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BROADBAND

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Antenna choices optimize broadband

Maximizing antenna coverage minimizes radio points

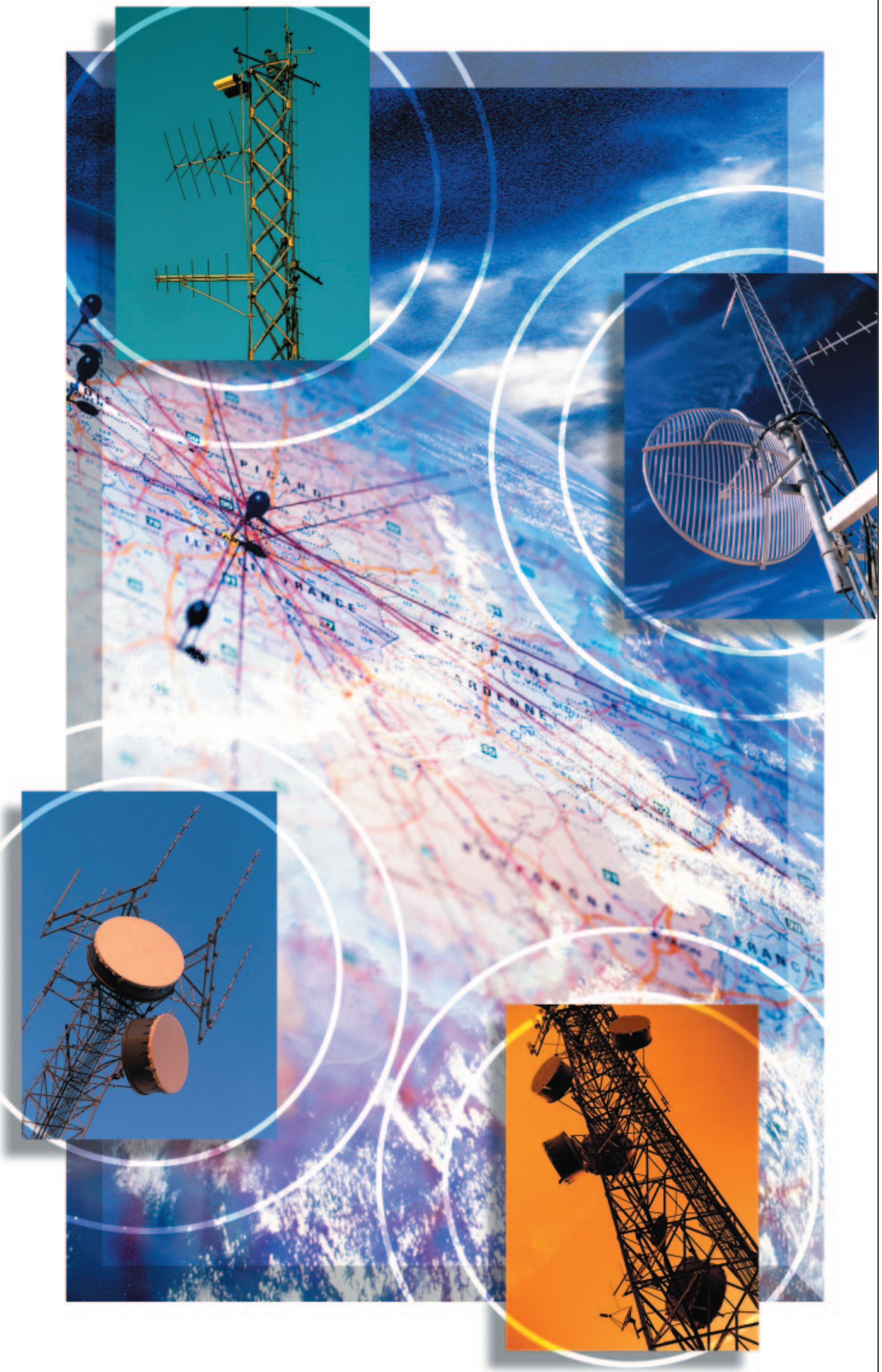
Broadband is basically a generic term for higher speed data transmission in point-to-multipoint service provider networks. Wire line networks using DSL technologies, cable companies and wireless networks based on UMTS (3G), Wi-Fi, or WLL standards offer so-called broadband transmission rates.

While there is some activity at millimeter wave frequencies, most of the emerging broadband wireless activity is centered on the 2.4 and 5.8GHz license-exempt bands utilizing the 802.11 families of standards.

To drive data communications to the next level, broadband is critical for the introduction of new services on phones and in providing Internet and other data users with enough bandwidth to send and receive images, video and even work remotely from home or on the road.

Wireless broadband is especially interesting as it offers many advantages over traditional fixed line DSL technologies and cable modems. They can be deployed faster than wired systems, reducing the time needed to recoup the initial investment. Wireless networks also require much less up front capital investment as their build out can be scaled both in terms of area coverage and capacity. This can be particularly attractive in rural and international markets where wired broadband infrastructure may not exist.

The advantages to customers are potentially enormous. By removing the need for a fixed link to a phone port workers will have true remote working capabilities



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and offices could literally be picked up and moved without the problems of cabling. You would even be able to take your office to lunch, an exhibition or even the beach.

Wireless ethernet

License-exempt wireless ISPs (WISPs) are rapidly gaining a share of the broadband picture. On the regulatory side, both in Europe and the USA, increased spectrum will be made available in the near future for license-exempt fixed wireless broadband (FWB) systems, driving this technology beyond just technology enthusiasts. It is estimated that there are more than 1,000 WISPs operating in North America alone, while in Europe interest is rapidly gaining pace.

Though not all wireless Ethernet systems utilize Wi-Fi (Wireless Fidelity), it is the one standard that has generated a lot of interest in FWB systems. Wi-Fi networks use radio technologies based on IEEE802.11b or 802.11a or 802.11g to deliver a secure, reliable broadband connection with an 11Mbps (802.11b) or 54Mbps (802.11a) data rate. Dual band products are also available (802.11g). WISP and Wi-Fi networks operate in the unlicensed 2.4 and 5GHz radio bands.

Optimizing broadband networks

Choosing the right mix of antennas can lead to significant cost savings in a network. As the antennas in wireless networks are a fraction of the price of the radio equipment, designers can maximize the coverage for each antenna to minimize the number of radio points required.

To achieve this aim, the antenna should exhibit high gain and efficiency. All the elements that make up an excellent sector antenna are based on high quality, robust PCBs to ensure industry leading efficiencies, high gain and low levels of interference. These characteristics all enable designers to significantly reduce the number of radio points in a typical network through a wider area of coverage per antenna.

Consequently, choosing the cheaper antenna often results in a more expensive overall network cost as it does not deliver sufficient coverage to effectively minimize the number of radio points required. Typically, low-cost antennas have poor or unreliable performance characteristics such as high loss and interference as well as inappropriate beam widths. All too common in low cost PCB antennas is the usage of lower quality board material that has higher losses.

So as the RF signal travels through the board, more energy is converted to heat and less energy passed through the circuit to eventually be radiated as energy from the antenna system. This phenomenon is known as antenna efficiency and the lower the losses, the higher the efficiency and ultimately the more energy that is radiated out of the antenna system.

Shaping RF performance

Beam-width is also a critical factor. If we consider the analogy of the RF beam versus a torchlight or strip light, it is easier to visualize what shaping RF performance means. Obviously a wider beam width results in the need for fewer points to illuminate a specific area.

However as the energy is now spread over a wider area, the energy does not travel as far.

It is the ability to focus coverage in the most useful area that ensures a high performance network. Focused coverage might also be a legal requirement as spillage into other areas may compromise other cells or interfere with other service providers.

However, the key is to achieve this with the lowest number of radio points possible, without compromising the service to the customer.

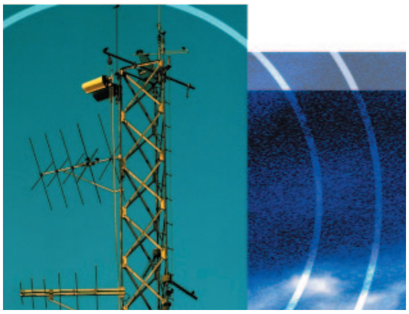
Terrain also plays an important part. For example, a valley might require more RF beams to illuminate "shadows," while a mountain or ridge would need a different configuration. Critical to efficient coverage is the ability of the designer to bring into play a wide variety of beam-widths. To this end you should seek a supplier that offers a wide variety of horizontal beam widths such as 60, 90, 120 and 180 degrees.

A high back-to-front ratio, which implies a small RF back-lobe, also plays an important part in shaping RF performance. A small back-lobe ensures that there is much less interference with other hubs or sectors towards the rear of the antenna allowing cells to be placed closer together and maximizing capacity in dense areas.

Figure 2 shows a typical sector antenna, sometimes referred to as a "hub antenna."

Pattern performance

Pattern performance refers to the shape and intensity of the RF beam that an antenna exhibits, rather than just the beam-width. Parabolic antennas, for example, can have tightly focused beams in both the horizontal and vertical beam widths, similar to a narrow torchlight and are typically used in point-to-point links where one needs to focus energy at one other single point. In point-to-multi-point systems one needs to cover a complete sector of potential users, thus a sector antenna offers an ideal horizontal coverage pattern similar to a strip light or fan beam.



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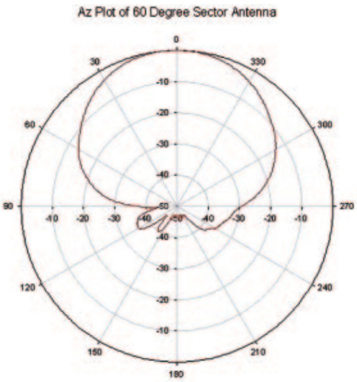

Fig. 1. Radiation pattern of "sector" antenna

This can be seen in Figure 1. These beam widths can be vertically or horizontally polarized or even offer dual polarization.

As the sector antennas cover a broad area, they are ideal for point-to-multipoint subscriber services such as LANs, WANs and WISPs. Ensuring the right pattern performance from an antenna is one of the critical factors in optimizing a network with respect to the terrain and coverage requirements.

Essentially, a wide variety of options go a long way to achieving a cost minimized system.

Fig. 2. Typical sector or "hub" antenna

Dual Band

Dual band antennas further reduce costs by allowing one band to be used for transmission and the other for reception. Other advantages include the ability to offer a higher capacity with one antenna or to provide diversity or redundancy within the network. Similarly, a dual band 2.4/5.8GHz antenna can future-proof the network by enabling an upgrade to a different frequency at a later date without the need to re-install an antenna, which is not only expensive, but also can influence performance.

Conclusion

Reducing costs and optimizing performance in a network is a balancing act that takes into account a wide variety of requirements, including coverage area, redundancy, present and future capacity and minimizing the need to re-install antennas to upgrade to a different frequency.

As the most significant cost savings are achieved by reducing the number of radio points in a wireless network, it is imperative that designers consider the choice of antennas carefully. Antennas with high gain, selective patterns and high efficiency can assure that networks are reliable and perform at their best. ■

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