Consultation Paper:

DEPLOYMENT OF WIRELESS BROADBAND TECHNOLOGIES IN SINGAPORE

INFOCOMM DEVELOPMENT AUTHORITY OF SINGAPORE

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DEPLOYMENT OF WIRELESS BROADBAND TECHNOLOGIES

1. INTRODUCTION

1.1 Wireless broadband technologies have been gaining traction in recent months. Wireless broadband networks typically provide access speeds at 256 kbps and above, to both mobile users and fixed locations. Each base station generally serves an area of up to several square kilometers. There are various proprietary solutions that have been developed for wireless broadband technologies. The World Interoperability for Microwave Access Forum ("WiMAX"), was set up to promote the deployment of broadband wireless access by using a global standard – IEEE 802.16, and certifying interoperability of products and technologies. Wireless broadband technologies are able to operate in various frequency bands including the 1.9 GHz, 2.1 GHz, 2.3 GHz, 2.5 GHz and 3.5 GHz bands. Successful technical trials, pilots and commercial deployments of wireless broadband technologies have been carried out in several countries like the United States("US"), Australia and South Korea.

1.2 There has been significant interest expressed by both local and foreign companies to deploy wireless broadband technologies in Singapore. The rapid advancements in wireless technologies and the growing demand for fast-speed data services have given rise to numerous opportunities for new service providers to enter markets quickly, rollout their networks rapidly and offer an entire suite of innovative broadband value-added services to businesses and consumers. In view of the interest shown by potential new entrants and considering the aim of the Infocomm Development Authority of Singapore ("IDA") to proliferate broadband services and usage in Singapore, IDA will be making spectrum available for commercial deployment as well as trials of wireless broadband technologies that **do not belong to the complete IMT-2000 family of 3G standards**[1]. IDA is also considering a market trial licence framework to facilitate market trial deployments of wireless broadband technologies. In addition, IDA is considering permitting existing 3G operators deploy wireless broadband technologies in their 3G spectrum bands, in addition to their 3G systems. These measures will help facilitate the deployment of wireless broadband technologies, thereby offering consumers a wider variety of broadband options.

[1] Under the 3G Spectrum Auction in 2001, IDA has committed to not allocate any new spectrum for 3G services before 1 January 2006, except for any 3G spectrum lots that were not auctioned out in the 3G Auction. 3G technologies are classified under the International Mobile Telecommunication-2000 (IMT-2000) family of 3G standards endorsed by the International Telecommunication Union. The complete IMT-2000 family of standards have to meet all three minimum theoretical data rates specified by ITU: (a) 144kbps for vehicular mobility or rural outdoor; (b) 384kbps for pedestrian mobility; and (c) 2Mbps for low mobility or stationary in-building coverage, and offer global seamless roaming and service delivery across the IMT-2000 family of standards.

1.3 However, as the adoption and use of wireless broadband technologies is still in the early stages, there are uncertainties with regard to the development of the wireless broadband market, in particular the technology, type and range of services that could be offered, and the spectrum requirements of operators. This document seeks the views and comments of the industry and members of the public on the potential of wireless broadband technologies, spectrum issues with regard to wireless broadband technologies, and IDA's proposals for a market trial licence framework and the use of 3G spectrum bands for wireless broadband technologies.

2. POTENTIAL OF WIRELESS BROADBAND TECHNOLOGIES

2.1 Parties interested in rolling out wireless broadband networks have given feedback to IDA that the deployment of such wireless broadband technology will result in numerous advantages for a new facilities-based entrant planning to enter Singapore's telecommunication market. The deployment of wireless technologies would enable cost effective and rapid rollout of high-speed, fully interactive, broadband local access infrastructure. This could potentially translate into more innovative pricing and service packages for broadband access for businesses and consumers, and in turn redefine the potential for high bandwidth interactive applications and spur broadband adoption in Singapore.

Questions

IDA welcomes views and comments on the potential of and benefits arising from the deployment of wireless broadband technologies, the likely services/applications to be deployed and the potential demand from businesses and consumers

3. 2.3 GHz AND 2.5 GHz SPECTRUM

3.1 IDA will be making the 2.3 GHz and 2.5 GHz spectrum available for deployment of wireless broadband technologies. It is noted that several other countries like the United States, South Korea and Malaysia have identified these bands for the provision of wireless broadband services.

3.2 IDA will be making available the spectrum for both Frequency Division Duplex ("FDD") and Time Division Duplex ("TDD") wireless broadband technologies, in line with its technology neutral stance. However, coexistence issues between wireless broadband systems (FDD & TDD) need to be considered and addressed, namely:

(a) For systems deployed in the same geographical area in adjacent frequency blocks; and

(b) For systems deployed across geographic boundaries in the same frequency blocks.

3.3 IDA has studied the technical specifications of various wireless broadband technologies. IDA notes that different wireless broadband technologies adopt different channeling arrangements. IDA is also aware that, in the US, the Federal Communications Commission ("FCC") is currently in the process of re-planning the 2.5-2.69 GHz band in the US. One of the suggestions to FCC, submitted jointly by the Wireless Communications Association, the National ITFS Association and the Catholic Television Network ("CTN") was to replace the existing 6 MHz channels in the US 2.5 GHz band with a combination of 5.5 MHz channels for wireless broadband systems and 6 MHz channels for high-power broadcast systems. To accommodate a wider range of wireless broadband technologies and systems, IDA is considering adopting a 5 MHz, 5.5 MHz or 6 MHz channeling plan for the 2.3 GHz and 2.5 GHz bands.

3.4 Based on IDA's technical assessment and discussions with industry players and vendors, we assessed that operators would typically require about 5-15 MHz of spectrum for rollout to parts of Singapore, and up to about 30 MHz of spectrum for nationwide rollout, depending on the transmission systems used, either a TDD or FDD system.

Questions

IDA welcomes views and comments on the allocation of the 2.3 GHz and 2.5 GHz bands for wireless broadband technologies and the harmonization of spectrum at the border areas.

What are the coexistence issues that need to be considered with regards to the deployment of systems (FDD & TDD) in the same geographical area in adjacent frequency blocks, and the deployment of systems across geographic boundaries in the same frequency blocks? What are the technical assessment and methodology to be used for the deployment and coordination of systems, including separation distances, power spectral flux density limits, out-of-band-emission limits, frequency guard bands etc, to ensure coexistence of system operations? What are the mitigation techniques that could be employed in case of co-channel interference between systems operating in adjacent geographical areas?

Does the 5 MHz, 5.5 MHz or 6 MHz channeling plan for the 2.3 GHz band and the 2.5 GHz band meet industry requirements? What is the appropriate duplex separation (Transmit/Receive) for the FDD wireless broadband technologies in the 2.3 GHz and 2.5 GHz bands respectively? What is the minimum, as well as optimal amount of spectrum

required by an operator for specific geographical deployment or nationwide deployment? Please provide supporting reasons for each comment and proposal made.

4. MARKET BASED ALLOCATION APPROACH

4.1 IDA is likely to adopt a market-based approach to allocate spectrum, via auction. IDA believes that the auction approach, is a fair and transparent way of allowing the market to value the spectrum, as opposed to administrative allocation which is subjective.

Key Characteristics

4.2 The framework previously adopted by IDA for the allocation of spectrum for 2G and Local Multipoint Distribution Systems ("LMDS")[2] contained the following key characteristics:

(a) The spectrum lots on auction were set out as generic lots and operators would bid on the quantity of lots they require, but not on the exact frequency bands. At the end of each round, the auctioneer would announce the aggregate number of lots being bid for, but not the specific quantity of lots for each bidder. The auction would close when the spectrum lots demanded equals the supply.

(b) The reserve price of each spectrum lot was set based at cost recovery levels for administering the spectrum for the base (first) year. The annual recurrent Facilities-Based Operator ("FBO") licence fees were kept separate from the price of the spectrum lots.

(c) The duration of spectrum rights was set at 7 years. For the base year, the winning operators pay the final bid price plus the FBO licence fees. For each subsequent year, the operators would pay the final bid price plus a 2.5% annual escalation factor, on top of the annual recurrent FBO licence fees. Spectrum trading for the provision of the same service would be allowed subject to IDA's approval.

(d) Eligible operators[3] were required to submit an Initial Offer ("IO") – the quantity of lots they wish to bid for at the reserve price, plus a Banker's

[2] LMDS is a broadband wireless point-to-multipoint communication system that provides digital two-way voice, data, Internet and video services. It can also be used for backhaul or as leased circuits. LMDS systems use a cellular-like network architecture similar to mobile networks, however, bandwidth is delivered from base stations to buildings, not moving subscribers.

[3] For the LMDS auction, interested operators were required to submit an application and IDA assessed the eligibility of the operators based on factors like financial and technical capability, public interest, etc.

Guarantee equal to the reserve price of their IO. If the total number of IOs was less than the supply of spectrum lots on offer, the auction would not proceed and IDA would grant the spectrum lots at the reserve price.

4.3 We recognise that the detailed auction design is, however, far more complex because it will have to factor in different gaming considerations and technology considerations unique to WBA. However, IDA's preliminary assessment is that these key characteristics should be retained for allocating the WBA spectrum for the following reasons:

(a) Reserve price – it is reasonable for IDA to set the reserve price at levels sufficient to at least recover the cost of administering the spectrum. It is also neater to keep the spectrum auction price separate from FBO licence fees and it reduces the volatility of the auction.

(b) Duration of spectrum rights – we believe that a spectrum right duration of 7 years is sufficient to provide business certainty for successful WBA providers.

(c) Submission of IOs – the purpose of an IO is to ensure that only serious players interested in acquiring the spectrum would enter the auction.

4.4 WBA technologies can be deployed on a regional basis or on a nationwide scale, depending on each operator's business plans. Imposing island-wide roll out obligation could potentially deter interested players from entering the market. However, to ensure that consumers are able to enjoy WBA services within a reasonable timeframe, and to prevent companies from bidding for spectrum trading purposes with no intention to provide WBA services, IDA intends to subject successful bidders to a service launch obligation of within 2 years from obtaining the spectrum from IDA. Successful bidders will have full commercial flexibility to deploy the infrastructure necessary to serve either on a regional or nationwide scale. However they will need to launch WBA services within 2 years of obtaining the spectrum from IDA. IDA reserves the right to impose a financial penalty (subject to a maximum of $1 million) on operators who fail to meet the service obligation, and subsequently, suspend the licence and spectrum rights if IDA determines that the operator will not be rolling out wireless broadband services within a reasonable timeframe after the 2-year mark.

Questions

IDA welcomes views and comments on the key features and service obligation to be applied for auctioning the spectrum for the deployment of wireless broadband technologies. If the key features are not appropriate, please provide supporting reasons why they are not.

Generic Spectrum Lot Size and Maximum Cap

4.5 Based on IDA's technical assessment of the various WBA technologies, we believe that there are no technical advantages for using the spectrum at different frequencies within a specific band[4]. Hence, the spectrum frequencies can be grouped into generic lots for allocation through auction. It is not necessary for potential WBA operators to bid for blocks with specific spectrum frequencies. Successful bidders will be assigned the specific spectrum frequencies based on the number of lots they have successfully bid for, taking into consideration the need to ensure sufficient duplex separation necessary for successful bidders using FDD systems. The generic lots are likely to be of 5 MHz, 5.5 MHz or 6 MHz size in the 2.3 GHz and 2.5 GHz bands. With generic lot sizes, IDA may hold two separate but concurrent auctions for the 2.3 GHz and 2.5 GHz bands.

4.6 To prevent unnecessary spectrum 'hoarding' during the auction, IDA intends to place a cap on the maximum amount of spectrum each bidder may bid for, which should be no higher than the optimum amount of spectrum required for nationwide deployment.

Questions

IDA welcomes views and comments on whether spectrum should be auctioned in generic lots or in blocks with specified frequencies; the appropriateness of the lot sizes; and the maximum amount of spectrum to be set.

5. DEPLOYMENT OF WIRELESS BROADBAND TECHNOLOGIES IN 3G SPECTRUM BAND

5.1 The International Telecommunication Union ("ITU") has identified the 1.9 GHz and 2.1 GHz frequency bands for the deployment of 3rd-Generation ("3G") technologies. 3G technologies are classified under the International Mobile Telecommunication-2000 ("IMT-2000") family of 3G standards endorsed by the ITU. Worldwide, several countries like Hong Kong, United Kingdom and other European countries, have auctioned out the 1.9 GHz and 2.1 GHz bands for 3G services since 2000. In Singapore, IDA auctioned the 1.9 GHz and 2.1 GHz bands in 2001 for the deployment of 3G services. Three mobile operators, SingTel Mobile, StarHub Mobile and MobileOne, were awarded the spectrum rights to the 1.9 GHz and 2.1 GHz bands for 3G services.

[4] For example, in the 2.3 GHz spectrum band, there are no technical advantages in using the frequency band at 2.3-2.31 GHz as compared to 2.31-2.32 GHz (and vice versa).

5.2 The three 3G operators are required to rollout 3G systems and services by 31 December 2004, as part of their 3G licence obligations. IDA is considering permitting the 3G operators to deploy wireless broadband technologies that do not belong to the IMT-2000 family of standards in their 3G spectrum, upon them fulfilling their 3G Licence roll-out obligation to complete the nationwide rollout of the 3G systems and services by 31 December 2004. This will give the 3G operators additional flexibility in using their 3G spectrum, and allow the deployment of wireless broadband technologies that operate in the 1.9 GHz and 2.1 GHz bands. IDA notes that this is in line with practices in other countries like Australia and the United States which allow the deployment of any fixed or mobile wireless technologies not limited to those associated with IMT-2000 family of standards, in the 1.9 GHz and 2.1 GHz bands.

Questions

IDA welcomes views and comments on the deployment of wireless broadband technologies in the 3G spectrum bands. Are there any technical considerations that the IDA should consider? Please provide detailed supporting reasons for each comment and proposal made.

6. ELIGIBILITY OF EXISTING 3G AND BROADBAND INFRASTRUCTURE PROVIDERS

6.1 Existing DSL and cable modem broadband infrastructure providers (with island-wide reach) and 3G providers such as the SingTel Group, StarHub Group and MobileOne, could be interested in acquiring spectrum in the 2.3 GHz and 2.5 GHz band and use wireless broadband technologies to complement their existing infrastructure to deliver services to end-users. IDA intends to allow existing DSL and cable modem broadband infrastructure providers (with island-wide operations) and 3G providers to bid for the spectrum, but intends to limit the amount of spectrum they can bid. This amount will be determined based on the minimum spectrum technically necessary for specific geographical deployment in Singapore. This takes into consideration the flexibility IDA intends to provide for existing 3G operators to deploy wireless broadband technologies within their 3G spectrum.

6.2 Due to the legal commitment made in the 3G auction, IDA will ensure that the WBA technologies deployed in the 2.3 GHz and 2.5 GHz bands do not belong to the complete IMT-2000 family of standards for deployment before 1 January 2006.

Questions

IDA welcomes views and comments on the eligibility of existing 3G and broadband infrastructure providers for the 2.3 GHz and 2.5 GHz spectrum, and the limit on the spectrum amount for which they could bid.

7. INTERCONNECTION AND ACCESS

7.1 To ensure fair and equitable open access to any content or service providers, IDA would require wireless broadband operators to interconnect their wireless broadband networks to the networks of any other service provider licensed by IDA. End-users should be able to choose, use and access the services of any content/service provider in a transparent and seamless manner. To ensure that consumers enjoy a minimum standard of service in wireless broadband access, wireless broadband operators may be required to comply with the minimum Quality of Service ("QoS") standards issued by IDA from time to time. Today, existing DSL and broadband service providers' are required to comply with a set of minimum QoS standards (see **Annex 1**).

Questions

IDA welcomes views and comments on whether there are issues that may pose problems to achieving transparent and seamless interconnection and open access. IDA further seeks comments on the type and level of QoS standards that will be appropriate and whether the existing set of QoS standards for broadband service providers are applicable for service delivery using wireless broadband networks. Please provide supporting reasons for each comment and proposal made.

8 MARKET TRIAL LICENCE FRAMEWORK

8.1 IDA currently has a 3-month trial framework for any party that wishes to conduct trials on any telecommunication services, systems and/or network for purposes of equipment testing, research and development or to assess the potential of certain technology, service or product. Trial operators under this framework are not allowed to charge their trial participants for the use of the trial services.

8.2 To help companies and licensees to better test the commercial viability of innovative technologies, including wireless broadband technologies, IDA intends to create a market trial framework to allow commercial charging of trial services. This Market Trial Licence scheme will be opened to new entrants as well as existing operators. This framework is designed with a view to support IDA's policy objective of promoting Singapore as a hub and test-bed for deployment of new technologies and to ensure fairness to market entrants that took the business risks and applied for full-fledge FBO and Services-Based Operator ("SBO")

licence for service provision. Therefore, the Market Trial Licence is set for a period of 6 months, with a maximum extension of 6 months, at a fee of S$2,500 per 6-month period. IDA believes that a 6-month trial period is sufficient considering that companies can set up their trial network to do technical trials under the existing technical trial framework before applying for the commercial trial licence to do commercial trials. A brief overview of this licence is set out in **Annex 2**.

Questions

IDA welcomes views and comments on the Market Trial Licence framework and the specific features set out in Annex 2. Is the Market Trial Licence framework conducive in helping market participants test the commercial viability of innovative service? Are there additional issues that IDA should consider? Please provide detailed supporting reasons for each comment and proposal made.

9 INVITATION FOR COMMENTS

9.1 IDA would like to seek the views and comments from the industry and members of the public on the issues and proposals raised in this consultation. This will allow IDA to have a better understanding of the issues and the different needs and requirements of the different interested parties. The questions are listed again below:

(a) View and comments on the potential of and benefits arising from the deployment of wireless broadband technologies, the likely services/applications to be deployed and the potential demand from businesses and consumers.

(b) Views and comments on the allocation of the 2.3 GHz and 2.5 GHz bands for wireless broadband technologies and the harmonization of spectrum at the border areas. What are the coexistence issues that need to be considered with regards to the deployment of systems (FDD & TDD) in the same geographical area in adjacent frequency blocks, and the deployment of systems across geographic boundaries in the same frequency blocks? What are the technical assessment and methodology to be used for the deployment and coordination of systems, including separation distances, power spectral flux density limits, out-of-band-emission limits, frequency guard bands etc, to ensure coexistence of system operations? What are the mitigation techniques that could be employed in case of co-channel interference between systems operating in adjacent geographical areas?

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(c) *Views and comments on the key features and service obligation to be applied for auctioning the spectrum for the deployment of wireless broadband technologies. If the key features are not appropriate, please provide supporting reasons why they are not.*

(d) *Views and comments on whether spectrum should be auctioned in generic lots or in blocks with specified frequencies; the appropriateness of the lot sizes; and the maximum amount of spectrum to be set.*

(e) *Views and comments on the deployment of wireless broadband technologies in the 3G spectrum bands. Are there any technical considerations that IDA should consider? Please provide detailed supporting reasons for each comment and proposal made.*

(f) *Views and comments on the eligibility of existing 3G and broadband infrastructure providers for the 2.3 GHz and 2.5 GHz spectrum, and the limit on the spectrum amount for which they could bid.*

(g) *Views and comments on whether there are issues that may pose problems to achieving transparent and seamless interconnection and open access. IDA further seeks comments on the type and level of QoS standards that will be appropriate and whether the existing set of QoS standards for broadband service providers are applicable for service delivery using wireless broadband networks. Please provide supporting reasons for each comment and proposal made.*

(h) *Views and comments on the Market Trial Licence framework and the specific features set out in Annex 2. Is the market trial licence framework conducive in helping market participants test the commercial viability of innovative service? Are there additional issues that IDA should consider? Please provide detailed supporting reasons for each comment and proposal made.*

9.2 Respondents are also invited to comment on any other issues not covered in this consultation document but which are considered to be relevant in the deployment of wireless broadband technologies.

9.3 IDA will consider inputs submitted and make its policy decisions thereafter. IDA will target to announce the spectrum allocation framework for the 2.3 GHz and 2.5 GHz bands, the market trial licence framework, and the policy decision on the deployment of wireless broadband technologies in the 3G spectrum bands by third quarter 2004.

9.4 All views and comments should be submitted in writing and in both hard and soft copies (Microsoft Word format), and should reach IDA by **12 pm, 30 April 2004.** Respondents are required to include their personal/company particulars as well as the correspondence address in their submissions to this Consultation Paper. Comments and views should be addressed to:

Mr Andrew Haire
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Fax: (65) 6211-2116

AND

Please submit your soft copies via email to:
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9.5 IDA reserves the right to make public all or parts of any written submissions made in response to this Consultation Paper and to disclose the identity of the source. Any part of the submission, which is considered by respondents to be commercially confidential, should be clearly marked and placed as an annex. IDA will take this into account regarding disclosure of the information submitted.

ANNEX 1

Existing QoS Standards for Broadband Access Services

QoS Indicator	*QoS Standard*
Network Availability	> 99%
Service Activation Time (from date of receipt of application)	5 working days or fewer
Network Latency (connection within the local network)*	=< 85 msec
Network Latency (for the international portion of the network)**	=< 300 msec
Bandwidth Utilisation (for connections within the local network)	=< 90%

* This latency figure extends from the broadband user to the broadband service provider's Internet Exchange (IX).
** The international portion of the broadband network extends from beyond the domestic broadband local network up to the network provider's first point-of-presence in the US, or the first point of entry in the US.

ANNEX 2

Brief Overview of Market Trial Licence Scheme

Interested parties can apply for the licence on a first-come-first-serve basis, subject to certain constraints like spectrum availability.

Period of licence	6 months. IDA reserves the discretion to grant extension of commercial trial period for a maximum of 6 months depending on the merits of the case, e.g., allowing smoother transition for commercial operations.
Licence fees	$2,500 for 6 months
Other fees	• Full spectrum fees for shared band: $1,750 for bandwidth less than 20 MHz; $3,100 for bandwidth more than 20 MHz • All radio-communication station and network licence fees as stipulated in the Telecommunications (Radio-Communication) Regulations • No Performance Bond required • Bankers' Guarantee of $100,000 for the provision of any pre-paid services or collection of monetary deposits • No refund if licence is cancelled or revoked
Application requirements	• Incorporated company under Registry of Companies and Businesses • Description of services provided, network/systems configuration • Submission of proposed price plans and terms & conditions of service subscription • Applicants do not need to submit business/financial/funding /rollout plans
Licence conditions	<u>General Conditions</u> • The licence is non-transferable • The trial operator shall not share the rights and privileges of the licence with 3rd parties • The trial operator shall comply with any directions issued by IDA, in exercise of IDA's powers, functions and/or duties under the Act, the IDA Act, and such other applicable law in force in Singapore • The trial operator shall provide IDA with any document or information that IDA may by notice require, on a timely basis and at the trial operator's own cost • Approval for the licence application must not be taken to pre-empt any approval from IDA for the applicant being licensed as a full-fledge Services-Based Operator or Facilities-Based

	Operator Trial participants • The trial operator is required to disclose to trial participants all risks and limitations of subscribing to the service on trial, for example, limited service period and service discontinuation after the trial period. • Trial participants are free to opt-out of the market trial at any time and there must be no obligations on trial participants to subscribe to any commercial service offered by the trial operator in future in the event that the trial operator becomes a full-fledge Services-Based Operator or Facilities-Based Operator Operating conditions • Any proposed interconnection to a public telephone network or any other telecommunication networks authorised by IDA shall be left up to commercial negotiations • Any siting of network equipment/systems in buildings or any other locations shall be left up to commercial negotiations between the trial operator and the premise owners • The trial operator shall be responsible to seek the necessary approvals from all relevant government agencies and departments for the deployment of its network/systems • Any changes to the trial, including changes to the operation of systems/services/equipment/networks must be submitted to IDA for prior approval. IDA may impose any additional terms and conditions it deems fit • The trial operator can only deploy its wireless networks and systems in the frequency bands specified by IDA • Wireless systems shall be subject to suitable power transmission caps as deemed necessary by IDA • Interference issues: ➢ The trial operator shall take all necessary precautions to ensure that there is no interference with any authorised networks of IDA ➢ The trial operator shall take the necessary steps, at its own costs, to solve any interference problems caused to, or by their networks • The trial operator has to notify IDA of service termination 1 month in advance • At the end of the licence period, the trial operator is prohibited from selling/transferring any of its network and/or systems to

	another licensee for any market trial deployment without the prior written approval of IDA