January 8, 2007

Intel Corporation would like to thank Anacom for issuing this Public Consultancy on Broadband Wireless Access and for giving us the possibility to comment.

Intel believes that the 802.16 / WiMAX technology can play a key role in Portugal, the details of our argumentation are embedded in the subsequent pages.

In case additional information is required, we would be pleased to provide the necessary clarification or complementary information.

Best regards

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Annex 1

Public consultation on Broadband Wireless Access

1. General Framework

2. Questions

1. BWA Framework

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

WiMAX is a key component of Intel's broadband wireless strategy to deliver innovative mobile platforms for broadband Internet connectivity anytime, anywhere.

There is a substantial unmet need for very high-speed wireless wide area Internet access to both fixed and mobile devices. WiMAX is an advanced technology solution, based on an open standard, designed to meet this need, and to do so in a low-cost, flexible way. WiMAX networks are optimized for high-speed data and should help spur innovation in services, content and new mobile devices.

Intel currently plans to integrate WiMAX and WiFi into its notebook platforms based on Intel® Centrino® Mobile Technologies. Pairing the two will help bring users the ultimate in high-speed mobile broadband. Intel believes that WiMAX, with its technical and economic advantages, should help enable mainstream adoption of personal broadband.

WiMAX represents a global connectivity opportunity in highly developed mobile market segments and developing countries where this technology may help provide affordable broadband services.

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

i. Power;

The WiMAX Forum profiles currently support the following power classes dependant upon modulation scheme.
Transmit power (dBm) for 16QAM

1. $18 <= Ptx,max < 21$

2. $21 <= Ptx,max < 25$

3. $25 <= Ptx,max < 30$

4. $30 <= Ptx,max$

Transmit power (dBm) for QPSK

1. $20 <= Ptx,max < 23$

2. $23 <= Ptx,max < 27$

3. $27 <= Ptx,max < 30$

4. $30 <= Ptx,max$

ii. Channels;

As stated previously, Intel suggests assignments of at least 2x21 MHz per operator with the possibility to grow assignments up to 2x28 MHz as capacity and demand grows.

Furthermore, Intel recommends that operators should be allowed to determine and manage appropriate guard channels themselves to get maximum efficiency from spectrum. This will allow operators to maximize the spectrum use, whilst ensuring sufficient protection to the neighboring licensees.

iii. Duplex mode (TDD/FDD);

Intel is encouraging Administrations to consider allowing greater access to this band for TDD-based technologies and not to consider this band as only a FDD band. This approach is fully aligned with ECC Recommendation (04) 05 where no preference or priority is suggested for FDD/TDD solutions.

iv. Modulation;

WiMAX is based on OFDM (Orthogonal Frequency Division Multiple) technology which has inherent advantages in throughput, latency, spectral efficiency, and advanced antennae support; ultimately enabling it to provide higher performance than today's wide area wireless technologies. Furthermore, many next generation 4G wireless technologies may evolve towards OFMDA and all IP-based networks as an ideal for delivering cost-effective wireless data services.

v. Standard applicable (if existing);

IEEE 802.16.2004 / ETSI HiperMAN
"LAN/MAN Broadband Wireless LANS"

IEEE 802.16e / ETSI
"Combined Fixed and Mobile Operation in Licensed Bands";

In order to maximize their spectrum allocation decisions, Intel recommends regulators should closely follow and support the normatives and recommendations of multiple standards-setting organizations, including: (a) the Institute of Electrical and Electronics Engineers (IEEE); (b) the European Telecommunications Standards Institute (ETSI); (c) the Wi-Fi Alliance (for IEE 802.11 products); and (d) the WiMAX Forum (for IEEE 802.16 products).

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

Wi-Fi, WiMAX, 3G technologies will be complementary technologies. Users will able to have always best connection over existing networks according to their place.

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

WiMAX enables true broadband speeds over wireless networks at a cost point to enable mass market adoption. WiMAX is the only wireless standard today that has the ability to deliver true broadband speeds and help make the vision of pervasive connectivity a reality.

There are two main applications of WiMAX today: fixed WiMAX applications are point-to-multipoint enabling broadband access to homes and businesses, whereas mobile WiMAX offers the full mobility of cellular type networks at true broadband speeds. Both fixed and mobile applications of WiMAX are engineered to help deliver ubiquitous, high-throughput broadband wireless services at a low cost.

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.

Intel suggests assignments of at least 2X21 MHz per operator with the possibility to grow assignments up to 2x28 MHz as capacity and demand grows. This would enable delivery of broadband services using any usage application known as BWA.

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

Intel believes that access to the 3.4 - 3.6 GHz band is highly desirable for the provision of wireless services. We encourage Administrations to consider releasing additional spectrum in this band to enable greater deployment of broadband wireless services and to promote competition.

We initially support access to the band for "fixed" and "nomadic" type services (as defined in ITU-R Recommendation F.1399) and once additional sharing studies have been undertaken we would support access to this band for "mobile" broadband wireless services.

2. Frequency Use

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

Intel was instrumental in the development of the proposed CEPT/ECC Decision and Recommendation and
fully endorses their approval.

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?

The propagation characteristics and the nature of the likely wireless deployments within laptops, handheld
devices and other form factors makes these bands unsuitable for mass market adoption.

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.

In the UHF (**470–862 MHz**) band, whater possible spectrum should be made available for mobile
multimedia broadcast network(s) prior to switch off date. Indeed, the "700 MHz band" could help the
broadband development in rural areas and increase the deployment of different technologies in the bands
currently used for analog TV. Expediting the digital TV transition could clear the 700 MHz band for new
wireless broadband services. This band would be particularly useful for wireless broadband in rural and less
densely populated areas given its outstanding propagation characteristics and could therefore promote a
wider development of multimedia services.

3.3-3.8 GHz, within which spectrum in the 3.3-3.4GHz, 3.4-3.6GHz or 3.6-3.8GHz bands would also
provide excellent opportunities for fixed, nomadic and mobile BWA applications. This spectrum also offers
roaming opportunities because of the wide geographical availability of spectrum from within this range. The
WiMAX Forum is already certifying fixed/nomadic equipment for the range 3.4 – 3.6GHz.

5.725-5.85 GHz is available for such purposes in many countries of the World for unlicensed/lightly
licensed applications..

Intel would like to insist that other bands not allocated to the broadcasting service also offer the
opportunity to provide multimedia services, specifically the bands at **2.5 GHz**. These bands at the moment
are designated for future cellular voice and data technologies such as 3G. 3G stakeholders in the ITU have
defined IMT-2000, which is a set of mobile wireless air interfaces that supports a particular mobile services
and network model. IMT-2000 includes WCDMA, CDMA-2000, TD-SCDMA, DECT and EDGE. Unfortunately,
the IMT-2000 definition does not comprehend new mobile wireless technologies such as WiMAX that were
developed after 2000. Nor is there currently an easy way to include these technologies in IMT-2000
definition. Today, a mobile wireless system based upon IEEE 802.16 technology does not qualify for IMT-
2000 because:

1) it is not an evolution of one of the current IMT-2000 air interfaces, and
2) it does not support legacy circuit switched voice.

Thus, even though WiMAX Forum Certified products based upon the IEEE 802.16 standard are targeting some called 3G spectrum bands such as 2.5–2.69 GHz, WiMAX systems will be blocked from using these bands unless countries adopt a policy of technology-neutrality. The potential positive effect of WiMAX development for mobile multimedia services could be substantially curtailed. It should be noted that IEEE has recently submitted into the ITU-R 8F an application for the 802.16e (specific profiles) technology to be considered as a new RTT interface within Recommendation M.1457. If successful then mobile WiMAX will be included as an IMT-2000 technology.

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.

Intel has no specific position regarding access to the BWA frequencies. However, Intel would be concerned if the licence award process resulted in excessive fragmentation of the spectrum which can lead to over complex coordination and cooperation requirements.

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)

WiMAX is developed as a global standard. Intel recommends the award of nationwide licenses since this will allow operators to offer services in all areas of Portugal and with the aim of providing worldwide roaming services.

For the success of operators national licences should be given. Operators with national licences can offer services within the country and gives potential to extend towards global roaming on worldwide WiMAX networks. Roaming, interconnection, coverage issues would be a problem with regional licences. WiMAX will be offered as a standard feature in all laptops, PDAs, mobile telephones.

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?

Intel prefers licenses to be issued with auction method to those with the best business case and the best utilization of the spectrum for broadband wireless

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

Intel does not have a specific view concerning license for incumbent operators, but is keen to ensure that whatever spectrum is made available is on a fair/equitable basis, and it is put to use in an efficient and timely manner. Intel strongly opposes spectrum hoarding (retention with no intention to use) and encourages regulation to guard against this activity (use or lose it).

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?

Intel believes that there is big demand for services beyond 3G wireless broadband. As a beyond 3G wireless broadband technology, Mobile WiMAX offers much higher data rates and advanced applications than 3G services. As an example currently in South Korea operators are offering WiMAX technology services (WiBRO) since there is a demand for higher data speeds. In fact, Wi-Fi, WiMAX, 3G technologies are complementary technologies. Users are able to have the most optimum connection over existing networks using a combination of these technologies based on the users location.

- WiMAX and 3G will coexist. Each service provider's distinct network environment and business imperatives will determine which technology or mix of technologies best meets their needs.

- WiMAX is optimized for IP-Based high-speed wireless broadband

- 3G is optimized for cellular voice and moderate data-rate applications

- Intel supports both WiMAX and 3G technologies with standard activities, R&D and product offerings.

From an Operators perspective Intel believes that utilizing a mobile WiMAX deployment as a data overlay in a 3G network can provide significant benefits, i.e. of loading data traffic which still maximizing voice capacity.

4. Introduction of BWA systems in the market
a) What conditions do you consider important for the successful implementation of BWA technologies?

Intel supports the award of nationwide licenses since this will allow operators to offer services in all areas of Portugal. This means that citizens will be able to access wireless broadband even when they are not at home or at work.

Intel does not have a specific view concerning licenses for incumbent operators, but is keen to ensure that whatever spectrum is made available is on a fair / equitable basis, it is put to use in an efficient and timely manner. Intel strongly opposes to spectrum hoarding (retention with no intention to use).

Intel believes that the greatest economic benefit from wireless broadband access is from the continued and long-term usage of the spectrum and not from the assignment process alone. Ideally Intel prefers licences to be issued to those with the best business case and the best utilization of the spectrum for broadband wireless. In the instance where there is more than one Operator then the Administration may consider an auction process – but the auction should not be structured to extract the maximum value for revenue generating purposes.

It typically takes 6-7 years to generate a positive cash flow. Therefore, a licensee should be able to expect to retain their license for a period of 15- 20 years.

Economic viability of a service provider's business case is highly sensitive to the size of the spectrum allocation license. Small allocations limit the capacity per km² requiring more infrastructure to meet demand. This impairs an operator's ability to create a compelling business case by:

- Affecting the range of services and Quality of Service that can be offered
- Increasing capital and operating expenses since spectrum available for deployment determines base station capacity. Capacity constraints accelerate the need to split cells. Excessive cell splitting causes significant operating and financial issues for operators.

Therefore, instead of reserving additional spectrum for future use, Intel suggests assignments of at least 2x21 MHz per operator with the possibility to grow assignments up to 2x28 MHz as capacity and demand grows.

Furthermore, Intel recommends that operators should be allowed to determine and manage appropriate guard channels themselves to enable maximum efficiency from spectrum. This will allow operators to maximize the spectrum use, whilst ensuring sufficient protection to the neighboring licensees.

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

Intel is poised to deliver the key components needed for successful WiMAX networks. It delivered the fixed WiMAX solution, Intel® PRO/Wireless 5116 wireless modem, and is now sampling a fixed/mobile dual-mode solution code-named Rosedale 2. The highly cost-effective Rosedale 2 solution was designed to support both standards with an easy upgrade path from fixed to mobile and is expected to further accelerate the deployment of WiMAX networks.

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

WiMAX bridges the gap between technology "haves" and "have nots." It offers the potential to do much more than just extend the power and reach of existing wireless networks. It supports a range of uses for communities around the globe that may have not had access to Internet service. WiMAX enables everything from basic high-speed access for homes to Internet telephony, business connectivity, and support for schools and government offices.

According to Sean Maloney, Intel executive vice president and ex-general manager of the Intel Mobility Group, "WiMAX-certified systems will provide the building blocks to connect the next five billion users to the Internet and truly usher in the broadband wireless revolution"

In collaboration with Intel—and using equipment based on the Intel® PRO/Wireless 5116 Broadband Interface—commercial networks have now been deployed such as the following carriers: Altitude Telecom (France), AXTEL (Mexico), BEC Telecom, S.A. (Dominican Republic), Dedicado (Uruguay), Globe/Innove (Philippines), Iberbanda (Spain), Irish Broadband (Ireland), SferaNET (Poland), Mikkelin Puhelin Oyj and Savonlinnan Puhelin Oy (Finland), Telgua (Guatemala), Ukrainian High Technologies (Ukraine), and WiMAX Telecom (Austria and Slovakia).

The global range of these carriers represents millions of customers.

5. Are they any other points you consider relevant?