towers and equipment;
- Network Service Providers (NSPs) for entities that provide basic connectivity and bandwidth to support a variety of applications;
- Application Service Providers (ASPs) for licensees that provide particular functions such as voice services, data services, Internet access services, IP telephony and other transmission services; and
- Content Applications Service Providers (CASPs): A special subset of applications service providers . including traditional broadcast services and services such as online publishing and information services.
  - The services falling under these categories are further subdivided into individual, class and exempt services. A total of 56 categories of licenced services and 24 categories of licensed facilities were reorganized into the four generic licensing classifications established by the CMA.

Source: MCMC http://www.mcmc.gov.my

Approach 4: Unified Access Licensing - India

- In October 2003, India adopted an Universal Access Service Licensing regime as a first step towards Unified Licensing
  - Technology and Service Neutral Regime
  - Long distance, Internet Services etc. licensed separately
  - Within a service area, license does not distinguish between types of access e.g. fixed, mobile, WLL
  - Basic Service operators had to pay a fees to enter UASL at levels of cellular mobile
  - 2G mobile spectrum (limited quantity) still a part of the license
  - Unified Access License considered as an intermediate step to Unified License.

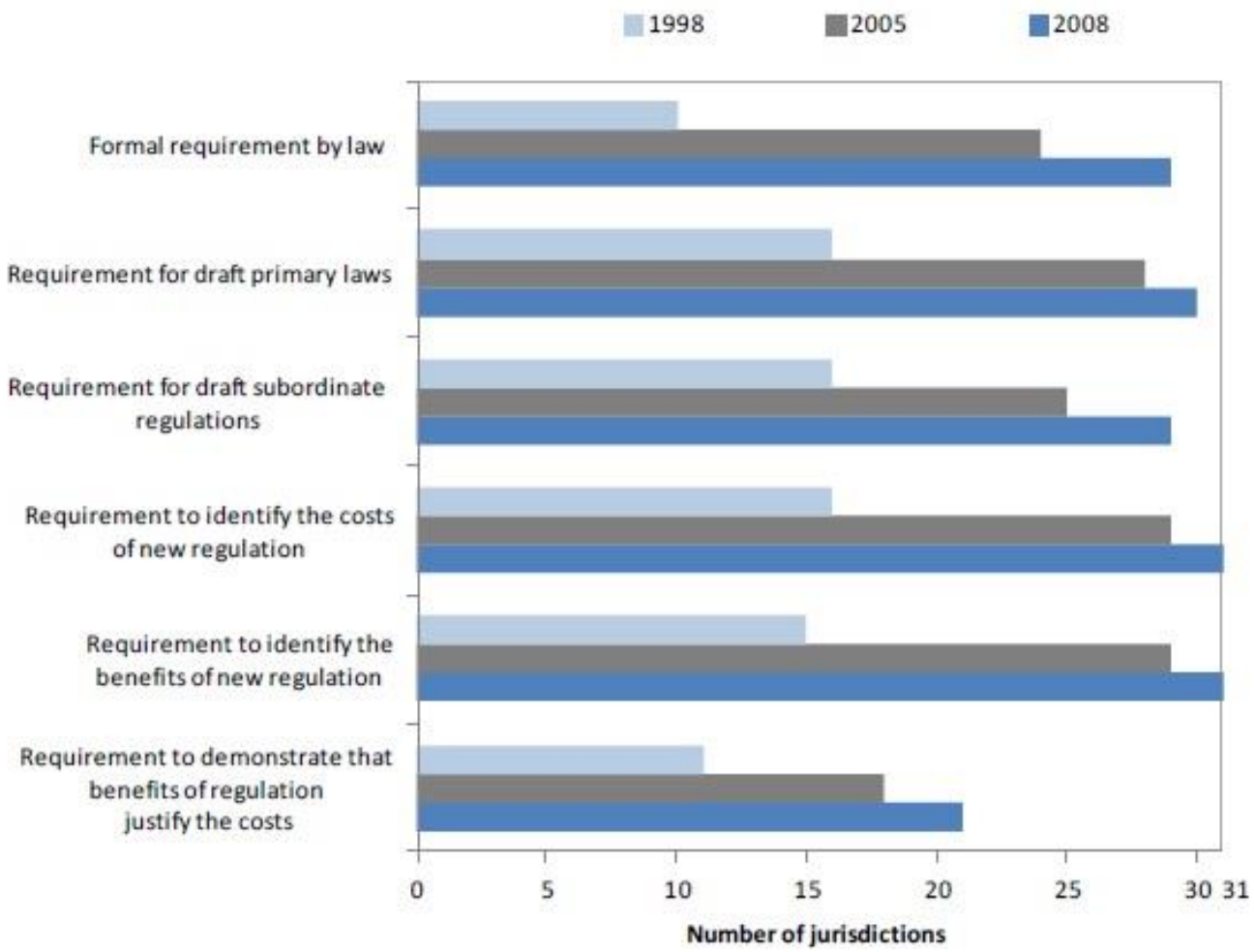
Regulatory Impact Analysis (RIA)

- Regulatory Impact Analysis (RIA) is a systemic approach to critically assessing the positive and negative effects of proposed and existing regulations and non-regulatory alternatives.
- Regulatory Impact Analysis (RIA) is valuable as a collaborative multidisciplinary approach consisting of natural and social assessments, legal and policy considerations, communications, public consultation, economic impacts, and decision analysis tools.
- RIA has been strengthened through the use of evidence-based tools for policy and regulatory analysis including techniques such as risk assessment, benefit-cost analysis, cost-effectiveness analysis and stakeholder engagement processes.

Key Parts to RIA

- The key parts that are critical for the successful completion of a RIA include:
  - Leadership through-out the organization endorsing and supporting stages of development of an RIA programme.
  - Leadership is characterized by pragmatism and the ability to communicate within the NRA, the private sector and the broad public,
  - Inclusive of divergent viewpoints;
  - Excellent project management plans and capabilities
  - Expertise and technical skills in understanding the state-of-the-art in respective disciplines - spectrum planning, engineering, etc.
  - An ability and willingness to draw upon work available from others in the private sector, academia and governments, domestically and internationally.

Recent Trends in RIA Implementation



Source: Requirements for RIA at central government level (1998 – 2005 – 2008), OECD, 2013

Spectrum Caps

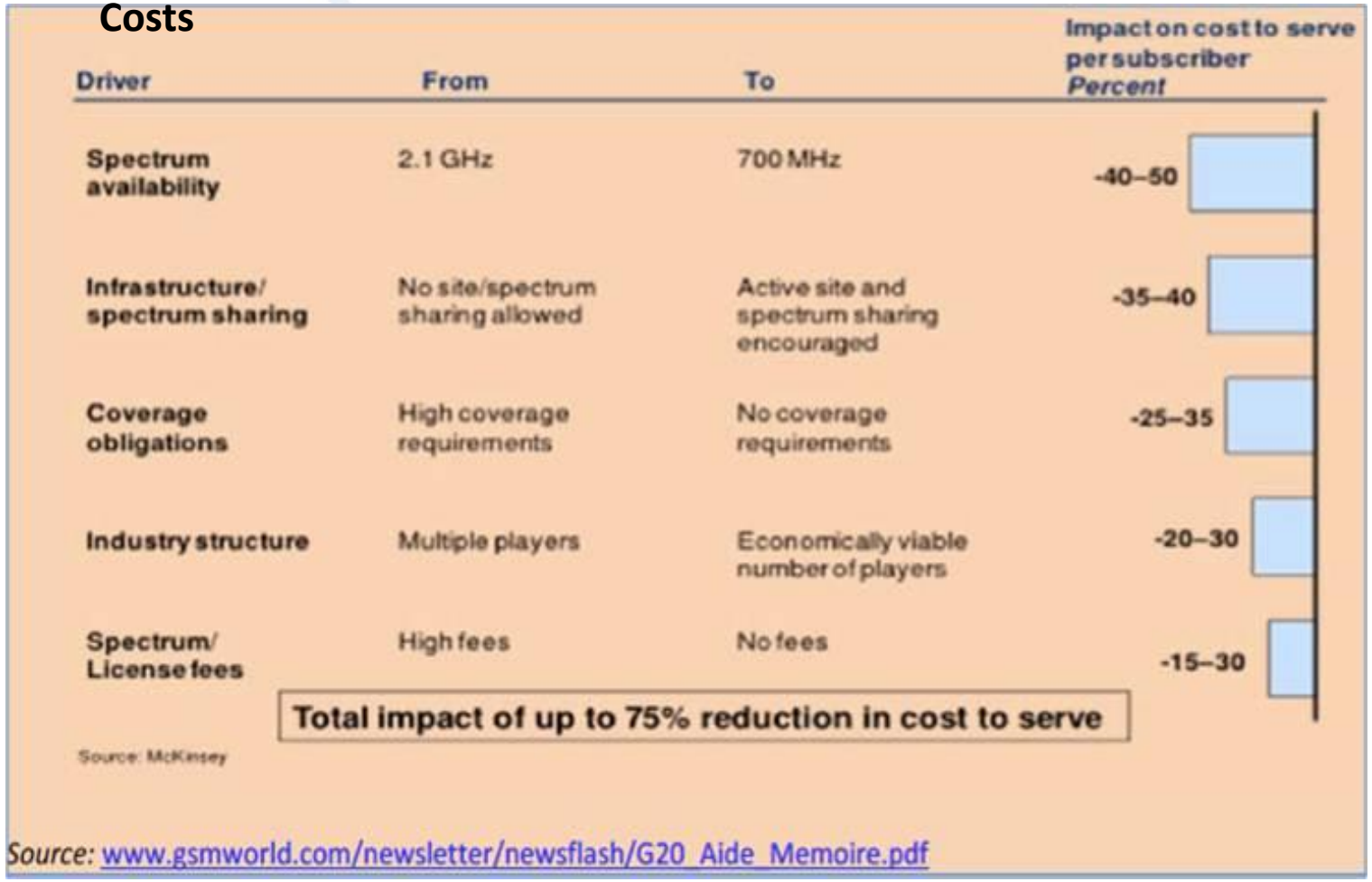
- Spectrum caps have been introduced in several countries as an ex ante means to implement competition policy in mobile communications markets. They have been applied to help ensure that no single mobile operator, or a very small number, can acquire all or almost all spectrum on offer either at the time of initial spectrum awards or in subsequent mergers of, or deals between operators.
- The goal is to prevent operators from gaining positions through large holdings of a scarce resource, i.e. spectrum, which they might then exploit anti-competitively so as to cause market failures with deleterious effects for customers and overall economic welfare.
- Other means than spectrum caps to ensure entry into the mobile market by multiple operators include issuing:
  - multiple separate licenses;
  - 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.

Types of 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 license, such as a different initial license 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 Policy Focus – Sharing can reduce costs

Impact of Spectrum Management on Mobile Broadband Network Costs



Source: www.gsmworld.com/newsletter/newsflash/G20_Aide_Memoire.pdf

Striking a balance

	Opportunities	Challenges
Command and Control	Centrally managed and planned Low risk of interference	Slow Requires managers to make technology choices Suboptimal efficiency
Market Mechanisms	Promotes efficient usage. Gets spectrum to the users who value it most	Possibility of hoarding Windfall gains Fragmentation
Flexible Use	Potentially efficient use of spectrum Prevents artificial scarcity and high values of spectrum	Perceived increased risk of interference Relatively untested
Sharing	More efficient use of spectrum that is already allocated	Requires some management Potential for interference Fragmentation
Commons	Promotes innovation Lower cost of regulation	Potential interference 'Tragedy' of commons Untested (except for short range applications)

Source: COMREG-Commission for Communication Regulation, 2007

Different mobile infrastructure sharing options are being used

Increasing depth of network sharing from left to right →

Site sharing	Mast sharing	RAN sharing	RAN + Core network sharing	Regional or national roaming
• Operators A and B share the same physical compound but install separate masts, antennas, and BTS/Node B. • The operators may decide to share support equipment, including shelters, power supply and air conditioning.	• A step up from site sharing, operators A and B share the same mast (or other structure such as a rooftop). Each operator installs their own antenna onto the shared mast. • As for site sharing, the operators may also share support equipment.	• Operators A and B share all access network equipment, including the mast, antenna, BTS/Node B, BSC/RNC and possibly also share backhaul to a point of connection with the core networks. • Despite sharing the same hardware, each operator keeps separate 'logical' control over the RAN by using its own software. • Each operator also uses its own assigned spectrum.	• Beyond RAN sharing, operators A and B could also share some or all parts of the core network. • To date the focus of interest for network sharing has concentrated on the access network.	• Agreements allowing users of operator A to roam onto the network of operator B if operator A's network is not present in a particular location. • 2G/2G, 3G/2G or 3G/3G roaming.

Session 14 – Stage II Exercise

- CommCo is to prepare a brief report outlining a recommended approach. The report should consider and describe the following:
  - Key stakeholders and participants;
  - Methodologies for estimating spectrum demand and the supply of spectrum in terms of the types, reliability and sources of information and data;
  - Timeframe for the study period;
  - Consultation processes and communication
- The results of the study shall inform the Ministry and CommCo on what should be the appropriate strategic policies and actions. The study and analysis to be done by CommCo should take into account those bands being considered for IMT including:
  - The second digital dividend band – 512-698 MHz
  - 1400 – 1600 MHz
  - 2700 – 2900 MHz

References for further reading

- Report ITU-R SM.2015 Spectrum Planning - Methods For Determining National Long-Term Strategies For Spectrum Utilization http://www.itu.int/pub/R-REP-SM.2015
- Report ITU-R SM.2093. Guidance on the regulatory framework for national spectrum management
- Recommendation ITU-R SM.1047. National spectrum management

Thank you