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An International Look at High-Speed Broadband

Darrell M. West

EXECUTIVE SUMMARY

In the American Recovery and Reinvestment Act of 2009, the U.S. Congress charged the Federal Communications Commission with developing a national broadband policy by March 17, 2010. Legislators asked the commission to outline policies that would be efficient, effective, and affordable, and that would advance the public interest in "consumer welfare, civic participation, public safety and homeland security, community development, health care delivery, energy independence and efficiency, education, worker training, private sector investment, entrepreneurial activity, job creation and economic growth, and other national purposes."

Darrell M. West is Vice President and Director of Governance Studies at the Brookings Institution.

Central to this request was the idea that digital infrastructure is vital to long-term economic, social, and civic development. Similar to highways, bridges, and dams, broadband and wireless represent infrastructures that make it possible for businesses to stay connected, innovate, and create jobs. Just as we need a strong interstate highway system and viable mass transit, we require accessible and affordable broadband so that businesses and consumers can reap the benefits of broadband and wireless technology.

In this report, I look at what other countries are doing in terms of broadband applications. Specifically, I examine four policy questions: 1) what broadband speeds are countries aiming for in their national plans? 2) how are various nations paying for necessary broadband investments? 3) what new applications become available at various broadband speeds? and 4) how valuable do other locales see broadband for the economy, social connections, civic engagement, and public sector service delivery?

Countries vary in size, population density, industry structure, regulatory environment, demographic makeup, and cultural patterns. Yet despite obvious differences, America can learn valuable lessons from other countries. People can see what other places are attempting in terms of new ideas and possible benefits to be gained from high-speed broadband.

In terms of speed, South Korea has the most ambitious national goal in terms of future broadband traffic. It is seeking to raise broadband speed to 1 gigabyte per second. Australia and Finland are aiming for 100 Mbps, while Germany has a stated target of 50 Mbps by 2014. These countries are pushing for high speeds because they see them as necessary for new health, education, energy, and civic engagement applications.

The challenge for most nations is how to improve access, open networks, and pay for faster service. The Federal Communications Commission estimates that it will require $350 billion to provide universal broadband coverage in the United States at 100 Mbps, yet the public investment authorized as part of the economic stimulus package is only $7.2 billion. The American public sector investment is the highest in the world. As a point of contrast, Japan is spending $3.7 billion; Australia is devoting $3 billion, Canada has budgeted $150 million, Finland $130 million, and Spain is spending $90 million. But the U.S. investment pales in

comparison to what is needed. Encouraging greater private sector investment is key to realizing the long-term benefits of broadband.

Faster speeds are vital to take advantage of new digital tools such as GIS mapping, telemedicine, virtual reality, online games, supercomputing, video on demand, and video conferencing. New developments in health information technology and mobile health, such as emailing X-rays and other medical tests, require high-speed broadband. And distance learning, civic engagement, and smart energy grids require sufficient bandwidth.

There is considerable evidence that widely available, affordable, and high-speed broadband furthers economic development, social connections, civic engagement, and electronic government. As noted in this report, a study of 120 nations between 1980 and 2006 undertaken by Qiang (2009b) estimates that each 10 percentage point increase in broadband penetration adds 1.3 percent to a high income country's gross domestic product and 1.21 percent for low to middle-income nations.

The United States should have three goals: 1) raising the household broadband adoption rate to 90 percent by 2020, 2) aiming for 100 Mbps of speed (similar to Australia and Finland) in order to facilitate new applications in education, health care, smart energy grids, public safety, video streaming and high definition television, games, video conferencing, civic engagement, and electronic government, and 3) improving data collection on broadband speeds and availability so consumers know what speeds they are paying for and policymakers have better adoption and availability information on which to base policy decisions.

Using Broadband to Jump-Start National Economies

Many nations around the world are investing in broadband infrastructure as a way to jump-start economies weakened by the recent financial collapse. The decline in stock market valuations, rise in unemployment, and reduction in overall economic growth has highlighted the need to target financial resources and develop national priorities. In conditions of economic scarcity, countries no longer have the luxury of being passive and reactive. Instead, they must be proactive and forward-looking, and think clearly about how to create the basis for sustainable economic recoveries.

Not surprisingly, given its long-term potential, a number of countries have identified broadband and wireless as crucial infrastructure needs for national development. Broadband is viewed in many places as a way to stimulate economic development, social connections, and civic engagement. National leaders understand that broadband is a cross-cutting technology that speeds innovation in areas such as health care, education, energy, and social networking. When combined with organizational changes, digital technology can generate powerful new efficiencies and economies of scale (Brynjolfsson and Saunders,

2009).

For example, high-speed broadband allows physicians to share digital images with colleagues in other geographic areas. Schools are able to extend distance learning to under-served populations. Smart electric grids produce greater efficiency in monitoring energy consumption and contribute to more environment-friendly policies. Video conferencing facilities save government and businesses large amounts of money on their travel budgets. New digital platforms across a variety of policy domains spur utilization and innovation, and bring additional people, businesses, and services into the digital revolution.

Researcher Christine Zhen-Wei Qiang (2009a) reviews the role of broadband infrastructure investments in the stimulus packages of leading countries and suggests that many locales have identified broadband as a key to future development. She found that the United States is investing the largest sum of money ($7.2 billion), followed by Japan ($3.7 billion), Australia ($3 billion), Canada ($150 million), Finland ($130 million), and Spain ($90 million).

Country	Time Frame	Broadband Goals
Australia	8 years from 2010	Deliver broadband at speed of 100 Mbps to 90% of homes, schools, and businesses
Canada	4 years from 2009	Extend broadband coverage to all currently underserved communities
Finland	7 years from 2009	Provide broadband to every household, with download speeds of at least one Mbps by 2010 and 100 Mbps by 2016
France	5 years from 2008	Provide universal access to broadband at affordable prices by end of 2010
Germany	10 years from 2009	Provide broadband access at 50 Mbps to 75% of households by 2014
Ireland	2 years from 2009	Provide broadband to all with minimum 1.2 Mbps
Japan	2 years from 2009	Extend broadband to all rural areas
Portugal	2 years from 2009	Extend broadband to 50% of homes by 2010
Singapore	5 years from 2009	Universal connection to Next Generation broadband by 2013
South Korea	5 years from 2009	Upgrade broadband to 1 Gbps
Spain	4 years from 2009	Extend broadband to rural areas

Source: Christine Zhen-Wei Qiang, "Broadband Infrastructure in Stimulus Packages: Relevance for Developing Countries,"2009a.

Taylor Reynolds (2009) has analyzed the role of communication infrastructure investment in economic recoveries among OECD countries and found that many view broadband development as crucial to their economic stimulus packages. He demonstrates that there is a strong connection between telecommunication investment and economic growth, especially following recessions. These kinds of investments help countries create jobs and lay the groundwork for long-term economic development.

Key Policy Questions

This year, the Canadian government became the first Western nation to say it would regulate Internet network management. Its Radio-Television and Telecommunications Commission voted to require Internet service providers to inform consumers of how they manage traffic and what the impact of their techniques is on customer service. According to CRTC Chairman Konrad von Finckenstein (Government Technology, 2009), "Canada is the first country to develop and implement a comprehensive approach to Internet traffic management practices….The centerpiece of our approach is a framework of analysis that will be employed to determine whether economic and technical practices are acceptable."

Finland made history the same month by declaring that its citizens have a "legal right" to broadband. It passed a law requiring telecommunications providers to "provide all Finnish residents with broadband lines that can run at speeds of at least 1 megabit per second" by July 2010 (Johnson, 2009). With 96 percent of its people already having access to broadband, the legislation affects the four percent who currently are unconnected. The nation's communications minister announced plans to bring 100 Mbps Internet speed to all residents by 2016.

France has not declared broadband access a legal right, but its courts have said it is a "basic human right". In a 2009 Constitutional Council action, officials ruled that people need broadband in order to participate in civic affairs and that the country should ensure that all its people had access (Webware, 2009).

In looking around the world, there are a variety of models by which countries are pursuing broadband development. Places vary enormously in the broadband speeds they value, how they fund infrastructure development, and how they handle under-served communities. Following sections show how leading nations are handling these issues.

Broadband Speed

Actual network speeds vary considerably across countries. A study conducted at SpeedMatters.org and reported by the Communications Workers of America (2009) found that South Korea had the highest average download speed of 20.4 Mbps, followed by Japan (15.8 Mbps), Sweden (12.8 Mbps), the Netherlands (11.0

Mbps), Germany (around 9 Mbps), and the United States (5.1 Mbps).

The question of necessary broadband speeds depends very much on national aspirations and views regarding the applications that are envisioned over the short- and long-term. South Korea has developed the most ambitious plan in terms of network speed. Its national goal is 1 Gbps. Australia and Finland are aiming for 100 Mbps, while Germany has a stated target of 50 Mbps by 2014.

The question for the United States is the mix of speed versus access. Limited financial resources mean we cannot achieve universal home access and 100 Mbps of speed at the same time. We need a mix of improving individual adoption and boosting access to schools, hospitals, and libraries so that these institutions can take advantage of new services.

Innovative social, health, and entertainment applications require greater bandwidth. According to the OECD (2008), the top bandwidth required for various applications runs as high as 18 Mbps for high definition television, 14 Mbps for online games, 13.5 Mbps for video on demand and Internet Protocol TV, and 13.4 Mbps for video conferencing. As these applications gain popularity, it will increase the demand for high-speed broadband.

Top Bandwidth Speed Required for Various Digital Content Applications	
High Definition Television	18 Mbps
Online Games	14
Video on Demand	13.5
Internet Protocol TV	13.5
Video Conferencing	13.4
Virtual Worlds	9
Web Browsing	4
Audio Streaming	1.5
Voice Calls	0.5

The California Broadband Task Force (2008) predicts that telemedicine, education distance learning, and digital medicine will require speeds between 10 and 100 Mbps. It furthermore concludes that high definition telemedicine, virtual reality, supercomputing and advanced research applications will require broadband speeds of over 100 Mbps.

A Nielsen Company study (2008) found that the growth of broadband utilization in New Zealand has stimulated what it calls "consumer generated media", such as blogging, social networking, file sharing, and multimedia. Among the interesting findings of this research were that video uploading has reached 43 percent of the online population, blog creation has increased to 28 percent, online profile creation has risen to 50 percent, and social networking has increased to 48 percent of the online population.

According to the Nielsen analysis, 62 percent of people 14 years or older have

used the Internet for browsing other people's online profiles in the past 12 months, while 45 percent have created profiles and 48 percent have joined "friend finder" sites. Half of all users are now reading blogs while 17 percent are creating them. Nearly 80 percent are sharing photos, 61 percent are uploading photos, 59 percent share links, 39 percent share videos, 31 percent upload music, and 24 percent upload video content.

The answer to "how fast?" depends in part on which applications people want in the future. West (2009b) analyzes mobile communications in the United States, United Kingdom, Spain, and Japan. When asked what the most important applications were, Americans named chat or instant messaging (23.2 percent), cheap international calling (15.5 percent), file sharing (7.6 percent), and video conferencing (5.2 percent). In the United Kingdom, chat was the top preference (30.4 percent), followed by cheap international rates (29.4 percent), file sharing (9.7 percent), and video conferencing (1.2 percent).

In Spain, file sharing was the most desired application (33.7 percent) followed by cheap international calling (21.4 percent), chat (12.5 percent), and video conferencing (10.7 percent). For the Japanese, cheap international calls were the most favored (12.5 percent), followed by chat (12 percent), file sharing (7.6 percent), and video conferencing (1.5 percent). Chat, instant messaging and international calling do not require high-speed networks, but video conferencing and other social applications do.

One of the reasons why South Korea is moving towards 1 Gbps networks is that it is the online "games-playing" capital of the world. Seoul has 26,000 "bangs", or online game rooms (Herz, 2006). The country has three television cable channels devoted exclusively to games. Young people gather at game rooms, at home, or in front of television sets to play large, interactive games with other individuals. Indeed, Korea recognizes these social gathering places as "third places", meaning locations other than work or home where people connect. It is estimated that over 5 million people play "Starcraft," one of the popular online games in Korea. Other popular games include, "Lineage," "Ultimate Online," "Kingdom Under Fire," and "EverQuest."

In terms of online music downloads, demand is growing in many countries. The United States already has $1,849 million in sales (16 percent of all music sales), compared to $778 million for Japan, $201 million for the United Kingdom, and $151 million for South Korea (OECD, 2008).

	Total Digital Music Sales (in millions)	Percent of Country's Total Music Sales
United States	$1,849	16%
Japan	778	15
United Kingdom	201	6
South Korea	151	61
France	128	8
Germany	117	6
Canada	51	7
Italy	41	7
Australia	37	6

Data from online film sales demonstrate that sales are expected to grow substantially in the near future (OECD, 2008). Revenue for online film in the United States in 2006 was $22.9 million, but is expected to grow to $1.975 billion by 2010. Similar trends are anticipated for the European Union. Its 2006 sales totaled $24.6 million, but is thought to grow to $1.356 billion in 2010.

Online video gaming furthermore is taking off among the youth of many nations. From a base of less than $1 billion in sales in 2002, it is expected to grow to over $15 billion (OECD, 2005). Digital games require fast broadband since they utilize virtual reality features, 3-D graphics, and multi-player platforms. For example the game "Anarchy Online" features thousands of players roaming through 480 square meters of territory, and battling adversaries along the way. It is estimated that over 720,000 people have played this game online.

Based on international experience, it is reasonable to conclude that demand for high speeds is going to rise dramatically as new applications come online. An analysis of other countries suggests that online music, video, and games are very popular, especially among young people, and each of these applications require faster speeds than what the United States has right now.

Broadband Financing

Some countries view broadband investment as a public good to be financed either by the central government or in conjunction with phone companies. Public officials in these places have placed a high priority on high-speed broadband and provided direct resources or indirect incentives for those investments. The Japanese Ministry of Communications and the Nippon Telegraph and Telephone company, for example, worked together to develop fast broadband.

A similar phenomenon happened in South Korea through KT, a company that combined Korea Telecom with KTF, a wireless carrier. Korea has the highest bandwidth of any nation because Kepco, its utility company, developed a fiber-optic cable network many years ago for its own use, and now leases the unused 90

percent of this network to service providers. Between KT and Kepco, consumers can purchase high-speed broadband for $25 a month (Herz, 2006). With cheap and speedy broadband, it is estimated that nearly all Koreans have access to fast broadband service.

Between 1995 and 2005, the Korean government invested $900 million in broadband and this stimulated $32.6 billion in private technology investment (Qianq, Rossotto, and Kimura, 2009). Public officials aggressively pushed high-speed applications in government and business. This sparked substantial increases in consumer demand. In exchange for the government dollars, private companies were required to connect public institutions (Williams, 2009).

Of course, Korea has benefitted from a set of favorable conditions not present in other countries. It has high population density and a homogeneous population that make it affordable to provide Internet service. Whereas the United States has 31 people per square kilometer, Korea has 476 and Japan has 337 (Kim, Moon, and Yang, 2004). Over 70 percent of Koreans reside in half a dozen cities. Its broadband backbone contains 13,670 miles of fiber-optic lines, less than what Verizon has in the state of West Virginia alone (Herz, 2006). Apartment buildings in Korea have rental rates based on bandwidth capacity and enterprising owners with fast pipes pitch Internet speed as a way to convince people to live in their units.

Most other nations have opted for a broadband system based mainly on private investment. The idea is that governments should not finance or compel commercial carriers to undertake broadband investment unless the latter see market conditions that are conducive to these kinds of investments. This allows companies to make relevant decisions based on their perceptions regarding return on investment.

Historically, the United States has relied on private companies for the bulk of broadband infrastructure. AT&T, for example, has invested over $44 billion in the last two years building a broadband and wireless network. Verizon has spent nearly $43 billion, while Comcast has invested $14 billion, Sprint $10 billion, and T-Mobile $8.5 billion. These investments have created networks to which 63 percent of Americans have home access (Pew Internet & American Life Project, 2009).

A recent report by the U.S. Federal Communications Commission estimated that it would cost $350 billion to create 100 Mbps universal broadband coverage in the United States (FCC report, 2009). With the federal government investing only $7.2 billion from the economic stimulus package, it is apparent that the vast bulk of the American infrastructure funding will come from the private sector.

A serious challenge for most countries has been bringing service to rural areas with low population densities or other under-served geographic places. The cost of wiring the "last mile" is high because of low concentrations of people and limited demand for service. It is here whether the public sector in most countries has played a significant role. According to Qiang (2009a), "for the goal of universal coverage of broadband services, countries are spending larger public

funding for rolling out high-speed networks to areas that are underserved or unserved by commercial internet service providers. The Finnish government plans to foot one-third of such costs. Others are contracting commercial providers to build the network with service obligations through a competitive bidding process (e.g. France, Ireland, Japan and Singapore). The EU and the US are adding resources to existing rural development or universal service."

Impact of Broadband on Economic Development

The influence of broadband access on economic development supports the complimentary connection of advanced digital infrastructure. Indeed, there are examples from other countries of how fast broadband spurs development and makes possible new businesses, products, and services (West, 2009a).

A Strategic Networks Groups (2003) study of broadband investment in a fiber optic network in the South Dundas township of Ontario, Canada found that an investment of $1.3 million led over several years to a "$25.22 million increase in GDP for Dundas County and $7.87 million increase for the Province of Ontario" and the creation of 207 jobs. Overall, researchers used a survey of businesses and organizations in the county to conclude there was an increase of $3.5 million in provincial tax revenues and $4.5 million in federal tax revenues that were directly attributable to the new fiber lines. Fifty-four percent of the area's businesses that had access to the fiber network reported they had job growth, compared to 27 percent of businesses that had dial-up Internet access and 5 percent for those with no Internet access.

Raul Katz, Stephan Vaterlaus, Patrick Zenhausern, Stephen Suter, and Philippe Mahler (2009) examine the impact of broadband on jobs and GDP in Germany. Overall, they estimate there will be gains of 968,000 jobs and 170.9 billion Euros added to the economy over 10 years. This amounts to 0.60 annual growth in GDP during the period from 2010 to 2020. Some of this growth arises in the form of network construction, while the remainder is generated by rising broadband penetration and subsequent innovation in business activity.

A study of 120 nations between 1980 and 2006 undertaken by Qiang (2009b) estimates that each 10 percentage point increase in broadband penetration adds 1.3 percent to a country's gross domestic product of high income countries and 1.21 percent in low to middle-income nations. This suggests that growth comes not just in direct forms, as estimated by other authors, but arises because broadband generates new applications for businesses and consumers.

As with many studies, it is useful to note the difficulties of estimating the economic ramifications of broadband development (see Atkinson, Correa, and Hedlund, 2008). Peter Collins, David Day, and Chris Williams of the Australian Government Department of Communications Information Technology (2007) review the literature on broadband and argue that studies need to incorporate "counter-factuals" into the analysis. It is not sufficient to draw a direct link

between investment and job growth. Rather, researchers must examine how much would have taken place in the alternative scenario of no broadband development and incorporate that in their conclusions. According to them, considering various possibilities provides a more useful basis for evaluating broadband.

Impact on Social and Cultural Connections

Shin (2005) describes the way in which broadband has facilitated the emergence of "digital cities" in Korea and the United States. Using a comparative case study of public networks, the author notes how broadband brings people together into knowledge networks and how these social connections helped people in economically depressed areas overcome spatial isolation.

Passerini and Wu (2008) identify a similar phenomenon in their analysis of "intelligent communities". They present best practices in terms of social capital development. Under their conception, "megacommunities" consisting of diverse, multilateral stakeholders use broadband technology to work for solutions to a range of health, environmental, and social problems. These enterprises form the backbone of the new knowledge economy and employ information and communication technologies to stimulate higher-level growth.

Preston and Cawley (2008) forecast a "virtuous circle" arising from European Commission efforts to develop a knowledge-based economy. The European Union's plan for an iNetWorked Society based on high-speed broadband emphasizes "demand-side" applications over "supply-side" infrastructure. With fast networks, government planners are stimulating new uses in business, work, and government.

Agamanolis (2008) draws on the European experience to describe how digital technologies enhance community, offer the change to encounter people outside one's common circle, and allow people to build relationships in new sorts of ways. Through the Human Connectedness group that existed between 2000 and 2005 at Media Lab Europe, researchers developed new applications designed to overcome spatial distance in human relationships. Among the prototypes that were constructed included virtual reality devices, adaptive speech interfaces that combined the spoken word with non-verbal gestures, biofeedback mechanisms, and audio bulletin boards that allowed people to share short audio messages with other people.

D'Costa and Kelly (2008) find that broadband provides a new platform for economic, social and cultural development in Asia. In reviewing data broadband subscribers and penetration rates, they argue that fast connections enable people to connect in new ways and build digital communities.

Impact on Civic Engagement

Fast broadband promotes civic engagement and new ways to follow politics and government. A number of public agencies around the world have developed interactive mapping software that allows citizens to chart data patterns in their neighborhood and innovative uses of videos or multi-media to engage people in public debates.

Geographic information systems (GIS) for purposes of civic engagement are becoming increasingly widespread. These are interactive sites that allow people to map a range of social, economic, political demographic, and policy features onto local, state, national, or international jurisdictions. For example, a number of cities have mapping capacities on government websites that enable site visitors to see crime or other rates broken down by individual blocks. This allows them to chart crime statistics, student achievement, or other data trends along social, economic, or political dimensions.

Steinmann, Krek, and Blaschke (2004) look at public participatory GIS, which focuses on ways to get citizens involved in civic decisions. They evaluate 12 GIS applications in the United States and Europe on interactivity, usability, and visualization. Among the projects analyzed were urban design visualization, resource management mapping, river basin analysis, and landscape planning. For example, the village of Bradford, England has maps that allow people to zoom and select specific features for study. Salford University employs an "Openspace" platform with 3D capacity that has users walk through a virtual city while submitting design suggestions to city planners. The Landreis Freising in Germany enables visitors to control development options on interactive city maps.

Cardenas-Hernandez and Rivera (2006) study the use of remote sensing and satellite imagery in natural resource management. Using the example of environmental degradation in western Mexico, they demonstrate how interactive GIS maps allow communities to participate in the sustainable management of rural communities. By interweaving information from conservation, agricultural, and irrigation zones, these maps help people understand the tradeoffs across policy domains.

Public officials increasingly are using online communications to keep in touch with constituents. For example, Hanssen (2008) analyzes how local politicians use digital communications to engage citizens and industry stakeholders in policymaking. He undertakes a national survey of municipal politicians and mayors in Norway to show that e-mail is the most important communications channel between local politicians and citizens. His study found that mayors employ e-mail in work-related communications more than other public officials.

Hayhtio and Rinnel (2007) argue that the Internet has become increasingly important to political participation and mobilization. Using the example of a Finnish protest against gossip journalism in 2006, they suggest that high-speed networks allow dissatisfied elements within society to organize, identify

supporters, and build coalitions. The campaign relied on the Internet to protest the publication of unmasked pictures of musician Lordi following the Eurovision Song Contest. Lordi was part of a Finnish heavy metal band that wore monster masks on stage. Despite strict instructions not to publish images of the group without their performance masks, several tabloid outlets printed pictures of members of the band out of costume. This riled group supporters, who used social networking sites and digital communications to organize a protest against the tabloid publications.

Rojas and Puig-i-Abril (2009) examine the impact of digital communication technologies on political mobilization and civic participation. Using data from a random public opinion sample of Colombia's adult urban population, these authors document how broadband Internet and mobile phones aid "expressive participation" in online protests. They undertook a survey of online information usage and found a relationship between digital information acquisition and political engagement. Those who sought information from the Internet were more politically active and expressive than those who were not. They conclude that in developing societies with high levels of political, economic, and social conflict, digital communications represent a valuable pathway for democratic political engagement.

Kim, Moon, and Yang (2004) argue that the Internet contributed to the political victory of Korean President Roh Moo-hyun in 2002. Because the Internet allowed the candidate to identify and mobilize supporters, and for people to gain news and videos from unfiltered sources, Moo-hyun has become known as Korea's first "Internet President". People got news from citizen journalism sites such as "OhmyNews" and this made it possible for the presidential candidate to bypass traditional political and economic elites, and appeal directly to the people for support (Joyce, 2007).

Impact on Public Service Delivery

High-speed broadband is vital to the emergence of online services in the public sector. Some countries have developed "smart cards" for citizen services that allow people to complete official transactions online quickly and efficiently. Taiwan has been a leader in this area. As shown below, over 22.8 million Taiwanese people made use of online services in the last year. They used high-speed broadband to file taxes, find land information, use health services, and track diseases, among other things.

Taiwan Public Agencies	Type of Online Service	Number of Users
Bureau of Labor Insurance Council of labor Affairs	Laborers and Farmers	8,345,739
Land Administration of Interior	Land Information	6,643,771
National Immigration Agency	Entry and Departure Data	2,654,571
Financial Data Center	Tax Filing	1,485,757
Taipei Financial Bureau	Focal Payment	1,134,410
Land Administration	Data Exchange	718,519
National Health Insurance	Insurance	342,367
National Immigration Agency	Alien and Mainland Chinese Spouse Database	296,483
Chunghua Telecom Corp.	Billing	255,287
Disease Control Bureau	Disease Monitoring	253,448
Others	Miscellaneous Services	707,360
Source: Taiwan Ministry of Interior Certification Authority Website		

Taiwan and Singapore have done the same thing through mobile devices. Taiwanese agencies provide wireless navigational systems, tour guide information, "buddy finders", and health care services through smart phones. In Singapore, public agencies allow citizens to receive personalized SMS alerts, renew passports, and pay road taxes. It also has an online civil defense force that encourages people to use the Internet to report bomb threats, get information on evacuation routes, recognize signs of a chemical or biological attack, or locate medical facilities.

Trkman and Turk (2009) present a conceptual model for the development of broadband and e-government. Looking around the world, they suggest that there is a strong relationship between broadband diffusion and the development of e-government and e-commerce. Countries that have fast broadband typically make greater process on building their public and private sectors.

Estonia has a "direct democracy portal" called "Today I Decide" that facilitates participation in government activities. The website publishes draft laws online and invites public comment on proposed regulations. And it provides a "citizen-initiated process" through which Estonians can propose specific laws or regulations, subject to review by government officials. Fully one-quarter of the suggestions submitted through this portal have qualified for serious consideration by government ministries and three percent have turned into formal legislative proposals for deliberation by elected officials.

Unusual among countries, Estonia has made extensive use of Internet-based voting. According to Alvarez, Hall, and Trechsel (2008), it has undertaken two national elections where citizens had the option of using digital technology. Voters employed their national identity card with digital signatures to cast ballots through secure smart cards. After undertaking quantitative surveys, the authors

found that e-voting enhanced electoral participation by young people and those who trusted online technology.

The Sheffield City Council in the United Kingdom has set up a web-based voting system by which citizens can cast ballots for elected officials. People were offered the choice of voting through paper ballots at a polling place, a personal computer, a telephone, or a mobile text messaging service. Over 2 million people participated in the election, the highest in recent years. Turnout through electronic means was especially high in precincts with a large number of students. Forty percent chose to cast their votes through electronic means. Post-election surveys found that 95 percent of voters were satisfied with the system and willing to vote electronically in the future (Interreg, 2006).

A global e-government study undertaken by West (2008) looked at the number and type of online services offered over the last decade and found a dramatic increase in governments turning to online service delivery. Of the websites around the world, 50 percent had services in 2008 that are fully executable online, up from 28 percent in 2007, 29 percent in 2006, 19 percent in 2005, 21 percent in 2004, 16 percent in 2003 and 12 percent in 2002 (West, 2005). In 2008, 19 percent offered one service, nine percent had two services, and 22 percent had three or more services.

Online Govt. Services	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**
None	92%	88%	84%	79%	81%	71%	72%	50%
One	5	7	9	11	8	14	11	19
Two	1	2	3	4	3	5	4	9
Three or more	2	3	4	6	8	10	13	22

However, not all geographic areas have benefitted from this progress. There are major variations around the world, and it is clear that areas with fast broadband were more likely to have online services. North America (including the United States, Canada, and Mexico) is the area offering the highest percentage of online services. Eighty-eight percent had fully executable, online services. This was followed by Pacific Ocean Islands (66 percent), Western Europe (59 percent), the Middle East (50 percent), Asia (49 percent), Eastern Europe (32 percent), Africa (30 percent), and Russia and the former Soviet republics (10 percent). In places where there is limited broadband, it is harder for governments to innovate and bring citizens the advantages of the digital revolution.

Percentage of Government Sites Offering Online Services by Region of World

	2001	2002	2003	2004	2005	2006	2007	2008
North America	28	41	45	53	56	71	62	88
Pacific Ocean Islands	19	14	17	43	24	48	28	66
Asia	12	26	26	30	38	42	36	49
Middle East	10	15	24	19	13	31	29	50
Western Europe	9	10	17	29	20	34	34	59
Eastern Europe	--	2	6	8	4	12	11	32
Central America	4	4	9	17	15	11	22	63
South America	3	7	14	10	19	30	46	75
Russia/Central Asia	2	1	1	2	3	11	10	10
Africa	2	2	5	8	7	9	9	30

There were a number of innovative services and applications that have developed on government websites based on high-speed connections. They included the following examples: Antigua and Barbuda's Department of Tourism has online newsgroups where people planning trips can have online discussions; Ecuador's Ministry of Defense site has streaming radio with options for news or different genres of music; Fiji has a website called Computerized Human Resources Information System, which matches people to jobs; there is a hieroglyphic translator on the Egyptian Tourism Website; Peru's Portal Commission Website offers a "Desktop Calendar" download that helps you organize your trip to Peru; inside the Canadian Health website, there are sections with an interactive drop down menu providing help to visitors concerning health care; the Canadian Portal has audio feeds that allow you to change the voice and speed of selected readings; the New Zealand Conservation site has an option that allows visitors to order reports and information according to region, and the Austrian Agriculture site allows you to calculate your ecological footprint based on various activities.

Conclusion

To summarize, it is clear drawing on the experience of other nations that high-speed broadband enhances economic development, social connections, civic engagement, and online government. Broadband no longer is just a technology issue, but is creating new applications in areas such as health care, education, energy, and entertainment.

High-speed broadband facilitates the adoption of remote wireless health monitors, GIS mapping, social media, distance learning, smart energy grids, file-sharing, and video conferencing. A number of public agencies around the world have developed interactive software that allows citizens to map data for their neighborhoods and make innovative uses of videos or multi-media to engage people in civic debates. These applications require faster speeds than currently available in many places.

The United States needs to place a priority to boost individual adoption to 90 percent by 2020 and raising broadband speeds to 100 Mbps. By emphasizing individual adoption and institutional anchors in schools, hospitals, and libraries, it allows many people (including those without home access) to take advantage of new digital applications while maximizing scarce financial resources.

Countries with fast and accessible networks are able to fuel innovation and create new types of applications for individuals, businesses, and governments. For example, Taiwan and Singapore have become world leaders in public service delivery "smart cards". Over 22.8 million Taiwanese people have used online services to file taxes, find land information, use health services, and track diseases, among other things. These are just a few examples of how digital infrastructure extends the technology revolution to more people.

Governance Studies
The Brookings Institution
1775 Massachusetts Ave., NW
Washington, DC 20036
Tel: 202.797.6090
Fax: 202.797.6144
www.brookings.edu/governance.aspx

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Christine Jacobs

Production & Layout
John S Seo

Email your comments to gscomments@brookings.edu

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