This paper is Nortel Networks' response to the most recent **"PROPOSED APPROACH TO FIXED-WIRELESS BROADBAND NETWORK DEPLOYMENT AND SERVICE PROVISIONING IN SINGAPORE**" published by Infocomm Development Authority of Singapore (IDA) dated 16 February 2000.

Please note that the numbering are corresponding to the above IDA's paper. It is organized in accordance to the specific questions in this paper and the responses are as follows.

2 Considerations of Issues Arising

2.1 Potential of Fixed-Wireless Broadband Technology

Services Delivery

Fixed-wireless broadband technology is used to support either incumbent operators or new competitive operators. Depending on a company existing infrastructure, it can be used as a fiber extension to an existing network or to compete with existing operators. Services such as voice, video and data can be offered.

The Nortel Reunion family includes both TDMA and FDMA technologies to address a wide spectrum of access requirements which include factors such as target markets, market penetration, end-user bandwidth and fixed vs. dynamic end user traffic characteristics. All members of the Reunion family support the same core network features and similar multimedia services. Operational familiarity is ensured. This ensures a valuable and powerful architecture by allowing the marketing and management of services to be transparent of the access technology used. Both FDMA and TDMA systems can be simultaneously deployed over a common radio within an access region to address the residential, remote corporate/enterprise Local Area Network (LAN) access, work-at-home, on-line service access, high speed Internet Access, Small Office/Home Office and other emerging markets.

Being an information hub to be in Asia, innovative service delivery and time to market are critical towards the success of this objective.

2.2 Competing Demands for Fixed-Wireless Broadband Technology

Nortel response to the competing demands here is strictly full-duplex LMDS (or BWA) technology using symmetrical transmission.

Allocation Process

I) Europe

While Europe is considered a common market, each country has its own licensing regimes and type approval processes. Realizing this could cause significant delays and cost burdens, ETSI established a standard BWA spectrum allocation specification, which allows for reuse of radio platforms across much of Western

Europe. . However, each country is free to adopt the recommendations or to reject the recommendations.

The frequency bands in Europe are licensed in accordance CEPT Recommendations and / or ITU-R Recommendations stipulating the "channel plan" requirements. The standard is based on T/R 13-02, which is a point to point specification. Within the allocated bands of this specification, there are no recommendations for specifying up and downstream traffic. The CEPT / ITU-R recommendations simply specify the frequency band pairing required. In point-to-point systems, the concept of up or down stream has no meaning.

II) North America

Similar to Europe the United States regulator, Federal Communications Commission (FCC) has allocated LMDS in bands A and B. Characteristics of the LMDS spectrum are as follows:

24GHz:
- 100 to 200MHz bandwidth (varies from area to area)
- 24.25GHz to 24.45GHz downstream, 25.05GHz to 25.25GHz upstream.
- This is the band with the most advanced equipment since it has been in active deployment since 1997. There are at least 4 suppliers offering commercial grade equipment. Service in this band could be deployed immediately.
- Nortel Networks strongly recommends that IDA adopt this band for LMDS and offers it for auction.

28 GHz Band:
- Standard blocks, but no detail specification.
- Block A has a main block of 850MHz and two sub-blocks of 150MHz each.
- Block B is spectrum restricted (150 MHz only)
- No transmit-receive specification or separation
- No channelisation within A & B
- No specification of services or connectivity (P-P, P-MP)
- Guard bands and detailed arrangement left to the operator
- Growth / band occupation left to the operator

The FCC allocations closely match the IDA current spectrum holdings. This, along with the 24GHz band will allow Nortel Networks and at least three other equipment manufacturers to actively support bids on LMDS projects in the Singapore market, resulting in fast market entry and competitive prices for spectrum license.

In terms of allocating the spectrum to operators, two distinct methods have been used by governments in North America.

- Auction
- Award

With the exception of the Teligent 24GHz spectrum, the US has auctioned off spectrum to the highest bidder. While this is an effective process, it is not necessarily the best option for providing the lowest cost to subscribers. Other governments, such as those in Japan and Hong Kong have awarded spectrum to those operators with the best business plan and service offering. Taiwan has taken this one step further by requiring a performance bond from the licensee after the spectrum is awarded. All of these methods ensure that the spectrum is used; however, the method of awarding spectrum to operators appears to provide the best value for both private subscribers and public users.

A time scale of 6 –9 months may also be considered as a benchmark from the award of spectrum to initial operation. If the operator is not in service, then the spectrum is awarded to another operator.

III) Japan

On top of European and North American standards, Nortel had been working closely with Japanese regulator in developing radio in Japanese market. Japan had allocated various blocks of frequency spectrum in different range. For 26GHz range in particular.

Application to offer BWA services in Japan – Process:

1. Submit Type I application for additional service
   > Approval granted by MPT headquarters, Tokyo

   - There are 4 sets of documentation to be submitted
   - Approval is required for a and b
     a. Type I application for additional service with BWA
     b. Technical conformance
     c. Service Yakkan
     d. Tariff

2. Submit application and receive approval for BWA Spectrum
   > Approval granted by MPT regional offices ; there are 11 regional offices
   Application is accepted beginning Dec. 25 98

Note: Both items 1 and 2 can be performed in parallel. Item 1. b, c, d can be submitted only after 1.a is approved.

Standards

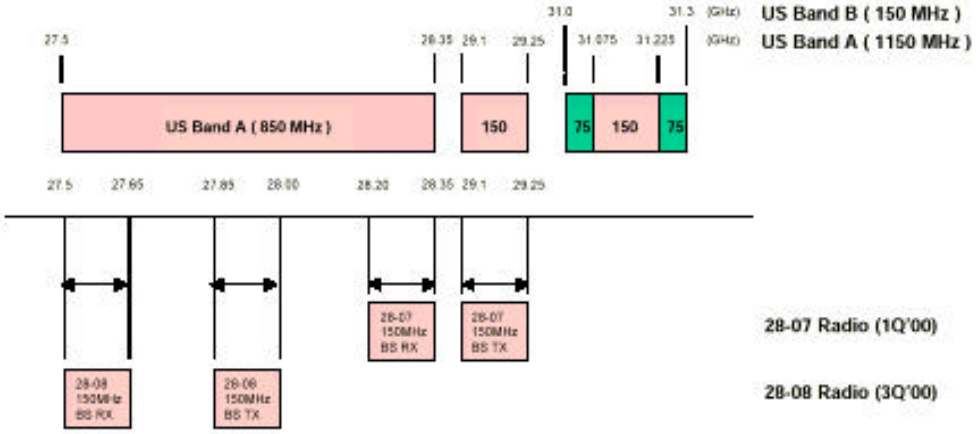
In terms of RF regulatory approvals, FCC/ETSI are the common standard supported by many equipment suppliers.

Adoption of both of these standards will allow all vendors to actively bid on LMDS projects in Singapore market, resulting in fast market entry and competitive prices for your license. Additionally, this action will also facilitate participation from many other vendors who have developed radio technology in the ETSI, FCC and Japan bands, thereby providing increase competition for LMDS equipment amongst the prospective license holders.

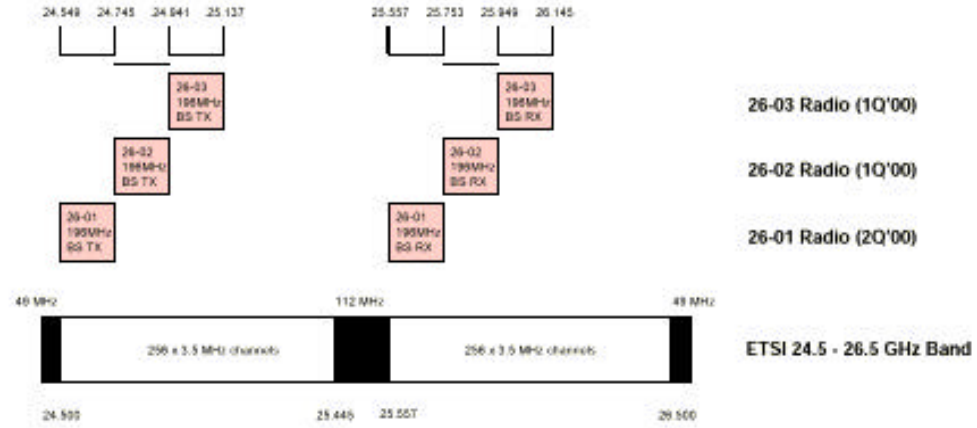
2.4 Spectrum for Fixed-Wireless Broadband Services

2.4.1 SPECTRUM AVAILABILITY

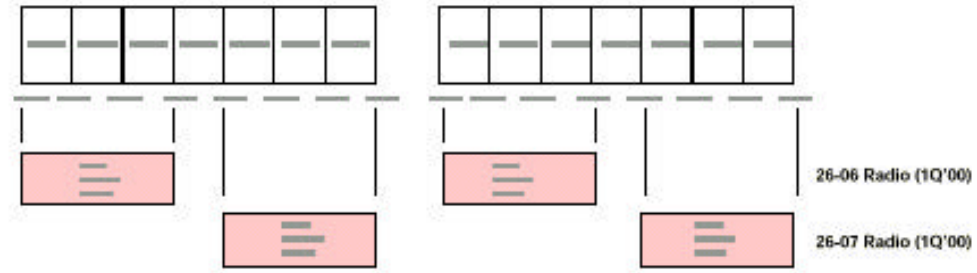
1. FCC LMDS A/B Band Radio Plan



2. ETSI 26GHz Radio Plan



3. Japanese 26GHz Radio Plan



2.4.2 Interactive Broadband Multimedia (IBBMM)

Spectrum Bandwidth Per Operator

In terrestrial fixed-wireless technology, bi-directional spectrum of 100 – 200 MHz is typical. Other countries have sub divided these blocks into smaller segments but awarded operators with a number of contiguous blocks. Allowing the operator to use contiguous sub blocks within a spectrum block allows suppliers more freedom when engineering systems. This also provides the flexibility of future networks expansion should the networks size grow over time. Therefore, while it is important to regulate the spectrum as a whole, regulating the engineering and use of spectrum within a block can be restrictive.

Based on Europe, North America and Japan standards. At least 5-6 LMDS bands can be made available for Singapore market with immediate deployment at 26GHZ and 28GHz. This will allow at least 5-6 service providers operating at these bands.

It should be noted that there is typically a separation between transmit and receive signals. For instance, those bands as specified in item 2.4.1 Spectrum Availability.

2.4.4 Licensing and Spectrum Allocation Approach

Please refer to section 2.2 and section 2.4.1. Nortel Networks recommends that spectrum be assigned based using the method that will provide the best value to subscribers taking reference from three major international bodies.

2.4.5 Provision Of Broadcasting Service

Providing spectrum for broadcast purposes has been considered by many other operators at >24GHz in the non-tropical environments. Considering the asymmetrical transmission for such applications, e.g. CATV, and given the nature of broadcast video, it is important to have strong signal that can travel considerable distances under the tropical environment like Singapore. Frequencies in the MMDS bands for broadcasting applications such as 2-6GHz are being proposed.

Therefore the proposed spectrum band in paragraph 2.4.1 of this paper should be used strictly for LMDS symmetrical transmission (or IBBMM) only. However other bands outside paragraph 2.4.1 may be considered for broadcasting applications to obtain the required bandwidth.

2.5 License Conditions

2.5.1 BWA License Duration

In a market, such as the US, where licenses are purchased, there is no time line. For licenses that are awarded, a level of performance should be expected from the service providers over a period of time such as 7-10 years. The renewal of the license can also be considered based on past performance and future development plans. This will help ensure that subscribers receive value for service and enable the IDA to influence

the direction of telecommunications in Singapore. It is recommended that the license given in Spore should be for at least 10-15 years in order to built a good business case.

2.5.2 License Award And Launch Date

If the IDA licenses service providers that can use existing equipment from suppliers (refer to paragraph 2.4.1), a realistic time frame from the time of award to deployment is less than 6 months. This will allow the operators to fulfill the necessary tasks related to site selection and preparation, etc. It will allow suppliers have enough lead time to queue manufacturing and provide the required services to support the deployments in Singapore.

2.6 Technical Considerations

2.6.1 Climate Considerations

This concern has been addressed by Nortel's Reunion Technology. There are engineering variables for examples, modulation schemes, availability, BER, transmission power, etc. need to be considered. Thus professional and experience engineering experts are required from the vendors. ITU has developed a body of knowledge to deal with the rain fade issues. These are extensions of the methods that have been used for many years by the point-to-point industry. Nortel has conducted trials in Hong Kong, Taiwan and many other countries under the tropical environments.

Regarding the concern of QoS, there are two different standards namely MCNS (Multimedia Cable Network System) and DAVIC (Digital Audio-Visual Council) for TDMA LMDS system. MCNS has well defined specific QoS but DAVIC does not. There is no provision for QoS support in DAVIC standard.

2.6.2 In Building Coverage

In almost all of the countries, there are companies specialized in in-building cabling for in-building coverage. For the case of Singapore, due to its well organized estates and building, this makes additional cabling easy. Moreover existing cable ducts may/should be allowed to use under well regulated environment.

4. Invitation of Comments

In summary, Nortel proposes the following for IDA consideration and would like IDA to keep the following statements as "Restricted".

- IDA to maximize the participation of all service providers for both local and foreign players including ISP operators, vendors, and local companies. Critically considering the proposed frequencies bands in order to shorten the time-to-market,

so as to benefit both business and consumers, and the economic development of Singapore in the IT industry.

- IDA may consider giving out part or all of the proposed bands depending on the needs of the applicants. The unused specific spectrum within that individual band may be considered for future network expansion and new service delivery.
- IDA to consider MMDS and MVDS in different spectrum outside the allocated LMDS bands.
- IDA to approach the LMDS licensing and spectrum allocation based on international bands and applicants' business plan mainly. Auctioning in Singapore may increase costs of business and maximum participation due to its market size. Moreover allow costs saving to service providers will ultimately give more room for innovative service delivery. Therefore cost of spectrums should be minimum to attract participation.
- LMDS (or IBBMM) service providers should be considered as separate from broadcasting operators.
- IDA to follow the three major international bodies from Europe, North America and Japan for its LMDS (IBBMM) spectrum allocations.
- IDA to consider the license given in Spore should be for at least 10-15 years in order to built a good business case.
- IDA to consider the award of LMDS license as soon as possible.
- IDA should critically consider the recommendations on the time-to-market and commercial deployment costs vs. market demand to avoid delayed deployment.
- IDA to facilitate to overcome any in-building cabling constraints which may be due to the public property housing ruling and ownership of property. IDA to also facilitate the maximum use of existing cabling structures; minimizing the cost of the license and spectrum means more room for in-building cabling investment for any service providers.

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