

The Spectrum Rubik's Cube: Updating the latest innovations in wireless technologies

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FCC Chairman Michael Powell keeps talking about rearranging the wireless spectrum much like the squares on a Rubik's Cube puzzle, but by now he has to be growing frustrated in his efforts to find the combination that creates a clear picture. While Chairman Powell is engaged with those lobbying for a favorable solution, engineers are creating technology that changes the game. Fortunately, the capital markets are ready for a game change as well, and with luck, it may soon be possible to put down that Rubik's Cube and play a new game.

Recently some have speculated that spectrum without bands is possible. Let the engineers and technology developers manage the use of the spectrum. Each radio signal would send and receive to its own device.

Last October in a RCR Wireless News article, Heather Forsgren Weaver, likened spectrum to be more like an ocean than land. Instead of assigning ownership like land parcels, the FCC would provide rules so signals could pass through the air like fish in water. While it could take the FCC some time to resolve how to reassign spectrum they already sold, some innovative pioneers are implementing technology so sophisticated and intelligent it facilitates wireless signals through the air without interference. Several companies are creating what some call "second generation" technology. Others might consider them the first generation of smart signals. Radio waves made smart by pioneers who are changing the game. And what they are doing has captured the attention of some investors.

Capital markets take notice

According to Matt Robison, Director of

Research for Ferris, Baker Watts, Inc., "the late 1990's was a time of 'Field of Dreams' investing. The market climate created the sense that if 'it' was built, then customers would come. This is well documented. Perhaps less recognized are the seeds of grass roots recovery. While on a different scale than before, innovative technologies are once again being evaluated by selective investors in addition to the resetting of valuations, we are starting to see the output of a Darwinian process throughout the industry – it is getting easier to recognize the survivors, and while examples tend to be of a smaller, localized scale, signs of tangible economic value are emerging."

Financiers demonstrated confidence when they awarded a California company, ArrayComm (www.arraycomm.com), with \$14M last December. In Australia, customers will soon experience the benefits of innovative personal broadband wireless service. ArrayComm spearheaded a consortium of companies to fund (\$14.3M) and provide portable broadband service to over 90 square miles (Phase I) of Sydney. Network deployment is scheduled for early 2003 by the members of the consortium; carrier Vodafone Australia, leading Australian ISP OzEmail, base station site owner Crown Castle Australia, telecommunications project managers Total Communications Infrastructure (TCI), network equipment manufacturer CommWorks (a 3Com company) and ArrayComm. What makes ArrayComm the pioneering company likely to prove radio signals can find their own destination? It is the patented i-BURST System, at the core of which is the patented IntelliCell technology.

IntelliCell technology is the key ingredi-

ent in i-BURST. Based upon fully adaptive smart antennas, IntelliCell provides for highly efficient use of spectrum, dramatically lowering capital and operating costs for voice or data IP wireless services. The i-BURST technology consists of base stations similar to ones that provide cellular mobile service throughout the world and wireless modems bought by consumers. The spectrum in Australia was bought by a wholly owned subsidiary of ArrayComm called CKW Wireless Pty Limited. Nitin Shah, Chief Strategy Officer, for ArrayComm, calls this wireless access, "personal broadband."

By mid 2003 Australian consumers will get their "personal broadband" at 1Mbps per user to the Internet and about a third of that speed back at a price competitive to current DSL or cable modem providers. At 1Mbps a customer can watch CNN on a laptop, conduct remote surveillance, download a complicated Internet page (with photos) in approximately two seconds or trade e-mail messages almost instantaneously. The modem, to be deployed in Phase I by Kyocera, is a small card with a flip-up antenna. Consumers can slip it in for immediate "plug and play" installation.

Another financial vote of confidence from venture capital firms provided IPWireless, (www.ipwireless.com) with an additional \$27M in funding. IPWireless offers a mobile broadband wireless technology solution for commercial deployments worldwide. The technology meets international UMTS standards and is now commercially effective in the 1.9 and 2.5 GHz licensed bands, and in continued tests has demonstrated success in bands less than 3.5 GHz.

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IPWireless provides the complete network infrastructure and portable modems for laptops and other handheld devices at a cost effective price.

Using microwave spectrum licensed by the FCC, Dallas-based Clearwire Technologies (www.clearwire.com) is an early adopter of IPWireless equipment. They recently launched in Jacksonville, FL. Clearwire customers self-install a simple modem card and experience two-way transmission speeds up to 9 Mbps. Immediately they are linked to the Internet and able to transmit data or video to accomplish their personal, business or entertainment desires.

In New Zealand, Walker Wireless and Vodafone deployed over 400 IPWireless modems in a successful commercial trial. One satisfied customer is the America's Cup boat. Riders achieve broadband access off shore while traveling at 80 miles an hour. Another pleased IPWireless customer is Sky Fiber (www.mauiskyfiber.com) on the island of Maui in Hawaii. Maui Sky Fiber provides broadband services to 125,000 residents, 60,000 employees, 1 million annual visitors, two universities, and the Hyatt Hotel. Instead of spending the estimated \$300,000 it would cost to wire the hotel with broadband service, they bought forty IPWireless modems. A supply perfect for the approximately five percent of the hotel's island visitors who request the new service at any one time.

A little known Canadian technology firm is also harnessing the benefits of smart antennas for point-to-point fixed wireless applications. Avendo Wireless (www.avendowireless.com) combines the benefits of multi-carrier modulation and the latest advances in multi-element antenna techniques to enable very high speed wireless access in dense urban environments. Avendo intends to license its technology to wireless equipment vendors who operate in various frequencies in the licensed and unlicensed bands. What is unique about Avendo's broadband technology is its ability to achieve very high data rates with high spectral efficiency in dense urban environments where line-of-sight (LOS) between buildings does not exist. By exploiting the frequency, time and space domains simultane-

ously, Avendo Wireless has combined what worked in the past with an inventive approach for the future.

Less than seven percent of the buildings in the United States have fiber deployed and available for use. Current fixed broadband wireless technology, although significantly less expensive to deploy than fiber, has limited applications because it requires line of sight. Avendo Wireless technology, when used by a carrier, system integrator, distributor or enterprise network manager delivers high data rates to 90% of buildings in a cost effective and easy to install manner.

Targeting data rates of up to 300M bit/sec in non-line of sight situations, Avendo Wireless is truly the "killer whale" traveling through the water without interference. Wireless carriers will use the technology to send backhaul signals in urban environments where the placement of base stations is a significant challenge due to the multiplying base stations necessary for data services. Similarly, high capacity deployments like those contemplated by wireless broadband service providers require high-speed backhaul solutions. Enterprise consumers will deploy Avendo Wireless to connect campus buildings or to an Internet Service Provider. Educational institutions will find that Avendo's technology is expandable and can be easily reconfigured. Even better, they will realize a less expensive flexible service than other alternatives. Avendo Wireless makes an excellent diversity strategy for enterprise or educational environments now completely dependent upon broadband data leased lines to complete their goals.

The Loea Corporation may feel like they are piloting a sub in the "underwater space odyssey" also known as 71-76 GHz spectrum. This spectrum is currently allocated for point-to-point government and private sector wireless service. Over a year ago, Loea could envision the new frontier of "bandless spectrum." They petitioned the FCC to make available 71.0 GHz through 81.0 GHz in a contiguous basis and not channelized or banded. Loea and other

technology providers in the millimeter space are awaiting the FCC decision.

Loea's technology was originally developed for military use for pilots to see through the fog. Engineers at Loea also see through the fog of traditional thinking. They discovered a first mile solution that can transmit data at speeds of 1.25 gigabits per second, providing data capacity equivalent to 650 T1 lines. The solution is inexpensive and is installed within one day. The fundamental technology improvement by Loea engineers is one transceiver developed to transmit and receive "pencil" beams even through windows.

Of Loea's technology innovation, FCC Commissioner Kathleen Q. Abernathy, observed, "This deployment model is unlike anything we have ever seen and may require new thinking on the appropriate licensing approach." In the meantime, in a trial the system demonstrated 99.999% reliability through fog, wind and rain for over a year at a one-mile distance. Presently deployed at the University of Hawaii, where the "virtual fiber" links students and researchers at the Hawaii Institute of Marine Biology on Coconut Island with the Monoa University's campus on the island of Oahu, 2.7 miles away. In New York, the Rudin Group is testing the technology to connect two company locations in lower Manhattan. The ability of the technology to transmit huge amounts of data over relatively short distances makes it an excellent disaster recovery application, network link for large enterprise and university locations and "first mile" connection for commercial buildings to existing fiber.

While Loea engineers see through the fog, an award winning Dallas company looks through obstacles in wave transmission. According to Sai Subramanian, VP of Product Management and Strategic Thinking at Navini Networks (www.navini.com), "The challenge was to mitigate interference." How do you live in an environment that is interference rich and not create interference? You use Navini's plug and play broadband access network. The innovative,

patented technology includes base stations, antenna systems, customer premise equipment and an element management system. The result is nomadic/mobile broadband service capability provided without a customer install.

Wireless broadband service providers, like Yourinter.Net (www.yourinter.net), a regional Internet Service Provider in Indiana, PA, provide their customers with Navini technology, enabling data rates better than cable or DSL, at a total cost to the carrier of 50 percent less than those alternatives. It is "power" that gives students and teachers at the University of Pennsylvania (IUP) campus, residents, and workers in all of Indiana Borough and parts of White Township significant data transmission speeds. Navini technology controls the "power" of the signal using adoptive phased array antennas. "Even in areas of heavy foliage, using unlicensed spectrum, we have been able to sustain broadband rates at distances up to three miles," said Subramanian.

Yourinter.net deploys broadband product offerings in the 2.4 GHz band and feels the technology, called "the Navini Ripwave, meets the needs of eager adopters of broadband technology because of the simplicity of the installation and speed it offers. The Ripwave modem commercial modems for the 2.4 and 2.6 GHz bands are both smaller than seven inches in height and depth and two inches in width. Yourinter.net customers take the modem with them for battery-powered Internet access anywhere anytime. The adoptive modulation provided by the Navini antenna solution provides broad coverage similar to PCS. Not limited to the 2.4 and 2.6 GHz bands, Navini works in the MMDS, WCS, and 3.5 GHz wireless local loop bands. In Asia, Navini is completing work on a PCMIA card for the 1.8 GHz band.

Waiting for the FCC's decision regarding use of the millimeter wave spectrum is another pioneer in millimeter wave technology, Telaxis (www.telaxiscomm.com). Telaxis originally built technology for use in government stealthy communications, often behind enemy lines. Seeing "the enemy" as traditional thinking, Telaxis's

newest technology enables short-range, high bandwidth data communications. At the high altitude, interference is dramatically reduced, there is low probability of interception and the high bandwidth achieves data rates of OC-48. Like Loea and Avendo, Telaxis creates technology ideal for enterprise and university campus locations, metropolitan customers and as a backhaul for broadband or mobile technologies.

Transmitting significant distances is a smart technology called GPRS. Some call GPRS "second generation technology" or 2.5G for mobile networks. GPRS is an abbreviation for General Packet Radio Service and is described as packet data capability overlaid onto a GSM network. Cyneta Networks (www.cynetanetworks.com) is one company proving that secure error free wireless data transactions are possible.

Carriers who buy Cyneta Network's Intelligent Packet Control Node (IPCN) for their networks are assured mobile data subscribers receive extraordinary quality of service and immediate customer access. The IPCN contains the intelligence to manage the acknowledgement duration, call initiation and completion. It assesses the network capacity. GSM cellular providers are upgrading networks to provide customers with immediate access to data services using their cell phones or handheld devices. IPCN enables cellular operators with increased control over their networks and the ability to react to real-time changes. Customers get reliable data services more available as a result.

Not as fast as broadband wireless services, GPRS gives customers about 10-40 kbps of data throughput. The advantage of GPRS data service is access. Available anywhere in the world where GPRS services are deployed, customers can immediately send and receive data and video. According to 3G America's, a wireless industry association, there are 220 GPRS wireless data networks in place today. Cyneta Network's IPCN is "what makes GPRS better" according to Brian Alton, CFO for Cyneta Networks. Carriers who deploy GPRS with Cyneta's IPCN provide their customers services as reliable as that they receive on their desktop.

Operators who add the IPCN to their network notice something else. They experience up to a twenty fold return on their investment as a result of reduced customer churn, optimization of their network and reductions in network equipment and channels required to meet customer demands. Operators also get the ability to diagnose and solve customer problems immediately. These benefits captured the attention of carriers and investors. Cyneta Networks added an additional \$25M in financing during a time of few investments.

Conclusions

Recent funding to these companies demonstrates investors are interested. Michael Powell and the FCC keep working on their spectral Rubik's Cube. In the meantime, some spectrum is underutilized, some is for sale, and some carriers believe they need more spectrum. Perhaps the FCC should stop shifting cubes and consider some phased implementation toward spectrum as a body of water. They could make available bands of spectrum to smaller entrepreneurs working with innovative technology companies like Avendo, ArrayComm, Cyneta, IPWireless, Loea, Navini, and Telaxis. Ultimately, this will pioneer the next generation of broadband services to our nation. Although there is no agreement for efficient spectrum use, and the solution may take some time, one thing is clear: Working together engineers, financiers, and the FCC will establish the environment for the next generation of spectrum use. Together they can solve the Rubik's cube puzzle or identify the next game. And it will be customers, who will pay to play. As a result, everyone will win. ■

About the Author

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