The World Beyond the Bells

By Judi Clark

Introduction

The incumbent local telephone carriers (ILECs) have long offered telephone services, and more recently, Internet communications services. A great deal of the telecommunications sector, however, is currently in financial jeopardy. Services that fill our communications needs include several alternatives to the telephone. This report looks at some of the business opportunities that are developing to augment, supplement or replace the remaining Bell telephone companies. It looks at two-way broadband Internet and mobile service providers, including cable and a host of radio or frequency spectrum-based technologies—whose regulatory and commercial futures are uncertain but whose potential impact is tremendous.

What, No Telephone?

In a recent paper entitled The Future of the Bells,[1] we learned that our four remaining Bell telephone companies, the incumbent local exchange carriers (ILECs), are holding a collective $135 billion debt in the form of long-term loans, and that their income stream for repaying these loans is diminishing because of market pressures based on a new set of technologies and telecommunications needs (e.g., the Internet and mobile communications such as cell phones). Recognizing that the telecommunications network has become an essential part of our daily lives, we saw how the ILECs have held their monopoly position against the government's policies and against the public interest by maintaining exclusive control over the last mile: the connection between the telecommunications network and nearly all homes and businesses. But even their arrogance and monopoly position will not save them from increasing debt and decreasing business. The paper concluded that as the ILECs' financial problems increase and bankruptcies are announced, we may witness the end of an era.

If the ILECs' monopoly power is effectively limited by new policy, legal and financial means (as they slowly declare bankruptcy and merge into greater monopolies), what will become of the telephone network? This is an important question in two contexts:

1) the telephone network is an important element of our social fabric, and
2) ILECs provide DSL service which is one of two major broadband[2] Internet access technologies.

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[1] Clark, Judi. The Future of the Bells. May 2002. <http://www.netaction.org/futures/BellsFuture.htm>.

[2] Broadband is a type of data transmission that uses a single medium (a wire) to carry multiple channels at once. DSL (which allows Internet access concurrently with regular telephone service) and cable (TV and modem) are two examples.

A major disruption of telephone and telecommunications services would be disastrous for our society, businesses, and government. Communication is so critical to our daily lives that the networks are becoming a part of our social and cultural "commons."[3] Current and perceived threats to the stability of this resource are causing an ad hoc social movement to emerge. New technologies are evolving to empower this social movement, which in turn is challenging controls by monopoly powers.

In order to circumvent the ILEC- and cable-controlled wires, people are increasingly turning to wireless technologies that make use of radio spectrum—arguably another element of the public commons (explored below). Many different factors will affect the uses and successes of this approach. This essay discusses some of the opportunities that will arise in a newly-competitive telecommunications marketplace.

The Goliaths of Broadband

Over the last few years, we have seen several prominent Internet service providers[4] abruptly close their doors, leaving a large body of commercial, non-profit and residential customers stranded and without a connection to the Internet. Many of these carriers were operating as competitive local exchange carriers (CLECs). Abetted by the Telecommunications Act of 1996,[5] the CLEC market rose and fell at the hands of a "deregulated" but tightly controlled telephone line-based environment. The CLEC bankruptcies were the result of a

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[3] "Related to the public domain is the more general idea of "the commons" -- resources that are not divided into individual bits of property but rather are jointly held so that anyone may use them without special permission. Think of public streets, parks, waterways, outer space, and creative works in the public domain -- all of these things are, in a way, part of the commons." From the Concepts page, The Creative Commons. 20 July 2002 <http://www.creativecommons.org/concepts/>.

[4] The disconnection of broadband customers was, for a while, quite harsh. Northpoint (which had around 100,000 business and ISP customers, which in turn provide DSL connections to about 500,000 corporate and residential end-users) & Excite@Home (which had 3.7 million cable modem customers) disconnected their networks without notice, stranding their Internet customers. These were two of the higher profile exits whose actions represented a significant setback to the broadband market. According to the FCC, there were approximately 9.6 million high-speed subscribers as of June 30, 2001. Approximately 7.8 million of these subscribers are residential or small business customers.

- Bourne, Emily. NorthPoint shuts down network. Total Telecom, 30 March 2001. 7 June 2002 <http://www.totaltele.com/vprint.asp?txtID=38574>.
- Wallack, Todd. Crucial time for ISP: Investor slams ExciteAtHome. San Francisco Chronicle/SF Gate, 28 August 2001. 7 June 2002 <http://www.sfgate.com/cgi-bin/article.cgi?file=/chronicle/archive/2001/08/28/BU114690.DTL&type=tech>.
- Wagner, Jim. Rumors Dog Rhythms Silence. InternetNews.com, June 21, 2001. 7 June 2002 <http://www.internetnews.com/isp-news/article.php/8_788871>.
- FCC Releases Report On The Availability Of High-Speed And Advanced Telecommunications Capability. FCC News, 7 February, 2002. 7 June 2002 <http://www.fcc.gov/Bureaus/Common_Carrier/News_Releases/2002/nrcc0201.html>.

[5] Telecommunications Act of 1996. Pub. LA. No. 104-104, 110 Stat. 56. 1996. Codified at 47 U.S.C. §§ 151 et seq., West Supp. 1997. 11 Mar 2002 <http://www.fcc.gov/telecom.html>.

number of factors, with the major one being the inability to work with or circumvent the ILEC's last mile barriers.

Competition as we have come to know it in recent years is quickly and quietly disappearing. The many Internet Service Providers (ISPs) from which we have chosen are now or soon to be gone. Infinite variety has been largely replaced by two choices: a monopoly phone company offering DSL, and a monopoly cable company offering cable modem service.[6]

Digital Subscriber Line (DSL), a copper loop transmission technology, is a product offered by the phone companies to allow Internet access over (and not interfering with) a regular phone line. The ILECs hold over 80% of the DSL market,[7] having largely foreclosed a competitive future from CLECs. While some of the telephone companies are currently on shaky financial ground, their future as providers of "broadband" services is, at least temporarily, supported by current congressional and regulatory activities, discussed below.

What if you don't want, or for reasons of distance or availability, can't get DSL? "The only real competition is cable—which also has consolidated into four main players and is dominated by two"[8] (AT&T Broadband, which is merging with Comcast, and Time Warner Cable). Encouraged by the Telecommunications Act of 1996, cable is also a viable competitor for local phone service.

Regulation Overview

In recent years many of the policy decisions made by Congress and the FCC have favored ILECs and/or cable companies. The Tauzin-Dingell bill that passed the House earlier this year, for example:

> "...(gives) the Bells control of the nation's telecommunications and technology infrastructure and threaten(s) the future deployment of both broadband and dial-up Internet access, as well as of competitive telephone service. The result for consumers would be less choice, lower quality service and higher prices for everything from basic phone service to Internet access."[9]

Similar bills are circulating in the Senate. The FCC is likewise concluding that "competition" will be promoted best by market forces.

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[6] It should be noted, however, that in the local phone service market cable companies have provided the only significant competitive choice for most consumers, and DSL service wasn't widely available until competition emerged from cable broadband service.

[7] Expanding DSL access the focus in the United States. Broadband Communications. 14 June 2001. 8 June 2002 <http://www.broadband.globalsources.com/MAGAZINE/BB/0107/BROAD02.HTM>.

[8] Mathewson, James. ReleVents: The Gloves are Off! ComputerUser.com, July 9, 2001. 11 June 2002 <http://www.computeruser.com/clickit/printout/articles/daily/3328,6,1,0709,3071336400001.html>.

[9] "Action Alert: Oppose H.R. 1542." Online newsletter. NetAction Notes, No. 81. February 19, 2002. 19 February 2002 <http://netaction.org/notes/notes81.html>.

"The FCC tentatively concluded the wireline broadband Internet access services—whether provided over a third party's facilities or self-provisioned facilities—are information services, with a telecommunications component, rather than telecommunications services. Information services include such services as voice mail and e-mail, which ride over telecommunications facilities."[10]
This information services classification would free the ILECs of requirements that have forced them to unbundle their networks and allow competitors to use their phone plants to deliver competing DSL services.[11] The effect of this regulatory decision is profound. "The Federal Communications Commission is quietly handing over control of the broadband Internet to a handful of massive corporations."[12]

With demand for broadband service growing, how is it that monopoly ILECs could be going bankrupt? Minimal competition for broadband services between ILECs and cable, or in some areas ILECs alone, is bad for customers: higher prices, long service contracts, expensive equipment charges. Although the ILECs' reluctance to unbundle their local resources is foreclosing the Competitive Local Exchange Carrier (CLEC) market's future,[13] the fact remains that competition from DSL service resellers would have promoted sales of ILEC resources as well. Service expansion is also hindered by the shortage of installation personnel—and ILECs are not hiring to expand at this time. Finally, what little competition exists between ILECs and cable providers helps lower prices. But DSL prices remain higher than cable, and two cable modems are being installed for every one DSL modem that's installed. Price parity affects market parity. The ILECs seem bent on squeezing every last penny from their diminishing future. Once other broadband and mobile communications alternatives are set loose on the marketplace, ILECs will certainly be in for a wild ride.

While current regulatory support firmly favors market forces, consumer demand may not last. Dissatisfaction with customer pricing and service, problematic timely delivery and declining quality of service are fueling the larger debate about a structural separation of the carriers from control of the content that travels over the Internet.

In addition, calls are coming from many public and commercial fronts imploring the Bush administration to develop a comprehensive policy to encourage broadband deployment and use. No clear plan or path has yet been announced, though the FCC said "that it will review most of its media ownership limits in one

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[10] Federal Communications Commission. FCC Launches Proceeding To Promote Widespread Deployment Of High-Speed Broadband Internet Access Services. Feb 14, 2002. 10 June 2002 <http://www.fcc.gov/Bureaus/Common_Carrier/News_Releases/2002/nrcc0202.html>.
[11] Greenberg, Brigitte. FCC Spawns Cable Industry Scramble. BroadbandWeek.com, February 19, 2002. 11 June 2002 <http://www.broadbandweek.com/news/020218/print/020219_cable_spawn.htm>.
[12] Benner, Jeffrey. Getting a Lock on Broadband. 7 June 2002. 8 June 2002 <http://www.salon.com/tech/feature/2002/06/07/broadband/print.html>.
[13] Clark, Judi. The Future of the Bells. May 2002. <http://www.netaction.org/futures/BellsFuture.htm>.

sweeping proceeding, delaying an expected relaxation of the caps for nearly a year."[14] A senior researcher at SRI Consulting Business Intelligence predicts that "such potential relaxation of media ownership does not appear likely to create a more competitive DSL market, but more likely will enable further consolidation and quite possibly fewer competitive choices for subscribers."[15]

Goliath, meet David. And Dave, and Davy...

Business and residential consumers are not content to stand still and be abused. Current broadband alternatives to DSL and cable (wire-based networking) include wireless (including satellite, terrestrial wireless, and optical) and, to a lesser extent, fiber networking. Wireless is generating the most interest—on the commercial front as well as among policy makers.

Wireless networking uses an over-the-air interface, using radio frequencies, to create connections between computers. These frequencies are often in the unlicensed range of spectrum[16] as allocated by the FCC.

> "Unlicensed spectrum has two principal advantages. First, because there is no licensing procedure, deployment can be fast and inexpensive. This makes it practical to mass market inexpensive wireless systems for which the cost of a single license would be a significant part of a system's overall deployment cost. Second, unlicensed spectrum is shared. Such sharing is essential for wireless systems that are moved from place to place, like laptop computers that can be connected via a portable wireless local-area network..."[17]

Unlicensed spectrum has several relevant characteristics: it is in limited supply, technical and end-user competition is momentarily problematic, incompatible technologies are built on specific frequencies, and special interests want to claim and license it as their own resource. Vastly greater public good could be achieved by maintaining or expanding this resource and allowing technology developers to solve some of their current problems.[18]

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[14] Davidson, Paul. FCC to review media ownership caps later. USA TODAY, page 3B. 18 June 2002 <http://www.usatoday.com/usatonline/20020618/4201004s.htm>.

[15] Gold, Michael. Senior Research Engineer, Media Futures Program, SRI Consulting Business Intelligence. Personal phone call. 6 July 2002.

[16] The term spectrum refers to the electromagnetic radiation spectrum. Long used for radio and television broadcast (and many other functions), spectrum uses vary from about 9 kilohertz (kHz) to thousands of gigahertz (GHz), called radio frequency (RF), and higher electromagnetic energy includes infrared (IR), visible light, ultraviolet (UV), X rays, and gamma rays. Most of the spectrum is licensed for specific uses by the FCC. A frequency allocation chart for the U.S. is found at <http://www.ntia.doc.gov/osmhome/allochrt.html> (last checked 3 July 2002).

[17] Peha, Jon M. The Path Towards Efficient Coexistence in Unlicensed Spectrum. 04-30-2000. 12 June 2002 <http://www.ieee802.org/16/human/contrib/80216hc-00_03.pdf>.

[18] Gillmor, Dan. Imagine: world with unlimited airwaves. San Jose Mercury News. Reposted on David Farber's email list. May 20, 2002. 25 July 2002 <http://www.interesting-people.org/archives/interesting-people/200205/msg00125.html>. Additional related thoughts by David P. Reed are at <http://www.reed.com/dprframeweb/dprframe.asp?section=openspec> (25 July 2002).

Unlicensed Spectrum and the Wireless Alternative

Unlicensed spectrum, available in certain frequencies, is used by several wireless applications including wireless home telephones and home networking. Several different technologies and companies are making use of this free resource. Some technologies conflict in their implementation and use with other popular technologies; for example, 802.11b networking with 2.4 GHz wireless phones. Many represent business models that are yet to be proven. Some of these approaches (both business models and technologies) are potentially disruptive to the assumptions of the current policy makers.

The broad and uncoordinated use of unlicensed spectrum raises management issues, including overuse and conflicting uses. Many manufacturers recognize the need to optimize or coordinate their purposes so as not to needlessly interfere with each other. Still, this spectrum is limited and may not accommodate all interested parties—adding a large element of uncertainty.

One proposal is to expand the available spectrum by re-purposing other existing uses. For example, more than 70% of households get their TV from cable or satellite. That means that VHF and UHF broadcasters are using valuable frequencies to satisfy a relatively small market. VHF frequencies also have special characteristics (the ability to bend around corners) that make it more valuable for public use. Since broadcasters who hold current licenses have never asked for a 2-way signal (enabling them to send and receive), the proposal suggests that the government should study the possibility of re-purposing the UHF/VHF licenses to provide an open, public good in the form of additional usable spectrum, with the unlikely possibility of creating a lifeline cable/satellite service to subsidize pay-TV as a more affordable, desirable alternative. This would, it's said, prevent a limited commercial market from hogging up desirable bandwidth.[19]

This proposal begs the question: whose spectrum is it anyway? The public is happy to make use of it under the common assumption that spectrum is a public good. The Telecommunications Act of 1996 includes a section on "spectrum flexibility"[20] that might allow such a re-purposing to occur. Such an

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[19] Many people feel that the idea of subsidizing pay TV as a taxpayer-supported "lifeline service" is ludicrous, hence the debate.

[20] The relevant sections from the Telecommunications Act of 1996, found at <http://www.fcc.gov/telecom.html> include:
SEC. 336. BROADCAST SPECTRUM FLEXIBILITY.
'(5) prescribe such other regulations as may be necessary for the protection of the public interest, convenience, and necessity.
'(c) Recovery of License: If the Commission grants a license for advanced television services to a person that, as of the date of such issuance, is licensed to operate a television broadcast station or holds a permit to construct such a station (or both), the Commission shall, as a condition of such license, require that either the additional license or the original license held by the licensee be surrendered to the Commission for reallocation or reassignment (or both) pursuant to Commission regulation.
'(d) Public Interest Requirement: Nothing in this section shall be construed as relieving a television broadcasting station from its obligation to serve the public interest, convenience, and necessity. In the Commission's review of any application for renewal of a broadcast license for a television station that provides ancillary or supplementary

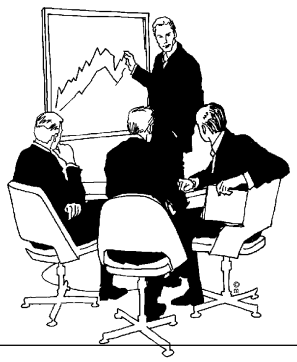
action would certainly encourage broadband deployment and use, a Bush administration priority.[21]

The Rocks in David's Sling

How is this likely to happen? Broadband competition is likely to take one (or more) of three forms: 1) a new marketing effort (and subsequent competition minimizing) by the incumbent ILEC/cable companies, 2) one or more new companies and technologies, or 3) community-based networks. Each will look a little different in the early stages. Examples might be illuminating.

New Marketing Efforts by the Incumbents

New marketing efforts are but short-term strategy to maintain their monopoly positions. Observing past behaviors, we might expect that any new plans introduced by incumbent ILEC and cable companies would restrict or prohibit any outside use of their resources, effectively strangling any competitive opportunities. Combined with flashy marketing campaigns and commercials, incumbents would likely undermine the efforts of competitors. What once was "new" would soon be more of the same old thing.



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services, the television licensee shall establish that all of its program services on the existing or advanced television spectrum are in the public interest. Any violation of the Commission rules applicable to ancillary or supplementary services shall reflect upon the licensee's qualifications for renewal of its license.

'(f) Evaluation: Within 10 years after the date the Commission first issues additional licenses for advanced television services, the Commission shall conduct an evaluation of the advanced television services program. Such evaluation shall include--

'(1) an assessment of the willingness of consumers to purchase the television receivers necessary to receive broadcasts of advanced television services;

'(2) an assessment of alternative uses, including public safety use, of the frequencies used for such broadcasts; and

'(3) the extent to which the Commission has been or will be able to reduce the amount of spectrum assigned to licensees.

'(g) Definitions: As used in this section:

'(1) Advanced television services: The term 'advanced television services' means television services provided using digital or other advanced technology as further defined in the opinion, report, and order of the Commission entitled 'Advanced Television Systems and Their Impact Upon the Existing Television Broadcast Service', MM Docket 87-268, adopted September 17, 1992, and successor proceedings.

'(2) Designated frequencies: The term 'designated frequency' means each of the frequencies designated by the Commission for licenses for advanced television services.

[21] Promoting Innovation and Competitiveness: President Bush's Technology Agenda. 18 June 2002 <http://www.whitehouse.gov/infocus/technology/tech2.html>.

A New Company

If a new company (or a few) were to begin, we might see a path similar to the introduction of the "horseless carriage" (as against the incumbent buggy manufacturers and railroad companies).[22] In 1908, Henry Ford introduced his first Model T for an affordable $850. Five years later, Ford slashed prices.

> "By 1930, the number of registered cars on U.S. roads [soared] to 23 million. ...[This was] a car that [achieved] unparalleled popularity and change[d] the automotive industry, and American life, forever."[23]

What kind of "carriage" are these new telecommunications access players offering? There are several families of technologies, including ultra-wideband, spread spectrum, 3G and 4G wireless, optical, and wireless mesh networks, and satellite access, among others.

Ultra-Wideband

Ultra-Wideband (UWB) technology transmits and receives very brief, energy efficient radio signals across a wide range of frequencies at once. Low power requirements make UWB difficult to detect and relatively mobile (due to low battery drain). The wide range of frequencies give UWB location flexibility—devices can be used inside and out, above and underground.

Critics claim UWB causes interference. The parties expressing the greatest concern may be those in the military infrastructure who are concerned about UWB devices interfering with Global Positioning Systems (GPS). Though UWB does span licensed and unlicensed frequencies, it can be tweaked to maximize its carrying capacity and security while minimizing or avoiding interference.

Spread Spectrum

Spread spectrum (SS) is a very useful technology that employs one of several frequency sharing models. One such model, frequency hopping, was co-invented by actress Hedy Lamar for use in World War II. Here, a transmitter and a receiver are synchronized to assemble a signal sent over rapidly switching frequencies. Another model, direct sequence, has less interference (it's more like background noise). Each has characteristics good for different settings. SS has the capability to be difficult to eavesdrop or jam, hence its use by the military.

SS technology is currently in wide use by several different industries, including CDMA[24] (such as used in Sprint's cellular) networks, many Bluetooth[25] and

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[22] As models go, cars certainly had unintended consequences that were felt later. This is likely true of today's emerging technologies, though it is beyond the scope of this paper to discuss.

[23] Streamliners Timeline: 1830 - 1919. American Experience, PBS.org. 12 June 2002 <http://www.pbs.org/wgbh/amex/streamliners/timeline/>.

802.11 wireless networking device manufacturers, and cordless home telephone makers. One of two approaches is taken in design and development: crowd out the competition so others can't use the assigned frequencies, or share the spectrum in a "peaceful coexistence" with other industries, service providers, and device manufacturers.

> "There are other ways to share spectrum, such as time division multiplexing (when a user is assigned a time slot rather than a frequency band), but this requires central coordination of every connection, so that time slots can be assigned and re-used efficiently. In contrast, SS allows many simultaneous connections to coexist by design (rather than by centralized control). Designers enable such built-in compatibility by agreeing in advance—that is, standardizing—various design parameters like spreading factor, sequence length, and power limits."[26]

As in the case of UWB, migration challenges are the biggest issue here: how do we move from popular, in-use technologies to better, faster, more efficient, but incompatible ones? Once solved, SS devices would have a longer range and higher security. Which approach do we want to encourage? What best serves the needs of the public?

3G and 4G Wireless

In an ever-expanding bubble of hype, next-generation wireless networks are at the center of the marketing universe. Third generation (3G) and fourth generation (4G) are touted as the desirable paths on which we're headed. Neither has arrived yet, and some have cast doubt on the future of 3G, given the troubled state it's currently in.

Existing telephone networks are slow and largely single-purpose. Integrated high-speed voice and data networks are the promise of 3G. They are slowly being rolled out, but are not fulfilling the marketing promises due to high cost and conflicting standardizing issues. Alternatively, 4G promises a true wireless broadband experience but is not expected to become a reality until late in this decade.

Enormous debt plagues the 3G operators, notably European giants BT (formerly British Telecom) and Deutsch Telekom. Although these companies have not emphasized the use of 3G for residential broadband service, it's plausible that—assuming these networks roll out as planned—3G providers will need to find every possible avenue to collect revenue. Though they now seem to insist on reserving 3G for mobile services—and pricing accordingly—the day may come when 3G companies experience pressure to exploit their spectrum for fixed

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[24] "Short for Code-Division Multiple Access, a digital cellular technology that uses spread-spectrum techniques. " Definition from Internet.com's Webopedia. November 27, 2001. 3 June 2002 <http://www.webopedia.com/TERM/C/CDMA.html>.

[25] "Bluetooth refers to a short-range radio technology aimed at simplifying communications among Net devices and between devices and the Internet. It also aims to simplify data synchronization between Net devices and other computers." Definition from Internet.com's Webopedia. August 2, 2001. 3 June 2002 <http://www.webopedia.com/TERM/b/bluetooth.html".

[26] Gold, Michael. Senior Research Engineer, Media Futures Program, SRI Consulting Business Intelligence. Phone call, 28 June 2002.

broadband service as well. The 3G technical specifications currently include this possibility.

Optical Networks

Two optical networking technologies are prominent: Passive Optical Networking (PON) and Free Space Optics (FSO). Both are concentrating on the "last mile" bottleneck: connecting the larger network to the home and business.

Passive Optical Networking (PON) lowers the cost of deploying broadband municipal *fiber* networks. PON takes two fiber optic strands and splits them, for example, into eight user strands. This technology is passive, which means no power is required and maintenance costs are much lower. "PON lets carriers go into new markets and share fibers among residential and small business customers."[27] Incumbent telephone companies are also expected to make use of it in their DSL deployment. Amusingly, PONs have existed since the early 1990s, when many analysts expected incumbent phone carriers to use them for so-called "video telephone" services that never materialized.

Free Space Optics (FSO) lowers the cost of deploying broadband municipal *wireless* networks. "Currently, about 75% of U.S. companies are within one mile of fiber optic backbones, but only 5% actually have connections. FSO is a line-of-site technology that uses modulated laser signals to transmit data through the air."[28] Advantages include its quick deployment, cost efficiency, and the absence of license fees. Concerns exist regarding performance during wet weather, but FSO networks are in service in several areas, including Tampa Bay, Baltimore, Philadelphia, Detroit, and New Jersey.[29] Like other wireless technologies, FSOs have the merit of often being easier to install: Rather than the enduring the costly process of laying fiber underground or via aerial lines, FSO users may simply mount optical transceivers on the exterior of buildings. It's good for temporary installations as well.

Wireless Mesh Networks

Mesh networking connects computers and other devices with each other in a way that enables and extends the reach of all users throughout the network. Mesh networks contain client and access points, which act as relays and routers to pass traffic on to similar devices. Traffic bounces along a series of these devices until it gets to its destination, much like packets on the Internet. This form of moving data allows for wireless access in areas that might not otherwise be served by larger broadband interests.

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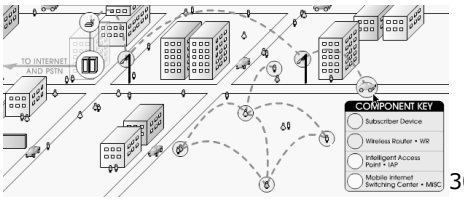
[27] Bernier, Paula. Passive Optical Networking Comes of Age. Xchange Magazine. 04/01/2001. 28 June 2002 <http://www.xchangemag.com/articles/141sec10.html>.

[28] Covert, Charles. Investment Analyst, St. Paul Venture Capital. Personal email, 20 June 2002.

[29] Weinschenk, Carl. PONs Hit the Big Time. Light Reading. Apr 24, 2002. 12 July 2002 <http://www.lightreading.com/document.asp?site=lightreading&doc_id=14383>.



[30]

Mesh networks have special design characteristics that make them desirable for certain areas or applications (e.g., the military): a line of sight between connecting devices is not required, devices are free to move around arbitrarily, efficient energy use, and limited physical security requirements. Latency, or relatively slow movement across the net, is a disadvantage.

Satellite Access

While still a bit costly, satellites have the ability to send and receive data in frequencies that range from multiple continents (for major broadcasters) to a single continent, and down to a single device. Satellite, ideal for remote locations not served by DSL or cable broadband, is used for a wide range of services including voice and video telephony, and non-streaming multimedia applications.

Unfortunately, two characteristics of satellites—very high latency and limited bandwidth—make interactive applications problematic. Use is also limited relative to where the satellite is in the sky—users must be in its footprint.

Software-Defined Radio

One other technology to watch is Software-Defined Radio. These new radios do a better job of using the "radio spectrum" to deliver advanced features and services. The reason: Hardwired radios require the establishment of standards that are extremely difficult to change, even when advances in technology yield better solutions. Software-defined radios (SDR or SR, for short) use a variety of modulation, frequency use and security techniques, and are programmable, which circumvents the problem of future obsolescence. In an age of changing and incompatible[31] wireless technologies, SDR has the potential to adapt. "SDR is uniquely suited to address the common requirements for communications in the military, civil and commercial sectors."[32] While they are flexible, they are also very costly right now. Over time, cost will certainly decrease.

Community Networking

The approaches discussed above were about technology. The best of science and engineering is nothing, however, without a context. In community networking, it's about the **people** that use technology. Wireless devices are becoming affordable and simple enough that almost anyone can—and will—use them to enrich their homes, workplaces, and lives.

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[30] Taken from Mesh Networks' Interactive Demo. 25 July 2002 <http://meshnetworks.com/>.

[31] In the US and Japan, for example, at least 4 different and incompatible cellular standards each serve millions of customers.

[32] SDR Primer. SDR Forum. 1 July 2002 <http://www.sdrforum.org/sdr_primer.html>.

This is the social movement mentioned above. People are taking matters into their own hands—to the extent allowed by wireless technology, the FCC regulators and incumbent business interests.[33] Community activists, public-minded technologists, public interest groups, and other change leaders are working to promote a broader social good – expanding services and availability in a sustainable way. Indefinite future use of volunteer networks is highly uncertain, however.

The perception at the business level is that you can't make money selling wireless broadband, particularly using unlicensed spectrum. Even though the cost of hardware and networking resources decreases as they become commoditized, and even if there are no licensing fees to contend with, unlicensed spectrum use has problems. There is no priority of one technology, vendor, or use over any other, so any one technology can and often does interfere with everyone else. No successful business model has yet been developed other than the slight profit margins achieved by commodity equipment manufacturers.

Nevertheless, if community networks were to take hold, it might be like the introduction of calculators to the slide rule manufacturers:

> "Tiny companies, many in Asia, began preprogramming silicon chips with mathematical functions, and powering them with batteries, resulting in hand-held calculators that:
>
> a. were far more accurate and easier to use than slide rules,
> b. had a host of additional functions as part of the package, and
> c. were increasingly affordable.
>
> Result: Big plastic slide rule makers went belly-up."[34]

Here, the technologies used to light up the public "commons" rely on wireless hotspots, and wireless rooftop and neighborhood networks. On a practical, community level, "it's easier to point antennas than it is to drag cables through the streets."[35]

Wireless Hotspots

Users have a growing demand for new and flexible ways of connecting to the net. "Hotspots—short-range wireless connectivity access points in public areas (coffee shops, hotels, airports and the like)—have emerged as a leading final-

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[33] The ad hoc social movement has many champions, including several prominent community groups and Internet Service Providers: <http://www.eff.org/Infra/Wireless_cellular_radio/wireless_friendly_isp_list.html> (25 July 2002). Not surprisingly, the list doesn't include incumbent telephone or cable carriers who are threatening to cut off service to or sue customers to prevent them from sharing their own service with others. The questions are quite complicated. Should a customer be prevented from extending her own network to cover, say, the fire escape where she sits? Are her friends disallowed from using her network while visiting?

[34] Larsen, Steve. Venture Partner, St. Paul Venture Capital. Personal email, 10 June 2002.

[35] Gold, Michael. Personal phone call, 15 June 2002.

feet solution."[36] We're not talking "last mile" or bottlenecks controlled by ILEC/cable companies. We're checking our email while waiting for a plane, or having a mocha at Starbucks.

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Rooftop and Neighborhood Networks

"When different wireless LANs are linked, you've got a permanent revolution. Right in your own backyard."[38] Groups of idealists and civic-minded activists can be a crazy bunch, especially when they have something to share with others. Here, it's broadband access. A growing number of network users are taking matters into their own hands and openly sharing their access with their neighbors.[39] Imagine walking through the Presidio (in San Francisco), or to Bryant Park (in New York), or past almost any of the government buildings in the state of Utah, opening up your wireless-enabled laptop or handheld device, and getting on the net—often for free.

With over 8 million 802.11b wireless network interface cards sold in 2001,[40] and about one million chips sold each month,[41] wireless networking represents a significant foray into alternative network connections. This is the technology used in neighborhood nets.

In another kind of neighborhood, apartments and other multi-dwelling units are partnering with Internet and telecommunications service providers to give their buildings wired access at a reasonable price. Many building managers are taking on the role as BLECs: building local exchange carriers, with slightly better power to negotiate terms of access than, say, a single homeowner.

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[36] Neichin, Gregory, Alker, David, Christie, Ed, Gold, Michael, O'Halloran, Joe. Wireless Hot Spots. SRI Consulting Business Intelligence Report. May 2002. p 1.

[37] Doonesbury comic, July 21, 2002. 21 July 2002 <http://doonesbury.com/strip/dailydose/index.cfm?uc_full_date=20020721&uc_comic=db&uc_daction=X>

[38] Churchill, Sam. Welcome to the Wireless LAN Revolution. Portland Community LAN Resource Guide. 5 July 2002 <http://sdots.com/wireless/>.

[39] The most common User Policies of the cable and telephone service providers disallow sharing with others. However, not all providers have such draconian policies, and not all users are connected to the net via those providers.

[40] Montalbano, Elizabeth; Kenedy, Kristen; Redman, Russell; Kovar, Joseph F.; Hooper, Larry. 5 Technologies To Watch -- Some Emerging Technologies Should Make Big Strides Toward Maturity In The New Year. Computer Reseller News. Dec 24, 2001, p34.

[41] Schwartz, Ephraim. It's a deafening sound: Bluetooth and wireless Ethernet rush into a noisy head-on collision. InfoWorld, 12 March 2001, p57.

From Victory to the Future

Several factors will determine the future success of these business models and technologies. We can bank on continuation of the social and commercial need for voice, data and wireless communication. The most significant factors will center, perhaps not surprisingly, around money, politics, and access to resources. But the most unpredictable element will be the public.

Recently we witnessed the disappearance of venture capital as the telecommunications sector experienced the beginning of a massive shake out. Many investors now question the accounting practices and investment histories of the industry's major players, frustrating the influx of investment capital. Increasingly, investors are not working from the same business model as the established ILEC/CLEC and cable industries, choosing instead to fund promising, cutting edge, and potentially disruptive efforts. The local networking movement may direct the venture capitalists and the marketplace. We have yet to see just how powerful it will be. Will home networking communities pose a serious threat to incumbent telecommunications providers? Will the influence extend to developing new presumptions and communications priorities?

On the market side, how ready and influential are ILEC alternatives (cable, fiber, wireless) to cooperate and embrace open architectures as a competitive strategy? What of their dreams of dominance?

Politics, as discussed above, will also be influenced by the burgeoning interest in frequencies of the radio spectrum. Federal Communications Commission (FCC) Chairman Michael Powell has confirmed his belief in market forces, but we have yet to see how this will promote competition or benefit the public. Alternative telecommunications investment and development may help steer the market toward the public interest, but we have yet to see if regulatory or legislative interests will support coalitions and cooperation among service providers, manufacturers, and users alike.

Access to resources will remain an area to watch. Will the government and/or courts enforce or encourage access to local rights-of-way? Currently, nine states have barriers to or have outlawed publicly owned telecommunications networks.[42] Interested citizens as well as investors should revisit municipal and state power to grant monopolies, especially when they adversely affect the public interest.

Finally, access to and use of the vast, recently-developed fiber optic network will be an area to watch. This resource is currently in very limited use due to similar "last mile" problems described above, and the fact that many fiber-owning companies are in various states of financial solvency. The marketplace for fiber access is redefining itself. Two different mindsets are at work here: the monopoly position of "scarce resources" versus the market-driven position of "add as needed."

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[42] Isenberg, David. SMART Letter. Online newsletter. No. 68. March 17, 2002. 17 March 2002 <http://isen.com/archives/020317.html>.

Protecting scarce resources is the ILEC/cable duopoly position. It isn't that fiber (or copper or new phone lines) is scarce in reality; it is that scarcity is defined by these monopolies as a way to maximize profits and slow or control growth and development of usable technologies. In the alternative, a competitive marketplace tends to add access and services as they are needed, and prices them according to what the market will bear. "Supply and demand will be growing at comparable rates. As such it is very likely that pricing will begin to play an even more important role in the evolution of traffic."[43] The latter will allow new technologies to be developed, new access methodologies to be tested and deployed, new markets to be explored.

The big questions to watch?

- How will the "last mile" infrastructure be implemented and funded?

- If the infrastructure is completed and fiber to the home/office is widely available, will resellers enter the market or will the Bells convince policy makers to let them keep their monopoly?
- What constraints will be imposed, and will users be able to circumvent them?

Ultimately, the question to ask is who will really be in control of our future?

About the Author

Judi Clark is currently a law student and President of ManyMedia, a Graphics Communication and Information Services Consultancy. She is also the force behind WomensWork.org, and a member of the NetAction Advisory Board. She has been an instructor in the University of California, Santa Cruz's corporate training department, past treasurer and member of the Board of Directors of Computer Professionals for Social Responsibility (CPSR), and served on the Steering Committee for several annual Computers, Freedom and Privacy (CFP) conferences. She has been involved with many professional and businesswomen's conferences and web sites, and is creator of the Role Model Project for Girls.

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[43] Coffman, K. G., Odlyzko, A. M. Growth of the Internet. AT&T Labs - Research. July 6, 2001. 27 Mar 2002 <http://www.dtc.umn.edu/~odlyzko/doc/oft.internet.growth.pdf>.