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International Standards and Global LMDS Technology Development

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Introduction

Fixed broadband wireless technology can now deliver services once thought only available through wired solutions. Long anticipated, it is delivering nicely on its promise of providing fast, cheap, flexible short-haul capacity. The basic transmission technology has been used for years, primarily for point-to-point dedicated links between nodes in a network. But recent breakthroughs in point-to-multipoint functionality and spectrum administration have blown open the door for broadband wireless to be used for integrated, high capacity, two-way digital short-haul services. The attributes of such a system make it extremely useful in areas where wired or satellite solutions were the available broadband access methods – and in those areas where such services were previously not cost-effective.

A new technology often presents issues to be resolved, and this one is no exception. Read on for spectrum sharing and product standardization issues, and a glimpse into the status of spectrum allocations for these services.

Background

Most technology-based industries generate an amazing alphabet soup of technology variations and acronyms, and broadband wireless follows suit. The acronyms vary according to frequency ranges and applications. MMDS (Multichannel Multipoint Distribution Systems) operates at 2GHz. MVDS (Microwave Video Distribution Systems) will operate at both 12GHz and 42GHz, and one of the most promising, LMDS (Local Multipoint Distribution Services), typically operates at 26-31GHz. Canada, Brazil, and other countries use a slight variation, describing the service as LMCS (Local Multipoint Communications System.) For purposes of this discussion, we will use LMDS as including LMCS.

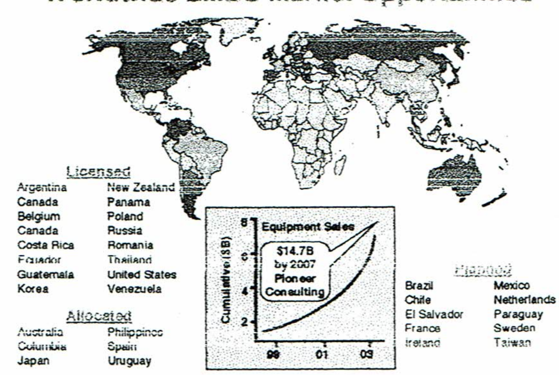
MMDS has been around for several years as a one-way video broadcast service. Recent rule changes in the US allow greater usage, authorizing channel aggregation and delivery of two-way services. In the UK and Western Europe, technical trials are underway for MVDS, and it is operational at 12 GHz in Hong-Kong. LMDS is also emerging. As discussed earlier, initial deployments are underway, and spectrum administrators around the world are allocating spectrum for delivery of fixed two-way multimedia services.

LMDS is distinguished from these other technologies in its multimedia, multipoint functionality – the ability to effectively distribute high-capacity digital voice, video and data services in truly multipoint fashion. Its applications fit the deregulation drift present in most countries today. It provides a flexible, inexpensive, reliable technology highly capable of capitalizing on the coveted, and until now elusive, competitive local loop opportunity.

Global Interest in LMDS

Interest in LMDS is a worldwide phenomenon. In countries with less developed infrastructure, it is seen as an inexpensive, low-risk, flexible system that in days can deliver state-of-the-art services to a broad local area. A piece of modern infrastructure can be operating immediately instead of in the months or years wired solutions would take. In countries with highly developed infrastructure, competitive opportunities in the local loop and creative entrepreneurial offerings are added to the basic use of LMDS for flexible, inexpensive local loop services. Spectrum allocation issues have been the one issue holding LMDS back from exploding into all these possibilities.

Worldwide LMDS Market Opportunities

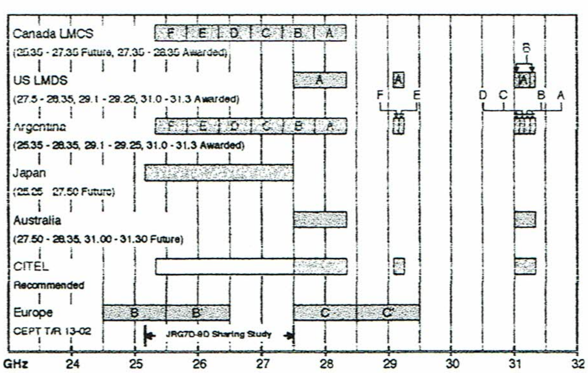


Like other natural resources, radio spectrum is administered by regulatory agencies. And because spectrum resources are finite, the allocation and assignment of licenses is carefully managed to maintain the integrity of the worldwide communications architecture. This means that spectrum allocation can be a painfully slow process. However, international regulatory bodies have taken proactive steps in the LMDS frequency allocation process. To date, sixteen countries have issued licenses, and many others are beginning the journey. Licensing of services in cornerstone markets like the United States and Canada has firms such as Pioneer Consulting forecasting tremendous revenue growth. LMDS deployments underway in North America, South America, Asia and Europe put substantial teeth into the notoriously toothless jaw of market prediction.

Multiple Licensing Approaches

Through valuable mistakes in the development of other telecommunications technologies, we know that thoughtful standards can smoothly midwife a technology into wide and effective use. Such standards can create great economies of scale. Considering a global marketplace and the tremendous worldwide potential of LMDS, definite advantages can be offered by spectrum allocation and product implementation standards.

Global LMDS/LMCS Bandplans



At the moment, allocation standards are non-existent. Many regulatory administrations are authorizing point-to-multipoint (PMP) radio system operations like LMDS over a block of spectrum for large geographic areas. Licensees are thus free to select or adjust to the best channel plans for their local market, equipment capability, and business plan. In such a market-driven allocation plan (currently utilized in the U.S. and other markets), the natural resource is used more fully. Subscribers, licensees and administrations all benefit.

Unfortunately, not all spectrum resources for LMDS are allocated this way. Current policies in some countries may be a holdover from point-to-point broadband wireless technology where interference issues are more critical. Or perhaps the policies are maintained by the instinctive self-preservation urges of government bodies. But the fact remains that many administrations are authorizing spectrum for LMDS on a per-link basis. Great time and expense cripple this type of allocation scheme. Administrations have become a party to interference arbitration, and the nature of the plan is contrary to the impetus most governments are putting on de-regulation. In the long run, block plans clearly better serve the growth of the industry and the administrations themselves. The figure below reflects a few of the allocations made or under consideration today.

Licensing Trade-offs

Global frequency management starts with the International Telecommunication Union (ITU). The ITU, a specialized agency within the United Nations (UN), acts as architect for the world's communications systems. With input from its member nations, the ITU recommends and coordinates allocations to assure equitable sharing of spectrum resources. As a example of sharing noted in the bandplan figure, joint rapporteur group 7D-9D is organized by the radio communication sector of the ITU. The group is studying sharing between inter-satellite service and fixed service, which includes LMDS, in the 25.25 - 27.5 GHz band. The result of the study will be some restrictions on LMDS systems in these frequencies. Active involvement in the study by LMDS proponents will assure transmitters are allowed to operate with enough power to meet service requirements.

Once a nation's spectrum has been allocated by the ITU, the internal licensing process is begun. Each country is free to choose a licensing process consistent with their policies and philosophies, and may choose to follow ITU recommendations. In the U.S., LMDS auctions were completed in March, 1998, and licenses were sold to qualified bidders meeting a minimum opening bid. In other countries, licenses have typically been distributed by concession.

Administrations authorize point-to-point (P2P) radio relay systems link-by-link using defined and fixed channel plans. A prospective licensee prepares an application for the desired frequency channels. Using coordination databases, administration officials confirm feasibility of the link frequencies and issue a station license. Channels are re-used by maintaining maximum frequency separation, low unwanted emissions, and wide geographic separation. For a P2P radio station, there is usually a one-to-one relationship between a station and a channel pair.

As mentioned in the previous section, the major disadvantages of authorizing individual links are the time, expense, and potential government liability of such coordination. In some cases, administrations have become very conservative about re-using channel pairs. This has lead to inefficient channel use and even longer lead times.

PMP radio systems present different issues than P2P systems because they deliver services to many subscriber terminals from a central hub. The hub provides coverage over a geographic area and usually operates on several RF channels to satisfy customer demand. In a large license area including several hubs, the licensee is self-motivated to re-use the spectrum investment, choosing service offerings that maximize customer satisfaction, and ultimately, revenues. If the frequency block allocated is around 1 GHz, PMP systems provide competition to high-bandwidth wired alternatives such as coax or fiber. The flexibility to use a large block of spectrum matched to the local market, through self-interest, results in the highest efficiency and lowest possible cost for services.

The optimum channel plans for PMP and P2P systems are also quite different. PMP systems multiplex or aggregate multiple subscriber connections into high-data-rate channels, then connect to one or more networks at the hub. Unlike P2P stations, the hub operates on many frequencies. A typical subscriber terminal may operate on only two: one to transmit, the other to receive. For some multiple access protocols, systems with high bandwidth downstream (hub to subscriber) channels and low bandwidth upstream (subscriber to hub) channels are the least costly to implement. This difference between downstream and upstream bandwidth demands can cause frequency to go unused if an administration dictates a symmetrically channelized frequency plan.

PMP systems licensed in a large geographic area still require frequency coordination, but only near license boundaries. The most common inter-system interference is from the licensee in the adjacent geographic area, so one licensee only needs to coordinate with a few others. Interference is also likely to be reciprocal, so adjacent licensees are self-motivated to find equitable solutions. It benefits all parties involved – administrations, licensees, and ultimately subscribers – when PMP systems such as LMDS are afforded the flexibility in frequency allocation and coordination their architectures allow.

Administrations which impose channelized bandplans on PMP licensees restrict the licensees' flexibility, their ability to minimize cost, and ultimately the economic benefits. For PMP systems, which work best when licensed over broad areas in large spectrum blocks, administrations and the public receive comparatively little benefit from imposing channelized bandplans. The exception is when the administration issues licenses on a per-channel basis and retains frequency responsibility within a small geographic area.

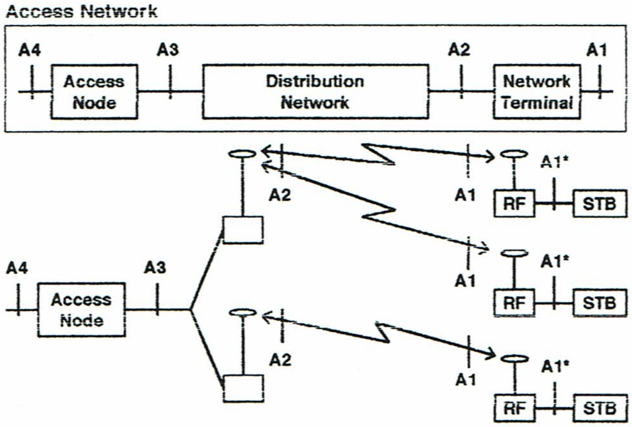
Product Standardization Issues

The need, benefit, and timing for LMDS equipment standards is widely debated. Standards could lower product cost, expanding the market and scope of LMDS products. But service providers, regulators, equipment manufacturers, component vendors, and ultimately, service subscribers, must all benefit from the standard. Leaving anyone out risks a negative impact to the industry. Also, product standards must fit all international regulatory frameworks. Several groups are positioning themselves to create an all-encompassing standard. If we learn from ISDN and TMN which generated early excitement then struggled for acceptance, we can avoid potential problems.

In the evolution of complex systems like LMDS, exciting developments are commonplace. The original standard may not have included the new application, and the choice to adopt a standard may compromise the systems approach. Several groups like the Digital Audio-Visual Council (DAVIC), the Motion Picture Expert Group (MPEG) and the European Telecommunications Standards Institute (ETSI) have been working on product standards for years. Though originally meant for a different purpose, several of these standards are potentially applicable to LMDS systems. To date, none have received complete acceptance in the LMDS industry.

Given differences in regulatory policy and planned use of LMDS systems, the critical mass for standards has yet to develop.

That said, LMDS systems tend to have a few common architectural blocks and interfaces. The figure reflects the interfaces DAVIC has identified for an LMDS system. The upper half of the figure reflects the DAVIC model for cable networks, and the lower for wireless networks. The A4 and A1 interfaces for wired networks are the most critical as they define the connections between the network and the subscriber. Positioning LMDS systems as a transparent alternative to wired solutions, the A4 and A1 interfaces are likely to follow existing standards for wired systems. For wireless networks, the A1, A1* and A2 interfaces are still being defined.



Each interface consists of a protocol stack. Each layer in the stack from the physical layer to the application layer is an independent candidate for standardization. In many cases, voice, video, and data can use a common physical interface. Intermediate level interfaces determine quality-of-service parameters which can be common between services. But the differences between real time voice and non-real time data lead to different adaptations because the application layer is by definition different for each service.

The A4 interface connects the LMDS system to core network elements like an ATM switch or wide-area network. Most system approaches have already settled on standard communication interfaces such as DS3 or OC3 for this connection. Following an industry standard for this interface is crucial because the switching or multiplexing platform selected will not usually support proprietary or LMDS-specific interface protocols.

The A3 interface is the intermediate frequency (IF) connection between the LMDS Access Node and the RF transmission electronics. In analog point-to-point radios, the A3 interface almost always is 70 or 140 MHz, but the A3 interface for LMDS has many approaches. The approach depends on the functional balance between the access node and the outdoor equipment block. Rapid development of semiconductor technology is causing substantial change in the A3 interface area. More digital functionality is moving into the outdoor equipment. At the A3 interface, some systems use baseband digital, some use 70 MHz modulation, and some use L-band (1-2GHz) multi-carrier modulated signals. Any standards set for the A3 interface would be vulnerable to rapid changes in radio system design, and would likely become obsolete quickly.

The wireless A2 interface is often called the "air interface." A common air interface is essential for services such as mobile telephone or broadcasting where a subscriber owns the equipment and may move a cell phone or television from one service provider to another. The need for an air-interface standard in fixed service systems like LMDS is less clear. For early deployments of LMDS, the RF component of the network terminal is likely to be owned and installed by the service provider, like cable set-top boxes have been owned by cable operators. The benefit to the consumer of standardizing the A2 interface is minimal until the consumer owns the device.

The A1* interface has some commonality with the A3 interface but is much more sensitive to cost. Like the A3 interface, the functions on either side of the A1* interface follow Moore's law of progress for the semiconductor industry. If the cable TV industry converges on a common A1* interface for offering two-way services in addition to video, then the LMDS industry will have a potential standard to use for A1*.

Summary

LMDS technology is exploding into a fertile global marketplace. It can easily provide an effective vehicle to augment existing infrastructure, and establish state-of-the-art infrastructure in previously underserved areas. Handled properly, its potential is virtually unlimited. But the cautions are as clear as the possibility. Restrictive channelization require-ments and unworkable standards can stop the growth before it starts. We can take a cue from mistakes made with other technologies such as

ISDN and TMN, keep the regulatory environment as open as possible, and watch the developments. Given the right conditions, LMDS may even surpass the already optimistic predictions for its success.

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