BRIDGING THE US INTERNET GAP: IT'S THE ECONOMICS ….

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The US invented the Internet and its underlying technology. Yet, the country is falling behind many of its competitors in the penetration of broadband access. In addition, the Internet is plagued with increasingly costly security attacks. Our research highlights the importance of economic mechanisms in addressing these problems.

The Problems

The ***penetration of broadband access*** to the Internet in the US is falling behind most other first-world countries. Japanese get 100Mbps access for about $40.00/month and many South Koreans have a comparable access rate in addition to broadband wireless access. Only 20% of US users get an access rate that exceeds 200kbps.

In 2005, the US ranked 25th in broadband access, with a growth rate that ranked 21st. The situation is getting worse(1). This broadband access gap is handicapping the US competitiveness in education, health care delivery, and economic productivity.

How can the country that invented the Internet fall behind Belgium, Canada, Japan, South Korea, and many other countries?

Security is a major concern for the Internet. Hardly a month goes by without a story about a laptop getting stolen with hundreds of thousands of unencrypted confidential records. Also, denial-of-service attacks are increasingly frequent and cause substantial damages to the targeted organizations (2).

Given all the cryptographic tools developed over the last fifty years and the importance of the Internet in business transactions, how can security remain so inadequate?

Possible Explanations

One often-cited reason for the gap in broadband access is the lower average density (31 people per square km) in the US, compared with South Korea (480), the United Kingdom (246), or France (110). However, the fraction of urban population in the US is about the same as in Europe (75%), which suggests that this factor may not be critical. After all, broadband penetration in Canada is larger than in the US and that in Australia is comparable although those countries' densities are ten times lower than that of the US.

Another often-mentioned reason is that other countries use governmental interventions to correct market failures, i.e.,

to provide funds for investments that may not be profitable in the medium term or to accelerate penetration. For instance, the South Korean government invested more than $1B in broadband access.

Some economists argue that providing high-speed Internet access has such a large impact on the effectiveness of the educational system, health care, research, and productivity that investing in it is a no-brainer for a government. After all, the US government invested massively in the highway network and it also provided the initial funding for the development of the Internet. It may be time to do it for broadband access.

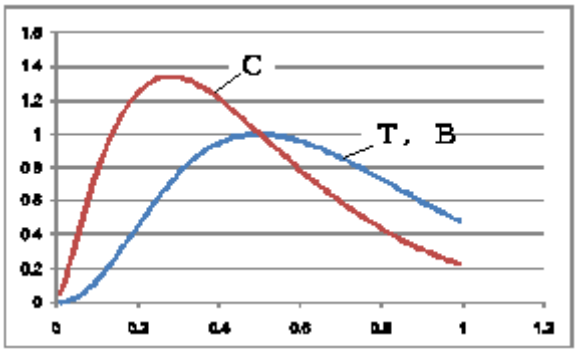
However, the current political and budget realities may be such that the most likely approach to filling the Internet gap is to improve the incentives for private investments.

The Role of Regulations

The value of the Internet grows rapidly because the network is open to all. Anyone can post information on the Internet. A small company can invent a new application and make it available (Google and Facebook were once small startups).

However, the Internet needs a balanced growth of applications, content, and transport. If the transport lags behind, as it is currently in the US, then all users suffer.

Under an NSF-FIND (Future Internet Design) research grant, our team investigates the impact of regulation on investment incentives for content and transport providers. One result of the research is that the growth of the Internet can be stimulated by authorizing specific charges by ISPs on content providers for delivery of high-bandwidth content. Such charges would stimulate additional investments in broadband access that would in turn generate more demand for rich content and higher revenue for the content providers.



The graphs[4] show the impact of enabling such charges on the revenue of content (C) and transport providers (T) and on the total volume of traffic in the network (B). The horizontal axis corresponds to different ratios of prices that content providers and ISPs can charge. A large value of that ratio means that content providers can charge advertisers more than ISPs can charge residential users. In this situation, the graphs show that not being able to charge for content delivery reduces the revenues of content and transport providers and the total utilization of the network.

Such form of pricing is controversial because it involves discriminating among users. Concretely, an ISP would charge a content provider for the delivery of its content but the ISP would not charge a regular user for the delivery of the same content. Such discrimination is not unusual. For instance, advertisers have access to a bulk rate for mail delivery whereas regular users do not. Nevertheless, one can legitimately worry that user discrimination might limit access to the internet to the less wealthy users or small corporations.

One possible compromise might be an 80%-neutral Internet. Under this model, 80% of the traffic would be neutral (non-discriminatory) and the remaining 20% would be subject to minimal regulation and to free-market forces. We are exploring the feasibility of such an approach.

What about Security?

Many researchers agree that the cause for such security lapses is not the lack of cryptographic tools. Freeware is widely available to encrypt confidential records on a laptop. Good virus detection and firewall software is readily available to limit distributed denial of service attacks. What are missing are proper incentives for users to take the appropriate security measures by installing and updating the suitable software and making use of it.

Under our NSF-FIND grant, our team explored models of economic incentives for security [5]. The studies show that the lack of awareness of the impact of security measures on the rest of society leads to under-investments in security. Although this effect is not surprising, its magnitude is significant.

We are exploring two approaches to correct this lack of awareness. The first approach is a direct mechanism whereby ISPs would provide a rebate on Internet access fees for users with secure computers. The second approach involves indirect mechanisms that provide better services to secure computers, either at the servers of content providers or in the transport network.

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[1] "US Falls to 25th in Broadband Penetration Worldwide - US Broadband Growth Below OECD Average" - April 2007 Bandwidth Report. http://www.websiteoptimization.com/bw/0704/

[2] Symantec Internet Security Threat Report. http://www.symantec.com/business/theme.jsp?themeid=threatreport

[3] NeTS-FIND 0627161: Market-Enabling Network Architectures (2006-2009).

[4] John Musacchio, Galina Schwartz, and Jean Walrand, "Network Neutrality and Provider Investment Incentives," preprint. http://robotics.eecs.berkeley.edu/~wlr/Papers/neutrality.pdf

[5] L. Jiang, V. Anantharam, and J. Walrand, "Efficiency of selfish investment in network security," preprint, 2008; http://robotics.eecs.berkeley.edu~wlr/Papers/libin-security.pdf