

Spectrum Management & Regulation

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Lonavala (India)

GISFI Standardisation Event

26 – 28 February 2010

Contents

- Spectrum management: need & concept;
- Basics of RF spectrum;
- Telecom & knowledge society;
- Indian Telecom Scenario;
- New Services – Spectrum issues;
- Approaches for optimal spectrum use

Need for regulation of spectrum

- RF spectrum a limited natural resource;
- 40 different wireless services need spectrum;
- Spectrum requirements always more than its practical availability/ usability;
- Wireless signals can not be stopped at national political borders;

Need for regulation of spectrum contd..

- Spectrum sharing, like
 - among services;
 - Geographical sharing
- Radio frequencies are susceptible to interference/ pollution;
- Interference nullifies system benefits/ utility;
- Hence, regulated use of spectrum essential;
- Regulation known as spectrum management;

Need for regulation of spectrum contd..

- All the frequency bands are shared between different kinds of radio-communication services.
- Demands on spectrum exceed supply.
- Assignment of frequency for one type of network impacts the operation of other network.
- Spectrum - international in character requiring national as well as international regulation.

RF Spectrum Management

- Combination of administrative, scientific and technical procedures to ensure efficient operation of radiocommunication services without causing harmful interference.
- It has national & international aspects and economic dimensions.

Spectrum Management features

- Spectrum Policy;
- Planning of spectrum usage – NFAP;
- Frequency Assignment & Licensing;
- Registration of assignments with ITU;
- International cooperation/ coordination;
- Spectrum Control – Enforcement
- Radio frequency monitoring;

Basics of RF spectrum

- RF Spectrum: Group of radio frequencies
- Propagation governed by laws of Physics;
- Susceptible to interference (RF pollution);
- Does not respect man-made borders;
- Different frequency bands have different propagation characteristics
- Hence, regulation international in character.

Basics of RF spectrum contd..

- Limited Natural resource;
- Theoretically, RF spectrum extends from 9 KHz to 3000 GHz;
- Limitation/ scarcity of RF spectrum due to suitability for an application and availability of appropriate & cost effective equipment for same;
 - With current technologies, frequency bands upto 3.5 GHz suitable for mobile services;
 - Short-Wave/ HF band suitable for trans-continental communication, e.g short wave broadcasting,

Basics of RF spectrum contd..

- New technological developments have helped exploit higher frequency bands;
- At the same time, requirements for spectrum have increased exponentially:
 - for public mobile services as well as for captive needs of various users
 - public and private, civil as well as military
- Consequently scarcity of spectrum continues.

Basics of RF spectrum contd..

- Growing, conflicting and competing demands on radio frequencies
- Spectrum requirements of new technologies need to be met in timely manner without unduly constraining the existing usage.
- Ensure availability of spectrum to the new technologies in a transparent manner
- Need to ensure efficient, economical, optimal and rational spectrum utilisation

Basics of RF spectrum contd..

- Frequency bands are shared by various services and national organisations like:
 - Defence
 - Police and Paramilitary forces
 - Security Agencies, including RAW, SPG and other VVIP Security Agencies
 - Public Utility Services
 - Public Telecom Services

Basics of RF spectrum contd..

- Broadcasting Services, Sound and Television
- Satellite based Services
- Maritime and Aeromobile services
- Safety Services
- Seismic Services including forecasting of natural calamities
- Rocket and Satellite launching
- Meteorological aids

Telecom & knowledge society

- Communication - A basic human need;
- Telecommunication – essential need of modern society;
- Modern telecom trend – greater mobility & increasing data rates for voice, data and multimedia services;
- Telecom increases productivity and brings immense socio-economic benefits like e-governance, tele-health, e-education, etc;
- Vast country like India needs both terrestrial and satellite based services.

Telecom & knowledge society Contd..

- Modern age of 'Knowledge Society';
- **'Anywhere, anytime, any device'** communication:
 - No distinction between fixed & mobile services
 - New Generation systems trying to meet it.
 - Data & multimedia likely increase to 90% of traffic
- Telecom & IT – compliment each other;
 - Developments in IT have helped develop advanced and faster telecom networks;
 - Modern telecom networks have helped in still faster development of IT and IT based services

Telecom & knowledge society Contd..

- Mobile systems can permit fixed applications, but not vice versa. Globally, operators prefer mobile systems, especially for rural areas, etc. having lower demand;
- Wireless services:
 - Permit faster & economical roll out in rural areas;
 - Help bridge the digital divide;
 - Also permit easy roll out in congested city areas;
 - Ease of maintenance.
- Affordable entry cost & tariffs important;
- Mobility possible through wireless only, needs spectrum.

Indian Telecom Scenario

- Present:
 - More than 500 Million mobile subscribers in India;
 - Total subscribers more than 525 Million;
 - No 2 globally in subscriber numbers (No 1 China)
 - Monthly addition 15 – 19 Million subscribers;
- Estimates/ Projections for 2014:
 - 1 billion customers/ devices (almost double);
 - To contribute 15% of national GDP and be the top most contributing sector for GDP (8th now)

New services – spectrum issues

- Cellular mobile networks need spectrum for:
 - Access network between Base Station & Handset (generally below 3.5 GHz);
 - Backhaul network between different base stations and Mobile Switching Center (MSC)/ Node in 10 – 30 GHz , if physical media not available;
 - Long distance network between different cities (below 10 GHz), if physical media not available/feasible;
 - Judicious mix of wireless and physical media.

New services – spectrum issues contd.

- Some common frequency bands for new services;
 - 1920 to 1980 MHz with 2110 to 2170 MHz (FDD);
 - 2.3 to 2.4 GHz for TDD systems;
 - 2.5 to 2.69 GHz for FDD and TDD systems;
 - 3.3 to 3.7 GHz for TDD systems;
 - 850/ 900 MHz & 1800 MHz bands (by refarming);
 - 700 MHz ‘Digital Dividend’ spectrum;
 - Many de-licensed bands for fixed-mobile convergence.

New services – spectrum issues contd.

- As per industry sources, an operator needs minimum 20 MHz of licensed spectrum for rolling out cost effective broadband network initially;
- Most of these bands are in use for various existing networks and need to be refarmed;
- Adequate spectrum for microwave backhaul & inter-city links also equally critical;
- Govt. has announced broad guidelines for auction of 3G and BWA spectrum.

New services – spectrum issues contd.

- For wireless services, larger capacity would need to be provided through:
 - Innovative add-ons (technological developments) for enhancement of capacity/ spectrum efficiency;
 - Installation of larger number of Base Stations;
- Still additional spectrum may be required – would need refarming of relevant spectrum;
- So, efficient use of spectrum by all critical.

Increasing the efficiency of spectrum utilisation

- National and International coordination
- Encouragement for the introduction of spectrum efficient technologies
- Choosing optimal sharing criteria to ensure Electro Magnetic Compatibility
- Vision, right perspective, mutual cooperation key elements for mitigating complexities in spectrum management.

Increasing the efficiency of spectrum utilisation contd..

- Optimum use of RF spectrum by all essential
 - Max. possible reuse of spectrum by all means;
 - Maximum possible links between fixed locations to be on physical media like OFC, etc.
 - Development of new, spectrum efficient modulation techniques; etc.;
 - Upgrade older wireless systems with new, spectrum efficient systems (e.g. digital TV).

Technological approaches – Change over to IP networks

- Current, circuit switched networks use dedicated channels for each individual call;
- Channel not used optimally despite various developments to improve channel utilisation;
- IP based networks, using packets of data, improve efficiency of network capacity;
- All modern systems now becoming IP based.

Technological approaches – SDR

- All assigned spectrum not fully used, always;
- Current wireless equipment operates in limited frequency band(s);
- With miniaturisation and large computing capacities, modern equipment (SDR) can operate in multiple/ large frequency bands;
- Software Defined Radio (SDR) uses part of spectrum which is not in use at a given time;

Technological approaches – Cognitive Radio

- In SDR, interference can occur if actual user starts operation;
- Cognitive radio is added to SDR;
- Cognitive radio first listens and if a spectrum is free, it starts transmission. If the actual user starts operation, cognitive radio shifts to some other free channel immediately.

Regulatory Approaches

- Various policy/ regulatory approaches essential to enforce optimal use of spectrum;
- Appropriate spectrum pricing one of tools;
 - Low pricing may lead to inefficient use & even spectrum hoarding;
 - High pricing may defeat the basic objective;
 - Charging for all spectrum usage for its efficient use by all users.

Spectrum charging

- NTP 99 stipulates - Spectrum usage fee shall be charged.
- Incentive for efficient use of spectrum and disincentive for sub-optimal usages.
- Govt. users did not pay for spectrum earlier
- Spectrum charging from all to enhance accountability among all users.

Thank You

