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Lessons from broadband development in Canada, Japan, Korea and the United States

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Abstract

Broadband network development does not always track closely a nations overall wealth and economic strength. The International Telecommunication Union reported that in 2005 the five top nations for broadband network market penetration were: Korea, Hong Kong, the Netherlands, Denmark and Canada. The ITU ranked the United States sixteenth in broadband penetration.

Aside from the obvious geographical and demographic advantages accruing to small nations with large urban populations, broadband development thrives when it becomes a national priority. Both developed and developing nations have stimulated capital expenditures for infrastructure in ways United States public and private sector stakeholders have yet to embrace. Such investments have accrued ample dividends including the lowest broadband access costs in the world. For example, the ITU reports that in 2002 Japanese consumers paid $0.09 per 100 kilobits per second of broadband access compared to $3.53 in the United States.

Economic policies do not completely explain why some nations offer faster, better cheaper and more convenient broadband services while other nations do not. This paper will examine best practices in broadband network development with an eye toward determining the optimal mix of legislative, regulatory and investment initiatives. The paper will track development in Canada, Japan and Korea as these nations have achieved success despite significantly different geographical, political and marketplace conditions. The paper also notes the institutional and regulatory policies that have hampered broadband development in the United States.

The paper also will examine why incumbent local exchange and cable television operators recently have begun aggressively to pursue broadband market opportunities. The paper will analyze incumbents' rationales for limited capital investment in broadband with an eye toward determining the credibility of

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excuses based on regulatory risk and uncertainty. The paper concludes with suggestions how national governments might expedite broadband infrastructure development.

Keywords: Broadband; Infrastructure development; Internet; Digital divide

1. Introduction

Few would dispute that information and communications technologies (ICTs) can effectively "prime the pump" of a nation's economy (OECD, 2002).[1] Efficient information age infrastructures enhance productivity (Grace, Kenney, & Zhen–Wei Qiang, 2004) by providing intelligent networks that can handle converging (Hukill, Ono, & Vallath, 2000) voice, data and electronic commerce applications. These infrastructures provide a comparative advantage in "knowledge-based" (OECD, 1995, p. 3)[2] industries that include such diverse fields such as data processing, banking, insurance, management and technical consulting, travel planning, customer relations management, business logistics, etc. With an increasingly global economy enhanced by reduced trade barriers and the quest by companies to find new growth opportunities, substantial incentives exist for public and private players to leverage comparatively greater competency in information and communication markets domestically and abroad (Zhen-Wei Qiang, Pitt, & Ayers, 2003).[3]

Curiously, the track record for ICT implementation achieved by individual companies and nations does not always correlate with other indicators of success in trade, development and quality of life. For example, the United States has excelled in a number of information industries, including public sector leadership in developing Internet and private sector success in electronic commerce and other ICT markets such as computers, software and integrated circuits (Leiner et al., n.d.). But surprisingly observers across the political and social spectrum have roundly criticized the state of broadband network development (Grant & Latour, 2003)[4] in the United

[1] "The capacity of countries and firms to develop and manage knowledge assets has become a major determinant of economic growth and competitiveness.... [I]nvestment in and exploitation of knowledge remains a key driver of innovation, economic performance and social well being. Over the last decade, investments in knowledge—as measured by expenditures on research and development (R&D), higher education, and information and communication technologies (ICTs)—grew more rapidly than gross fixed capital formation." OECD (2002).

[2] "Knowledge is now recognized as the driver of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance. The term '*knowledge-based economy*' stems from this fuller recognition of the place of knowledge and technology in modern ... economies."

[3] See also, World Summit on the Information Society and the Role of ICT in Achieving the Millennium Development Goals, web site, available at: http://topics.developmentgateway.org/ict/sdm/previewDocument.do~activeDocumentId=815843; ICT for Development Web site, available at: http://topics.developmentgateway.org/ict; International Telecommunication Union, The World Summit on the Information Society Web site, available at: http://www.itu.int/wsis/.

[4] ICT development covers many diverse segments of a national economy. Accordingly, broadband development, by itself, may not serve as a complete measure of national success or failure in ICT development. On the other hand, one cannot overemphasize the importance of broadband network access for a variety of ICT services, including high speed Internet access and an increasing percentage of Internet-delivered services, such as Voice over the Internet Protocol, telephone services. "Currently VOIP [Voice Over Internet Protocol] accounts for less than 3% of global voice phone

States (Ferguson, 2002; Morgan, 2002).[5] Comparatively poor deployment of broadband network in the United States contrasts with far greater success achieved by other nations, including ones with no prior success in ICT development and with fewer financial resources than the United States (Hopkins, 2004).

The International Telecommunication Union reported that as of 1 January 2005 the five top nations for broadband network penetration were: Korea, Hong Kong, the Netherlands, Denmark, and Canada (ITU, 2005). The ITU ranked the United States 16th in broadband penetration. The Organization for Economic Cooperation and Development reported that in mid-2003 the top market penetration for member nations occurred in: Korea, Canada, Iceland, Denmark and Belgium with the United States ranked tenth (OECD, 2003a).

One might infer that comparatively poor new telecommunications infrastructure development (FCC, 2004)[6] in the United States and in other developed economies would adversely affect overall ICT development and global marketplace success. Indeed some stakeholders seeking more aggressive governmental support and regulatory relief in the United States claim that the nation collectively has forgone billions in lost business revenues and productivity gains (Pociask, n.d.).[7] These assertions make sense in light of the view that national and private investments in ICT have a multiplier effect by accruing dividends far greater than simple recoupment of costs (New Zealand Trade and Enterprise, n.d.; The Digital Opportunity Initiative, 2001).[8]

(*footnote continued*)
calls, according to an AT&T estimate. But a number of trends are working in its favor, say industry executives: the boom in demand; the evolution of the technology which permits companies to offer services beyond the reach of conventional phones; and the spread of broadband connections, which make VOIP much easier to use.''

[5]''The pace of deployment and technological progress in broadband, or high-speed, services remains seriously inadequate, a problem that results from the monopolistic structure, entrenched management, and political power of incumbent local exchange carriers (ILECs) such as BellSouth and Verizon and the cable television industry. It is worsened by major deficiencies in the policy and regulatory systems covering these industries. Failure to improve broadband performance could reduce U.S. productivity growth by 1 percent per year or more, as well as weaken public safety, military preparedness, and energy security'' (Ferguson, 2002). ''[Bill] Gates said US broadband would lag behind European and Far Eastern countries by 'five to six years'. He slammed US telecom providers and cable networks for recently increasing prices'' (Morgan, 2002).

[6]Current broadband infrastructure enhancements primarily involve upgrading existing telephone and cable television networks. Digital Subscriber Link service from local exchange carriers involves an upgrade to local loop copper wires so that they offer more bandwidth capable of providing both legacy voice telephone service and Internet access. Cable modem service from cable television companies involves the partitioning of an existing broadband wire into separate video delivery and Internet access links. Unlike most nations, cable modem access has predominated in the United States. Cable modems provide 75.3 percent of all broadband services in the United States while DSL serves 14.9% as of December 2003.

[7]''Waiting for computer screens to fill has resulted in $25 billion a year in lost e-commerce and countless billions of dollars in lost time for consumers.''

[8]''ICT is an integral component of every sector in the New Zealand economy—working behind the scenes as an 'enabler'—and is also a major sector in its own right. … The information and communications technology sector:

- makes a significant contribution to export growth
- can have a multiplier effect across other sectors
- can transform business and operational processes
- lifts productivity
- improves health and education outcomes
- has the potential to add exceptional value to New Zealand's traditional industries.''

Aside from the obvious geographical and demographic advantages accruing to small nations with large urban populations, broadband telecommunications network development has become a national priority for many nations. Governments in many developed and developing nations have organized a cohesive and comprehensive strategy for stimulating capital investment in ICT infrastructure and for expediting the deployment of ICT services in ways United States public and private sector stakeholders have yet to embrace. Such efforts have accrued ample dividends including the lowest broadband access costs in the world. For example, the ITU reports that in 2002 Japanese consumers paid $0.09 per 100 kilobits/s of broadband access compared to $3.53 in the United States (ITU, 2003a). This wide disparity exists in part, because Japanese broadband service providers have made the investment necessary to accommodate robust demand and to achieve economies of scale.

This paper will identify what institutional conditions in legislative, regulatory and business forums achieve success in developing faster, better cheaper and more convenient broadband services. The paper will concentrate on what strategies have worked well in Canada, Japan and Korea and what institutional constraints have handicapped broadband development in the United States. The paper uses broadband development as a proxy for considering how institutions can achieve greater efficiency and effectiveness in ICT development despite vastly different geographical, political and marketplace conditions.

2. Why ICT incubation matters

Both developed and developing nations recognize that ICT provides an effective opportunity to improve national living standards through enhancement of productivity (Hanna, 1994; Zhen-Wei Qiang et al., 2003).[9] Few would dispute that telecommunications and information processing technologies serve as powerful agents for economic and social development by improving access to information, enhancing trade in commodities and services, reducing costs and achieving efficiency gains:

> ICT can help enhance the working of markets and reduce transaction and coordination costs within and across organizations. This is of particular relevance to developing countries where transaction costs are very high because of logistical problems. ICT applications can enable improvements in productivity and quality in a number of sectors … such as agriculture, manufacturing, infrastructure, public administration, and services such as finance, trade, distribution, marketing, education and health (Sein & Harindranath, 2004).

(*footnote continued*)

(New Zealand Trade and Enterprise, n.d.). "Well-targeted ICT interventions in five key interrelated areas can play a crucial role in igniting and sustaining this development dynamic by creating the necessary conditions to achieve critical mass and to reach the thresholds required for significant multiplier effects and increasing returns to scale" (The Digital Opportunity Initiative, 2001).

[9]"Information technology dramatically increases the amount and timeliness of information available to economic agents—and the productivity of processes to organize, process, communicate, store, and retrieve information … [thereby impacting] countries, as producers and users of this technology" (Hanna, 1994, p. 1).

Nations must continually improve ICT innovation, incubation and exploitation, because an increasingly integrated global economy can quickly erode a nation's comparative advantages, particularly ones prone to volatility resulting from technological innovation. For example, ICT provides developing nations with greater opportunities to accelerate their ascent of a technology development learning curve through technology transfer and foreign direct investment. While ICT first might generate threats to employment in developed nations through outsourcing, it might subsequently jeopardize wealth generation in knowledge industries as emerging nations establish their own research and development prowess. When developing nations wean themselves of dependency on developed nations' patents and innovations, the upside revenue generating opportunities become more contestable among all nations.

For example, China has quickly evolved from providing cheap labor for component assembly, e.g., cellular radiotelephones, to a nation that can challenge its developed counterparts on the intellectual property and standards developed for next generation equipment. In the span of a few years Chinese companies have increased the amount of value they contribute to a product and in turn the financial returns accruing for such effort. Chinese mobile telephone manufacturers initially assembled handsets for sale domestically. Soon these companies provided world class quality assurance, in addition to cheap labor, so that their assembled handsets rivaled anything offered in the global marketplace. Not content with low margin assembly work, some manufacturers have collaborated with the Chinese government, technology parks and universities to develop the intellectual property needed for next generation mobile telephones. In short order, Chinese companies have migrated from ICT original equipment manufacturers for other companies, to ICT royalty paying ventures marketing their own equipment, to ICT innovators possibly soon to seek royalty payments from other manufacturers (Yan, n.d.).[10]

ICT development presents both challenges and opportunities to all nations. Developing nations no longer face the inevitability of having to organize their economies solely for the benefit of developed countries that provide the market demand for cheaply produced products. Developed nations can no longer consider technology transfer as largely a one-sided transaction that expands market penetration without risk of lost markets in the future.

3. The role of government in ICT incubation

Regardless of political and economic philosophy, national governments have significant functions to play in ICT development. Successful strategies have included an expansive governmental role in several areas including:

- Developing a vision and strategy.
- Promoting digital literacy, i.e., the ability to use digital technologies to pursue information, communications and entertainment interests.
- Investing in infrastructure, aggregating demand and serving as an anchor tenant.

[10]In a joint venture with Siemens the China Academy of Telecommunications Technology has developed the TD-SCDMA mobile radio standard for third generation mobile radiotelephones. This is the first telecommunications standard proposed by the Chinese industry and accepted as one of several standards by international forums.

- Fostering facilities-based competition.
- Creating incentives for private investment and disincentives for litigation and other delay tactics.
- Offering electronic government services, including healthcare, education, access to information, and licensing.
- Promoting universal service through subsidies and grants.
- Revising and reforming governmental safeguards to promote a high level of trust, security, privacy and consumer protection in ICT services, including electronic commerce.

Nations with successful ICT development strategies do not appear to quibble about whether government should meddle in areas that the private sector possibly could manage exclusively. However, one person's view of government stewardship might come across to another as "industrial policy" and centralized management by the public sector. Successful ICT incubation appears to require government involvement, albeit with a light hand that stimulates and rewards investment, reduces unneeded regulatory scrutiny, and promotes global marketplace attractiveness without "tilting the competitive playing field" to favor a specific technology or company.

4. ICT incubation in the United States

Curiously even as the United States severely lags in broadband market penetration, this nation has achieved global supremacy in other ICT markets in part through the successful partnership of the public and private sector. The 'United States' model for ICT development favors entrepreneurialism and private enterprise coupled with direct and indirect financial support by government primarily through early stage incubation. For example, the Internet originated as a collaboration of government agencies and universities under the auspices of the Defense Advanced Research Projects Agency, a branch of the United States Defense Department. The Internet later evolved under loose management and financial support from the National Science Foundation with the Department of Commerce administering domain name registration. While the United States government later eliminated direct financial underwriting when it privatized the Internet backbone, few would argue that early underwriting and anchor tenancy exemplified effective and successful government incubation of ICT.

In the United States, governmental underwriting of Internet development had a short time span, because of an institutional predisposition against government management of commercial markets and the perception by entrepreneurs that high monetary rewards justified risk taking. In stark contrast to the absence of broadband incubation, the United States government got involved early, but calibrated a timely exit strategy when a critical mass of private resources had developed. The United States government could make a quick exit, because venture capital could readily replace taxpayer financed investment, research and development. Additionally a well developed marketplace for lawyers, accountants, consultants, and entrepreneurs made it possible for private risk taking. A favorable tax climate ensures that ample rewards provide incentives for entrepreneurship.

High technology hotbeds, such as Silicon Valley, California demonstrate a largely private orientation to ICT development in the United States. In an assessment of what makes Silicon

Valley, California a high technology development success, the authors of *The Silicon Valley Edge* (Lee, Miller, Hancock, & Rowen, 2000) suggest ten factors:

(1) Favorable rules of the game—laws, regulations, and conventions for securities, research and development, taxes, accounting, corporate governance, bankruptcy, immigration and development designed to support entrepreneurship and risk taking.
(2) Knowledge intensity—the region has achieved a critical mass of ideas for new products, services, markets and business models. Silicon Valley serves as a magnet for entrepreneurs, educators, venture capitalists and people with vision.
(3) A high quality and mobile work force—talented, educated and motivated people seek to make a home and a fortune in the region.
(4) Results-oriented meritocracy—talent and ability accrue rewards in Silicon Valley without regard to race, ethnicity and age.
(5) A climate that rewards risk-taking and tolerates failure—the region supports a high risk/high reward calculus, but also makes it possible for entrepreneurs who have experienced failure to regroup and try again.
(6) Open business environment—the region supports robust competition, but also knowledge sharing. This win/win environment results from the frequent formal and informal interactions among people with similar interests and objectives. Networking and relationships matter as much as technological innovations.
(7) Universities and research institutes that interact with industry—major universities like Stanford foster exchanges among academics and entrepreneurs.
(8) Collaborations among business, government and nonprofit organizations—the region houses universities, trade associations, labor councils, service organizations and companies all of which collaborate and network with an eye toward a successful future.
(9) High quality of life—despite traffic congestions, soaring housing prices, relentless pace of work and recent power outages, Silicon Valley offers proximity to open spaces and urban amenities.
(10) Specialized business infrastructure—the region provides access to specialists needed for economic development including consultants, lawyers, venture capitalists and executive recruiters.

ICT incubation in the United States has achieved great success, in part, thanks to largely underemphasized governmental involvement. However, one should not discount the effect of early government financial involvement coupled with ongoing financial benefits accrued through favorable tax treatment and other financial incentives, e.g., tax holidays, revenue repatriation, infrastructure improvements and favorable immigration policies.

5. ICT development failures in the United States

The fact that the United States lags significantly in broadband infrastructure development provides a stark contrast to the success story outlined above. Several legislative and regulatory initiatives have failed to achieve the intended results, or have backfired. While the United States

may lead in technology incubation at technology parks and in regions, such as Silicon Valley, California, the nation substantially lags in the increasingly essential first and last kilometer access to ICT provided by broadband telecommunications networks. This failure juxtaposes with this nation's leadership in commercialization of the Internet and broader electronic commerce markets.

The failure of the United States to develop best in class broadband infrastructure results, in part, from lack of investment in new ICT technology by incumbent telecommunications service providers. Additionally, most market entrants concentrated on serving long haul transmission markets while opting to rely on incumbents to provide first and last kilometer access at promotional prices as required by law. The Telecommunications Act of 1996 (Frieden, 1997) provided a legislative qui pro quo for incumbent Bell Operating Companies: authority to provide long distance toll telephone services in exchange for providing local exchange access based not on historical technology deployment costs, but on forward looking, best practices new technology costs (Frieden, 2003a, b). While the incumbent Bell Companies welcomed the opportunity to generate new long distance telephone service profits, they objected as "confiscatory" the duty to enhance competitors' market share by offering local exchange network access at rates well below what they considered cost and what they would demand in commercial negotiations (Baumol & Merrill, 1997; Spulber & Yoo, 2003).

The Telecommunications Act of 1996 did not stimulate the development of viable local exchange service competition and the upgrading of local networks to provide broadband, high-speed data services (Dibadj, 2003). The Bell Operating Companies refused to make the necessary investments based on the view that they should not have to continue subsidizing competition, particularly in light of the fact that many new competitors did not appear inclined ever to migrate from reselling Bell network capacity to building and operating their own local facilities.

Additionally, both incumbents and newcomers suffered heavy financial losses as a result of severe reversals in the markets for anything relating to the Internet. The bursting of the dotcom bubble shifted investor sentiment from irrational exuberance to extraordinary pessimism. Investment bankers quickly moved from supporting acquisition of market share to requiring evidence of near term profitability, thereby making capital investment contingent on largely unachievable results.

Additionally, the proliferation of operating standards, particularly in wireless services, has fragmented telecommunications equipment markets and has made it difficult for any one company or technology to reach a critical mass. Consensus on operating standards can occur as a result of government stewardship, market forces or stakeholder collaboration. In the United States none of the three options has occurred, resulting in slower rollout of some ICT technologies and adoption by consumers.

The combination of market downturn, legislative failure and lack of consensus on operating standards has removed many of the incentives for risk taking and investment, even as the need for network upgrades proved essential for the evolution of high-speed broadband ICT services. Stakeholders appeared more intent on competing in the courtroom than in the marketplace. The incumbent Bell Operating Companies made infrastructure investment contingent on securing massive regulatory liberalization which, if implemented, might result in the establishment of a shared monopoly among telephone and cable television companies without significant government oversight.

Broadband network development in the United States already has begun to accelerate as the overall economy improves and as the Bell Operating Companies succeed in securing regulatory relief, including forbearance from having to comply with requirements specified in the Telecommunications Act of 1996. However, the potential for much faster and earlier rollout of new ICT technologies existed in the United States without government legislators and regulators, having to dismantle still essential regulatory safeguards.

6. Best practices in ICT development

Nations as diverse as Canada, Japan and Korea provide insights on how to achieve maximum success in ICT development and what roles governments can effectively assume. These and other nations offer insights on how government-led integration of technology incubation and development can generate ample dividends. While these governments readily encourage private enterprise and direct foreign investment in technology ventures, they do not shy from pursuing an active and vital role. In vivid contrast to the United States model where government incubates and quickly departs, best practice ICT development in many nations demonstrates the benefits from long-term involvement by honest, technologically sophisticated government officials that understand the stakes involved and work conscientiously to establish a transparent, efficient, flexible and positive business environment for the long run.

For example, in many nations governments sponsor science and technology parks where the government or a government appointed manager integrates all of the necessary elements for "the production and commercialization of advanced technologies by forging synergies among research centers, educational institutions and technology-based companies" (Petree, Petkov, & Spiro, 1999). Governments can achieve this synergy primarily through investments, preferential policies and focused leadership under the auspices of an economic development board that underwrites programs designed to finance research and development projects and to promote commercialization of applied research.

Put another way, nations have expedited ICT development by mastering the ability to foster an efficient and favorable business environment. This environment results, in part, from the ability of technology parks and other development vehicles to foster:

- cooperation in both pure and applied research and development with scientific research institutes and laboratories;
- ease of access to venture capital;
- the availability of professional, technical, administrative and legal assistance;
- state-of-the-art information and telecommunications services; and
- a fair and transparent business infrastructure.

7. Indigenous comparative advantages

Before considering what public and private actions can do to expedite ICT development, one should appreciate that a significant set of indigenous factors that contribute to, or deter progress. A number of localized characteristics favor ICT development independent of concerted actions.

For example, geography and demographics can make ICT development tasks easier or harder as a function of nation size, population density, per capita income, percentage of high rise housing and size of households.

Nations and administrative regions such as Korea, Singapore (Aizu, 2002; Wong, 2003)[11] and Hong Kong (ITU, 2003b) should have an easier ICT development task simply because telecommunications carriers have fewer lines to install and more people possibly served by these lines. Geographically small nations, with little rugged terrain and high incomes can achieve ubiquitous digital network access on a timely and efficient basis, perhaps even without having to create a sizeable fund for subsidizing service to rural and low-income residents. Similarly, with a population skewed to youthful, urban apartment dwellers, telecommunications carriers can more readily introduce new services and achieve comparatively higher penetration rates than what carriers in other nations would achieve. A nation such as Korea enjoys a larger percentage of technology "early adopters" keen on accessing services that provide faster, better, smarter, cheaper and more convenient solutions to existing requirements coupled with a willingness to use technologies to serve new wants, needs and desires. Well educated Korean youth with sufficient discretionary funds supported ICT development first by frequenting personal computer gaming rooms, known as PC bangs, and later by embracing new markets including streaming music, Internet and wireless messaging and online photography.

Additionally, one cannot underestimate the impact of attitudes toward ICT and the extent to which entrepreneurs will take risks to provide services offering clearly better consumer benefits. A culture favoring education, speedy resolution of problems and risk taking favors ICT development, because consumers will more readily embrace technologies that provide tangible improvements. The push of new technologies meets an equally aggressive demand pull.

8. Acquired comparative advantages

Indigenous comparative advantages cannot reliably propel a nation into ICT development supremacy, nor do the identified factors help explain why some nations excel while others falter. Acquired comparative advantages result from concerted efforts by the public and private sector to achieve ICT development with an eye toward fostering improvements in the quality of life, individual wealth and national economic development (OECD, 2003b). The best advantages result when governments effectively calibrate the scope of intervention to the degree of market stimulation required and the extent to which ICT development would not occur but for government subsidization, demand aggregation, and sponsored pilot projects.

9. Government vision, strategy and stewardship

The acquisition of comparative advantages in ICT development appears impossible without some degree of government involvement. No matter how attractive "blue sky" technologies appear on the horizon, governments may need to jump start new technology adoption and thereby accelerate the accrual of a critical mass needed to achieve scale economies and the ability to offer services at rates a mass market will support. Before private enterprises can operate largely

[11]Izumi Aizu compared successful deployment in Korea versus mixed results in Singapore.

free of government meddling/support, a technology incubation phase typically must occur as was the case for Internet development in the United States. Governments willing to undertake an active role need to reach closure on a vision of what constitutes ICT development success and what steps they should take to achieve these outcomes.

10. Canadian government efforts

The Canadian government also launched a series of early ICT development initiatives articulated in the 1990s (Industry Canada, 1994; Government of Canada, 1996; Connecting Canadians Web site). The Ministry of Industry articulated a strategy to make Canada the most connected country in the world[12] and to achieve ICT development primarily through the promotion of on-line access, developing ICT-intensive "smart communities," creating incentives for the creation of indigenous content for transmission via the Internet, expediting electronic commerce and delivering electronic government services (ITU, 2003c). In 2001 a National Broadband Taskforce specified a strategy for achieving ubiquitous access to broadband networks and services by 2005 (Government of Canada, 2004). Specifically the Task Force established several access priorities including the view that all communities, including small businesses and residential users, should have Internet access at throughput speeds in excess of 1.5 megabits/s, rural access rates should not exceed urban rates, and the local broadband infrastructure should extend to schools, public libraries and other public access points.

The Task Force identified two funding vehicles for achieving these goals:

(1) A top-down infrastructure government support model that creates broadband network and service investment incentives.
(2) A bottom-up "community aggregator model" where government funded pilot programs and the delivery of electronic government services help stimulate the generation of sufficient demand to use existing network capacity and stimulate the construction of new facilities.

11. Korean government efforts

The Korean government articulated an action plan in 1997, entitled *Cyber Korea* 21 (Government of Korea, 1999, 2002) when the Ministry of Information and Communications articulated a vision of a "knowledge-based economy" where every citizen would have access to a personal computer, the government would expedite development of an information infrastructure and all stakeholders in ICT would work together (ITU, 2003d) to increase productivity, employment and exports (Government of Korea, 2003; Dahlman & Andersson, 2001). The Korean government recognized that the scale and ambitiousness of such a vision would require several types of initiatives and financial inducements (Lee, n.d.) including:

- Efforts by regulatory authorities to encourage infrastructure investment by incumbents and market entrants (OECD, 2004).

[12]For background on Canada's broadband initiatives see http://www.broadband.gc.ca/pub/media/index.html.

- Regulatory parity among operators with an eye toward promoting facilities-based competition, but also market entry by operators who might need to access some facilities of the incumbent.
- Direct underwriting, loans, favorable tax treatment, and other types of financial support for construction of new high capacity backbone digital, broadband networks.
- Financial support for research, development and technology demonstration projects; subsidies for purchase of personal computers by low-income citizens.
- Promoting digital literacy including the ability to use information technologies for interacting with government and for acquiring information, communications and entertainment services (Han).
- Supporting electronic government, education, e-commerce (Lee, O'Keefe, & Yun, 2003), healthcare and other types of ICT-mediated services.[13]

12. Japanese government efforts

Japan developed a high level national information "e-Japan" strategy in 2001 with ambitious goals addressing infrastructure, human resources, e-commerce, e-government and network security (see Prime Minister Japan and His Cabinet). [14] Perhaps smarting from less robust development than nearby Korea, Japan expedited the development of the world's most advanced telecommunications and information networks, blending private and public sector initiatives (ITU, 2003e, Ishii, 2003). The e-Japan strategy triggered the development of 220 separate projects in its first year and achieved the goal of linking 30 million households to high speed Internet access options (Yamada, 2004; Takada, 2003; Taniwaka, 2003, 2004). Today Japanese residential consumers have the highest throughput speeds and the lowest per megabit cost.

13. Regulatory initiatives

Perhaps the key regulatory initiative pursued by nations such as Canada, Korea and Japan lies in effectively changing the regulatory climate without triggering costly and protracted litigation such as that which has thwarted progress in the United States. Nations can use regulatory change to promote facilities-based and resale competition through incremental deregulation of the sector, liberalization of rules affecting incumbent carriers and mandating cost-based and compulsory access to the incumbent carrier's switches and transmission capacity at fair and compensatory

[13]For extensive research and reports on ICT issues in Korea and elsewhere see Korea Informatization Promotion Committee Web site at: http://www.ipc.go.kr/intra/HPEnglish.nsf. and Korea Information Strategy Development Institute Web site at: http://www.kisdi.re.kr/.

[14]See Prime Minister of Japan and His Cabinet (2001), Information Technology web site, available at: http://www.kantei.go.jp/foreign/it_e.html; "We will strive to establish an environment where the private sector, based on market forces, can exert its full potential and make Japan the world's most advanced IT nation within five years by: (1) building an ultra high-speed Internet network and providing constant Internet access at the earliest date possible, (2) establishing rules on electronic commerce, (3) realizing an electronic government and (4) nurturing high-quality human resources for the new era." e-Japan Strategy, Jan, 2001, available at: http://www.kantei.go.jp/foreign/it/network/0122full_e.html.

rates. Progressive tax policies, including investment tax credit further stimulate incentives to invest in ICT infrastructure.

National regulatory authorities have to find a way to create incentives for incumbents and newcomers alike to invest in infrastructure needed to provide high-speed broadband data services. The key driver for such investment lies in the development of sustainable competition with a multiplicity of operators in each of the technologies providing broadband services now or prospectively, viz., wireline telephony operators first using embedded copper and later using fiber optic facilities, wireless operators and cable television ventures. As a result of competition in conventional voice telephone services, incumbents typically face declining margins and the potential for commodity pricing, i.e., limited ability to differentiate their telephone service from that offered by other carriers. Faced with such competitive necessity it follows that incumbents would have to diversify services and pursue new profit centers including value added network, wireless and data services (Frieden, 2003a, b).

The need to respond to declining revenues in core business lines and new deregulatory opportunities have begun to stimulate interest in expediting delivery of broadband services by United States carriers. However, years earlier, carriers in Canada, Japan and Korea made such investments as a result of governmental encouragement, real or perceived competitive necessity and internal market forecasts. Meanwhile in the United States incumbent telephone companies complained about the unfairness in having to unbundle their networks and offer access to individual elements at rates below market. Cable television ventures succeeded in thwarting efforts to force them to provide common carrier like open access to any Internet Service Provider in lieu dedicated access to a corporate ISP affiliate or joint venture partner.

Carriers in best practice nations accepted the regulatory mandate and turned their attention to capitalizing on new market opportunities. Carriers in the United States resorted to litigation and delay with an eye toward conserving capital until such time as the demand for broadband services became unassailable. Such stalling tactics resulted from conditions of heightened fear, uncertainty and doubt resulting from an economic downturn largely triggered by a decline in confidence that the Internet and demand for Internet services would trigger perpetual growth. Carriers more willing to embrace change and to accept the onset of a ''new world order'' predominated by data services (Kiser & Collins, 2003; Frieden, 2003b) appear better equipped to capitalize on new market opportunities. Carriers keen on conserving capital and reducing risk exposure appear less able to migrate from a business plan predominated by voice services, despite the fact that this once core market has deteriorated and will continue to decline as consumers migrate to wireless and Internet-based, data services.

14. Supply side stimulation: underwriting research, funding pilot programs and community champions

Nations offering best practices in supply side stimulation recognize the importance of triggering an expedited migration from narrowband to broadband services and promoting widespread availability of new services at attractive prices (United Kingdom Department of Trade and

Industry and Brunel University, 2002).[15] While preferring private carriers to make the transition to broadband on the basis of competitive necessity and declining margins in basic voice telephony markets, government at the local, provincial and federal level volunteered to provide financial support under conditions of market failure, i.e., the unwillingness of private firms to make the investment based on the view that they lacked certainty whether they could accrue a sustainable and adequate profit. Such self-help programs brought broadband digital services to hinterland locations north of the artic circle in Canada, primarily through assessment of business plans of community groups also known as "community champions" and the grant of up to 50% of the eligible costs anticipated to develop a broadband program.

Ironically the use of metered pricing for narrowband services made it financially more attractive to migrate to unmetered, always on ("all you can eat") broadband services. Unlike in the United States, telecommunications consumers in many nations have to pay per minute rates for access to voice telephone and Internet services. With the onset of broadband services, charged on a flat-rated monthly basis, even moderate World Wide Web surfers could opt for unlimited access at a slightly higher rate.

15. Demand side stimulation: promoting digital literacy, aggregating demand and delivering e-government services

Best practice includes efforts by national governments to stimulate and aggregate demand primarily by offering citizens better ways to acquire government, education and health services. While youthful video gamers needed no inducement to appreciate the benefits of high speed, online access, others grew to appreciate the time saving and productivity enhancements available from broadband services. For example, high-speed data networks make it possible for remote communities to secure medical consultations with local nurses and doctors based at urban teaching hospitals, as well as rapid transmission of X-ray images. E-learning possibilities include high-speed access to data bases, multi-media learning tools, and video conferencing with teachers in a virtual classroom environment.

16. New challenges to developed nations

Developed nations such as Germany and the United States increasingly have to rely on ICT markets to accrue competitive advantages that generate wealth and support high existing standards of living. These nations can no longer simply assume that developing nations will serve as largely untapped markets, or as low cost assemblers and manufacturers of goods using intellectual property created in developed nations. For developed nations ICT development generates new risks and insecurity not only in light of employment losses due to outsourcing, but

[15]Stewardship by the Korean government offers several vehicles for expediting broadband deployment and use. See United Kingdom Department of Trade and Industry and Brunel University, *Investigating Broadband Deployment in South Korea—Broadband Mission to South Korea* (October 2002); available at: http://www.broadbanduk.org/reports/SKorea_report.pdf.

also because ICT incubation in developing nations helps them become innovators as well as low cost assemblers.

Developing nations such as China have already established themselves as least cost manufacturers using the intellectual property created elsewhere. ICT incubation for some developing nations provides the opportunity to become more than technology licensees and copiers. For developed nations to maintain their comparative advantage in ICT, they must continually prime the pump through research and entrepreneurship. As never before ICT incubation provides upside opportunities for all nations.

17. Conclusions

ICT development, including investment in a robust broadband infrastructure, requires extensive coordination and cooperation among private and public sector players. Successful ICT development typically occurs if and only if both types of participants stick to roles proven to maximize benefits. For government the empirically proven role involves neither a laissez faire abdication of responsibility, nor intrusive, heavy-handed, command and control regulation that predominated when private or government monopolies largely controlled the roll out of ICT. Governments can enhance ICT development by articulating from the top a broad vision of what ICT can do for a nation and its citizens, while leaving to community champions the flexibility to propose specific, "bottom-up," projects that aggregate the supply of services needed to support the build out of a telecommunications infrastructure.

For the private sector, the proven role does not involve extensive litigation, and delayed investment, or the leveraging of ICT investment in exchange for even greater deregulatory relief. The private sector needs to make the necessary investments in ICT incubation, but government can create incentives for such investment by underwriting and guaranteeing loans, providing favorable tax treatment and financially supporting a portion of the necessary research, development and technology demonstration projects.

Governments do not serve as a catalyst simply by throwing money at the "problem" of insufficient ICT development. Wasted investment in ICT development can occur if government relies on one category of private sector participant, e.g., incumbent local exchange telephone companies, to administer the major programs designed to promote universal access to basic telecommunication services. The incumbent develops a reliance on, and expectation for this funding source and has little incentive to achieve a universal service goal, as opposed to justifying an ongoing source of subsidies for preferred beneficiaries which includes the carrier itself. Developing a recurring subsidy and funding mechanism, as opposed to relying primarily on ad hoc project funding, typically justifies the need for an extensive bureaucracy similarly keen on pursuing an ongoing mission, or expanding broad development goals. Ironically, the universal service funding mechanism in the United States, which promotes subsidized access to often unmetered basic telephony, has created disincentives for consumers to migrate to available, but unsubsidized broadband services.

Nations achieving comparatively greater success in ICT development demonstrate the value in having a specific mission, achievable goals and policies designed to achieve success. The governments of Canada, Japan and Korea articulated a vision of what ICT could do for both and

public and private sectors beneficiaries. At the macro-level, these nations created laws that created incentives for risk taking and innovation and penalized litigation and strategies to delay making necessary investment in capital-intensive projects. At the micro-level these nations linked public funding with private initiatives that aggregated demand, generated matching funds and justified the installation of ICT even in geographically unattractive locales.

The United States has largely failed to match its comparative advantage in private ICT incubation, such as Silicon Valley, with similar world class governmental incubation, despite having achieved success in developing and then privatizing the Internet. The lack of success in recent governmental incubation efforts, e.g., in broadband market penetration, stems largely from the failure to appreciate the need to blend and integrate both private sector entrepreneurialism and public sector stewardship. Such stewardship involves active governmental involvement, as cheerleader, referee, loan guarantor, grant funder and anchor tenant in a sector that many in the United States believe warrants little if any government involvement. Nations exhibiting best practices in ICT development clearly show the benefit of a combination of public and private initiatives.

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