WHITE PAPER

Network 2020: Connecting Everyone to Everything

Communications Then and Now

2010 marks the dawn of a new era in communications. While the past decade has seen innovations that have opened up global communication and commerce, it was just a warm up for what will come in the next decade. Networks will evolve to support an insatiable appetite for constant communication, information, and entertainment. And, over the next 10 years, everyone and everything will be connected—everywhere.

It's unimaginable that just 10 years ago, mobile phones and Internet access were limited to the privileged few. In fact, the percentage of users worldwide who had a mobile phone or access to the Internet was near the single digits. Being relatively new technologies to consumers, mobile phones and the Internet had limited functionality. Mobile phones were restricted to voice and text messages, while most users still accessed the Internet through dial-up connections.

Going forward, networks will not only connect people to people, but people to machines and machines to machines—creating billions of potential nodes on this increasingly valuable grid.

With the turn of the century, these communication technologies started to evolve in ways that forever changed how users connect with the world. Broadband quickly replaced slower dial-up connections. In wireless technology, NTT DoCoMo in Japan launched the first commercial 3G network, bringing data capabilities to the mobile phone.

Ten years later, users—from consumers to enterprises—see broadband and wireless technologies as integral to what they do every day. Consumers and workers expect an "always on" connection to their world, whether that's the ability to instantly share photos with friends across the country or analyzing supply chain issues in near real-time from virtually anywhere around the world. Businesses and governments realize the value of networks to provide solutions to many of their greatest challenges, especially integrating systems and users both inside and outside the company walls.

Fundamental to innovation in communications are networks. The past decade saw significant advancements; innovation in the next decade promises to be just as impactful. The boundaries between wired and wireless will all but disappear as bandwidth capabilities increase. And, networks will offer more flexibility so organizations will respond much faster to shifting business needs, with the ability to set up custom solutions in hours instead of months.

Over the next decade, successful IT leaders will be the ones who pay close attention to consumer communication and network technology trends as these shape both the workplace and the marketplace. Users will expect the same experience wherever they are, with whatever they are doing. This expectation will drive the need for new solutions, creating new opportunities for organizations that respond. Broadband, wireless, and global IP technologies will be at the heart of global economic growth.

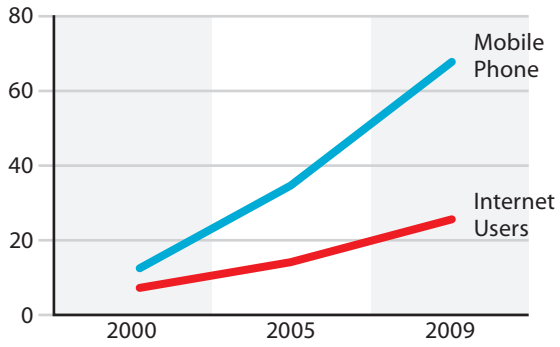

Figure 1. Global Penetration Rates

In the year 2000, the global penetration rate for mobile phones was just 12 percent and only 6 percent for the Internet. In 2009, worldwide mobile penetration was at 67 percent and 26 percent for the Internet.[1]

[1] Measuring the Information Society 2010, International Telecommunication Union
www.itu.int/ITU-D/ict/publications/idi/2010/index.html

Network Evolution: The Next 10 Years

To meet future needs, today's networks are already undergoing major changes. Advancements in the way technology components relate, including moving toward a more service-oriented architecture, provide increased bandwidth flexibility, more rapid provisioning of network services, and put much more control in the hands of the enterprise. These network changes, along with user demand, produce trends that reduce the challenges of today and introduce new solutions for tomorrow.

Increasingly Intelligent Networks

To enable major, new communication capabilities, intelligence will be embedded in networks. Embedded intelligence will make network control more automated, dynamic, and flexible. In the coming decade, communication between network components won't be tightly tied to specific hardware, but will instead reside in an interoperable standards-based control layer so that newly-added network components, like switches and multiplexers, can signal themselves to the other network components, allowing dynamic configuration.

Networks are moving towards being more effectively application aware. This means they will provide different service levels, depending on the application. Application-aware Virtual Private Network (VPN) tools enable organizations to achieve prioritized levels of performance for Private IP network applications such as VoIP, enterprise resource planning (ERP), and video. The proper network assessment, reporting, dynamic bandwidth, and packet-marking tools let organizations closely monitor performance, make adjustments, and achieve cost efficiencies.

Over the next 10 years, networks will become more resilient as their self-healing capabilities become more sophisticated and effective. Mesh networks will be pervasive throughout the world. They will provide automatic restoration and real-time management of voice and data traffic by intelligently rerouting traffic around any damaged components to another point in the mesh. The mesh network also will provide predictable and more acceptable latency, improving performance times when compared to the past, where breaks in the network may have caused service to be seriously degraded or unavailable. With mesh networks, it will be much faster for data sent from its entry point in the network to reach its destination in the event of a network disruption than it has been using SONET ring technology.

Verizon is the first network provider to deploy undersea cable mesh technology, providing seven-way route diversity in the Pacific and across the Atlantic. In 2009, an earthquake and subsequent tsunami damaged 10 sub-marine cable systems were damaged in more than 20 locations in the Asia-Pacific region. Verizon's global mesh network operated exactly as designed, rerouting traffic within milliseconds of the multiple cable breaks, finding the best paths for the highest quality restoration of traffic.

Going forward, a new generation of application-aware networking services will launch, enabling networks to sense and dynamically adapt its resources to the needs of applications running over them.

The development of private IP networking, particularly with regards to application-aware networking, is accelerating at a much greater rate than public IP and there is currently no sign of this changing.[i]

Pervasive Bandwidth

In the years ahead, multimedia applications will continue to increase. The surge includes 3-D video, video sharing, video monitoring, conferencing, and streaming—all in higher definition than is possible today. As an example of the trend, a 2010 volcanic eruption in Iceland caused a sharp rise in video conferencing. Globally, mobile data traffic will double every year through 2014, and will grow to 3.6 exabytes per month.[ii] The increased volume will cause data traffic to skyrocket and require capacity not currently available.

In the past, bandwidth available to a user at a given site was available only in coarse increments, selected at the time of provisioning. Enterprises upgrading to higher capacity faced costly projects that could take months to plan and implement. Increasingly, network technologies such as bandwidth deployment over fiber optic cables and via Ethernet access networks will allow rapid upgrades often without the need for long projects, costly site visits, and physical construction projects.

On-demand bandwidth capability is available today, though not yet widely used. Over the next decade, use will increase dramatically. Organizations will still need to be conscious of bandwidth needs when designing networks, but will find that the flexibility after the initial deployment is far greater. Greater flexibility allows easy adjustments that more readily meet changing business needs.

The growth of bandwidth-intensive applications will make dynamic and on-demand bandwidth capabilities routine. In many cases, businesses will be able to upgrade bandwidth almost instantly,

without human intervention, triggered by consumption patterns and parameters set in advance. Organizations may pay for underlying capacity and then peak bandwidth and data transfer utilization, in a model similar to today's commercial electricity suppliers.

Wireless will realize the most impactful bandwidth milestone. Fourth-generation (4G) wireless networks will bring broadband capacity to mobile devices at rates approaching, and potentially surpassing, 10 times the current capacity. The first commercial 4G wireless network was deployed in Scandinavia in late 2009 using Long Term Evolution (LTE) technology, and large scale deployments are scheduled to begin in the U.S. in 2010. LTE not only provides customers with true broadband speeds, it will also embed wireless connections in cars, buildings, machines, and appliances—enabling what some people call the "Internet of things."

Verizon Wireless will be among the first carriers in the U.S. to launch LTE. Trials in Boston and Seattle demonstrate the network is capable of peak download speeds of 40 to 50 megabits per second (Mbps) and peak upload speeds of 20 to 25 Mbps, though average, real-world rates are expected to be 5 to 12 Mbps on the downlink and 2 to 5 Mbps on the uplink. Based on internal estimates, aggregate growth in wireless data carried by Verizon will skyrocket after LTE is deployed, with an increase of more than 2,000 percent between now and the end of 2014.

Pervasive IP Connectivity

As technology platforms continue to evolve, the barriers between wireless and wired networks and devices around the world will eventually disappear. Consumers and businesses will expect their applications to move seamlessly between platforms, no matter which network they're connected to at the moment. And they'll demand access to all of their content—regardless of where it's stored—anytime, anywhere, and on any device.

This trend is already underway with fixed mobile convergence (FMC), where mobile phones transparently switch a voice call in progress between the cellular network and VoIP. The goal of FMC is to provide a seamless transition of voice, data, and even video communications between different types of networks, no matter the location or what device is used, providing the user with an optimized, always available experience. Soon it will be commonplace to continually watch a television show or video presentation while moving between devices.

The move toward 4G technology with LTE will push networks closer toward FMC. In the near term, LTE will enable billions, perhaps trillions, of devices to connect. Wireless sensors will then integrate everyday items, such as household appliances and medical monitoring equipment and businesses will widely deploy Machine to Machine (M2M) wireless communications solutions to track assets, remotely monitor inventory, and ensure that distant equipment is operating properly. These types of sensors will provide data that suggest the need for proactive maintenance, or instantly report service interruptions. LTE will also enable a new generation of broadband to wireless applications.

At the 2010 Consumer Electronics Show, Verizon demonstrated a small, handheld tablet device that streamed the movie "Up" in 1080p over LTE at 4 Mbps. Verizon also demonstrated live, high-quality videoconferencing over LTE using portable units from Creative Labs.

Everything as a Service

Today, IT leaders are embracing cloud-based services. What initially began as software as a service (SaaS), cloud services grew to include more types of services, such as applications, servers, software, data center space, storage, and network equipment. Some of the significant benefits to using virtualized infrastructure are reduced capital costs and less IT support to administer, compared to traditional approaches.

In 2020, it's predicted that business processes and functions will decouple from their technology components. The underlying technical architecture will be invisible to users and, just like electricity, users will "just turn it on" and not worry about how it works. Standards will continue to progress to allow different technologies to operate seamlessly. Security will remain a concern but will evolve with more security approaches built into the network service components, reducing the burden on both companies and end users.

Over the next several years, most software applications will become cloud-based. This will be true for both consumer and enterprise applications. End-user computers will resemble more of today's netbooks or tablets, and will be used as a device to connect to cloud services—public or private. No longer will users need to download and install software applications, as they will be accessed and managed by the cloud provider. While companies and individuals will still be involved in planning for their needs, in the way they might plan for the electricity capacity needed for a new office or factory, communications service providers will handle the execution on a day-to-day basis.

The pricing model for software and applications will also change by 2020. Today, most software is priced based on the number of servers or users. But pricing will evolve to a true usage-based model, reflecting actual usage and offering easier scalability. This type of pricing gives IT and business leaders more visibility and control over budgets and spending, tying expenses directly to the business value.

Extending the cloud model beyond the typical software as a service and computing as a service paradigms, Verizon Business recently began offering a direct connection option functionality to content-delivery network providers (CDNs) as part of its Partner Port Program. CDNs deposit consumer-focused content directly to the Verizon Internet backbone network at regional carrier "hotels" without the need for connections that use longer, less direct, and often costly middlemen architectures that involve multiple connections, or "hops," among multiple carriers.

Most connected devices will have "direct access to web-based cloud content and applications." [iii]

Purpose-built Solutions

A trend in the next decade will be purpose-built networks that solve particular business requirements. By separating the network functions or services from the technology, businesses can specify a custom network to suit particular business needs. In the past, a physical network would have been built to accomplish this. Virtualization of these services will make it possible to create a logical network without building a physical network.

The industry is moving away from the slow and awkward methods of adding point-to-point links that result in a tangle of lines and excess equipment. Many are choosing VPNs that run over the public Internet or private clouds based on Multi-Protocol Label Switching (MPLS) network technologies. VPNs and private clouds let organizations customize their network solution by specifying the type and level of security required to meet the business and regulatory needs, the bandwidth required, and the data storage features.

Through 2020, the VPN and private cloud trends will continue. While lingering concerns about availability and security will encourage many enterprises to participate in private cloud-based interconnections for key relationships, the flexibility of Internet-based connections have enormous and growing appeal. However, even in industries like financial services, where the largest players tend to be late adopters of many technologies, a marked shift away from physical private networks and toward MPLS-based private cloud networks exists.

It's not too difficult to imagine different types of virtual industry markets and exchanges developing as a result of the expected changes. On the energy horizon is smart grid. By providing two-way communication between the user and the utility company, and between utility companies, an energy market is taking shape that allows more fluid pricing, encouraging high value conservation at times of peak demand, and will let users sell electricity to other users. In the healthcare field, health information exchanges are forming as a way to securely share patient information across different medical facilities. These exchanges help doctors avoid repeat patient tests, reduce missing patient data, and increase the quality of care.

Early in 2009, Nasdaq OMX selected to move to an open connectivity model for its Nordic markets by replacing its proprietary participant network with the Verizon Financial Network (VFN). The VFN is a dedicated and purpose-built business infrastructure specifically designed to share market data and execute timely trades. VFN offers financial services customers a fully end-to-end managed and supported, highly scalable and low latency interface to the financial services ecosystem.

The Network of Tomorrow

By the year 2020, communications networks will be an even more integral part of everyday life than they are today, both at home and in the workplace. Network-driven technology will be a key enabler of daily activities, yet it will become more transparent to the user. No longer will the user care about how it works—just that it works.

The network of tomorrow will produce a hyper-connected environment. Intelligence will be built into the fabric of everything imaginable—and some things not yet imagined—all enabled by pervasive communications technologies. While many of the advancements that will be commonplace in 2020 are already taking shape, a few advancements seem to be straight out of a science fiction novel. These innovations will impact everyone and everything. For example:

- **Apparel.** Various wearable devices such as glasses or visors with built-in cameras and video displays will both record and transmit information. Inconspicuous displays will send streaming information to the user, such as a restaurant menu as a diner walks by a restaurant or tech support through a virtual reality demonstration. Gaming vests will provide forced feedback as part of an augmented reality experience.
- **Home.** The fiber-enabled smart home will be a platform for managing every function of the digital ecosystem, from home security and energy management to medical monitoring, telework and distance learning. Refrigerators will have a touch surface that displays grocery lists and coupons, and the ability to track contents for real time "inventory" control. Even carpets will be smarter, tracking the health of the elderly by sensing erratic movements that may predict a fall.
- **Energy.** Household appliances can already be remotely controlled to run at off-peak times. San Diego Gas and Electric found that if 80 percent of its customers used their washers and dryers at off-peak times, it could eliminate two power plants.[iv] Energy pricing will become dynamic, changing in real-time, motivating users to be more energy efficient.
- **Healthcare.** A patient's wireless device will receive reminders about medication and therapy, in-home devices will provide daily monitoring of vital statistics for preventative care, and patients will consult with out-of-town doctors and specialists over high-definition 3-D video connections. Many people will have body sensors, tiny wireless devices intended to track their vital signs.
- **Government.** City-centric applications will report traffic and parking conditions using GPS-enabled sensors that provide real-time notifications for public transit, and even monitor the city's air and water quality. Crime detection will be aided with context-aware video surveillance that reports unusual activity. Civil services will be tailored to the individual, supported by the full integration of government systems.
- **Enterprise.** Using the cloud model, traditional businesses will sell their internal capabilities as services that are separate and distinct from their regular business offering, just as Amazon does today with their Web-store infrastructure. RFID tags will become multifunctional sensors that not only provide item location but also item health, which is useful for tracking food shipment. The percentage of teleworkers and "digital nomads" with no fixed regular work location will grow significantly, with the ability to work and video conference on one device that can connect anywhere.

The combination of increasingly powerful and intelligent networks and innovative applications and devices will create a whole new way to run a home, an enterprise, a community, or an economy.

Conclusion

Users already have high expectations of their communication technology. This will continue to the point of dependence. Users will come to expect always-on access to the Internet that supports their lifestyles in every way. None of this would be possible without the foundation of solid and advanced communication networks.

In the future, network providers will continue to drive open, IP-based technical standards that allow new technologies to work together. Favorable regulatory structures will encourage continued investment and innovation. To drive the solutions and services of 2020, network providers will form alliances with other providers and partnerships with application developers and device makers.

Now is the time for business leaders to take inventory of how the rapid evolution of networking technology and the new expectations of employees and business partners will affect day-to-day business. Unprecedented access to real-time data, combined with communication platforms that are available anywhere and anytime, will not only increase the rate of change for existing business models, but will substantially increase the pressures of global competition. At regular intervals, IT leaders should sit down with key business leaders and third-party experts and discuss how these trends impact their business models.

Together, the team should identify opportunities to foster innovative experiments, capitalizing on new capabilities to deliver new products and services. Also, the team should evaluate where functions might move to the utility model, and resources could be reinvested. Having identified potential opportunities, the team should then conduct forward-looking pilot projects. While some opportunities may not prove fruitful, the ones that do will create a new competitive advantage.

Broadband, wireless, and global IP technologies will be the heart of coming economic growth. The evolution of the network over the next decade will not only enable new products and services, but also create a number of new jobs. A study last year by the Information Technology & Innovation Foundation (ITIF) found that an investment of $30 billion in America's digital infrastructure would create or retain 949,000 U.S. jobs, plus spur creation of an additional 500,000 small business jobs.[v]

US Federal Communications Commission chairman Julius Genachowski recently unveiled a national broadband plan to push greater broadband capabilities by 2020. Genachowski says, "It's so important because broadband is essential to fostering 21st century jobs, investment, and economic growth. It's also so important because of the vital role broadband must play in advancing key societal goals in areas like education, health care, energy, public safety, democracy, and small-business opportunity."[vi]

The next decade brings exciting new innovations and changes, powered by unlimited, instantaneous access and the expansive reach of converged global connectivity. Intelligent devices of every size, shape, and function will seamlessly interconnect users, businesses, and governments to create new connections that enable smarter people and a more intelligent world.

Just think of the possibilities!

Verizon Business looks forward to helping unleash every sector of the economy to reinvent itself to produce real growth, real innovation, and real change for our customers globally.

To learn more about network innovations that can shape the way you reinvent your organization, contact your Verizon Business account manager or visit www.verizonbusiness.com/thinkforward.

About Verizon Business

Verizon Business, a unit of Verizon Communications (NYSE: VZ), is a global leader in communications and IT solutions. We combine professional expertise with one of the world's most connected IP networks to deliver award-winning communications, IT, information security and network solutions. We securely connect today's extended enterprises of widespread and mobile customers, partners, suppliers and employees—enabling them to increase productivity and efficiency and help preserve the environment. Many of the world's largest businesses and governments—including 96 percent of the Fortune 1000 and thousands of government agencies and educational institutions—rely on our professional and managed services and network technologies to accelerate their business. Find out more at www.verizonbusiness.com.

The network is moving from just being an enabler to being the foundational driver for the new economy.

i Enterprise Networking in 2020: executive summary, Ovum, January 13, 2010

ii Cisco Visual Networking Index: Forecast and Methodology, 2009-2014, June 2, 2010

iii Telecoms in 2020: executive summary, Ovum, December 24, 2009

iv Wireless will be used to make electrical grid smart, RCR Wireless, September 3, 2009, www.rcrwireless.com/article/20090903/FRONTPAGE/909039996/1091/-wireless-will-be-used-to-make-electrical-grid-smart

v The Digital Road to Recovery: A Stimulus Plan to Create Jobs, Boost Productivity and Revitalize America, ITIF, Jan. 2009, www.itif.org/files/roadtorecovery.pdf

vi Prepared Remarks on National Broadband Plan, Chairman Julius Genachowski, FCC Open Agenda Meeting, Washington, D.C., February 18, 2010, http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-296394A1.pdf

verizonbusiness.com/thinkforward

verizonbusiness.com verizonbusiness.com/socialmedia