

Get The Signal Loud And Clear

WILL TOMORROW'S ANTENNAS PROVIDE THE PERFORMANCE, RANGE, AND CAPACITY THE WIRELESS COMMUNITY DEMANDS AT A PRICE THAT THEY CAN AFFORD?

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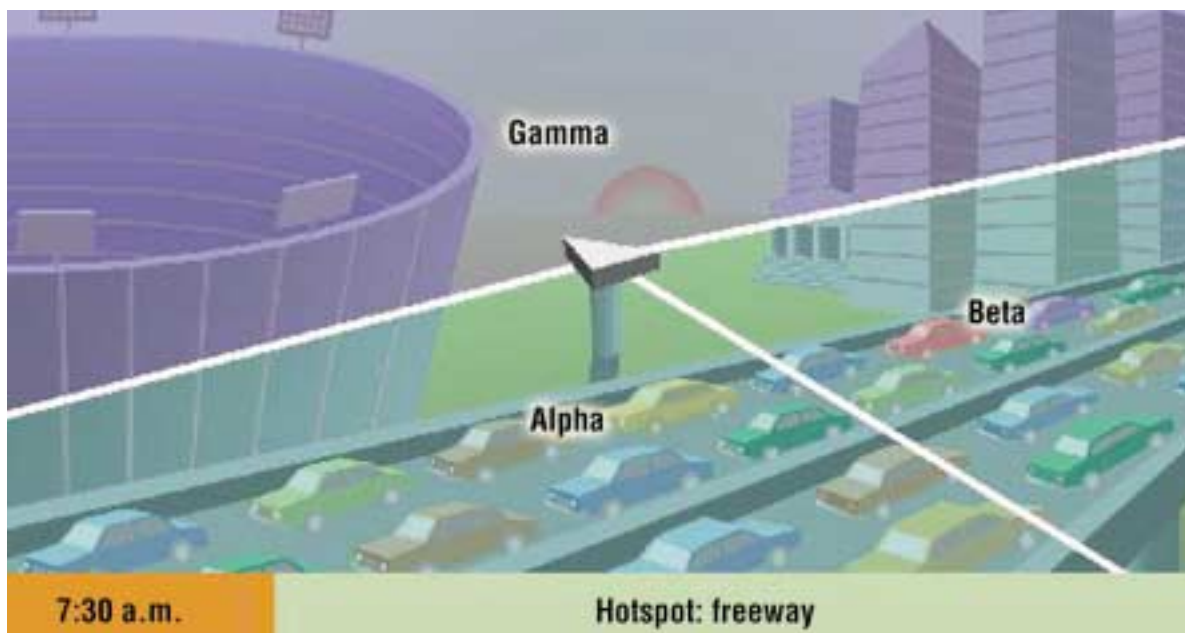
WIRELESS technology today is crucial to unlocking the power and reach of future communications networks. That is, of course, if certain key obstacles can first be overcome. Antennas are a prime example of the challenges that still lie ahead. Traditionally, antennas have been used to capture sufficient signals. While this is still the case today, they must now do so in the face of a growing litany of requirements. Today's antennas must, for example, offer higher performance and increased range at a lower cost. They must be rugged and able to address zoning issues. And, most important, they must be able to offer increased capacity. With the migration to third-generation (3G) networks and products, the issue of capacity will increase exponentially. Making the most of limited spectrum resources will become a critical responsibility for antennas going forward.

As Albert Berger, director of marketing at RangeStar Wireless, Inc. (Aptos, CA), explains, "As we witness

the migration to 3G wireless devices, the importance of an antenna on any wireless device becomes increasingly vital. The antenna represents nearly 50 percent of the operational importance of any device. The next generation of wireless devices will be smaller in size and merge multiple platforms and technologies."

With continuing consumer expectations for access to wireless voice and data, and the difficulties currently experienced by base-station manufacturers and wireless providers in meeting this new demand, it seems clear that new antenna technology will offer a viable option for increasing capacity, coverage, and data range. But just how does a vendor create a network that has higher performance, yet retain the same or better form factor of a standard cellular antenna? Adding more hardware means dealing with zoning issues, real estate, and construction costs, thus preventing this more-traditional approach from being a viable long-term solution.

One option may be the adaptive array, or smart an-



1. This graphic illustrates how the load balancing espoused by Metawave's smart-antenna solution works.

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tenna. A smart antenna is defined as a computer-controlled cellular base-station antenna that uses advanced beam-allocation to optimize the usage of a specific tower. It addresses the challenges of carriers to meet high-data-rate requirements by increasing the performance of the network to efficiently manage allocated spectrums, thus saving time and money. For wireless operators, this means the ability to add capacity and optimize the system by load-balancing usage of the tower.

As an example of how this technology works, consider for a moment that every cellular tower has three sectors, one or two of which might back up to a forest. One sector faces the interstate and is always under heavy load. Smart antennas can load balance these sectors with computer-controlled beams to enable better quality on the networks and more users on the tower. By effectively balancing tower capacity between high- and low-traffic areas, the network becomes more efficient. The end result is that network capacity can increase anywhere from two to four times for a fraction of the cost of building a new tower or adding a new carrier.

Metawave Communications (Redmond, WA) is one company that now offers a smart-antenna solution (Fig. 1). According to the company, operators now face the pressures of staying competitive by offering data services while simultaneously accommodating continued growth in voice service. Smart antennas provide operators with a cost-effective means to increase the capacity

and improve the performance of their wireless networks. They allow operators to make more efficient use of their network infrastructure and achieve a greater return on their investment.

Many of the large code-division multiple-access (CDMA) carriers, such as Verizon Wireless (Reston, VA), currently utilize Metawave's smart-antenna technology to solve today's capacity issues. Plans are now underway by Metawave to further refine its technology so it will be capable of addressing capacity issues down the road for 3G devices and beyond.

ArrayComm (San Jose, CA) also offers a smart-antenna or adaptive-array technology designed to improve the capacity, coverage, and quality of wireless voice and data networks across all air-interface standards. Its solution—IntelliCell technology—uses proprietary base-band-processing technology and arrays of standard antennas to continuously optimize, in real time, the communication channel with every wireless user.

According to Michael Callahan, vice president of technology licensing at ArrayComm, "IntelliCell achieves extraordinary gains in spectral efficiency which translates into significant increases in network performance. This is achieved by focusing radio signals on individual handset antennas instead of broadcasting them throughout the cell."

EMS Wireless (Norcross, GA) provides wireless base-station antennas that address zoning and capacity issues facing today's wireless infrastructure providers. Recently, the company intro-

duced three highly compact antenna families that offer greater network capacity, blend easily with the environment, and are simple to install.

The offering includes the personal-communications-services (PCS) Micro AcCELLerator, the cellular Micro AcCELLerator, and the Dual-DualPol antenna families. The PCS family consists of 6.25-in. (15.88-cm)-diameter DualPol antennas packaged so that a single antenna provides the equivalent of a three-sector site. They operate between the frequency range of 1850 and 1990 MHz. The cellular Micro AcCELLerator antenna family consists of 16-in. (40.64-cm) diameter antennas that can blend with existing structures without sacrificing performance or reliability. Here again, innovative packaging makes a single antenna equivalent to a three-sector site. They operate between 806 and 896 MHz. The Dual-DualPol antenna family is essentially four antennas in one integrated package. This panel antenna enables customers to double their network capacity and is resistant to signal-fading while enabling a more compact cell-site tower structure.

Of course, other antenna solutions loom on the horizon as well. They are not only for use with base stations. RangeStar Wireless, for example, has developed high-performance embedded antennas that are smaller, lighter, cheaper, and easier to integrate for use in 3G applications. These compact antennas are broadband, unequal current-density dipoles. The antenna is a highly efficient resonator designed to act as the



2. The 2.4-GHz antenna from Centurion International is the latest addition to the company's wireless ComAer product line. Its benefits include reduced chances of bending and breakage, reduction in overall size of handset, low SAR, increased sensitivity, and impedance matching without the need for additional circuitry.

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frequency-determining element of an asymmetrical dipole antenna. The printed-circuit board (PCB) of the wireless device provides the second half of the dipole. This technical approach provides designers with external antenna performance in an embedded antenna. As a result, the RangeStar technology can outperform existing external antennas.

RangeStar's newest embedded antenna products include a triband, low specific-absorption-rate (SAR) antenna for Global System for Mobile Communication (GSM) phones, a quadband antenna that can be embedded into the hinge of notebook computers, and an antenna for Bluetooth and in-building Internet data applications. The triband antenna operates in the 900-, 1800-, and 1900-MHz GSM frequency bands used throughout the US and Europe. It lowers hardware cost by supporting multiple feed points and reduces RF exposure by using optimal directional pattern and metallized plastic substrate.

By comparison, RangeStar's quadband antenna supports three types of wireless services—general-packet ra-



3. WhereNet's (Santa Clara, CA) locator tag system is pictured here. The company manufactures a vehicle-inventory-management (VIM) application that provides real-time tracking of cars from assembly line to final shipment from the factory yard. It consists of wireless tags, antennas, location processors and software integrated with the information-technology (IT) infrastructure to provide constant vehicle visibility and management. The locator tag, or WhereTag, is shown hanging from the rearview mirror of a Lincoln Navigator.

dio service (GPRS) consisting of 900 to 1800 MHz, Bluetooth applications, and 802.11a unlicensed applications. It also

supports vertical and horizontal polarization and provides hemispherical coverage. This means the antenna can

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operate when the notebook is open, closed, in a docking station, or even within a briefcase.

Finally, RangeStar's 2.4-GHz embedded antenna is designed for 802.11 unlicensed applications. It can be easily adapted to Bluetooth applications and provides a user-friendly, cost-effective means of supporting modem operations in today's laptops, handheld organizers, access points, and in-building wireless

Internet systems. Additionally, it supports dual-polarization. This means that it can establish a strong communications link in a variety of orientations. The result is increased flexibility in device design and a reduction in the signal degradation from multipath effects.

Centurion International (Lincoln, NE) is another company that now offers a 2.4-GHz embedded antenna module (**Fig. 2**). This ground-independent antenna

can be mounted in vertical or horizontal positions without sacrificing performance while offering high-gain performance. It supports Bluetooth and other wireless-local-area-network (WLAN) application standards, including the IEEE 802.11, HomeRF, and Open Air.

While antenna products play a key role in wireless products today, the integration of antennas into electrical devices and systems is just as critical. Toward that end, a number of vendors have developed design-tool solutions specifically geared toward antenna design. Ansoft (Pittsburgh, PA) is one company that offers such a solution. Its offering is the Ensemble tool for the design of RF and high-frequency wireless circuits and planar antennas. A professional and student versions of the tool are available. The tool accurately handles the analysis and design of a wide variety of high-frequency electromagnetic (EM) problems, while at the same time providing detailed graphics and a friendly graphical user interface (GUI).

There is little doubt that antenna technology will play a defining role in enabling the wireless industry's migration to 3G devices and beyond. It is, after all, a prerequisite part of any wireless device today, whether in a base-station, cellular phone, or even for use in automobiles. One of the issues currently under investigation, for example, is how Bluetooth or some other short-range radio technology might be used in automotive wireless applications. Key to this type of endeavor would be a move to use in-vehicle antenna technology.

WhereNet's (Santa Clara, CA) deployment of WhereSoft vehicle is a prime example of this move and it is only the beginning (**Fig. 3**). WhereSoft vehicle is a new vehicle-inventory-management application that can track—in real time—vehicles within 10 feet of their location across miles of factory space or parking slots. Ford Motor Company's Michigan Truck Plant (MTP) is the first vehicle-manufacturing facility to implement the WhereSoft vehicle solution. The application works by using a combination of antennas and wireless tags to locate the vehicles.

In the end, while vendors continue to refine antenna technology and design, consumers can begin to look forward to the host of innovative applications it will ultimately enable. **WSD**