Presentation on Spectrum Allocations for Future Wireless Communications

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Outline of Presentation

- Allocations, allotment and assignment of spectrum
- Evolution of wireless communications
- Identification of spectrum for mobile services/ applications
- Studies at ITU-R
- Challenges ahead for

Spectrum Allocation

- Is done by ITU for all the Regions of the World through World Radiocommunication Conferences (WRCs) for all radio communication services in order to make their co-existence without any harmful interference
- International Frequency Allocation Table of Radio Regulation is developed/modified based on the decisions of WRCs
- Identification of spectrum for various radiocommunication services/ applications is done based on the proposals received from member administration and consensus on the issues in the Conference
- Sharing Studies at ITU-R Study Groups where ever required ensure the coexistence of various radio services in the bands

Spectrum Allocation

- **During the Conference all proposals are discussed and decisions are taken for opening of the bands for new services or extension of the existing bands**
- **These decisions are reflected in the International Frequency Allocation Table of Radio Regulation and other regulatory provisions for use of bands which forms the basis for allotment by the administrations**
- **Spectrum allocation is necessary in order to operate interference free operation for each radio service**

Spectrum Allocation

- **Each frequency band is shared among radio services but the sharing is possible only with alike systems**
- **Sharing is possible by way of geographical separation, time sharing and technical solutions like use of smart antenna and intelligent radio system**
- **Almost all these bands are shared with other services. Inter-service sharing issues are thus very significant and much time is spent ensuring that the different services are compatible - detailed studies are made before a band is allocated at WRC.**

Spectrum Allotment

- Spectrum allotment is done by the National Spectrum Management Agency through National Frequency Allocation Plan (NFAP);
- Based on the proposals received from various stake holders and national priorities, equipment availability and market forces, the frequency bands are identified for specific applications taking in to account the decisions of WRCs and also protecting existing assignments
- The frequency sub-bands are allotted to service providers, wireless users for deployment of their services in specific service areas.

Spectrum Assignments

- Spectrum assignment is done by the National Spectrum Management Agency for a specific location keeping in view the technical parameters of the radio equipment
- EMI/EMC is ensured before making any assignments to any users for a specific location
- These assignments become part of the National Frequency Register which is taken into consideration for future assignments

EVOLUTION OF WIRELESS SYSTEMS

0G

- 0G refers to pre-cellphone mobile technology, such as radio telephones that some had in cars before the advent of cellphones.
- One such technology is the Autoradiopuhelin (ARP) launched in 1971 in Finland as the country's first public commercial mobile phone network.

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1G

- 1G (or 1-G) is short for first-generation wireless telephone technology, cellphones. These are the analog cellphone standards that were introduced in the 80's and continued until being replaced by 2G digital cellphones.
- One such standard is NMT (Nordic Mobile Telephone), used in Nordic countries, Eastern Europe and Russia. Another is AMPS (Advanced Mobile Phone System) used in the United States

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2G (or 2-G)

- It is short for second-generation wireless telephone technology. It can transfer data with low bit rate and SMS messaging besides voice call.
- 2G technologies can be divided into TDMA-based and CDMA-based standards depending on the type of multiplexing used. The main 2G standards are:
  - GSM(TDMA-based), originally from Europe but used worldwide
  - IS-95 *aka cdmaOne, (CDMA-based, commonly* referred as simply CDMA in the US), used in the Americas and parts of Asia
- 2.5G services are also available in many countries using above

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- 3G (or 3-G) is short for third-generation mobile telephone technology
- The services associated with 3G provide the ability to transfer both voice data (a telephone call) and non-voice data (such as downloading information, exchanging email, and instant messaging).

3.5G

• High-Speed Downlink Packet Access or HSDPA is a mobile telephony protocol, also called 3.5G . High Speed Downlink Packet Access (HSDPA) is a packet-based data service in W-CDMA downlink with data transmission up to 8- 10 Mbit/s (and 20 Mbit/s for MIMO systems) over a 5MHz bandwidth in WCDMA downlink.

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- HSDPA implementations includes Adaptive Modulation and Coding (AMC), Multiple-Input Multiple-Output (MIMO), Hybrid Automatic Request (HARQ),
- fast cell search, and advanced receiver design.
- HSDPA is being deployed in North America and other countries in the world.

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4G

- 4G is an initialism of the term Fourth-Generation Communications System.
- 4G system will provide an end-to-end IP solution where voice, data and streamed multimedia can be served to users on an "Anytime, Anywhere" basis at higher data rates than previous generations.
- No formal definition is set as to what 4G is, but the objectives that are predicted for 4G can be summarized in the next slide.

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- 4G will be a fully IP-based integrated system of systems and network of networks wired and wireless networks (e.g.: computer, consumer electronics, communication technology…)
- Providing 100 Mbit/s and 1 Gbit/s, respectively, in outdoor and indoor environments
- High security
- Offering any kind of services anytime, anywhere
- Affordable cost and one billing

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- Support interactive multimedia, voice, video, wireless internet and other broadband services.
- High speed, high capacity and low cost per bit. Global mobility, service portability, scalable mobile networks.
- Seamless switching, variety of services based on Quality of Service (QoS) requirements

International Allocations for IMT

- WARC-92 and WRC-2000 identified have identified the following frequency bands for IMT-2000
  - 806-960 MHz
  - 1710-1885 MHz
  - 1885-2025 paired with 2110-2200 MHz
  - 2500-2690 MHz
- WRC-07 identified the following band for IMT
  - 450-470 MHz
  - 698-806 MHz
  - 2300-2400 MHz
  - 3400-3600 MHz

National Allocation of spectrum

Spectrum for 2G services-

- 822-844 MHz paired with 869-889 MHz, presently being deployed for CDMA based 2 G networks in the country
- 890-915 MHz paired with 935-960 MHz, presently being deployed for GSM based 2G networks
- 1710-1785 MHz paired with 1805-1880 MHz, presently partially being deployed for GSM based 2G network

Spectrum for 3G services-

- 450-470 MHz
- 1900-1910 MHz paired with 1980-1990 MHz
- 1920-1980 MHz paired with 2110-2170 MHz

Identification of spectrum for new wireless services

NFAP-2008 has identified Spectrum for IMT including Broad band Wireless Access in line with the decisions taken in WRC-2007 as per below-

698-806 MHz

2300-2400 MHz

2500-2690 MHz

3300-3600 MHz

Spectrum allocation for 3G and BWA as per Guidelines issued by Government

3G-

- Spectrum shall be auctioned in blocks of 2x5 MHz in 2.1 GHz band (1920-1980 MHz paired with 2110-2170 MHz). The number of blocks to be auctioned would vary subject to the availability of spectrum in different telecom service areas .

- Spectrum shall be auctioned in the 450 MHz band, in 800 MHz band for EVDO services, and in 1900 MHz band (1900 – 1910 paired with 1980-1990 MHz) when it becomes available.

Spectrum allocation for 3G and BWA as per Guidelines issued by Government

BWA

- Spectrum shall be auctioned in the 2.5 GHz and 2.3 GHz bands for data services. Each successful bidder can get 20 MHz in 2.3 and 2.5 GHz bands in a telecom service area.

- Spectrum in 700 MHz and 3.3-3.6 GHz bands shall be auctioned as and when it becomes available.

Spectrum allotment for 3G and BWA

- 2X5 MHz spectrum in 2.1 GHz band has been allotted to MTNL and BSNL for operation of 3G service in its service areas.
- The operation of 3G service by MTNL in Delhi and Mumbai and BSNL in Chennai has been commenced.
- 20 MHz spectrum in 2.5 GHz has also been allotted to MTNL and BSNL for operation of WiMAX in its service areas.
- BSNL has started deployment of WiMAX in its services areas.

ITU-R and its Study Groups

- ensure the rational, equitable, efficient and economical use of the radio-frequency spectrum by all radiocommunication services, including those using the geostationary-satellite or other satellite orbits,
- carry out studies without limit of frequency range and adopting Recommendations on radiocommunication matters.
- Technical studies carried out in Study Groups are required to provide technical bases to WRC

ITU-R 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

Recent Studies at ITU-R Study Groups

- Sharing studies between IMT system and other services in the frequency band 790-862 MHz by WP5D
- Impact of Ultra Wide Band (UWB) in communication technology
- Channeling plan for frequency bands identified in WRC-07 (Revision of ITR-RM1036)
- Work on development of IMT parameters for its radio interface (revision of ITU-RM 1457)
- Studies on out of band emissions for BTSs and mobile stations using terrestrial radio interfaces of IMT (revision of 1580 and 1581)
- Work on Software Defined Radio and Cognitive Radios in SG-3

Challenges before implementation of future wireless

- Spectrum issues
  - Spectrum for future wireless (IMT) has been identified by WRC-2007 and its availability is to be ensured by the country concerned due to current usages in the band.
  - difficult to design a wireless system without knowing the channel. As such channeling plan for harmonised use is essential.
- Complex resource allocation

  Management of time, frequency and spatial resources in a multi-network, multi-user environment
- **Interference**
  - Multiple access interference control and mitigation in heterogeneous environments (coexisting air interfaces, varied terminals and services) is an issue.

Thank you