March-April 2/2006 G59399

rf & wireless EUROPE

Radio Waves President Andy Singer demonstrates the rigorous quality testing of millimeter wave microwave antennas

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Millimeter Microwave Commercial Antenna Systems

Figure 1: Sector antennas for the multipoint end

Modern microwave links are quite prevalent due to the cost effective nature of utilizing microwave point-to-point links to relay traffic compared to wire-line rental rates and fiber usage

Wireless microwave links also can serve as an excellent back-up to fiber-optic links. With such a high demand for implementation of links, but limited frequency spectrum, governments have recently authorized additional spectrum in the millimeter wave bands. There are number of creative applications commercial network operators and their partners have found for these millimeter microwave bands. This article will outline several of these exciting applications for commercial millimeter microwave bands and the antenna systems utilized for these applications. One of the common themes for these bands is their ability to provide high bandwidth capacity. Although the link range can be limited due to the nature of the propagation at these frequencies, the bandwidth capability provides for a number of useful and cost effective applications, some not previously possible with wireless networks. Due to the high frequency range, antennas design and production becomes significantly more complex in the millimeter range. Advanced electromagnetic design tools are required during development and advanced manufacturing techniques combined with mature quality systems are required to produce these antenna systems.

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Most of us can remember that at the height of the telecom bubble LMDS (Local Multipoint Distribution Systems) was touted as the next frontier that would allow CLECs to take on the world of incumbent telecommunications providers. As we know Fiber and DSL utilized by the incumbent providers became the most prevalent method of broadband access and most CLECs could not develop a sustainable business model. LMDS which is typically deployed between 24 GHz and 28 GHz still survives, but has found greater success for cellular and other broadband backhaul in areas of dense cell site deployments. LMDS utilizes a PMP (point-to-multipoint) architecture and as such requires hub (sector) antennas and directional dish antennas for the customer presence end (CPE).

The multipoint end utilizes a sector antenna similar to one shown in figure 1. These sector antennas (horns) typically have a beamwidth of 90 degrees and require very specific and robust pattern shaping to allow for proper system performance. Other beamwidths such as 45 degrees and 60 degrees can be utilized in certain applications. As can be seen in a typical pattern in figure 2, the roll-off and side lobe reduction are substantial. These horn antennas require very tight manufacturing tolerances to assure this type of performance and assure it on a consistent basis. The customer presence end would use a high performance dish antennas such as the Discriminator seen in figure 3.

Moving up in frequency another millimeter wave frequency range that is popular is the 38 GHz band. The 38 GHz band is currently seeing significant interest in the EMEA (Europe, Middle East and Africa) due to many of the traditional lower PTP

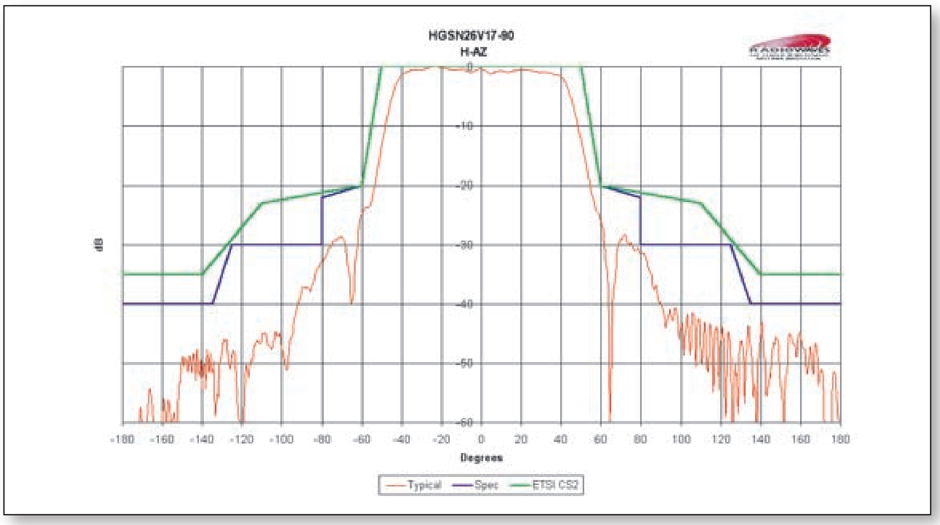

Figure 2: Roll-off and side lobe reduction

Figure 3: High performance dish antenna for the customer presence end

point-to-point microwave bands being full. These networks are standard PTP microwave links that utilize a millimeter microwave frequency. The antennas typically utilized are high performance one foot and two foot microwave dishes.

One of the more exciting areas for current and future deployments is the 60 GHz band. Current deployments arte mainly in the US, Canada and Japan. Some case-by-case deployments are just now just occurring in Eastern Europe, Asia and Africa. These systems have a range of up to two miles dependant on regional weather variations. Antennas for 60 GHz are high performance point-to-point parabolic antennas. Figure 4 is a picture of integrated 60 GHz antenna typically utilized. While the achievable link distance is a limitation the bandwidth capability is a significant advantage. Applications for these radios include LAN extensions and extending the reach of a fiber or service backbones. A complete 60 GHz link can be purchased for $20,000, which provides a full gigabit. The FCC has allocated spectrum in the United States between 71 GHz - 95 GHz in order for companies to provide multi-gigabit point-to-point connectivity. The three specific bands are 71 - 76 GHz, 81 - 86 GHz and 92 - 95 GHz often referred to as e-band. These bands are the highest yet licensed by the FCC. Currently they are licensed in the USA and expected to be licensed in Europe mid to late 2006.

These new bands are open to all types if users including carriers, utilities, government and public safety agencies. The e-band systems can operate over approximately one mile (depending on regional weather variations) and offer the ultimate in bandwidth. Due to the nature of propagation at this frequency range and innovative licensing, frequency reuse opportunities are excellent. The FCC also chose to allow a “light licensing” program via an industry database, which greatly speeds the process. The 70 and 80 GHz E-bands are considered of highest interest for these very broadband communications links. With the allocated 5 GHz bandwidth in this portion of the e-band radio manufacturers will eventually be providing data rates of 10 Gbps (OC-192) capabilities. One of the leading providers of radios for the 60 GHz band is Bridgewave Communications. Bridgewave will have e-band radios shipping by the 2nd quarter of 2006 complete with integrated high performance antennas.

Figure 4: 60 GHz antenna

Antennas for e-band application are typically high performance one and two foot parabolic dish antennas. Typically these antennas are integrated with the ODU (outdoor unit) to avoid transmission lines losses and to simplify installation. One should be careful with antennas at these millimeter wave frequency bands. If an antenna’s cost seems to low, it might just be. Repeatable manufacturing tolerances are critical in these bands and if tolerances are not consistent, antenna performance can suffer very significantly. If the machining of a feed tube is off by a mere .002 the antenna may loose as much as 10 dB of gain at these frequencies. Having a mature and rigorous quality program is essential to the manufacturing and ultimate performance of antennas at these frequencies.

One of the specifications that is of key interest to users of millimeter wave antennas and other frequency ranges is antenna gain. One needs to be careful when assuming a catalog specification in the manufacturers catalog is the actual gain of the antenna. There is no industry association and in most cases no government entity that tests antennas and assures compliance to specifications such as gain. Thus a manufacturer can state any number for gain in a catalog. To be certain of the gain a particular antenna model provides, you really need to have the antenna tested on a qualified antenna range. Antenna performance is a key factor in the ultimate performance of these millimeter microwave networks, so time spent researching antenna selection is a wise investment.

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