07 July 2010

To: Aileen Chia (Ms)
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On behalf of Intel Global Public Policy, Corporate Affairs, and Intel Singapore, we thank you for your invitation for industry consultation on Spectrum Framework for Fourth Generation (4G) Mobile Communication Systems in Singapore dated 29 March, 2010.

Please find enclosed our answers to select questions in this consultation.

Yours Sincerely

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Before the
Infocomm Development Authority of Singapore

COMMENTS OF INTEL CORPORATION

In response to the

INDUSTRY CONSULTATION PAPER

Spectrum Framework for Fourth Generation (4G) Mobile Communication Systems in Singapore

June 7, 2010

I. INTRODUCTION

Intel Corporation commends the IDA for continuing the initiative to create a spectrum policy and planning framework which will foster the adoption and growth of new wireless technology to the benefit of Singapore and its citizens. Intel Corporation is the world's largest semiconductor manufacturer and a leader in technical innovation. Intel is also a leading manufacturer of communications and networking chips and equipment.

To realize the benefits of the rapid technological innovations that are occurring in the communications industry, and to promote the economic and social benefits that broadband can deliver, Intel agrees that Singapore should continue a flexible, "Technology and Service Neutral" approach to spectrum management. Licensees should be free to pick from among competing wireless technologies (including those utilizing TDD and/or FDD duplexing modes). In bands most promising for global harmonization, Intel recommends regulators

should allocate abundant spectrum for Broadband Wireless Access (BWA) and allot licenses that have large bandwidth and are truly flexible. Then licensees, in response to market forces, will be free to achieve the benefits of innovation and economies of scale and interoperability through the adoption of international standards. They will have an incentive to converge on one technology where the benefits of convergence are greater or adopt a new technology where those benefits are greater. Consumers will be better off if markets, not bureaucrats, make these tradeoffs. Lastly, guard bands, where appropriate, should be structured to allow licensees to use them for transmission if they are not needed.

General recommendations:

Intel encourages the flexible assignment of the entire 2.3 and 2.5 GHz bands to include Broadband Wireless Access (BWA) in a technology and service neutral manner as quickly as possible. As global bands available for broadband wireless access, flexible assignment of the entire 2.3 and 2.5 GHz bands will allow Singapore citizens to enjoy the benefits of the economies of scale created by the international allocation. Furthermore, we recommend the assignment of national or large regional spectrum licenses and believe licensees should be able to aggregate bandwidth subject to a competition review.

Provided below are answers to select questions in this consultation.

Question 1

IDA invites views and comments on the projected spectrum requirements to meet end users' demand for mobile broadband beyond 2015. To what extent can the existing wireless and mobile networks support the anticipated increase in mobile traffic? IDA also invites views and comments on the likely technologies for the deployment of 4G mobile communication system that will meet end users' mobile communication needs beyond 2015.

Intel Answer: In general, broadband wireless technologies will continue to play an increasingly important role in fulfilling the broadband needs of Singapore as well as global citizens. While predicting the specific needs for spectrum are difficult, we recommend the release of spectrum as quickly as possible to unlock the benefits that BWA technologies have to offer. Studies have shown that the main benefit of assigning spectrum comes from the benefit of new services as opposed to the auction revenues or benefits to the carriers. Indeed, the net present value of the total consumer surplus or benefit generated by mobile services is typically 10-20 times the auction value of the spectrum the services use. Furthermore, using reasonable cost of money assumptions, delaying the start of these benefits by 3 years may waste 25% of this consumer benefit.[1]

Question 2

IDA invites views and comments on the possible radio-frequency spectrum bands, besides the 700/800 MHz, 2.3 GHz and 2.5 GHz bands that would be suitable for 4G mobile communication systems and the likely timeframe for deployment. To what extent are the 900 MHz, 1800 MHz and 2.1 GHz alternative bands for 4G deployment? Are there other frequency bands that are currently not allocated but could be potential candidates for 4G system deployment?

Intel Answer: Intel recommends that spectrum bands be assigned in a truly technology and service neutral manner. That is, operators should be allowed to deploy any technology and service within their spectrum allotment, provided they do not interfere unreasonably with their geographic or frequency neighbors. In this way, operators and manufacturers will continue to have incentives to innovate, and provide the latest technologies and services to their customers free of overly rigid regulatory classifications.

Question 3

IDA invites views and comments on the demand for the 2.5 GHz band after 2015 in Singapore and the technologies that are currently being developed for use in the 2.5 GHz band. Are these likely to complement or substitute existing networks? Please also comment on the availability of the network equipment.

Intel Answer: There are 2 main technologies in different stages of development which are likely to be deployed in the 2.5 GHz band, WiMAX and LTE. WiMAX technology has been available for some time, while LTE is still in development. The WiMAX Forum reports 588 WiMAX deployments have been made in 148 countries

[1] Analysis of an accelerated digital television transition; Coleman Bazelon, Analysis group, 2008

worldwide, 112 in the 2.5 GHz band alone. With over 143 subscriber devices certified to date, WiMAX technology continues to gain global economies of scale, optimizing costs to global consumers. In general, these 4G technologies can be both complementary or a substitute to the existing networks.

Question 4

IDA invites views and comments on the paired and unpaired spectrum arrangements in the 2.5 GHz band after 2015.

Intel Answer: Intel supports approaches which allow operators to flexibly deploy the technology that best fits their needs. There are two options that could enable this approach. First, band plans, similar to the United States 2496-2690 MHz band, can allow the licensee to choose either FDD or TDD operation. This approach would grant operators the flexibility to deploy TDD technologies in paired spectrum, provided the appropriate technical and operational criteria are met. Second, operators can be permitted to determine the relative ratio of paired and unpaired spectrum, similar to the approach proposed in the United Kingdom, Netherlands, and Colombia. Under this approach, in the first round of auction, operators would indicate whether they were interested in paired or unpaired spectrum. The regulator would then determine an appropriate band plan and allocate the blocks in the second round of the auction. This method also allows regulators to maintain the 120 MHz duplex gap (and any associated economies of scale) used by FDD technologies. This approach does not dictate technology winners and losers by artificially making less spectrum available for TDD technologies.

Question 5

IDA invites views and comments on whether the size of 5 MHz guard block at the frequency boundaries between paired and unpaired spectrum is sufficient to safeguard the adjacent band. IDA also invites views on our proposal not to specify guard block requirement between licensees using the TDD or FDD band.

Intel Answer: 5 MHz of spectrum between the paired and unpaired frequency blocks should be sufficient, however, Intel supports the use of operator coordination and if needed, the use of shared restricted channels rather than mandating guard bands. Additionally, Intel believes that any guard channel should be shared fairly and equally across adjacent duplexing/channel boundaries, as opposed to applying solely to the FDD or TDD portion. Furthermore, operators should be encouraged to cooperate and consider mutual interference mitigation techniques when building out their networks.

Question 6

IDA invites views and comments on whether allocating 5 MHz spectrum lot size is appropriate for the current technologies in the 2.5 GHz band. IDA also invites views on our proposal to allocate spectrum in individual blocks of 5 MHz and let operators who need a larger carrier size to combine multiple blocks together. Alternatively, should IDA allocate in larger blocks based on multiples of 5 MHz?

Intel Answer: Intel agrees that a minimum of 30 MHz is needed to enable an adequate business model. Any assignment method should take this into account and allow operators to aggregate spectrum as they see fit subject to a competition review.

Question 7

IDA invites views and comments on our proposal for an interleaved band plan with combinations of 15 MHz and 20 MHz paired spectrum blocks as well as 25 MHz of unpaired spectrum blocks available for assignment in contiguous block of 15 MHz, 20 MHz and 25 MHz respectively by IDA and whether this would be appropriate. IDA also invites views and comments on the practical measures that operators would implement to allow coexistence of BSS and mobile services in the same band in the border areas so that more spectrum blocks can be made available

Intel Answer: Intel recommends a fully flexible band plan, for more detail please see the answer to question 4. Regarding border interference considerations, we recommend setting an absolute limit on emissions at the border. We also recommend facilitating cooperation between neighboring operators to address coexistence concerns. As an example, in the US co-channel operators must comply with a limit of 47dBuV/m measured at 1.5 m height over the channel bandwidth at the operator's geographical boundary[2].

Question 8

IDA invites views and comments on the likely technologies for the 2.3 GHz band and the availability of network equipments for use in the band. IDA also invites views on our proposal to retain the existing channeling plan for the 2.3 GHz band and to allocate the spectrum in blocks of 5 MHz when the band is re-allocated after 2015. Please also comment on whether the current amount of 50 MHz spectrum available in the 2.3 GHz band is sufficient to meet industry demands after 2015.

Intel Answer: There are currently 4G technologies in the form of WiMAX, available and already deployed for the 2.3 GHz band Intel agrees that 5 MHz lots should be used as the fundamental increment on which bidders can aggregate their overall spectrum allotment. Realizing that 30 MHz block sizes are typically a minimum amount needed for a successful business model, and that even more spectrum will be required for future advanced mobile systems, Intel recommends that operators are afforded the ability to aggregate the amount of spectrum to support their business needs, subject to competition review, and that all available

[2] FCC Code of Federal Regulations, Title 47, telecommunications, Part 27.55, power strength limits

spectrum be assigned as quickly as possible for broadband wireless access technologies, including the entire 2.3 GHz band.

Question 9:
IDA invites views and comments on what is an appropriate timeframe for IDA to allocate the 2.3 GHz and 2.5 GHz bands. Should the allocation of the 2.3 GHz band proceed separately from that of the 2.5 GHz band, given the greater uncertainty over the timeframe in which the 2.5 GHz band would be available? If so, when would be an appropriate timeframe for IDA to allocate the 2.3 GHz band?

Intel Answer: Intel recommends that both the 2.3 GHz and 2.5 GHz bands be assigned as quickly as possible.

Question 10:
IDA invites views and comments on what would be a fair and efficient allocation mechanism for the 2.5 GHz band. In the case where there are existing deployments in the band, should IDA grant first rights of refusal for the current right-holders?

Intel Answer: Intel agrees with the IDA's proposals to utilize market based mechanisms such as auctions and spectrum trading to ensure optimum use of the spectrum. Additionally, we favor long license terms and renewal expectations to encourage risky, long-lived investments.

Question 11:
IDA invites views and comments on the proposal to impose both service provisioning and coverage obligations on the operators awarded the 2.3 GHz and 2.5 GHz spectrum after 2015. In particular, what would be an appropriate service provisioning obligation and the timeframe for deployment bearing in mind that the spectrum assignment is likely to take effect only from 1 July 2015? Similarly, what would be an appropriate measure for service coverage obligation and the timeframe for deployment?

Intel Answer: While Intel supports build out requirements where market forces are not sufficient to assure rapid deployment, it is important that such requirements do not discourage investment by setting overly ambitious goals.