



**2136 Ford Parkway, Suite 251  
St. Paul, MN 55116-1863**  
[www.greatrivercorp.com](http://www.greatrivercorp.com)

**Great River Policy Paper Series  
Future Competitive Landscape for Wired  
Cable and Wireless Broadband  
Networks**

**Contact:**  
**Laurie A. Derechin**  
*President & CEO*  
651-699-5150 Office  
651-503-9553 Mobile  
[lderechin@greatrivercorp.com](mailto:lderechin@greatrivercorp.com)

## **Future Competitive Landscape for Wired Cable and Wireless Broadband Networks**

### ***Introduction***

As the media and industry publications have reported over the last few years, new wireless technologies continue to be developed and deployed to deliver broadband data. Although several different platforms have been introduced or may be introduced in the next several years, the focus of this report is primarily on the most promising and fastest next generation wireless technology otherwise known as 4G LTE ([http://en.wikipedia.org/wiki/3GPP\\_Long\\_Term\\_Evolution](http://en.wikipedia.org/wiki/3GPP_Long_Term_Evolution)). In addition, several wired technologies are being deployed now and in the future to continue to increase the speed of wired broadband, but by most accounts 4G LTE is the most likely solution to be widely commercialized.

Based upon current information available, we will compare in this report the relative differences and in some cases competitive advantages and opportunities for collaboration that we foresee in the future for broadband cable networks and 4G LTE. As a result, we have framed the discussion here to compare this emerging new competitive wireless broadband entrant into the delivery of broadband services. We have included questions which we think are relevant to the topic and could ultimately affect the revenues and profitability of a cable broadband company like ours, and ultimately its valuation.

We also note that various wired technologies are being used in current cable markets, including *DSL*, *Video DSL* (VDSL), *Hybrid Fiber Coax* (HFC), which deploys a fiber optic backbone into the neighborhoods and strings coaxial cable into the homes, and *Fiber to the Home* (FTTH). For the purposes of this discussion we are assuming the operation of a cable HFC network that will encounter competition from a network operated by an incumbent telephone company using DSL and in some cases VDSL and FTTH. However, in general, Great River Communications Corp. (GRCC) will target markets with incumbent telephone companies which are not currently operating VDSL and/or FTTH networks. In the non urban markets we plan to acquire and operate as the incumbent cable provider, we will look to purchase or enhance the systems to be the most robust/"fattest pipe" in those markets.

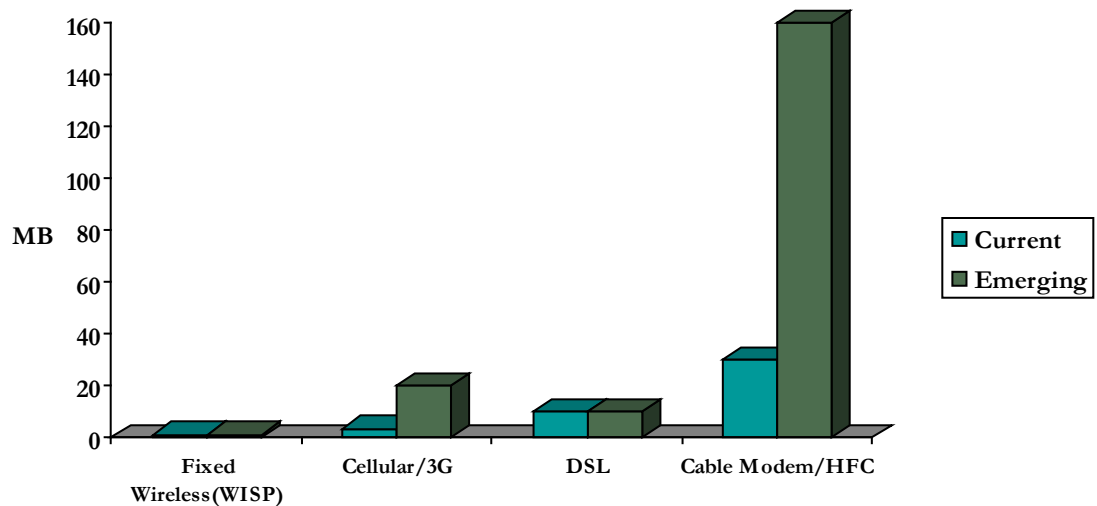
## ***Executive Summary***

In this policy paper we find that cable broadband networks are and will always be the superior network for the increasingly video intensive digital content that consumers are accessing with higher and higher frequency. We also conclude that they will not be supplanted by 4G LTE wireless broadband networks in the future. Rather they will continue to hold a significant portion of the US broadband market and ensure that investments in these network assets provide a good return to investors. Most wireless and wired broadband experts with whom we have inquired all state that at this juncture no one can be fully certain of the costs and timing involved for the full mass deployment of 4G LTE and its future role in the marketplace.

However, after careful consideration and research with experts of both wired and wireless technology, we believe that it is not a matter of wireless or wired broadband supplanting the other, but rather that the two technologies will be complimentary. As manufacturers of the consumer telecom devices such as cell phones, modems and computers improve the user experience inside and outside the home, using wired and wireless technology will be key to a ubiquitous user experience. We believe that existing cable assets and customers in the wired world will make it not only more valuable but attractive for future acquisition by others who understand this evolution whether they operate wired and wireless networks. The details below outline our assessment in this white paper.

### ***Current Situation: Cable Broadband Networks Superior Choice - Increasingly Video-Intensive Content***

Currently Great River is targeting the acquisition of fiber optic broadband HFC networks in non urban markets. These networks today have a significant speed advantage over today's 3G wireless data networks as the chart below illustrates.



Today cable broadband networks are vastly superior networks for the ever more bandwidth intensive content that consumers are downloading. Some major cable companies in the US are now capable of providing their customers up to 160 Mbps

downloads, whereas the fastest wireless download 3G can offer is about 20 Mbps. As users continue to download increasingly video rich content to their iPods and watch TV shows and movies downloaded directly from the Internet, the cable broadband access platform is the most superior broadband access application for information and entertainment in the home today.

Arun Bhikshesvaran, Ericsson's CTO, in the article, ***Will Wireless Broadband Supplant FTTH***, from the online telecommunications publication, ***Light Reading*** (May 14<sup>th</sup> 2008) answered the question as follows: "Mobility is becoming an increasingly important part of our lifestyle. But the convenience of fixed broadband in terms of raw data rates is always going to be an advantage over what you get with wireless." (See Appendix 1) He also noted that consumer behavior is a key factor in ensuring that both wired and wireless broadband access will remain important. "There is a different kind of premium associated with high speed access at home vs. on the road...at home you get rich communication and entertainment experiences, whereas mobile is completely different" (Wireless and wired broadband) are "going to be complementary. I don't think it will be one versus another. We are building our business based on increases in consumer demand as the 'internet generation' matures."

### ***Docsis 3.0 Is now Commercially Available Today and can Reach Download Speeds of 160 Mbps***

What's more, cable operators are rolling out a new technology today that will allow providers to offer consumers download speeds of 160 Mbps. With additions of software and consumer set top boxes, Comcast has upgraded 20% of its networks across the US with Docsis 3.0. (See Appendix 2 for a full description of Docsis 3.0.) This allows cable broadband networks the advantage in the next 4 years to offer the highest speeds which users can take advantage of in their home broadband connections.

In addition, by migrating away from analog to a fully digital platform, their networks will be freed up to offer greater speeds than are available now on the older analog platforms used to deliver video. As a result, fiber to the home is not necessary to deliver faster and higher quality speed and data throughput on the wired cable networks. In comparison, even if 4G LTE can offer faster wireless speeds (predictions are at best 100 Mbps), no commercial launch is even in sight until 2012. Equipment manufacturers Ericsson and others such as consultants implementing the technology note that major hurdles still exist including cost and availability of equipment, towers, and bandwidth spectrum. (See, "Dreaming of Wireless Broadband", **Gigaom.com**, a wireless broadband online journal, February 22, 2008 in Appendix 3) HFC networks with advanced software and equipment will continue to be the most robust option that is cost effective. In addition, as the cost of fiber continues to decline, in new land developments or other extensions of its network, it becomes increasingly more cost effective for cable broadband companies to lay fiber directly to the premise.

### ***Fiber to the Home Will Maintain the Absolute Physical Advantage over 4G LTE Wireless Broadband***

Ericsson's CTO Bhikshesvaran explained at the conference entitled **The Future of Broadband (May 2008)** that wireless broadband deployments have a physical limit that Fiber to the Home does not. To deliver 100 Mbps to 150 Mbps of speed, the

wireless carriers need 20 Mhz spectrum, of which they have a very limited amount, giving Fiber to the Home and other wired broadband networks continuing compelling advantages.” (See Appendix 1)

***Unsolved Technical Issues of Wireless Networks Could Limit How Much Consumers will Substitute Wireless Broadband for Wired Broadband***

The launch of 4G also has some technical hurdles to jump over before they can ever hope to supplant wired broadband networks. Two issues to which experts do not see a quick resolution are: 1.) slow wireless backhaul, which is a crucial link in the network and 2.) concentration ratio or effective throughput.

**1. Slow Wireless Backhaul.** Experts on 4G LTE wireless admit to having problems taking data from their towers and base stations and then connecting it back through their networks, otherwise known as the backhaul infrastructure. John Roesse, Nortel’s CTO noted that the wireless carriers are currently using about 3 T-1 type connections (a T-1 is equal to 1.544 Mbps of capacity) to connect their 3G base stations, which typically have only 10 Mbps of capacity. (See Appendix 4) In a 4G world, much greater capacity will be needed to carry the data, in most cases at least ten times the capacity they are currently using. Several options are being explored, including microwave technology. But most experts agree that wired networks need to be available to the towers to work effectively. Roesse notes that even at slower 3G speeds today, the backhaul infrastructure isn’t ready to do the hard work.

**2. Limited Throughput Concentration Ratios.** Wireless 4G and wired cable networks are shared networks. As a result, the speeds a network can deliver will vary depending upon the number of users and the amount of data they are sending and receiving. This so called, throughput, or Concentration Ratio, is another factor which will have an effect on the wireless broadband and wired broadband experience once 4G becomes available. All Internet Service Providers (ISPs) make deliberate decisions on how to “oversubscribe” their bandwidth on the assumption that not everyone will be online at the same time. ISPs have to determine how much and where the sharing happens on an on-going basis. This is what drives the “effective bandwidth” any single user has during peak times. As fiber networks progress from 160 Mbps today up to 1 Gbps and in the future and 4G LTE wireless networks move from Mbps to 1 Gbps, Nilandri Sekhar Nath, a Contributing Editor to TMCnet, noted the limitations in speed that wireless network can offer. (See Appendix 5) He argues that a user getting 20 Mps or 40 Mbps using 4G wireless network, will probably not have the same experience as a wired network. Only users who do not use lots of applications requiring video will be able to get along using wireless access. Wired networks will still retain the bandwidth advantage.

***Most Cable Broadband Infrastructure Costs Already Expended; Many Wireless Infrastructure Costs Are Not***

Because 4G LTE is still in the Research and Product Development phase no one knows for sure if the projected launch date of 2012 will remain on schedule. As noted previously significant costs will be incurred to design and manufacture entire new networks, equipment, software and spectrum to deliver the technology. To date, AT&T and Verizon have spent \$21 billion on spectrum auctions. In addition, much debate still exists around the timing of deployment of 4G LTE, in particular, due to the cost of the

upgrading of the backhaul infrastructure needed to support the higher speeds of 4G LTE. *Infonetics*, an industry publication, reports that at least \$4 billion will be spent on wireless backhaul equipment by 2010. In contrast, most of the cable networks that GRCC will be buying have already been upgraded and have the capability to deliver higher speeds. With the current launch of Docsis 3.0 standards, we will be focused only on costs of new software and customer premise equipment (CPE).

***Not “Either Or” Wired/Wireless: Integrated Wired & Wireless Networks Most Likely Outcome***

While some proponents of wireless technologies including WiMAX and LTE see a disruptive future world where wireless technology is ubiquitous enabled by 4G, another scenario is more likely, one that eventually creates a single, multi-access IP network, knitting together all kinds of access methods from someone’s cell phone into their home and back. (See Appendix 6). This concept of an integrated collaboration between wired and wireless broadband providers allows for more operating efficiency and revenue-enhancing opportunities for providers in the future. The following examples are just a few of the efficiencies and increased revenue scenarios being discussed by industry insiders today:

**1. More Interconnection/Integration Between Service Providers Increases User Experience and Operating Efficiencies:** Today when they are on their mobile devices, consumers leverage a 3G network. When they are in their home they take advantage of their wired broadband network and they use two different providers. In the future the integrated network will allow consumers to be on the 4G network when they are mobile and switch over to their wired connection when they are in the home or office. Motorola is working on mobile hand devices which will be able to connect with set top boxes and laptops in the home. So the consumer sees no service interruption between inside and outside coverage. As Michael Seymour, Vice President of Alcatel-Lucent’s North American Broadband Wireless Unit says: “As we move away from very disjointed networks to more a flat Internet Protocol (IP) architecture, we see incumbent operators and telcos moving to an IPTV solution and MSOs integrating the quad play with WIMAX. Integrated services and more seamless inside/outside coverage are really going to drive the new models.” (See Article “4G Is Just One Piece of the Mobile Broadband IP Puzzle”, Xchange Magazine, June 10<sup>th</sup>, 2008 in Appendix 6) In that same article John Hindle, Director, Mobile Service Provider Marketing, Cisco Systems Inc. says: “We are trying to connect people to the apps and services they want access to. They’ll get there not just with WiMAX or LTE – it could be fixed Ethernet, DSL, Cable etc. As a human being, you’re not making a conscious choice as to which access network to use. You’re focused on cool devices and applications, and you just want them to work.”

We have had discussions with an experienced new regional wireless broadband start up team that understands this roadmap to collaboration. They have clearly stated to us the benefit of partnering with a wired broadband provider. In addition to some revenue enhancement opportunities of collaborating with a firm like GRCC, there is also a “load management” benefit. If consumers can offload to a wired broadband network when they are in their homes or offices, it puts much less pressure on the throughput speeds of the wireless networks.

## **2. Interconnection Also Makes Increased Revenue Opportunities Easier:**

John Hindle, Director, Cisco Systems also stated: "If we can accelerate applications across networks and do revenue sharing between operators, that's a good way to accelerate revenue growth. Such a collaborative model is crucial to the industry, between both peers and even competitors."

Another example of this collaboration emerging is the new merger between Clearwire and Sprint's Xohm 4G WiMAX unit to create Clearwire Wireless. Both Comcast and Time Warner are busy launching Docis 3.0 across their wired broadband networks in the US. At the same time they have invested in Clearwire Wireless. They are already taking action on integrating their networks so that when their wired customer leaves their network, they are not in danger of losing them and ultimately having them substitute wireless broadband for their wired services. This deal gives these cable giants access to a nationwide spectrum footprint. Under the wholesale deal the cable operators can resell service under their own brand name and effectively offer the quad play to keep customers bundled up with their services. Bundling discounts will continue to help cable broadband providers keep their customers based on single provider and volume discount opportunities.

Hindle, Director, Cisco Systems summed up by saying: "Our customers see it as a broader picture than 2G, 3G, 4G and wired. Mobility is less of a technology choice and becomes just a fundamental characteristic of the network....."the service provider that can say 'Don't worry about it, we'll get it to you and make it nice for you, and you don't have to worry about anything'. That is the one who wins." GRCC will be ready for this collaborative opportunity as it presents itself in its markets. Depending upon the evolution of the deployment of the technology, and the players that enter its markets, because of GRCC's customers and networks, GRCC will continue to have a competitive advantage.

### **Future Opportunity for Great River Communications**

Great River Communications will stay ahead of the technology curve in its markets to offer the most robust wired connection in its niche market. Today that means offering the customer the best home broadband connection and experience. As new wireless technologies reach our market, we will still have the best connection for our customers. As the customer base begins to look to integrate solutions over wireless and wired networks, Great River will be ready with products and solutions for its customers. We would also expect that other providers of either wireless or wired services may look to collaborate with us. In recent discussions with potential players in the delivery of wireless products, our market positioning has been confirmed. Overall we see having a competitive advantage in our niche markets for years to come

## Appendices

### Appendix 1

#### Will Wireless Broadband Supplant FTTH?

Article from [lightreading.com](http://lightreading.com)

MAY 14, 2008

Even if [Sprint Nextel Corp.](#) (NYSE: [S](#) - [message board](#)) and [Clearwire LLC](#) (Nasdaq: [CLWR](#) - [message board](#)) are successful in building their nationwide WiMax network, they won't pose an immediate threat to wireline broadband service growth, according to some experts at *Light Reading's The Future of Broadband* conference yesterday. (See [Sprint, Clearwire Create \\$14.5B WiMax Giant](#) and [Mobile WiMax.](#))

It might be tempting to think about a mobile network displacing wireline broadband, but the idea is "a combination of speculation and reality," said Arun Bhikshesvaran, CTO of [Ericsson AB](#) (Nasdaq: [ERIC](#) - [message board](#)) North America, during an interview with *Light Reading*. "Mobility is becoming an increasingly important part of our lifestyle. But the convenience of fixed broadband in terms of raw data rates is always going to be an advantage over what you can get with wireless."

Consumer behavior, too, will ensure that both types of broadband access remain important.

"There is a different kind of premium associated with high speed access at home versus on the road," Bhikshesvaran said. "At home you get rich communication and entertainment experiences, whereas mobile is completely different. It is going to be complementary; I don't think it'll be one versus the other."

During one panel discussion about making the transition to fiber-to-the-home (FTTH) in the U.S., an audience member asked whether wireless broadband deployments would present a challenge to FTTH.

"Looking around the world, it's quite feasible that a multi-megabit service that is reasonably priced could provide an interesting alternative to wireline," said [Heavy Reading](#) chief analyst Graham Finnie. "My view, though, is that it could challenge wireline broadband in general, but not FTTH specifically."

Bhikshesvaran elaborated further on the issue saying that wireless broadband is too limited and can't run the services necessary to challenge FTTH. "There is a physical limit. You need the spectrum. In order to deliver 100 Mbit/s to 150 Mbit/s, you need 20 MHz, and there are hardly any carriers with a significant amount of that. So FTTH offers compelling advantages."

So does that mean [AT&T Inc.](#) (NYSE: [T](#) - [message board](#)) and its slower fiber-to-the-node network could be vulnerable? "I think we're at the start of a two to three year test period for AT&T," said Joe Savage, president of the [FTTH Council](#) to *Light Reading*. "They'll have over a million subscribers by years end, so we'll find out if they become permanent subscribers or if they become churn."

Even if wireless broadband can match FTTH's bandwidth someday, wireline fiber could still serve a useful purpose in wireless backhaul. "A number of the folks deploying FTTH are also anticipating fiber-to-the-cell site," said Savage.

Carriers aren't alone in anticipating deploying fiber to cell towers. [Calix Networks Inc.](#), which just released a line of MDU ONTs, says that one of the implementations it expects from the new product line is at cell towers for delivering GPON-based wireless backhaul. (See [Calix Joins MDU ONT Party](#).)

— Raymond McConville, Reporter, [Light Reading](#)

## Appendix 2

<http://en.wikipedia.org/wiki/DOCSIS>

**Data Over Cable Service Interface Specification (DOCSIS)** is an international standard developed by [CableLabs](#) and contributing companies that include: [ARRIS](#), [BigBand Networks](#), [Broadcom](#), [Cisco](#), [Conexant](#), [Correlant](#), [Harmonic](#), [Intel](#), [Motorola](#), [Netgear](#), [Terayon](#), and [Texas Instruments](#). DOCSIS defines the communications and operation support interface requirements for a data over cable system. It permits the addition of high-speed data transfer to an existing [Cable TV](#) (CATV) system. It is employed by many cable television operators to provide Internet access (see [cable internet](#)) over their existing [hybrid fiber coaxial](#) (HFC) infrastructure. The first DOCSIS specification was version [1.0](#), issued in March 1997, with revision [1.1](#) (adding [Quality of Service](#) (QoS) capabilities) following in April 1999. Because of increased demand for symmetric services such as IP telephony, DOCSIS was revised to enhance upstream transmission speeds; [DOCSIS 2.0](#) was released in December 2001. **Most recently, the specification was revised to significantly increase transmissions speeds (this time both upstream and downstream) and introduce support for [Internet Protocol version 6](#) (IPv6). This version, [DOCSIS 3.0](#), was released in August 2006.** Cross-version compatibility has been maintained across all versions of DOCSIS, with the devices falling back to the highest supported version in common between both endpoints ([cable modem](#) and [cable modem termination system](#)).

## Appendix 3

### LTE: Dreaming of Wireless Broadband

Article from Gigaom.com

[Stacey Higginbotham](#), Friday, February 22, 2008 at 12:00 AM PT

After a quick demonstration of Ericsson's LTE base station, which boasted a throughput of 150 Mbps on download and 30 Mbps for uploads, I experienced one of those moments of technology utopia. I could see a world without wires, a life with fewer cables running into the house and no phone jacks on the wall.

Although the LTE standard is capable of the above speeds, in the real world it will likely resemble 20 Mbps down and 5 Mbps up, said Keith Shank, the man who showed off Ericsson's LTE base station to

me. But that's still crazy fast, especially since LTE would be deployed on a much wider basis than speedy services such as FiOS (which tops out at 50 Mbps up and 20 Mbps down in some services areas).

With speeds like that, two big shifts could occur in telecommunications. The first shift is already happening as the major players launch [unlimited voice plans](#). Suddenly it becomes moot to have a [wireline](#) telephone, and the geographic boundaries that framed a consumer's telco provider choices are gone. If I can use my cell phone economically for voice, I can [cut the cord](#) to my landline or the digital phone I have from my cable provider.

You can rightly argue that unless you have great coverage indoors, then cutting the twisted pair may not make sense, but considering the simplicity of [femtocells](#), [T-Mobile's UMA](#) efforts and even voice over Wi-Fi, the landline might finally be ready to give up the ghost. I confess that I still have two, but am cutting off one outright and once I can port my old number, switching to a service like [Toktumi](#) for the second phone.

So I've eliminated one line going into my home. But what about broadband? With visions of [personalized television](#) dancing in my head, along with music services, gaming and voice, I find it hard to let go of the idea of a fat pipe coming into my home. Streaming HD movies while someone else talks on the phone or transfers files requires a lot of bandwidth. It looks like LTE could do that.

There are a few discordant notes in this wireless utopia, starting with the carriers. As with their control of mobile networks, ranging from [Verizon disabling Bluetooth](#) to today's efforts to channel people through their own [portals](#), it's hard to believe they would let themselves become a munificent provider of the cloud. Nope, they'd want to be the gateway to that cloud.

That gateway might be a server that a consumer accesses to get to subscription content or perhaps even the consumer's own content stored in the cloud, but it would be controlled by the carrier. Another burst of reality in this dream is the time frame. While folks at [Ericsson believe LTE](#) is about four years away, it will take time to reach the masses, from both an availability perspective and a cost perspective.

LTE isn't the only option out there for wireless broadband in the home or office. WiMax is a slower contender, with actual deployments existing and planned. There's also the existing 3G network, which some people use to provide all of their broadband needs today. But as I sit here with my cable connection, lusting after FiOS, I have to admit that LTE looked pretty sweet.

## **Appendix 4**

### **4G Wireless & the Ensuing Bandwidth Boom**

**Article from Gigaom.com**

**By [Om Malik](#), Friday, April 11, 2008 at 7:42 AM PT**

[My previous post about](#) LTE taking the lead in the 4G wireless sweepstakes prompted some interesting [comments, including](#) those of [sharp readers](#) who pointed out the pokey nature of the wireless backhaul networks. As luck would have it, I had a breakfast meeting this week with John Ruese, chief technology officer of Nortel and [one of the most astute people](#) I know in the broadband business.

Whether because of a [perceived fear of WiMAX](#) or a sudden spurt in data revenues, the LTE announcements made earlier this year didn't come as a surprise. In the U.S., two major carriers, [Verizon and AT&T](#), are looking to roll out their LTE networks in the early part of the next decade.

Roese had correctly predicted that LTE would arrive much faster than people thought, and he seems to have a much better handle on the 4G timeline than others in the wireless industry. It seemed appropriate to ask him about the wireless backhaul business and the bandwidth demand that LTE will create.

Instead of giving me a pithy quote, Roese laid out the kind of compelling argument only an engineer can make. He pointed out that the wireless carriers are currently using around 3 T-1 or DSL-type connections to connect their 3G base stations. (In some cases they use microwave or passive optical network connections.) A 3G network [base station](#) typically has 10 Mbps of capacity.

In a 4G world, where three antennas will form an arc to provide coverage, each antenna will need a 100 Mbps, or about 300 Mbps total, Roese explained to me. The carriers would prefer more headroom, for if there are four carriers per base station, the bandwidth demand per base station could run closer to about 2 gigabits per second.

Clearly today's pipes aren't going to be enough. Optical/metro Ethernet might be one of the better options for the 4G bandwidth needs, according to Roese. There are point-to-point wireless backhaul solutions that could come in handy as well, but he said fiber is the real answer. Even at slower 3G speeds, today's backhaul infrastructure isn't ready to do the hard work.

Level 3 is one bandwidth provider that could benefit from the LTE-driven demand in the U.S.; we're told the company has fiber as close as 1,000 feet to most base stations in the country.

From an equipment standpoint, the wireless broadband buildout spells opportunity. Infonetics reports that spending on backhaul equipment will grow to \$8.2 billion in 2010 from \$4.5 billion in 2007. Juniper Networks wants a piece of that; it recently started offering the [BX7000 family of products](#). (More on this @ [Search Telecom](#))

## Appendix 5

### How Will 4G Bandwidth Stack Up Against Wired Broadband?

Article from TMCnet.com

By [Niladri Sekhar Nath](#)

TMCnet Contributing Editor

One number no consumer ever sees advertised is "concentration" ratio, though every Internet service provider makes deliberate decisions about how much to "oversubscribe" its bandwidth. A typical cable modem or digital subscriber line service aimed at consumer users might routinely use a 200:1 contention ratio, where 10 Mbps of Internet bandwidth is shared by 200 subscribers, on the assumption that they won't all be online at the same time.

T1 services more generally aimed at business customers typically use a less-severe concentration ratio of perhaps 8:1.

The reason that is significant is that the contention ratio determines effective throughput at peak hours of usage. All core bandwidth is shared in the access network. The issue is how much sharing, and where the sharing occurs. That is one good reason why the effective bandwidth any single user might experience is only partially determined by the stated peak bandwidth of an access circuit.

Contention is an issue for both wireless and wired access networks, and though radio capacity obviously is shared by everybody trying to use a single cell site, so is capacity for all cable modem users in a single neighborhood served by an optical node, as well as bandwidth shared by all DSL customers on the "trunk" side of a digital subscriber line access multiplexer.

Fiber-to-home services such as Verizon's FiOS ([News - Alert](#)) also use concentration, so the issue in some cases is how to compare the "real world" performance a wired customer might expect, compared to similar performance using a 3G or 4G wireless connection, assuming similar customer penetration (obviously a lightly-loaded network is going to perform better than a heavily-loaded network, and 4G networks will have light loading at first).

Still, as Long Term Evolution networks progress from scores of megabits per second up to about 1 Gbps, and as fiber-to-curb networks offer 20 Mbps to 40 Mbps now, scaling to 60 Mbps or so in the future, while FiOS style networks might offer 50 Mbps, with capacity also growing to 1 Gbps in the future, the issue of effective throughput is one measure of how much substitution potential might exist.

In other words, if a user can get 20 Mbps or 40 Mbps using 4G, is that a functional substitute for the same bandwidth available on a wired network? Possibly. Users who do not use lots of applications requiring video might well be able to get along quite nicely using wireless access.

With moderate to heavy loading of a 4G tower, though, wired networks are certain to retain a bandwidth advantage. As a practical matter, a wired network almost has to offer more bandwidth to remain relevant. So expect effective, real-world bandwidth obtainable from wired networks to remain at a multiple of the wireless bandwidth, as wireless bandwidth continues to grow. Whether the ratio is 2:1 or 10:1 will be the issue.

*Gary Kim ([News - Alert](#)) is a TMCnet contributor.*

## **Appendix 6**

### **4G Is Just One Piece of the Mobile Broadband IP Puzzle**

**Article from [xchangemag.com](http://xchangemag.com)**

**Tara Seals**

06/10/2008

While proponents of WiMAX and LTE see the future as a disruptive world of ubiquitous, broadband mobile connectivity enabled by 4G, there's a bigger picture to consider: the creation of a single, multi-access IP network, which will knit together all kinds of access methods, from 4G to DSL.

In some ways it's the IMS dream (again) of an access-agnostic core wherein the applications are abstracted from the network layer, using SIP to seamlessly traverse multiple types of transport and access networks.

"We're trying to connect people to the apps and services that they want access to," said John Hindle, director of mobile service provider marketing at [Cisco Systems Inc.](#), which bought WiMAX vendor Navini Networks last October. "They'll get there not just with WiMAX or LTE — it could be fixed Ethernet, DSL, cable, etc. As a human being, you're not making a conscious choice as to which access network to use. You're focused on cool devices and applications, and you just want them to work."

#### 4G Mobile Broadband

That kind of fixed-mobile convergence is not just a nice-to-have; there are pragmatic rationales at work as well. The industry as a whole has accepted the fact that networks of any sort, fixed or mobile, are moving to IP, and endpoints are increasingly IP-capable. Eventually, that will give operators the opportunity to collapse multiple networks onto a common infrastructure (IMS or otherwise), which is a positive from an opex standpoint because that translates to one management view and set of support systems. (See xchange's June cover story, "[Leading Telecom Technologists Join Forces to Get a Handle on Convergence](#)," for more on industry efforts to collapse networks and deliver converged services.)

It also makes interconnection with other service provider networks that much easier, which becomes important as a revenue dimension. "People are writing very creative applications," explained Hindle. "If we can accelerate applications across networks and do revenue sharing between operators, that's a good way to accelerate revenue growth. Such a collaborative model is crucial to the industry, between both peers and even competitors."

The new [Clearwire's](#) relationship with the cablecos offers a view toward the beginnings of this vision. The cable industry's DOCSIS standard provided WiMAX with its initial medium access control (MAC), which allows nodes to talk to each other; and WiMAX and DOCSIS look the same at Layer 2. That means that running applications seamlessly across WiMAX and cable landline networks is not only possible, but almost a no-brainer. And that means integrated services can be rolled out more easily for the quad play as well as business applications.

"As we move away from very disjointed networks to more of a flat IP architecture, we see incumbent operators and telcos moving to an IPTV solution and MSOs integrating the quad play with WiMAX," said Michael Seymour, vice president of [Alcatel-Lucent's](#) North American broadband wireless unit. "Integrated services and more seamless inside/outside coverage is really going to drive new models."

Similarly, collaboration between LTE and WiMAX, and even Wi-Fi, is not too far-fetched. [Wavesat](#), a semiconductor company, in May introduced a family of multimodal chipsets that combine WiMAX, Wi-Fi and future migration to LTE once that standard is finally gelled. [Motorola Inc.](#) is working on the same thing.

The network side allows collaboration too. "If you look out a few years, you'll see that we will have two different competing technologies," said Fred Wright, senior vice president for cellular networks and WiMAX at Motorola. "But the performance on the uplink and the downlink are similar, both use OFDM,

and there's an immense amount of commonality between the two. We estimate 65, 70, 80 percent reuse between the two, including the smart antennae, hardware platform and some of the software."

The upshot of all of this? Happier end users and profitable operators. "Our [service provider] customers see it as a broader picture than 2G, 3G, 4G and wired," said Cisco's Hindle. "Mobility is less of a technology choice and becomes just a fundamental characteristic of the network. It's what we do, we move. It's not about, 'Will I have WiMAX?' It's about, 'How do I build a business here?' At the end of the day, the network exists to make money. How do we do that?"

The answer, he said, lies in speeding the innovation of integrated services. "People just want a cool mobile/home phone that lets them get football clips, no matter where they are," he noted. "The service provider that can say 'Don't worry about it, we'll get it to you and make it nice for you, and you don't have to worry about anything' is the one who wins."