

Spectrum Management Issues for Broadband Services

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I. Introduction

In latest wireless technologies are being developed fast and new telecommunication services are being delivered for the high speed, service convergence and high mobility. For the seamless service, multimedia services should be a variable in indoor/outdoor, under ground and moving area. The wall between communication and broadcasting is disappearing and different networks can exchange the services like wireless and the Internet. The multiple service including text, voice, video is becoming and need more wide bandwidth spectrum. In the 21 century, the need of spectrum is increasing rapidly. It is very important to manage spectrum for ubiquitous convergence mobile communications.

The radio spectrum means electro magnetic waves from few 10 kHz to few 100 GHz, and many services are located in VHF, and UHF band.

Fig.1 shows the band names of the wavelength on each frequency bandwidth.

- . VLF (Very Low Frequency; below 30 kHz): Experiment
- . LF (Low Frequency; 30 ~ 300 kHz): Local comms.
- . MF (Medium Frequency; 300 kHz ~ 3 MHz) : AM
- . HF (High Frequency; 3 ~ 30 MHz): Long distance comms.

- . VHF (Very High Frequency; 30 ~ 300 MHz): FM, TV
- . UHF (Ultra High Frequency; 0.3 ~ 3 GHz): TV, Mobile
- . SHF (Super High Frequency; 3 ~ 30 GHz): Satellite
- . EHF (Extreme High Frequency; 30 ~ 300 GHz): Satellite

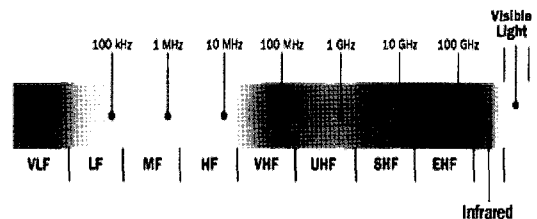


Fig. 1. Radio Frequency Spectrum and Band Names

The radio frequency spectrum is a vital and limited national resource. Spectrum contributes to significant technological innovation, job creation, and economic growth, and it enables military operations, communications among first responders to natural disasters and terrorist attacks, and scientific discovery.

Recent years have witnessed an explosion of spectrum-based technologies and uses of wireless voice and data communications systems by businesses, consumers, and governments. Today there are over 2 billion wireless phone customers in the world ^[1] and, increasingly, businesses and consumers are installing

systems that use unlicensed spectrum to allow wireless data, called Wireless Fidelity (WiFi), on their premises. The government makes extensive use of spectrum for radars, communications, geolocation/navigation, space operations, and other national and homeland security needs. The FCC (Federal Communications Commission) [2] effort to unlock the economic value and entrepreneurial potential of U.S. spectrum assets while ensuring that sufficient spectrum is available to support critical government functions.

The existing legal and policy framework for spectrum management has not kept pace with the dramatic changes in technology and spectrum use. Under the existing framework, the government generally reviews every change in spectrum use, a process that is often slow and inflexible, and can discourage the introduction of new technology. Some spectrum users, including government agencies, maintain that the existing spectrum process is insufficiently responsive to the need to protect current critical uses.

II. Spectrum Management Organization

There are two organizations that establishing and issuing policy regarding allocations and assignments of frequencies governing the Federal and Commercial spectrum use in America.

The NTIA (National Telecommunications and Information Administration) [3] is responsible for managing the Federal Government's use of the radio frequency spectrum. The NTIA is the regulating agency for all federal spectrum use.

Also known as the Red Book [4], this publication of the OSM (Office of Spectrum Management) of the NTIA, is the official source for all technical regulations relating to the use of the electromagnetic frequency spectrum. To achieve this, OSM receives assistance and advice from the IRAC (Interdepartment Radio Advisory Committee). OSM carries out this responsibility by

- establishing and issuing policy regarding

allocations and regulations governing the Federal spectrum use;

- developing plans for the peacetime and wartime use of the spectrum;
- preparing for, participating in, and implementing the results of international radio conferences;
- assigning frequencies;
- maintaining spectrum use databases;
- reviewing Federal agencies' new telecommunications systems and certifying that spectrum will be available;
- providing the technical engineering expertise needed to perform specific spectrum resources assessments and automated computer capabilities needed to carry out these investigations;
- participating in all aspects of the Federal Government's communications related emergency readiness activities; and,
- participating in Federal Government telecommunications and automated information systems security activities.

The NTIA is the President's principal advisor on telecommunications and information policy issues, and in this role frequently works with other Executive Branch agencies to develop and present the Administration's position on these issues. The NTIA of the U.S. Department of Commerce was established in 1978 by Executive Order 12046.

Since its creation, the NTIA has been at the cutting edge of critical issues. In addition to representing the Executive Branch in both domestic and international telecommunications and information policy activities, NTIA also manages the federal government use of spectrum; performs cutting-edge telecommunications research and engineering, including resolving technical telecommunications issues for the federal government and private sector; and administers infrastructure and public telecommunications facilities grants.

Fig.2 show the role of spectrum management between NTIA and FCC organization defined by Communications Act [5].

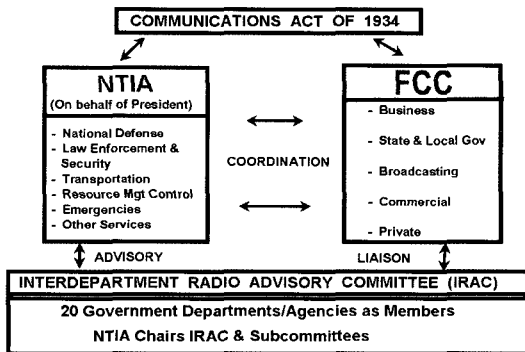


Fig. 2. United States Spectrum Management Organizations [6]

The FCC (Federal Communications Commission) is an independent Federal regulatory agency responsible directly to Congress. Established by the Communications Act of 1934, it is charged with regulating interstate and international communications by radio, television, wire, satellite, and cable. Its jurisdiction covers the 50 states and territories, the District of Columbia, and U.S. Possessions.

The FCC is directed by five commissioners appointed by the President and confirmed by the Senate for five-year terms, except when filling an unexpired term. The President designates one commissioner to serve as chairman. As the chief executive officer of the Commission, the chairman delegates management and administrative responsibility to the Managing Director. Certain other functions are delegated to staff units and bureaus and to committees of commissioners. The commissioners hold regular open and closed agenda meetings and special meetings. They also may act between meetings by "circulation," a procedure by which a document is submitted to each commissioner individually for consideration and official action.

The Commission staff is organized by function. There are six operating Bureaus and 10 Staff Offices. The Bureaus' responsibilities include: processing applications for licenses and other filings; analyzing complaints; conducting investigations; developing and implementing regulatory programs; and taking part in

hearings. The Offices provide support services. Even though the Bureaus and Offices have their individual functions, they regularly join forces and share expertise in addressing Commission issues. More on the FCC organizational structure and the Bureaus and Office functions are described at their website [2].

III. Spectrum Management Policy

It is important that the government move from its traditional spectrum management paradigm of 'command and control' to a paradigm of market-oriented allocation policy to provide more flexible allocations that allow multiple uses so that spectrum can be put to its highest and best use.

Policy considerations are interference, federal vs. non-federal spectrum management, licensed vs. unlicensed. Spectrum can be parceled in time, space, and frequency, applicable to cognitive radio.

Fig. 3 shows the procedure and input document flow from announcement of spectrum to order [6].

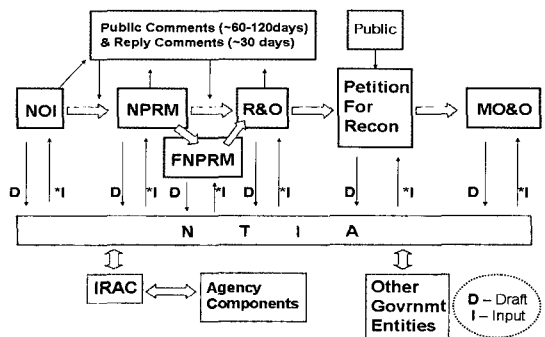


Fig. 3. FCC/NTIA Administrative Procedure Document Flow (NOI: Notice of Inquiry, NPRM: Notice of Proposed Rulemaking, FNRPM: Further Notice of Proposed Rulemaking, R&O: Report & Order, MO&O: Memorandum Opinion & Order)

Presidential Spectrum Initiative is led by the NTIA. NTIA has defined seven projects that, taken together, present an implementation plan and address the

recommendations of Reports 1 and 2, as directed by the President. The following projects aggregate related recommendations that NTIA staff will address:

- To improve stakeholder participation, NTIA has established a high-level interagency advisory group, the Policy and Plans Steering Group (PPSG). NTIA also established the Commerce Spectrum Management Advisory Committee (CSMAC), an advisory committee composed of non-federal government representatives.
- To better serve US global interests in international spectrum use, NTIA has released a report exploring the US preparatory process for World Radio Conferences (WRCs).
- To leverage the benefits of advanced information technologies (IT), NTIA launched a new system that coordinates frequency use between the private and public sectors in the 70/80/90 GHz range. In addition, NTIA is modernizing its business practices and increasing the effective application of IT to improve federal spectrum management.
- To facilitate the reallocation of spectrum to commercial uses, NTIA worked with Congress to ensure passage of the Commercial Spectrum Enhancement Act. NTIA is working with the FCC to implement the provisions of the Act. As a result, 90 MHz of spectrum, half of which is federal spectrum slated to be reallocated to commercial use, will be auctioned as soon as June 2006 for advanced wireless services.

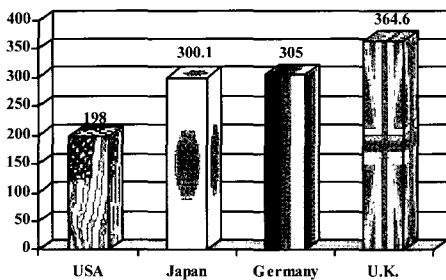


Fig. 4. MHz of Spectrum Available by Nation.

Fig. 4 shows the available bandwidth of spectrum reallocation by the government in V/UHF band [7].

IV. Outstanding Issues

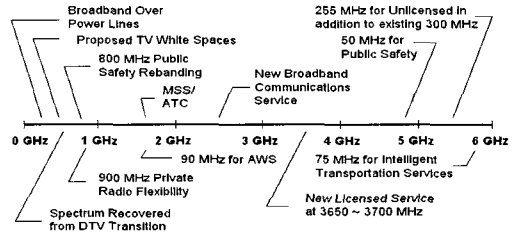


Fig. 5. Current FCC Spectrum Activities

Fig. 5 shows current FCC spectrum activities, but the chart is not all-inclusive [8]. The characteristics are increasing of low power devices with small coverage and unlicensed devices. The issues interested by many people are described and summarized.

■ TV "White Space" legislation

Many TV channels in every market are vacant and unlicensed operation is proposed on unused TV channels that need mechanism to protect TV receivers. Now TV channels also used for land mobile, wireless microphones, medical telemetry, radio astronomy. FCC NPRM on unlicensed use of vacant channels is 4 watts EIRP for fixed and 0.4 watts EIRP for portable that to protect TV operations, unlicensed device looks for "control signal" identifying locally vacant channels, or uses "detect-and -avoid" (DAA) technology, or has built-in GPS and channel database. Senate introduced legislation requiring FCC to allow unlicensed operation in TV bands in Feb. 2006. Broadcast industry vigorously opposes Senate bill that concerned about interference to TV reception and seeks delay at least until end of digital TV transition.

■ Proposed service changes in the 902-928MHz

Present uses of 902-928MHz are ISM devices (Industrial, Scientific, and Medical), LMS (Location and Monitoring Service), federal uses (radar, fixed and mobile), amateur radio, unlicensed devices. Proposed service is M-LMS (Multilateration LMS) that triangulates from differences in arrival times. M-LMS licenses were auctioned for \$4.4 million already but never constructed since US Government turned off "dither" in GPS that greatly improved accuracy and prices dropped sharply. In FCC NPRM, to drop restriction on type of service, request technical proposals, eliminate spectrum aggregation limits and retain current CFR regulation 45.15 protections.

■ 5GHz U-NII band expansion[9]

FCC R&O added 255MHz to the 5.8GHz U-NII (Unlicensed National Information Infrastructure) band that expanded band covers 5.470-5.825GHz. New requirements across entire band to protect radars are DFS (Dynamic Frequency Selection) and TPC (Transmit Power Control). But compliance test procedure was difficult to specify and implementation dates repeatedly postponed. In this March, NTIA filed companion test procedure that agreed to by FCC, NTIA, and industry panel. Under current schedule, DFS (Dynamic Frequency Selection) and TPC rules take effect for certification application field on or after July 20, 2006 and devices imported or marketed on or after July 20, 2007.

V. Future Spectrum Management

Upcoming FCC spectrum auctions and opportunities are introduced. AWS-1(BW90MHz) is scheduled for June 29, 2006. Congress decreed broadcasters must turn back analog broadcast spectrum in the 700MHz spectrum band (698-806MHz) by Feb. 19, 2009. Already 24MHz has been allocated to public safety and other

24MHz has been auctioned for commercial use. The remaining 60MHz must be auctioned no later than Jan. 28, 2008. To put this 190MHz in perspective, approximately 180MHz of spectrum is currently allocated for all of cellular/PCS. Other spectrum opportunities include BRS/EBS(2.5GHz), AWS-2, 3650-3700MHz, and White Spaces in broadcast spectrum.

Future spectrum management directions are as follow as:

- . Improve stakeholder participation and maintain high qualifications of spectrum managers
- . Reduce international barriers to US innovations in technologies and services
- . Modernize federal spectrum management processes with advanced information technology
- . Satisfy public safety communication needs and ensure interoperability
- . Enhance spectrum engineering and analytical tools
- . Promote efficient and effective use of spectrum
- . Improve planning and promote use of market-based economic mechanisms in spectrum management

VI. Conclusion

In general, there are two approaches to the re-use of the scarce vital resource: a market-oriented approach and a command-and-control approach. The former is to recognize spectrum as a tradable resource, which allows market mechanisms for spectrum management, such as spectrum trading or leasing, to remove ineffective radio services from markets and adopt new high-value-added services. The latter is to focus on the leading role of governments, which enables the recycle of spectrum through refarming existing frequencies.

For the commercial radio spectrum, Korea has already introduced to its spectrum framework such market mechanisms as charging for the allocation of frequencies and allowing spectrum leasing. In addition, a survey of the status of spectrum use is conducting,

and the revision of regulations for spectrum refarming is ongoing. The recycle of radio spectrum, given the potential rising demand, is an urgent issue for Korea. Therefore, improving spectrum frameworks as well as reshaping the overall telecommunications regime would be necessary. However, it would be more important to boost the competitiveness of the overall communications market basically focusing on spectrum management.

References

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