



Spectrum Reform

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Singapore
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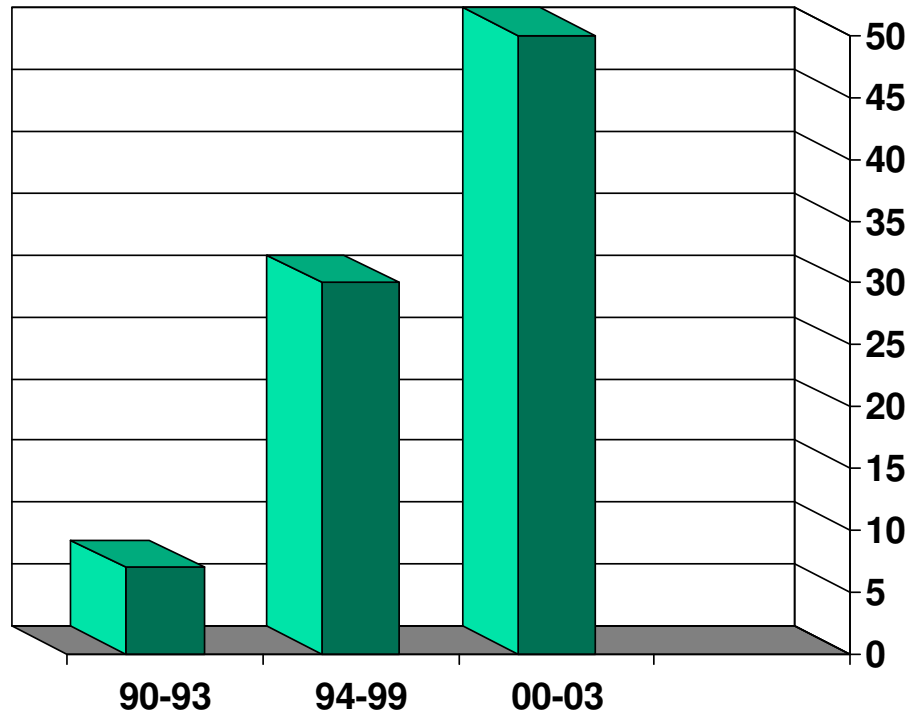


Introduction

- Ronald Coase in 1959 proposed creating property rights in spectrum
- “Tell us Professor, is this all a big joke?”
[Coase wins Nobel Prize in 1991.]
- Spectrum auctions now held in 27 countries.

Growth in mobile, thus critical demand for spectrum

Investment in mobile sector as % of total telecom investment in developing countries

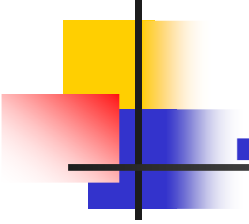


Source: World Bank

Mobile internet access will increase spectrum demand.

How to get more: reallocation, use of higher frequencies, improved technology, increased sharing.

Framework for spectrum decisions

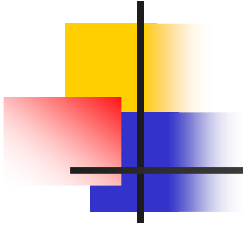
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- **International treaties** set rules and standards for using the spectrum, ITU Table of Frequency Allocations specifies 40 or so service categories (mobile, broadcasting, satellite, public safety, etc.)
 - **Allocation:** each country allocates specific spectrum bands for particular uses, in conformity with ITU Table of Frequency Allocations;
 - **Service Rules:** Technical standards to prevent interference, pricing and fees, build out requirements.
 - **Assignment:** “first-come, first-served,” hearings, lotteries, auctions.
 - **Monitoring and enforcement.**



3 approaches to spectrum policy

1. Traditional spectrum management
 - Government determines uses and users
2. Market-based approaches
 - Market determines uses and users.
 - Flexible, exclusive licenses
3. Unlicensed use (commons)
 - Open entry for approved devices

(1) Traditional approach



- Spectrum is a “limited resource” that must be allocated among uses and users by governments.
- This approach goes back to the 1920s and 1930s.

“Typical” bands for some specific uses

Spectrum uses	Type of service	Typical bands	Total MHz in US
Aeronautical	Radio services for aircraft	Narrow bands upto 16 GHz	
Amateur Radio	Leisure, CB radio	Narrow bands upto 259 GHz	Unlicensed 129 MHz
Broadcasting satellite	Downlink TV, Uplinks to feed content.	12 GHz. Uplinks 14 and 17 GHz.	TV 500 MHz; Radio 25 Mhz
Broadcasting terrestrial	Radio and TV to public	Radio:0.5-26, 88-108 MHz; TV 470-854 MHz	AM/FM radio 21 MHz; TV 402 MHz [294 MHz after 2009]
Fixed wireless	Wireless local loop, broadband internet	2.5, 10.26, and 28 GHz	
Mobile	Voice and data, telephone, text, internet	Standardized bands upto 9.3 GHz	190 MHz [existing] 152 MHz [added in 2007-2008]
Radio navigation	Satellite, meteorology, GPS, maritime	Numerous bands upto 265 GHz	
Military	Large variety of military applications	Across the spectrum	
Public safety	Fire, police, emergency coordination	Several bands 56-395 MHz	



Singapore Spectrum Allocation Chart

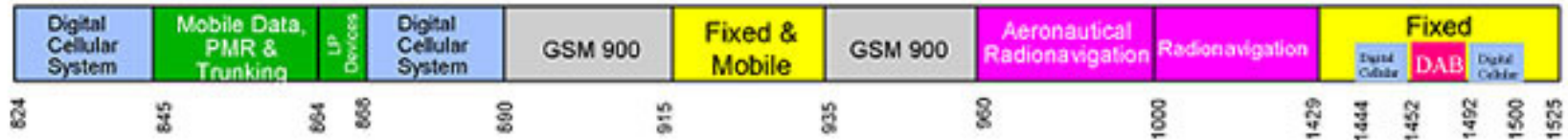
0.009 to 400 MHz



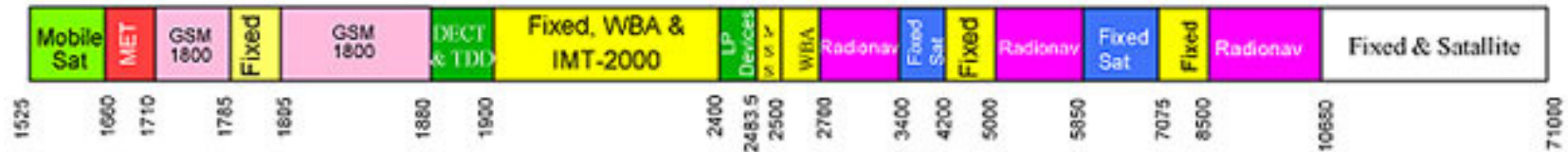
400 to 824 MHz



824 to 1525 MHz



1525 to 71000 MHz





Evaluation of spectrum management

- Proven expertise over decades
- Effective in preventing interference

But...

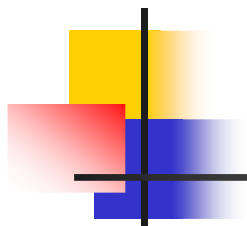
- May not be able to fully respond to new demands
- Inflexibility results in inefficiencies



(2) Spectrum property rights

- Government grants exclusive and transferable rights to users to use specific frequencies
- Users may sell, lease, divide or aggregate spectrum
- Rules to prevent harmful interference

Property rights in practice

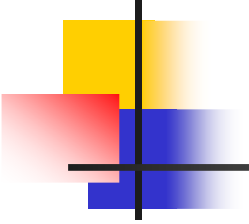


Guatemala (1996) adopted “rights regime” in early stages of privatization and liberalization.

The result:

- more spectrum available to mobile carriers;
- More competition between carriers;
- Lower retail prices for phone service;
- Increase in phone service output.

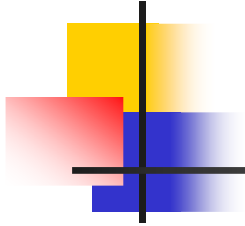
Evaluation of spectrum property rights

- 
-
- Creates incentives for efficient use
 - Enhances transparency and reduces corruption
 - Reduces regulatory burden

But...

- Only if many traders
- Potential conflict with public policies, e.g., revenues, windfalls, service obligations
- WRC allocations may limit scope of reform

(3) Commons



- Spectrum is made available to all users with approved devices
- Technical standards to limit interference
- Service flexibility



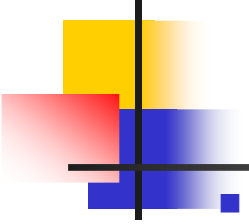
Evaluation of spectrum commons

- Lowers entry barriers, permits innovation
- Encourages use of spectrum-efficient technologies?

But...

- Risk that commons will be overused
- Commons may not be as attractive for investment as exclusive rights
- Enforcement issues, e.g., too many devices

Summary of issues for reform

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- Spectrum for new services given to only one provider, creating artificial scarcity and higher prices
 - Large blocks of spectrum allocated for public or military
 - Unclear rules lead to political interference and corruption
 - Cross-border interference issues
 - Conflict in government role: new services or revenues
 - Failure to make detailed allocations in national frequency plans

Source: Wellenius and Neto (2008)

Regulatory environment for spectrum in select Asian countries



Pakistan:

- Scored highest among the six countries in the survey.
- Law requires Frequency Allocation Board to issue licenses in 30 days.
- In 2004-5, 103 licenses issued for Wireless Local Loop and Value Added Services using radio frequencies.

■ **Thailand:**

- Law is not clear about how to allocate frequencies. Private operators are uncomfortable with the regulatory uncertainty.
- Licenses are non transferable. In past, first-come, first-served. But mobile allocation was so large that some bandwidth was resold to 3d parties.

■ **Sri Lanka**

- Survey scores higher for mobile than fixed, but complaints exist about ad hoc frequency allocation.

Source: LIRNE-Asia Telecom Regulatory Environment Assessment

(cont'd)



Philippines

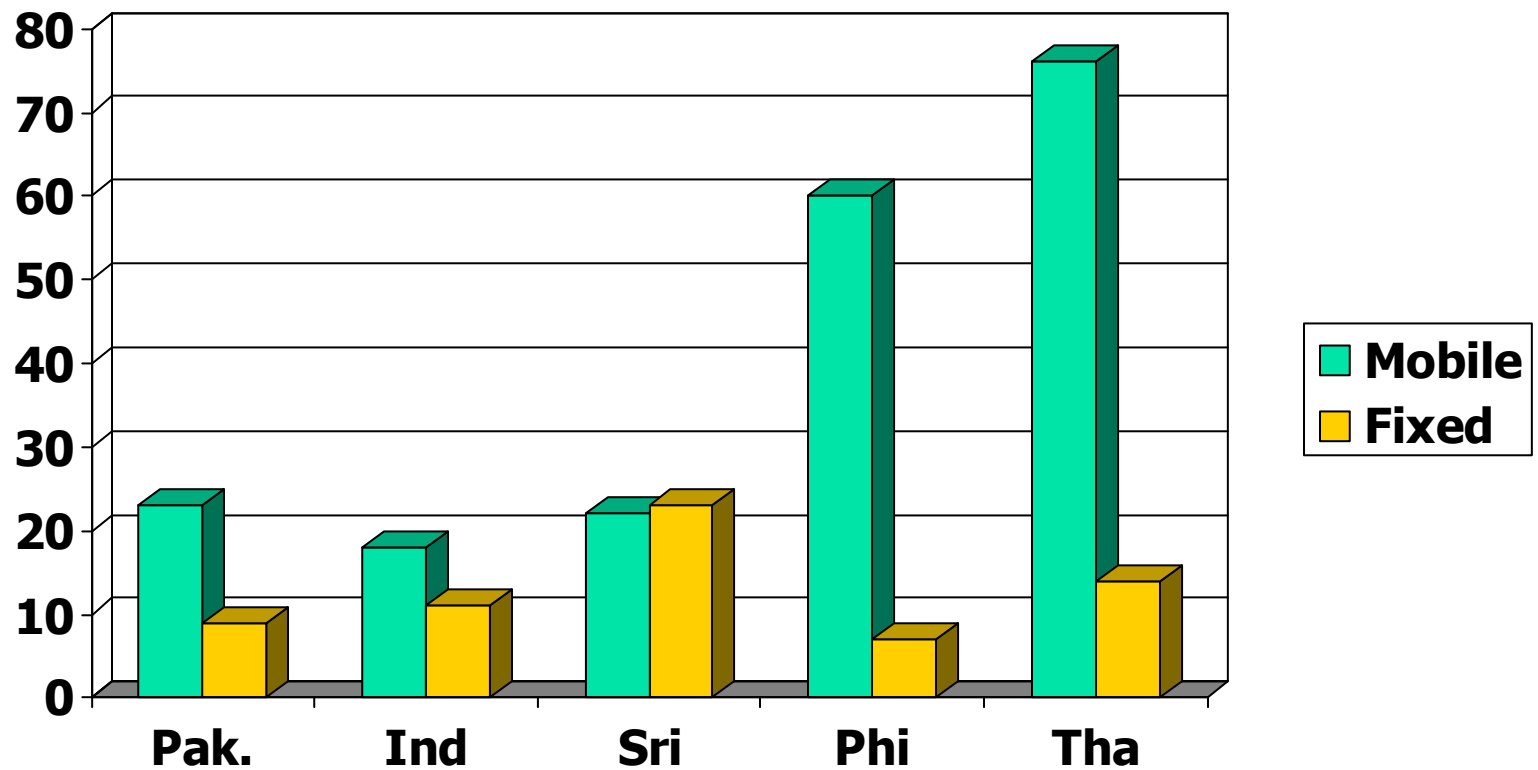
- In 2005, 3G allocations made
- Survey results higher for mobile than fixed but political interference results in regulatory ineffectiveness.

India:

- Report suggests that spectrum usage has been wasteful.
- Administrative allocation is inefficient and may have led to under-pricing of spectrum, i.e., below market value.
- Delays in frequency allocation are often criticized.
- Shortages exist, e.g., average allocation to cellular operators is 6.2 MHz, compared to worldwide average of 17.18 MHz.
- Government seeking to reallocate 45 MHz from military to commercial use.

Source: LIRNE-Asia Telecom Regulatory Environment Assessment

Fixed v. Mobile use in select countries: *Is there correlation to spectrum reform?*



Source: LIRNE Asia



Options for developing countries

- **Do nothing:** lost opportunity to improve spectrum usage and service delivery
- **Full spectrum rights regime:** Most feasible if few existing licensees, good chance to leapfrog, e.g., Guatemala, El Salvador
- **Piecemeal reforms,** e.g., flexibility of use, limited unlicensed use (e.g., WiMax, WiFi), reducing public sector use

Source Materials



ICT Regulation Toolkit: Radio Spectrum Management, (January 2007).

- Rohan Samarajiva "Preconditions for Effective Deployment of Wireless Technologies for Development in the Asia-Pacific", *Information Technologies and International Development*, Vol.3, No. 2, (2007).
- Bjorn Wellenius and Isabel Neto, "Managing the Radio Spectrum: Framework for Reform in Developing Countries," *World Bank Policy Research Working Paper* (March 2008).
- Thomas w. Hazlett, Giancarlo Ibarguen, Wayne Leighton, "Property Rights to Radio Spectrum in Guatemala and El Salvador: An Experiment in Liberalization," *Review of Law and Economics* (2007).
- Dale N. Hatfield, "Spectrum Management Reform and the Notion of the 'Spectrum Commons,'" *Southern African Journal of Information and Communication*, Vol. 4 No.Spring (2005).