1) BWA framing

a) Define and describe the technologies covered by BWA, indicating positive aspects and possible fragilities.

One key requirement for BWA network architecture is to seamlessly integrate fixed and nomadic subscribers into both existing fixed and mobile network architectures. The Alcatel-Lucent WiMAX strategy aims to provide a comprehensive end to end solution tailored for all operators types.

Alcatel-Lucent not only focus on the introduction of a new radio access point, but intends to develop an end to end solution for carrier grade high throughput nomadic services.

To achieve it, Alcatel-Lucent uses innovative technologies both on the radio part, on the basis of the future proof 802.16e air interface based on SOFDMA, variant of OFDM, and on the network infrastructure part, on the basis of an IP based solution, and network solutions for a seamless WiMAX RAN introduction.

All operators, fixed and mobile, faced almost the same issues when dealing with WiMAX, or today with WiFi, access. In the public area, they need to address issues such as security and billing of the end-user services, on a consistent basis with already deployed services. Furthermore inter-working functions with existing radio access are key parameters to ensure successful deployment of WiMAX access.

Therefore it enables Alcatel-Lucent to provide a WiMAX system with key following features

- High data throughput per user,
- High capacity per cell,
- High spectral efficiency,
- Low latency and solutions to perform,
- Transparent access between different access networks,
- Integration in various network architecture: greenfield WiMAX network deployment and Integration in fix or mobile architectures.

Operators deploying radio access points for high throughput services face several challenges that WiMAX infrastructure suppliers should answer, mainly around,

- Minimizing the operators investment through minimizing radio sites,
- Backhauling requiments.

Overall WiMAX network deployment strategy is to deliver high throughput nomadic services with a global coverage.

In the deployment of such new radio technology and new services, the optimization of the CAPEX is a key parameter for the overall success and to permit operators to reach financial targets. As the main part of operator's network investment is made of radio sites, it is an absolute target in order to achieve this coverage strategy to minimize number of radio sites.

As radio sites are becoming more and more scarce resources, due to raising environmental concerns, an adequate strategy would be to favor solutions for sharing sites between existing deployed cellular networks sites and WiMAX networks.

WiMAX systems shall implement advanced radio features that permit to balance the extra attenuation due to:

- **Higher carrier frequency**; the path loss increases with the frequency and WiMAX usually operates in frequency ranges higher than conventional cellular systems,
- **Larger transmission bandwidth**; the receiver sensitivity is proportional to the transmission bandwidth. WiMAX typical bandwidth is 10 MHz compared to 200 kHz for GSM based systems or 5MHz for WCDMA based systems,
- and, **Deep indoor penetration**; indoor reach is a must for WiMAX in any environment whereas in cellular it is a must only in urban area.

But advanced radio features are defined in 802.16 standards to offer the desired performance (i.e. very high data rates –several Mbps- in a cellular environment), mainly modulation type SOFDMA, smart antennas technologies, UL subchanneling.

WiMAX system solutions should include radio sites backhauling options for different kind of physical supports, mainly

- Wireless Solution (e.g. PDH, SDH or WiMAX Self-backhauling),
- Copper Solution (e.g. the technology based on g.SHDSL could offer through bundling multipair copper pairs the required throughput),
- Fiber Solution

The WiMAX technology is based IEEE 802.16e-2005 and the WiMAX Forum has provided specific profiles that support interoperability.

The current certification profiles are listed in table below

Evolutionary WiMAX (IEEE 802.16e-2005, SOFDM)	4.935 - 4.990 GHz	TDD	5 MHz
Mobile WiMAX (IEEE 802.16e-2005, SOFDMA)	2.3 - 2.4 GHz	TDD	5, 10 MHz (dual)
	2.3 - 2.4 GHz	TDD	8.75 MHz
	3.4 - 3.6 GHz	TDD	5 MHz
	3.4 - 3.6 GHz	TDD	7 MHz
	2.496 - 2.690GHz	TDD	5, 10 MHz (dual)

The above certification profiles reflect the current situation within the WiMAX Forum (November 2006). However, to respond to worldwide market needs, more profiles (TDD and/or FDD) are expected to be released, including profiles in the band 3.6-3.8 GHz.

The WiMAX Forum regularly evaluates the requirement for new or revised certification profiles.

b) Define the radio parameters of the technologies mentioned above, including:

i. Power;

On the Front End Unit, power amplifier (PA), low noise amplifier (LNA), RF filter and Rx/Tx antenna switch to permit the TDD mode of operation, are implemented.

The power amplifier is used in the transmit path and delivers 35dBm RF mean output power to the antenna connector (42,5 dBm max).

ii. Channels

- 3.5 MHz(*), 7.0 MHz
- 5.0 MHz, 10.0 MHz
- 8.75 MHz
- 14 MHz or 20 MHz for further release
- (Not in the WiMAX Forum profile)

Table here under shows mapping between Channel Bandwidth and FFT size:

Channel Bandwidth	10 MHz	8.75 MHz	7 MHz	5 MHz	3.5 MHz*
FFT size	1024	1024	1024	512	512

iii. Duplex mode (TDD/FDD);

The duplexing mode is TDD.

The DL/UL Frame ratio is configurable from Operation & Maintenance Center in 3 steps: 3/1, 2/1, 1/1. The exact number of OFDM symbols in each DL or UL part depends on the selected channel bandwidth, and the permutation schemes used within the frame (PUSC, AMC 2*3,…).

TDD switching timing for HW parts: 15µs < TTG < 50µs and 15µs < RTG < 50µs depending on Channel bandwidth, and possible number of OFDM symbols in 5ms frame, remaining (TTG+RTG), can reach up to around 160 µs. Adjustable TTG (with 50µs RTG) values are under WiMAX Forum Profile definition.

Alcatel-Lucent foresees to propose different bands according to the different available bands for WiMAX services around the world, that are mainly in 2.5GHz and 3.5GHz families:

- 2,5 GHz licensed band
- 2.3-2.4 GHz
- 2.5-2.7 GHz
- 3,5 GHz licensed band
- 3.3-3.4 GHz (according to market demand)
- 3.4-3.6 GHz
- 3.6-3.8 GHz (according to market demand)

Furthermore Alcatel-Lucent currently investigates the feasibility to extend its product family towards unlicensed spectrum bands, mainly in 5GHz.

iv. Modulation;

For both downlink and uplink, depending on MS capability and Air link propagation conditions (AMC mode), available modulations and FEC puncturing schemes at BS are:

- QPSK ½ & ¾
- 16-QAM ½ & ¾
- 64-QAM 2/3 & ¾

v. Applicable standard (when existing);

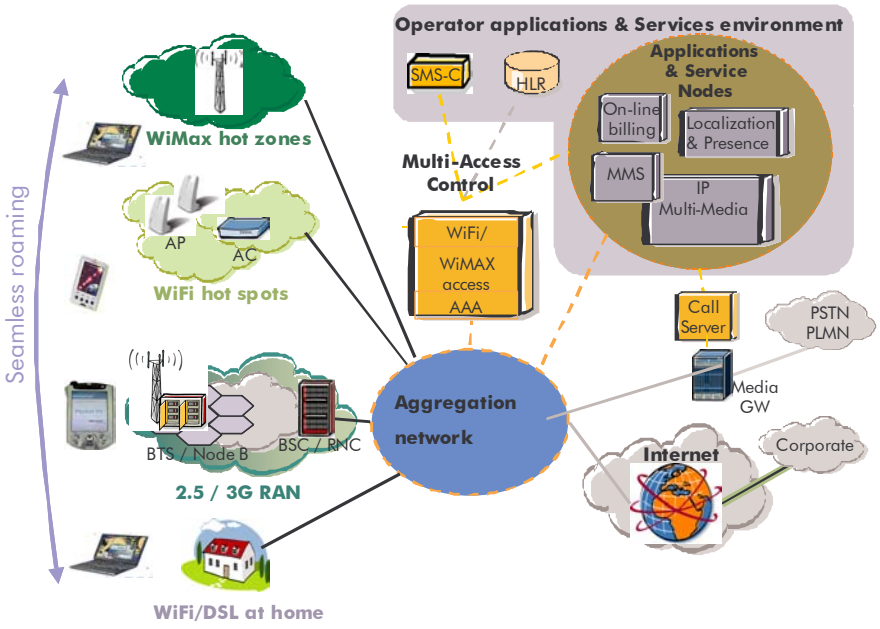
- IEEE 802.16e / ETSI HiperMAN
- “Combined Fixed and Mobile Operation in Licensed Bands”;

vi. Coexistence amongst the various technologies and/or variations of same technology;

By integrating WiMAX into their networks, mobile operators can boost their service with high bandwidth, complementing their data service portfolio, while accessing to the same applications (messaging, agenda, portal, …) being offered on both networks with a single billing and subscriber profile. Mobile operators have already a wide coverage cellular infrastructure and therefore can reuse existing radio sites and backhauling equipment to facilitate the deployment of WiMAX. . Thus, the mobile operator’s subscriber can benefit from global coverage : WiMAX, WiFi, Mobile 2G & 3G.

The main architecture strategy is to ensure nomadic users, what ever their access network (wireless, wireline) can take advantage of a common service architecture (billing, authentication, operators services…). In this sense the integration of a WiMAX nomadic offer into a fixed or mobile infrastructure can be similar to a WiFi integration offer.

The depicted solution enables end-users to enjoy an "Always best connected" experience when accessing their applications via the best available network be it at home, on the pause or on the move. WiMAX becomes an additional radio access solution to be taken into account in the global network architecture.

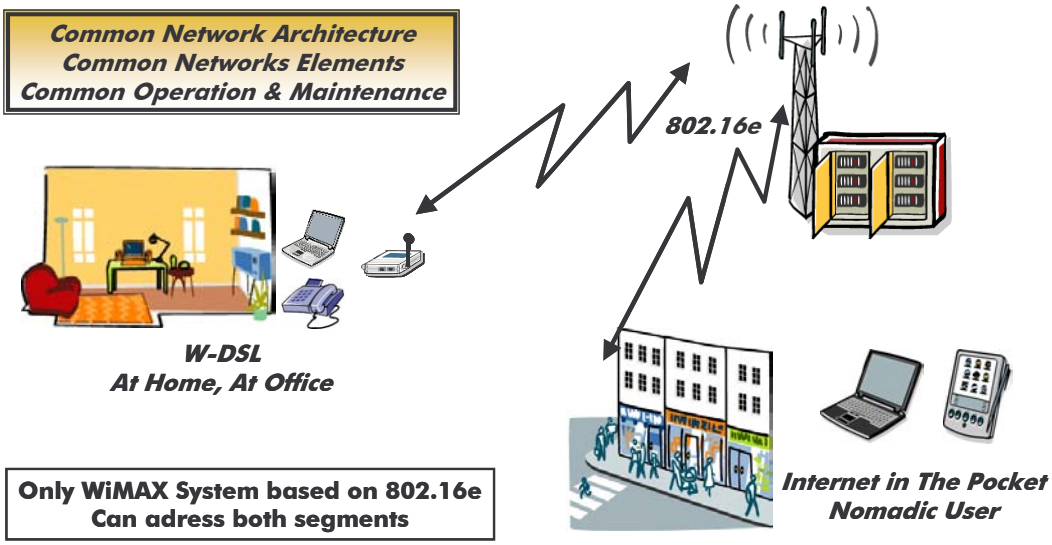


Furthermore, with WiMAX introduction Alcatel-Lucent intends to propose the optimum solution managing secure seamless handover between networks at the highest data rate possible, all from a single end-user subscription.

c) What type of use is best suited to BWA technologies: connection to end user, transmission network or both?

Thanks to its innovative set of features, WiMAX based on 802.16e can address whole set of applications, Wireless DSL, ie Fixed Wireless Access applications (people at home or at office) and as well Nomadicity and mobility networks (people equipped with reduced form factor terminals, like laptops with PCMCIA modules or PDAs).

One system for all applications principle will lead to very important economy of scale. Operators will have the opportunity to bundle services into a grouped offer : Wireless DSL at home **bundled** with nomadic service, all connected to a single radio access network.



New Usages

WiMAX Forum has defined four categories of usages and will deliver in its first release specifications for the end to end system architecture targeting all usages up to the simple mobility, opening large new service opportunities coupled to the availability of new devices.

- **FIXED ACCESS**

  Fixed Access service is the most basic form of WiMAX network operation and mimics fixed DSL or cable broadband services. No mobility, ie no connection portability or handovers are supported in this scenario. The end user terminal

may select and occasionally change its connection to the 'best' available Base Station depending on the quality of the signal.

- **NOMADICITY : CONNECT HERE AND THERE**

  Nomadic service adds the capability for the end user terminal for broadband services from different access locations in an operator's WiMAX network ; however stationary access is presumed from the subscriber terminal for the duration of each connectivity session. Connections (and connection contexts) are not retained between two network (re)entry instances.

- **PORTABILITY: ON THE WALK**

  This is the first usage scenario where some mobility is provided to the end user through continuity of data session when moving and serving base station modification. Simplified mobility mechanisms, ie best effort, are embarked and the user may experience a glitch in connectivity or perceive some latency or quality of service performance degradation. Application level continuity without user intervention is provided.

  The end user can walk around while connected to the network and experience no connectivity interruption except possibly briefly when changing serving cell.

- **SIMPLE MOBILITY: ON THE MOVE**

  Some optimization of the mobility mechanisms, including usage of handover mechanisms, ensures the subscriber to get access to broadband service when moving : he or she can walk, drive, take a bus etc. up to 50km/h/100km/h but experiences some service degradation when performing the handover while maintaining the data session. This mode is optimized for non real time applications when moving.

- **FULL MOBILITY: REAL-TIME APPLICATIONS**

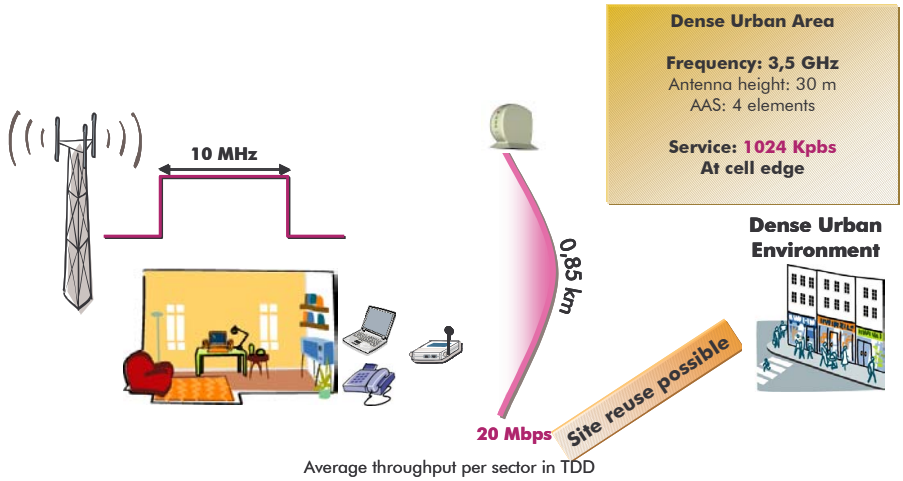
  Full Mobility operation is optimized for latency intolerant applications at vehicular speeds of at least 100 km/hr with enhanced mechanisms to ensure handover latency less than 50 msec that is suitable for real-time applications such as VoIP at any mobility rate and packet loss during handovers.

d) What types of service could be offered by each technology? Please explain in concrete terms the amount of spectrum needed to provide these services and the capabilities of the identified technologies.

The overall strategy is to be able in general to have similar Radio grid as the one deployed by Mobile operators. This strategy will permit **to minimize CAPEX** for operators as well as possibly sharing radio sites in order to multiple the number of new sites especially in Urban areas.

Alcatel-Lucent has performed a lot of simulations studies to analyse WiMAX performances, and such strategy is compatible with 2.5 and 3.5GHz bands (or similar) for Urban and Sub-Urban areas.

For instance, for dense urban scenario, at 3.5GHz and 10MHz channel (ensuring more than 20Mbps average throughput per cell, and minimum service for end user at 1mbps at cell edge) we can achieve 0.85km cell radius that is compatible with GSM grid.



Dense Urban scenario at 3.5Ghz

For suburban areas, based on 3.5Mhz channel, and still at 3.5GHz, nearly 1.5km cell can be achieved.

Nevertheless for rural areas, cell ranges are not sufficient to achieve Indoor modem deployment, while using 3.5GHz (or 2.5GHz) band. Indeed cell range decreases to around 5kms.

e) What is the target market and how big is the market envisaged for the technologies/services offered?

To make optimal use of this new radio access network, adequate integration and interworking mechanisms with existing operator's core networks. Three levels can be foreseen :

- **Common access control, authentication**

  Users can take out a single subscription and receive a single bill through the different access networks. The solution is based on Authentication, Authorization and Accounting (AAA) mechanisms.

- **Access to common services**

  All flows are routed through the home network by using tunneling mechanisms. This interworking scenario gives the home operator full control of the service offering (including billing, policy control), and provides the user with the same set of services that he or she is used to some other access network.

- **Service continuity across different access networks through support for mobile IP**

  Although initially users will simply want to access their services, they will rapidly also demand service continuity, despite the implications for throughput and quality.

Integration in Fix Network Architecture

The strategy is to bring an end to end solution to various types of fix operators in order to integrate easely a wireless access network based on WiMAX technology.

Beyond the WiMAX Radio Access Network, Alcatel-Lucent proposes a set of Core Network Functions solutions for easy integration and interworking :

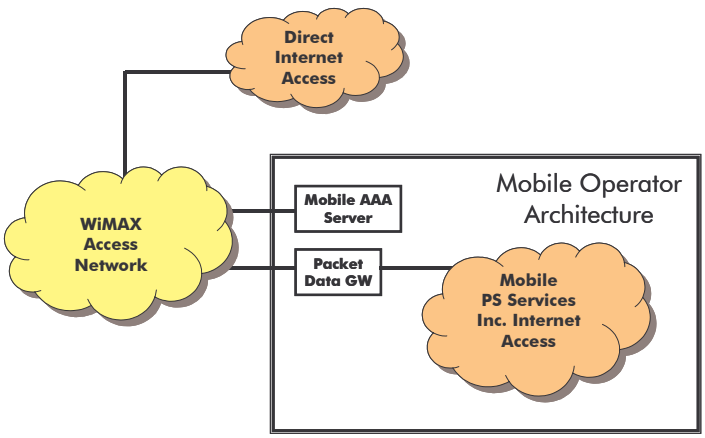
- AAA using EAP-TLS or EAP-SIM authentification
- Firewall for Direct Internet access from Access Control
- Basic set of charging counters for Charging Gateway connection
- Home Agent for Macro Mobility management

Integration in Mobile Network Architecture

The global proposed strategy is to use similar mechanisms as those developed for Wireless LAN integration in mobile architecture. This integration aims to get

WLAN Access, Authentication and Authorisation, through the Mobile System,

IP Access, meaning that in addition of access to a locally connected IP network from the WLAN, the end user is able to establish connectivity with mobile operator IP networks via the mobile system and architecture.



Such approach permits the end user to access operator services and have identical access & authorization mechanisms based on SIM and USIM.

The main functions of the interworking unit PDG, Packet Data Gateway, are to provide a Tunnel Termination Gateway between WiMAX Access Network and Mobile Core Network, and following functions : charging gateway interfaces, IP address allocation, authentication in external networks and single access to Mobile Core network PD domain services. These functions can be seen as a subset of GGSN functions in 3GPP case.

WiMAX as IP Based Network

An all-IP network can be defined as having an IP Core network architecture, an IP Radio Access Network (RAN) architecture, mobile terminals that are IP host devices and an air interface that is optimized for packet data delivery (rather than circuit traffic such as voice).

The costs advantages provided by an all-IP network are considerable, by converging voice and data onto a single network, reducing the initial capital expenditures required to deploy the network and also the operating expenses.

Alcatel-Lucent builds a Full IP based WiMAX system through

- Full support of Internet protocols,
- IP Transport,
- Mobile IP mechanisms,
- Voice Over IP service based on SIP Protocol,

WiMAX Mobility Solutions

The Alcatel-Lucent mobility solution is based on a multi-layer IP based mobility:

- Micro mobility corresponds to a handover between WiMAX base stations managed by the same access router.
- Macro mobility corresponds to a handover between Wimax base stations managed by different access routers.
- Inter technology mobility corresponds to a handover between radio access networks of different technologies.

A multi-layer IP based mobility

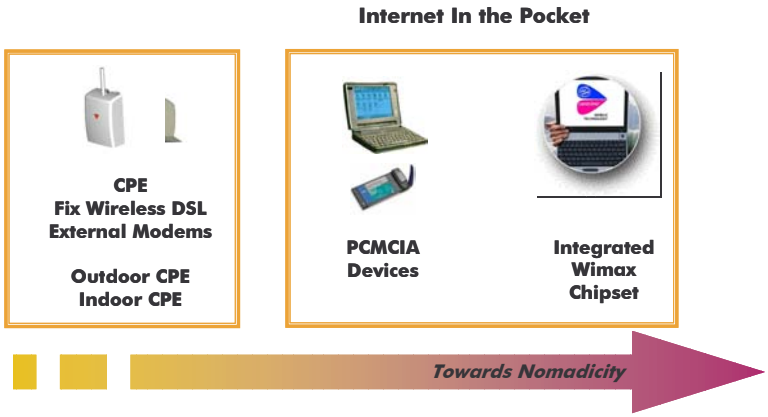
These mechanisms based on the Internet Protocol (IP) level using the Internet Engineering Task Force (IETF) Mobile IP (MIP) protocol permit simple mobility to users under the WiMAX RAN coverage and will permit change of access network among for instance WiMAX, WiFi, Digital Subscriber Line (xDSL) and Mobile GPRS/UMTS networks.

The key benefits seen from end user are

- Hassle-free operation: No user intervention is required when the access network changes.

- Seamless network connectivity: Connectivity is not interrupted during the move.
- Application transparency: Any application that tolerates packet loss will remain available with a tolerable interruption, allowing ongoing session recovery.

WiMAX based on 802.16e will permit availability of PCMCIA modules (not feasible with 802.16d) and later on integration directly in laptops or PDA modules. This availability will drive the Nomadic market.



To address the Wireless DSL market with Fixed Wireless applications, standalone terminals either indoor (plug and play device installed near desktop) either outdoor (indoor modem but with high gain outdoor antenna) are used. Neverthess for cost effective solution and wide adoption of WiMAX technology, Alcatel-Lucent edvises the usage of Indoor terminal instead of bulky and expensive outdoor terminals.

2) Frequency use

a) What comments do you have on the content of the CEPT/ECC decision and recommendation in Annex?

Today in general, some resources are available around the world in two main bands for ***WiMAX first deployments*** are :

- 3.5GHz (3.4-3.6) : In Europe, Africa, Middle East, Asia-Pacific and some Latin America countries,
- 2.5GHz (2.5-2.7) : in North-America, Brazil, Mexico, some South Eastern Asian countries,

There are also some resources available in 2.3GHz band in US, and some APAC countries with in particular South Korea with development of WiBro system now converged with WiMAX based on 802.16e and in 3.3GHz (India for instance).

Alcatel-Lucent supports the view **to minimize the number of frequency bands** for WiMAX application in order to create **this economy of scale** for the whole value chain. Furthermore state of the art technology today does not permit, on a cost effective solution basis, to get higher than 200MHz bandwidth equipments for Infrastructure.

Therefore Alcatel-Lucent preference for WiMAX frequency allocation is

- 2.5 and 3.5GHz licensed bands,
    - Licensed bands is a guarantee for operators to safeguard their investment and allow to provide quality of service
    - In the case of 3,5 GHz allow the Portability usage where today in some countries nomadic services are only authorized, to foster the deployment of innovative new data services
    - License sufficient bandwidth per operator (30 MHz and above) to be able to provide optimized cost pe bt delivered thanks to large throughput per equipment
- In second priority, ie based on some local specificities, some bands such as 2.3GHz or 3.3GHz that could be easily available for TDD only systems.

All these bands, are quite suitable for an optimized network deployment in **Urban/Sub urban** environments, but Alcatel-Lucent considers that deployment of Broadband Wireless system in Rural conditions requires some Frequency Allocation in Sub-1GHz band, for instance in 700MHz where already some allocations are available in USA or in some APAC countries.

In addition to widely used 2.5 and 3.5GHz bands, Alcatel-Lucent believes that operating WiMAX in the 700MHz band provides some significant advantages, in particular for an India-like environment. WiMAX at 700MHz allows a network architecture consisting of large cells. Therefore, lower CAPEX for a given geographical area, reasonnable economics although serving a relatively low subscriber density over

a vast area. Moreover, possibly to have common site GSM and WiMAX with similar coverage for Voice through GSM and data access through WiMAX, thus well suited for rural applications and remote areas. The 700MHz band is traditionally a broadcast band, where some rearrangement are foressen in the context of Digital TV introduction (Digital Dividend)

There is strong interest in TDD systems and such systems are best suited to adaptive antennas and similar technologies that will greatly enhance the services available to customers and overall spectrum efficiency. TDD operation can bring enhanced flexibility allowing systems to adapt with changing traffic requirements in a spectrally efficient manner and do not require paired spectrum.

Alcatel-Lucent advises usage of TDD thanks to higher performances for Broadband Wireless Applications :

- Easier allocation,
- Lower terminal costs,
- Better spectrum usage, especially for IP based services, with U/D partitioning

b) Under what conditions do you consider that an operator authorised to operate FWA in the 3.5 GHz and/or 24.5 GHz or 27.5 GHz bands could expand their services, changing their current technology to use BWA technology?

Currently Mobile WiMAX is supported on TDD only and as such if an operator were to upgrade their existing network using the latest mobile WiMAX technology, therefore, provided the licence blocks of spectrum are typically 2x15 MHz, then changing current technology would be feasible. The WiMAX Forum does not currently support the use of the 24.5 or 27.5 GHz bands and therefore offers no opinion.

Using a licensed frequency spectrum (700MHz and 2.5 or 3.5GHz) enables the regulator to clearly define some conditions within the license framework, such as :

- Define a start-up period for the operator after license attribution, after which the operator is obliged to deploy commercial services,
- Obligation of a minimum geographical coverage within a certain period,
- Obligation of minimum percentage of subscriber coverage within a certain period,
- Define the geographical area(s) for which the license(s) are applicable,
- Define the nature of services allowed or prohibited by the license,
- Define the duration of validity of the license

However, Alcatel-Lucent recommends that license conditions be well adapted to the demographic specificities and the economic development objectives of the country, not loosing sight of operator's business cases feasibility.

But above all, using a licensed frequency spectrum makes sure that any operator using this spectrum is pursuing the same objectives in terms of services and its economics. No operator will be able to interfere or hamper the quality of a competing operator's system and services, as the bandwidth within the licensed spectrum is clearly allocated and its pupose clearly defined.

A fair set of regulation rules can be determined in such a way that operators will pursue a long term investment strategy whilst assuring a reasonable profit from their operation, which in turn will be attractive for investors.

ASPECTS ABOUT THE USE OF UNLICENSED SPECTRUM,

For quite some time broadband wireless access systems operating in the unlicensed spectrum are available on the market. One of the main aspects of using unlicensed frequency bands is: "…everybody can do everything in such a frequency band…since there is no regulation …"

In other words, there is a high risk of radio interference – thus danger for Quality of Service – since every operator can use the whole or parts of this unlicensed spectrum at its own discretion. This opens the door for operators who maybe seduced by searching a swift commercial success, instead of pursuing a long term investment strategy; and regardless of any consideration for a particular regional development strategy, be it of economic or of social reasons.

In most countries the use of unlicensed frequency band is allowing to use only equipment with reduced radio transmission power. Consequently this does allow only limited cell sizes – compared to WiMAX systems in licensed spectrum which allows considerable higher transmission power, thus much bigger cell sizes

Subsequently, using unlicensed bands requires more capital expenditure, not only for more base stations (BTSs) because of smaller cell sizes, but it requires also higher investment for the necessary site preparation of BTSs and antennas.

Last not least, most of the systems working in unlicensed spectrum are using protocols and interfaces which are proprietary to its supplier, which has the following consequences:

a) The evolution of such protocols are entirely in the hands of its supplier as they are not controlled by any international standardisation body.

b) Due to the proprietary nature there is virtually no inter-working between system components from different suppliers

c) therefore once the operator made his initial choice he is tight to one single supplier; and competitive procurement from the suppliers market becomes impossible

c) Which frequency bands do you consider suitable for the provision of BWA, taking into account such factors as international harmonisation, the state of technological development and the costs involved, the type of authorisation (with waiver or not of radio license), as well as the need for coexistence with other technology systems? Please state reasons.

REGULATORY ISSUE	BASIC REQUIREMENTS	JUSTIFICATION
Spectrum allocation	• Priority : 2.5GHz or 3.5GHz • Local specificities : 2.3 or 3.3GHz • 700MHz band for Rural	Deployment Models : • 2.5 or 3.5 for urban suburban • 700MHz for rural
Optimal amount of spectrum allocated per operator license	• Blocks of 30 (or 2x15) MHz	On the basis of 3 operators on a same area and total vailability of minimum 100MHz including 10MHz for guard bands.
Licensed service definition	Open definition allowing for any combination of converged fixed-mobile, nomadic broadband application	Based on the new spectrum management principle of “flexibility” for frequency usage, meaning, no service restrictions in these originally ITU Fixed wireless service reserved bands
Air interface specification	Any non-proprietary BWA standard compliant air interface (guaranteed QoS and interference protection)	Based on regulatory principle of “technology neutral” regulation
Light power emission constraints	More or equal to an average 63 dBm eirp (transmitter output power at antenna port + 35 dBm)	To allow for usage of smart antennas (integrated AAS)
Allowed duplexing mode	TDD mode	TDD preferred mode for flexibility in data communications.
Channelling arrangements	Should be flexible – within 3.5, 5, 7, up to 14 MHz	US market at 5 and 10 MHz EU market at 3.5 7 MHz and 14 MHz – flexibility would increase performance and lower costs

The success of WiMAX will readily depend on the availability of spectrum and the constraints which could be attached to. In particular mobility restrictions applied to certain frequency bands may hinder the deployment of innovative mobile broadband applications. To ensure the success following points have to be considered:

- Alignment of frequency allocation sizing and criteria with the needs of new generation BWA solutions (30 MHz per operator minimum),
- Apply the principles of technology neutral to BWA licenses and avoid unnecessary constraints to benefit from the best performance allowed by the technology (FDD/TDD, Advanced Antenna Systems (AAS), …),
- Spectrum usage authorizations must avoid restrictive service definition. Flexible usage scheme should privileged to promote nomadic, portable and different degrees of mobility services.

3. BWA implementation in Portugal

a) Do you consider that access to BWA frequencies should be restricted to certain bodies? If so, please indicate which ones, and give reasons who you consider it necessary to put such restrictions in place.

In general, Alcatel-Lucent favors a forward-looking approach in the definition of licensing conditions in order to provide operators with maximum flexibility in the development of their networks.

Licensing conditions should not restrict an operator from being able to implement any usage mode, whether it is fixed, nomadic and full mobile. License terms should either explicitly mention fixed, nomadic and mobile usages, or avoid any implicit restriction of the usage mode. Alcatel-Lucent envisages mobility as an actual requirement.

In addition, any initial restriction in the licensing conditions — for instance, the exclusion of mobility — could be extremely difficult to remove at a later stage, taking into account the conditions of the initial licensing fees, as well as the conditions under which the spectrum was first assigned.

As a result, Alcatel-Lucent recommends that legacy WLL operators be permitted to request a change in their licensing terms in order to realign them with the terms applicable to BWA operators, thus allowing WLL operators nomadic and/or mobile modes. This would allow legacy WLL operators to deploy any technology, application and usage mode of their own choice. Moreover, in order to give the customer full benefit of the extended field of applications, the handover between BWA cells of a given operator should not be forbidden. Roaming agreements between BWA and mobile operators, or between BWA operators should not be restricted.

Nevertheless, Alcatel-Lucent would not encourage an excessive fragmentation of the spectrum which can lead to dificult and unfeasible implementation of BWA business plans.

b) Do you consider that BWA services should be offered nationwide or would it be more suitable to limit them geographically (in which case please give details of the geographic location(s) you consider the service should be limited to)

Licensing should offer adequate provisions for the development of BWA operator business; therefore, Alcatel-Lucent supports a plan in which BWA operators are selected to operate over wide areas, preferably at the national level.

The number of BWA license owners should result from a careful analysis of market conditions. On the one hand, competitive rules need to be satisfied, but on the other, too many operators may result in market fragmentation (which was one reason for the unviable businesses of FWA). Of course, the number of license owners would have to be adapted to specific conditions in each country.

c) What type of procedures do you consider most suitable for the allocation of rights/selection criteria for BWA systems in the bands mentioned in the Annexes?

Alcatel-Lucent does not have any specific position as to the selection criteria for BWA license operation.

d) What type of requirements, as regards coverage obligations, quality of service, interoperability or other, do you consider should apply to usage rights?

Alcatel-Lucent proposes that operators should be allowed to fully manage the evolution of networks for the duration of the license by themselves. More specifically, they should be allowed to choose any technology, services, applications or usage modes that are deemed appropriate for their business models without changing the terms of the license.

Alcatel-Lucent would also encourage an implementation timeline supporting the i2010/eEurope's Action Plan 2005, which in turn identifies massive broadband access as an important milestone.

e) Do you consider that BWA services will complement or coincide with other existing or future technologies (in operation or planned) in the same or other frequency bands?

Mobile networks offer mobility, ubiquitous coverage and voice support but at high price and with limited data rates. WiMAX can be positioned as a complementary solution by offering high bandwidth when required, in particular, in urban and sub-urban areas, making portable Internet a reality by extending public WLAN hotspots to metropolitan areas coverage for nomadic and mobile data centric service delivery.

Public WLAN, while offering clear benefits, is limited in coverage (hotspot) and mobility capabilities. WiMAX overtakes these limitations and offers broadband connectivity in larger areas (hot zones). WiFi and WiMAX solutions are also complementary, with WiFi being more adapted for short range indoor connections (in particular in the enterprise and at home) and WiMAX for long range outdoor connections.

WiMAX can also serve as complement to DSL services which has seen massive urban and sub-urban deployments, whereas coverage of remote areas - smaller towns and rural areas - is lagging behind. Hurdles to overcome are the poor line quality of the installed copper base, the large distances to the central offices or cabinets, or the low population density. In this context, WiMAX, with its QoS support, longer reach is naturally positioned as a viable first mile(s) option to offer broadband access to residential users.

In Portugal, the low user density and in certain cases quality of the copper pair prevent mass scale DSL deployment and foster the need for alternate broadband technologies. In this context, WiMAX is positioned as an excellent option. Moreover,

the possibility of offering broadband services in combination with voice services will gradually lead to narrowband WLL substitution.

Parameters such as availability of the copper, distance to the remote unit/central office, backhauling costs, and inhabitant density will drive the choice for one or other of these solutions.

4. Introduction of BWA systems in the market

a) What conditions do you consider important for the successful implementation of BWA technologies?

Alcatel-Lucent recommendations as to address a successful implementation of BWA technologies are all under the same frame of having a flexible licensing terms, including:

- **Coverage Areas**

  One should look at the so-called FWA/LMDS market which failed dramatically, beeing one reason the multitude of licensed operations with small coverage areas.

  Therefore, licensed coverage areas must be compatible with efficient business cases favouring wide-areas (even national level) over small coverage areas.

- **Spectrum Allocation**

  Frequency blocks should be made available in a suficient ammount that enables each operator to choose the basic channel width, letting it better adapt its channel planning to specific service conditions and market dynamics.

  Typically, in urban environments 40 MHz TDD per operator (2x20 MHz for a paired block) and in rural areas ideally 30 MHz or at least 20 MHz per operator.

  Again, it should be avoided a much fragmented spectrum allocation as this limits business case feasibility for each and every licensed operator.

- **Service-Neutral Approach**

  One should look at the so-called FWA/LMDS market which failed dramatically beeing one reason the excessive service restrictions (no backhauling allowed initially and service allowed only for fixed access limiting addressable market).

  Therefore, Alcatel-Lucent recommends to adopt a neutral approach to the band usage mode (e.g. mobile usage in a fixed allocation, generally referred as a service-neutral approach).

  This could work provided that this usage mode is compatible with allocated applications as shown by compatibility studies. Then, all usage modes – fixed, nomadic and mobile – could be introduced whatever the radio services allocated in the frequency band and regardless of their status. Moreover, this approach would allow the introduction of full mobility WiMAX, even in bands where only fixed service is allocated a primary status.

  This approach, to which Alcatel-Lucent is strongly commited, is supported by the European Commision.

b) When do you consider that BWA technologies will have the necessary conditions for successful implementation in the Portuguese market?

WiMAX is on the intersection of two fast growing markets – broadband and mobility :

- Mobile operators want to offer true broadband, in competition with the fixed line operators;
- With DSL, fixed line operators have monopolized broadband, but with HSDPA and CDMA2000 on the way they need to add mobility to their broadband offering;
- Fixed line operators need to fill-in the DSL white and grey zones. There is an opportunity to be the first to provide service in remote areas not yet reached by the fixed line network;
- New entrants are seeking an alternative to the incumbents' unbundled access lines

While several BWA technologies can fullfill part of above market demand, Alcatel-Lucent believes that WiMAX, in its 802.16e revision, is the only BWA technology able to answer today to all above market demands.

The key for mass-market adoption of WiMAX is the diversity and availability of the terminal equipment that supports the IEEE 802.16e-2005 standard. The Alcatel-Lucent WiMAX solution is the first 802.16e-2005 compliant solution on the market and it is available today. This means that it is interoperable with a variety of new devices including consumer electronic products (gaming consoles, video tablets, video cameras), PDAs, laptops and smart phones that will integrate WiMAX 802.16e-2005 capabilities in the near future.

To ensure it is fully supported on the customer premise side, Alcatel-Lucent has worked to promote the rapid growth of the CPE and terminal ecosystem, engaging in different partnerships with technology and device manufacturers.

Through its industry partnerships, Alcatel-Lucent offers a wide range of customer premises equipment that are completely interoperable with the Alcatel-Lucent WiMAX solution.

These devices allow secured early deployments of a full end-to-end WiMAX solution and ensure that customers can quickly get all the associated benefits of the emerging WiMAX market.

On the following tables one can evaluate end-user devices available or soon to be available by the 2nd Quarter of 2007 for mass-market production, with associated technical characteristics and applications suited for.

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	PCMCIA	Simple CPE	Multi-users CPE	Outdoor CPE
TYPE	PC Card	Indoor self Install	Indoor self Install	Outdoor self install single unit and Indoor gateway
SERVICES	Data	Data, voice		
FORM FACTOR	PCMCIA type II > Height: 58 mm > Width: 125 mm	Single box > Height: 5 cm > Width: 12 cm > Depth: 16 cm	Single box > Height: 6 cm > Width: 17 cm > Depth: 21 cm	Indoor unit > Height: 17 cm > Width: 21 cm > Depth: 4 cm Outdoor RF unit with antenna > Height: 21 cm > Width: 21cm > Depth: 11 cm
CONNECTIVITY	PCMCIA	1 x Ethernet 1 x POTS	4 x Ethernet 2 x POTS Wi-Fi 802.11 b/g	4 x Ethernet 2 x POTS Wi-Fi 802.11 b/g
TX POWER, ANTENNA SYSTEM	23 dBm, 2 dBi rotating antenna	27dBm, 6 dBi embedded patch antenna, and RF connector for external antenna	27dBm, 6 dBi embedded patch antenna, and RF connector for external antenna	23 dBm, 14 dBi directive outdoor antenna
WIMAX AIR INTERFACE	IEEE 802.16e-2005 air interface > 2.3 GHz, 2.5 GHz and 3.5 GHz versions > 3.5 MHz, 5 MHz, 7 MHz, 8.75 MHz and 10 MHz bandwidth > AAS beam forming (according to WiMAX forum profile) > CC, convolutional turbo code (CTC) > QPSK, 16 QAM, 64 QAM (DL) > QoS management, relying on classification > Security: EAP-TTLS based user authentication, 128 b AES based data ciphering			
IP NETWORKING		Advanced IP networking features: > DNS relay, DNS cache > User configurable router (RIP v1, RIP v2) and NAT (one-to-one, many-to-one) > Embedded security : NAT firewall with SPI, DoS, DDoS > VPN pass through (IPSec, PPTP & LT2P pass-through)		
WI-FI			802.11 b/g, 64/128 b WEP, WPA, MAC address filtering >>	
VoIP		Standard SIP based VoIP (RFC3261): > G711, G723 (option) and G729ab codecs, including voice activity detection, silence suppression, comfort noise generation > G168 echo cancellation > DTMF detection > Fax T.38, fax and modem pass through G711 > CLIP/CLIR, message waiting indicator (MWI) > Call waiting, call forwarding, call transferring, 3 way conference, call hold/retrieve		
CPE MANAGEMENT	Local management (from PC application with PCMCIA, and from Web interface for CPEs): > Parameters/configuration setting > SW upgrade > Diagnostic/monitoring			
		Standard based remote management, over WiMAX air interface: > Configuration and control (Telnet, SNMP, TR-069) > Software upgrade (FTP/TFTP/HTTP)		
ENVIRONMENTAL AND REGULATION	> WEEE Eco directive 2002/95/EC > Storage conditions: -25 C to 55 C, 10% to 95% humidity > Operation conditions: 0 C to 45 C, 10% to 90% humidity (non-condensing) > EMC and safety: ETSI EN 301 489, EN 60950, CE marking > Operation conditions for outdoor unit: -30 C to 60 C, 5% to 95% humidity (non-condensing)			

Alcatel-Lucent have shipped multiple 16e systems that are in active use by customers around the world. We started developing 16e product in 2005 before the standard was finalized, and we were one of the first to market with a 16e base station.

Alcatel-Lucent is developing all three profiles required to address the global market – 2.3GHz (for Korea and some of South America), 2.5GHz (for North America and parts of Europe) and 3.5GHz (for Europe and South America).

In regards to WiMAX operations, Alcatel-Lucent has already rolled out several 16e systems (some already in Europe). In addition, still during past 2006, Alcatel-Lucent got involved in a dozen WiMAX trials worldwide and we are currently getting 40 more trials in the pipe just for the first half of 2007. Undoubtely, WiMAX is ready for mass deployment and operators are perceiving it worldwide.

Alcatel-Lucent believes that 2007 will see a true dissemination of WiMAX operations worldwide simply because we have 16e systems and end-user devices interoperable and available for mass production.

c) In what way would you be interested in using and eventually commercialising BWA technologies?

Alcatel-Lucent does not have any specific position on this topic.

5. Are they any other points you consider relevant?

Alcatel-Lucent believes major points were adressed in the other paragraphs.