True High Capacity Networks; A regulatory framework

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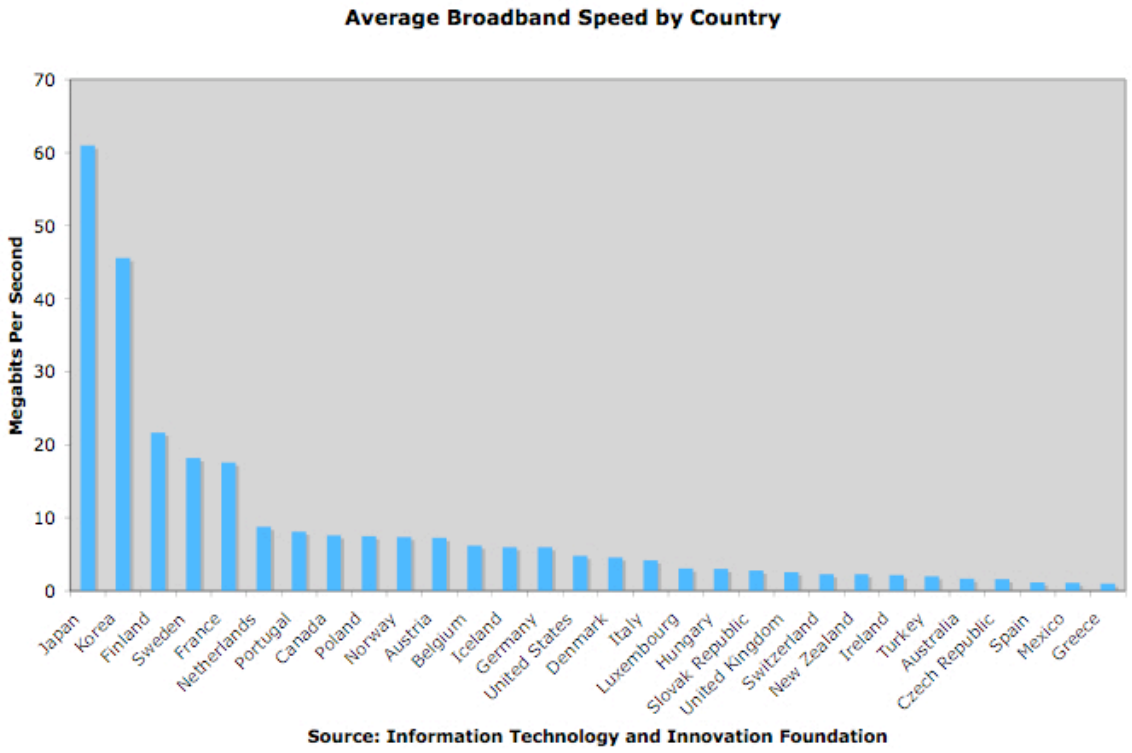
The United States is at a technological crossroads. At a time of dramatically increased demand for Internet capacity and unresolved issues around the concepts of Network Neutrality, a new regulatory approach is needed to both incentivize bandwidth deployment and maintain an open Internet. Although it has lagged many developed countries in the speed of its Broadband Networks, a new President has challenged network providers to match the speed and capacity of the best of the Asian networks with fourth generation technology running at 50 MBPS symmetrical, that we will call **High Band**, to distinguish it from the slower Broadband Internet.



Such networks will eliminate last mile bandwidth scarcity, but will also require a new regime that dispenses with any public-policy limitations on network management for all networks that combine an open, neutral channel of 8 MBPS alongside a managed IP network that would deliver High Definition TV on demand alongside voice, date and broadcast TV. This paper confines itself to the High Capacity networks needed to stream High Definition video and so its policy recommendations do not apply to the wireless networks being deployed.

The Coming Bandwidth Crunch

The technological lag in broadband speeds and diffusion that President Obama noted during the campaign is certainly not due to backbone capacity, as the Wall Street Journal recently noted, "an excess of capacity of long-haul networks has led to a collapse in pricing." What is lacking in the United States is the next generation of high capacity network to the home—High Band. As you can see from the chart above, such networks using fiber to the home at 50+ MBPS symmetrical are currently available in Japan and South Korea. Fortunately a few American companies have invested in these Fourth Generation Networks that will put them on a level with the best of the Japanese and Korean telecoms. The arrival of High Band is desperately needed in light of what some are calling Visual Networking. A brand new research paper from Cisco[1] highlights the future growth of bandwidth use driven by Internet video and social networking.

> -Global IP traffic will increase by a factor of five from 2008 to 2013; approaching 56 Exabyte's per month in 2013, compared to approximately 9 Exabyte's per month in 2008.

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[1] http://www.cisco.com/en/US/netsol/ns827/networking_solutions_sub_solution.html

-By 2013, annual global IP traffic will reach two-thirds of a zettabyte (673 Exabyte's). A zettabyte is a trillion gigabytes.
-By 2013, the sum of all forms of video (TV, VoD, Internet Video, and P2P) will exceed 90 percent of global consumer traffic.
-By 2013, global online video will be 60 percent of consumer Internet traffic (up from 32 percent in 2009).
-Mobile data traffic will roughly double each year from 2008 through 2013.

What is most important to realize that this new world of Visual Networking—real-time video flowing in great quantities in all directions at once—is distinctly different in form from earlier Internet capacity architecture. The high definition videoconference of the future is a symmetrical event with equal capacity flowing upstream and downstream. With the exception of companies that have built fiber to the premises, current broadband networks are not ready for this future. The fact that some firms are preparing for this transition is an American reaffirmation that our history of communications leadership is not over and so there is no reason to doubt the capacity of the current American Internet ecosystem to deliver world-class products and services. The purpose of this paper will be to outline a potential regulatory framework that both encourages innovation and investment in High Band while preserving the open Internet ecology that was invented at America's great Universities, with the key support of the Federal Government. Our basic notion is that government and large telecom companies have been cooperative partners in the foundational aspects of modern communications technology for over 100 years and there is no reason to believe that they should become adversaries at the very moment when America could once again regain its leadership role in true high capacity networks and applications.

History

Although the recent history of innovation has been based around the romantic myth of the garage start up, the kind of investment and innovation that will be needed in the next 20 years harks back to earlier models. The story of the Bell System and its research lab, Bell Laboratories, is one of the great narratives of American innovation. Bell Labs was located in a 13 building research complex at 463 West Street in Manhattan, where it operated from 1898 to 1966. Most of the scientists that worked there were relocated to facilities in New Jersey in the mid 1960's. It was without question the most important industrial research center in the world. Its scientists won six Nobel prizes between 1937 and 1998 for everything from demonstrating the wave nature of matter, the invention of the transistor to the discovery of cosmic microwave background radiation. Thus the profits of a monopoly telephone provider, funneled into its R & D subsidiary not only benefited the telephone services consumer but the general society as a whole. But the innovations of Bell Labs went far beyond the applied sciences research agenda. Over the course of its history, all the basic tools of our contemporary communications culture were invented at the lab. The list of inventions at the Lab is astounding: facsimile transmission, the first synchronous sound motion picture, the first long distance television transmission, the first unbreakable one-time pad cipher, the first electronic speech synthesizer, the first solid-state electronics, the transistor, the photovoltaic cell, the first analog computer, microwave radio relays, the first digital computer, the laser, C Programming language, UNIX, OFDM, TDMA, CDMA, C++, fiber optic transmission and the first 32 Bit single chip microprocessor.

When AT&T was broken up in 1984, Bell Labs was spun out into a separate company eventually named Lucent. Although Lucent continued to make important innovations it is safe to say that the end of the continuous stream of profits from the regulated monopoly, AT&T, that had funded Bell Labs, brought an end to the most extraordinary sixty years of innovation in corporate history. Activists who rail against the size and scale of large telecom companies need to realize the downside to the break up. It is true that innovation in applications and hardware have continued to flow from companies like Apple that once started in a garage. But today the innovators like Apple with their I Phone and Verizon with their High Band FIOS network play on a roughly equal playing field of companies with market capitalization above $75 Billion. The next stage of innovation will be expensive and misguided competition policy could lead to a massive misallocation of capital based on the flawed notion that we need many firms building fiber to the home. Craig Moffett of Bernstein Research has compared this to the notion that we would need two subway lines along 42nd Street in New York for consumer choice to flourish.

The second misperception in the understanding of American communications innovation is in the role of the government as partner with both business and academia in the development of technology. It is important to note the historical role of the Defense Advanced Research Projects Administration (DARPA) in the development of the networked computer and the foundation of the modern Internet. Established in February of 1958 as a direct response to the Soviet Union's launch of Sputnik, DARPA's first major $2 million grant went towards building the computer time-sharing programs that eventually became known as MULTICS. The early research was done at MIT and by

1962 Bell Labs and General Electric were brought in as corporate partners. This established the template for DARPA, a small flat agency (often called “100 geniuses and a travel agent”) that could fund University research that would then flow into the corporate R & D labs. The work on time-sharing soon developed into ARPANET (the first wide area packet switching network and the precursor to the Internet), TCP/IP, the browser and the first hypermedia system. This model for government, university and corporate cooperation is critical for U.S. competitive standing because the future of High Band applications will require cooperation.

The third (and most important) historical issue facing policy makers relates to the evolutionary business models flowing from the rise of the Broadband Internet. To put it most starkly, the current “free” business models of even the most successful companies are unsustainable. Craig Moffett of Bernstein Research recently commented on Google’s You Tube: “In contrast to the latest wave of business articles about "free" as the new business model, we would argue there is no such thing as free – someone always pays. YouTube is an interesting case in point. Revenue estimates for 2009 are in the $200 to $250 million range, but costs are estimated to be somewhere in the $400 to $700 million range. Who makes up the difference? Google shareholders, of course. For those of us who lived through the "new economics of the Internet" in the late 1990s, seeing it happen all over again with Google brings a wry smile. In fact, what seems to be emerging is an Internet variant on an old GM adage: ‘we lose money on every car – but we make it up on volume.’ Substitute video for car and you have a pretty accurate description of YouTube's current business model.” Those of us with a memory of the late 1990’s can well recall the road-kill.

Google can afford to lose this kind of money because, as the New York Times pointed out, "last year, Google sold nearly $22 billion in advertising, more than any media company in the world." Obviously the economic anomaly of "free with advertising" is driving much more of the Internet's value to Google than would occur in normal circumstances, and therefore Google has taken the lead innovator role in support of the Internet ecosystem (displacing network operators who once carried the responsibility for the much broader area of communications innovation). Unlike our earlier example of Bell Labs leading the innovation curve, based on Bell network cash flows, Google has seized the innovation leadership in ways that are now being questioned by anti-trust regulators.

> The Justice Department derailed an important partnership between Google and Yahoo in November because of concerns it would cement Google's dominance and reduce competition. And Google now faces three new government antitrust investigations.
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> The Justice Department is examining the hiring practices at Google and other technology companies, and it is investigating a class-action settlement between Google and groups representing authors and publishers. The Federal Trade Commission is looking into ties between the boards of Google and Apple.[2]

But for Google or any other major Internet portal to believe they can repeal the laws of supply and demand, is a fool's errand. By allowing every blog and Internet site in the

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[2] "Google Makes a Case That it Isn't So Big", New York Times, June 29,2009, p.B1

universe to sell advertising, they have managed to drastically devalue the price of an individual ad unit. Thus even high quality journalism sites like the New York Times find their online ad prices plummeting. Although the current situation may be working for Google and a few others (taking commission on tonnage), it points towards a future in which the notion of a purely ad supported media system is unsustainable. It is even possible that this could lead to the second Internet bubble bursting, with consequences as dire as the year 2000 bubble. As Robert Thompson, Managing Editor of The Wall Street Journal said to Charlie Rose, "Google devalues everything it touches. Google is great for Google but it's terrible for content providers."[3]

What is needed is for Content providers and network operators to work together develop business approaches that benefit consumers as well as all industry segments. Recent research out of the U.K.[4] shows a significant move from downloading to streaming of music as Broadband speeds increase.

> The research revealed that many teenagers (65%) are streaming music regularly, with more 14 to 18 year olds (31%) listening to streamed music on their computer every day compared with music fans overall (18%).

Clearly this transition is a boon to record companies as the streaming sites such as Pandora are paying royalties for the use of the music. As we begin to apply this same model to Video as in the Hulu.com site, jointly owned by NBC and Fox we can begin to

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[3] http://www.siliconvalleywatcher.com/mt/archives/2009/02/google_devalues.php

[4] http://www.guardian.co.uk/music/2009/jul/12/music-industry-illegal-downloading-streaming

realize a future built around high band streaming of high quality content supported by various business models.

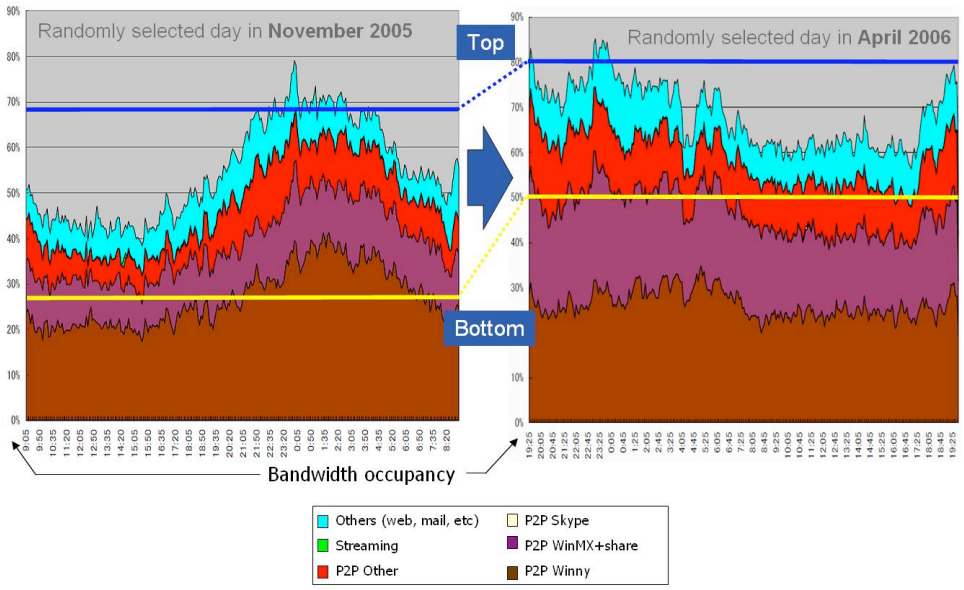
Current Competitive Framework

Our reading of the history of U.S. telecom innovation leads us to three conclusions. First, for the U.S. to regain its communication leadership, operating networks have to be able to fund massive R & D as well as the major capital improvements associated with Fiber Optics in the last mile. Such efforts require massive scale and competition policy should be aimed at achieving this efficient scale. Attempts to mandate competition in the last mile (such as in the CLEC fiasco of the late 1990's) have led to the loss of $ billions on the part of investors and taught us that judging telecom competition policy by consumer product standards is self-defeating. Second, that the role of government funding of basic communications research is critical, but also functions best in a long term partnership between government agencies, universities and the corporate sector. Third, that current notions that the "free with advertising" business model of Broadband is sustainable are overstated. This leads us to believe that policy makers should focus on two basic areas: Encouraging innovation in High Band and creating a network openness policy that both creates "neutral bandwidth" for standardized free services and allows for the provision of subscription "high band" services.

High Band

Much of the American communications infrastructure was built on a "Broadcast Model" that is becoming increasingly irrelevant in an "on demand" world. Both the cable and satellite TV networks were designed for a "one to many" one-way transmission of

professional content with little or no interaction. The very nature of satellite transmission and the architecture of cable's QUAM modulation system (built on a 30-1 downstream model) make the transition to a world of Web 2.0 extremely cumbersome. Web 2.0 refers to the symmetrical two-way nature of social networks, blogs, wikis, You Tube, and Peer to Peer (P2P) services (as can be seen by this graph of upstream traffic from the Japanese Ministry of Telecommunications).



If the U.S. is to have a world class Broadband network to the home, it therefore must be capable of speeds of 50 MBPS both upstream and down stream. In our opinion the only present technological solution to this is a fiber to the home (FTTH) network. Although there have been improvements in the DOCSIS 3.0 standard for cable modems, there is no existing technology that can compete with fiber at the present time. Illusions that some sort of wireless broadband could carry this level of symmetrical bandwidth are merely pipe dreams. Such FTTH networks exist today in Japan and South Korea and are being deployed in the United States by Verizon and a few Fiber-to-the-Home providers. These networks are capable of handling voice, Data, Broadcast IPTV and Streaming Video on

Demand and will be the world standard by 2015. Obviously a good deal of capital expenditure on the part of telecom networks will be necessary to bring fiber to the home to most communities, but these networks will also require both providers and the policy community to rethink issues like Network Neutrality.

Network Neutrality

The issue of Network Neutrality has been contentious since the moment the FCC changed the definition of Broadband from a telecom service to an information service, stripping the common carrier obligations. Much of the battle has been fought over notions of bandwidth scarcity that would not exist in the world of High Band we are describing. It is understandable that net activists might be concerned with the issue of Network Neutrality if a cable service provider was allocating only 30 MHz of a 750 MHz cable plant to IP Broadband. In that situation the possibility the network provider might advantage certain Content/web site providers over others is a legitimate concern. The shared bandwidth constraints of cable Hybrid Fiber-Coax networks or telecom ADSL could mean that a single customer downloading or uploading huge files could slow down the whole neighborhood node. But a fiber to the home network is not plagued with these constraints and so it is important for regulators to create a different set of principles for High Band Networks that are not constrained by scarcity. We believe the Annenberg Center Principles on Network Neutrality[5] are a good starting point. We quote from the document.

[5] http://www.justicetalking.org/documents/AnnenbergCenterPrinciples_FINAL.pdf

3. Basic Access Broadband: Broadband network operators should provide "Basic Access Broadband," a meaningful, neutral Internet connectivity service.[6] Beyond providing this level of service, operators would be free to determine all service parameters, including performance, pricing, and the prioritization of 3rd party traffic.

Although the Annenberg Center Principles were arrived at in consultation with telecom, content and public policy participants in the spring of 2005, they still seem a good starting point with the caveat that the time for "increasingly symmetric bandwidth at higher speeds" has arrived. If we asked network providers to carve out a "neutral" 8 MBPS symmetrical channel on a 50 MBPS system, then network operators should be free to configure specific subscription based services on their remaining 42 MBPS that might require innovative network management tools. The technical rationale for 8 MBPS is to allow for one high definition stream (currently 6 MBPS) in addition to data traffic and "overhead" room.

Conclusion

The future American communication network will feature a seamless combination of personalized video, voice and data available on demand to our TV, PC or mobile handset. The video will flow to the TV and the PC in high definition and to the mobile handset in far higher quality than we now experience. To reach this goal we need well-capitalized networks capable of the large capital expenditures of building fiber to the

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[6] Network operators providing basic access should not insert themselves in the traffic stream by blocking or degrading traffic. Traffic should be carried regardless of content or destination, and operators should not give preferential treatment to their own or affiliated content in the basic access service. The specific parameters (speed and latency) of this service will be reviewed on a quadrennial basis. Current thinking is that speeds of 1.25+ Mb/s downstream and upstream would be acceptable at this time, moving to increasingly symmetric bandwidth at higher speeds in the future.

home and 4G mobile networks. These networks will not suffer from the last mile bottleneck of current broadband configurations such as ADSL or DOCSIS, and thus will need a different regulatory framework to provide the value added subscription services which are needed to maintain the quality of America's knowledge economy. Movies, music, games, education and news will all be reconfigured in the digital upheaval we are experiencing. But to prosper, the content providers will need new business models in partnership with network providers. Every effort should be made to incentivize the construction of High Band Networks and to begin immediately to rethink how those networks will be regulated. To ignore the opportunity would be to condemn the United States to second-class status in the information economy.