

TELE-WHAT? BROADBAND APPLICATIONS EXPLAINED

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The following article was developed to answer repeated requests for assistance in educating consumers about fiber-to-the-home technology. What applications are made possible by truly high-speed broadband connectivity? How do they/will they work and why are they positive? What am I missing without broadband?

With this in mind, we've created a basic, comprehensive overview of the major broadband applications, in consumer-friendly language and format. Feel free to share it with anyone who may benefit — print-friendly and e-mail options are available on the first and last pages of this article, or feel free to link directly to it. And, of course, e-mail GuideLines Online to let us know if articles of this nature are useful to you. More technical commentary on these and other broadband applications can be found in the Telecommunications International Association's definitive October 2003 report "The Economic and Social Benefits of Broadband Deployment."

Anything with "tele-" in the title is just for Internet-savvy computer science geeks, right? Not anymore. If "tele-" terms make you cringe or tune out, read on. "Tele-" applications, such as telecommuting and telemedicine, are leading the way in a broadband revolution, and they are much easier to understand than you may think.

So first things first: Acronyms can be intimidating, and the world of telecommunications and broadband can be full of them. Terms like voice over Internet protocol (VoIP), high-definition television (HDTV) and video-on-demand (VOD) are getting lots of buzz but not a lot of explanation. Even telemedicine, videoconferencing and distance learning sound a little too technical for comfort. Here's the truth behind the terminology: these technologies are actually life-enhancing opportunities, for people from every walk of life, all over the world.

For the purposes of this article, we've grouped the major broadband technologies into three sections:

Fiber versus copper - Why FTTH?

- A single copper pair is capable of carrying 24 phone calls (1.5 Mb/s)
- A single fiber pair is capable of carrying over **10 million** simultaneous phone calls (64 channels at 10 Gb/s)
- A fiber-optic cable with the same information-carrying capacity (bandwidth) as a comparable copper cable is less than 2% of both the size and weight



CORNING

FIGURE 1: PURE PHYSICS: FIBER HAS MORE BANDWIDTH CAPACITY THAN ANY OTHER COMMUNICATIONS TECHNOLOGY.

Consumer social applications, including telemedicine, distance learning and telework; consumer entertainment applications such as HDTV, VOD and online gaming; and broader social applications like e-government, agriculture and assistive technologies for people with disabilities.

But let's start with the basics: What makes all these technologies work? Most rely on streaming audio and video, where text, sounds or images are transferred from one place to another through an always-on connection. With truly high-speed broadband connectivity, voice and video transmission come through clearly, so users at each end of the connection can see and hear each other without confusing delays or frustrating interference. (Those of you with cell phones, dial-up Internet or satellite television service know these negatives very well.)

Here's the catch — but don't worry, it's an easy one to fix: these technologies require large amounts of bandwidth (a "fatter pipe" for transmitting data) to work effectively. Fortunately (See? We told you it was an easy fix), fiber-to-the-home (FTTH) technology provides users with true high-speed broadband connectivity directly to the home, with enough bandwidth to carry multiple voice, video and data channels, simultaneously and unconstrained, bringing these exciting opportunities to all areas of life.

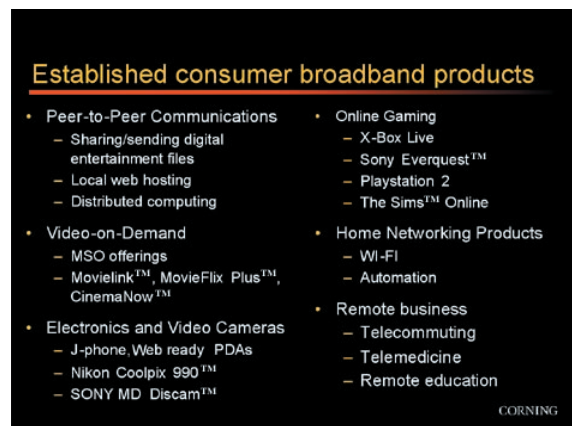


FIGURE 2: THE APPLICATIONS ARE ALREADY HERE, AND WITH THEM COME THE NEED FOR FIBER TO THE HOME.

Consumer Social Applications

Healthcare, education and work experience are important, no matter where you live. With advances in broadband technology, patients in remote areas can receive specialized medical care, students who can't attend class in person can see their professors from home, and businesses can hold face-to-face meetings with international colleagues. Telemedicine, distance learning and telework make all of this possible.

TELEMEDICINE

How you'll experience it: Interactive patient care, including diagnosis and treatment. Affordable, easy-to-obtain medical supplies and prescriptions at a click. Anytime, anywhere.

The technology behind it: Voice, video and data streaming — two-way. Minimum of 12-20 Mb/s for practical, care-quality video streaming; medical imaging files, such as MRIs, are often 5 gigabits each.

Get the picture: Elderly patients in a more remote area of Canada are screened for diabetic

retinopathy using a retinal camera, transmitting the images to a specialist over 100 miles away for immediate diagnosis and treatment recommendations.

Telemedicine offers its best benefits through two-way transmission, letting doctors diagnose and treat patients anywhere, at any time. Most telemedicine applications consist of two different types of technology: “store-and-forward,” which lets doctors and patients transfer digital images, and interactive televideo (IATV), or two-way television, where medical specialists and patients can see and talk to each other. X-rays and other patient information can be sent from a local doctor to a medical specialist instantly, reducing wait time and painful or expensive travel to the specialist.

The result is not only better, faster care but also earlier diagnosis and medical treatment. Telemedicine also enables the families of people in assisted-living homes to monitor their loved ones regardless of location, using cameras, sensors and other technologies to view patient activities, life signs and staff response times, and giving families more peace of mind. Increasingly, physicians are transferring prescriptions directly to the pharmacist online, allowing them to be checked instantly for side-effects or dangerous drug interactions.

According to the Association of Telehealth Service Providers, doctors are currently using telemedicine in rural areas, school districts, home-health settings, nursing homes, cruise ships and even on NASA space missions.

DISTANCE LEARNING

How you’ll experience it: Real-time access to libraries, teachers, other students and classes, regardless of location. The ultimate in educational choice.

The technology behind it: While the Internet has become de rigueur for most students today, in and out of a bricks-and-mortar classroom, video streaming (with its 12-20 Mb/s minimum requirement for useful quality) is becoming increasingly important.

Get the picture: Primary and secondary students in small towns access libraries in the world’s largest metropolitan centers, downloading data and audio/video resources; universities link students across continents for video-streamed collaboration and class work.

Distance learning enables students to complete all or part of their education at a location geographically apart (e.g., home) from the location of the institution hosting the program (e.g., campus). Increasingly, in addition to the de facto use of e-mail and message boards, distance learning uses video and audio media streaming to enable communication between classmates — who may be as geographically distant from each other as they are from the campus — and with their professor.

Video and audio streaming often challenges professors to provide better-organized and more

clearly presented instruction. Students can attend class with the most-qualified faculty, connect with experts in any part of the world, and access diverse media simultaneously, such as blackboards, handouts and videos, no matter where they live. And for those with disabilities, distance learning can sometimes offer more advantages than in-person classes would. Video transmission is better for distinguishing motion and lip movements, and audio transmission provides better voice quality than a student might hear from the back of a classroom.

Distance learning also enables students in poorer or more isolated rural schools to access educational resources that are often more readily available in affluent or urbanized areas. It allows college students to study at their preferred universities, when the brick-and-mortar campus is a continent away. And it offers a cost-effective method for businesses to provide training and continuing education to their employees regardless of location.

TELEWORKING

How you'll experience it: Highly qualified employees working more hours — happily — from remote locations, while conducting business with colleagues and clients. And saving their employers money while they're at it.

The technology behind it: Two-way voice, video and data streaming makes virtual offices a reality, and the business-grade connectivity that employees are used to makes it practical.

Get the picture: One international company paying for employees' broadband connection is seeing, on average, an additional hour of work per day from employees. Another has reduced office space by 35 percent using telework, saving millions of dollars while simultaneously increasing employee productivity.

Odds are, you are either teleworking yourself, or your coworkers are, whether you realize it or not. Sometimes it's called "telecommuting": working from home or working from somewhere other than the office location, some or all of the time. More than 80 percent of all full-time U.S. employees either telework or have colleagues who do, according to a 2002 study by the American Business Collaboration (ABC) for Quality Dependent Care.

There are generally three different kinds of telework: 1) full-time work from home; 2) work from multiple locations, such as home, office, airports and hotel rooms; or 3) work from a customer satellite office. "Virtual offices" even allow employees to time-share office locations, spending only a portion of their time in the brick-and-mortar building and allowing companies to rent or build less office space for the same number of employees.

Similar to distance learning, streaming audio and video simplifies group meetings and enables people with disabilities to work with greater flexibility. Like the other broadband applications, telework allows for the presentation of information in multiple formats, including video with captions.

Telework is beneficial to both employees and employers: Employees spend less time commuting and

more time working, a particular advantage in both high-traffic cities and more remotely located towns. Recruitment and retention of the best-qualified employees becomes easier for companies that offer at least part-time telecommuting capabilities, and employees who feel they have achieved a greater “work-life balance” by spending less time in the office and on the road. Although they are likely to work more hours than those who work at the office, teleworkers are less likely to feel physically and emotionally drained at the end of the day, according to ABC’s study.

Consumer Entertainment Applications

Broadband technology has opened a whole new world of entertainment — where users can interact with each other and with applications to experience whole new levels of fun. Advancements include high-definition television, video-on-demand and online gaming. If your idea of excitement is a deck of cards, you don’t know just how much fun people in the world of broadband technology are having without you.

HIGH-DEFINITION TELEVISION (HDTV)

How you’ll experience it: Cinema-quality video and sound in your own home; no waiting in line for tickets, no outrageous prices for popcorn. Instead of just watching PGA golf, feel like you’re on the course.

The technology behind it: With dramatically improved sound and picture quality enhancing your viewing experience, required data rates are inevitably higher. Most experts agree on a minimum 12-20 Mb/s connection per channel; now imagine multiple HDTVs watching different high-def channels at the same time.

Get the picture: The major U.S. television networks are already offering many TV shows in high-definition, and adding more to the lineup frequently, and most non-fiber networks have found the bandwidth capacity to offer a few high-definition channels.

HDTV is a television display technology, producing sharp, life-like images and crisp surround sound. Viewers feel like they’re watching their favorite movies — and now even some television programs — in a theater.

To get technical, the picture on a standard television (the one probably in your living room) has 200,000 pixels — the tiny squares that make up the picture. HDTV has up to 2 million. In addition, while traditional televisions use a 4 by 3 aspect ratio, most movies are filmed in a wider 16 by 9 aspect ratio — simulating the actual human field of vision and creating a surprisingly more intense viewing experience. Combine that with Dolby Digital surround sound capability, which more and more HDTV shows are using, and HDTV seems the obvious choice for movie and television lovers worldwide.

The word on HDTV is spreading quickly. Manufacturer-to-dealer HDTV sales for the first quarter

of 2004 totaled 1.39 million, a 104 percent climb over the same period in 2003. By 2007, nearly one-third of American households will have HDTV in their living rooms, according to the Consumer Electronics Association.

VIDEO-ON-DEMAND

How you'll experience it: The movie or television you want to watch, when you want to watch it, even if Netflix doesn't have it in stock or you forgot to set your TiVo.

The technology behind it: Content (at about 2 Mb/s for the average movie) is generally available on a server centrally serving multiple subscribers, who share their upstream and downstream bandwidth. Most VOD services today, operating on bandwidth-constrained non-fiber networks, offer a limited number of shows at one time. HDTV further strains the capability of non-fiber networks, as it generally requires 12-20 Mb/s.

Get the picture: Nearly 5 million of you in the U.S. are VOD subscribers, and that number will jump to 14 million by 2007, according to InStat/MDR.

Have you ever wished you could pause your favorite television show to get a snack — or maybe even rewind it to hear that laugh track one more time? Perhaps you couldn't care less about that latest teen comedy at your local theater but you still regret missing that award-winning indie movie from a few months ago. With video-on-demand, it's all possible. VOD is a service that allows users to select content, such as television shows, movies and games, from a central server for viewing on a television or computer screen. Using broadband technology, viewers can begin watching the programs at any time and even control playback much like a VCR, with the ability to rewind, pause or fast-forward whenever they like.

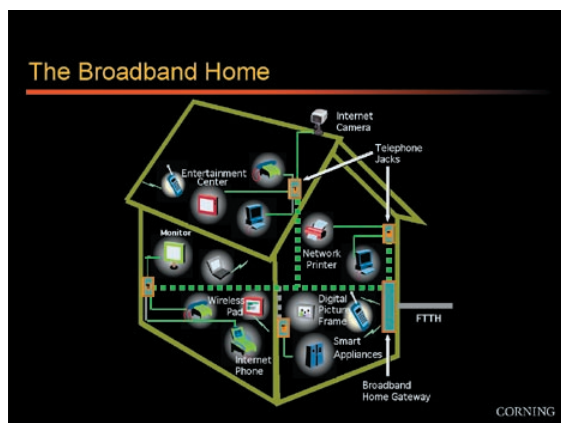


FIGURE 3: THIS IS NO "FUTURE HOME." IT'S FULLY CAPABLE TODAY, PROVIDED YOU HAVE THE BANDWIDTH TO HANDLE IT.

The VOD market is expected to grow 58 percent annually, from \$349 million in 2003 to \$2.2 billion in 2007, according to a study by Jupiter Research, a division of Jupitermedia Corporation. The most obvious use of VOD is for entertainment, but it can also come in handy in classroom settings or job training sessions. VOD can also be used in videoconferencing or to enhance presentations with workable video clips.

ONLINE GAMING

How you'll experience it: Gather in “cyberspace” to challenge your friends — or strangers — to a virtual football grudge match or a duel in the wizard-rich forests of some mythical planet. Graphic-rich, highly interactive games available to download — to your computer or game console — and to play at the click of a button.

The technology behind it: While most online games have been designed to load as many static graphic elements as possible to the client side (that's your computer), there's still quite a lot of two-way data flying around. Most current online games recommend nothing less than a broadband connection.

Get the picture: Forty-three percent of gamers say they're playing online at least one hour per week; that's up from 32 percent only two years ago. Many online games boast tens of thousands of registered players.

If you like to play computer or video games, you're not alone. According to the Entertainment Software Association, half of all Americans age six and older play too. But if your trusty 1984 joystick embodies the extent of your gaming experience, you might be surprised at the possibilities within the exciting world of online gaming.

Online gaming may not be what you think — especially if thoughts of solitaire and the occasional game of hearts spring to mind. Role-playing games (RPGs) let players create characters within an imaginary world, and those characters interact with other players' characters in an online setting. This has expanded to include massively multi-player online role-playing games, or MMORPGs, allowing tens of thousands of players to play simultaneously and interact in real-time. Online RPGs take place within expansive three-dimensional environments, with high-quality graphic elements that users can alter during game play. If you've ever wished you could have super powers, build your own city, or fight dragons on a daily basis, then the world of online gaming is definitely your domain.

For more on online gaming, read [“Not-So-Foolish Games”](#) from the Winter 2003 issue of GuideLines Online.

Broader Social Applications

A firefighter waits in the basement of a burning house for direction from his supervisor. A farmer needs scarce resources quickly in the midst of a severe drought. A patient who is deaf tries to read the doctor's lips to understand the diagnosis. Although government and agriculture might seem like unlikely places for broadband applications, that's where broadband benefits matter the most. Along with making life just a little more convenient, telecommunications technology goes a long way to help people in need.

GOVERNMENT

How you'll experience it: No more waiting in line to renew your vehicle registration. Safer travel through real-time monitoring of airplane cockpits and enhanced remote surveillance of airports, bus and train stations. Delivery of critical medical services remotely during natural disasters.

The technology behind it: Video streaming for remote real-time surveillance; sharing of data in real-time among multiple locations; VoIP for easily reroutable, sustainable voice services in times of crisis.

Get the picture: The Telecommunications Industry Association (TIA) and the European Telecommunications Standards Institute (ETSI) have teamed up to finalize international standards for public safety broadband technologies.

After the September 11, 2001, attacks in the United States, the always-important matter of public safety has taken on new significance. Incorporating broadband technology into security and communications systems is a large step toward protecting the nation's cities.

There are many national security uses for broadband, including position location technology for rescue efforts, real-time cockpit monitoring, electronic surveillance and remote backup in case of biochemical threats, attacks or quarantines. Broadband enables communication systems and work to continue from remote locations in the event of a crisis, ensuring rapid response in even the worst of scenarios. Firefighters can use three-dimensional imaging and positioning to determine the exact location of other firefighters or trapped victims and contact supervisors for specific directions in the midst of the flames.

The government can also use broadband to supply forms and information online, preventing long lines and frustrating delays at government offices. This is especially helpful for anyone who works long hours, or those with mobility problems who can't get to government offices before 5 p.m., if at all. This also prevents waste, fraud and abuse of government information and saves mailing, printing and handling costs.

AGRICULTURE

How you'll experience it: Farms that produce more, and more cost-effectively; healthy, thriving farms that are more environmentally friendly.

The technology behind it: Voice, video and data all have a place here, with the most significant cost benefits to be seen in two-way video streaming for livestock auctions, remote veterinary medicine and detailed weather analysis.

Get the picture: Over 60 percent of the beef cattle sold in Quebec is auctioned electronically. A U.S. company offers detailed satellite imagery online for farmers, plant pathologists and conservationists.

Farmers, located in rural areas often with huge geographic separation from their markets and often with infrequent communication with other farmers, can benefit greatly from the opportunities that

broadband technology creates. Broadband offers risk management and pricing information for farmers, clearing the way for improved farm productivity. Broadband technology within agriculture enables the electronic exchange of supplies, products and livestock. According to the TIA, virtual livestock auctions bring farmers in contact with people they never would have seen in person, often coming together in virtual enterprise zones, or electronic markets for agriculture. Farmers also have access to tele-veterinary services, saving the expense of bringing the doctor to the farm — or even more costly, bringing the animal to the doctor.

Broadband can best help farmers in times of crisis. During a drought, broadband access means quick, efficient distribution of scarce resources across a region. Production and distribution tracking is another important capability, helping farmers locate recalled food before it gets distributed and detect food tampering from miles away. By enabling telework, broadband also offers farmers the ability to supplement their incomes from the farm, as many farms do not turn a large-enough profit to support the families living on them.

PERSONS WITH DISABILITIES

How you'll experience it: People with disabilities achieving new ways to communicate with the world; the ability to check in on your disabled parent or child, living independently, from another location in real-time.

The technology behind it: Video and audio streaming in particular will be critical to the assistive technologies of people with disabilities, to ensure crystal-clear quality of visuals and sound.

Get the picture: Deaf populations with no access to local sign language services use video streaming to connect with a remotely located interpreter, who assists with communications during doctor visits, business meetings and social functions.

According to the World Association of Persons with Disabilities, nearly 50 percent of the world's population is disabled or has a family member who is disabled. That means that the lives of nearly 3 billion people globally could benefit today from the opportunities created by broadband technologies.

With broadband's support of full-motion video, those who are deaf or hard of hearing can have remote access to an interpreter. Streaming video means the images are sharp and clear, instead of jerky, delayed images that make it nearly impossible to understand sign language motions. This means instantaneous interpreting at any time, making better use of the small pool of qualified interpreters, since they can simultaneously facilitate multiple requests. This is especially helpful for those in remote or rural areas, who would not normally have access to an interpreter at all. Broadband also enhances "peer-to-peer" signing, again using video streaming for those who are more comfortable signing with others than reading information on paper or screen.

Other broadband applications include computer speech recognition, speech synthesis and protocol conversion. This means that information can be converted from one form to another with customized

software — so a person who is blind can listen to a fax, instead of reading it, through the conversion of text to voice. Speech recognition can also make public events accessible for those who are deaf or hard of hearing, and electronic voting uses broadband technologies to convert voting booth information into understandable forms for those with visual or cognitive disabilities.

For people with disabilities, the telemedicine and telework options available through broadband can mean more independent, satisfying lives. Video and data streaming allow real-time monitoring by medical staff and loved ones to check on a person with disabilities living alone. For people with disabilities for whom a normal office environment is challenging or impossible, working from home offers financial independence and job satisfaction.