Focus

On Broadband Wireless Internet Access

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Focus *On Broadband Wireless Internet Access* is founded upon the following tenets:

1. Internet technology is becoming the foundation for nearly all communications, commerce, and entertainment services;
2. For Internet access to be truly usable, always-on Broadband Internet access is required;
3. By the end of the first decade of the 21st century, Internet access will be ubiquitous;
4. In the "last mile", wireline-based technologies and systems will generally prove to be insufficient or not cost-effective to provide ubiquitous, always-on, Broadband Internet to most homes and businesses;
5. In the near term, Broadband Wireless Internet Access in all its forms – Sub 11 GHz, Above 11 GHz, Free Space Optics, Ultra Wideband, Licensed, License-exempt has emerged as *the most likely technology* to provide cost-effective, ubiquitous, always-on Broadband Internet Access.

Focus *on Broadband Wireless Internet Access* is written in an informal, easy-to-read style, with an emphasis on clear explanations of why a particular company, product, or development in the Broadband Wireless Internet Access industry is significant. Each issue contains a number of *original*, in-depth articles and news stories. ***Focus*** is a just-in-time, short-lead-time publication, using Adobe Acrobat (.pdf) format, and email distribution. ***Focus*** *On Broadband Wireless Internet Access* is published by:

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Motorola Begins Testing "WISP" Broadband Radio

Motorola has been conspicuously absent from the Broadband Wireless industry, preferring to focus its wireless expertise on two-way radio and cellular communications and related businesses such as pagers. Several years ago, Motorola acquired General Instruments and merged GI's cable television set-top box product line into Motorola's Networks Sector.

In the last few months, I've received reports from several sources that Motorola has begun field trials of a new product, called "WISP" (Wireless Internet xxx xxx?). Details are sketchy, but here are some of the features claimed for WISP:

- Operates in the Unlicensed National Information Infrastructure (UNII) band at 5 GHz
- Capable of operating Point-Point (P-P) or Point-Multipoint (P-MP)
- Range P-MP approx. 4 Km, Range P-P approx. 15 Km
- 60 degree beamwidth (integrated antenna)
- Base speed is 10 Mbps symmetric
- Base station and Customer Premise Equipment (CPE) are the same unit
- Integrated networking protocol is TCP/IP
- Relatively inexpensive, priced about the same as a cable or Digital Subscriber Line (DSL) modem - $200 - $400

One of the most interesting aspects of WISP is that it reportedly uses "plain" Frequency Modulation – FM. If true, this helps to explain why WISP is relatively inexpensive and relatively simple – complex, expensive modulation systems such as Quadrature Amplitude Modulation (QAM) – 64 are not used. Because specific modulation techniques are not mandated for UNII, FM is certainly acceptable.

To add some context to the unconventional use of FM in the WISP product, I'll relate a conversation I had with Marty Cooper, of ArrayComm during an interview. Ever since I had read of Motorola's role in developing the first cellular phone system in conjunction with Bell Labs, I had been curious why Motorola had chosen to use "ordinary" FM, which could be intercepted relatively easily by anyone using a scanners. Cooper had been in charge of the

Motorola team that had developed cellular technology, and claims to have made the very first cellular phone call. I asked Cooper "Why did Motorola choose to use "ordinary" FM on its cellular system? Cooper replied that Motorola is the world leader in FM technology in two-way radio. FM was (and is) one of Motorola's core competencies.

In that context, it certainly makes sense that Motorola would experiment with the use of FM in Broadband Wireless. FM is well-known for "capture effect" – when two transmitters transmit simultaneously, the strongest signal "captures" a receiver, and the weaker signal is not heard at all, causing no interference. In the context of broadband wireless, the capture effect may help considerably in the construction of Point to Multipoint networks, where a Customer Premise Equipment (CPE) receiver may have coverage from more than one base station transmitter, in which case the strongest (closest) transmitter would "capture" the receiver.

It's also notable (on a number of levels) that Motorola is entering the Broadband Wireless industry in 2001. (To be clear, there has been no announcement, or publicity of WISP, and it's not clear if WISP has sufficient backing within Motorola to actually become a full product.).

- With the telecommunications market spiraling towards what many consider depression levels, the addition of Motorola as a new supplier in the Broadband Wireless industry would be a considerable vote of confidence for the industry as a whole.
- WISP's use of UNII spectrum will be one of Motorola's first, if not its *very* first use of license-exempt spectrum, giving a considerable boost to *that* segment of the Broadband Wireless industry.
- Motorola's expertise in cable modems and the resulting intimate knowledge of the wireline broadband market should prove useful.

When and if Motorola WISP becomes a full product and details made public, ***Focus*** readers will be one of the first to know.

WCA Broadband Now!

The theme for the Wireless Communications Association International (WCA)'s 2001 annual trade show held June 24 – 27 was Broadband Now! This year's show, held at Boston's World Trade Center, reached record attendance of 2,500+ and a sold-out exhibit hall, despite an increase in space of 65% from last year's show in New Orleans. WCA's shows are notable for their superb lineup of keynote speakers from international, industry, government, consultancies, academia, and not-for-profit sectors of the Broadband Wireless industry. The WCA show is also notable for addressing all the sub-industries of Broadband Wireless – sub-11 GHz, above-11 GHz, Free Space Optics, and recently, noticeably increased attention to license-exempt wireless using 2.4 GHz ISM and 5 GHz UNII bands.

Increasingly, the WCA show is serving as the nucleus of a number of affiliated events, and the 2001 show was the best yet, offering a very wide array of presentations that offered every possible perspective.

The venue for Broadband Now! was Boston's World Trade Center complex, an excellent venue for such an event and situated in a picturesque part of Boston (apparently a good fit with the WCA as the 2002 show was advertised in the 2001 show's program as being held at the Boston World Trade Center). It was obvious from the quality of the event, and the depth of the professionalism of the WCA staff that the WCA is blessed with an incredibly hard-working team. This was especially noticeable in the Press Room, which was staffed full-time and offered a quiet, productive refuge from the busy din of the show floors and the common area.

Among the 225 speakers that included a number of former FCC officials and CEOs, one of the best-received presentations was a keynote speech by new (*very* new; at the time of her speech, on the job for only a few weeks) FCC Commissioner Kathleen Abernathy. Abernathy electrified the audience with her statement, in reference to the possibility of reassigning the 2.5 – 2.7 GHz ITFS/MMDS spectrum for new 3G cellular systems: "I am unwilling to jeopardize the rollout of wireless broadband services you are offering to consumers. There are other options." It was quickly noted that this was the very first public statement by a current FCC official offering *any* guidance on the issue of the possibility of reassignment of the ITFS/MMDS spectrum. For context, the very real possibility that ITFS/MMDS spectrum could be reassigned for 3G mobile telephone services was quite palpable. Abernathy's speech made a huge impact on the attendees, and was immediately reported by a number of news outlets.

The Broadband Now! theme was well chosen, as there were numerous examples offered by speakers of existing Broadband Wireless systems currently in operation in revenue service, often providing Broadband services where there are no competitive Broadband services available, such as rural areas. A surprising number of those systems were small service providers in rural areas using ITFS/MMDS spectrum, a group which has been badly overlooked.

Sunday's sessions, which focus on International issues, were slightly marred by the absence of many expected International attendees from Latin America whose flights

were seriously delayed or cancelled due to delays at Miami International Airport. A number of speakers spoke about the effect that funding and spectrum problems in the US are having on International deployments of Broadband Wireless because of the perceived leadership role of the US in such matters. This was surprising news; at last year's WCA conference International speakers declared their deployments were relatively healthy with few problems obtaining funding and spectrum.

Another highlight was a number of presentations over the four days of the conference discussing AT&T Wireless Services' Fixed Broadband Wireless (formerly "Project Angel") system as a representative success of Fixed Broadband Wireless technology over wireline technology. Several AT&T Fixed Wireless Services personnel including President and CEO Michael Keith offered surprisingly candid presentations of their business model and technology. The target market of AT&T FWS is consumers and small businesses and offers 1-4 voice lines and Internet access. AT&T, having long experience with voice services, advanced the view that higher profits are to be made from voice services than pure Internet access. As an example, as a Competitive Local Exchange Carrier (CLEC), AT&T FWS can offer bundled long distance, and is using that to great effect, especially in Texas. In Texas, the bundled long distance offering is so attractive (basically, all calls within Texas are a local call) that numerous AT&T FWS customers have voice services only- no Internet.

In speeches, press releases, and interviews Sprint, WorldCom, and Nucentrix Broadband Networks all indicated that their commitment to large deployments using MMDS spectrum in their respective service areas were not only continuing, but would accelerate. In a lunch keynote address, Len Lauer, President of Sprint's Global Markets Group reiterated Sprint's strong commitment to, and favorable experiences with its current deployments, but offered few specifics on Sprint's future plans. In an exclusive interview, Worldcom declared that its technology trials were complete and that it will proceed with deployments of Hybrid Networks and Vyyo equipment in eight additional markets including Minneapolis by the end of third quarter 2001, for a total of thirteen markets. Nucentrix announced that it has received FCC licenses for deployment of MMDS services in 57 of its markets, primarily in Texas, Oklahoma, and the Midwest. Also of note was Nucentrix' statement that deployment in these markets will only commence after Nucentrix can "… finalize the selection of a long-term technology platform". These were welcome announcements on several fronts, indicating confidence by these major MMDS service providers that the ITFS/MMDS spectrum is unlikely to be reallocated to 3G services, and that there is indeed a market for vendors of MMDS equipment.

Also notable at Broadband Now! were was the nearly-overwhelming selection of equipment offerings by numerous vendors, addressing every niche in the Broadband Wireless industry, such as:

- Very low cost Customer Premise Equipment (CPE); Raylink exhibited its line of very low cost 802.11 PC Cards modified (with FCC Type Acceptance, Raylink claims) with an external antenna pigtail adapter. Raylink also offers PC Card to Industry Standard Architecture (ISA) bus adapters, PC Card to Personal Computer Interconnect (PCI) bus adapters, and PC Card to Universal Serial Bus (USB) adapters for the Raylink radio card.
- Low cost, user installable, license-exempt / 2.4 GHz; Cirronet exhibited its WaveBolt system whose CPE is a simple, integrated "brick" which is mounted on the outside of the home or small business on the wall closest to the base station. The (included) long cable is run inside, and connected to a PC's USB port and a power adapter.
- Non-line-of-sight, user installable CPE using MMDS; NextNet Wireless has obtained FCC Type Acceptance for its Expedience customer-installable CPE unit and associated base station hardware. NextNet claims that its CPE works up to five miles (again, using an indoor CPE device) from a base station.
- Non-line-of-sight 902-928 MHz – 2.4 GHz signals are often blocked by foliage, and one solution in such cases is to make use of the 902-928 MHz band. WaveRider Communications exhibited its new LMS 3000 system that operates in the 902 – 928 MHz band.
- Toll-quality wireless telephony services; Raze Technologies exhibited its SkyFire system which incorporates integral, remotely monitored battery backup for "life-safety quality" voice services
- Well proven products; Harris Corp., Hybrid Networks, Netro, and Spike Broadband Systems were among those that exhibited well-proven products for service providers
- Carrier-class products and support services; Alcatel, Hughes Network Systems, and Thomcast Communications Wireless Division were among the many large exhibitors with extensive experience with large system rollouts and carrier-class support services.
- License-exempt very high-capacity, short-range links; Canon USA, fSONA Communications Corp., LightPointe, and Plaintree Systems exhibited their optical systems with varying technical approaches.
- Noticeably absent in the exhibits area was networking giant Cisco Systems which was shown as an exhibitor in early Broadband Now! material, but apparently withdrew its exhibit relatively late in the planning process.

Increasingly, the annual WCA conference serves as a nucleus for a number of associated functions and groups. In 2001, some of these included:

- Women's Wireless Network which met separately for a Strategy Meeting and a Dinner and Reception
- International Engineering Consortium (IEC) which held its ComForum educational program in conjunction with WCA 2001
- WCA's License-Exempt Spectrum Subcommittee was reorganized into the License Exempt Alliance (LEA) under the leadership of Chairman Jai Bhagat of AIR2LAN. The formation meeting of the LEA was very well attended, and by all accounts the LEA is off to a very promising start.
- The formation meeting of the Free Space Optical Alliance (FSOA) was similarly well attended, and most felt that this very first face-to-face meeting of almost all Free Space Optics vendors was promising and productive.
- Broadband Wireless industry organizations such as Broadband Wireless Internet Forum (BWIF), the Orthogonal Frequency Division Multiplexing (OFDM) Forum, and the Time Division Duplexing (TDD) Coalition and others had varying degrees of presence at the show.

Over the four days, there was good representation of smaller wireless service providers throughout the pool of speakers including those that make use of both licensed and license-exempt spectrum. However, a statement by an FCC staffer in one panel discussion, to the effect of "*many in the FCC feel that Wireless Broadband technology seems very promising and could well play a role in solving the Digital Divide problem*", illustrated a definite perception problem in recognizing that Broadband Wireless systems *are* solving "digital divide" problems *now*. Such perception problems within the key wireless regulatory agency of the US offers evidence on just how far Wireless Broadband has to go to be truly accepted as a broadband technology on a par with DSL, cable modems, and satellite. This particular panel discussion featured several rural wireless service providers, all of whom are providing broadband services via wireless to rural areas that would likely not have any broadband services from other technologies.

A story about WCA 2001 wouldn't be complete without a mention of the excellent after-hours event traditionally held by Marconi (continuing the precedent of Hardin & Associates, which Marconi acquired). This year, Marconi offered a catered boat cruise of Boston Harbor. This provided a relaxed venue in which to continue conversations and strike up new acquaintances. My Thanks to Marconi for the excellent entertainment.

In summary, the prevailing mood of WCA 2001 was optimism laced with realism for the Broadband Wireless industry. The record attendance was especially encouraging given that a number of other technical and telecom trade shows in 2001 have reported significant drops in attendance. There have certainly been a number of casualties in the Broadband Wireless industry over the past year, but many others, including numerous startups, appear to be healthy and poised to offer wireless Broadband services in aggressive competition with cable and telephone service providers. Others have chosen the "go where the big guys aren't" strategy. Still others apparently hope to align with cable and telephone companies so those companies could begin offering wireless broadband services to better serve customers. The pall of uncertainty about potential reallocation of MMDS spectrum appears to be lifting. In marked contrast to numerous venture capital reports and news articles, WCA 2001 Broadband Now! showcased a demonstrable market for broadband wireless equipment.

Part 18 RF Lighting A Potential "Extinction Level Event" For Communications Users Of The 2.4 GHz Band

The phrase "ELE – Extinction Level Event" entered the popular consciousness several years ago as a result of the popular movie "Deep Impact". In the movie, an enormous asteroid is observed to be on a collision course with Earth. The asteroid is sufficiently large that an impact on Earth will cause catastrophic effects, mostly a dust cloud that will block sunlight for many months if not years, triggering the death of plant life, and soon after most animal life.

The term ELE came to mind as I read about a new lighting technology from **Fusion Lighting, Inc.** (www.fusionlighting.com) that uses microwave energy in a new, very high-efficiency lighting system, dubbed "RF [Radio Frequency] Lighting".

An August 6, 2001 article in the Wall Street Journal titled "Energy-Saving Light-Bulb Maker Battles With Satellite-Radio Firms For Bandwidth describes a battle-in-the-making between Fusion Lighting, Inc. and two companies that plan to offer satellite-based broadcast radio – Sirius Satellite Radio, Inc. and XM Satellite Radio. At issue is the amount of interference that Fusion's new devices would cause to the satellite radio broadcasts at 2.32 – 2.345 GHz, which are considerably removed from the spectrum where Fusion's devices operate – 2.4 – 2.4835 GHz. The satellite radio broadcasters have concluded that Fusion's devices, as proposed, will cause substantial interference to their transmissions.

Left unmentioned in the WSJ article, and only now beginning to be noted by many users of the 2.4 GHz band is that if the Fusion devices are capable of causing such trouble for satellite radio broadcasting… *what would the effect be to communications users of the 2.4 GHz band, where the Fusion devices will be operating?*

2.4 – 2.485 GHz in the US is used by two very different types of equipment. The older, more well established use of the band is for Industrial, Scientific, and Medical equipment (ISM) such as household and industrial microwave ovens. Operations of such devices are governed under the FCC's Part 18 rules. Basically, Part 18 devices are expected to radiate only – not receive and thus, are not communications devices.

The second major use of the 2.4 GHz band is for license-exempt communications equipment governed under the FCC's Part 15 (15.247) rules.

Because the Part 15 rules specify "robust" modulation techniques such as Frequency Hopping Spread Spectrum (FHSS), Part 15 and Part 18 devices can generally co-exist, for example microwave ovens in a household rarely operate for more than a few minutes at a time, so cordless phones and wireless networks operating in the 2.4 GHz band can continue to operate. Conflicts were anticipated when the Part 15 operation was first envisioned, and the following requirement was levied on Part 15 devices:

(1) [Each Part 15] device may not cause harmful interference, and (2) [Each Part 15] device must accept any interference received, including interference that may cause undesirable operation.

Basically, buyer beware / use at your own risk.

Fusion's RF lighting system is a good example of a Part 18 device. RF technology is useful for any number of purposes other than communications, and the FCC and industry recognized this and set aside various chunks of spectrum for industrial use.

The problem comes that the 2.4 GHz band is now used by an incredible number of number of communications devices – cordless telephones, wireless Internet access networks, wireless Local Area Networks, and soon all manner of simple devices with Bluetooth embedded in them- with an accumulated investment of (at minimum) billions of dollars.

How we got to this situation is that there was steadily increasing demand by various companies for spectrum for wireless networking and related applications, but there were no large swaths of spectrum that were suitable. There were demonstrable needs for wireless LANs in warehouses and hospitals. There were demonstrable needs for temporary wireless links.

Eventually the FCC decided to **offer a Faustian bargain**: Industry could use the existing ISM spectrum if they adhered to certain technical limitations with no expectation of protection. It was clearly in the FCC's mind that there would relatively few Part 15 devices, and that for the most part they had heard the last from Industry. The Part 15 rules were tough, and it would be extremely challenging to make radios work under such conditions… and, they'd have to develop newfangled spread spectrum technologies that were previously used only by the military and developed at great cost.

But, Industry found the Part 15 "deal" to be perfectly acceptable. Industry understood the Part 15 deal better than the FCC did. Industry's major goal was to be able to offer wireless devices that did not require a license from the FCC, so that such wireless devices could be sold over the counter – to anyone, everywhere. Industry foresaw that there was a market for millions of such devices (I doubt that Industry, at that point, projected that such devices would rapidly number in the billions…)

That there were technical obstacles to overcome… well, that was just a barrier to entry for potential competitors. As we've come to expect, where there is a demonstrated demand, technology can overcome, and that's exactly what happened. The biggest factor that made the difference is the rapid increase in capability of application-specific integrated circuits, and digital signal processors. Taken together, spread spectrum radios *could* be built, at affordable prices, that met the FCC's Part 15 rules. Gradually, an entire Part 15 industry evolved… far beyond the wildest imaginings of the FCC.

What Will Happen? There are a number of factors at play, and very high stakes, so there are a number of possible scenarios. The first scenario is that, quite apart from its effects *within* the 2.4 GHz band, the effects of the new Fusion Lighting devices outside of the 2.4 GHz band must adhere to existing regulations. It's difficult to ascertain from what has been published to date (particularly when Fusion Lighting is being very circumspect with potentially damaging details of its proposed product), but it appears that Fusion Lighting claims to meet the "out of band emissions limits" for Part 18 devices.

The counter-argument from the satellite radio broadcasting companies is that even if Fusion Lighting's proposed products are within out-of-band emissions limits, their transmissions are still being impacted.

To which Fusion might be expected to reply (to the effect of) "If a satellite radio broadcasting system is too precarious to deal with other signals that should have been expected, then you didn't do your homework."

The satellite radio broadcast companies' position is that this kind of interference has never been previously been an issue. Etc. You can understand why this is such a hot issue at the FCC.

But, within the 2.4 GHz band… if a Fusion Lighting device is activated, it will severely impact the use of all manner of Part 15 devices in the area around it. For example, 802.11b is becoming very popular in both large and small companies, and becoming even more popular for home use (because to hook the kid's computer up to the cable modem doesn't require any new wires). Cordless

phones are also increasingly using 2.4 GHz. What happens when a nearby gas station installs RF lighting… and all 802.11b devices and 2.4 GHz cordless phones for a mile in diameter stop working?

The RF Lighting issue is quite the dilemma for the FCC, which was hoping that Fusion Lighting would be willing and able to modify their device so that it wouldn't cause interference to communications equipment. But that appears unlikely, and Fusion Lighting appears to be within its "rights" to apply for an FCC Part 18 certification to begin manufacturing. But if Part 18 certification is granted and RF Lighting devices become widespread (and it appears very likely that they will, given their inherent energy efficiencies), is the FCC willing to "sacrifice" much of the utility of the 2.4 GHz band in exchange for one company's (at the moment…) product?

The group likely to be **most severely impacted** by Fusion Lighting devices are Internet Service Providers that are using wireless equipment to connect to their customers. The vast majority of Wireless ISPs (WISPs) use equipment that operates in the 2.4 GHz band. Some equipment is purpose-built for ISP use, and many others use modified Wireless Local Area Network (Wireless LAN) equipment. What all WISPs have in common is that their signals are relatively "fragile". The FCC's Part 15 rules apply equally to equipment used by Wireless ISPs, so the ISPs compensate for low transmitted power with high-gain, directional antennas. This approach allows them to have enough "signal margin" to achieve a reliable link… but if a source of interference appears nearby, the link will likely be disrupted.

It may well be possible to overcome interference in the 2.4 GHz band from RF lighting devices… but doing so won't be inexpensive or easy. For example, link margins can be improved by building multiple hub sites with short paths instead of just a few hub sites with relatively long paths. Another approach is to buy better 2.4 GHz band equipment that is more robust, such as that offered by WIMAN Systems (www.wiman.net).

A long term solution to interference issues in the 2.4 GHz band is to **begin using equipment that operates in the 5 GHz band**. In the US, there is a total of 300 MHz of spectrum available for license-exempt wireless devices at 5 GHz. 100 MHz of this spectrum is also ISM spectrum, with the potential of industrial devices being operated there also. But the other 200 MHz is "virgin" spectrum and reserved exclusively for communications.

A number of companies now offer equipment for the 5 GHz band, and as the price of RF components for 5 GHz continues to fall, more and more equipment will become available. The emergence of equipment compliant with the 802.11a Wireless LAN standard is expected to play a major role in increasing the popularity of equipment for the 5 GHz band. Where 802.11b offers (theoretical) speeds up to 11 Mbps and operates in the 2.4 GHz band, 802.11a offers (again, theoretical) speeds up to 54 Mbps and operates in the 5 GHz band.

If RF Lighting is an "ELE" to communications users of the 2.4 GHz band, at least there is time to begin "planning for survival" – planning for migration to 5 GHz, study of new equipment, lining up additional financing, etc.

Profile of Cascade Networks A Small Town Wireless Internet Service Provider

In my more than four years of writing about Broadband Wireless Internet Access, I've encountered a number of small service providers like the one you're about to read about. Mostly they serve smaller markets, and use off-the-shelf wireless equipment in innovative ways to provide broadband Internet access. In most cases, such service providers are the only providers of broadband Internet access in their service area.

Despite the existence of hundreds, if not thousands of such service providers, there's an amazing lack of recognition that the fabled "Digital Divide" is, in fact, being bridged by such providers. Add to that the lack of recognition at some of the highest levels of government (such as a senior FCC staff member that I spent some time with earlier this year) that relatively inexpensive license-exempt wireless equipment is in fact being used very effectively for such purposes. This article commences a long series of stories about Internet Service Providers (ISPs) making effective use of wireless.

Cascade Networks (www.cascadenetworks.net) is an Internet Service Provider (ISP) located in the small city of Longview, Washington, about 50 miles North of Portland, Oregon on the banks of the Columbia River. The combined population of Longview and sister city Kelso is approximately 44,000, and the major industry in Kelso/Longview is the manufacture of forestry products such as paper and wood.

Cascade Networks was begun early in 2001 from the implosion of another ISP. The other ISP had begun life as a dialup ISP, and had begun using wireless to provide faster-than-dialup services to selected clients. Several key personnel had a number of grievances with the other ISP, and in time-honored tradition, quit to start their own company, Cascade Networks. CN is currently self-funded, and very much in startup mode.

In the months since it was founded, CN has acquired more than 100 customers, including most of the larger businesses in town. Many of the customers are from the

former ISP; when it went out of business, the wireless customers could not go back to the slow speed of dialup and were desperate for reasonable Internet connectivity. One CN customer is an appliance parts store that receives supplier updates that are large Adobe Portable Document Format (PDF) files, which are problematic to download using a dialup Internet connection.

For wireless equipment, CN uses off-the-shelf Cisco Aironet 340 802.11b wireless access point units. At each customer premise, CN connects the 340 to an exterior-mounted flat panel antenna, aimed at one of a number of CN hub sites in the area.

At their hub sites, CN makes use of a combination of channel diversity (there are only three non-overlapping 802.11b channels in the 2.4 GHz band), vertical and horizontal polarization, and sectorization to service numerous clients and keep throughput relatively high, despite the fact that 802.11b and the 340's are not designed for Wide Area Network use.

CN's backbone connection is through the Northwest Open Access Network (NOANet), a joint venture of a number of Northwest Public Utilities Districts (PUDs) and the Bonneville Power Administration (BPA), and makes use of excess fiber capacity in BPA's extensive power distribution network. NOANet has a Point Of Presence (POP) at Seattle's Westin Building, which is the Seattle area's main interconnection point for most fiber networks in the region. The agreement with NOANet allows Cascade Networks excellent Internet connectivity at reasonable cost.

An unusual service that CN offers is video surveillance. Kelso/Longview is located near a number of private and public forests. The forests, and forest products manufacturers have been the target of a number of protest actions in recent years. Because the surveillance targets were usually remote, conventional Closed Circuit Television (CCTV) wasn't a very good (when available, it was very expensive) and video recordings, while useful in helping to identify who the offenders were, aren't of much use in avoiding damage.

CN began offering video surveillance services using inexpensive (with resulting poor image quality) webcams coupled to a web server, CN quickly upgraded to using professional-grade video surveillance equipment which is far more rugged with much better video quality. Video surveillance customers can monitor via a CN-provided web page, or make their own arrangements.

What impresses me most about Cascade Networks is that they are able to offer the residents and businesses of Kelso and Longview Washington better Internet connectivity than many residents and businesses in major cities.

www.strohpub.com/focus.htm

R.I.P. Metricom

In this case, R.I.P. doesn't mean "Rest In Peace", but rather "Rest In Pieces". As I bring this issue of ***Focus*** to a close, details of the resolution of Metricom is still not clear. After attempts at selling Metricom as a "package deal" – network, intellectual property, licensed spectrum holdings fell through (including a reported offer from AOL Time Warner of $100 Million), it was determined to sell Metricom's assets at "auction".

It was apparently a peculiar auction, where Metricom had the ability to reject offers if they were found to be insufficient… and reportedly most were, including one truly laughable attempt by a company based offshore and requesting advance payment for preferential pricing on the resurrected Ricochet network.

But… reports of the death of Ricochet may be premature. Apparently there is still a possibility (admittedly it's very, very slim) that the Ricochet network will be reactivated. Reactivation is certainly technically feasible. The majority of the network remains in place, and it's likely that the Wired Access Points (WAPs) where data transiting a Ricochet network is routed onto wirelines will be in existence for at least another month before leaseholders begin to clean up the mess left behind.

Interestingly, Ricochet is getting more positive press after shutdown than it was getting when the network was available. Many influential tech journalists have publicly mourned the loss of Ricochet connectivity (myself included – I've been a Ricochet customer for a number of years in the Seattle area). In the last several weeks there have been reviews of new cellular-based mobile data services based on General Packet Radio Service (GPRS) by AT&T Wireless and Cingular, offered initially in the Seattle area. The reviews were, if anything, lukewarm, and those who had experience with Ricochet rated the Ricochet experience far superior (ironically, Metricom never did complete the Seattle-area upgrade to 128 Kbps service before winding down deployments and upgrades immediately prior to bankruptcy).

There's no end of speculation and condemnation about what went wrong with Ricochet and Metricom. Obviously there were business issues aplenty, but here are some of the key points as I see them:

- Metricom's marketing for Ricochet was nowhere near as effective as it needed to be. Mobile Broadband Internet Access was a new category to most people, and they needed to be educated. The resellers such as Worldcom and a number of others were to provide marketing to build the brand. Some resellers didn't market at all. "Saturation"

advertising in San Francisco and San Diego, along with (experimental) lower pricing substantially raised the take rate for Ricochet… but way too little, way too late.

- Ricochet II (the 128 Kbps service) pricing of ~$70/month was too high from the beginning. That pricing level was set to allow sufficient margin for the resellers, but the price was simply too high for an unfamiliar service.
- Metricom's marketing for Ricochet emphasized the use of Ricochet for laptop users – only showing laptop computers and emphasizing the use of PC cards. There were many potential desktop users that may well have bought Ricochet because they could not get any Internet service other than dialup. The external Ricochet modems work well with desktop PCs. Metricom belatedly addressed this issue in their marketing, but again, too little, too late.
- The Ricochet infrastructure was subcontracted out, partially to Worldcom. From reports, there appeared to be little accountability on costs and quality of deployment by subcontractors. The upgrade of the San Francisco Ricochet network to 128 Kbps was botched and had to be completely redone. The upgrade of the Seattle network, for the second time, was in progress when the Ricochet networks were shut down. Worldcom architected a totally wireline infrastructure to each Wired Access Point, when (in many cases) it would appear that point-to-point wireless links would have made more sense in the long term. However, Worldcom, basically having a blank check from Metricom, had no incentive to optimize the cost-effectiveness of the Ricochet infrastructure. They sold wireline connectivity… and they sold a lot of it to Metricom.
- Metricom's aggressive national rollout schedule was something of a deal with the devil. To gain credibility – with potential investors, resellers, equipment providers, and other parties, Metricom had to offer the promise of a large, national customer base, and plans to accomplish a national rollout in a reasonable timeframe. If Metricom had offered a staggered, more affordable deployment schedule, it simply wouldn't have been viewed as credible.
- One option that Metricom apparently didn't explore was the idea of franchising each major city, with separate fundraising efforts for at least some of the major cities. It's possible that a franchise approach could have resulted in more completed rollouts without the need for direct Metricom investment, freeing Metricom to concentrate on technical and network management, and more effective marketing.
- Although 128 Kbps was quite usable, Metricom had plans as of several years ago to increase user speeds to 256 Kbps using a new Ricochet chipset being developed by National Semiconductor (NS). The Ricochet II network can accommodate 256 Kbps user modems with no change. Apparently the NS chipset never came to be. Not only would a 256 Kbps service have been twice as fast for users, but it's likely that a 256 Kbps service at $70/month wouldn't have met with quite the resistance that the 128 Kbps service at $70/month did. As mobile telephone companies begin to deploy wireless data services which are claimed will eventually reach speeds of up to 115 Kbps, a Ricochet 256 Kbps service would provide a clear differentiation.
- It's been speculated that competition from "Public Wireless Access Points" such as those offered by MobileStar at company-owned Starbucks stores, and pending wireless data service offerings by mobile telephone companies were a factor in Metricom's failure. Mostly, I discount this theory because the former are nowhere as ubiquitous as Ricochet was, and speeds (and pricing) of the latter remain unimpressive. Where there were working Ricochet networks, performance was impressive.

Metricom pioneered two areas that I think are worthy of mention, and will be used in many other systems in the years to come.

- Metricom was the first to use light poles as "structures" for wireless networks. In many ways, light poles are "just right" – not too tall, so that nodes wouldn't interfere with each other excessively, and "tall enough" to get up above the ground clutter. Unlike other wireless networks, Metricom was able to deploy Ricochet nodes with a simple architecture – wireline connectivity was needed only at the Wired Access Points (WAPs), not in every neighborhood. The original (28 Kbps) Ricochet network, and to some extent, Ricochet II (128 Kbps) were mesh networks, using wireless connectivity between nodes. Some future wireless networks will likely use a similar architecture as Ricochet, and the use of light poles has now been proven to be effective.
- Metricom was also one of the first Wireless Internet Service Provider to make use of license-exempt spectrum. In addition, Metricom used 902-928 MHz for user-to-poletop communications. 902-928 MHz is usually derided as being practically useless for communications, suitable only for baby monitors and cordless phones with a range of only few hundred feet. The main obstacle to use of 902 – 928 MHz for wireless networks is that very powerful paging transmitters operate at each end of the band. Metricom developed effective strategies to deal with the paging transmitters, including a "brick wall" of expensive mechanical filters in each poletop node, and robust Spread Spectrum modulation techniques.

Although the Metricom story isn't quite over, and the Ricochet network may yet be resurrected 'à la Iridium, Metricom had many laudable achievements. Most notable, there was a collective groan from Metricom's customers when the Ricochet network was shut down – customers that would have happily continued to pay the price Metricom was asking. Contrast this with other service provider failures such as Northpoint and Rhythms – those companies were not mourned whatsoever. Ricochet was very much a unique service, and there is nothing currently available that can replace it.

I don't think the true technical elegance of the Ricochet system will be widely understood for some time. At some point in the future, wireless access points will be small and ubiquitous, mounted on small, existing structures, and often as not, will link to each other via wireless. That is a user's wireless device will connect to a small, low-power access point on one band, and the access point will connect to another access point or a wireline interconnect. Such access points will serve multiple networks… and few will be able to imagine doing it any differently.

For example, Ricochet technology, even Ricochet I at 28 Kbps, is ideal for deploying Internet access in metropolitan areas of lesser-developed countries where even dial-up Internet access is seldom an option (incredibly poor, and very few phone lines). Only a minor adaptation to Ricochet would be needed for deployment in almost any city worldwide (the GSM mobile phone system uses half of the 902-928 MHz band), and perhaps a battery pack and a solar panel would be needed in countries that don't have reliable power.

Metricom's failures appear to be largely business failures, to some extent caused by harsh investment climate resulting from the "dot bomb" and telecom industry failures. Metricom took some daring gambles… and unfortunately, they lost. In the culture of Silicon Valley, where Metricom was headquartered, the failure of one's company does not mark a person as a pariah. Quite the opposite – having a failure "under your belt" makes a person more attractive to other companies, quite simply because painful mistakes made once are unlikely to be repeated.

By these standards, the people of Metricom will find a receptive audience for their talents. Their hard-won experiences will directly translate to successes in other wireless Internet access systems and services.

Stop The (Virtual) Press!

On Friday, August 31, 2001, it was announced in the Bankruptcy Court that a deal is pending for Aerie Networks (www.aerienetworks.com) to acquire at least the poletop nodes and Wired Access Points (WAPs) of Ricochet networks in the states of California, Colorado, Connecticut, New Jersey, New York, and Washington. It is possible that Ricochet networks in other states will be acquired by Aerie in future negotiations, but that is not certain. Any Ricochet facilities that Aerie does not purchase will be considered to be "abandoned in place", with the property / facility owner able to dispose of the equipment left behind in any manner they see fit (expect to see lots of Ricochet poletop units and other equipment appearing on eBay).

Aerie apparently will not purchasing two critical components of the Ricochet network(s). One is the Network Interface Facility (NIF) which is the "meeting point" in each metropolitan area where Ricochet Resellers connect their networks into Ricochet networks. The other are the two Ricochet (one primary, one backup) Network Operations Centers.

It appears likely that Worldcom, one of two prime investors in Metricom (the other is Paul Allen's Vulcan Ventures) will not continue to provide connectivity between Ricochet facilities under the new ownership, and dealing with that issue alone could take several months before Ricochet networks could come back online.

There are hints that Wireless WebConnect (WWC) will be involved in Aerie Network's rescue of Ricochet. This development is a welcome one, and makes complete sense, as WWC (previously BusinessTel) was Metricom's "agent" for customer service and billing prior to Metricom changing to a multiple reseller strategy. WWC would have the systems in place for billing to resume, and from all accounts, possesses considerable technical expertise relating to the Ricochet system that would be invaluable to Aerie Networks (which appears to have no previous experience with wireless technology).

I emphasize that, as promising as these developments are, *nothing* is certain- yet. Only the barest details were announced, and a formal agreement was *not* consummated- *only* an announcement that there would *likely* be an agreement. No details of financing were announced, and of course the bankruptcy court must agree to any deals.

"Telecom Dark Ages" – Not!

One of my most useful and productive resources for my writing is a private mailing list run by Dewayne Hendricks, who is well-known in Silicon Valley wireless community. One recent thread of discussion on Dewayne-Net (and spread to other venues) is the emergence of a "Telecom Dark Ages" – that a near-term recovery in the telecom industry is unlikely because many Competitive Local Exchange Carriers (CLECs) and Internet Service Providers (ISPs) have gone out of business, and the Incumbent Local Exchange Carriers (ILECs), with no effective competition, now have little incentive to deploy

new services and buy new equipment, and have begun raising prices.

I have a different view, based on my strong belief that the use of Broadband Wireless Internet Access makes truly effective competition with an ILEC possible. With no need to lease wireline facilities from an ILEC, and therefore be subject to predatory practices and pricing by the ILEC, there can be effective competition.

In my research, I see ample activity to refute the premise of a Telecom Dark Ages… but such activity isn't exactly headline news in the popular press. So, I posted the following to Dewayne-Net, where it was met with silence; no response even from the poster to whom this is a direct reply. Apparently he, like many, simply prefers to assume the worst because that's the path of least resistance and offers the most camaraderie. I thought that ***Focus*** readers would be interested in this perspective. Unfortunately, I wasn't able to secure permission to reprint the original message.

Dewayne:

I'm compelled to point out that most of the recent postings to this list are of the "gloom and doom, told you so" variety. It seems to me that's, at least in part, a function of the well-known adage that "bad news gets headlines". Good news seldom makes headlines, especially when it runs counter to the current fad of the "telecom bloodbath".

[The author of the original post] vastly oversimplifies the situation. Granted, the death toll of CLECs, wired and wireless, has been great. In many cases, especially some of the highest-profile cases, such deaths appear to be richly deserved. But it's certainly NOT a case of telecom competition being extinct, and I continue to dispute that [The author of the original post]'s "Telecom Dark Ages" has indeed fallen. Lately, that's a bit of a lonely quest...

One major observation; telecom competition outside North America is robust, and there are many new companies formed only within the last few years that are healthy and even profitable. Many of them use wireless, because it's the only infrastructure that makes sense in their markets. Put fiber where it's easy, cheap, or absolutely required. Everywhere else, use wireless.

Within North America there are hundreds if not thousands of small ISPs and CLECs doing a great business. Many of them are providing high-bandwidth, last mile, competitive services via wireless. One I spoke to in the last week serves the areas around the Hollywood movie studios with wireless; people there need high bandwidth to send digital video around for editing, and are willing to PAY for it. In Miami and several other cities, e-xpedient provides 100 Mbps to businesses in high-rise buildings. Cogent (picking up some of the remains of Broadband Office) and Yipes! bring fiber to buildings. Terabeam is in revenue service with its Free Space Optics system in Seattle, just started in Denver, and plans to be in several other "NFL" cities by the end of the year. Sprint continues to deploy its (wireless) Sprint Broadband Direct service to consumers. Even as Worldcom hammers nails into the coffin of Metricom, it has just begun deploying its wireless broadband service. Kite Networks and Air2LAN are two well-respected companies using license-exempt spectrum. New Edge Networks continues to deploy CLEC DSL in secondary and rural markets. Tachyon.net and StarBand (with a recent investment by EchoStar) is doing a good business providing satellite-based Internet in areas that simply can't GET broadband any other way. Although it's tough to think of AT&T Wireless as a CLEC, it IS in fact a CLEC, providing last mile voice and Internet service via wireless in Dallas and a number of other markets. ArrayComm is demonstrating its iBurst system, which offers REAL 1 Mbps/user service, and is fighting the good fight in the FCC and in Congress to help them understand that the much hyped and near hopelessly unrealistic "3G" is the only future of wireless. Covad, surprisingly, is still alive...

Malibu Networks, Aperto Networks, BeamReach Networks, BreezeCOM, Harmonix, Cannon, fSONA, and a couple of dozen other vendors have gear ready to go NOW that bridge the last mile via wireless (both RF and optical) representing various speeds, capabilities, and price points. Several vendors are lining up with very impressive new products (two incredibly promising products aren't even out of stealth mode yet) that will break new ground in capabilities and price points. Contrary to Robert's scenario, there IS a market for this equipment - see the above snapshot of some service providers.

Certainly there will continue to be attrition; some service providers will be consolidated or declared beyond hope and liquidated. Same for some equipment vendors. But there IS, and will CONTINUE to be at least SOMETHING of a competitive market. That it's not SEEN as competitive is something of a blessing for the competitors as they won't necessarily be on ILEC's radar. The funding issue is certainly problematic, but the businesses that are able to STAY in business during this bleakest of periods are certainly demonstrating that they have a viable business.

This isn't wishful thinking on my part. It's simply easier to believe that "all the competition has been killed off" because that's been the situation of many high profile companies. It takes a bit of digging to uncover the myriad of successful competitive companies that are still alive, serving customers, and (according to [The author of the original post]), doing the impossible- actually getting NEW funding. One case in point is Goldman Sach's recent $97M investment in Clearwire Technologies - a wireless wholesale service provider.

Ask yourself... is there any LESSENING of demand for broadband services? How COULD there be?!?!?! An awful lot of business efficiencies that have been developed over the last few years absolutely require broadband - at reasonable prices. That demand was being filled by so

many competitive companies that aren't there anymore; some of that demand is being filled by ILECs, but much more of it is being filled by other competitors expanding (oh SO cautiously and conservatively) into new markets. Granted, expanding by one or two markets every six months isn't nearly as noteworthy as pushing into 20 markets every six months (and may companies who attempted that feat rest in pieces), but at least it's SUSTAINABLE. The completive telecom companies that survive this downturn will be VERY formidable competitors indeed in the months and years to come.

I feel that this discussion of "Telecom Dark Ages" will look, in a few years, just about as unrealistic as the discussions of a few years ago of the great, unstoppable Internet economy do now.

Thanks,
Steve

WIMAN Systems An Often-Overlooked Wireless Equipment Vendor

The reason that I got involved in writing about Broadband Wireless Internet Access is that I was fascinated by the technology, the vendors, the equipment, and indeed the whole idea that you could do Broadband, *Wireless* Internet Access. As an Amateur Radio Operator involved in digital communications, I was familiar with wireless digital communications, and even Internet Access via wireless was familiar to me from helping to build the Seattle area's Amateur Radio TCP/IP Network.

But the sheer ingenuity and inventiveness of vendors in the Broadband Wireless Internet Access industry continue to amaze me, and I actively seek out and investigate new companies as I become aware of them. One of the primary differences between ***Focus*** and trade publications is that I don't wait for companies to make the news and then just regurgitate a press release, but rather I seek out such companies and highlight them. You can expect many stories like this one in future issues of ***Focus***. I am very impressed with WIMAN Systems, and I suspect that you will be also.

WIMAN Systems (www.wiman.net), formerly known as Airdata WIMAN Systems, has been manufacturing wireless data equipment since the mid-1990's. WIMAN Systems is the US branch of Altvater Airdata Systems GMBH & Co. KG of Rappenau, Germany. WIMAN's target markets are primarily non-North American markets, although that has begun to change in 2001.

Prior to 2001, WIMAN had an exclusive agreement with PSINet for use of WIMAN equipment in North America. PSINet briefly offered a wireless Internet access service called InterSky, which from all accounts was well received by customers, and was cost effective and technically successful, but was deployed in only 15-20 cities. An additional issue was the development delay of the next generation WIMAN radios. Overall, it appears that PSINet had internal problems that likely doomed the InterSky service.

Outside of North America, WIMAN equipment sells well because it offers a number of relatively unique features that are particularly useful for International deployments:

- Operates in the 2.4 GHz band, which is generally allocated for license-exempt operation worldwide. (Versions for the 2.3 GHz band and 2.5 – 2.7 GHz (MMDS) band are also available).
- Very robust modulation technique based on Frequency Hopping Spread Spectrum modulation.
- Deterministic performance using Time Division Multiple Access (TDMA) – each user is allocated minimum time slots, and if additional bandwidth is needed, additional time slots are dynamically assigned.
- Highly scalable – numerous base station units can be placed on a single tower without mutual interference.
- Flexiblility – the radios can accommodate Ethernet, V.35, X.21, Frame Relay, as well as provisions for Cisco, Ascend and other routers.
- Highly sensitive receiver – more effective use can be made of the limited amount of RF transmit power permitted in license-exempt spectrum.
- Speed – raw signaling rate is 2 Mbps, committed information rate (CIR) is 512 Kbps bi-directional.

WIMAN Systems is currently shipping the WIMAN II, which offers a 4x increase in speed over the original WIMAN hardware.

The robust modulation is a critical differentiating feature. In many countries, especially developing countries, rules for operating equipment in the 2.4 GHz band are similar to those of the US FCC… but in contrast to the US, such rules in developing countries are routinely ignored. There simply aren't enough regulatory personnel to police the rules, and as a result, use of high power amplifiers with 2.4 GHz equipment is common. The effect of excessive amplifier use is that the 2.4 GHz band is "polluted" with high-power signals. WIMAN equipment is in use in many such "challenging" RF environments, including Haiti, Puerto Rico, Columbia, and Nigeria.

One of the ways in which WIMAN manages interference is that the radio monitors the data throughput and if there are errors, the radio will retry at 8mS intervals; this behavior typically cuts through any interference. The fact that there was an error is not "passed up" the TCP/IP stack

to cause a TCP/IP retry – errors are handled at the radio (physical) layer. In many countries other than the US, "adaptive hopping patterns" are allowed. Adaptive hopping monitors the overall usefulness of each hopping channel, and if a particular channel or channels has excessive interference (no data can be transmitted on those channels), then the WIMAN II can "skip" that channel. At this writing, the FCC is actively considering a revision to the Part 15 rules to allow Adaptive Hopping.

Truly deterministic performance is relatively rare in a Broadband Wireless Internet Access system – most such systems offer only "best effort" performance. WIMAN's use of TDMA techniques, and Master/Slave signaling insure that WIMAN units don't interfere with each other. Remote (customer) units don't transmit except during their assigned timeslots.

WIMAN Systems regards the scalability of their system as its primary strength. Use of 40 different frequency hopping patterns, and the ability to synchronize transmissions means that up to 40 units can be co-located on a tower. The synchronization of transmitters means that one radio isn't transmitting while another radio close to it is trying to receive a signal from a remote unit (the receiver would be "desensed" (deafened) by the relatively strong signal of a nearby transmitter. In practical terms, such scalability means that as more capacity is needed in a system, it can be added as needed without expensive antenna sectorization or development of new sites.

In marked contrast to most other Broadband Wireless Internet Access systems, WIMAN equipment's built-in interface flexibility makes it very easy to deploy for organizations that have extensive wireline deployments. For example, WIMAN II has a built-in Frame Relay interface, so WIMAN II systems can be installed, and remotely managed and monitored exactly like other Frame Relay equipment.

WIMAN reports being approached by numerous Incumbent Local Exchange Carriers (ILECs) Post Telephone and Telegraph (PTTs) from a number of countries about the use of WIMAN II. Such carriers are being required to begin offering broadband services such as DSL, and to do so requires extensive infrastructure upgrades, and view license-exempt wireless as a potential alternative to wireline. Such large organizations are usually very shy about the use of license-exempt spectrum.

The prime concerns of a carrier are reliability of the service, scalability, and reliability of the hardware. WIMAN takes pride in connecting skeptics up with numerous satisfied service providers in a number of "challenging" RF environments outside the US. The clear implication is that if it can be made to work reliably such locations, it can certainly be made to work reliably here in North America.

Plaintree Systems
Free Space Optics Equipment Vendor Uses LEDs Instead Of Lasers

As part of my ongoing research on Broadband Wireless Internet Access, I've watched the emergence of the second (or third?) wave of Free Space Optics (FSO) vendors and technology emerge. To someone who's not familiar with FSO, the phrase "Fiber optics… without the fiber" pretty well gets the idea across.

The "first wave" (my term, and estimation) was based on (relatively) high-powered laser technology to provide high-bandwidth connectivity at relatively short range. In the last five or so years, a new generation of FSO vendor, and several new FSO technologies have emerged. In my opinion, FSO is a straightforward extension of Radio Frequency (or, more precisely, millimeter-wave) wireless communications, and in strict physics terminology, optical is simply "closer to the top of the electromagnetic spectrum". In Broadband Wireless Internet Access, FSO is just now beginning to emerge as a "just another option", along with microwave and millimeter-wave RF systems.

Plaintree Systems of Ottawa, Ontario, Canada is an FSO vendor that, unlike the majority of FSO equipment providers, has eschewed the use of laser technology in favor of using Light Emitting Diodes (LEDs) as the core technology of their systems. Plaintree was founded in 1988, and (through a corporate acquisition) has over a decade of experience in LED-based wireless communications systems.

Plaintree has two primary reasons for using LEDs rather than lasers.

- Plaintree judges LED emissions to be inherently more eye-safe than laser emissions. Though almost all laser-based systems are classified as eye-safe under one or more set of regulations, Plaintree sums up the argument with a simple comparison: Which would you rather look into – a television remote control (infrared LED) or a laser pointer (laser)? [*Admittedly, this is a grossly simplified discussion on the issue of eye-safety in relation to FSO. Future issues of* ***Focus*** *will discuss this issue in depth, and in future articles about other FSO vendors, "equal time" will be given to their claims of eye-safety.*]
- The reliability of LEDs, particularly in very hot environments (such as the Middle East) is superior to that of lasers, with Plaintree's units claiming a Mean Time To Failure (MTTF) of 25 years.

Plaintree sees the potential market for its products as huge in the near term. Much of the demand may come from deployment of 3G wireless telephone networks that will require much more backbone connectivity. Plaintree

observes that RF spectrum is increasingly crowded and it's growing more difficult to coordinate new RF links. In comparison, FSO links are nearly hassle-free, and for the path lengths in question, typically under 2 miles, reliability is comparable.

Other markets that Plaintree has identified are Internet Service Providers (ISPs) and linking buildings on a campus when it's not feasible to use fiber optics, especially when inter-building linking is provided for a monthly fee by another party such as a local telephone company. Plaintree feels that the market for FSO is growing "organically" due to increased demands for bandwidth, such as 100 Mbps Local Area Networks (LANs) supplanting 10 Mbps LANs and the lack of corresponding last-mile high bandwidth infrastructure.

Though Plaintree claims not to be in direct competition to RF-based systems, Plaintree makes a compelling case for the superiority of FSO over RF:

- License-exempt, and unlike RF-based license-exempt systems, little possibility of harmful interference
- FSO systems can be deployed very densely, for example, (theoretically) dozens of FSO systems can be operated from the same roof
- RF systems and networks are more complex to construct and maintain

Obviously, there are drawbacks to FSO, with Plaintree's responses:

- *Range is considerably less with FSO than with RF-based systems, especially when inclement weather such as fog is a factor, resulting in less than 5-9's (99.999% availability).* Somewhat true. The majority of the market demand for FSO links is for relatively short links such as between campus buildings and downtown high-rise buildings. Within recommended range limits for Plaintree's units (which vary for each locale), reliability is comparable.
- *One of the primary motivations for laser-based FSO systems is that LED-based FSO systems cannot achieve high data rates such as OC-12 (622 Mbps).* The fastest data rate that Plaintree currently offers is OC-3 (155 Mbps), which satisfies the majority of current and near-term demand.

In discussions, Plaintree goes to great pains to explain that they are targeting what they perceive as the "sweet spot" of the FSO market with their current lineup of products. While there *is* demonstrable demand for FSO products faster than OC-3, the demand for "up to" OC-3 links is considerably greater. Plaintree offers the example that there's little or no cost advantage in the use of a Gigabit FSO link and installation of fiber (although the installation time for the Gigabit FSO link is considerably less).

Plaintree has a well-established sales and support network that extents to a number of International locations.

ArrayComm Backs TDD Coalition

I've watched ArrayComm for a number of years now, and I've been consistently impressed with its technology and its personnel. ArrayComm has an incredible resource and spokesperson in CEO Martin (Marty) Cooper. Cooper and ArrayComm play up Cooper's history with Motorola and having led the team that, with AT&T Bell Labs, developed the first cellular telephone system. Cooper has been one of the most visible figures in the Broadband Wireless Internet Access industry, and is widely quoted. If ArrayComm's proposed iBurst Wireless Internet Access system is to have a realistic chance of entering commercial service, there is as much work to be done in Washington DC as there is in San Jose, California where ArrayComm is headquartered. ArrayComm and Cooper are *very* realistic as to where the "battle" for mindshare and spectrum needs to be "fought" – in the Press, and in Washington DC, including both Congress and the Federal Communications Commission (FCC).

In March, 2001, ArrayComm appointed former US Ambassador Bradley Holmes to head its new Washington DC office. Holmes was an inspired choice for such a position, causing one longtime FCC observer to remark: "Watch and learn, boys and girls, and observe the *right* way to accomplish spectrum policy changes in DC". Indeed, if the spectrum policy "game" is to be played, it must be done so by the rules of DC, which is a completely alien environment to most technology companies. To its considerable credit, ArrayComm is one of the very few companies involved in the Broadband Wireless Internet Access industry to recognize the need for, and be willing to "pay the going rate" (former Ambassadors likely don't work cheap) for effective representation of its positions.

Although this story is nominally about the TDD Coalition, some background about ArrayComm is in order. Currently, ArrayComm's main product is a "smart antenna" system (actually, the intellectual property of… they don't produce hardware) for mobile telephone networks called IntelliCell. IntelliCell has the effect of multiplying the available spectrum in a mobile telephone network by allowing much more frequent spectrum re-use than with conventional mobile telephone base station antenna systems.

ArrayComm has applied their IntelliCell technology to the creation of a new class of Broadband Wireless Internet Access system called iBurst. iBurst provides 1 Mbps data "stream" to "stationary" users. iBurst is intended to be used in a number of diverse ways, such as laptop users sitting at a café, downloading an hour or more of video or audio files to a portable player, voice and/or video over IP,

etc. iBurst does not attempt to provide full "mobility" connectivity; for example iBurst connectivity is lost when a car starts moving… but is quickly re-established as the car stops at a stoplight.

Much of the "magic" of iBurst is that most of the complexity of the system resides in the base station. iBurst uses a relatively simple modulation scheme and its channel access protocol is Time Division Duplexing (TDD). [A brief refresher – in Time Division Duplexing, transmit and receive cycles are separated by time – transmit, then receive, then transmit, *on the same frequency*. There are numerous *other* techniques to separate transmit / receive cycles – divide them by Frequency (FDD), Codes (Code Division Multiple Access – CDMA), etc.] An iBurst base station "focuses" (using IntelliCell technology) a 1 Mbps data stream on each iBurst user, allowing the user device to be relatively simple – the "heavy lifting" of signal processing, etc. is all done at the base station. (This is certainly not to discount the amount of work that is going into the development of iBurst user devices, which is considerable.)

ArrayComm chose to use TDD because, for its purposes, it is the most efficient channel access protocol for digital communications. ArrayComm, or more accurately, its licensees who will build iBurst networks, will need dedicated spectrum… and there currently isn't much "mindshare" about spectrum policy that isn't being influenced by the "desperate" situation of additional spectrum required for deployment of 3G mobile telephone services.

ArrayComm could lobby on its behalf… but such lobbying tends to be ineffective when couched in the terms of benefiting only one company. There were a number of other companies involved in the Broadband Wireless Internet Industry that also have chosen to use TDD (again, it's a very efficient approach, both from the electronic development, and the amount of spectrum required). All the TDD users faced the same battle for mindshare in Washington, DC that ArrayComm did, so it was decided to form the TDD Coalition to advocate for spectrum policies that were truly technology neutral – at least somewhat accommodating of the needs and capabilities of TDD.

One of the hardest points that the TDD Coalition has to begin getting across is that "3G" is not necessarily the "all things to all people" wireless technology of the future that the wireless telephone industry is portraying it as, and that there are alternate technical approaches that can perhaps satisfy the need for Broadband Wireless Internet Access better than "3G" services. Needless to say, that particular message is not being well received by the wireless telephone industry, who is attempting to focus any and all discussion about wireless issues in the context of obtaining additional spectrum for "3G" services. ArrayComm and the TDD Coalition knew it would be a bit of a fight.

When and if that message is understood by the appropriate parties, then comes the bigger task of actually *obtaining* spectrum for use by TDD systems. The problem is that mobile telephone technology currently uses Frequency Division Duplexing (FDD); phone and base stations transmit on one frequency, and receive on another, and do so simultaneously. As a result, all spectrum allocations for mobile telephone systems (including 3G) are for "paired" spectrum – a block of spectrum reserved for transmit, and another block reserved for receive, allocated together.

Such spectrum allocations are twice what is required for TDD, since TDD doesn't (technically) transmit and receive at the same time, and it can use the same block of spectrum for both. (In practice, the changeover from transmit to receive, and back is near instantaneous).

But, the FCC and other organizations concerned with spectrum allocation aren't getting the message that TDD systems are coming, and continue to allocate spectrum in paired blocks. This has two undesirable effects:

- Cost of spectrum is priced unrealistically high because FDD systems are forced to compete for "twice as much spectrum as they need", artificially inflating the cost at of spectrum at auction
- Fewer TDD systems are authorized; offering a paired block of spectrum as two individual blocks of spectrum will result in two TDD-based systems, likely competing with each other, rather than just one.
- Most importantly, blocks of spectrum that aren't suited for FDD use ("pairing" isn't possible), but suitable for TDD use *aren't* currently being made available because such blocks of spectrum are perceived as "useless"

Other spectrum allocation organizations have set aside spectrum for TDD use, including Europe and Japan. One FDD success stories is Japan's Personal Handyphone System (PHS) which currently offers 64 Kbps data, and by the end of the year, 128 Kbps.

Another point that the TDD Coalition hopes to make is that the major motivating factor in the "push" for "3G" systems is data services, and arguably, TDD is more efficient for data services than the proposed "3G" services.

It's quite possible that wireless phone carriers will deploy iBurst as "3G" services are increasingly delayed (and new (paired) spectrum for "3G" is not found, but spectrum appropriate for TDD use is identified.

Companies of the TDD Coalition:

- Adaptive Broadband
- Aperto Networks
- ArrayComm
- BeamReach Networks
- CALY Networks
- Clearwire Technologies
- Harris Corp.
- IPWireless

- LinkAir
- Malibu Networks
- Radiant Networks
- Raze Technologies

Amir Rosenzweig Is New President of Alvarion

In ***Focus*** Issue 1, I discussed the transition of BreezeCOM's US CEO. In this issue of Focus, I was very pleased and honored to be offered one of the first interviews that Amir has granted since assuming his role as President of Alvarion, the company formed by the merger of BreezeCOM and Floware.

One of the first topics we discussed was the more general aspects of the merger. Unlike many merger corporate mergers during this "time of troubles" in the telecommunications industry, BreezeCOM and Floware Wireless System's decision to merge was a proactive measure to create a stronger company with a wider range of products, rather than the desperate "please buy our company so that our stockholders salvage *something* from their investment" type of merger that is more common currently.

The corporate cultures of the two companies were compatible, both being based in Israel, with its relatively homogenous population. By the time of the merger, Alvarion had already consolidated facilities and many staff positions, especially marketing and engineering. Alvarion's engineering staff is already at work "cross fertilizing" between the two lines of products. A new marketing office for Latin America has been opened in Miami.

BreezeCOM and Floware's product line had little overlap. BreezeCOM's products operated in spectrum "below 11 GHz" and Floware's products operated in spectrum "above 11 GHz". Floware had almost no presence in the North American market, and BreezeCOM is a dominant player in its market segments. For the foreseeable future, the BreezeCOM and Floware product names will be retained to capitalize on the well-established brands.

Rosenzweig sees his primary near-term task as moving Alvarion to be focused more on providing solutions rather than merely "selling boxes". Alvarion's predecessor companies are truly complimentary on this point. Floware sold primarily to telecommunications carriers and Original Equipment Manufacturers (OEMs) as a solutions provider. BreezeCOM's corporate personality tended toward "ship more boxes". BreezeCOM's product line is "moving up the food chain, with its carrier-class BreezeAccess II product line for both licensed and license-exempt spectrum. BreezeCOM's "ship more boxes" history from its much more competitive marketplace will likely help reduce cycle times and aid in cost-reduction, resulting in a more competitive Floware product.

Although there will be little overlap between the two product lines, a near-term task is to combine and enhance the management systems the entire product line.

A glaring gap in the combined product line is a lack of products for the (varied) 5 GHz bands of the US, Europe, and Japan. Development of 5 GHz products were in progress at pre-merger BreezeCOM, and will likely benefit from Floware expertise. The first 5 GHz product to emerge from Alvarion will be instructive, as the 5 GHz bands offer characteristics that are applicable to both BreezeCOM's (5 GHz is license-exempt) and Floware's (higher in spectrum than BreezeCOM products, more likely to be used by carriers) expertise. The first Alvarion 5 GHz product will be a high-bandwidth point-to-point link.

In discussion about products, Rosenzweig was surprisingly candid. Alvarion is experiencing surprising success selling its BreezeCOM products to rural telephone companies to allow the telephone companies to provide second telephone lines. Such products are not marketed as "first phone line" products, as they (currently) have no provisions for "life safety" use such as battery backup, channel priority for 911 calls, etc.

In response to discussion about lower-priced, customer installable Customer Premise Equipment (CPE), Rosenzweig is adamant that Alvarion won't engage in "price wars", which he views as a destructive practice and having no real benefit for the industry as a whole. Rosenzweig points out that Alvarion's support services are widely praised, and Alvarion has gone to extraordinary lengths to insure that its products *and systems* comply with all aspects of FCC Part 15 rules. (A story in the September, 2001 issue of ***Focus*** will discuss why this is an under-appreciated, yet critical differentiation in vendor selection.) Alvarion also works hard on quality issues to insure that failure rate is minimal (so much so that sales of profitable extended warranties are down).

We briefly discussed the potential opportunity in mobile Broadband wireless Internet access resulting from the shutdown of Metricom's Ricochet wireless Internet access system. Alvarion has provided equipment and technical assistance to a number of customers that have implemented mobile (to some extent) Internet access systems. The majority of such systems provide "hot spots"; for example a police car can park in a well-lit parking lot in its patrol area to update their daily report on a laptop computer and then transmit the report via email without needing to return to the station. Another mobility system is that several airports in Europe are equipped to provide wireless data services to airplanes, and become active whenever an airplane "rolls within range" of a terminal.

(It's not out of the question that BreezeCOM equipment could be adapted to provide a Ricochet-like wireless Internet access service, and in fact several high-profile Alvarion customers have implemented "digital canopy" saturation-coverage networks, but such systems were designed for "no external antenna needed' wireless Internet access coverage to homes and businesses, rather than mobile users.)

We discussed the "Industry Leader" role that BreezeCOM that under BreezeCOM's previous US management had been largely abdicated. Rosenzweig mentioned with pride that one of his first appointments upon assuming his new role was promoting Patrick Leary from Southeastern US District Manager to the role of Chief Evangelist, Alvarion North America. Rosenzweig was keenly aware of the critical role of evangelists in promoting new technologies, having seen Microsoft's highly effective use of evangelists. Leary is an inspired choice for such a role, having recently been appointed to the Wireless Communications Association's new License Exempt Alliance committee, and providing a highly professional representation of Alvarion on the high volume, at times contentious isp-wireless mailing list. Leary / Alvarion is one of the very few vendors offering an official presence on this list, which is monitored by many, if not most ISPs that use wireless. These early moves are very promising for Alvarion to assume more of an industry leadership role- which the industry badly needs.

Rosenzweig goes to great pains to emphasize Alvarion's stability, that BreezeCOM sales were relatively flat the current fiscal year, which probably counts as a roaring success that sales didn't precipitously decline. Alvarion's customer base is diverse, selling strongly in North America (more than 500 customers, and many of those are distributors) and Internationally, with no one customer representing more than 10% of sales, Floware sales have increased in the current fiscal year, and the efficiencies of minor staff reductions, facilities consolidation, and marketing should result in Alvarion having a reasonably successful year despite the telecommunications industry downturn.

From The Editor

Since the publication of the first issue of ***Focus*** in June, and its debut at the Wireless Communications Association International's Wireless Now! show in Boston, I've received many positive and appreciative comments, and lots of constructive feedback. One of the most gracious comments I received was from Andrew Kreig, President of Wireless Communications Association International, in their July 19, 2001 Weekly Bulletin:

Technology commentator Steve Stroh (steve@strohpub.com) of Woodinville, WA, a WCA member, launched the newsletter ***Focus: On Broadband Wireless Internet Access****. It is defined by a vision: "That the primary method of Broadband Internet access is very likely to be wireless -- Broadband Wireless Internet Access." The first issue and the author's excellent reputation suggest that the newsletter ($595 annually) fills an important purpose…*

We have a few **new subscribers** this issue, for which I am most appreciative. I'd like to welcome to the ***Focus*** family:

- fSONA Communications Corp. of Richmond, British Columbia, Canada,
- Caly Networks of Sunnyvale, California USA, and
- Townsend Communications of Port Townsend, Washington USA.

Publishing Schedule – As you'll note, this is a combined July / August issue, which reflects the realities of summer schedules. With the combined issue, subscribers will have their subscription adjusted so that they will receive twelve issues, as promised.

Some of the feedback I received from the June issue of ***Focus*** was that I am being a bit too "partisan" about Broadband Wireless Internet Access and "handicapping" various wireline technologies "unfairly".

Focus *On Broadband Wireless Internet Access* is, admittedly, something of an unwieldy title (and very much a work in progress; suggestions are appreciated, with a free one-year subscription of Focus if a suggested title is chosen). I wanted the title of this newsletter to reflect that it was narrowly "focused" (sorry…) on Broadband Wireless Internet Access (the resulting title is you get from a techie who likes to write but doesn't have much access to marketing help).

I'll readily concede that there are wireline technologies out there that, in theory, can wipe out any potential cost advantages of Broadband Wireless Internet Access- likely a near-infinite number of them. A few that come readily to mind are:

- CityNet's "sewerbots" that pull fiber-optic cable through municipal sewer systems. But CityNet doesn't bridge from the main (sewer) line to the basement of the building – that's still a manual process, and thus still high in cost.
- Various flavors of "new and improved" DSL. But such newer systems pretty much require a wholesale (expensive) upgrade of the DSL equipment in the central office… not likely.
- (A personal favorite) Repeaters that amplify the DSL signal for longer range between the user and the central office. How does the repeater get powered, and where will these hundreds of little electronics boxes be installed, approximately halfway between the user and the central office?

- Data over power lines. This story surfaces every few years, claiming "this time they've *really* got it working"
- Hybrid Fiber Coax, with the fiber running much closer to the individual home than previously
- Sending fiber-to-the-home as a "sleeve" over existing overhead power lines
- Any number of fiber-to-the-home systems, including one by Corning that allows a fiber to be buried in a trench as narrow as a couple of inches-deep saw blade cut, so that fiber can be run straight up the driveway without worrying about nicking buried gas, water, power lines, etc.
- And many, many more…

The point I'd like to make about these wireline systems is simply that, while they're certainly feasible in theory, in practice, it's highly unlikely that they'll happen, or that they're uneconomical to deploy. There is little incentive for the ILECs to deploy them, and if a competitive service provider is going to deploy new facilities, it would seem to be more cost effective to instead deploy Broadband Wireless Internet Access facilities.

Here's a description of the most technically elegant, cost-effective, *simplest* Broadband Internet Access system I've ever heard of. There is a small company actually doing this. They simply went to the city government and did the necessary work to obtain rights of way on the power and telephone poles. They then began deploying a fiber network on the poles. Wherever there was a cluster of 20+ houses, a fiber was terminated into a 20 (small number of houses) to 200 (large number of houses) port Ethernet switch/router (suitably weatherized, power conditioning to use 220V AC from the mains, etc.) From the switch/router, Category-5 Ethernet cable (specially made to be hung overhead like telephone "drop" cables) was run to the house. Each household then has switched 10 Mbps Ethernet – Internet over "pure" Ethernet. Eventually, the switches and home gear will be upgraded to handle 100 Mbps. This approach works, it's cost-effective, it's simple to deploy and maintain, and I don't have a clue how it could actually be implemented on a wide scale.

Short of that… I think Wireless Will Win, because it offers much better economies of deployment, service differentiation, and upgrades than wireline systems for the foreseeable future, especially in comparison with the wireline systems deployed right now in the real world, and likely to be deployed in the near future, in the last mile.

So… I'm certainly not blinded by prejudice that "Wireless Is Best" (just because it's Wireless), but in my research, I genuinely have not seen a next-generation wireline system that seems genuinely doable and is actually in some danger of widespread deployment. Apologies for a long answer to a short question.

Another comment from a prospective subscriber was that ***Focus*** seems appears to neglect the "Above 11 GHz" technologies and companies. Well, that was true of Issue 1, but it certainly isn't my intention to neglect the "Above 11 GHz" market in ***Focus***, and I'd argue that I didn't even neglect it in Issue 1. Recall that Issue 1 featured an article about a "THz" vendor – Terabeam and their use of FSO.

Seriously, it's my intention to cover the entire spectrum of Broadband Wireless Internet Access technologies – from "DC to Daylight" (almost literally) – including the "Below 11 GHz RF section of the industry, the "Above 11 GHz RF section of the industry, and the "THz" / FSO section of the industry; licensed and license-exempt. Any modulation technique. While I'm not limiting my coverage to North American deployments, technologies, or companies, in reality I'm "challenged" by a modest research / travel budget, poor non-English language skills, and only so much time. It's certainly my hope that Focus will become a much more rounded publication, with multiple writers, International coverage, and a somewhat more comprehensive overview of the industry. But, in the meantime, I'm having a great deal of fun writing ***Focus*** and, of course, learning more every day about this fascinating industry, technologies, and companies.

Finally, there were some comments and questions about my "positioning" of ***Focus***. Marketing 101 probably teaches that you're supposed to have a carefully crafted "position" statement for a publication such as ***Focus***. I don't… at least not a carefully crafted one. The closest thing I have to one goes something like this.

In addition to my writing for hire, I've been asked at various times to consult on Broadband Wireless Internet Access. The purpose of a typical consultation is to get a person or group "up to speed" on the technologies, companies, trends, etc. in the Broadband Wireless Internet Industry for individuals or groups coming "cold" into the industry and needing to "ramp up" quickly. Typically this is a conversation of limited duration; they get to ask all the questions they wish for a set fee, and I answer to the best of my ability and knowledge. My hourly consulting fee is what I consider reasonable, and I've not heard any complaints that it's too high. As for the price of ***Focus***, consider it as a year's worth of consulting on Broadband Wireless Internet Access (pretty cheap).

I decided to try to make ***Focus*** the nexus of my activities in Broadband Wireless Internet Access. Since the telecom downturn, there's little freelance work available, so ***Focus*** provides me with an outlet for my "feature article" writing. I like to think that I'm not writing ***Focus*** "at" the readers, but rather that I'm sharing interesting things that I've learned *through* ***Focus***. ***Focus*** is also an extension of my consulting activities, allowing me to research and write about companies that I think are doing and building interesting things, and the technologies that empower them. Lastly, ***Focus*** is something of a goad for me to complete my long-promised book on Broadband Wireless Internet Access. The chapters in the book will look a lot like some of the longer articles in Focus… and that's certainly exactly a coincidence. My goal, when I quit my

day job early in 2000 was to complete the book. Shortly after my "liberation", I was offered a number of lucrative writing-for-hire opportunities… and that income was very welcome. Recently, Tina, my long-suffering wife reminded me that I was in danger of welshing on my promise to her, myself, and many readers, of the book. So, the main chore for Fall, 2001 is regular publication of ***Focus***, followed closely by steady progress on the book. In future issues of ***Focus***, you'll hear more about the book.

Lastly, I would like to take a moment to ask that, if you find ***Focus*** to be useful and insightful, please take a moment to recommend it to colleagues. A subscription form is located on the last page of this issue for ease of printing and copying.

Thanks!

Steve

Letters

Since we've just begun publication of ***Focus*** *on Broadband Wireless Internet Access*, we don't have any letters yet specifically directed at the contents of ***Focus***.

This month I'd like to explain what my policy, and hopes, are for letters. A number of other newsletters that I admire have made the reader's letters, and the editor's responses, a significant part of the content of those newsletters. This serves several purposes: 1) It makes the newsletter more interesting to read, 2) It provides something of a reality check on what's written in the newsletter, 3) the readers likely know of things that the editor doesn't.

So, Letters and Editor's replies will be an integral part of Focus. Initially, while readership is relatively low, this will be a pretty intimate exchange of ideas and points of view. As ***Focus*** grows, it may not be possible to include all letters that are submitted… but we'll do our best.

Here are the initial guidelines for Letters to ***Focus*** *on Broadband Wireless Internet Access*:

- All editorial commentary letters (including email) to ***Focus*** *on Broadband Wireless Internet Access* will be considered to be submitted for inclusion in the Letters section of ***Focus*** *unless otherwise stated*.
- Letters may be edited for space and relevance (and such edits will be noted)
- If you do not wish for your letter to be included in the Letters section of ***Focus*** *on Broadband Wireless Internet Access*, please state that in the letter.
- If you prefer to remain anonymous, but have your letter included in the Letters section of ***Focus*** *on Broadband Wireless Internet Access*, please state that in the letter and the request will be honored.
- All letters must include contact information; no anonymous communications will be published.

So, Please write! I very much look forward to exchanging ideas with ***Focus*** readers!

Upcoming, In The September, 2001 Issue of *Focus*:

- The Darwinian Effect of License-Exempt Wireless
- A Look At Public Wireless Internet Access Co-Ops
- The Evolution Of 802.11 – On Beyond "B"
- Wireless Ethernet Compatibility Alliance (WECA) Faces Difficult Challenge in 802.11a
- A profile of an innovative Wireless Internet Service Provider
- An introduction to the Amateur Radio Service – it's *not* just old white guys in the basement sending Morse Code to each other any more
- And much, much, more

Events Of Interest To The Broadband Wireless Internet Industry

Please let me know of events that will be of interest to those in the Broadband Wireless Internet Access industry, and they will be featured as space permits. If I plan to attend a particular Event, it is noted.

- September 7, 2001, Irvine, CA – License-Free Wireless IP Workshop Series, Shorecliff Communications, Inc. www.scievents.com/wisp/
- September 10-14, 2001, Denver, CO – IEEE 802.16 Meeting 15 grouper.ieee.org/groups/802/16/meetings/mtg15/index.html
- September 9-14, 2001, Atlanta, GA – Networld + Interop Fall 2001 www.key3media.com/interop/
- September 11-13, 2001, Barcelona, Spain – 24th SDR Forum General Meeting www.sdrforum.org/MTGS/next_meeting.html
- September 11-13, 2001, San Diego, CA – Wireless IT & Internet 2001, CTIA www.wirelessit.com/general (I plan to attend this event.)
- September 12, 2001, Denver, CO – Wireless ISP Seminar, BreezeCOM, Inc. www.breezecom.com/CorpInf_30210.asp?tNodeParam=1

- September 12-14, Lake Tahoe, NV – Gilder/Forbes Telecosm Conference – Telecosm V, Forbes, Inc. and Gilder Publishing.
  www.gildertech.com/public/conferences.html
  (I *wish* I could attend this conference!)
- September 12-14, 2001, Sarasota, FL – Wireless Training Class, Wave Wireless Networking
  www.wavewireless.com/whatsnew/
- September 17-21, 2001, Bellevue, WA – IEEE 802.11 Interim committee meeting.
  grouper.ieee.org/groups/802/11/index.html
- September 18-19, 2001, Hamburg, Germany – 6th International OFDM Workshop
  ofdm.tu-harburg.de/
- September 21-23, 2001, Cincinnati, OH – ARRL and TAPR Digital Communications Conference, American Radio Relay League (ARRL) and TAPR, Inc.
  www.tapr.org/dcc
  (I plan to attend this event.)
- September 24-25, 2001, Dallas, TX – Private Broadband Show, Private & Wireless Broadband Magazine
  www.privatebroadband.com/conference.html
- September 26, 2001, San Jose, CA – Wireless ISP Seminar, BreezeCOM, Inc.
  www.breezecom.com/CorpInf_30210.asp?tNodeParam=1
- September 26-28, 2001, Oberpfaffenhofen, Germany – Third International Workshop on Multi-Carrier Spread-Spectrum (MC-SS-2001) & Related Topics
  www.dlr.de/kn/kn-s/mcss2001
- October 2-3, 2001, Santa Clara, CA – 802.11 Planet Conference and Expo, Fall 2001.
  seminars.internet.com/80211/la01/index.html
  (I plan to attend this event.)
- October 9-11, 2001, Las Vegas, NV – ISPCON Fall 2001, Penton Media, Inc.
  www.ispcon.com/fall2001
  (I plan to attend this event.)
- October 10-12, 2001, Sarasota, FL – Wireless Training Class, Wave Wireless Networking
  www.wavewireless.com/whatsnew/
- October 16-18, 2001, Cincinnati, OH – Wireless LAN Workshop, Wireless-Nets Ltd. / Jim Geier
  www.wireless-nets.com/ws_overview.htm
- October 22-23, 2001 – Leuven, Belgium – OFDM Forum meeting
  www.ofdm-forum.com/index.asp?ID=8&MID=0
- October 24, 2001, Bellevue, WA – Wireless ISP Seminar, BreezeCOM, Inc.
  www.breezecom.com/CorpInf_30210.asp?tNodeParam=1
  (I plan to attend this event.)
- October 29-31, 2001, San Diego, CA – Wireless LAN 2001
  www.it-telecomsolutions.com/pages/conferences/wirelesslan.htm
- November 7-9, 2001, Sarasota, FL – Wireless Training Class, Wave Wireless Networking
  www.wavewireless.com/whatsnew/
- November 11-16, 2001, Portland, OR – IEEE 802 Plenary meeting (includes meetings for 802.11 and 802.16)
  grouper.ieee.org/groups/802/meeting/
- November 13-15, 2001 – San Francisco, CA – SDR Forum Annual Meeting
  www.sdrforum.org/MTGS/next_meeting.html
  (I plan to attend this event.)
- November 28, 2001, Portland, OR – Wireless ISP Seminar, BreezeCOM, Inc.
  www.breezecom.com/CorpInf_30210.asp?tNodeParam=1
  (I plan to attend this event.)
- December 12-14, 2001, Sarasota, FL – Wireless Training Class, Wave Wireless Networking
  www.wavewireless.com/whatsnew/
- January 14-16, 2002, San Jose, CA – WCA Technical Symposium
  www.wcai.com/events.htm
  (I plan to attend this event.)
- February 12-14, 2002, Anaheim, CA – Broadband Wireless World Forum
  www.scievents.com/bwwf02/default.asp
  (I plan to attend this event.)

Focus

On Broadband Wireless Internet Access

Steve Stroh, Editor

www.strohpub.com/focus.htm

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