The Future of Residential Broadband in the US

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INTRODCUTION

Residential broadband refers to the technologies that provide a high-bandwidth connection to the Internet for residential consumers. These technologies offer significantly higher bandwidth (by at least one order of magnitude) and lower latency response; and are a replacement for the fading residential dial-up technology. Residential broadband has made possible an entirely new online experience. Watching a video stream, downloading music in seconds, video and voice chats, and real-time gaming are available to consumers through the high bandwidth and low-latency properties of broadband.

Broadband is a generic term which subsumes two distinct technologies: DSL and cable. In the future, we anticipate new technologies with compatible functionality, such as WiFi (wireless Internet) and BPL (broadband over power lines), to be included under the same "broadband" moniker. For the purposes of this report, the technical discussion is restricted to the present use of the term and focuses primarily on DSL and cable.

In this report, we have evaluated the residential broadband industry from four perspectives:

1. Market and competition
2. Technology
3. Economics
4. Policy and regulation

MARKET AND COMPETITION

Broadband access is essential to an expanding Internet-based information economy. Lower prices for broadband access have accelerated market transition from dial-up to broadband. Figure below illustrates the fast growth of broadband penetration among US households. Broadband's share of residential internet access is increasing at roughly 11% per year.

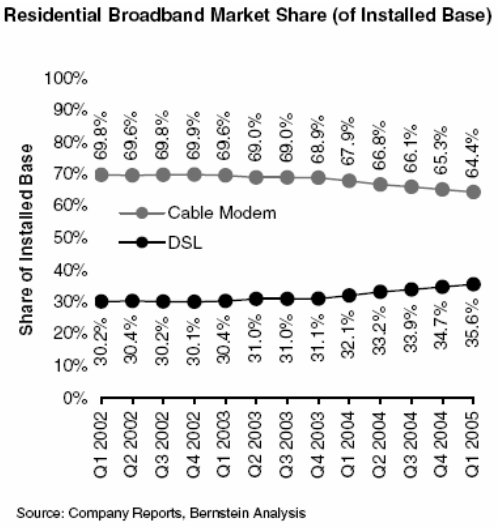
in millions	2003	2004	2005E	2006E	2007E	2008E	2009E	2010E
RESIDENTIAL BROADBAND HOUSEHOLDS								
Total Broadband Households	**25.1**	**34.0**	**42.8**	**51.2**	**59.1**	**65.4**	**70.0**	**73.4**
% Change	*42%*	*36%*	*26%*	*20%*	*15%*	*11%*	*7%*	*5%*
Broadband Net Additions	7.5	8.9	8.8	8.4	7.9	6.3	4.5	3.4
Broadband Penetration of U.S. Households	23%	31%	39%	46%	53%	58%	62%	64%
Broadband Share of U.S. Internet Households	37%	49%	60%	70%	79%	85%	89%	92%

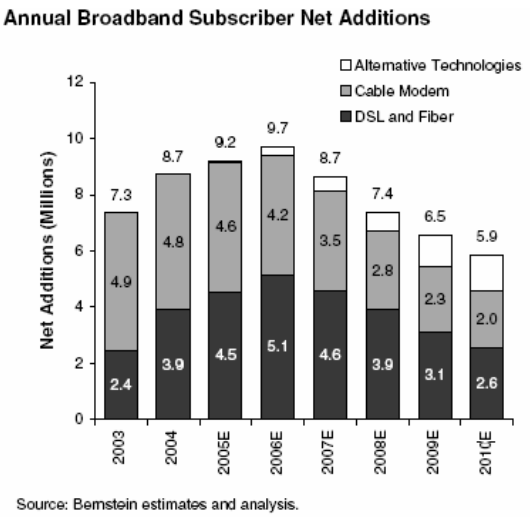
Source: SG Cowen & Co., company reports

Many Americans today can choose between several service packages of competing broadband providers. Telephone companies, wireless carriers, cable TV service providers and satellite providers are aggressively getting into the broadband business. New technology platforms are also growing. Increasingly, users of "WiFi" technology can get high-speed Internet connections at "hot spots" located at coffee shops, hotels, airports, city parks, streets, and squares. These proliferating service providers are increasingly competing with each other, and this competition holds down prices, increases consumer choice, and creates a vast new array of services. Despite the above, the primary battle is still between the DSL and cable companies (see Figures below). The major competitors in these two sectors are:

DSL companies: SBC Yahoo, Verizon, Bellsouth, Qwest

Cable companies: Comcast, Time Warner Brothers, Cox, Charter, Cablevision





TECHNOLOGY

Digital Subscriber Line (DSL)

DSL refers to the "last mile" of wiring that comprises a regular residential landline telephone connection. This wiring is typically a small gauge copper wire running between the local telephone exchange and the user's residence. In practice, the maximum length of the last mile is restricted by the line's lossiness and is around 20,000 feet. Beyond this length, copper wires are too lossy to sustain the bandwidth characteristics necessary for DSL. Customers located any farther from the local telephone exchange cannot be accommodated.

One important feature of DSL is that it allows simultaneous use of the same copper wire by both traditional voice traffic produced by a telephone and data traffic exchanged between the customer's DSL modem and DSL modem located at the end of the local telephone loop. These two types of traffic utilize non-overlapping frequency ranges and are easily distinguished. At the local central office, voice traffic is routed over the traditional telephone system and data traffic is routed through the Internet. Furthermore, unlike dial-up technology, the DSL connection is "always on". DSL modems are in constant communication, thus no connection establishment needs to take place. The connection is ready when the user is.
Most DSL service offered to residential consumers is actually asymmetric, i.e. the bandwidth capacity for downstream traffic (to the user) is higher than the bandwidth capacity for upstream traffic (from the user). The theoretical bandwidth limitation is 1.5-8Mbits/s downstream and 1.5Mbits/s upstream, although a basic consumer DSL service comes with 768Kbits/s downstream and 128Kbits/s upstream.

As mentioned previously, digital subscriber lines run directly between a customer's residence and the local telephone exchange station. Therefore, each consumer gets a dedicated "last mile" connection. In turn, the bandwidth allowed for by the phone line is also dedicated in its entirety to a single household.

Cable

Cable broadband is a comparable offering utilizing existing TV cable lines instead of existing phone lines as with DSL. A part of TV cable infrastructure relies partly on fiber optic lines; however, the bulk of wiring and the "last mile" wire in particular, is still a coaxial cable which carries cable television to people's homes.

The downstream data is packed into a frequency range which corresponds to a single cable channel, i.e. downstream data traffic is but a tiny fraction of the bandwidth carried by cable. The upstream data is even less taxing, occupying only a fraction of a single channel. The Internet traffic is injected into and extracted from the lines by the means of a cable modem, which acts similarly to a DSL modem in that it is able to distinguish between the two types of data: TV feeds and Internet data traffic.

One disadvantage of cable broadband is that the bandwidth is effectively shared by all users of the same coaxial lines. It is not uncommon for whole neighborhoods to be wired with a single coaxial line. For instance, a customer may notice degradation in response time and bandwidth at peak hours of the day. The degradation is especially apparent when the connection is used for applications requiring low latencies, such as real-time online games. This problem can be

addressed by laying additional lines to increase capacity or opening up several "channels" to Internet traffic. (Question: How many homes can be accommodated by single coaxial cable?)

An advantage of cable broadband is that the quality of the connection is independent of the distance between the user's home and cable company's local exchange. A digital CATV system is already designed to provide digital signals at a particular quality to customer households. The common bandwidth capacity for cable internet is between 1.5Mbits/s and 3Mbits/s for residential subscribers.

For comparison purposes, a high quality voice feed consumes approximately 90Kbits/s, a low quality one -- 30Kbits/s; and HDTV feed consumes upwards of 20Mbits/s, well above the speed limits of DSL or cable. HDTV over broadband is still feasible. However, difficulties due to various compression schemes that may get the bandwidth requirement within the desired bound still exist. This technology has not yet matured, but is likely to come into play within the next 2 to 3 years. Likewise, the bandwidth limitations of both cable and DSL are expected to grow similarly to the increase in bandwidth available on the Internet backbone itself. (Question: How to deliver HDTV content in the long term?)

Broadband over power lines

Broadband over power lines is the set of technologies that enables residential internet connectivity over the power grid. There are few patches of deployments around the world, principally in Europe and Australia. Today, this technology remains in the state of flux, with many technical issues remaining. These issues include interference with radio signals, rapid loss of signal, and others. At the same time, the ubiquity of power lines is unmatched by either cable or phone networks.

Worldwide Interoperability for Microwave Access (WiMAX)

WiMAX is a new wireless technology similar to WiFi but with increased speed, range, and encryption. The above features make WiMAX a suitable candidate to replace/supplement the "last mile" residential broadband connectivity of residences. For instance, this technology can be used to join existing WiFi "hot spots" into a mesh network suitable for municipal wireless service. These mesh networks will be then able to deliver wireless broadband effectively to a large population. Currently, this technology is still mostly in the testing phase but shows great promise and is backed by Intel, Microsoft, and other leading technology companies.

ECONOMICS

Since early last year when several big cable operators rolled out landline telephone service, competition between the cable and traditional telephone industries has intensified. Each side is attempting to poach the others' customers through bundling of telecom offerings, including telephone service and high-speed Internet access. In this sector, price and speed define main battle line.

DSL pricing remains low. SBC and Verizon, which account for 58% of total U.S. wire line households, are offering entry level DSL service for $14.95 per month (SBC's DSL service offers a download speed of 1.5 Mbps; Verizon's entry level DSL product has a download speed of 768 Kbps). The RBOCs are also pricing 3+ Mbps DSL service at a significant discount to cable modem service. The cable companies have responded to aggressive DSL price promotions by offering increased download speeds, as well as slightly lower prices via various promotions. (Comcast offers a download speed of 3-4 mbps and charges $42.95 per month. They have promotion prices for $19.99 for the first six months)

Now more and more companies see bundling as a way to keep existing customers while attracting new customers from rival companies. Companies want to make use of economies of scope such as voice and data services leverage video investment or share cap ex and op ex. A study has observed that the monthly churn rate is greatly reduced by bundling services.

Video Only: 2.6 %

Voice only: 3.0%

Double Play: 2.2%

Triple Play: 1.5%

To put these figures into perspective, consider the fact that 17% of US households move each year, which translates into a fixed monthly churn rate of 1.4%.

Both DSL and cable have one service that other lacks. Telephone companies don't currently offer video services on a large scale. While, cable companies lack wireless offerings. Though this will soon change as both DSL and cable companies have either acquired or reached collaborative agreements with other companies that offer services that they lack. Recently, a consortium of cable operators including Comcast Corp., Cox Communications Inc. and Time Warner Inc. are close to an agreement to sell cellular service using the wireless network of Sprint Nextel Corp. Hong Kong's biggest telephone company PCCW has started television offerings where customers

pay for just what they want to watch. With its TV service, PCCW became one of the first phone companies in the world to offer a combination of voice, data and TV, something known as a "triple play" in the industry. Furthermore, this same company also recently acquired control of a cellular system and plans to bundle it as an additional service.

POLICY AND REGULATION

Information and communications technologies (ICT) are crucial for the emergence and growth of national economies. Broadband technology is one component of ICT that has seen a remarkable increase in demand during the past few years. This demand will only continue to grow as access to the Internet is no longer perceived as limited to academic and corporate contexts. Rather, it should be accessible by the general public through residential broadband connections. Naturally, the economic forces of the market should drive innovation and competition among broadband providers to meet this demand. However, this is not always the case. A recent study by the International Telecommunications Union (ITU) published earlier this year places the US as 16th in the world in broadband penetration, well behind the leaders: South Korea, Hong Kong, Netherlands, Denmark, and Canada. Critics of the study are quick to point out that the study fails to take into account the geographic and demographic aspects of the nations under study. While certain geographic and demographic properties (small nation with highly educated population) may facilitate broadband adoption and penetration, they are by no means the deciding factors. Rather, it is the effective mixture of legislative, regulatory, and investment initiatives that will catalyze the broadband industry. To illustrate the implications of such a national broadband strategy, we will briefly discuss the models adopted by Japan and Korea and their successes. Finally, we contrast those models with the current situation in the US where no such national broadband strategy exists.

Both Japan and South Korea enjoy not only high levels of broadband penetration but also high broadband access speeds. Customers in these countries benefit from applications that leverage this higher quality of service. These include VoIP, teleconferencing, remote diagnosis and medical services, interactive distance education, and rich multimedia entertainment. In addition, Japan currently has the lowest price per month for broadband access. These achievements were possible through the adoption of a national broadband strategy by both governments. This strategy included debt guaranties, favorable tax treatment, partial subsidies, and other types of financial support for the construction of high capacity fiber backbones and the deployment of residential broadband networks. Most importantly, they stipulated an open access model where

competitors may use existing residential telephone infrastructure for a modest fee. These factors spurred intense innovation and competition by broadband service providers, leading to better quality of service and lower costs for the customer.

In contrast, a consequence of the lack of a national broadband strategy is that the US broadband penetration is nowhere near that of its Asian counterparts. This may seem ironic as the US is the birthplace of the Internet and has always been known for encouraging technological innovation. However, the lack of growth in US broadband can primarily be attributed to the "monopolistic structure, entrenched management, and political power of incumbent local exchange carriers (ILEC) such as BellSouth and Verizon and the cable television industry" and further worsened by the major deficiencies in the policy and regulatory systems covering these industries (Ferguson, 2002). For example, it appears that the US Congress is divided on the issue of how to regulate broadband for the best benefit. This legislative tug-of-war is most apparent in the two bills currently being debated regarding the establishment of municipal wireless. Existing cable and DSL companies view municipal wireless as a serious threat and vehemently oppose its establishment, even in areas where they have no service presence. They have managed to persuade several lawmakers to introduce the "Preserving Innovation in Telecom Act of 2005" which prohibits state and local governments from providing any "telecommunications, telecommunications service, information service, or cable service" where a private company is offering a similar service. In response, other lawmakers not bought by these telecom companies have introduced the "Community Broadband Act of 2005" which seeks to protect the ability of local governments to provide municipal wireless services.

Additionally, the Federal Communications Commission (FCC) which oversees the policy for regulating the nation's telecommunications appears to be terribly confused. Instead of open access, the FCC has opted for multiplatform competition between cable and DSL. This approach is questionable, as neither party wants to encourage development of cheap broadband since it will threaten their existing offerings and profitability. Even the FCC's own method for determining US broadband penetration is misguided. Everyone in a ZIP code is "covered" if at least one person there has a broadband connection. This approach is clearly erroneous and leads to artificially inflated values for broadband penetration.

In the arena of wireless technology, there is an active debate on what is the best policy to manage spectrum (i.e., the frequencies range over which wireless devices operate). Traditionally, FCC has used an outdated model where applicants were issued a license for a specific purpose for the duration of 10 years. This license could be renewed, which was almost always granted. However,

the license must be used for the specific purpose that was stated in the initial application. This rigid policy prevents licensees from making novel uses of their awarded spectrums for alternative uses such as the support of emerging wireless technologies. As the current available spectrum becomes increasingly crowded, the FCC has realized the need to better manage existing allocated spectrum as well as open up new spectrum. Recently, the FCC adopted an auction based method for allocating spectrum and has relaxed its usage policy to allow for spectrum uses not originally specified in the application. These steps are certainly in the right direction, but much more needs to be done. In summary, broadband legislation should appreciate the need to blend and integrate both private sector entrepreneurialism and public sector stewardship. This can be realized through a mixture of legislative, regulatory, and investment initiatives.

CONCLUSION

The share of residential broadband in US households with internet access has seen a dramatic increase over the past few years and is expected to continue to rise. Broadband is quickly replacing older technologies such as dial-up, and the main competition remains between cable and DSL companies. These companies have utilized service bundling as a strategy to keep existing customers as well as to attract new ones, and to strengthen their hold of the market. Furthermore, they have segmented the market by price and speed with each side, cable and DSL, taking sides. While new technologies such as WiFi, Satellite, BPL, and WiMAX are encouraging, they do not currently pose a significant threat to the existing incumbents. Unfortunately, this domination by cable and DSL has stifled broadband innovation in the US. To rectify this, there is a need for a national broadband strategy. This strategy should include an open access model as well as economic incentives to encourage competition, leading to lower prices and higher quality of service.

In the short-term, cable will continue to have a competitive advantage over all other competitors due to their existing infrastructure and “quadruple play” bundling strategy. In the long-term we do not foresee a winner that will take all the market, but rather there will be a market where cable, DSL, and other newer technologies will co-exist.

APPENDIX

Porter's Five Forces:

To better understand the economic forces that driving this market, we provide a brief examination of the residential broadband market using in terms of Porter's five forces.

Bargaining power of suppliers:

At first glance, it might look like broadband equipment suppliers have considerable bargaining power over operators. Indeed, without high-tech broadband switching equipment, fiber-optic cables, cable boxes and billing software, telecom and cable operators would not be able to do the job of transmitting data from place to place. There are a large number of large equipment makers around such as, Nortel, Lucent, Cisco, Nokia, Alcatel, Ericsson, Tellabs. There are enough vendors, arguably, to dilute bargaining power. The switching costs from one supplier to another are relatively low. It is possible, that suppliers even offer deals to broadband providers to switch. Broadband power lines usually are owned by one of the telephone or cable companies in the area. Other broadband providers have to lease the lines.

Bargaining power of customers:

In nowadays competitive industry bargain power of customer is high. Broadband services are treated as commodity. People do not care about the technology provider, as long as they are getting what they want. Cable and DSL broadband providers fight over customers by providing a bundle of services. For example, cable companies such as Comcast, AOL Warner, Cox Cable Company, and others, offer cable, phone and internet together. These companies try to lock in customer with their services. To acquire customer cable and telephone companies offer special deals, for example, three month of cable for discount price, installation for free or discount if the customer gets a bundle of services. In the future, when new broadband providers will come to the game bargaining power of the customers will increase.

Threat of new entrants.

Web-contents providers, such as Google, Yahoo could be potential new entrants to the broadband market. Right now Google proposed to provide free WiFi with speed of 300kbs for the City of San Francisco. Google will pay $8 - $20 million for the network and recuperate through advertising services. Free WiFi already exists in Portland, Oregon. Another new entrant is utility

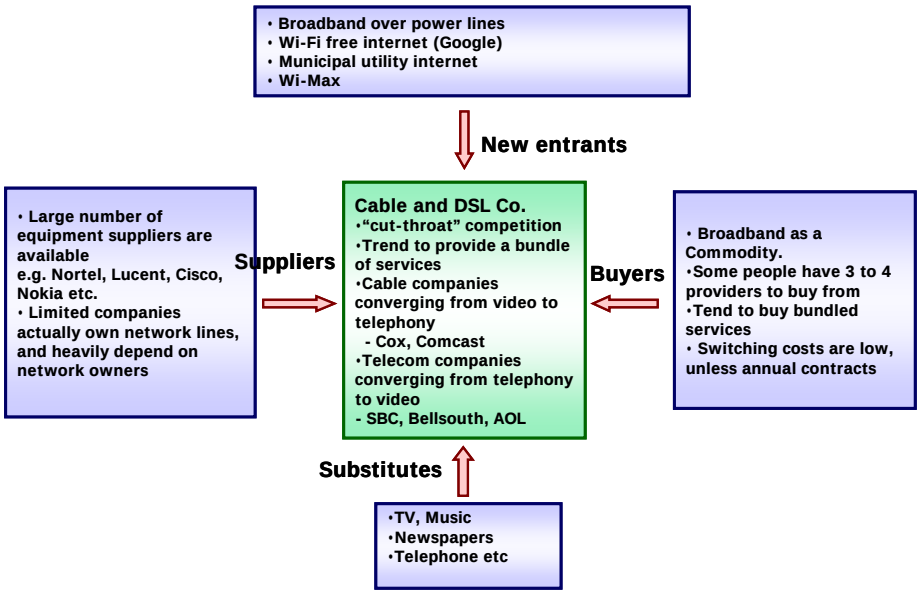
agencies internet providers that could provide high speed internet for a small fee For example, Philadelphia plans to build the largest municipal wireless internet in the US and offer it for $10. Finally, broadband over the power lines is a possible entrant. For example, the city of Manassas, Virginia offer broadband over power lines for comparable cost to other services – 30$/month, which is kind of too expensive to be competitive.

Threat of substitutes.

Currently, there are no major substitutes for residential broadband (cable, DSL). However, one can listen to the music watch TV, talk on the phone or in person instead on using high-speed internet. Not to mention, that a person could satisfy his or her needs by using broadband connection at work place or in the public places where WiFi is available.

Competitive Rivalry

Competition between cable and DSL is "cut-throat". New technology is prompting a raft of new entrants to the broadband market. Cable monopoly will be hard to break in the residential broadband services. The decision of a consortium of cable operators including Comcast Corp., Cox Communications Inc. and Time Warner Inc. to enter to an agreement to sell cellular service using the wireless network of Sprint Nextel Corp., will make cable companies market share position stronger, because they will be able to bundle even more services. DSL companies do not have ability to provide TV cable.



Comparison of US Broadband Providers

U.S. Consumer Broadband: Q2-05 Competitive Analysis

Company	Offering*	Broadband Subscribers**	Free Modem	Free Dialup	Proprietary Content	Pop-Up Blocker	Free Customer Support	Parental Controls	Spam Filters	Web Hosting/Storage	Email Addresses	Comments
DSL												
SBC Yahoo!	$14.95/month with 1 year commitment (online orders) 1.5 Mbps down / 384 kbps up $24.99/month with 1 year commitment (Online orders) 3 Mbps down / 1.5 kbps up	6.0 million	✓	✓	✓	✓	✓	✓	✓	✓	11	SBC's penetration of households at the end of Q2:05 was 26% in the PacBell territories and 21% across all its regions. Net additions were 1.7 million in the last four quarters and total subscribers increased 39% y/y.
Verizon	$14.95/month with 1 year commitment (online orders) 768 kbps down / 128 kbps up $29.95/month with 1 year commitment ($19.95 for 1st 3 months) 3 Mbps down / 384 kbps up Promotion: First month free.	4.2 million	✓	O	✓	✓	✓	✓	✓	✓	9	Verizon partnered with Yahoo to offer a co-branded broadband service (similar to the SBC/Yahoo partnership). Net additions were 1.3 million over the last four quarter and total subscribers increased 44%.
BellSouth	$24.95/month; (256 kbps down / 128 kbps up) $32.95/month; (1.5 Mbps down / 256 kbps up) $42.95/month; (3 Mbps down / 384 kbps up) Promotion: Free modem, free MP3 player with 3 months of Napster, and free S/H.	2.5 million	✓	✓	✓	✓	✓	✓	✓	✓	5-8	BellSouth reported net subscriber additions in Q2:05 of 124,000. Total DSL subscribers increased 42% y/y. BellSouth eliminated the promotion for its DSL Lite 256K service, but 1.5 mbpsand 3.0 mbps subscribers grew 48% sequentially from Q1:05.
Qwest	$39.99/month 1.5 Mbps down / 896 kbsp up Promotion: $24.99 for first 12 months / $19.99 with qualifying phone plan. $49.99/month 3-5 Mbps down / 896 kbsp up Promotion: $34.99 for first 12 months / $29.99 with qualifying phone plan.	1.2 million	✓	O	✓	✓	✓	✓	✓	✓	11	Qwest reported 337,000 net DSL subscriber additions in the last four quarters and total DSL subscribers were up 40% y/y. DSL service includes MSN Premium. DSL availability reached 73% of lines at the end of Q2:05.
Cable Modem												
Comcast	$42.95/month 4-6 Mbps down / 384-768 kbps up Promotion: $19.99/month for first six months	7.7 million	✓	O	✓	O	✓	O	O	✓	7	Comcast added 1.7 million cable modem subscribers in the last four quarters. Total subscribers increased 28% y/y, but net additions were down 9%. Household penetration was 18.9% at the end of Q205.
Time Warner Cable	$44.95/month 5 Mbps down / 384 kbps up Promotion: $29.95 for first 6 months	4.3 million	✓	✓	✓	✓	✓	O	✓	✓	5	Time Warner reported net additions of 775,000 in the last four quarters and total subscribers increases 22% y/y. Penetration was 22% in Q2:05.
Cox	$64.95/month 5 Mbps down / 768 kbps up $49.95/month 4 Mbps down / 512 kbps up Promotion: $25 off the first 3 months	2.8 million	✓	✓	✓	✓	✓	✓	✓	✓	7	Cox ended the year with 2.8 million subscribers, a 27% y/y increase. Net additions were flat in Q2:05 versus Q2:04. High-speed subscriber penetration was 26.9% at the end of Q2:05.
Charter	$39.99/month 3 Mbps down, 256 kbps up Promotion: $26.95/month for first six months	2.0 million	✓	O	✓	O	✓	✓	✓	✓	10	Total subscribers increased 18% y/y. High-speed subscriber penetration was 18.4% at the end of Q2:05.
Cablevision	$49.95/month (44.95 w/ Cable) Up to 10 Mbps down Promotion: $29.99/month for first six months + free S/H	1.5 million	✓	O	✓	✓	✓	✓	✓	O	5	Cablevision subscribers increased 29% y/y and net additions totaled 340,000 during the last four quarters.

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