WiMAX Forum® Position Paper for WiMAX™ Technology in the 700 MHz Band

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1.0 Introduction

In the last decade telecommunication capabilities and subscriber usage have changed dramatically. This is especially valid for mobile and Internet based services. Along with the strong increased usage of mobile and IP based services, the dependency of individuals, corporations and entire economies on the availability of respective telecommunication networks has increased dramatically. In addition to basic voice connectivity, broadband data services can play a key roll in economic development in both developed and emerging markets. This information technology revolution is available only for those who have affordable access to these broadband networks. Currently less than 20% of the global population has access to the Internet.

It is the charter of the WiMAX Forum® to foster broadband connectivity anytime and anywhere. Mobile WiMAX™ Release 1.0 products are presently available for several frequency bands in the range between 2300 MHz and 3800 MHz [Ref 1] to address numerous current spectrum allocations worldwide. Even though WiMAX systems based on OFDMA employ the most advanced technology in terms of modulation schemes and advanced antenna systems, cell ranges are constrained by physical propagation characteristics in the aforementioned frequency bands. This is not an issue in high population service regions with high capacity demand where smaller cells are required to meet data density requirements. When subscriber densities are low however, larger cells would be ideal to distribute the sector capacity in an economically optimized way over a wide area. Larger cells can best be realized with the availability of lower frequencies. Access to spectrum below 1000 MHz for broadband wireless services would enable more cost-effective deployments in low-density areas.

TV broadcasting services currently occupy a large portion of this spectrum. With the ongoing digitization of broadcasting services, much of this spectrum will become available for alternative services. This spectrum gain is commonly referred to as the "Digital Dividend". The World Radio Conference (WRC-07) has recently identified portions of this spectrum for IMT services. The spectrum in question, with regional differences, spans the range between 470 MHz and 862 MHz, and is commonly referred to as the "700 MHz Band". As an IMT technology, Mobile WiMAX is well positioned to use its undisputed advantages in the 700 MHz band to help relieve the Digital Divide in many regions of the world.

It is in fact, potentially, the only available technology that has the necessary performance, economic structure, and global support to provide for high quality cost-effective broadband access in rural regions with low subscriber density. Complementing WiMAX in the 700 MHz band with deployment of WiMAX networks in the higher frequency bands in higher population density regions, operators will have the opportunity to offer the best balance between cost and system capacity.

The purpose of this paper is to explain the WiMAX Forum's position, status, and planning for WiMAX products in the 700 MHz frequency band.

2.0 Market Status and Demand

Broadband Internet drives the world. WiMAX is positioned to connect the unconnected 80% of the global population

- The world is rapidly moving towards an Information Society that highly depends on Information and Communication Technology[1] (ICT).
- The benefits of Information Technology are unevenly distributed between developed and developing countries and within societies. This digital divide has to be turned into a digital opportunity for all to avoid further social and economical disintegration.
- It is widely recognized that access to ICT plays a fundamental role in promoting education, economic growth and social development.

2.1 Fixed Services

Recent studies[2], as shown in Figure 1, show that the number of fixed lines in developed countries is declining and the growth in developing countries is minimal. Worldwide fixed line penetration is less than 20% for a technology that has been available for over a century.

Fixed lines are not affordable in many regions

[1] ICT is defined as technologies for fixed, mobile and Internet communications

[2] World Information Society Report 2007, ITU – UN CTAD

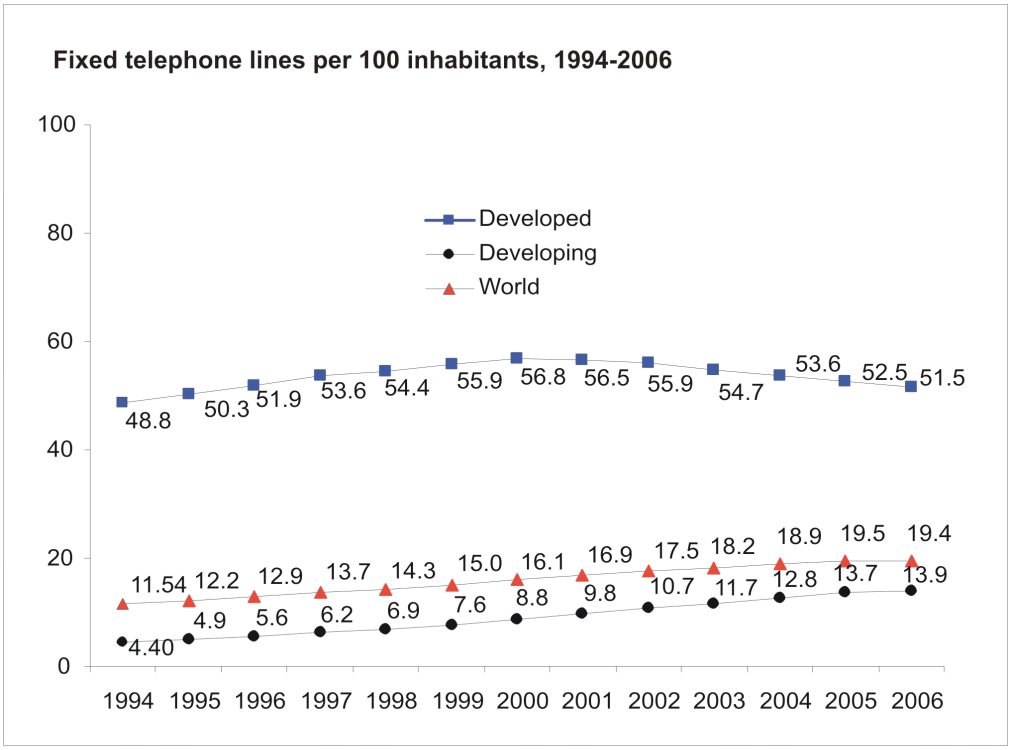


Figure 1: Worldwide Fixed Line Penetration

2.2 Mobile Services

In sharp contrast to the slow penetration for fixed-line technology, global mobile penetration for voice services, as shown in Figure 2, has grown to over 40% in a little more than a decade. This illustrates the fact, that wireless coverage requires only a fraction of capital cost and time for implementation compared to wireline based technologies. This is all the more valid the lower the population density and availability of reliable infrastructure.

Wireless connectivity is more economical and quick to implement

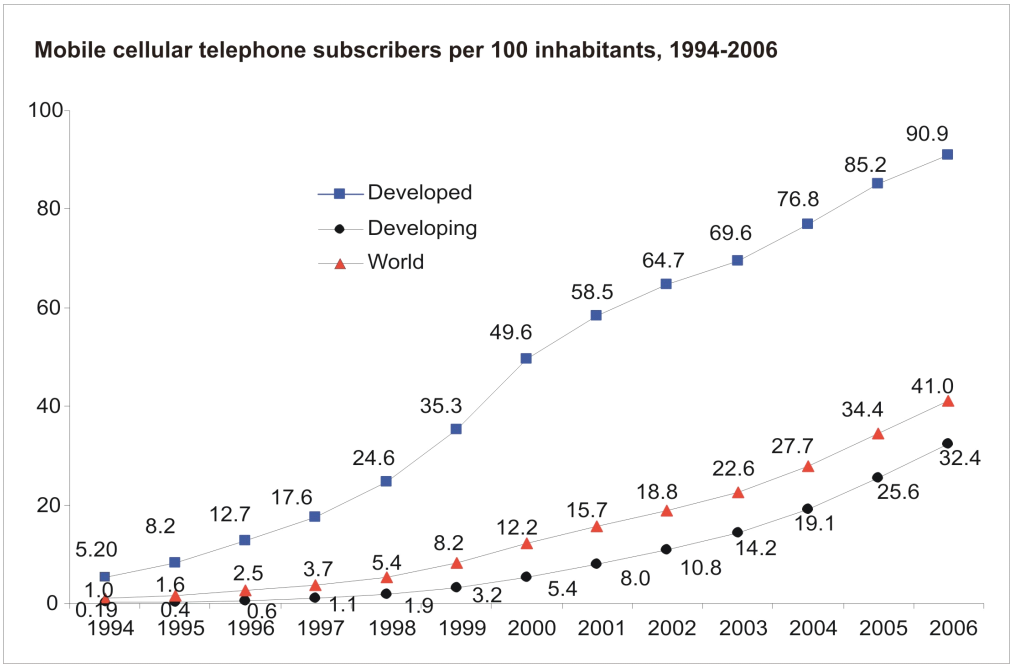


Figure 2: Worldwide Mobile Penetration

2.3 Internet Services

As shown in Figure 3, the world is far more divided in terms of Internet penetration rates.

- Almost 60% use the Internet in developed countries
- About 10% use the Internet in developing countries
- In the 50 least developed countries Internet users only total about 1%.

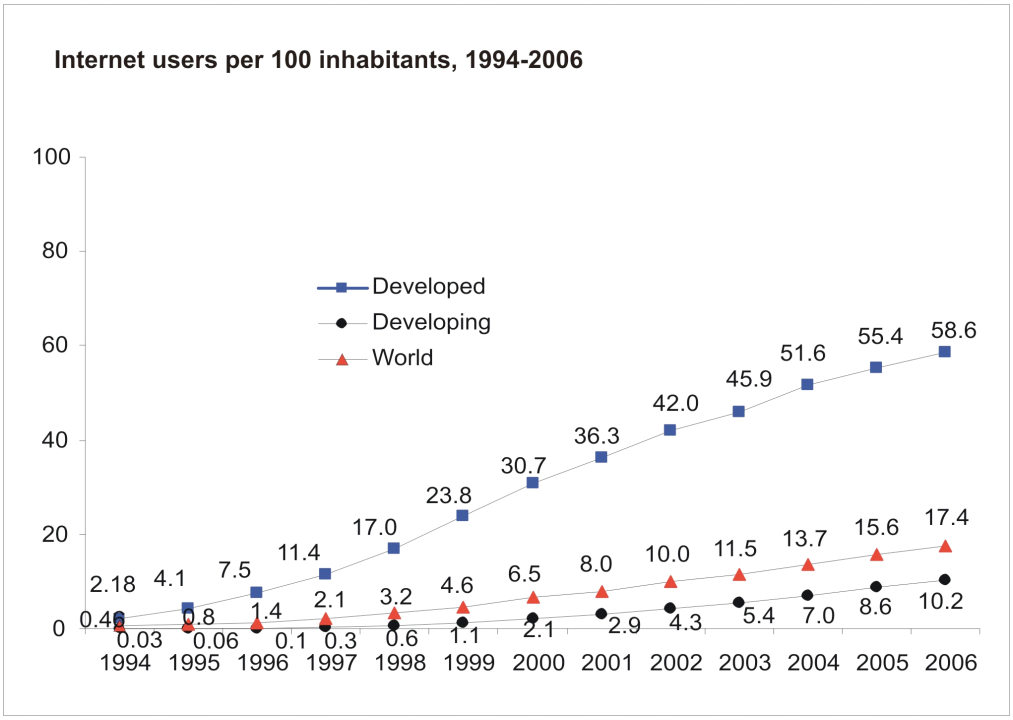


Figure 3: Worldwide Internet Users

82% of the global population are not enabled for Internet

Internet connectivity is not only constrained by network availability but also by usable bandwidth, connection cost, and individual affordability.

- Denmark has more than twice the international Internet bandwidth than all of Latin America and the Caribbean combined
- Low bandwidth translates to higher prices, slower speed and reduced affordability
- There is a logarithmic relationship between Internet penetration rates and Gross National Income (GNI) per capita
- 74% of all broadband (BB) subscribers are located in high income countries, representing 16% of the population and spend 2.1% of monthly GNI per capita for the service.

In contrast however;

- Only 0.7% of BB subscribers are located in low income countries, representing 37% of the population and spend 909% of monthly GNI per capita for the service

Broadband access must be made affordable for the majority of the population

Even though the most urgent demand for BB connectivity is in developing countries, developed countries also suffer from the digital divide phenomena. In Europe, for example, the overall DSL coverage of the EU-25 countries amounts to 88%. However, the respective rural DSL penetration is only 66%[3]. A similar ratio also applies to many other developed countries. This disparity in BB connectivity can be attributed to the cost of extending conventional wireline technologies into regions with lower population densities.

34% of Europe's rural population does not have DSL coverage

3G Mobile broadband is partially available in only high-density regions of developed countries providing, on average, 50% to 60% population coverage. Due to performance, cost, and coverage reasons, usage is picking up rather slowly. The cost per bit is not economically viable for broadband applications in low-density regions.

Similar to voice penetration, the only affordable solution is a globally standardized, cost-effective wireless broadband technology

WiMAX can bridge the divide and connect the unconnected

In summary the following conclusions can be drawn regarding the status of the market:

- There is high global demand for broadband connectivity in regions with low population density in both developed and developing countries

[3] Broadband Coverage in Europe, 2006 Survey, IDATE Consulting & Research

- The best solution to bridge this divide is a cost-effective, globally standardized wireless technology
- A technology such as WiMAX can cost-effectively serve fixed, nomadic, portable, and mobile usage models for broadband services on a global scale

3.0 Technical Considerations

The UHF frequency band from 470 MHz to 862 MHz, often referred to as the 700 MHz band, has lower propagation losses than the 2500 MHz or 3500 MHz bands being used today for WiMAX deployments. Benefits realized are lower path loss, better building penetration, and lower Doppler shift. These benefits translate to improved range and coverage resulting in a lower cost per subscriber in range-limited deployment scenarios.

Pass loss at 700 MHz is 26.5 dB lower

Metropolitan area BWA deployment for urban, suburban, and rural regions with indoor mobile subscriber stations is compared using a set of common parameters for system level simulations [Ref.2]. These include environment, channel models, delay spread, Doppler spread, and spatial characteristics. These analytical and simulation studies show that path loss is lower by approximately 26.5 dB, building penetration losses improve about 3 dB, and Doppler spread is about 10 dB better.

In range-limited scenarios the number of required base stations is less for 700 MHz

In deployments, that target cost-effective wide area coverage, a considerable saving in the number of base stations can be realized in the 700 MHz band compared to deployments in the higher frequency bands. Network design however, will be constrained by actual subscriber distribution and capacity requirements. It is important therefore, to analyze a more typical large-scale wide area deployment scenario with variable demographic conditions to gain a more accurate assessment of the deployment differences.

Coverage in the 700 MHz band is better

The UL link budget is typically the determining factor for cell range and coverage in the 700 MHz band. Advanced Antenna Systems (AAS), that significantly improve link margin, capacity and interference in higher frequency bands, are not, or only at lower efficiency applicable for 700 MHz due to size and antenna spacing limitations. Nevertheless, the lower path loss in the 700 MHz band provides for a significant coverage benefit. Under certain conditions in addition to the lower path loss, improved Carrier to Interference Noise Ratio (CINR) for DL data sub carriers in the order of 3 dB also contributes to higher data throughput per user compared to the higher frequency bands.

Deployment advantages in suburban and, especially, low-density rural regions

Deployment advantages can be realized in urban and suburban regions provided sufficient spectrum is available to meet capacity requirements commensurate with the subscriber density in these regions. For regions with lower population density, significant deployment advantages can be realized even with small spectrum assignments.

700 MHz can compliment 2500 MHz and 3500 MHz networks

In urban environments, with high subscriber density and high-capacity demand, smaller cells are necessary. In these cases, the application of 700 MHz is very much constrained by available spectrum, interference, and channel capacity. Due to the absence or limited efficiency of AAS for interference mitigation, a cost-effective deployment approach would be to deploy 700 MHz umbrella cells for coverage and compliment them with 2500 or 3500 MHz macro- or micro-cells to meet capacity requirements.

TDD provides better spectral efficiency with asymmetric traffic

WiMAX profiles for 700 MHz will be available for Frequency Division Duplexing (FDD) as well as for Time Division Duplexing (TDD) to be compatible with different worldwide channel assignments. Although many spectrum allocations will support either TDD or FDD, the asymmetric traffic expected in broadband data-oriented networks will generally favor WiMAX solutions based on TDD where allowed. This enables optimal

spectral efficiency resulting in higher DL base station capacity and a more cost-effective deployment with fewer base stations. Spectral efficiency is of utmost importance, since the amount of spectrum available in the 700 MHz band will generally be more limited than the higher bands. Therefore this extremely valuable spectrum resource needs to be used in the most efficient way to allow for mass usage where it is needed the most.

4.0 Regulatory Aspects

4.1 Spectrum and Regulation

The WiMAX Forum sees the changes underway in the UHF frequency bands as an exciting opportunity to extend the Mobile WiMAX broadband footprint into areas that are economically difficult to serve at higher frequencies. This will increase competition in suburban and urban areas and, where regulation permits, allow the use of high transmit powers to provide longer-range asymmetric services.

The WiMAX Forum was pleased to see that the 2007 ITU World Radiocommunications Conference (WRC-07) made important decisions that impart greater flexibility into the spectrum that will no longer be essential for terrestrial television once TV services become completely digital. Via a number of new and amended frequency allocations and footnotes in the Radio Regulations, the ITU has created opportunities for mobile broadband to move forward significantly.

The ITU has identified UHF spectrum, that may be used for WiMAX broadband services

Spectrum in the 470 MHz to 862 MHz range has now been identified with primary frequency allocations to terrestrial Mobile Service. It should be noted however that different portions of this spectrum are being addressed in different regions and countries. There are also regional differences in when the spectrum will become available.

Primary allocations are protected from harmful interference and, especially when taken together with the existing primary Broadcast Service allocations, there is opportunity for very flexible usage limited only by imagination and regulatory and technical constraints yet to be determined by the spectrum management community. The protected status makes the spectrum very attractive to potential WiMAX operators.

Indeed, the ITU has gone still further, and has created regulatory provisions that identify the entire part of the UHF spectrum recently allocated to the Mobile Service as being available to *those administrations wishing to deploy IMT services*. IMT is the new ITU-R umbrella name for both IMT-2000 and IMT-Advanced. WiMAX is the 6th air interface in IMT-2000. Thus from the WiMAX Forum's point of view, the new IMT spectrum identifications are very compelling.

White paper on spectrum opportunities at frequencies below 1000 MHz

It is expected that a WiMAX Forum White Paper on *Spectrum Opportunities at Frequencies below 1000 MHz* will be published early in 2008, and the WiMAX Forum is rapidly evaluating these opportunities. Certification Profiles for these frequencies are already under development. The WiMAX Forum Regulatory Working Group (RWG) is rapidly evaluating the regulatory and spectrum engineering aspects of the bands, into which WiMAX Forum Certified™ systems, matching these profiles, will undoubtedly be deployed.

WiMAX technology supports both FDD and TDD duplexing

WiMAX technology can operate in both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) modes. Several areas of study are underway within the WiMAX Forum for both TDD and FDD to explore satisfactory co-existence with other spectrum users. Areas to be addressed include:

- DL and UL compatibility of WiMAX with fixed and broadcasting systems
- Compatibility with other mobile technologies that might share the band with WiMAX
- Compatibility with systems for other Services to which the band is allocated
- Cross-boundary interference issues

Many of these topics will also be evaluated within the ITU-R, notably within a new Joint Task Group JTG5/6 on *Studies on the use of the band 790-862 MHz by mobile applications and by other services*. The WiMAX Forum welcomes the timely action by the ITU Conference Preparatory Meeting in setting up this group, as it will undoubtedly expedite the development of a stable radio-regulatory regime for these bands, and one that is globally recognized.

This ITU-R initiative will stimulate extensive regional and national preparatory meetings operating to the ITU driven timescales. The WiMAX Forum is an active Sector Member of all 3 ITU Sectors[4], and the Forum's RWG has a specialist Task Group to engage in the discussions at global, regional and national levels in support of the WiMAX Forum's ITU aspirations. The WiMAX Forum will fully engage in this broad range of discussions.

The WiMAX Forum is proactive with ITU study groups to help define a stable regulatory environment

To facilitate Regional engagement worldwide, the WiMAX Forum has been accepted as an observer in the CEPT[5] Electronic Communications Committee, as an Associate Member of CITEL[6] Permanent Consultative Committee III, and it has applied for MoU status with the APT[7]. WiMAX Forum members are also very actively working with their national regulatory administrations and regulators. This will allow the Forum to provide timely information to regional local regulators about WiMAX technology, and also enable the Forum to better understand the details of the emerging local conditions.

Communication with regulators is of key importance. 2007 has seen the development of the WiMAX Forum's *Regulator Outreach* program which welcomes, as observers, people from regulatory and government organizations. There are currently approximately 190 such observers from more than 80 countries. The outreach program includes a specific web site for regulators thus providing a trusted source of information on spectrum and regulatory elements of the WiMAX eco-system. A focus for this site in 2008 will be the rapidly developing WiMAX information related to the "700 MHz Band" and similar frequencies in the UHF band.

The WiMAX Forum will expand its Spectrum and Regulatory Database to include the bands below 1000 MHz

An important service that the WiMAX Forum provides for its members is its Spectrum and Regulatory Database. This database is maintained and updated regularly through frequent contact with the regulatory community. A key objective for 2008, with work

[4] Radiocommunications Sector, Telecommunications Sector and Development Sector.

[5] CEPT Conference of European Postal and Telecommunications Administrations.

[6] CITEL: Inter-Americas Telecommunications Commission

[7] APT: Asia Pacific Telecommunity

already underway, is to include information for the new bands emerging from WRC-07. Following the WRC, many national administrations are deciding if, how, and when they will make the new bands available. The WiMAX Forum will track the developing situation, communicating with members and contributing responses to national consultations as necessary.

5.0 WiMAX Release and Profile Evolution

WiMAX Forum Activities and Plans for 700 MHz Profile Development

Based on recent spectrum developments and increased interest among WiMAX Forum members in deploying broadband access networks at UHF frequencies, the WiMAX Forum has initiated several studies across different working groups related to WiMAX solutions for frequencies around 700 MHz.

During the WRC 2007, parts of the UHF frequency range were allocated to the Mobile Service on a primary basis, and identified as being applicable to the deployment of IMT radio access technologies. Figure 4 summarizes the results of these allocations across the three major worldwide regions. Depending on the market requirements and regulatory decisions in each region, these frequency bands may be used for deployment of TDD or FDD based systems, or both.

While the regulatory requirements for the 700 MHz band are being discussed and defined internationally, there is more clarity for requirements in the United States (see Figure 5).

Development of new 700 MHz WiMAX profiles is dependent on specific band plan and regulatory requirements

700MHz View in WRC

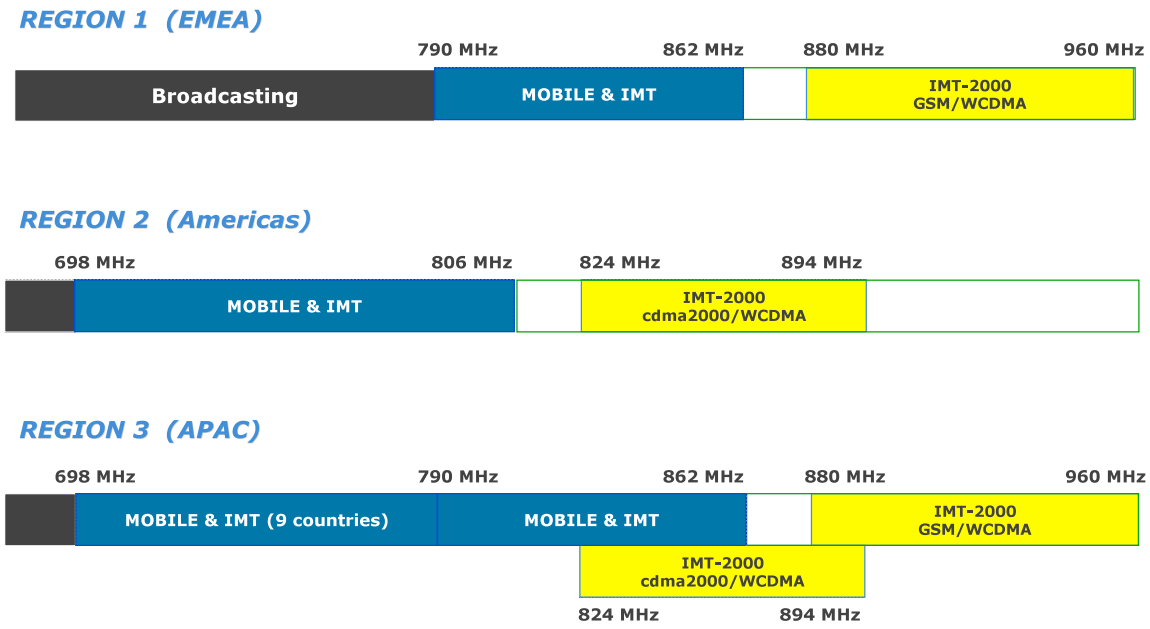
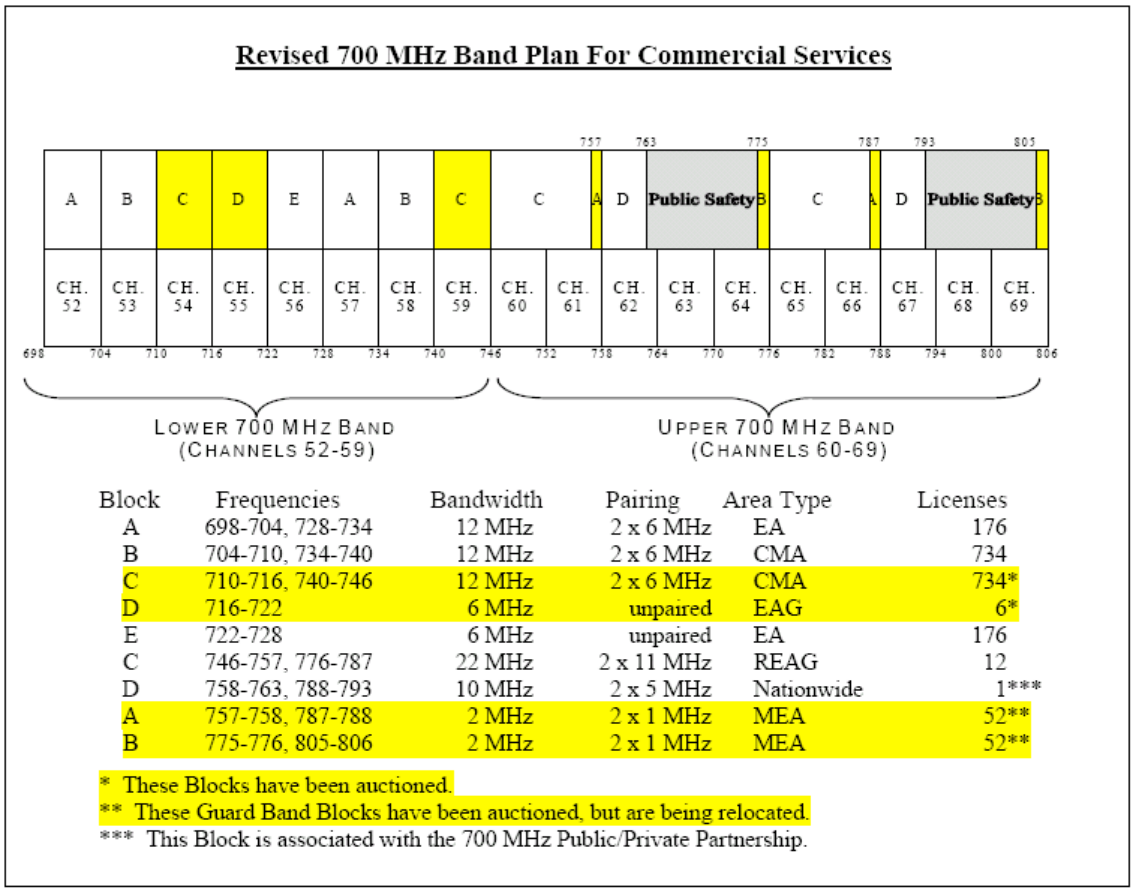


Figure 4: WRC-07 Results for New Spectrum Allocations



Block	Frequencies	Bandwidth	Pairing	Area Type	Licenses
A	698-704, 728-734	12 MHz	2 x 6 MHz	EA	176
B	704-710, 734-740	12 MHz	2 x 6 MHz	CMA	734
C	710-716, 740-746	12 MHz	2 x 6 MHz	CMA	734*
D	716-722	6 MHz	unpaired	EAG	6*
E	722-728	6 MHz	unpaired	EA	176
C	746-757, 776-787	22 MHz	2 x 11 MHz	REAG	12
D	758-763, 788-793	10 MHz	2 x 5 MHz	Nationwide	1***
A	757-758, 787-788	2 MHz	2 x 1 MHz	MEA	52**
B	775-776, 805-806	2 MHz	2 x 1 MHz	MEA	52**

* These Blocks have been auctioned.
** These Guard Band Blocks have been auctioned, but are being relocated.
*** This Block is associated with the 700 MHz Public/Private Partnership.

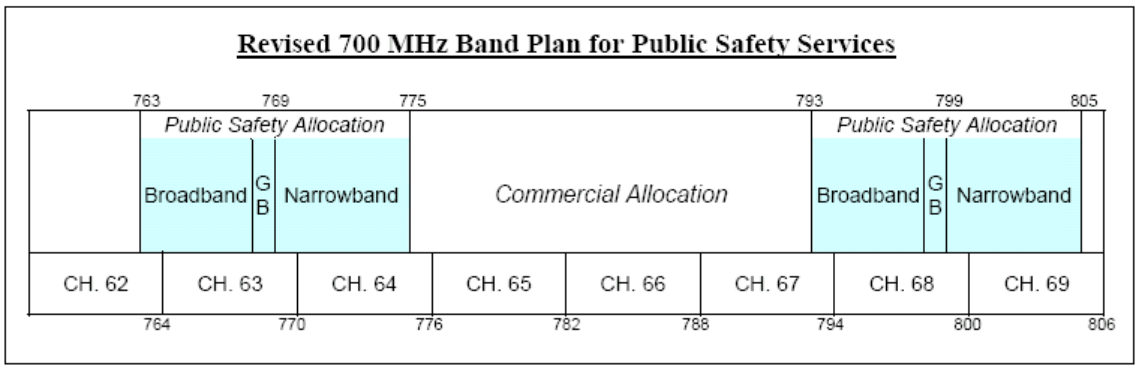


Figure 5: 700 MHz Band Plan for Commercial Services in the United States

In the United States the FCC has partitioned the band into "Lower" and "Upper" 700 MHz bands as shown in Figure 5. This includes updates made July 31, 2007.

- The lower band (698–746 MHz) consists of eight 6 MHz blocks, six of which are paired blocks (i.e., suitable for FDD deployment, but not mandated) and two unpaired blocks (D and E) that are designated for Aloha Broadcast (block D).
- The upper 700 MHz band, (746-806 MHz), includes Public Safety as well as commercial allocations, blocks C and D. Four guard bands are also set aside in the upper 700 MHz band. The upper 700 MHz band spans the former TV channels 60 through 69.

WiMAX Forum is in the process of developing profiles for the 700 MHz band for TDD and FDD

Given the clarity of the band plan in the United States, trends and projections on 700 MHz band allocations internationally, the WiMAX Forum has realized the need for introducing certification profiles for both TDD and FDD systems in the 700 MHz band within the 2009-2010 timeframe.

While the currently published Release 1.0 System profile and certification efforts are focused on TDD systems in the 2.3, 2.5, and 3.5 GHz bands, various working groups in the WiMAX Forum are working on defining requirements and parameters needed to extend the system profile to new bands including those around 700 MHz, and to also enable efficient FDD operation. These activities are included in the development of the Release 1.5 profile. Figure 6 shows the projected timelines for WiMAX Forum activities related to Release 1.5.

While the Service Provider Working Group (SPWG) has defined high level requirements for the 700 MHz band, the Technical Working Group (TWG) is creating technical requirements and parameters for the 700 MHz band based on regulatory requirements in the US and band plans still emerging internationally. These technical requirements are expected to be reviewed and approved for certification planning and execution in the near future.

FDD profiles will be included in WiMAX Release 1.5

For FDD systems in the 700MHz band, WiMAX products are expected to comply with Release 1.5 requirements for certification and according to IEEE 802.16 Rev 2

specifications. The certification of Release 1.5 based products, including the 700 MHz FDD profile, is currently projected to begin in Q4 of 2009.

700 MHz TDD Profiles will also be based on Release 1.5 or on Release 1.0, depending on market demand

Depending on market demand and the status of regulatory requirements, WiMAX TDD systems in the 700 MHz band will be developed and certified based on Release 1.5 at about the same time as the FDD system or, if needed, based on Release 1.0 system profiles in a shorter timeframe.

In 2009 WiMAX will be 700 MHz band ready

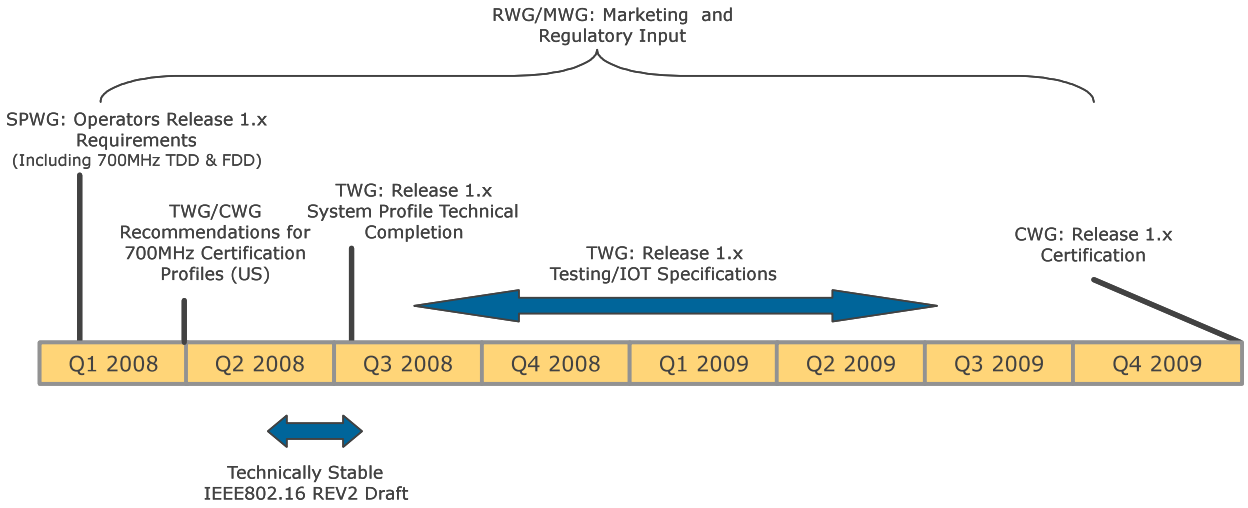


Figure 6: Projected WiMAX Release 1.5 Timelines

6.0 WiMAX Ecosystem Support for 700 MHz

For many regulatory regimes, a key objective driving the interest in the 700 MHz band is to enable solutions that provide a cost-effective extension of broadband applications into regions with low subscriber density. This is a multi-dimensional endeavor since the solutions and the user experience are dependent upon many components of the WiMAX Ecosystem as shown in Figure 7. Together these components not only provide a viable

environment but also help achieve the goal of providing access to broadband services through WiMAX anytime, anywhere.

The demand for broadband access is universal, however only a limited percentage of consumers have access to fixed or mobile broadband networks. This is especially true in emerging markets. Both, technical availability and commercial affordability constrain widespread usage causing the world to be more and more divided.

There is pent-up demand for broadband usage, Anytime and Anywhere; Availability and affordability are key

Along with the WiMAX Forum's activity of defining profiles for the 700 MHz band, the entire WiMAX Ecosystem must be prepared for the respective product range extension. First in line are equipment manufacturers for base stations and associated RF component suppliers. The first 700 MHz pilot systems have already arrived in the field for testing and fine-tuning. The most critical elements are the chipsets. They provide the Nuts-N-Bolts of the technology. Key pieces are the base-band MAC, RF-ICs and the power amplifier in addition to processors and memories. Typically system design and validation can cause a long lead-time for new products. Therefore, it is essential to have chipset manufactures closely aligned with operators and standardization bodies. Through the WiMAX Forum's Technical Working Group (TWG) various leading chipset vendors are participating in defining the 700 MHz band profiles. This ensures that chipsets are available as soon as specification and profiles are defined. In terms of CPE chipsets, the emphasis is not only to cover a single new frequency band, but in order to save on design, validation and manufacturing costs, to target wideband and multi-band solutions. This will enable connectivity to WiMAX networks operating in different frequency bands and thus extend its usage globally.

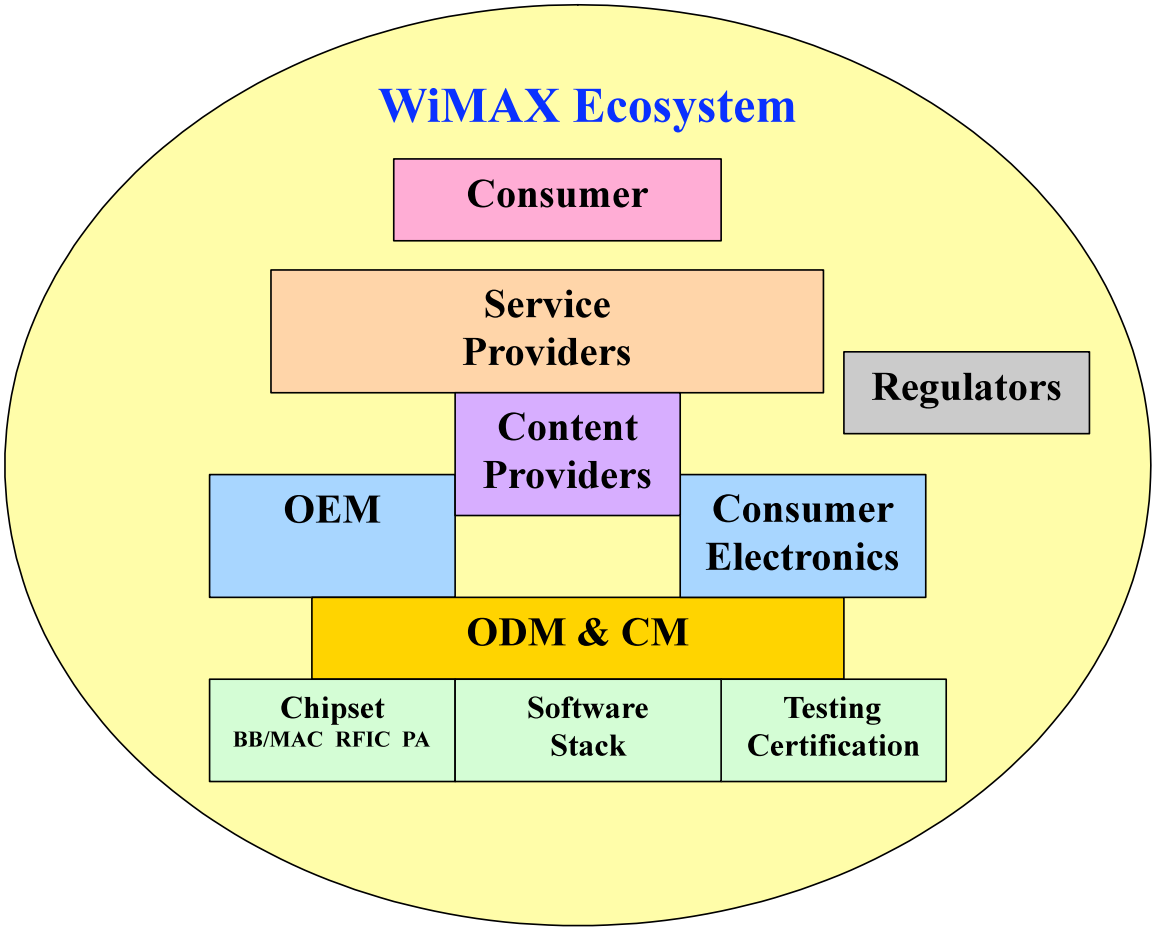


Figure 7: The WiMAX Forum Ecosystem

First 700 MHz CPE chipset samples will be available in H2-2008, production is scheduled to begin in 2009

Service providers have clearly indicated that they are awaiting solutions that are cost-effective in low density markets. WiMAX in the 700 MHz band has the capability to meet these requirements and reach new subscriber segments. This provides for new perspectives for content providers to fuel network applications and hence sustain the usage and take-up rates.

The WiMAX Forum is acting as the catalyst for putting together the entire Ecosystem. It further drives the OPEN technology adoption and fosters competition through certification programs. The WIMAX Forum is bringing all these components together so that they interwork and are synchronized to deliver products on time. It is very important, as only then the economies of scale can be realized to deliver advanced cost-effective solutions.

The WiMAX Ecosystem is on track for 700 MHz systems

7.0 Commercial Deployment Aspects

Broadband cellular wireless networks are typically constrained by two key metrics:

- **Cell Capacity**
  - Determines the number of users that can be served simultaneously with a specific data rate
  - Is in direct relation to population and subscriber density
  - Is relatively independent of frequency band for the same channel BW and channels per cell
  - In capacity driven networks the number of cells are derived from the required data density in the area to be covered knowing the achievable throughput per cell
- **Cell Range**
  - Is limited by propagation path loss
  - Is greater in the lower frequency bands
  - Is dependent on usage model and terminal parameters: fixed, indoor, outdoor, nomadic, mobile, etc.
  - For coverage constrained networks, the number of required cells are derived from the geographic area to be covered, the terrain characteristics, and the known cell radius

Optimum deployment is achieved, when coverage and capacity requirements are in balance

To provide adequate coverage with an optimized balance between deployment cost and performance in regions with low population or subscriber density, larger cells are essential. Large radius cells are achievable in the 700MHz band.

Cost-effective solutions for deployment in low density regions require access to spectrum below 1000 MHz

WiMAX in the 700 MHz band will meet performance and coverage requirements to ensure commercial success

The attributes of WiMAX will ensure commercial success in the 700 MHz band:

- Achievable cell range from 5 km to 30 km, depending on terrain, usage, and CPE type
- Number of cells for coverage are 3 to 5 times lower compared to 2500 or 3500 MHz
- CAPEX optimized for coverage
- Cell capacity is scalable to meet changing and growing demand
- Support for multiple usage models from fixed to mobile
- Lower OPEX due to indoor operation capability of active units
- Comparable spectral efficiency to solutions in the higher bands
- 700 MHz is ideal for dual or triple band operation to complement urban networks
- Positive feedback from equipment and component suppliers
- Positive business case for developing and developed markets
- Access to spectrum below 1000 MHz provides better coverage and significantly improves the economics for deployment in low density rural areas

With WiMAX in the 700 MHz band, broadband connectivity becomes affordable for the unconnected

8.0 Conclusion

The WiMAX Forum believes that the 700 MHz band will play an important role in wireless broadband deployments. WiMAX is leading the market in terms of technology innovation, performance, efficiency and global support. It is a logical step for the WiMAX Forum, to fully commit to develop profiles for the 700MHz band to ensure product availability in a timely fashion. Depending on rapid clarification of required regulatory details in various regions, certified WiMAX products can be expected in 2009. Even with limited spectrum assignments, WiMAX in the 700 MHz band can provide a cost-effective solution for delivering broadband services to residents in areas that would be uneconomical to serve with conventional wire-line or other wireless access technologies. WiMAX deployments in this band can be expected to play a key role in helping to bridge the Digital Divide and transform it to Digital Opportunities for the "unconnected" worldwide.

The WiMAX Forum is committed to WiMAX solutions in the 700 MHz band

Acronyms

AAS	Advanced Antenna Systems
BB	Broadband
BS	Base Station
BW	Bandwidth
BWA	Broadband Wireless Access
CAPEX	Capital Expense
CINR	Carrier to Interference + Noise Ratio
CPE	Customer Premise Equipment
DD	Data Density
DL	Down Link
DSL	Digital Subscriber Line
EU	European Union

FCC	Federal Communications Commission
FDD	Frequency Division Duplex
GNI	Gross National Income
GSM	Global Standard for Mobile communications
IMT	International Mobile Telecommunications
IP	Internet Protocol
ITU	International Telecommunications Union
MAC	Media Access Control
MS	Mobile Station
OFDMA	Orthogonal Frequency Division Multiple Access
OPEX	Operating Expense
RWG	Regulatory Working Group
SPWG	Service Provider Working Group
TDD	Time Division Duplex
TWG	Technical Working Group
UHF	Ultra High Frequency
UL	Up Link
UMTS	Universal Mobile Telephone System
WRC	World Radio Conference
WiMAX	Worldwide Interoperability for Microwave Access

References

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