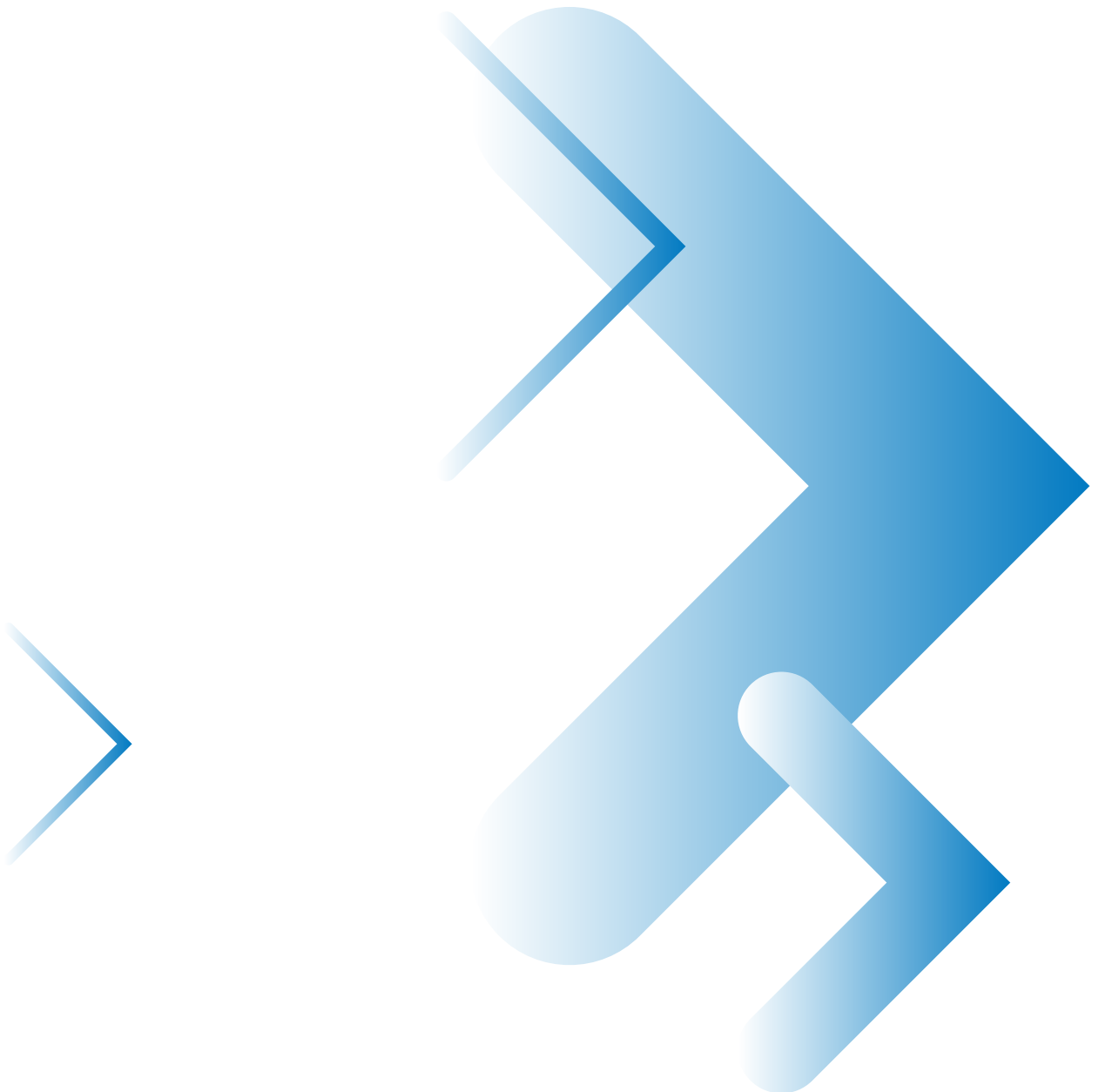




Anticipating the Bandwidth Bottleneck

Meeting Future Bandwidth Demands



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We live in a media-crazed world, where individuals create, consume, and share media in ways never before imagined. And these consumers are not just demanding more media. Due to multitasking, they're packing more media consumption into smaller slices of time, significantly increasing the amount of bandwidth needed to support individual viewing habits. This increased bandwidth consumption is compounded by the fact that a growing portion of U.S. households with multiple PCs and TVs routinely receive multiple media streams on multiple devices thanks to new features

such as picture-in-picture (PIP), video over the Internet, and Digital Video Recording. This ever-increasing consumption of content will continue to require unprecedented amounts of bandwidth. For service providers to effectively compete they must design their infrastructures to ensure adequate bandwidth for the near future—a future that will include more high-definition (HD) television, more multitasking, and more interactive offerings. Carriers who get the bandwidth quotient right and manage that bandwidth effectively, while successfully delivering on the “triple-play service goods,” will set the stage for high growth, high profitability, and new levels of customer loyalty. Motorola can help carriers “get bandwidth right.” With over a decade of digital television expertise, Motorola offers unique insight into future bandwidth usage.

The Multi-Device Household

The number of digital content sources in U.S. households is multiplying because the number of consumer electronic (CE) devices has multiplied. Becoming commonplace are CE devices such as mp3 players, portable media players, digital cameras, game consoles, smart phones, media adapters, PCs, flat-screen TVs, home theater systems, and DVRs. Consider the following:

- The average U.S. household now owns 26 CE products
- The average teen household owns 35 non-discreet CE products

Because teen utilization of CE products is high, service providers can expect future consumers to be attached to CE products.—8th Annual, 21.

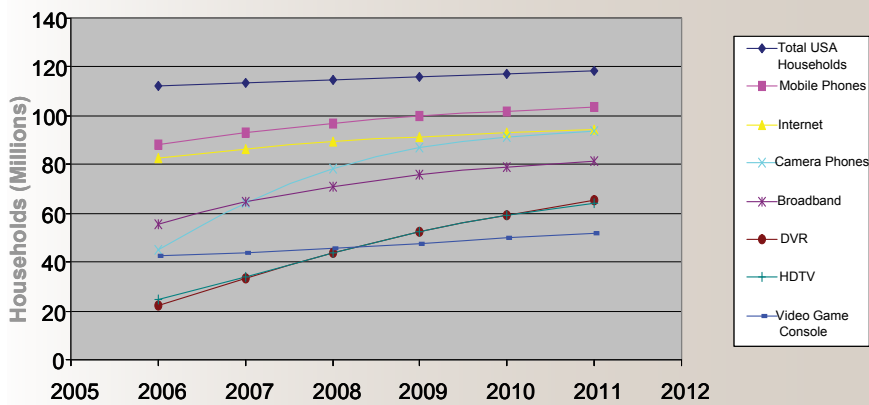
- Households with six or more people, on average, own an impressive 42 non-discreet CE products
- The average single household owns 14 CE products

CE ownership is more concentrated among households with fewer occupants.—8th Annual, 21

CE devices such as HDTV consume bandwidth directly. Other CE devices such as an 8 Megapixel camera consume bandwidth indirectly (e.g. when photos are uploaded to internet sites such as Snapfish). According to industry analysts and research firms, many CE devices such as game consoles, entertainment PCs, Digital Video Recorders (DVRs), and flat-screen TVs are moving toward high-definition and will consume even more bandwidth. Gone are the days when the number of TVs in a household determined the number of video signals sent into your home. With the advent of digital television, old viewing habits are being replaced with new ones such as PIP viewing, on-demand viewing, DVR recording, video over the Internet, passive viewing and recording, time-shifted and place-shifted viewing, and multi-tasking. So instead of the current average of around two video feeds per subscriber, four or more video feeds per household may be a likely requirement in the very near future.

Another reason why many believe there will be massive leaps in bandwidth consumption in the next few years? Some of the biggest bandwidth-consuming technologies are being adopted faster and in larger numbers than lower-bandwidth-consuming technologies. For example, it is predicted that by 2010, 87 million of the 114.9 million U.S. households will have HDTV, but only 34.4 million will have VoIP.

Forecast: USA HH Technology Adoption 2006-2011



Forrester Research September 2006

FIGURE 1: US HH TECHNOLOGY ADOPTION

Early Adopters, Laggards and Fringe Users

Industry and consumer research firm, Parks Associates, has identified five tiers for U.S. household technology adoption based on ownership and usage of digital technologies with an emphasis on Internet usage. These segments include the biggest bandwidth consumers and range from technology "early adopters" to "laggards" and "fringe users."

"By 2010, the number of early adopting and laggard tiers will grow while the number of non-internet households will shrink. The effort to sell next-generation services and products, particularly bundled packages, will be focused primarily on the higher tier households." —Park Associates, *Media Servers: Analysis & Forecasts, Q2, 2006*

Understanding the consumers who are likely to lead the pack for technology adoption and digital media consumption is of keen importance to service providers because these consumers (even fringe users) represent a sizable and growing market. A recent report from Parks Associates found that:

- Technology adoption levels are generally higher within each subsequent tier. As would be expected, Tier 5 households have the highest adoption levels overall and Tier Zero the lowest. Tier 5 homes present a rich digital ecosystem that can take advantage of technologies and services that help integrate these devices.
- The likelihood of being an early adopter is generally related to age, education, income, and gender. At the same time, there are more subtle demographic shifts with respect to marital status and household characteristics, which makes the adoption tiers more distinguishable.
- Early adopters are less price-sensitive. Tier 5 households generally expect a smaller discount in exchange for switching to a bundle than Tier Zero households expect.

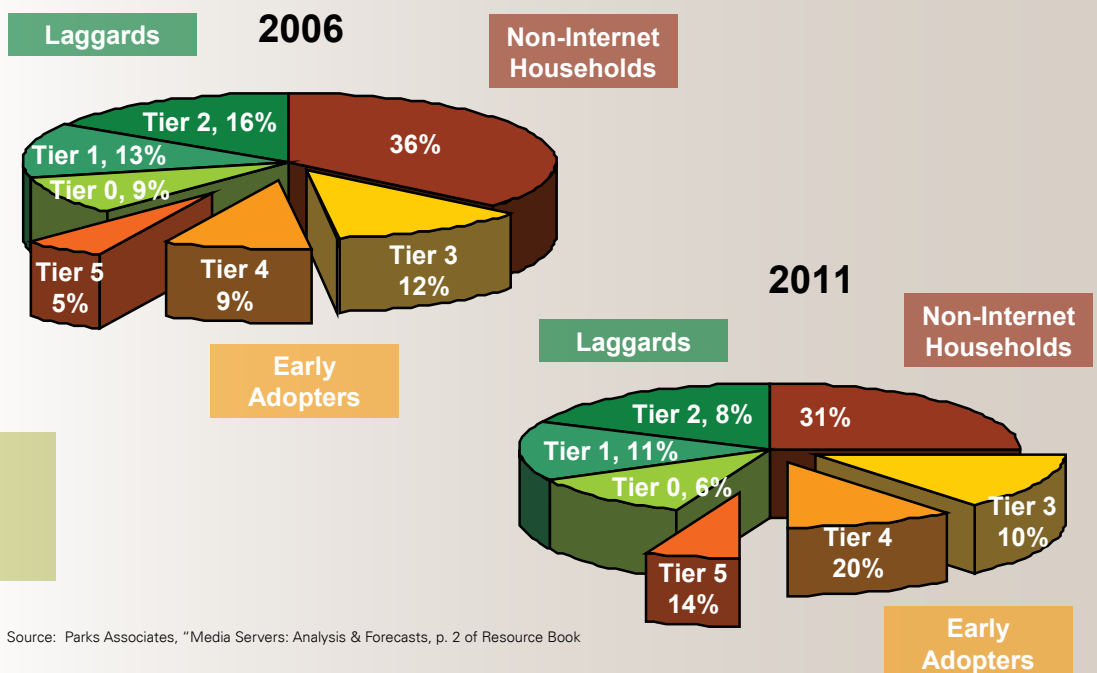
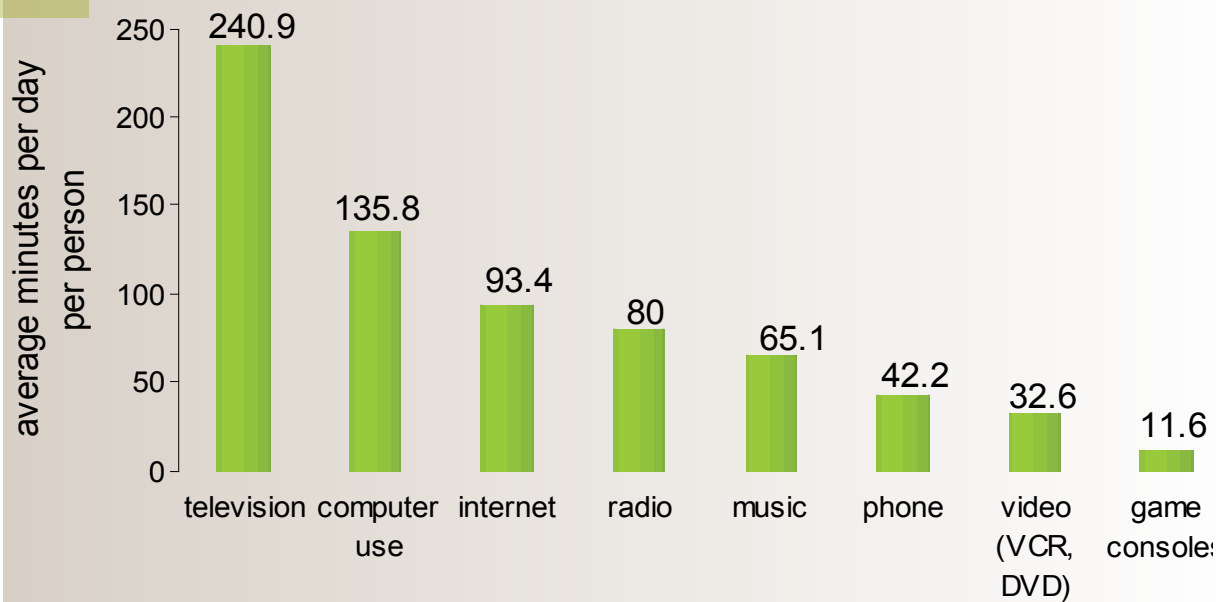


FIGURE 2: NUMBER OF EARLY ADOPTERS, LAGGARDS AND FRINGE USERS

Source: Parks Associates, "Media Servers: Analysis & Forecasts, p. 2 of Resource Book

FIGURE 3: THE AMERICAN MEDIA DIET

Daily Usage of Media by Source



Sources: bar graph from "How the Internet is Changing Consumer Behavior and Expectations," by Lee Rainie, Pew Internet & American Life Project (5/9/06)

- A healthy percentage of Tier 2-5 users are willing to switch to a telco for bundled services prior to publicity, advertising or word-of-mouth.

Almost twenty-eight percent of early adopters—Tiers 3-5—and twenty-four percent of Tier 2 users are willing to switch to a telco bundled service—Parks Associates, Media Servers: Analysis & Forecasts

Who's Hogging All The Bandwidth?

One way to better understand how consumer demand is exacerbating the bandwidth problem is to examine the average American's media consumption habits. According to Nielsen ratings, the average household watches more television than ever before—approximately 8 hours per day in 2005. As we become a culture of multitaskers, more media (and consequently, more bandwidth) is consumed simultaneously.

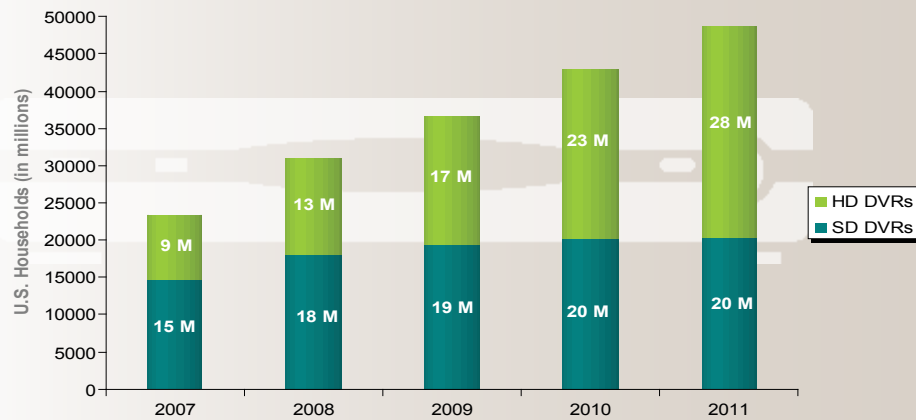
"As people reallocate their shares of time, they slice their attention even more thinly by packing multiple activities into their blocks of time." The average 8-18 year old consumes a total of eight hours and thirty-three minutes of media a day but does so in only six hours and twenty-one minutes because they are multitasking. — Pew Internet & American Life Project

To anticipate the real demand for bandwidth, carriers should pay close attention to those areas where high usage and high bandwidth converge. Not surprisingly, video (and specifically, high-definition video) represents the highest bandwidth usage in the home today, requiring both predictable bandwidth (broadcast TV) and unpredictable bandwidth (unicast or video on demand services.) And whether this video enters the home through televisions or computer devices, video services will have significant impacts to the network. The aggregate bandwidth requirements for multiple SDTV and HDTV video streams must be appropriately anticipated.

To launch a new competitive service and successfully deliver on the potential of a "triple play" voice, video, and data bundle, service providers must construct a network that has bidirectional capabilities with bandwidth for both upstream and downstream traffic.

Gone are the days when the number of TVs in a household determined the number of video signals sent into your home; four or more video feeds per household may be a likely requirement in the very near future.

DVR Penetration
Standard Definition Units vs. High Definition Units



Source: IMS Research

FIGURE 4: DVR PENETRATION
SD v. HD

The network must also have IP VPN for best effort data services, asymmetric bandwidth, and sophisticated Quality of Service (QoS) capabilities to diminish video and voice packet loss, jitter, and delay. IGMP is also required to enable multicast for viewing common, linear content. To meet customer expectations, service providers must be able to maintain an acceptable Quality of Experience (QoE) not only during average subscriber viewing behavior, but also during peak viewing behavior (e.g. during major sports events), and in the event of unpredictable peaks and surges (e.g. during disaster coverage).

The Impact of HDTV

TV viewing habits have changed significantly since the fifties. Instead of the entire family gathering around a single TV set, today's viewing is more distributed. In fact, most U.S. households now have two or more sets and it is a widely held assumption that HDTV sets will cause this number to rise to three or more per household. (*Deploying, 1*) An impressive sixty percent of the replacement TVs purchased in 2006 was made up of HDTV sets. Experts predict that by 2010, all replacement purchases will be HDTV sets. (*Kagan Research, The State of High-Definition Television, 6th Edition, 2006*)

With 46.4M HDTV sets shipped in 2006, the number of HDTV sets shipped by 2011, will more than quadruple.—CEA Market Research Report, April 2006

Significantly, a high percentage of HDTV purchases by 2010 will be repeat buyers, which means multiple HDTV sets and DVRs per household. With individual households adding a second or even a third HD set to their service bundle, per home bandwidth requirements will be exceedingly high—especially

when you consider that each HDTV set in a multiple HDTV household will likely receive more than one HD channel at a time. That's because the use of PIP is likely to rise as is the number of small portable video display devices and a host of other consumer electronic devices that could be on the receiving end of a flow of IP-based video channels. (*Deploying, 1*)

HDTV subscribers spend roughly one-third of their time watching HD programming.—Parks Research, Digital Entertainment: Changing Consumers Habits

Another way HD will impact bandwidth consumption is more readily available HD content. During 2005, about sixty percent of the primetime line-up of NBC and ABC was broadcast in HDTV and approximately thirty percent of all network programming in 2006 was HD. By 2008, there will be fifty HD channels with all HD content. (*Americas TV, 182*) When that happens, we'll probably see anywhere from fifty to seventy-five percent of the programming also available in HD. Within an extra two years or so, roughly one-hundred percent of programming will be available in HD. By 2010, we'll see a full adoption of HD VOD. (*State of HD, OD2 Kagan, 252*) Of course, as HDTV sets become more prevalent, the bar will be raised in expectations for superior image quality.

DVR adoption is on the rise as well and will soon be commonplace. IMS Research predicts that by 2010, there will be more HD-DVRs in U.S. households than SD-DVRs, as indicated in Figure 4. In fact, sixty-five percent will be HD-DVRs. This leads IMS Research to predict that "the majority of IPTV providers will need to roll out an HD tier within the next few years if they wish to remain competitive." Whole-home DVR systems will grow as well—from 1.5M at end of 2006 to nearly 15M by the end of 2010, according to Parks Associates. DVR usage itself is also on the rise. Households with DVRs record an average 11.3

= 18 Mbps

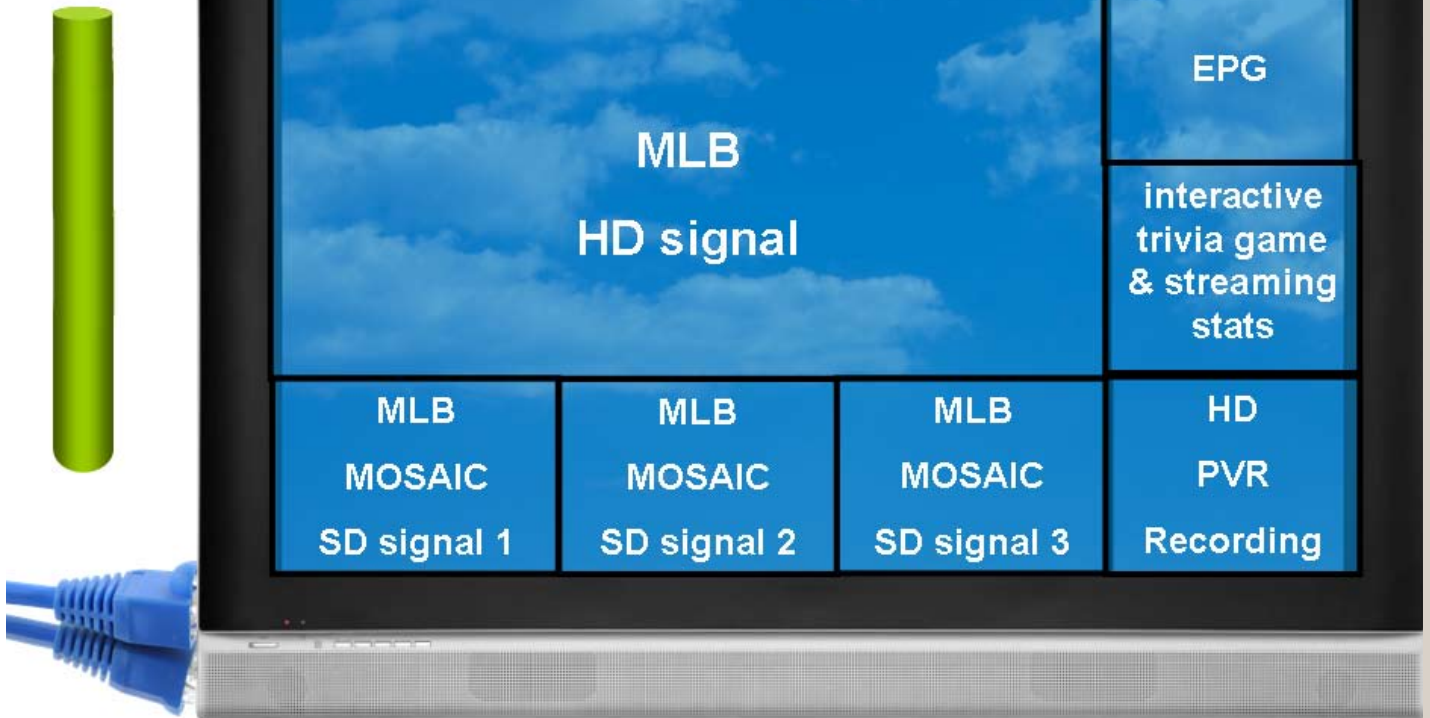


FIGURE 5:
1 DEVICE ≠ 1 STREAM

programs per week. This is up 23 percent from last year. (*DVR Households, Leichtman*) The DMA Group predicts that by 2010, eighteen percent of media will be accessed on demand, either through video on demand or DVR viewing.

Ninety-five percent of DVR users tend to use them every week. Adults who own DVRs watch an average of six hours and fourteen minutes of live primetime TV every week and an additional hour and forty-nine minutes in playback mode. That's twenty-nine percent more than non-DVR users.—Nielsen: DVR Users Really Do Watch More TV, August 3, 2006

Whereas all tiers generally prefer live TV to recorded TV, Tier 5 deviates from the pattern and assigns more weight to recorded TV. People in this tier generally spend less time watching TV than individuals in other tiers, and want more control over what they watch and when. (*Media Servers, 24*) New services such as TiVo Guru Guide now allow subscribers to find programming and automatically record shows based on recommendations from editorial experts at some of the nation's biggest brands; brands such as Sports Illustrated, Star Magazine, Entertainment Weekly, and Automobile Billboard. These and other "bandwidth in the background" trends should be given serious consideration when making infrastructure design decisions.

When you factor in the new multitasking habits of early adopters and fringe users, it's easy to see how one person could consume 18 Mbps of bandwidth on just one device.

Although 18 Mbps per person per device may be considered extreme today, it could represent typical usage in the very near future—especially when you consider other influencers that will further fuel HDTV adoption and use. For example:

- Travelocity lets people search for flights, cars and hotels right off of Windows Live. This too is a PIP-based marketing program.
- DirecTV offers interactive functions for its NFL Sunday Ticket subscribers. Forty percent of subscribers now use the interactive functions and of those who use it, two-thirds use it more than ten times a day. Additionally, more than two-thirds use interactive functions for the NCAA college basketball tournament service. (*Advertising Age, July 27, 2006*)
- In an effort to boost digital TV sales, the FCC has implemented regulations effectively stopping analog televisions from being sold after 2007. In August 2002, the FCC mandated that, by July 2007, all new television 13 inches...and larger must be equipped with a tuner for digital OTA broadcasts, following a three-year phase-in. In July 2007, all other devices that include TV receivers, such as VCRs and DVRs, must also include DTV tuners. (*Americas TV, 183*)



Sources: PC data from "The State of Consumers and Technology: Benchmark 2005" Parks Associates (July 29, 2005); bandwidth data from "Broadband market Updates: Beyond Bandwidth," Parks Associates (2Q 2006) p. 37; Motorola (2007)

FIGURE 6: BANDWIDTH USER DATA

- Panasonic and Sony Corp. announced licensing for AVCHD, a high-definition (HD) digital video camera recorder format, as well an expansion of the format's specifications.

"Sports fans are the no-brainer market for iTV. In their world, information is king. If you don't have your fantasy information at hand, you feel left out. Stats are the language of sports.— Eric Shanks, Executive VP-DirectTV Entertainment

"The Web reached 62% and was used for an average of 108 minutes on an average day for the average adult—very similar to radio and far outpacing print media. Thirty-one percent of (teen) internet users download videos, eighty-one percent play online games, fifty-one percent download music, forty-three percent buy products and thirty-three percent share their own creations."— Pew Internet & American Life Project

The Implications of Broadband

Thanks to the increasing availability of high-speed internet, a growing number of consumers now enjoy faster download and upload times and better online experiences. These enhanced experiences are fueling an important sea change in American households. According to an In-Stat April 2006 study of Broadband Digital Homes in North America, thirty percent of homes now have one PC, thirty-two percent have two PCs, twenty-two percent have three PCs, ten percent have four PCs at home, and five percent have five or more PCs at home. So the PC bandwidth story is no longer about more PCs getting into more households, it's that more PCs are being brought into households that already have multiple PCs.

With the continued decline in price and continued proliferation of higher bandwidth services, many experts agree that the growing number of broadband subscribers will have a significant impact on bandwidth—especially when you consider how "always on" high-speed connections amplify and intensify internet use. People go online more often, spend more time logged on, and engage in bandwidth-intensive activities more frequently. The Senior Director of Media at Nielsen/Net Ratings recently said, "We're past the point where decreasing prices and increasing availability will move the needle for providers; the remaining consumers will be pushed to broadband as the internet continues to move beyond text-based information to a comprehensive source of video." Lehman Bros. believes that "the battle for the home is likely to be won or lost in the high-speed data arena."

"PCs with tuners will constitute a growing percentage of the total market, accounting for more than 600,000 units in 2006 and growing to nearly six million units in 2010."—Media Servers

As high-speed broadband becomes ubiquitous there will be fewer single PC households and more multi-PC households and these homes will create and share content in new and exciting ways. As of May 2006, the average number of simultaneous file sharing users at any given moment was approximately 9.7 million worldwide, with approximately 6.7 million of these users from the United States, according to BigChampagne, LLC, which tracks file-sharing activity. In the same period last year, BigChampagne tracked 8.6 million average users globally and 6.2 million in the United States. And although the '20-80' rule seems to apply to broadband services—twenty percent of subscribers worldwide are consuming eighty percent of the bandwidth—this time-honored quotient appears to be shifting toward '30-70'.

Video is Fueling Data Demands

According to a March 2006 report from *Pew, Internet & American Life Project*, on a typical day some fifty million Americans now turn to the internet

for news sources, which typically include video clips. But news is just one of many internet-based video applications that are driving demand for greater broadband speeds. *The Online Publishers Association* found that twenty-four percent of American internet users watch online video at least once per week and fifty-eight percent of the people who frequently watch online video use two to five different video sites. A July 2006 article by *The Hollywood Reporter* reported that "viewers are now watching more than 100 million videos per day on YouTube's site, marking the surge in demand for its 'snack-sized' video fare." YouTube's success is a sign of the internet times as is Google's introduction of video advertising, Netflix's promise of delivering movies online, and AOL's reinvention of itself as a giant video portal. "Web video is exploding. Advertisers are moving in swiftly with TV-like commercials. Movie studios are negotiating with big digital platforms. Search companies like MSN and Yahoo Inc. are buying programming and emerging as online video destinations in their own right. Even TV networks are jockeying for position." (*Big TV's Broadband Blitz*, 8/1/06) As a result, online video ad dollars are now growing faster than any other type of internet advertising. And according to eMarketer, Inc., online video ad dollars are expected to grow at double the rate of the overall ad marketing in the next four years, rising to \$2.35 billion by 2010. In fact, demand is so strong that income for fifteen or thirty-second spots that run before or during an online video are now on a par with TV.

"By 2008, sixteen million people will be paying to download or stream movies from the Internet. By 2010, U.S. will download more than 3.6 billion paid music or video files, up from 400 million in 2005.—Parks Associates, VOD & PVR: Analysis and Forecasts, 3Q 2004, and Media Servers: Analysis & Forecasts Executive Summary, Q2 2006

The rise of video on the internet is being driven both by supply (content providers) and demand (consumer). Currently, higher tier households are more likely to download and upload video on the internet. In fact, The Yankee Group estimates that by 2008, customers will download 37 million movies. Service providers must be prepared for rapidly increased video content demand on the web.

Other Contributors to Bandwidth Usage

New technology advances, consumer trends and increased use of online entertainment services will place additional demands on bandwidth. For example:

> "It used to be that the real heavy users were two percent of our subscriber base. But now, we would consider heavy users to be thirty to thirty-five percent of our subscriber base."

**Kevin Crull
President of Residential Services
Bell Canada**

Trends that will increase bandwidth consumption in U.S. households

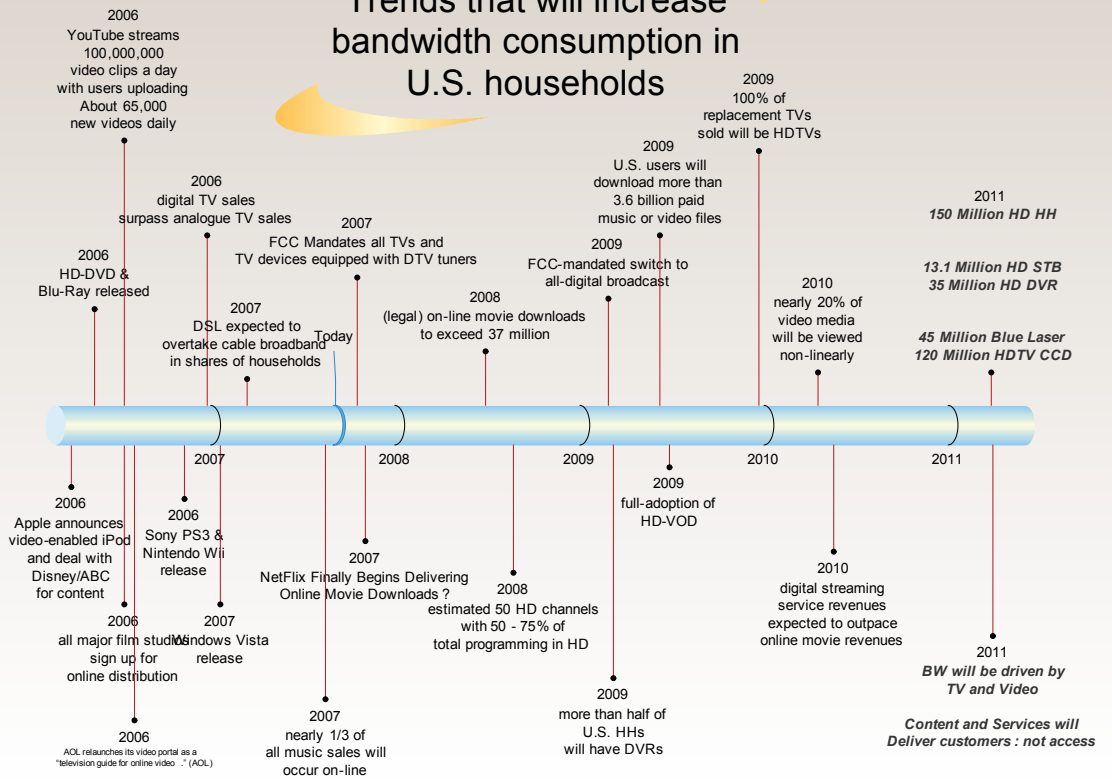


FIGURE 7: US TRENDS INCREASING BANDWIDTH CONSUMPTION IN HH

- Gaming.** The number of internet gamers in the U.S. who frequently play games online (at least on a weekly basis) grew from 18 million to 68 million between 2002 and 2005, according to Parks Associates. By 2009, digital distribution of PC games, including digital downloads, subscription Web games, and on-demand gaming services, are expected to account for \$1.3B, compared to less than \$800M in retail sales. (*Parks Associates, Networked Gaming 2005*)
- Massively Multiplayer Online Games.** MMOGs or MMOs enable players to compete with and against each other on a grand scale, and sometimes to interact meaningfully with people around the world. Most MMOs require players to invest large amounts of their time into the game. Parks Associates predicts that by 2009, MMOG will become a market worth \$1.2B in the U.S. alone.
- HD Gaming.** The move to HD will extend into the gaming arena and the trend toward an HD format will, of course, dramatically increase the size of files. One HDTV video-game trailer, for example, is 54Mb.
- Ridiculously Simple Syndication.** There are more signs that marketers and PR pros are thinking picture-in-picture using the RSS file format. Intel PR has created a special RSS gadget that streams press releases to the Google Personalized Home Page.
- HD-DVD Players.** New Blu-Ray high-def DVD players are able to go online and download new content whenever you slip in an HD disk. So movie

trailers, actor biographies, and even exclusive web sites could be called up by the disc, with the extra content saved on the player itself.

- Upstream Usage.** Consumers are using more applications that demand higher upstream bandwidth, including remotely accessing PCs and home networks, remotely accessing (placeshifting) video and TV content, backing up online content, and videoconferencing. According to a *Broadband Market Update*, "Upstream bandwidth (faster upload speed) will become a more important differentiator for different service tiers."

So How Much Capacity Do We Really Need?

Decisions that drive design requirements for the network infrastructure should include the following:

- Type of video.** HDTV can use three to six times the bandwidth of SDTV. This impacts the bandwidth through the delivery network.
- Number and type of devices in a household.** More video-based CE devices will increase content sharing and downloading. Estimate an average based upon demographics.

- **Type and number of conversational services.**

The mechanism used to supply communication services, such as voice and video conferencing needs to be defined in order to design the network and determine the equipment needed to support these services. Different implementations—e.g. POTS digital transmission, VoIP or VoATM—place different requirements on the network.

- **Types of data services.** Data service has the lowest priority in most triple play implements. Data traffic can be bursty with delays. If bandwidth is constrained, this constraint is applied to data services. When data services are part of a bundled offering, there is a guaranteed minimum bandwidth, which needs to be built into the network design and implementation.

- **Fiber presence.** Fiber can be deployed as fiber to the curb (FTTC), fiber to the node (FTTN), or fiber to the home/premise (FTTH/FTTP). The decision on the role of fiber in the solution has implications for the overall design and is usually based on the business case and the current network design. For example, the decision to use FTTC or FTTN will dictate the use of either ADSL2+/VDSL to the home (last mile.)

- **Service quality metrics.** Priorities based on the traffic and its characteristics include data traffic, which is typically 'best effort', voice traffic, which demands real-time flows but is generally low-bandwidth, and video traffic, which has the highest bandwidth utilization. Multicast (broadcast) video traffic has a constant load and high customer expectations. When they tune to a channel, they expect to receive the requested channel immediately. This content is typically shared among multiple users. Unicast (on-demand) video traffic, on the other hand, is specific to a single subscriber. It is set to the lower priority of the two types of video traffic.

Estimated Bandwidth Usage by U.S. Household Segments

The "laggards" (Tiers 0-2) will have an average of 1.5 HDTVs by 2010. A significant percentage of these users watch TV at peak viewing hours and use the Web two-to-three hours per day.

Tier 0 is typically made up of women without a college education. These women are unlikely to have kids living at home. In a survey conducted by *Parks Associates*, thirteen percent of Tier 0 users indicated that they would be willing to switch to a telco.

Tier 1 is typically made up of 'empty nesters' with significantly lower income than higher tiers (and also higher divorce rates). Eighteen percent of Tier 1 users indicated that they would be willing to switch to a telco.

➤ **"Network levels at peak use times can be as much as twenty-five times higher than during low-use periods."**

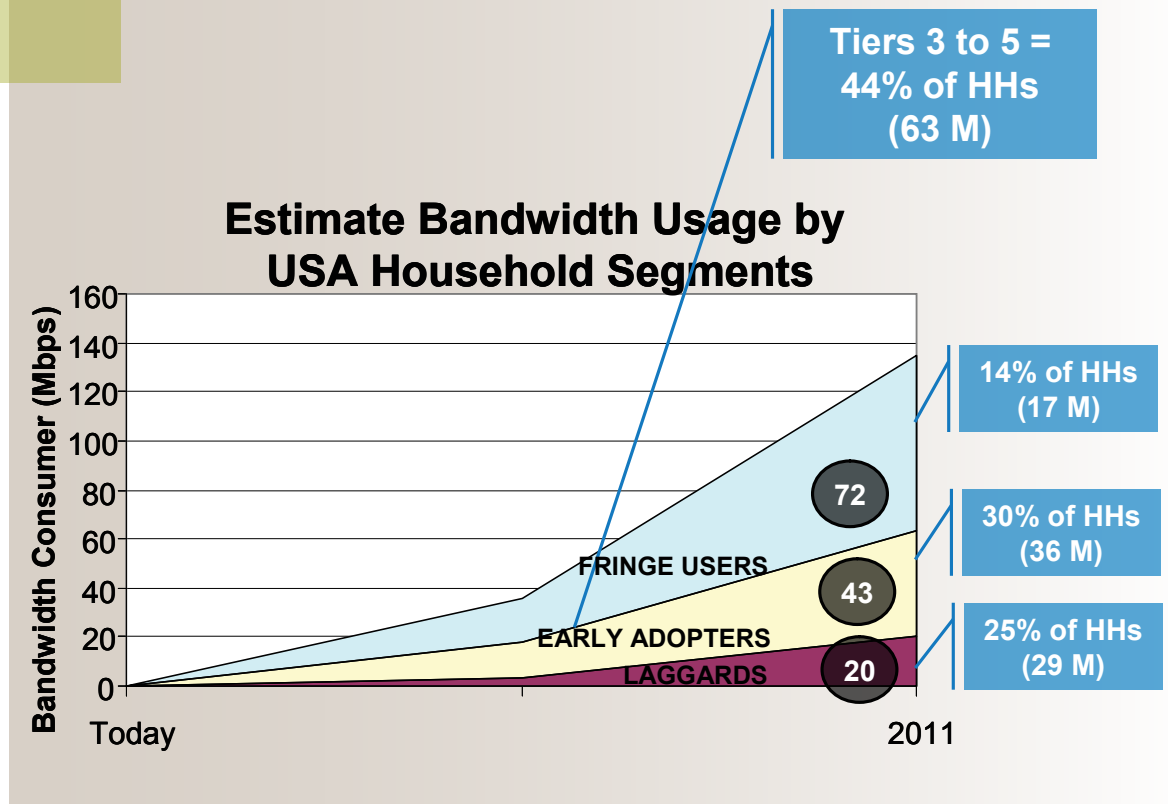
Demand On Today

A disproportionate number of Tier 2 users live without other adults and are between 45 and 55 years old. Incomes are generally representative of the U.S. population. This tier typically has some college schooling but no degree. Estimates for bandwidth usage (derived in part from *Parks Associates* demographic profile) during a "prime time" moment in this household (with an HD-DVR or an HDTV versus an SDTV) bumps up against or exceeds 24 Mbps. The whole network doesn't have to be sized for this but each household does because it matters if they can get what they want, when they want it.

Tier 3 users are typically married with kids and live in owned, not rented, free-standing houses. Tier 3 users are fairly representative of the general population in education and age and much more likely to stream music and video than lower tiers.

Tier 4 users are typically 25-34 years old, generally married and living in free-standing homes. The head of the household usually has a four-year college degree but not a graduate degree. Tier 4 users are likely to live with other adults and to play computer games—both online and offline. Nine percent of Tier 4 users stream video daily and twenty-four percent stream video 1-3 times per week. Early adopter households generally have four members (two parents, one child and one teen) and are already adopting HDTV, HD-DVRs, and high-speed internet and when there is a teen in the house bandwidth usage is likely to go up. In a survey conducted by *Parks Associates*, early adopter households expressed their intent to subscribe to services such as HDTV and VoIP. The estimated bandwidth usage for early adopters (derived in part from the *Parks Associates* profile) ranges from 10 Mbps (to support the popularity of all kinds of video content including music videos, movie clips, advertisement videos, and full-length sporting events) to 40 Mbps with a teen internet user in the home.

FIGURE 8: BANDWIDTH USAGE BY FRINGE, EARLY ADOPTER AND LAGGARD USERS



The “fringe” users in Tier 5 consist of young, single males or unmarried couples with high incomes. Fringe users typically have a college level education, with many still in school. They are unlikely to live alone and live in a free-standing house or own their home. Unlike the other tiers, fringe users assign more weight to recorded TV so they can have more control over what they watch and when.

These households use multiple streams, often HD video streams, at a time. Fringe users, while a small majority, are less sensitive to price and are market drivers for video and bandwidth consumption. Current bandwidth levels can barely meet their needs now, let alone in five years. So service providers will have to size their networks for peak usage versus what’s needed for the average user. The estimated bandwidth usage for fringe users (derived in part from the *Parks Associates* profile) is 72 Mbps. This would support the fact that fringe users engage in all internet and computer activities more than the other tiers and are more likely to create music and copy music CDs, watch streaming video and TV on their home computer, play online games, use peer-to-peer applications, and download videos daily.

2010, U.S. users will download more than 3.6 billion paid music or video files, up from 400 million in 2005.— Parks Associates, Q2 2006

As seen in Figure 8, within five years, 24 Mbps of bandwidth is not going to be enough for almost a third of the U.S. households. This statistic is significant since these households can represent a prime target for bundled services. Bandwidth consumption per household is only going to continue to increase as television services and related functionality are brought online.

Also consider the fact that the customer mix is likely to change over the next few years, with more advanced and early adopters after a few years.

Conclusions

With each passing month, U.S. households are consuming more and more bandwidth, and this trend will continue to accelerate. The number of bandwidth consuming devices per household is growing and the consumer’s media consumption habits are changing, driven by new trends in passive viewing and recording, internet video and on-demand viewing, multitasking with more than one device, and the growing availability of high-definition programming. This increase in video consumption is driving the increase in bandwidth usage. Already, more than 44% of U.S. households are defined as high-bandwidth users. By 2011, these households will require at least 40 Mbps of bandwidth, with many needing as much as 80 Mbps.

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VOIP - Parks Associates - "Digital Voice Communications in the Home" p. 38 (1Q, 2006)

Set Top Media Servers - Parks Research - "Media Servers Analysis" p. 70 *for units shipped, but will assume one server per HH

High-Def DVD HHs - Kagan Research - "The State of High Definition Television" p. 262 (October 2005)



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