IMT-2000 Implementation – Spectrum and other Regulatory Considerations

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Overview

- Spectrum management functions and considerations
  - Regulatory goals in allocation and assignment of spectrum
  - Other considerations
  - Techniques for assigning spectrum
  - Secondary Spectrum trading
- IMT-2000 spectrum issues
  - Background on IMT-2000 spectrum
  - Frequency bands identified for IMT-2000
  - ITU spectrum recommendation
  - IMT-2000 technologies and spectrum
  - Considerations in choosing frequencies for IMT-2000
- Examples of flexible regulatory policies
  - United States FCC
  - Sweden PTS
  - United Kingdom OFCOM
- 3G CDMA commercial networks around the world

Spectrum Management Functions and Considerations

Spectrum is a finite resource and regulators should maximize its use to protect the continued viability of current users and to provide opportunities for new services to be deployed. The demands for spectrum continue to raise the importance of spectrum management.

These functions include:

- Allocation
  - For general services, such as mobile and fixed terrestrial, mobile and fixed satellite, amateur radio, etc.
- Development of service rules
  - Sets essential technical criteria
  - Minimal requirements permit operators to be flexible
- Assignment
  - To individual users or licensees
- Compliance and enforcement
  - To prevent harmful interference, unauthorized use

Regulatory Goals in Allocating and Assigning Spectrum

- Maximizing spectrum efficiency
- Ensuring equity for all citizens
- Providing adequate spectrum for national defense and public safety
- Coordinating international communications

Other Considerations for Allocating Spectrum

- Technology neutrality
  - Allocating spectrum for generic services rather than specific technologies provides flexibility for rapid changes in the development of new technologies
- Flexible services rules
  - Making service rules as flexible as possible reduces regulatory burdens on service providers and enables them to meet their customers' needs in the immediate and longer term (e.g., permits provision of fixed and mobile services by the same service provider)
- Regional/global coordination
  - Maximizing regional and global allocation commonality assists in the development of larger economies of scale for equipment, and in the provision of "borderless" services
- Advent of secondary spectrum trading
  - Use of markets to allocate spectrum for commercial use
  - Reserve spectrum for public services and use pricing as incentive for efficient management
  - Importance of generic allocations (trade across bands and uses + change in technology and use)

Techniques for Assigning Spectrum

First-come, First-served

•**Pros:** speed, inexpensive

•**Cons:** may not end up in hands of an entity that values it the most; value of license not taken into account; resellers instead of public may profit

Auctions

•**Pros:** speed, may be less expensive than beauty contest, entity who places highest value on license wins, spectrum is public resource so revenues benefit citizens, provide information about economic value of spectrum

•**Cons:** could lead to increased concentration in industry, may ignore non-financial public interest objectives (equity), revenue potential may create incentive for government to restrict output and raise prices

Beauty Contest

•**Pros:** awards license to contender who would best service public interest, allows for equity considerations, can require licensees to serve isolated areas

•**Cons** : time consuming, expensive, no rules for a "tie", less transparent than other techniques, allows government to determine what the market wants

Lotteries

•**Pros:** quick process, provides rule for "tie"

•**Cons** : unqualified party can win, resellers instead of public may profit

Spectrum Trading

- What is spectrum trading?
  - facility to allow licences to be transferred directly from one user to another within a regulatory framework with safeguards
  - *trade across bands and across uses + change of use and technology*
- What are some benefits of spectrum trading?
  - Encourages market to drive implementation and make decisions in a clear regulatory framework with competition oversight
  - Allow the right to use a particular block of spectrum to be transferred to and used by higher value users and services; in the long term this leads to more efficient use of spectrum and greater benefit to the economy
  - Enables lower transaction costs of accessing spectrum, increase competition and facilitate innovative products and services
  - Facilitates quick response to changing demand
- What are some challenges to implement spectrum trading?
  - In order to ensure interference does not become an issue, a dispute resolution procedure should be envisioned.
  - Important to protect small users of spectrum and those using spectrum for astronomy and scientific research

IMT-2000 Spectrum Background

- The ITU has taken a lead role in the development and deployment of IMT-2000, and has recently updated its Recommendation on IMT-2000 (ITU-R M.1036) IMT-2000 spectrum usage
- The ITU's World Radio Conferences in 1992 and 2000 identified several frequency bands for the deployment of IMT-2000 systems and services
- This identification is not an allocation to a particular technology or set of technologies, nor is it an allocation to a new service
- Instead, the identification is a recommendation to administrations to use these frequencies for IMT-2000 technologies in an attempt to harmonize use of the bands internationally

Terrestrial Frequency Bands Identified for IMT-2000

806-960 MHz

1710-1885 MHz

1885-2025 MHz

2110-2200 MHz

2500-2690 MHz

IMT-2000 technologies will be deployed in all frequency bands

Ref: World Radio Conference – 2000 (WRC-2000) Istanbul, June 5, 2000:
Footnote S5.388 is associated with Resolutions 212 and 223 (the 1.9 and 2.1 bands)
Footnote S5.384A is associated with Resolution 223 (the 1.7 and 2.5 bands)
Footnote S5.317A is associated with Resolution 224 (the 800/900 bands)

ITU Recommendation on IMT-2000 Spectrum

- ITU-R approved a Recommendation on Frequency Arrangements for IMT-2000 (ITU-R M.1036)
  - Approved at the Radio Assembly in June, 2003
  - The Recommendation proposes seven frequency pairing arrangements for IMT-2000 system deployments, plus three unpaired bands*
    1. 824-849 paired with 869-894 (cellular)
    2. 880-915 paired with 925-960 (GSM 900)
    3. 1920-1980 paired with 2110-2170 (UMTS)
    4. 1710-1785 paired with 1805-1880 (DCS-1800)
    5. 1850-1910 paired with 1930-1990 (PCS)
    6. 1750-1800 paired with 2110-2160 (new arrangement)
    7. 1710-1770 paired with 2110-2170 (new arrangement)
    8. 1880-1920, 1910-1930, 2010-2025 (unpaired spectrum)

*ITU WP 8F will develop recommendations on pairing arrangements for the 2500-2690 MHz band at a future date

ITU Recommendation on IMT-2000 Spectrum cont.

- Administrations are encouraged to allow existing pre-IMT-2000 systems to migrate to IMT-2000
  - The first commercial IMT-2000 systems were implemented by upgrading existing cellular and PCS systems in the 450, 800 and 1800 and 1900 MHz bands
- Administrations may implement IMT-2000 in any band allocated for the Mobile Service (not just the identified bands)
  - Several countries have deployed IMT-2000 systems in the 450 MHz band
  - China is planning to implement IMT-2000 in the 2300-2400 MHz band
  - The United States recently auctioned frequencies in the 700 MHz band that can be used for IMT-2000
- Administrations may implement IMT-2000 in the identified bands using different pairing arrangements from the ones included in the Recommendation
  - Korea's PCS operators have upgraded their systems to IMT-2000 using 1750-1780 paired with 1840-1870 MHz
  - Japan's cellular operators have upgraded their systems to IMT-2000 using 887-924 paired with 832-869 MHz

IMT-2000 Technology and Spectrum

- The ITU has approved five radio air interface standards (ITU-R M.1457) and has identified multiple frequency bands for IMT-2000
  - The IMT-2000 technologies are frequency agnostic
    - Both of the primary IMT-2000 standards, WCDMA and CDMA2000, will be deployed in multiple frequency bands
  - The CDMA2000 standard is defined for:
    - 400 MHz, 800 MHz, 900 MHz, 1700 MHz, 1800 MHz, 1900MHz, and 2100 MHz
  - The WCDMA standard is defined for:
    - 1800 MHz, 1900 MHz, 2100 MHz
  - The decision in which bands IMT-2000 technologies are first deployed depends on regulatory decisions, the marketplace, and politics

WRC 2003 Developments

- ITU-R World Radio Conference (WRC-03) approved plans for the future development of IMT-2000, and created a new agenda item on IMT-2000 for WRC-07 (agenda item 1.4):
  - "To consider frequency-related matters for the future development of IMT-2000 and systems beyond IMT-2000 taking due account of the results of ITU-R studies in accordance with Resolution 228. (Rev. WRC-03)"
  - Res. 228 (Rev.WRC-03) invites further studies of lower frequency bands for IMT-2000:
    - "To invite ITU-R to conduct regulatory and technical studies on the usage of frequencies below those identified for IMT-2000 in No. 5.317A for the future development if IMT-2000 and systems beyond IMT-2000"
- WRC-03 also identified frequency bands for Public Protection Disaster Relief (PPDR), noting the ability of IMT-2000 technologies and systems to meet PPDR requirements
  - "Administrations are encouraged to consider the future development of commercial technologies and systems, such as IMT-2000, to meet the needs of PPDR organizations"

Considerations In Choosing Frequencies for IMT-2000

- Priorities must be ranked
  - Cost of equipment (leveraging of economies of scale)
  - Advanced services (high speed Internet access, multimedia, etc.)
  - Capacity to meet projected demand
  - Evolution of existing pre-IMT-2000 systems (leveraging investments)
  - Roaming (national, regional, international)
  - Spectrum utilization and efficiency
  - Competing uses for frequencies and cost of relocation of existing systems
- Multi-band, multi-mode phones will play an important role
  - There is no single frequency band and no single technology that will be used worldwide
  - Multi-band, multi-mode phones will be necessary to provide nationwide coverage for IMT-2000 subscribers as new networks are rolled out
  - International roaming between different IMT-2000 networks will be possible through multi-band, multi-mode phones

Considerations In Choosing Frequencies cont.

- Technology and Frequency Selection Make a Difference
  - Economies of scale for wireless equipment already exist for pre-IMT-2000 systems existing frequency bands
    - Permitting existing systems to upgrade to IMT-2000 will maximize existing economies of scale, keep costs low, and enable new services to be delivered quickly
    - Operators deploying IMT-2000 systems in new spectrum must build an entirely new network from the ground up, which will have significant impact on network costs and time to market
  - Spectrum will continue to be a scarce and valuable resource
    - Utilization of spectrally efficient technologies in available spectrum will be critical
  - Early licensing for IMT-2000 does not equate to early deployment

Example of Flexible Spectrum Policies: USA FCC

- Flexible technology neutral service rules allow IMT-2000 to be deployed by commercial mobile radio service operators (includes cellular, PCS and specialized mobile radio (similar to PAMR/PMR)) in already auctioned bands: including 700 MHz, 800 MHz, and 1.8/1.9 GHz.
- The FCC recently adopted service rules on 5 different frequency blocks within the 1710-1755 MHz / 2110-2155 MHz band.* These bands can be used to offer a variety of new and advanced wireless services, including voice, data, and broadband services popularly referred to as 3G services – using high-speed fixed and mobile networks. Many countries in the Americas, including Canada, have announced their intentions to auction this band as well.
- Secondary spectrum trading has existed for some time; current focus is on removal of unnecessary regulatory barriers and enabling a wide array of spectrum leasing arrangements with Wireless Radio Service licensees.
  - Flexible policies continue evolution toward greater reliance on the marketplace to expand the scope of available wireless services and devices, leading to more efficient and dynamic use of the important spectrum resource to the ultimate benefit of consumers.

Federal Communications Commission Press Release, "FCC Adopts Third Generation ("3G") Rules Making 90 MHz of Spectrum Available for Broadband and Advanced Wireless Services," October 16th, 2003: http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-240030A1.doc

Example of Flexible Spectrum Policy: Sweden PTS 450 MHz Band

- Swedish regulator, PTS, recently conducted a public consultation on the 450 MHz bandwidth for digital mobile services
- Spectrum seen as suited for covering large areas and a natural complement for 3G operators who by law must meet coverage obligations
- Technology neutral approach on the spectrum
- PTS received 13 responses from companies interested in making use of the 450 MHz bandwidth
- PTS to determine soon whether to auction spectrum or issue it vi a beauty contest

Example of *Evolving* Flexible Spectrum Policies: OFCOM's Proposal on Spectrum Trading and Liberalization of Spectrum Use

UK's OFCOM recently issued a public consultation on spectrum trading* covering

1. secondary spectrum trading based on the Cave Review which espouses both "*trade across bands and across uses + change of use and change in technology*" and
2. liberalization on existing spectrum licenses (i.e. permission to change use and/or technology where no transfer of license occurs)

Proposal Highlights:

- Introduction of secondary spectrum trading and liberalization by 2004 w/ completion set for 2007; some exemptions to tradable spectrum on justified grounds;
- Change in use will permitted with some exceptions, based on non-harmful interference principles;
- Tradability will be universal based on existing rights;
- OFCOM's role in secondary market will be laissez-faire (self market/industry driven);
- Sectoral competition rules based on merger regulations should be sufficient to watch over anti-competitive behavior

Commercial 3G CDMA Networks (1/4)

Country	Operator	Date	Technology	Frequency Bands
Korea	SK Telecom	Oct. 1, 2000	CDMA2000	800 MHz
Korea	LG Telecom	May 1, 2001	CDMA2000	1800 MHz
Korea	KT Freetel	May 2, 2001	CDMA2000	1800 MHz
Japan	NTT DoCoMo	Oct. 1, 2001	WCDMA	1900 and 2100 MHz
USA	Monet	Oct. 21, 2001	CDMA2000	1900 MHz
Romania	Zapp Mobile	Dec. 7, 2001	CDMA2000	450 MHz
Brazil	Telesp	Dec. 10, 2001	CDMA2000	800 MHz
USA	Leap Wireless	Jan. 17, 2002	CDMA2000	1900 MHz
USA	Verizon Wireless	Jan. 28, 2002	CDMA2000	800 and 1900 MHz
USA	MetroPCS	Feb. 1, 2002	CDMA2000	1900 MHz
Canada	Bell Mobility	Feb. 12, 2002	CDMA2000	800 and 1900 MHz
Japan	KDDI	Apr. 1, 2002	CDMA2000	800 MHz
Puerto Rico	Centennial Wireless	Apr. 4, 2002	CDMA2000	1900 MHz
Brazil	Telefonica Celular	Apr. 16, 2002	CDMA2000	800 MHz
Canada	Telus Mobility	June 3, 2002	CDMA2000	800 and 1900 MHz
New Zealand	Telecom N.Z.	July 22, 2002	CDMA2000	800 MHz
Chile	Smartcom PCS	July 26, 2002	CDMA2000	1900 MHz
USA	Sprint PCS	August 8, 2002	CDMA2000	1900 MHz

*Source: company press releases

Commercial 3G CDMA Networks (2/4)

Country	Operator	Date	Technology	Frequency Bands
USA	Cellular South	Sept. 9, 2002	CDMA2000	800 MHz
Moldova	Interdnestrcom	Sept. 30, 2002	CDMA2000	800 MHz
Israel	Pele-Phone	Oct. 1, 2002	CDMA2000	800 MHz
Colombia	EPM-Bogota	Oct. 2, 2002	CDMA2000	1900 MHz
India	TataTeleservices	Nov. 7, 2002	CDMA2000	800 MHz
Venezuela	Telcel	Nov. 13, 2002	CDMA2000	800 MHz
USA	KiwiPCS (Comscape)	Nov. 14, 2002	CDMA2000	1900 MHz
Venezuela	Movilnet	Nov. 20, 2002	CDMA2000	800 MHz
Canada	Aliant Mobility	Nov. 25, 2002	CDMA2000	800 MHz
Canada	MTS Mobility	Nov. 27, 2002	CDMA2000	1900 MHz
Indonesia	Telecom Flexi	Dec. 1, 2002	CDMA2000	800 MHz
Australia	Telstra	Dec. 1, 2002	CDMA2000	800 MHz
Ecuador	Bell South	Dec. 3, 2002	CDMA2000	800 MHz
Panama	Bell South	Dec. 3, 2002	CDMA2000	800 MHz
Russia	Delta Telecom	Dec. 16, 2002	CDMA2000	450 MHz
Japan	J-Phone	Dec. 20, 2002	WCDMA	1900 and 2100 MHz
Mexico	IUSACELL	Jan. 24, 2003	CDMA2000	1900 MHz
Puerto Rico	Verizon Wireless	Feb. 4, 2003	CDMA2000	800 MHz

Commercial 3G CDMA Networks (3/4)

Country	Operator	Date	Technology	Frequency Bands
Belarus	Belcel	Feb. 10, 2003	CDMA2000	450 MHz
Thailand	Hutchison CAT	Feb. 27, 2003	CDMA2000	800 MHz
Italy	3 (Hutchison)	Mar. 03, 2003	WCDMA	1900 and 2100 MHz
UK	3 (Hutchison)	Mar. 3, 2003	WCDMA	1900 and 2100 MHz
Nicaragua	BellSouth	Mar. 26, 2003	CDMA2000	800 MHz
Dominican Republic	Centennial Dominicana	Mar. 27, 2003	CDMA2000	1900 MHz
China	China Unicom	Mar. 28, 2003	CDMA2000	1900 MHz
Canada	Sasktel Mobility	April 10, 2003	CDMA2000	800 MHz
Columbia	BellSouth	April 15, 2003	CDMA2000	800 MHz
Australia	3 (Hutchison)	April 15, 2003	WCDMA	1900 and 2100 MHz
Austria	Mobilkom	April 25, 2003	WCDMA	1900 and 2100 MHz
Brazil	Giro (Vesper)	May 01, 2003	CDMA2000	800 MHz
India	Reliance Infocomm	May 1, 2003	CDMA2000	800 MHz
Sweden	3 (Hutchison)	May 5, 2003	WCDMA	1900 and 2100 MHz
Austria	3 (Hutchison)	May 5, 2003	WCDMA	1900 and 2100 MHz
Russia	SOTEL- Video	May 10, 2003	CDMA2000	450 MHz
India	Garuda 1X	May 19, 2003	CDMA2000	800 MHz
Guatemala	BellSouth	May 20, 2003	CDMA2000	1900 MHz

Commercial 3G CDMA Networks (4/4)

Country	Operator	Date	Technology	Frequency Bands
USA	Midwest Wireless	June 16, 2003	CDMA2000	1900 MHz
Vietnam	S-Fone	Jul. 01, 2003	CDMA2000	800 MHz
Guatemala	PCS	Jul. 15, 2003	CDMA2000	1900 MHz
Taiwan	APBW	Jul. 29, 2003	CDMA2000	800 MHz
Chile	BellSouth	Aug. 11, 2003	CDMA2000	1900 MHz
Denmark	3 (Hutchison)	Oct. 15, 2003	WCDMA	1900 and 2100 MHz
Russia	MCC	Nov. 1, 2003	CDMA2000	450 MHz

THANK YOU!

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Backup Slides

Licensing Update

By the 3rd quarter of 2003, roughly 123 3G licences have been issued around the world*

Trends:

- Overspending on licenses- €110bn spent during 2000-2001 alone.
- This generated a sharp increase of the debt level of telecom operators and consequently a downgrading of their credit ratings.
- Failure to attract sufficient number of bidders for 3G licenses: ex: France, Belgium, Greece and Luxembourg. Leads to unused and thus inefficient use of spectrum.
- License holders attempt to return licenses.
- 3G license conditions especially roll-out obligations under scrutiny. Especially in those countries where early coverage obligations proved to be incompatible with the availability of equipment.
- Trend shifts from auctions towards beauty contest and revenue sharing. Lowering of payments/fees and discussion of spectrum trading and liberalization in spectrum use.

* *UMTS Forum*

IMT-2000 Technologies

- **The ITU has approved five radio air interface standards (ITU-R M.1457) and has identified multiple frequency bands for IMT-2000**
- **Five ITU IMT-2000 recognized air-interfaces: WCDMA (IMT-DS), CDMA2000 (IMT-MC), TD-SCDMA (IMT-TD), DECT (IMT- FT), EDGE (IMT- SC).**

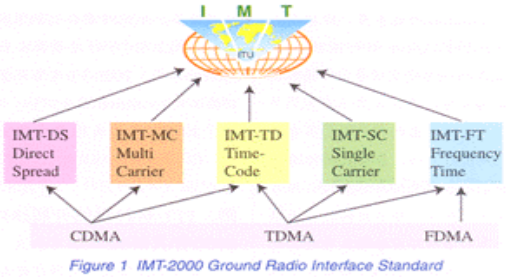

Figure 1 IMT-2000 Ground Radio Interface Standard

3G CDMA Technology in 450 MHz Band

Transmit Frequency Band (MHz) Block Designator			
Band Subclass	Access	Mobile Transmit	BTS Transmit
A	0	452.500-457.475	462.500-467.475
B	1	452.000-456.475	462.000-466.475
C	2	450.000-454.800	460.000-464.800
D	3	411.675-415.850	421.675-425.850
E	4	415.500-419.975	425.500-429.975
F	5	479.000-483.480	489.000-493.480
G	6	455.230-459.990	465.230-469.990
H	7	451.310-455.730	461.310-465.730

Band Class 5 (450MHz) is defined in TIA/EIA/IS-2000 (CDMA 2000 1X) and TIA/EIA/IS-856 (CDMA 2000 1xEV-DO)

CDMA2000 1X at 450 MHz NMT 'A' Band

- Preferred CDMA450 Frequency bands