HMM?

How Much Media

Report on American Consumers

How Much Media? 2013
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Date of Publication: October 2013

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ACKNOWLEDGEMENTS

This report is the product of industry and university collaboration. We are grateful for the support of our industry sponsors and the research and administrative staff at the Institute for Communications Technology Management (CTM) at USC Marshall School of Business.

Financial support for the HMM research program is gratefully acknowledged:

Alcatel-Lucent

AT&T

Cisco Systems

Hewlett Packard

PricewaterhouseCoopers

Seagate Technology

Verizon Wireless

Special thanks for research and editorial guidance is extended to Dr. Jeffrey Burke, Seagate Technology, Kenneth DeAngelo, Hewlett-Packard, Christopher Lui, AT&T, Gerard Power, Alcatel-Lucent, and to Laura Perez and Robyn Adriance, research assistants.

This report draws heavily on three previous reports on information creation and growth: How Much Information? Report on American Consumers 2009, conducted by Roger Bohn and James Short, and How Much Information? 2000 and 2003, conducted by Peter Lyman and Hal Varian.

Special thanks is also extended to Lucy Hood, President and Chief Operations Officer of the Academy of Television Arts and Sciences, and Dr. Josette Bonte, CTM Chief Strategy Officer for program support, research and editorial guidance.

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Report Design by Theresa Jackson, Orchard View Color: www.orchardviewcolor.com

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Executive Summary

By 2015, it is estimated that Americans will consume both traditional and digital media for over 1.7 trillion hours, an average of approximately 15 and a half hours per person per day. The amount of media delivered will exceed 8.75 zettabytes annually, or 74 gigabytes - 9 DVDs worth - of data sent to the average consumer on an average day. A zettabyte is 10 raised to the 21st power bytes, a million million gigabytes. These estimates are from an analysis of more than 30 different sources of media data, ranging from traditional media (TV, Radio, Voice telephony) to new digital sources (tablet computers, mobile gaming devices, smartphones, mobile video). Media consumed while at work is not included.

We define media consumed as flows of data delivered to households and to people, and we measured the time of consumption and the byte throughput of the data delivered. Video sources dominate bytes, with 3.8 zettabytes coming from television and 2.46 zettabytes from computer gaming. If hours are used as the measurement, media delivered is much more widely distributed, with substantial amounts from radio, Internet applications such as social media, browsing and search, and others including messaging and email communications. All of our results are estimates, based on publicly released data from data providers including Neilsen and ComScore, media company disclosures, and analysts.

Hours of consumption grew at just over 5% a year from 2008-2013, due to a combination of increasing viewer hours per capita, from 11 hours per day to an average of over 14 hours per day, and population growth. Averaged across all media sources, media delivered in bytes is growing at a rate of 18% per year. This is less than the capacity to process data, driven by Moore's Law, rising at least 30 percent a year, but is still impressive.

Traditional media continues to dominate our daily media consumption, with TV and Radio contributing 60% of the hours. New digital sources, however, are having major effects on most forms of media consumption. Over half of all media bytes are now received by computers, with mobile computers the most rapidly growing segment. In 2008, mobile computers accounted for approximately 3% of all bytes, by 2013 it is almost 10%, representing a year over year growth rate of 27 percent.

While in the past media consumption was overwhelmingly passive - we sat and watched TV or listened to radio - new media consumption is increasingly interactive, with time-delayed, multi-tasking and interrupted viewership fast becoming the typical consumptive behavior.

1 MEDIA TRENDS IN U.S. HOUSEHOLDS 2008-2015

1.1 Introduction and Overview

For the better part of three decades, the supply of digital media presented to individuals and households in America has been growing at compounded rates ranging between 9% and 30% per annum for the majority of the media Americans watch, listen to or communicate with – television, radio, cellphones, computers, computer gaming. But there are big exceptions to average rates. For selected user populations, video consumption on mobile devices (YouTube, Netflix), smartphone texting, or social networking on Facebook have much higher rates of growth in usage time, number of users and tasking whereby individuals receive and process multiple media flows almost simultaneously. Users quickly switching back and forth between different media content and tasks –asynchronously and interrupted – is fast becoming the norm for much media use.

Media consumption on the other hand, what we actually pay attention to, has been growing at compounded rates ranging between 3% and 5% per annum, much less than supply but still impressive given there are only 24 hours in a day. This growth is even more noteworthy as the latest U.S. Bureau of Labor Statistics data on daily leisure and sports time show essentially no growth since the BLS first started tracking American time use in 2003 - about two and a half hours a day.[1] For the media industry, the bright side in this data is we are spending more of the leisure time we have consuming media. Conversely, on the other side the disparity between supply and demand continues to widen. The upshot – the amount of media flowing today and tomorrow will be much greater than the ability of people to pay attention to it.[2]

This report on "how much media" summarizes our findings about media consumption in America. That is, how much media flowed to individuals and households in the United States over the years 2008 to 2012, and in the years projected out to 2015? Our data includes media flows consumed in the home as well as outside the home for non-work-related purposes, listening to the radio in the car, talking on a cell phone, or updating a social media page at a coffee shop. It does not include media consumed by individuals in the workplace. Future work will look at media consumption in the enterprise, and on an international scale.

We have reached a number of conclusions about the volume of media flow and media time in America. A few highlights:

- Americans receive a massive amount of media daily and on an annual basis. In 2008, U.S. media consumption totaled 3.5 zettabytes, an average of 33 gigabytes per consumer per day. By 2012, total U.S. consumption had increased to 6.9 zettabytes, an average of 63 gigabytes per person per day. Over that period, bytes increased at a compound rate of 18% a year. In contrast, when byte growth is averaged out over a much longer time period, bytes have grown at 6% annually since 1980. Note this is far less than the rate of growth of computer and information technology performance.

- Time-wise, Americans spend a proportionately huge amount of time receiving media. Viewer time is correlated with the volume and quality of the media being consumed – all things being equal, consumers are more likely to increase viewer activity as content quality and device performance improve. How strong the correlation and whether there are thresholds in total viewer time are key questions. In 2008, Americans talked, viewed and listened to media for 1.3 trillion hours, an average of 11 hours per person per day. By 2012, total consumption had increased to 1.46 trillion hours, an average of 13.6 hours per person per day. Media time increased at a CAGR of just over 5% per year over this period (2008-2012).

- Television remains the main source of media time for Americans, though its dynamics are shifting as viewers can access TV content on multiple devices. All told, Americans spend three fifths of their total media time watching some form of TV (traditional, delayed view, and viewing TV content on other devices). Traditional TV accounts for about half of all media bytes consumed.

- Gaming accounts for over a third of all media bytes consumed in the home, owing to the high performance of gaming devices and the extended time usage of selected gamer segments. However, the dynamics of gaming are changing as well, with some traditional gaming segments (console

gaming, high performance desktop gaming) slowing, while other gaming segments (mobile, social gaming) are increasing in the number of active users and usage time.

- Social media in its many forms continues to grow, but the rate of growth in some dominant sites, Facebook, YouTube and Twitter for example, has slowed recently in the number of active users, site activity, and total time spent on the site. For example, the number of active users reported on Facebook declined in 2012, from approximately 166 million in 2011 to 158.5 million in 2012. However, measuring social media activity is still more art than science, and caution is advised in interpreting reported trends. We comment later on these trends.

This report focuses on U.S. consumers and households. Future HMM reports will expand the focus to include a) the workplace, b) other regions, and c) machine to machine (M2M) data. The report is divided into five sections:

- Section 1 introduces our concepts and reports on aggregate media trends in the changing U.S.
- Section 2 looks at traditional media consumption (TV, Radio, Voice Telephony)
- Section 3 looks at digital media (Computers, Smartphones, Social Media, Gaming)
- Section 4 looks beyond the numbers and asks where dislocations in future media growth may occur
- Endnotes cover references and data sources

Counting Very Large Numbers

One Byte = One character of text

Kilobyte (KB) = 10^3 bytes = 1,000 = 1 page of text

Megabyte (MB) = 10^6 bytes = 1,000,000 = one small photo

Gigabyte (GB) = 10^9 bytes = 1,000,000,000 = One hour of High-Definition video, recorded on a digital video camera at its highest quality setting, is approximately 7 Gigabytes

Terabyte (TB) = 10^{12} bytes = 1,000,000,000,000 = a typical large capacity desktop or notebook hard drive

Petabyte (PB) = 10^{15} bytes = 1,000,000,000,000,000 = AT&T currently carries about 20 petabytes of total IP and data traffic on an average business day

Exabyte (EB) = 10^{18} bytes = 1,000,000,000,000,000,000 = Cisco estimates that global mobile data traffic is currently about 2 exabytes per month

Zettabyte (ZB) = 10^{21} bytes = 1,000,000,000,000,000,000,000

1.2 Counting Media – Measures and Methods

How much media, of what kinds and quality, and on what devices do Americans' consume? This turns out to be a difficult question, as there are no agreed upon measurements for the key words: media type and consumption, media quality, and how much. The data reported here is based on our own definitions of media and how to measure it, guided by industry practice.

What does this report cover?

This study reports on media consumers in the United States from 2008-2015. For each year, we standardized on end-of-the-year measurements. However, in some cases active users and user behavior is changing so rapidly that a single end-of-year measurement does not capture the full picture. In such cases we included additional measurements and factored this information into our analysis. Later versions of this report will standardize on multiple measurements per year. All of our data are from secondary sources; see the technical report for a list of sources.

Our calculations for measuring media flow and time of use start with breaking "media" down into 30 categories and subcategories of delivery media. For each delivery type, we estimate the number of people who actively use the media, and the average number of hours per user per time unit (days, weeks, months, year). (**Table 1)**

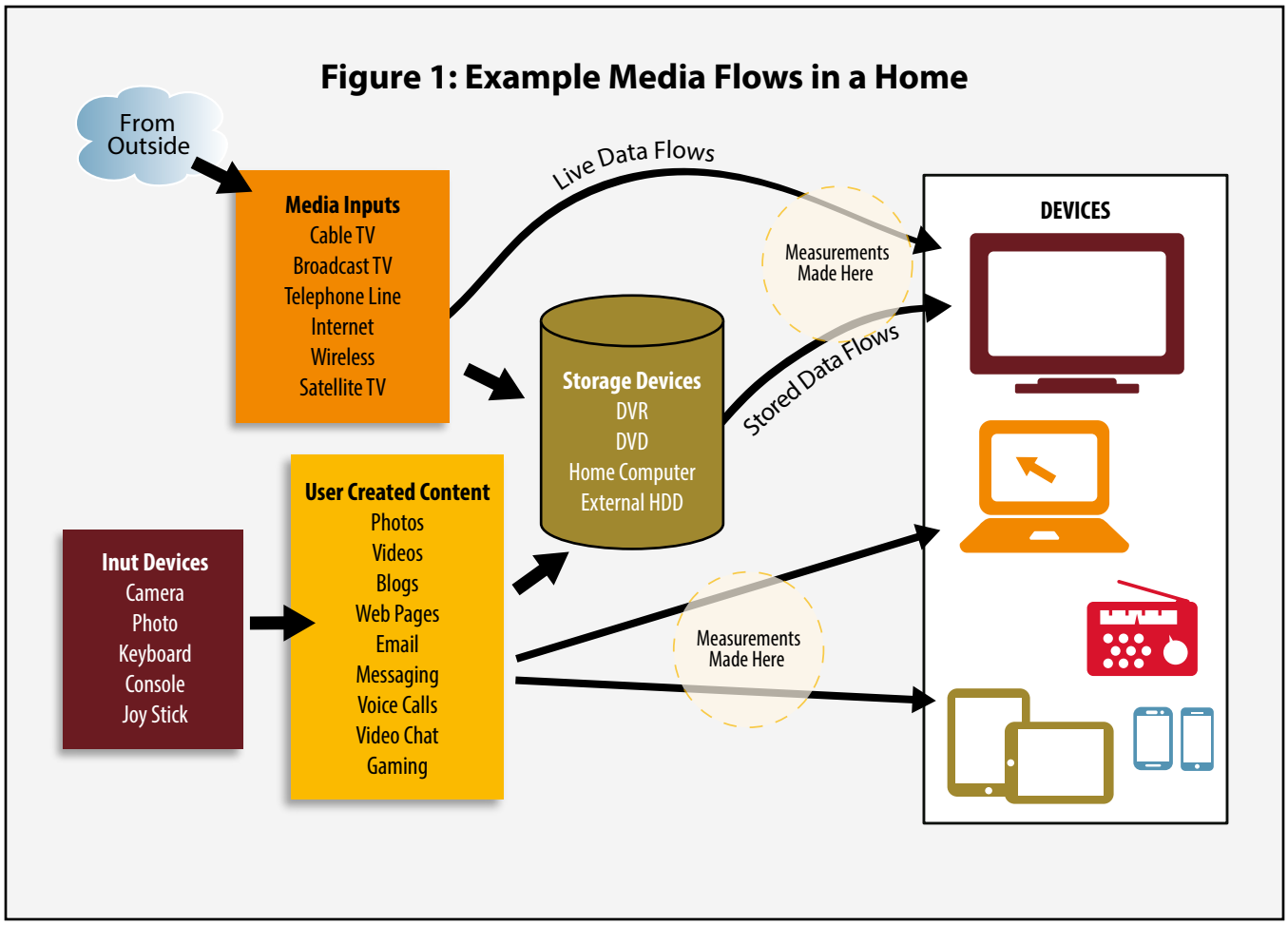
Table 1: Media Analyzed

TV	Cable TV (SD, HD) OTA TV (SD, HD) Satellite TV (SD, HD) Mobile TV Delayed View Internet Video
Radio	Network Radio (AM/FM) Satellite Radio Internet Radio
Phone	Fixed Line Voice Cellular Voice
Computer	Home Computers on the Net Mobile Computers Tablet and Smartphones Social Media Internet Applications (SMS)

The data on active users and hours is compiled from a large number of sources, including media measurement firms such as Neilsen, Arbitron, ComScore, government sources including the U.S. Census Bureau and Bureau of Labor Statistics, company disclosures including SEC filing data and corporate news releases, investor and analyst briefings, media foundation publications and a variety of research and industry studies on special topics. The total number of information sources consulted was in the many hundreds, representing several thousand individual items. A separate technical report covers methodology, data sources and special topics.

Our approach measures media data flows delivered for use by a person. We include all data delivered directly to people at home, whether for personal consumption (such as entertainment), for communications (email, texting, voice), or for information gathering or transactions (Google search, mobile transactions). Data delivered to machines (M2M), such as smartphone GPS location data, is not analyzed in this report. **Figure 1** illustrates some of the data flows in a typical household. The media content flowing to consumer devices are the flows we are interested in.

As shown in **Figure 1**, we measure the number of hours that a consumer watched, used or listened to media and the number of bytes required to present it. We analyzed U.S. consumers aged 2 and above, measuring the sum of fixed and mobile device non-office usage for all consumers.[3] Measuring bytes is controversial, as it emphasizes data types that stream at very high rates (video streaming, computer gaming), yet may account for only a fraction of the hours spent consuming media each day. Take radio: in 2008 Americans spent about 21 percent of their media time listening to radio, but this usage accounted for less than one percent (<1%) of the total bytes received each day. Why the large discrepancy? Because audio content can be compressed at very high rates, thereby reducing the byte totals. Note we measure all streams of data presented to the consumer.



If three people are watching television in a household, we measure it as three streams of data. If one of the TV viewers is also answering e-mail on a smartphone or tablet computer, we count both activities.[4]

To obtain total media consumption for a given year, we sum the number of active users, hours, and device throughput (in bytes per second) over the 30 media delivery types, as illustrated in **Figure 2**.

1.3 How Many Hours?

How many hours do Americans spend with different sources of media? In 2008, we estimate that an average American on an average day received 11.2

Media flows versus stored media

Our definition emphasizes flows of data – data in motion. We count every flow that is delivered to a person as data. Another approach could look at data that is stored somewhere, such as a television show stored on a DVR for later viewing, or a movie stored on a Blu-ray disk, whether or not it is subsequently viewed. We are looking at stored media separately and will report on it in the future.

hours of media. By 2012, the average increased to 13.6 hours per day. Considering that in the 24 hour day we sleep for 8, this means that three-quarters of our waking time is devoted to receiving some form of digital media. Note however that our method adds up all streams of data received, which in theory could sum to more than 24 hours in a day. Adding up media time in this manner is consistent with industry practice, in that the individual delivery systems must deliver the streams whether or not they are being viewed. Consumers on the other hand, may or may not receive media streams concurrently, viewing one as primary and another as secondary, or delayed viewing using a DVR. It is widely assumed, for example, that a percentage of television viewership time is passive – the TV is on in the background, with consumers viewing content as interests dictate. We lack precise ways to analyze simultaneous media consumption, and there are no authoritative studies on the topic. We comment further on this later in the report.

Our hourly data for all media sources over the period 2008-2015 are tabulated in **Figure 3**:

Our data on annual media hours confirms many of the trends consumers see in their own personal media use and those in their homes – a decrease in voice telephony (fewer voice calls, more messaging), the increasing importance of mobile computers (we include smartphones and tablets in this category), and the increasing time use of home computers as secondary screens to view video and engage in social networking. Arbitron and Internet radio providers such as Pandora report increasing numbers of radio listeners online, but growth in total annual hours for radio is flat over 2008-2012. Television hours show a modest increase (2%-3% a year) reflecting increases in Internet and mobile TV viewer numbers and usage, offsetting declines in the number of OTA and cable viewers. As Internet services such as Hulu and Apple TV gain viewer numbers and time usage, these trends will accelerate.

Figure 2: Calculating Total Annual Media Consumption

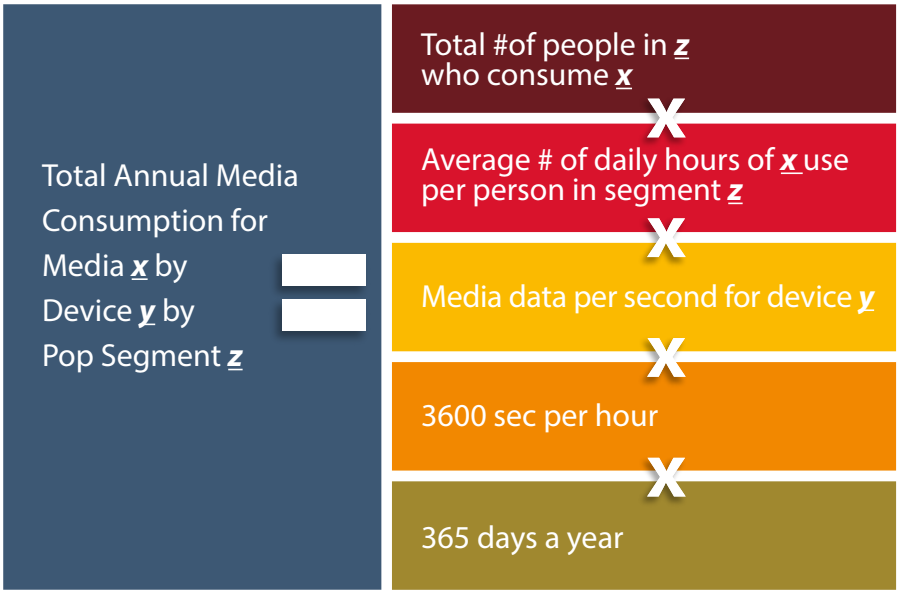
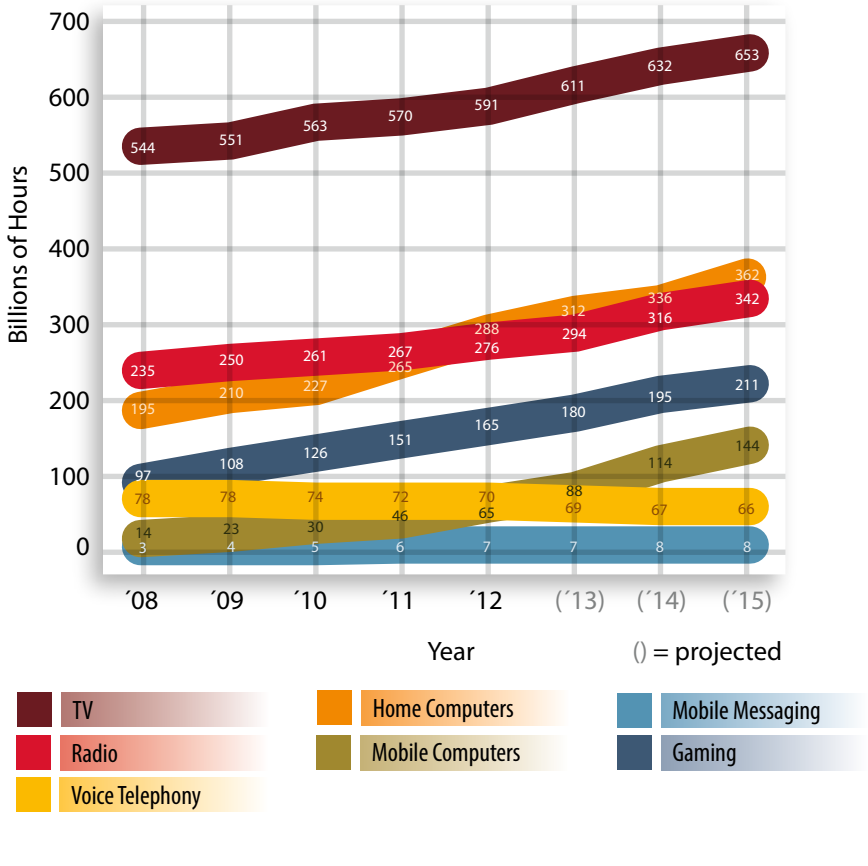
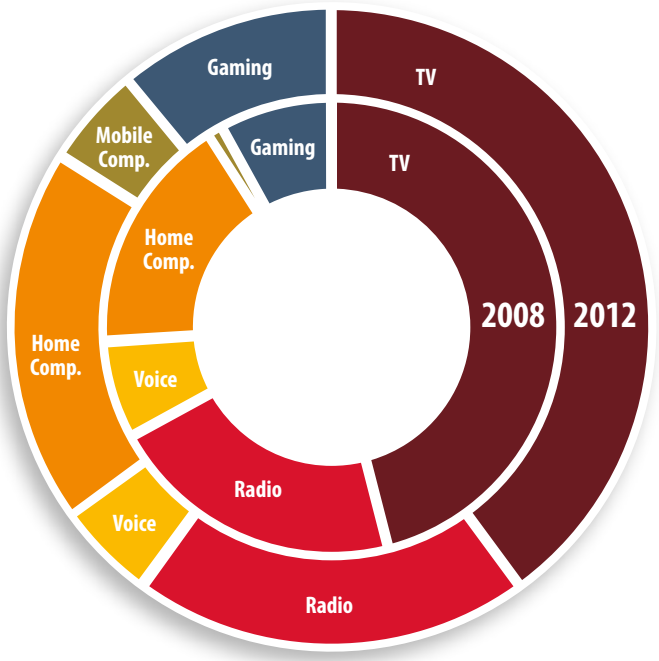


Figure 3: Growth in Total Annual Hours, US Households, All Sources, 2008-2015



Our hourly data also confirms that the largest chunk of the average American's media day is spent watching television. We estimate that in 2008, on average 46% of media time was devoted to watching TV (including DVDs, time-shifted viewing, and real-time viewership). An additional 21 percent of media time was devoted to listing to radio, although a large percentage of this time was in-vehicle commute hours. In other words, traditional media still dominated U.S. households in 2008 – more than seven hours watching TV and listening to the radio a day, totaling two-thirds of total media time. By comparison, computers accounted for 26% of media time, including browsing the Internet, playing computer games, texting, watching videos on PCs, and so on **(Figure 4)**.

Figure 4: Percentage of Annual Hours, US Households, All Sources, 2008 & 2012



2008	2012	
46%	40%	TV
21%	20%	Radio
7%	5%	Voice Telephony
17%	19%	Home Computers
1%	5%	Mobile Computers
0%	0%	Mobile Messaging
8%	11%	Gaming

If we fast forward to 2012, we see the cumulative effect of a number of important trends in media consumption. TV viewership as a percentage of total media time has dropped to 40%, radio has decreased slightly to 20%, but computers now account for over 30% of total media hours. Mobile computers (smartphones, portables, tablet computers), which accounted for just 1.2% of total hours in 2008, account for 5% of total media hours in 2012. Gaming has increased from 8% to 11%. What are we to make of these trends? Despite the popular belief that the ubiquitous computer and smartphone dominate modern media life, traditional media (TV, radio and voice telephony) still account for two-thirds of U.S. household media time. Of course the picture is a changing one as digital platforms continue to grow, but they are still only a third of total annual media time.

Of course, our hypothetical "average American on an average day" is a composite of many different media consumers. For example, although adults frequently complain about how much time children spend watching TV, in fact American teenagers watch less TV than older Americans, while the largest amount is watched by those aged 60 to 65: less than 4 hours per day versus more than 7.[5]

How do we compare current trends with American media consumers of the past? Not surprisingly, total media consumption has gone up. The per capita time spent consuming media has nearly doubled from 7.4 hours per day in 1960 to 13.5 hours per day in 2012. Of course, the types of media have changed. When the 1960s analysis was conducted, it included a variety of media that either doesn't exist today or are fast approaching obsolescence – telex,

telegrams, mailgrams, direct mail, first-class mail and fax. Several have been stalwarts for decades and longer (first class mail service in the U.S. dates to 1879), but such longevity for media platforms in the digital age is unlikely.

Simultaneous Media and Multi-tasking

We do not adjust for double counting in our analysis. If someone is watching TV and using the computer at the same time, our data sources record this as two hours of media data flow. The logic is the delivery platform must deliver the data, whether or not it is being consumed. This is consistent with long industry practice. Note, however, that this means there are theoretically "more than 24 hours in a media day!" The use of multiple simultaneous sources of media is analyzed in "Middletown Media Studies: Media Multitasking" by Robert A. Papper, Michael E. Holmes, and Mark N. Popovich.

1.4 How Many Bytes?

While hours of media delivered for consumption is useful in drawing inferences about long-term media trends, it does not take into account the transformation from analog to digital media, nor the rate at which the underlying technologies in digital devices and device platforms are improving. Indeed, most of the media we consume arrives to us in the form of bits and bytes. Music, online "newspapers," voice calls and messaging, and increasingly, video content all are digital services sending media data to individuals and households. While imperfect, bytes represent a standard metric for calculating the volume of media data flowing to individuals and to households. As with our previous measure, hours, technically we are measuring bytes presented for use, not bytes consumed. The two are correlated but are not the same.

Much of our work has gone into estimating bytes. To reiterate, our method for measuring bytes starts with our measure of viewer hours. For each media type, such as high definition TV, we estimated the rate at which media data is delivered, or "bandwidth," measured in bits per second. Multiplying bandwidth by the number of hours, and adjusting for the time conversion between seconds and hours and between bits and bytes yields the total number of bytes for that category.

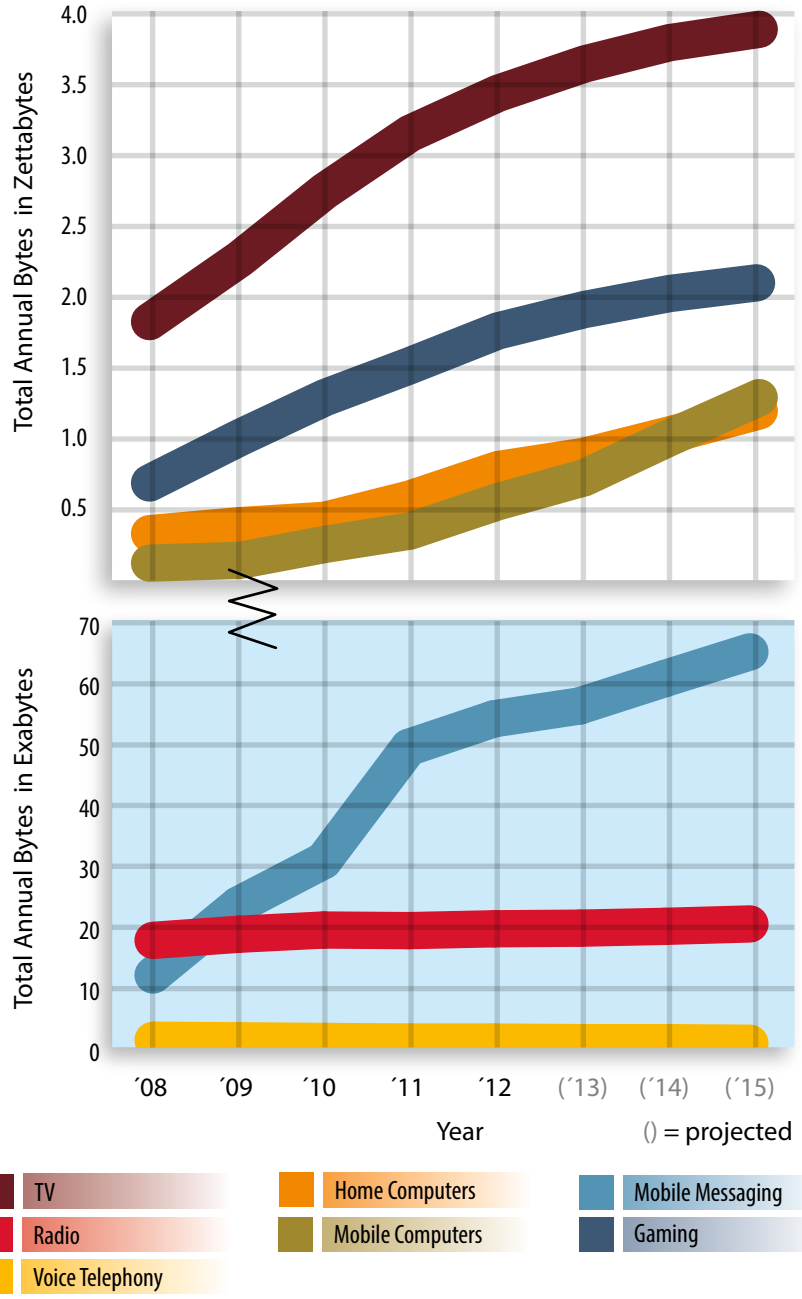
There is a significant complication to calculating bytes, however, which involves determining the correct bandwidth to use in our estimates. Digital data travels over data networks compressed, using software ("compression software") that algorithmically reduces the size of data files / data packets transmitted between points to reduce system load. The rate of compression for some types of media data can be very small, 5 percent of the uncompressed rate for example, but for some media types it can be much greater, approaching factors of 10, 20, and for some video compression standards, a theoretical limit of 60 and higher. For some media, dynamic compression is used, whereby a higher rate of compression is used when network system load is high, and vice versa. We have consulted many sources and discussed our compression assumptions with industry experts to obtain reasonable estimates. In background work supporting this report, we report both uncompressed and compressed bytes for all media types. To be consistent with previous reports, we report compressed bytes when estimating total annual bytes for all media types.

How many bytes are flowing to American households on an annual basis? It will not surprise anyone to say: A LOT. In 2008, we estimate that an average American on an average day received 33 gigabytes of media data, about 4 DVDs' worth. By 2012, this increased to 63 gigabytes, or about 8 DVDs' worth, each and every day. In 2008, bytes totaled 3.5 zettabytes of media data for all Americans for the year; the corresponding number in 2012 is 6.9 zettabytes with a CAGR annual increase of just over 18%.

Our byte data for all media sources over the time period 2008-2015 is tabulated in **Figure 5**.

Media flows for the major media categories for 2008 and 2012 are shown in **Figure 6.** In 2008, TV was the largest source of bytes, over 54% of all bytes consumed. Indeed, only three media activities contribute a significant number of bytes - television, games, and computers – everything else adds up to less than 4% (gaming consumed approximately 34% of all bytes, and computers, both home and mobile, consumed 11%).

Figure 5: Growth in Total Annual Bytes, US Households, All Sources, 2008-2015



By 2012, we see the aggregate effect of video consumption and social media use on home and mobile computers. TV is still the largest source of bytes, but its percentage of total bytes has fallen to 47%, and gaming growth is flat, only a 1 percentage point difference. The big story is the growth in mobile computers (smartphones, tablets, feature phones) and home computers, which have almost doubled in their byte consumption as a percentage of total annual bytes, from 11% in 2008 to almost 20% in 2012. The effect of mobile devices is also present in gaming, the specifics of which will be clearer when we address the caregory later in this report. Byte consumption in gaming continues to increase, but its percentage of total bytes was relatively constant over the period 2008-2012. However, we project that as TV viewers continue to shift to alternative platforms, gaming will continue to increase as a percentage of total byte consumption, from 2013-2015.

How much is 6.96 zettabytes?

If we printed 6.96 zettabytes of text in books, and stacked them as tightly as possible across the United States, including Alaska and Hawaii, the pile would be almost 14 feet high.

In Sections 2 and 3 we "drill down" and report hours and bytes for individual media categories. However, for individual categories where appropriate, we compare compressed and uncompressed bytes for several reasons. First, logically we are interested in understanding how the volume of media bytes has changed over time as a function of improving device capacities and usage, not changes owing to different compression rates/technologies over time. It makes most sense to separate out the effects. Second, as noted the rate of digital compression is not a constant. In many situations compression rates vary according to factors such as time of day, average and peak network load, quality of service and many other network factors. Therefore for the purposes of this report, where we report uncompressed bytes, this gives us more of a measure of device and usage capacity – an upper limit – than an actual "working" usage number. In a later technical paper, we will report a more detailed analysis.

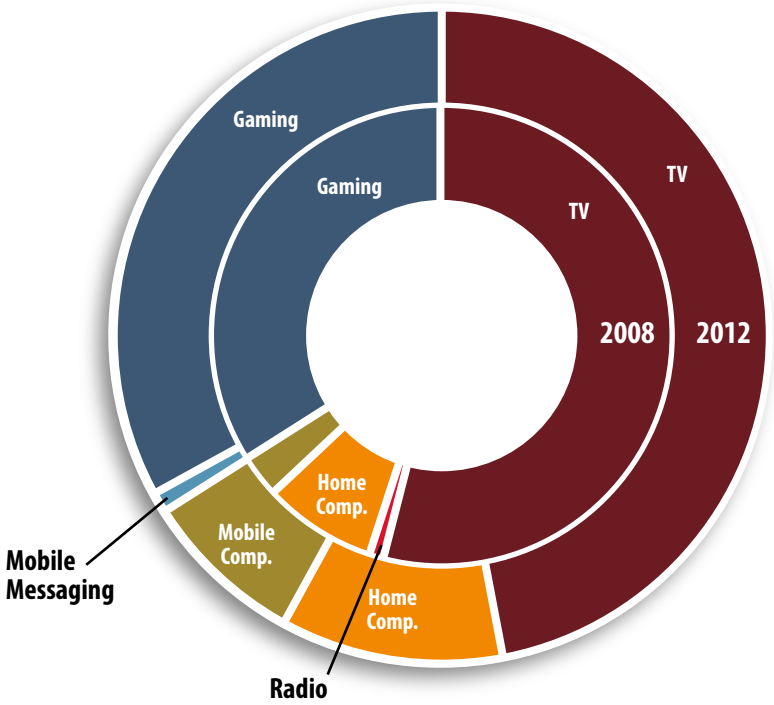
Whatever the precise definitions used for measuring bytes however, one fact stands out: video consumption dominates all other forms of media data when measured in bytes. Even high-resolution digital photographs are tiny in comparison with most video. A high resolution digital picture might be 10 megabytes, but this is equivalent to only 20 seconds of a standard TV picture. This leads us to the byte consumption patterns shown in **Figure 6** – only three activities contribute a significant number of bytes – television, gaming and watching video on computers.

1.5 Media Value

One implication of our definition is that we only measure media each time that it gets used. This measurement of "media usage as flow" follows typical industry practice - however it does not address data stored on primary storage media including digital books, DVDs, CDs, MP3 players, smartphones, computer hard drives, digital video recorders (DVRs) and external hard disk drives (HDDs). Indeed, while our statistics for media data consumption are many times larger than the total data storage capacity of the devices themselves, a complete picture of household media would include both "flow" data and "stored" data.[6]

Another implication of our definition is that hours and bytes measure the volume of media, not its value. There are many potential criteria for measuring the value of a stream of data, including selling price, willingness to pay, development cost, audience size and subjective judgment. But there is no clear way of comparing the value of media streams, especially when comparing different types of media, presented differently, over different time periods. Is viewing a televised sports event in high-definition more valuable than viewing it in standard definition? Or is having a cable package with 300 channels more valuable than one with 150 channels, when most people view between 6 and 12? And how have relative media values changed over time? We can conclude that consumption is correlated with value, but it isn't the same thing, and the larger problem is that the value of one form of consumption can't be

Figure 6: Percentage of Annual Media Flows in Bytes, US Households, All Sources, 2008 & 2012



2008	2012	
54%	47%	TV
1%	0%	Radio
0%	0%	Voice Telephony
8%	11%	Home Computers
3%	8%	Mobile Computers
0%	1%	Mobile Messaging
34%	33%	Gaming

directly compared with the value of another form of consumption - there are other variables involved.

So what media – television or gaming or social media for example – is more valuable? Unfortunately none of our quantitative measures captures this. The volume of media data presented and consumed over a typical day does not tell us enough to accurately determine its value or impact.

The right information in a media stream – a direction to drive when lost – can be of great value. At the other end, bytes are now so cheap to produce and distribute that for much of the media volume, we are conditioned to ignore it, or to view it passively while doing other "more important" activities. Media value is another topic. Here we focus on the volume of data.

2 TRADITIONAL MEDIA

"Media" can be roughly classified into "consumptive media," data that is accessed and consumed by individuals in households and on mobile devices for the purposes of entertainment, searching for information and communications, and media that is created and accessed for productive use in workplaces. We are concerned here with the first.

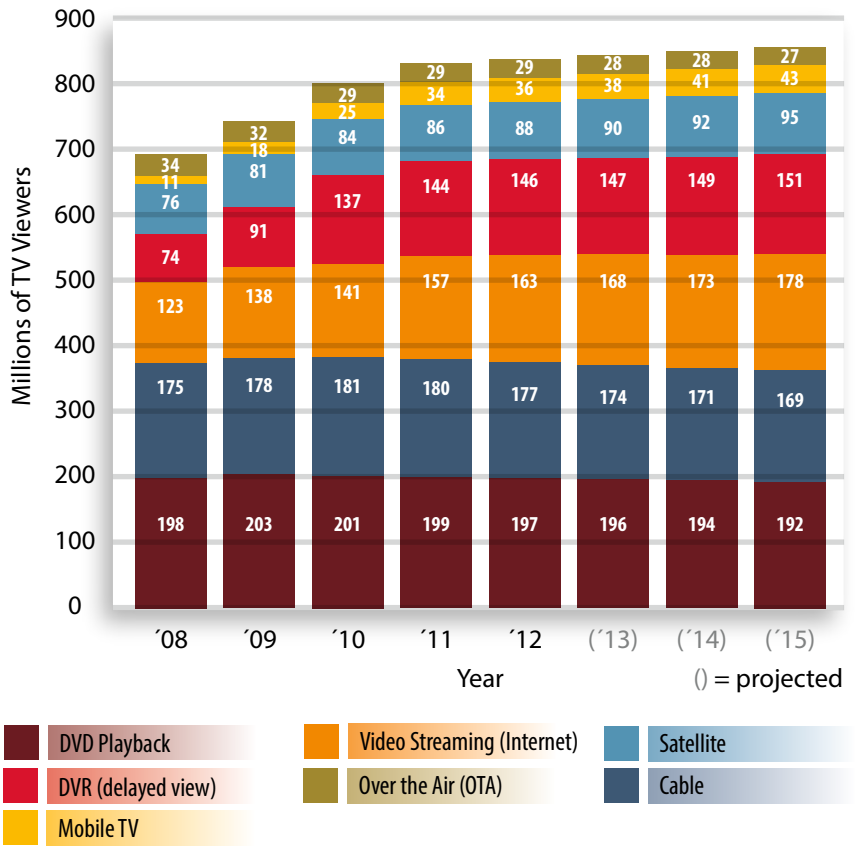
This section discusses "traditional" media in U.S. households – media data flows delivered and consumed by individuals that preceded the computer era. They are "traditional" in the sense that the content and mode of consumption are time-honored – sitting on the couch watching television in the family room, speaking on the telephone, or listening to a Sunday radio show.

2.1 Television

Americans are heavy users of TV, and on both of our measures of media flow (hours and bytes), TV is by far the largest source. However, television usage measured in hours per person per day has ebbed and flowed around the four and three-quarter hour per person mark since 2008.[7] Indeed, whether you have 150 channels on digital cable or just a handful of channels of over-the-air broadcast TV, you still have only a limited number of hours to watch TV. Total TV time has not changed dramatically despite today's broader channel choices and higher-definition TV reception.

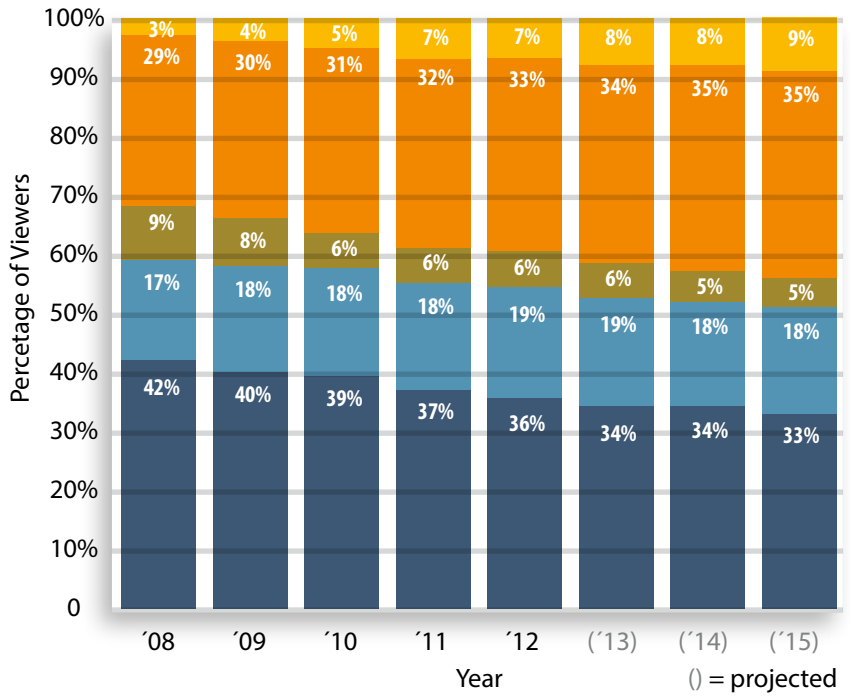
While HDTV began to take off with consumers in 2008, far more homes had HDTV sets (53 percent in January 2009 according to estimates from the Consumer Electronics Association) than actually received HDTV signals (approximately 40 percent although estimates vary). It is quite common for TV owners to not realize that their "high definition" TV set is actually showing only standard TV signals. For those households that did receive HDTV, it was estimated in 2008 that roughly 40 percent of their viewing hours were high definition.[8] Even so-called "high definition" television programs vary considerably in quality. One reason is that original content varies, but another is that cable companies often choose to offer a higher number of channels, with lower bandwidth and lower quality per channel, rather than the reverse. Over the air, cable, and satellite TV are transmitted at an average of 4 megabits per second, although this depends on what compression methods are used. We estimate that high definition TV averages about 12 megabits per second. Putting all of this together, we used an estimate of 4 megabits per second for standard TV, and 7.2 megabits per second for the weighted

Figure 7: Number of TV Viewers by Device, 2008-2015



Note: Viewers may be counted multiple times, once for each device used.

Figure 8: Percentage Viewer Distribution by Primary TV Device, US 2008-2015



Note: Percentage of viewers who view TV and TV content on each primary delivery platform. Note viewers may be counted more than once. Columns may not sum exactly to 100 percent due to rounding.

average bandwidth of TV into homes that receive HDTV. Television is always compressed for transmission and then uncompressed for viewing, and we measure the compressed bit rate. And if two people are watching the same show on the same TV set, it shows up twice in our measurements.

Neilsen reported in May of 2011 that U.S. television ownership had dropped for the first time in 20 years, from 98.9% of American households to 96.7%.[9] Two reasons were cited, a weakening economy and perhaps, an increasing percentage of young consumers who were viewing TV content on computer devices. "Perhaps" because the Neilsen data could not show whether these consumers were simply delaying purchase of a TV set, or had decided not to purchase a television in the future. In whatever case, the great majority of Americans own or have access to a TV set and TV devices. **(Figure 7)**

Note the bar totals in this figure add up to over 700 or 800 million people, as the information in the figure is the relative sizes for each component of the bars, not the totals (viewers are counted for each device they use, therefore an individual

viewer could be counted 1 for each device, or a total of 7 times - 1 for each viewer mode). The relative percentages for the primary TV delivery modes are shown in **Figure 8**.

We see in these two figures a slight decline in traditional TV (cable, satellite and OTA viewers), a notable decline in DVD viewership, and an increase in mobile TV, video streaming over the Internet, and DVR (time shifted) viewer numbers.

As noted in Section 1, in 2008 the estimated 286 million U.S. viewers averaged four and three quarters an hour of TV viewing time per day.[10] Total TV time accounted for 46% of total annual hours of media consumption, and 54% of total bytes. By 2012, the total number of TV viewers had increased to 298 million, and these viewers averaged a slightly lower four and a half hours of TV time per day. Total TV time accounted for 40% of total annual hours of media consumption, and 47% of total bytes. The decline in daily viewing hours was driven by three factors, the most important of which are increased viewership of TV content on digital devices (tablet computers, smartphones), and increased DVR (time-shifted) usage, as shown in **Figure 9**.[11]

Neilsen's numbers show very slight changes in daily TV viewer time over the period 2008-2012 - some would argue within sampling error - but the big story is the growth in DVR usage, from 14 minutes a day in 2008 to 25 minutes a day in 2012, a CAGR of 15.6% per year.[12] **(Table 2)** Taken together, increasing DVR usage more than offsets the modest decline in traditional TV viewership time. Important in the Neilsen data was the reported decline in DVD usage. Many had expected that DVD usage would increase as the price of Blu-ray players declined and more consumers bought HDTV sets on which to watch Blu-ray content (ironically, the biggest purchasers of Blu-ray disks when they were introduced came from the gaming industry, because Sony built Blu-ray technology into its Playstation 3 game console, making it the most widely used Blu-ray player in the world). We will continue to look into DVD usage going forward.

Beyond the numbers, the emerging picture from television viewer data is that despite predictions to the contrary, in fact the reported data on traditional TV viewership is remarkably stable over the last five years. Yes, Neilsen data records slight decreases in daily viewing hours, and DVR usage is shifting real-time viewership, but the difference in the normalized time per day is 5 seconds from 2008 to 2012. What are we to make of this?

Table 2: TV and TV Device Viewer Time per Day, 2008-2012 (Source: Neilsen, 2013)

Year	TV	DVR	DVD	Total
2008	4:44	0:14	0:16	5:14
2009	4:40	0:17	0:15	5:12
2010	4:38	0:20	0:13	5:11
2011	4:39	0:22	0:11	5:08
2012	4:35	0:25	0:11	5:15

Note: Based on Q4 data from each year.

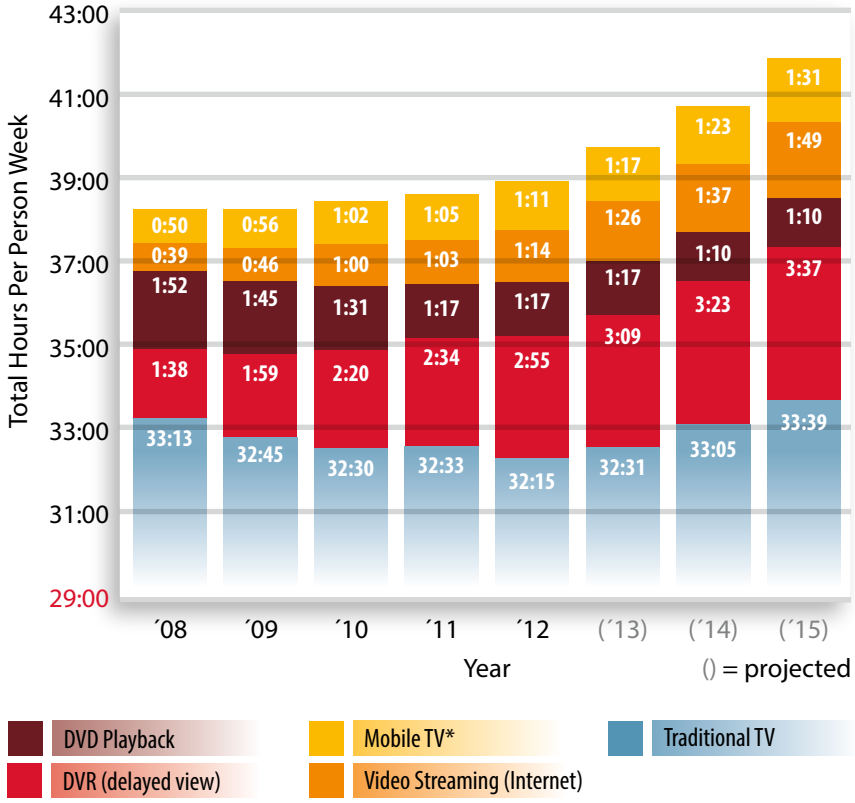
There are several possible explanations. First and perhaps most often advanced, it is argued that while the TV may be turned on for over 4 hours a day, no one is watching it continuously. For a portion of the time, the TV is simply on in the background. An early study of media multitasking found that among 13 to 24 year old viewers, television was 8 times more likely to be the primary media activity than the secondary activity (music). And perhaps more surprisingly, apart from all computer activity summed together (email, computer games, homework, etc.), more time was devoted to television as the secondary activity than all other secondary media usage. The study concluded that the importance of these two viewer behaviors, the prominence of TV as a primary medium, and TV's prominence as a secondary medium compared to all other media, helps explain the sheer volume and constancy of time devoted to television.[13]

A secondary hypothesis draws on recent observational studies suggesting that the bulk of tablet usage is in front of a television, most often in the family room in the household. The assertion is that the viewer is "watching TV" but multi-tasking on the tablet or computer in the background – sending messages, answering email, etc. Indeed, many studies have argued that most media consumption today is either conducted as media multitasking – people switching back and forth between different media – or the simultaneous use of two or more media (e.g., the TV is on and the viewer is watching it and doing something else). The two viewership behaviors are related but different. Results from

experimental studies recording "full-on" media multitasking have shown that individuals switch their attention between media at very high rates - in one study averaging 120 switches per 27.5 minutes of media multitasking. Attention spans were very short, less than 5 seconds, as viewers constantly switched between different media.[14] Simultaneous media consumption has less task switching behavior, and most studies use television as the primary media, and analyze differences with selected other media "pairs" (examples: watching TV and using a computer, watching TV and reading a newspaper, etc.). A key finding is that combining television viewing with internet activity is the most popular media combination, with television playing the primary role.

A final hypothesis takes into account TV content is highly duplicated. Television shows are shown in multiple formats, time zones, and increasingly on multiple platforms. The sheer volume of viewership time is correlated with the amount of duplicated content available, which is growing as the number of channels and viewer platforms increase.

Figure 9: TV Viewer Time per Person per Week, All TV Sources, 2008-2015



Note: Totals do not adjust for double counting. If someone is watching TV, for an hour, and using the computer at the same time, it is recorded as two hours of data.

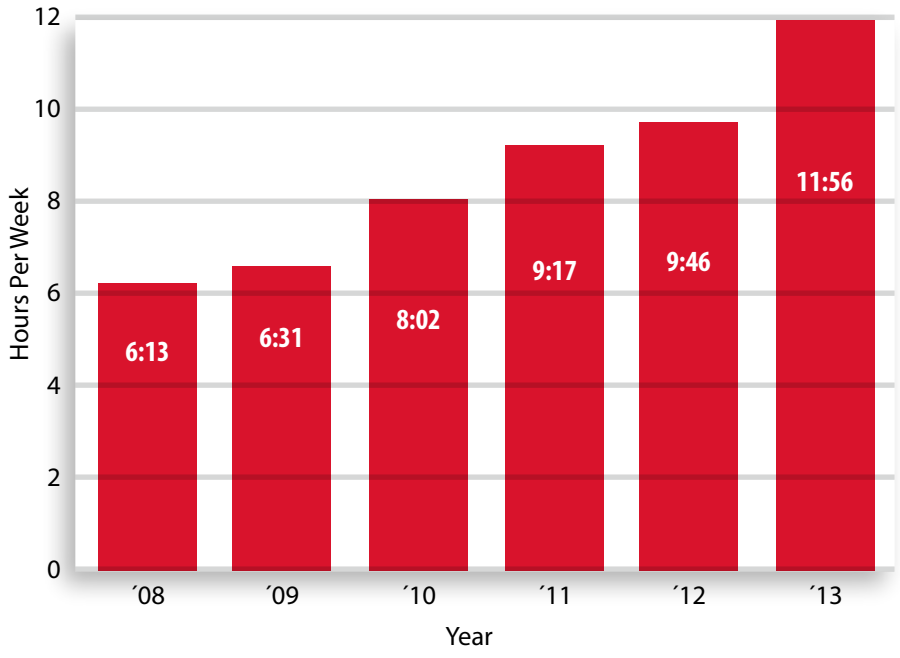
*Mobile subscribers watching video on a mobile phone.

2.2 Radio

In September 1979 the British pop group, The Buggles, released "Video Killed the Radio Star," a wistful reflection on the passing of the 1960s music era dominated by radio. Famously, "Video" became MTV's inaugural music video, and when MTV began broadcasting in 1981, Video didn't kill the radio star, it was the reverse, thanks to the popularity of television. Radio today continues with traditional AM/FM network radio reaching 243 million Americans, who listen on average to slightly over two hours a day. But the big news in radio is the growth of Internet radio, provided by firms such as Pandora, Jango and Spotify. Online radio reaches an estimated 66 million Americans, who tune in for slightly less than 12 hours a week. **(Figures 10 & 11)**

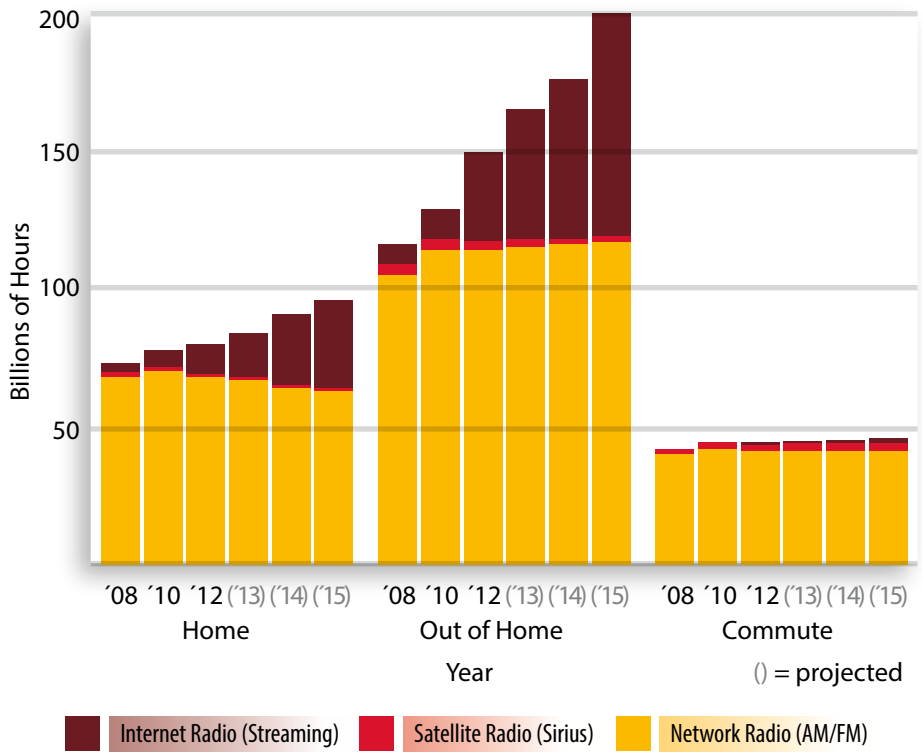
In terms of bytes, audio requires very low data rates. Even without factoring HDTV into the equation, video requires roughly 30 times more data throughput than audio. Or to compare satellite services, the throughput of satellite TV (1,800 megabytes per hour) compares to 8 megabytes per hour for satellite radio. Radio bytes as a percentage of media bytes, therefore, are not a major factor. In total, all US radio listeners received about 9 exabytes of data in 2008; in 2012, about 10 exabytes. Online radio contributed approximately 54% of the bytes in 2012, AM/FM network radio 30%, and the remaining 17% of bytes, satellite radio.

Figure 10: Average Self-Reported Time Spent per Week with All Sources of Online Radio



Source: Arbitron, The Infinite Dial 2013

Figure 11: Total Annual Radio Hours, All Sources, All Locations, 2008-2015



Source: Arbitron

2.3 Voice Telephony

The question for voice telephony over the last several years has been a classic chicken and egg dilemma – are people talking less on the telephone because they have always wanted to talk less, or do they talk less because a new set of consumer devices (feature and smartphones) and applications now provide easy capability to send messages, thereby driving the substitution of messaging for voice. Our data does not capture the behavioral reasons for the decline in voice, but it does illustrate the relative changes in hourly usage.

Figure 12 shows the total number of voice hours on all telephony devices (fixed line, mobile phones, VoIP) for the years 2008-2012 and projected out to 2015, against the total number of messaging hours over the same time period. Note the typical format, voice hours against the number of messages, is different as we have converted the number of messages to an estimate for the number of hours required to compose, send, receive, and read those messages.[15] The data shows that in 2008, mobile messaging hours were approximately 3.5% of total voice telephony hours, and by 2012 had grown to over 9%, a growth rate of 27% a year. Is the decline in voice hours due to the obvious reason, namely the value of asynchronous communication? Or if the communications industry had developed an easy and profitable voice messaging service, would the data in this chart look very different? [16] Whatever the reasons, it appears safe to conclude from **Figure 12** that messaging is substituting for voice, and we have projected that trend to continue out to 2015.

While overall voice hours are dropping, mobile and VoIP hours as a percentage of total hours are both increasing **(Figure 13)**. In 2008, mobile was about half of total hours; by 2012, it had increased to over 71%, an annual increase of 9%.

Our byte calculations for fixed landline users (also known as 'POTS' for 'plain old telephone service') are for voice traffic, and do not include DSL nor dial-up Internet service through a wired telephone connection to the home. Using data supplied by the FTC, we calculated 1.1 exabytes for landline telephone service, and 1.36 exabytes including VoIP and mobile voice for 2008. The corresponding totals for 2012 were 0.7 exabytes for landline (reflecting the decline in landline subscriptions), and 1.12 exabytes including VoIP and mobile voice. Landline bytes are approximately 12 times greater than mobile bytes, reflecting the greater compression of voice signals carried over wireless connections.

Figure 12: Comparing Total Annual Voice Hours With Total Annual Messaging Hours, 2008-2015

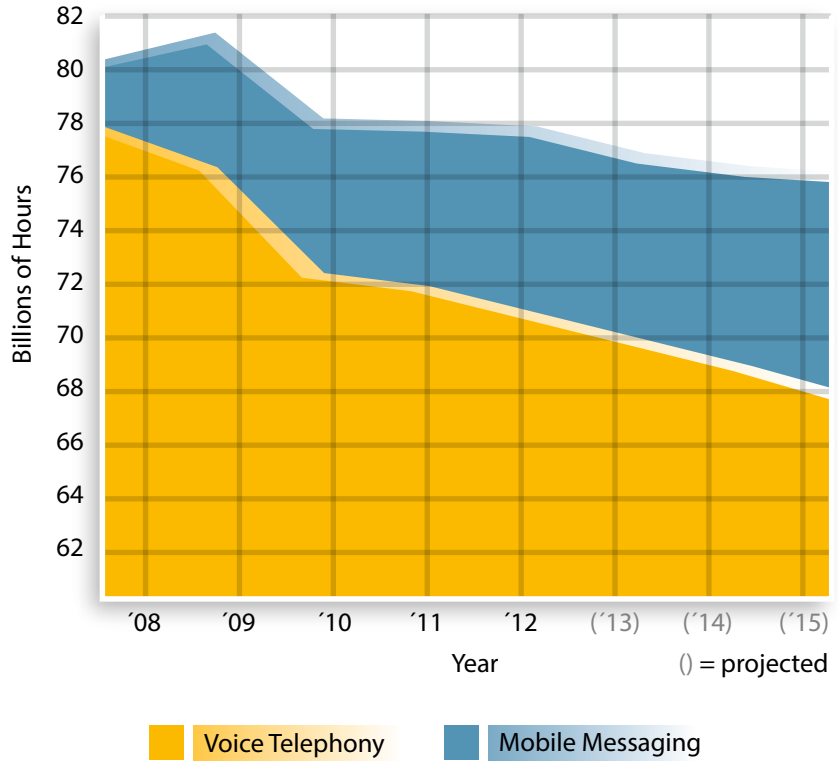
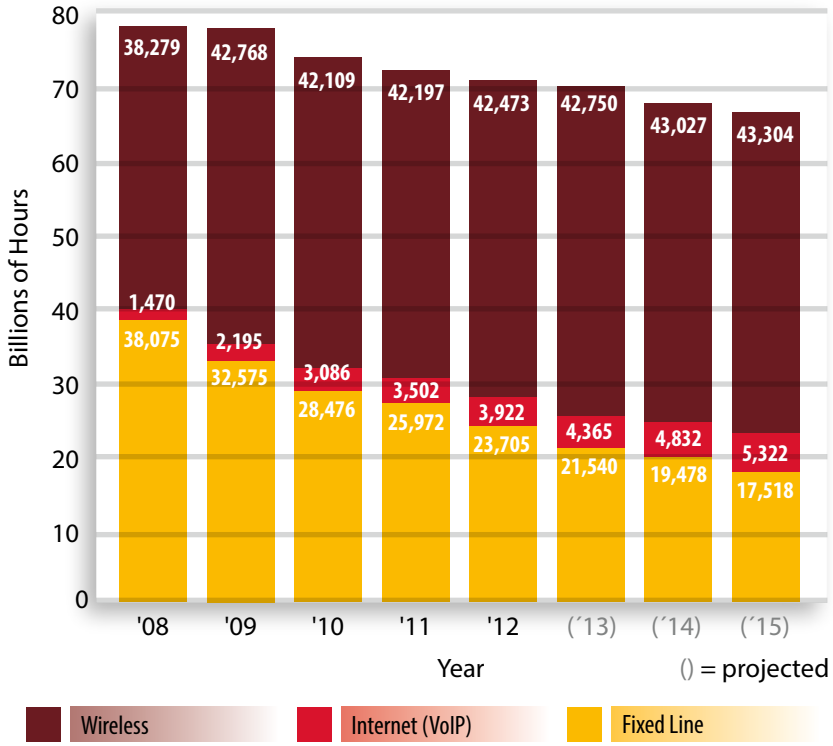


Figure 13: Total Voice Hours per Year for Wireless, Internet, and Fixed Line, 2008-2015



3 DIGITAL MEDIA

New digital technologies continue to remake the American home. Fifteen years ago 40% of U.S. households had a personal computer, and only one-quarter of those had Internet access. Current estimates are that over 80% of Americans now own a personal computer with Internet access, and increasingly that access is high-speed via broadband connectivity.[17] Adding iPhones and other 'smart' wireless phones, which are computers in all but name, personal computer ownership increases to more than 90%. Many households now boast dozens of digital devices for entertainment, information and other purposes: 3G phones, HD television sets, DVRs, home computers, game consoles and portable gaming machines, PDAs, MP3 players, consumer HDD storage devices, and so on.

In this section we report on four major categories of home computer use:

- Accessing the Internet for Web browsing, communications (including email) and social networking;
- Uploading, downloading and watching videos on the Internet;
- Computer gaming on consoles, home computers and mobile gaming devices, and
- Mobile computer use, including tablets, smartphones and feature phones

In 2008, the average American spent just over three hours a day using some form of computer, not including time at work. That was 27% of total media hours and 46% of all media bytes. By 2012, computer use had grown to four and a half hours per day, or over a third of total media hours and 53% of all media bytes (an

increase of 6%). The vast majority of these bytes are attributed to computer gaming (33% of all media bytes in 2012), whereas the majority of the time Americans spend using computers involves the more commonplace Web browsing, communications (email), and social networking.

3.1 Home and Mobile Computing on the Net

The Internet has revolutionized how Americans communicate. In 1980, email was essentially non-existent in U.S. households, and sending a fax was the hot new way to communicate faster and cheaper than Telex or first-class mail. By 2008, 226 million Americans spent about a third of their information hours on the Internet reading and responding to email, and the other two-thirds web browsing, searching for information, gaming and viewing streamed audio and video content.[18] Text-based applications dominated – video consumption accounted for just 4.5% of home computer media hours, and 17% of mobile computer hours. By 2012, for the 283 million Americans using computers, text-based applications continued to dominate total media time, with video consumption on home computers increasing to 8% of total media hours, and approximately 12% of total media hours for mobile computers.

Figure 14 gives the total number of US mobile data users over the estimated total US digital media population – that is, the total number of individuals in households with access to digital media. The information in this chart is the relative growth in mobile data users as a percentage of the total US digital media population, from 56% of the total population in 2008 to over 60% in 2012.

The most widely used Internet application in 2008 was email, accounting for just over 34% of all hours on the Internet.[19] Because email is largely text-based, it accounted for relatively few bytes. But the big story here is that by 2012, email had fallen to 23% of all hours on the Internet, a major change. By all accounts, this decrease largely reflects the combined effects of increased messaging and social media use, two topics addressed later in this report.

By comparison, in 2008 Americans spent slightly more hours on web browsing and searching for information (35% of all computers hours on the Internet).[20] As in email however, a major change took place from 2008-2012: web browsing and Internet search increased from 35 to 46% of all hours on the Internet, reflecting the increasing use of the Internet as an information utility. Of course, there are many factors involved, among them: increased use of mobile computers where browsing and search applications are more heavily used; increased home and mobile eCommerce; more and better content that users want to search for; and improved browsing and search functionality.

The relative change rates for home and mobile computer applications for 2008-2015 are shown in **Figure 15**. Note the relative decrease in hours for home computer communication applications, such as email and messaging. At the same time,

Figure 14: Growth in Total US Mobile Data Users, 2008-2015

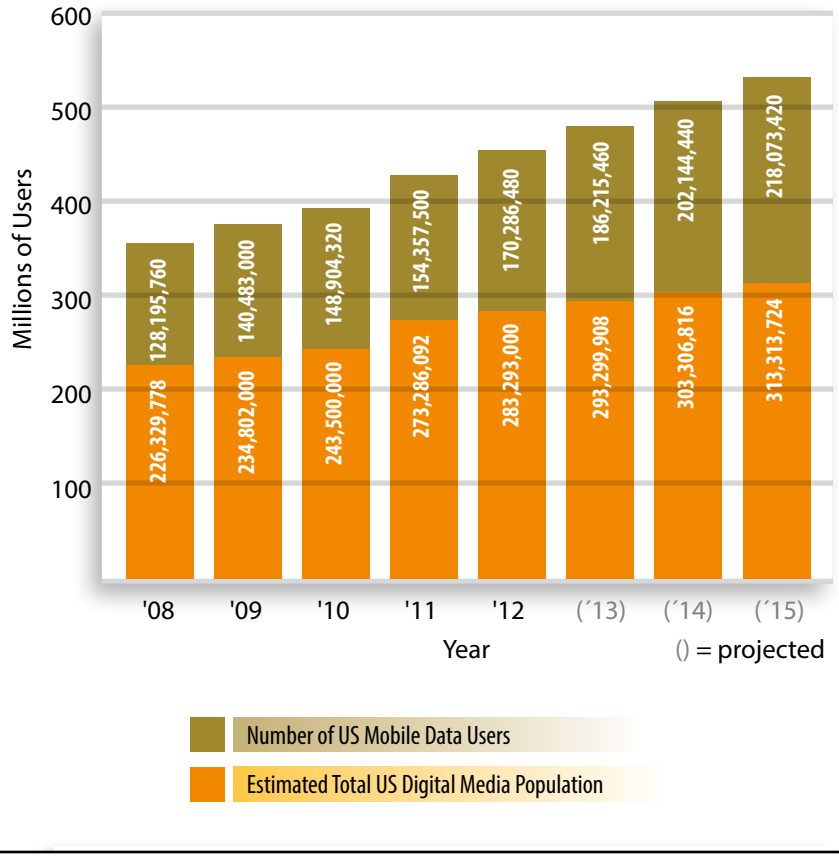
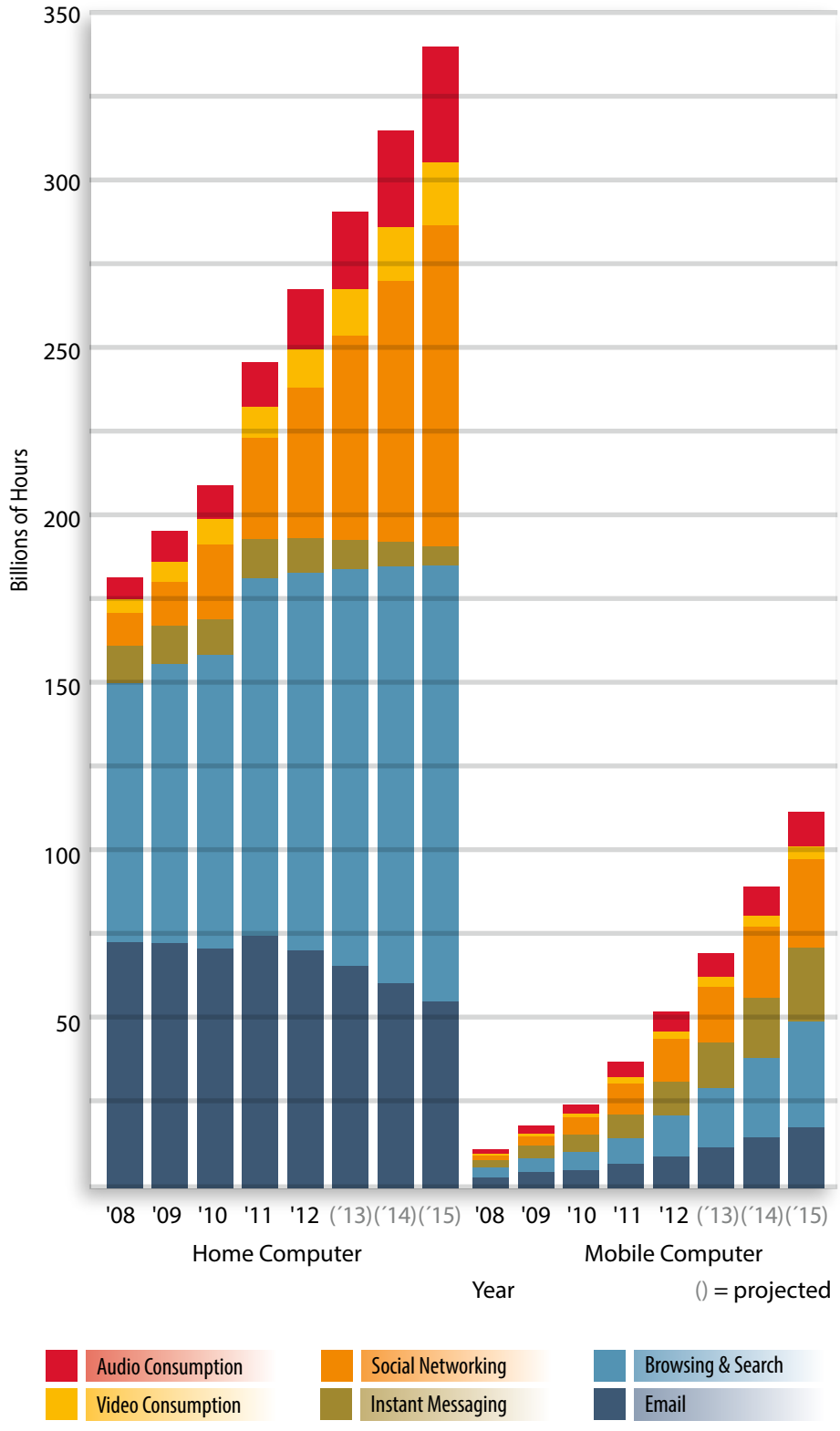


Figure 15: Total Annual Hours, by Application, for Home and Mobile Computers, 2008-2015



these applications are increasing in hours of use on mobile computers.

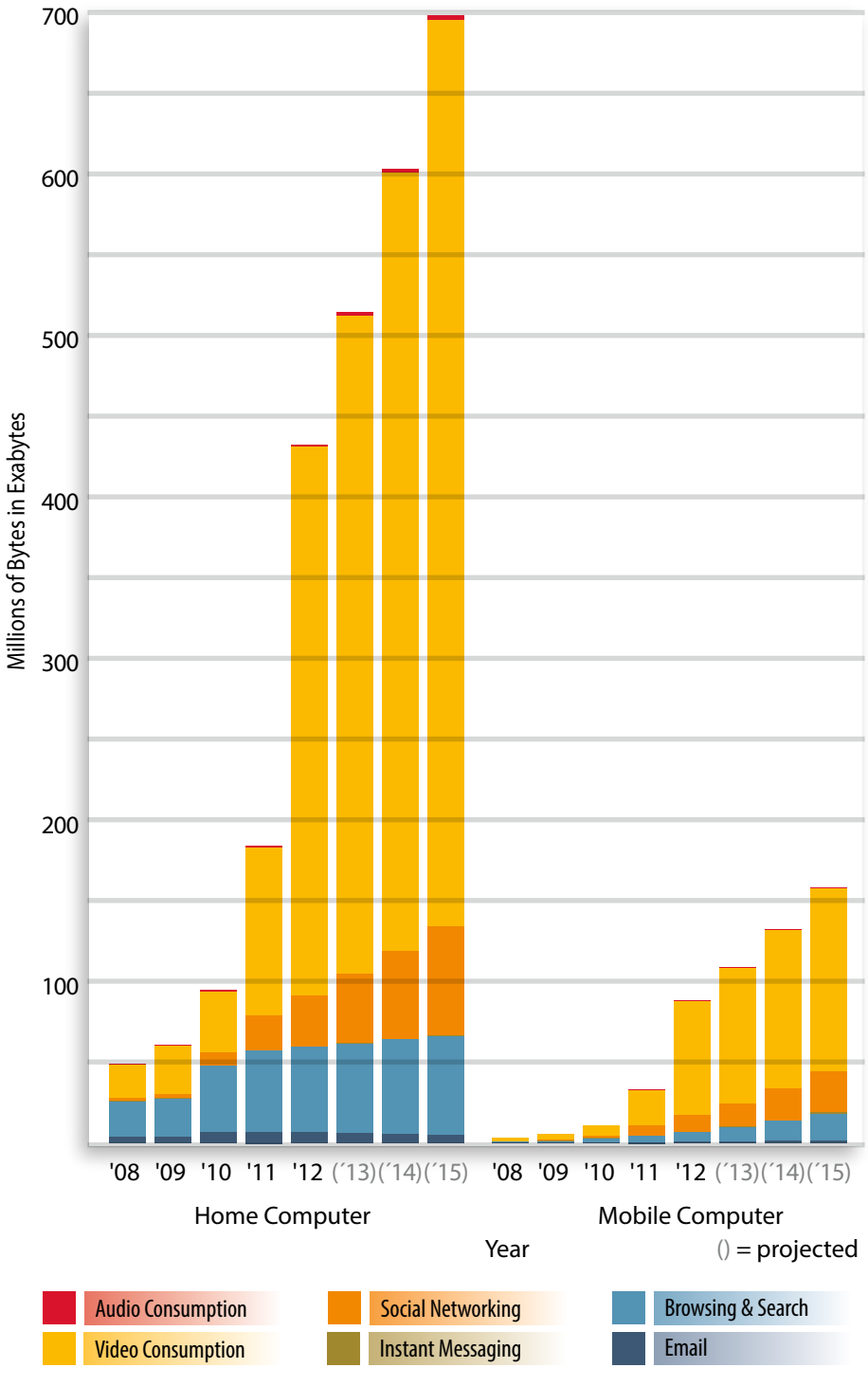
For our byte measure we tracked the bytes that actually move over the "pipe" into the home. This bandwidth is limited by the average download speed, which varies considerably by region, what service plan the consumer is signed up for, and by time of day.[21] By the end of 2008, on a per capita basis the average U.S. broadband consumer had an average speed of 2.4 megabits per second of network capacity available (theoretically), but owing to the multitude of factors affecting actual delivered network speed, we assumed an average speed of 100-200K bits per second, which gave an estimated 28 exabytes of data in 2008, just 0.8% of total annual bytes. By 2012, with increased usage and higher bandwidth capacity available to the average consumer, text based Internet applications gave an estimated total of 92 exabytes of data for the year, about 1.35% of total annual bytes - an increasing percentage but still just a drop in the bucket. The reason: video and graphics content require much higher data throughputs to the user. The upshot: the growth in residential bandwidth is driven by video demand and potentially by new and undefined applications that require bandwidth as a key resource.

Note: Messaging applications include Instant Messaging on home computers and text and multimedia messaging on cell phones.

The growth in capacity requirements for Internet applications is shown in **Figure 16**. Note that while Internet browsing and search are over half of consumer hours on the Internet, bytes are just a fraction of the total, and as a percentage of the annual totals, are falling. Why? As video consumption and social networking (which includes video) increase, their byte requirements increase disproportionately. The other take away from this figure is simply that only three applications count if you are measuring bytes now or in the forseeable future: video, social networking and Internet browsing and search.

We measured Internet video, such as YouTube, MySpace and Hulu, together as one category. Although there were 123 million Internet video viewers in 2008, their average viewing time was less than 3 hours per month. By 2012, viewer numbers had increased to 162 million, but more importantly, average viewing time increased to five hours and fifty-one minutes a month, a CAGR of 20.4% a year. And for selected subpopulations, per month viewer time increased even more rapidly – YouTube for example, went from 1:11 (hrs:mins) average time per viewer in 2008 to 3:23 in 2012, a CAGR of 30.6%.

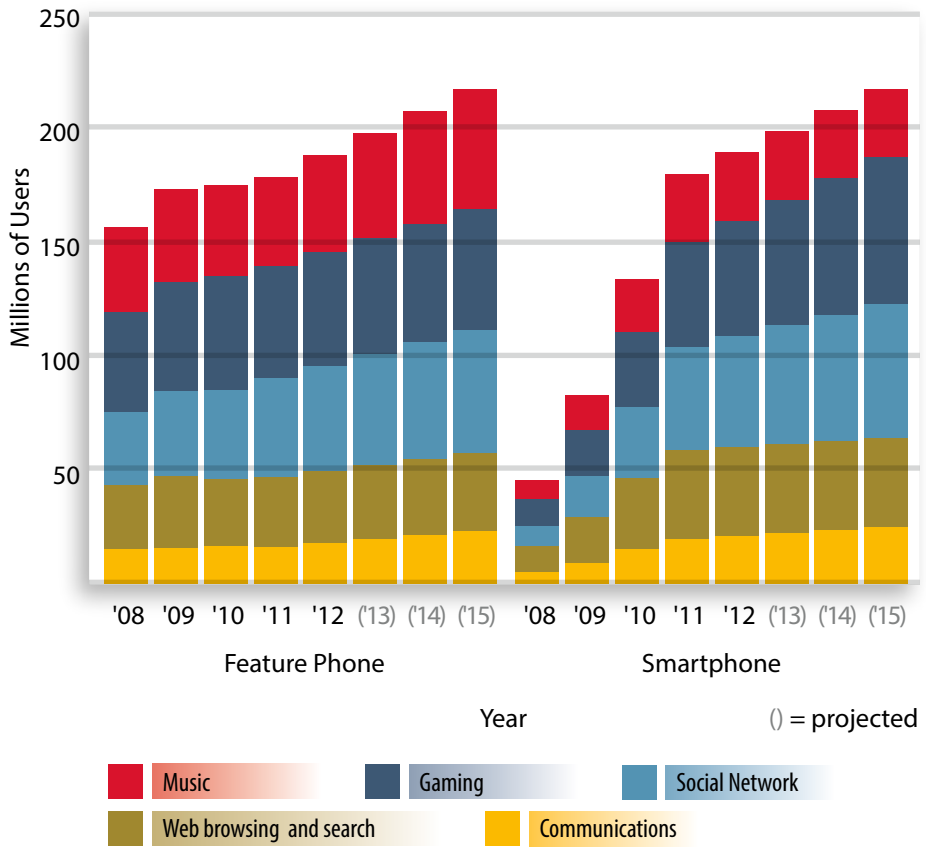
Figure 16: Total Annual Bytes, by Application, for Home and Mobile Computers, 2008-2015



Viewership of "regular" television shows on the Internet, through sites such as Hulu, may have a big effect in the future, but their current numbers are still small in aggregate terms.[22] Furthermore, the resolution of Internet video varies considerably by site and by service plan (free or paid subscription), and aggregating these numbers may obscure the evolving picture more than clarifying it. Although in principle delayed download methods such as peer-to-peer and Apple TV (from iTunes or similar web sites) can increase video download sizes, surveys of consumers don't yet indicate significant use. Too, whatever the pipeline into the home, providing high quality video costs more for the provider, be it YouTube, Hulu, or otherwise, because they must pay for all of the bandwidth used at their end. YouTube only made so-called HD video available late in 2008, and even that has a much lower resolution than high definition television.

As a result, Internet video is growing 20 – 30% a year, but in the aggregate is still small by most measures. In 2012, the higher bandwidth of video compared with email, web browsing and search is countered by the smaller number of users (162 million versus 283 million) and the much smaller number of average hours per user (6 versus 76 hours per user per month).

Figure 17: Application Usage, Feature vs Smartphones, 2008-2015*



*Note: Excludes mobile TV. Communications includes voice telephony and messaging.

3.2 Feature Phones, Smartphones and Tablet Computers

Feature and Smartphones

It is difficult to overestimate the impact of feature and smartphones on the voice and data communications of the average American consumer. Some form of feature or smartphone is now ubiquitous in the U.S. – approximately 326 million Americans have mobile phones, Neilsen and M:Metrics estimate that over 170 million Americans have access to the mobile Web, and over 50% of that 170 million do so with a smartphone. Mobile telephony (voice) continues to account for about half of cell phone hours in 2012, but Americans are increasingly using handheld devices to access information on the Internet, to communicate with family and friends via short message service (SMS) "texting", and to use a growing set of personalized applications (apps) that are available for download and use. In Section 2 we reported on voice telephony usage on fixed residential and mobile phones. In this section we report on the 170.2 million U.S. mobile subscribers with access to the Internet (2012), of which Neilsen and M:Metrics classify 104 million as "active" mobile data users (defined as greater than 1-3 accesses per month).

In 2008, there were approximately 100 million feature phone owners who purchased some form of mobile data plan; the corresponding number for smartphone owners was 22 million.[23] By 2012, that proportion had reversed – 82 million feature phone owners subscribed to a data plan, and the number of smartphone data users had risen to 89 million U.S. consumers. Excluding time spent watching mobile TV (see Section 2), measurement firms such as Neilsen, Comscore, Flurry Analytics and others track five application categories: communications (text and multimedia messaging); web browsing and search (Google); social networking (Facebook, LinkedIn, Tumblr); mobile gaming and music (including iTunes and music streaming services such as Pandora). While all application categories have significant usage, three dominate: gaming, social networking, and web browsing and search. **(Figure 17)**

Figure 18, Total Annual Hours, shows the total number of annual hours by application by phone type. As we would expect, the size of the bars in this chart correlate with the number of users for each application – that is, as the number of users increases, total time usage increases. Note that the total number of annual hours for smartphone users tops feature phone users for the first time in 2012. Note also the relative sizes of the stacked bar components for the three highest usage applications – gaming, social networking and web browsing. Total hours for feature and smartphones was approximately equal in 2010, but total annual hours of smartphone usage increased significantly in 2011.

Figure 18: Total Annual Hours, by Application, Feature vs Smartphones, 2008-2015*

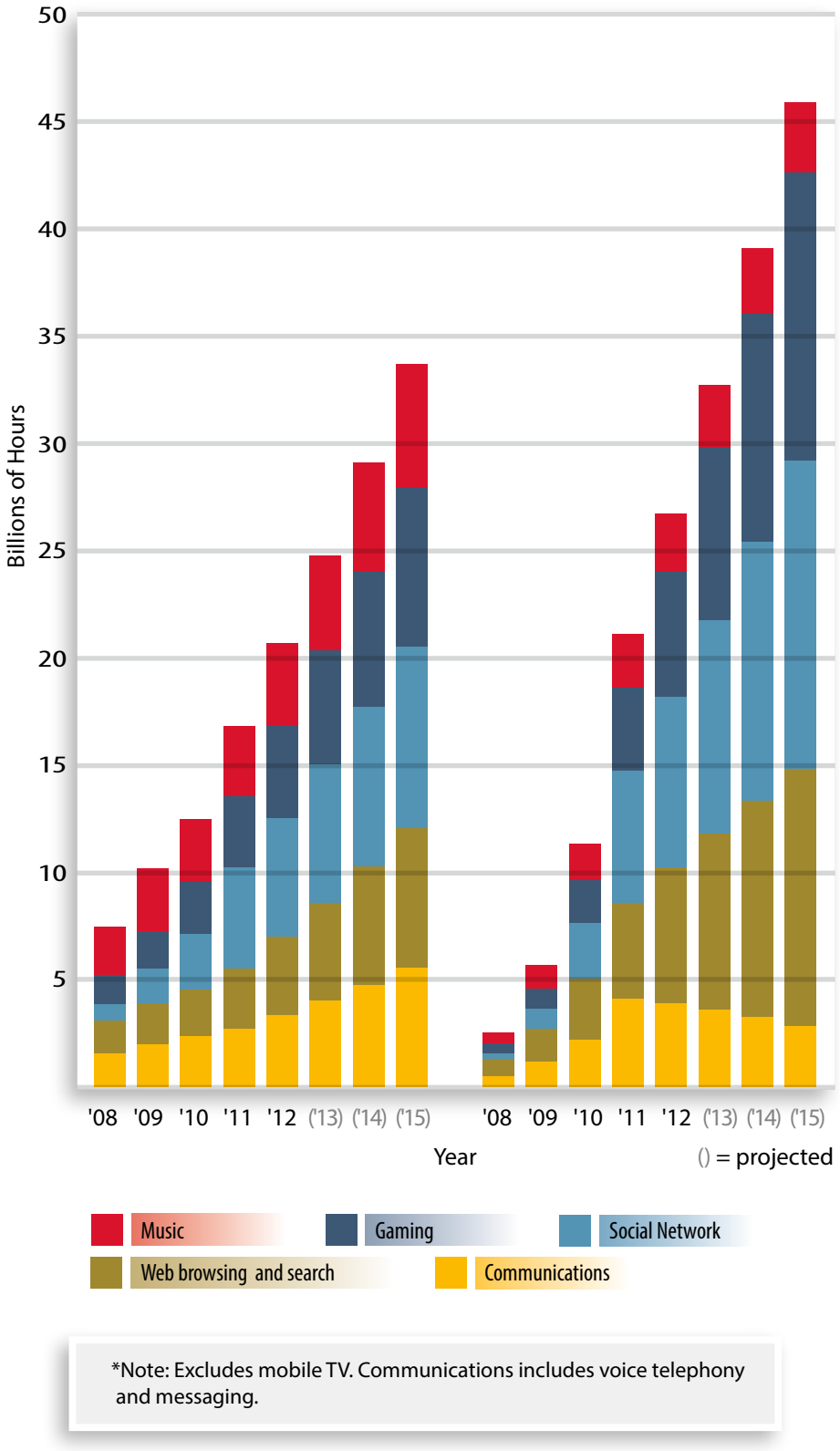


Table 3: Weekly Hours of Application Use, Feature and Smartphones, 2008-2015

	2008 Hours per User / Week	2012 Hours per User / Week	CAGR
Feature Phones			
Communications	1:59	3:37	16.20%
Web browsing and search	1:03	2:13	20.50%
Social networking	0:28	2:20	49.50%
Gaming	0:35	1:38	29.30%
Music	1:10	1:45	10.30%
Total Time	**5:15**	**11:33**	**21.80%**
Number of Users	**99,992,693**	**81,737,510**	**-4.90%**
Smartphones			
Communications	1:59	3:37	16.2%
Web browsing and search	1:18	3:06	24.3%
Social networking	0:35	3:09	52.4%
Gaming	0:43	2:12	32.4%
Music	1:10	1:45	10.3%
Total Time	**5:46**	**13:49**	**24.4%**
Number of Users	**21,998,392**	**88,548,970**	**41.6%**

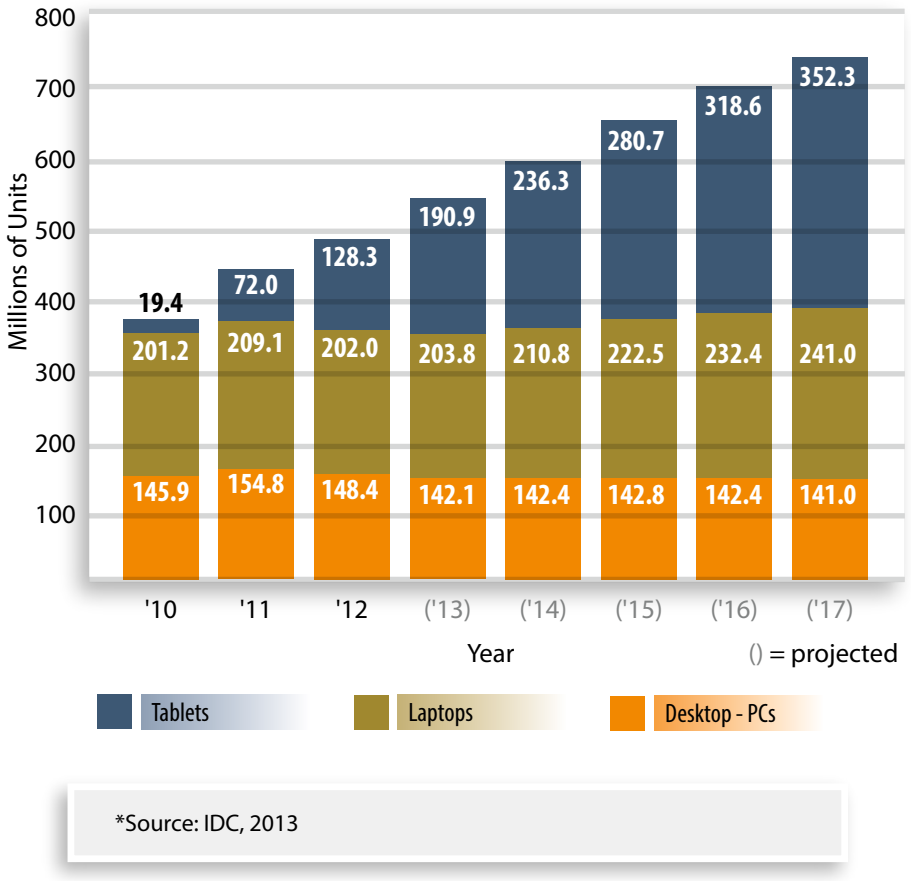
In **Table 3**, we drill down and look at the weekly time usage of feature and smartphone applications, comparing years 2008 and 2012. Smartphone data users have increased from 22 to 88.5 million users, a CAGR of 42% over this period, while feature phone subscribers decreased from 99.9 to 81.7 million subscribers (a CAGR of -4.9% per year). If we look at the most rapidly growing applications, social networking hours of weekly use grew at a rate of over 50% a year, gaming 32% a year, and web browsing and search 24% a year for smartphone users.[24]

Tablet Computers

While smartphone penetration and application usage have reached critical mass, tablets are moving in the same direction, albeit with sharp disagreements over how fast tablets are reaching critical mass, and what shape the installed base of mobile devices will look like in the future home. As a form factor, tablets are multimedia computers, offering a data point into how consumers may take up connected television. But in the future consumers will be able to view "TV content" on screens of many different shapes, sizes and formats, and the range of hardware choices is increasing, not decreasing. As a first step, we can compare smartphone and tablet application usage to see what the similarities and/or differences in their use may tell us.

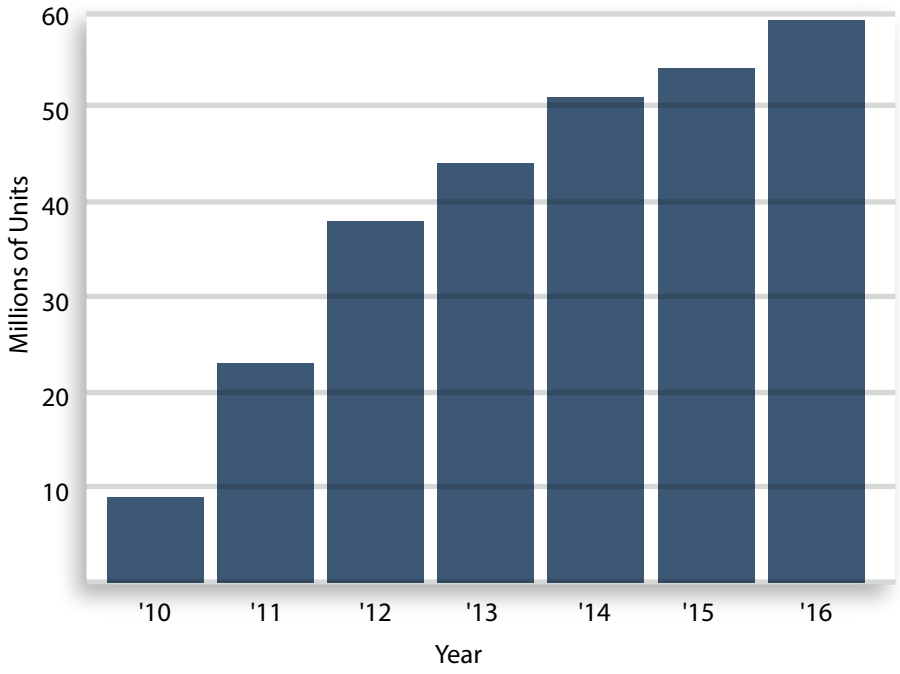
Since the introduction of the Apple iPad in April 2010, much has been made of the potential, long term disruption of the desktop PC and notebook computer markets. Amidst significant industry disagreement, it appears safe to conclude that the immediate impact of tablet computers has been to depress PC and notebook sales for a 2-3 year period of new computer purchasers (those buying their first computer) and replacement computer purchasers, and the numbers reported by IDC, Gartner and CEA bear this out. **(Figures 19 & 20)** What is less clear, however, is whether the magnitude of this effect is long or short lived. While no one in the industry or analyst communities would predict a return to pre-tablet sales numbers for PC and notebook computers, the desktop PC and notebook computer market is still a large one and will remain so in the foreseeable future.[25] In media terms, this translates into the simple point that PC and notebook platforms remain important distribution platforms for digital media, as our aggregate totals reported in Section 1 confirm.

Figure 19: Forecast for Global Shipments of Tablets, Laptops and PCs, 2010-2017



*Source: IDC, 2013

Figure 20: Tablet Sales Forecast for US, 2010-2016

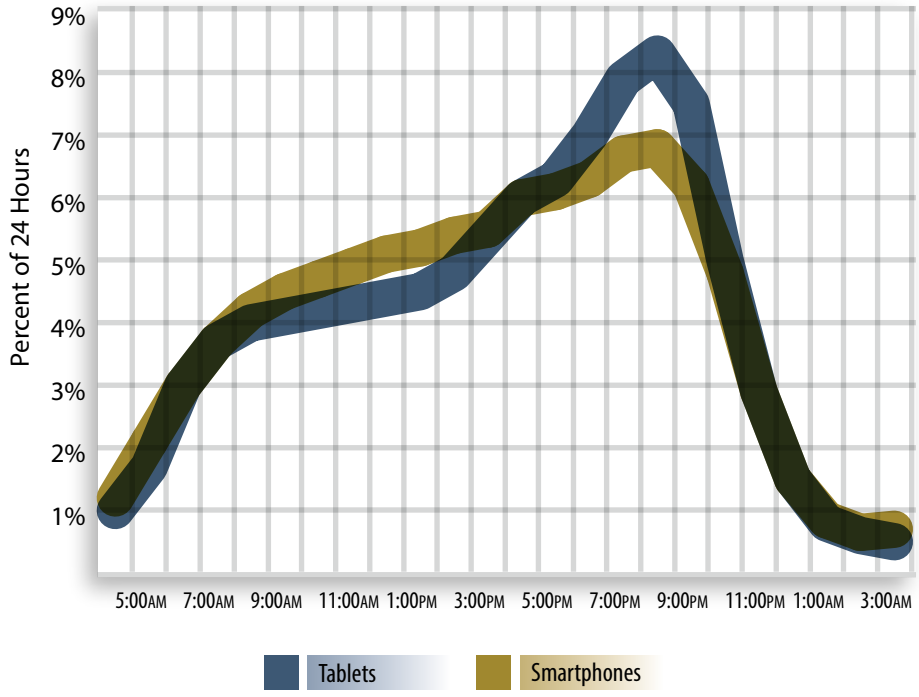


Source: Forrester Research, 2013

Comparing hourly usage profiles of tablets and smartphones, **Figure 21** illustrates the respective profiles over the course of a day. Each horizontal line in the figure is divided into 24 one hour segments, and the percent of daily use during that hour is recorded on the vertical axis. For example, at 5 AM, both smartphones and tablets register about 1% of their total usage over 24 hours. At noon, smartphones register about 5% of their total daily use, and tablets about 4%. Note that tablets have a greater spike of use during the prime-time television window, from 7 PM to 10 PM, whereas smartphone usage is distributed more evenly in the hours from 8 AM to 11 PM. This data indicates that tablets are much more likely to be used at the same time as televisions, either alongside the TV or instead of it.[26]

Finally, if we compare the percentage of time spent across application categories for smartphones and tablets, **Figures 22** and **23** show some important differences. Tablets are used more for media and entertainment, including a very high proportion of Games (67%), Social Networking (10%), Entertainment (9%), and News (2%), accounting for four-fifths of consumptive time on tablets.[27]

Figure 21: Usage by Hour, Tablets vs Smartphones, 2012



*Note: Each vertical line represents one hour in a 24 hour day. Adding up the hourly percentage moving horizontally across the figure sums up to 100%.

Source: Adapted from Flury Analytics

Figure 22: Time Spent per Category, Tablets, 2012

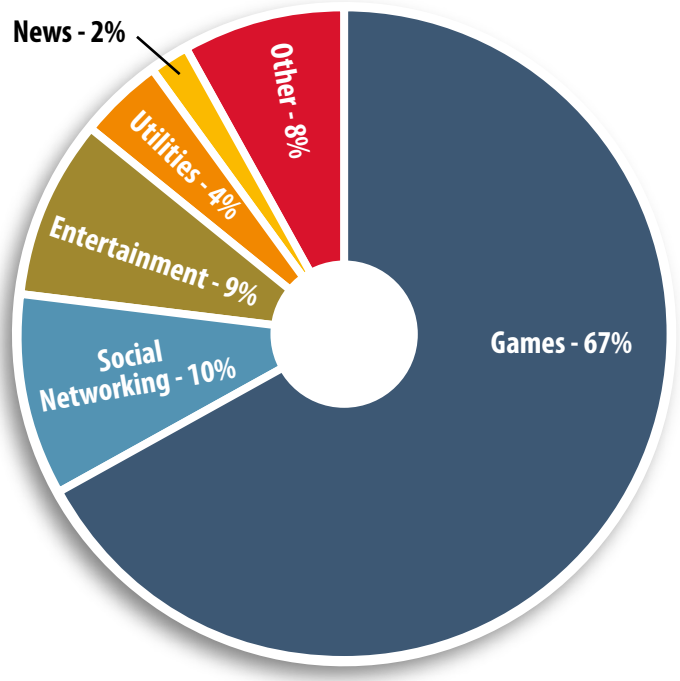
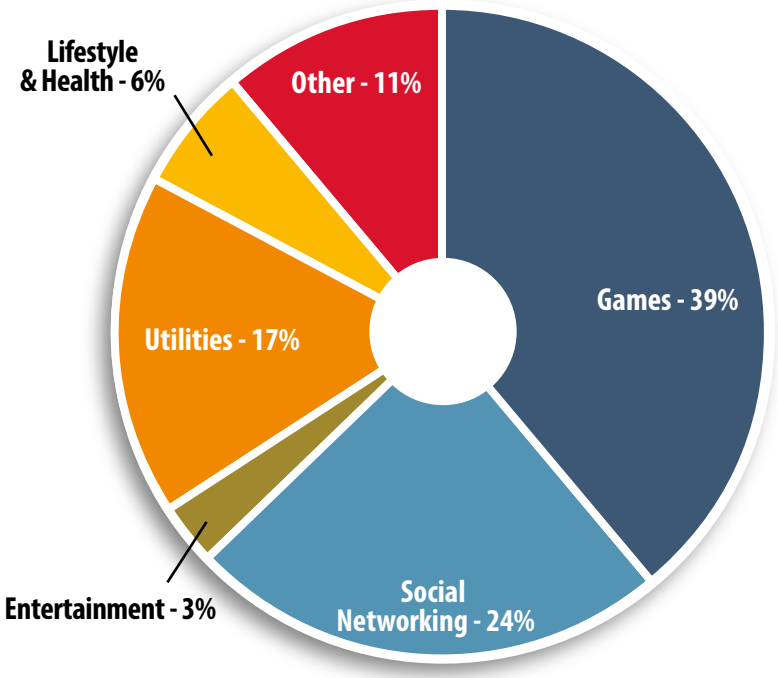


Figure 23: Time Spent per Category, Smartphones, 2012



Conversely, smartphones are more communications and task oriented (as we would expect), with Social Networking (24%), Utilities (17%), and Health & Lifestyle (6%) comprising about half of all smartphone usage. Gaming (39%) pops up as a significant application category on smartphones as well.

The data presented in this section speaks to the growth and application mix of new media, where traditional viewer content (TV and Radio) is increasingly mixed with interactive content distributed on mobile platforms of increasing capacity and functionality. Usage time and active users are doubling every two to three years, and while totals (hours and bytes) are still embryonic compared with traditional media volumes, at these rates of growth, scale effects for new media will start kicking in within the next 3-5 year time frame (we discuss this further in Section 4).

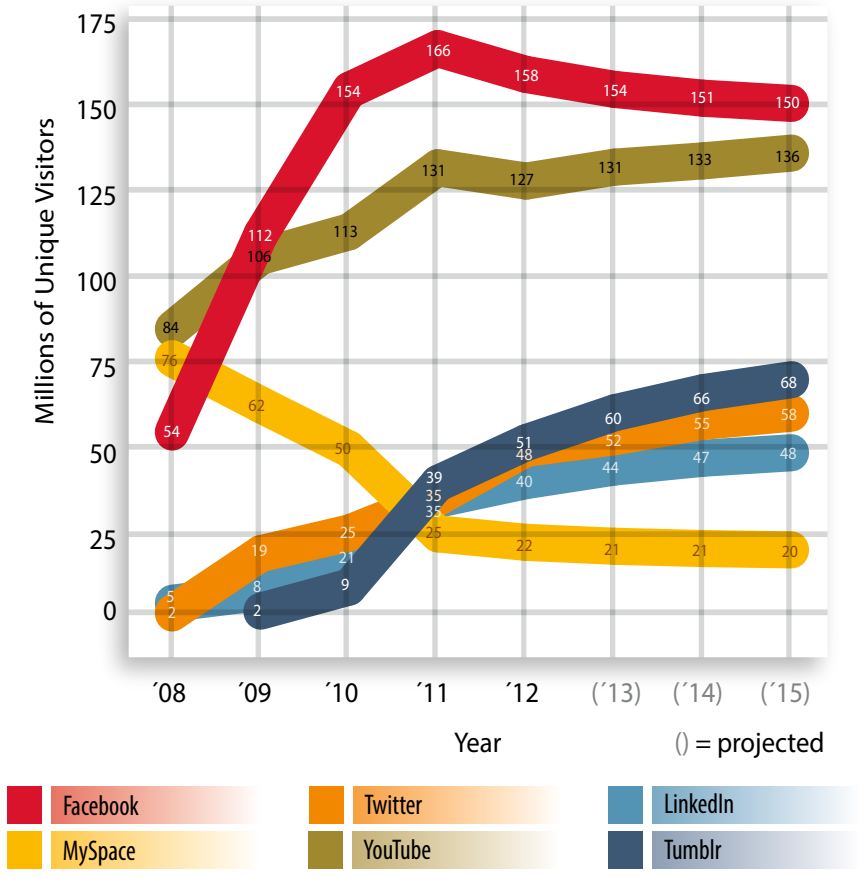
Interpreting tablet computer use remains a challenge given relatively scant (verifiable) data and noisy marketing. Despite all of the thunder and light, preliminary data on tablet use shows very different usage profiles than for PC and notebook computers, and for smartphones as well. This indicates that tablet users may be developing their own, different usage profiles as they have done previously for other personal devices, such as PDAs (anyone remember the Newton?) and portable gaming devices. All told we should not find this so surprising and the trend will likely continue as more tablet formats and functionalities hit the marketplace. Moreover, as tablets continue to sell, we don't know whether the 45 million tablet users now will be much like the 65 million tablet users forecast by 2016. It is certainly possible if not likely that the next 20 million tablet users will have different usage profiles than the first 20 million users.

Finally, when we factor in price, hardware costs are a falling percentage of "total media costs" for consumers and households, and people may rationally purchase "horses for courses:" an average cable household spends $1200 - $1500 a year on their monthly cable bill, tablet computers run between $300 and $700, and notebooks run $400 - $600 for consumer models. In other words, while not insignificant, hardware costs are declining in relation to network and content service costs, which are trending upwards. As that gap widens, consumers may elect (rationally) to purchase additional digital devices for specialized functions (example: consumer external hard disk storage).

3.3 Social Media

The popular U.S. television show "The Big Bang Theory" portrays the relationship between lead character Sheldon Cooper and girlfriend Amy as taking place as much on social media, in this case video chat, as in person. The not-so-subtle suggestion is that remote communications is as effective for nerds as any other form of communication, and for many social situations is preferable. Weighing in on the opposite side of the ledger is Sherry Turkle's *Alone Together* which lays out the contrary case - that the current fascination with text messaging (remote communications) and social networking does not close social distance, but rather increases it. Turkle writes that fully understanding our evolving screen behaviors will take time. Email researchers took many years, a decade and longer, to work out the basic behavioral changes brought on by the widespread adoption of email at work and home. For social media, there is little reason to suspect a deep understanding will take any less time, given the later is more complex and we receive it in so many different ways. In this respect email was easy – in the beginning it was entirely computer based. Our data does not address the behavioral complexity of social media in its many different forms and platforms - but the data does provide us with estimates of social media growth and preliminary measures of consumption on the platforms we use to receive it.

Figure 24: Total Number of Unique Visitors per Year, Social Media, US 2008-2015



Sources: Neilsen, ComScore, analysts and company disclosures.

There are hundreds of social media sites, on topics ranging from gardening to genealogy, dating, sports and science – and it was not practical to attempt coverage of even a small percentage of these sites as the required data is not publicly available. Therefore, on the basis of size (number of active users), transaction volume (number and volume of site activity), and rate of growth in these factors we selected six sites for detailed analysis: Facebook, MySpace, Twitter, LinkedIn, YouTube and Tumblr. To be sure, this is not a statistical sample - rather, it is a qualitative sample selected to be broadly representative of the most active social networking websites. While YouTube is not generally classified as a social networking site, it competes for time and usage with both social networking and traditional television and as such provides an important comparison. On the data side, it should be noted that data collection for the six social media sites for the years 2008-2012 was challenging. The large measurement companies – Neilsen, ComScore and Arbitron – use different measurement criteria, have different scope and reporting timetables, and their data disagrees much more often than it agrees. Too, as social media has grown significantly since 2008, the measurement companies have routinely updated their data collection methodologies and it is not always clear whether their time series data has been back adjusted. In these circumstances we have done the best we can with the data and data codebooks available. A final note is the data reported in this section is a drill down of aggregate data reported in previous sections. For example, the YouTube data reported here is included in the Internet video data reported in Sections 1 and 2. One should not, therefore, add any of the hours or bytes reported in this section to the totals reported in previous sections – to do so would double count previously reported numbers.

Four of our six social media sites continue to add to their population of active users. **(Figure 24)** In 2012, Facebook reported a decline in unique visitors in the U.S., and we have projected that decline to continue out to 2015. After a period of spectacular growth early in the decade, by 2008 MySpace was starting to lose its active user population to rivals Facebook and YouTube. By 2012 MySpace was no longer tracked by the main measurement firms as comprehensively as in earlier years, and we have projected continuing decline in users based on an estimated 22.5 million active users in 2012 (down from 76 million in 2008). Tumblr reported significant increases in its user populations in 2011 and 2012 (39.6 and 51.5 million respectively), and we have relied on company disclosures for the data reported here. **Figure 25** shows the same data in a stacked bar format.

Average weekly hours per user for each of the six social media sites is shown in **Figure 26**. Note the chart shows comparative data for the two dominant sites, Facebook and YouTube, with per user weekly hours reported by both ComScore and Neilsen showing Facebook's average user time flat or slightly declining in 2011 and 2012 (and therefore we projected flat to 2015). YouTube's weekly user hours is reported to be growing at roughly 34% CAGR from 2011 to 2015 (from 0:41 per week to 2 hours and 14 minutes per week).

LinkedIn's slow growth is characteristic of a "functional" site, where the roughly 40.4 million unique visitors (2012) spend an average of approximately 5 minutes a week checking, updating and maintaining user site information. However, it is likely that both LinkedIn and Twitter's average numbers are heavily skewed – that is, a relatively small number of active users spend disproportionately greater amounts of time on the site, with the long tail of less active users lowering the average. Data that would allow us to investigate this skew is not publicly available, and we continue to investigate. Finally, Tumblr's self reported data shows very high growth over the period 2010-2012 (from 27 minutes per week per user in 2010 to 40 minutes per week in 2012), and this growth rate (CAGR of 22%) is reflected in our 2015 projection. By 2012, MySpace's user population has declined to an estimated 22.5 million unique visitors, and for that population average weekly hours was reported as approximately 43 minutes a week.

Total annual hours for all users of the six social media sites investigated is shown in **Figure 27**. According to our projections, by 2015 Facebook and YouTube together will account for 85% of the total hours represented by these sites. If we look at the rate of growth over the period 2008-2015, total hours increased from 6.3 billion hours to 35.2 billion hours, a compound average growth rate (CAGR) of 28%.

Finally, how do the user hours represented in these sites compare with the hourly usage of traditional media, television and radio, and time spent viewing video on the Internet? **Table 4** shows the average daily and weekly hours of use for the average

Facebook
MySpace
Twitter
YouTube
LinkedIn
Tumblr

Note: Visitors can visit more than one site. Hence totals exceed total population.

Sources: Neilsen, ComScore, analysts and company disclosures.

Figure 25: Total Number of Unique Visitors per Year, Social Media, US 2008-2015

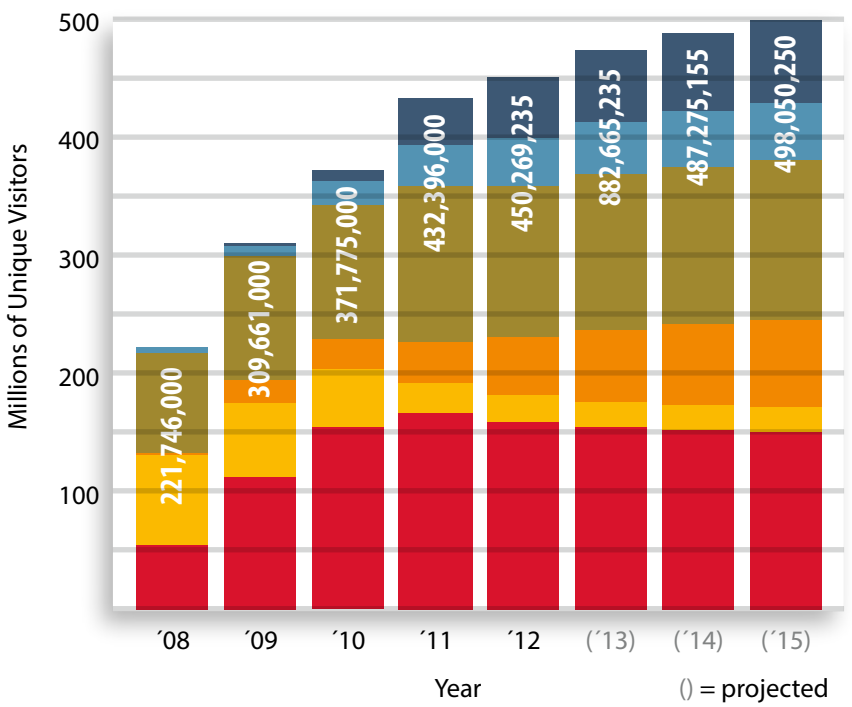
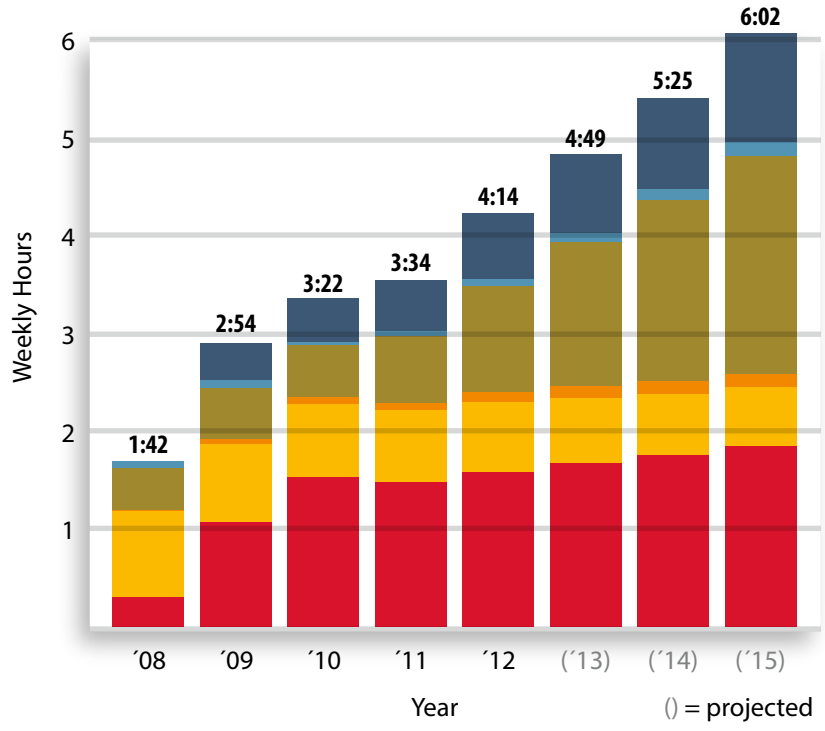


Figure 26: Average Weekly Hours per User, Social Media, US 2008-2015



media consumer. For purposes of this comparison, YouTube's numbers are included in viewing video on the Internet, and we have dropped MySpace to draw a typical user – a consumer who watches TV and listens to music, occasionally views Internet video, and is active on four social media sites, Facebook, Twitter, LinkedIn and Tumblr.

As we found in Section 1, traditional media usage dominates average consumption. If we compare TV and Radio with Viewing Internet Video and the sum of time spent on four social media sites, Facebook, Twitter, Tumblr and LinkedIn, new media accounts for just 8% of average weekly time consumption. Of course, these numbers are averages of what we have earlier described as skewed distributions for new media – it is obvious that younger populations would move the 8% higher, probably significantly higher. But think of this data as evidence of consumption at scale – it answers the question, for the digital population as a whole, on average what percentage of hourly consumption is attributable to viewing video on the Internet and the four social media sites represented in this analysis? The answer is 8%. Of course, that 8% is growing each year, and many say that the users represented in this sample are defining the next media generation. But what is also shown is we still have a way to go for new media "at scale."

Figure 27: Total Annual Hours All Users, Social Media, US 2008-2015

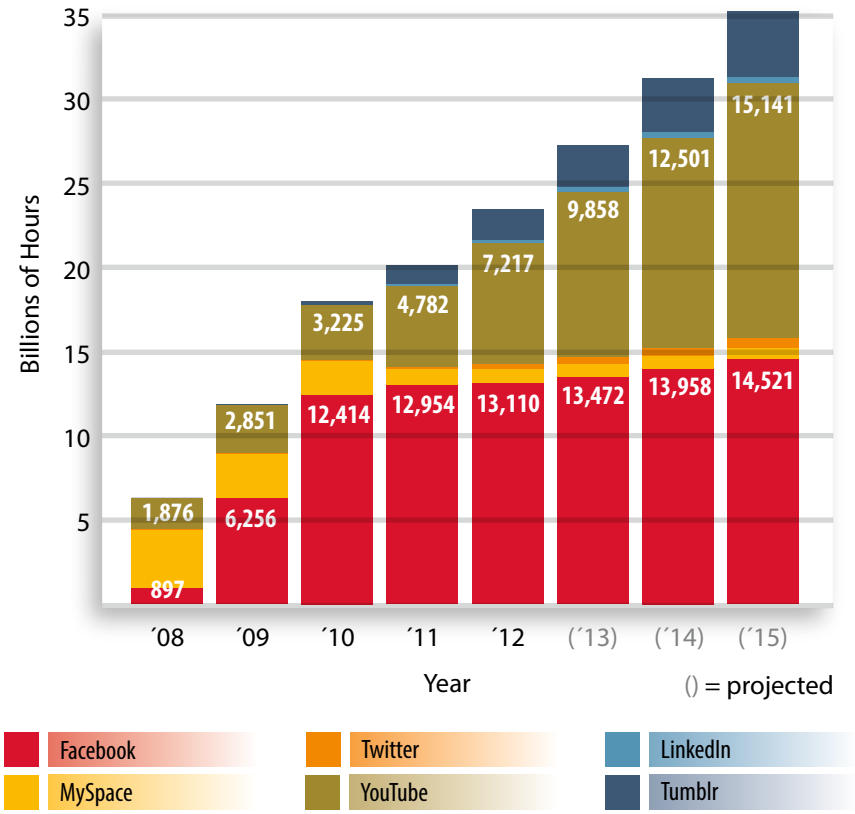


Table 4: Comparing Average Weekly Use, Traditional & Social Media, 2012

	Daily Time per User	Weekly Time per User
	(h:mm)	
Television	4:39	32:35
Radio	2:08	14:56
Internet Video	0:10	1:14
Social Media	0:22	2:26

Facebook+Twitter+Tumblr+LinkedIn

3.4 Computer Gaming

The image of the hard-core computer gamer of the 1990s and 2000s, the predominantly male-dominated hardware wizard and game-play master online and offline, has ebbed and flowed in influence in contemporary media analysis. Gaming's influence as an innovation driver in consumer technology has been pervasive, from hi-spec consoles and PC gaming computers, to the network / bandwidth requirements of massively multi-player games, all the way down to the human interface devices used for the hi-spec games themselves (joysticks, pilot simulators, etc.). But Moore's Law has caught up with the commodity side of consumer gaming, in the form of hi-spec smartphones, tablet computers and cheap single-player and multi-player gaming titles (software) that have created a large-scale market around social gaming, evidenced in titles including FarmVille and Words With Friends.[28] Ironically this growth has unearthed one of the precepts of the earlier era, that gaming behavior, be it hard-core or social, provides us with early indications of how future media interaction will unfold, be it in interaction, in video consumption, or in the adoption and use of advanced user interfaces. For the most part it has not worked out this way in gaming. What we have learned, for the most part, is that hard core gamers turn out to be hard core gamers, and their behaviors are not representative of future or even hi-tech future media consumers. Fast-forwarding to the current focus on social gaming, the jury is still out on who is wagging the proverbial dog's tail – the gamers or the general media consumer who also happens to play mobile games. Which of the two drivers is the dominant one? There are strong views on both sides, and the industry implications of the difference are quite important.

On the metrics side, it is difficult to talk about computer gaming in the aggregate, because there are many different categories of gaming and each type is associated with different players as well as hours and bytes consumed – suffice it to say that gaming measurement is struggling to catch up with gaming behavior. Engineering-driven device capture methods say something about user-machine interaction, logs and diaries (including self reporting) say something about what gamers are willing to document, and full-blown observational and experimental laboratory studies, for the most part, study gamers in small scale settings (all things being equal, the more intense the activity being studied, the narrower the sample used to study that behavior). All contribute to an evolving picture of gaming, but none by itself is sufficient. We have therefore generated our data from multiple sources. These sources in turn have used different measurement criteria, field methodologies and gamer classifications. We have done our best to reconcile the different approaches to form a consistent, time-series picture of gamers, usage and bytes. However the reader is cautioned to know that more art than science is involved in gaming measurement, and the numbers reported here are subject to refinement as our methods and data improve.

We have classified gamers using a seven category taxonomy that categorizes gamers by gaming device and by user characteristics, ranging from "extreme gamers" (4% of the gaming population) to "casual gamers" (17% of the population) **(Table 5)**.[29] Many gamers of course play on more than one type of gaming device, which is not surprising since most social gamers play games on their cell phones.

Hardware is a critical factor in determining gaming performance and the volume of data generated by computer, video and mobile games. We classify hardware into four categories:

- Advanced gaming computers, used by 8 million players in 2012;
- Standard computers – 129 million users;

Table 5: Gaming Classifications

Gamer Category	# of Users (in millions)	User %
Extreme Gamer	8	3.80%
Avid PC Gamer	30.9	14.70%
Console Gamer	42.5	20.20%
Online PC Gamer	31.9	15.10%
Offline PC Gamer	23.8	11.30%
Family Gamers	37.5	17.80%
Casual Gamers	36.3	17.20%
TOTAL	**211**	**100%**

- Console game machines, such as Microsoft's Xbox, Sony's Playstation and Nintendo's Wii – 42.5 million users in 2012; and
- Portable gaming machines, including the Sony PSP, Nintendo DS, and cellphones and tablet computers – 95 million users.

For each hardware type, we estimated the video throughput for an "average machine" in the class, playing an "average game." High-performance gaming PCs use some of the most powerful processors in the world to generate graphics, called "Graphics Processing Units" (GPU). Some GPUs have over one billion transistors, and more than 200 parallel processors running at once. We estimated the bandwidth of these machines at approximately 100 megabits per second – eight times that of high definition TV. An estimated 40 million users spend an average of 115 hours every month playing games on these computers. They account for an enormous share of all media bytes consumed by U.S. households in 2012: 930 exabytes annually or approximately 13.4% of all bytes consumed. This large role of high-end computer gaming is particularly noteworthy because it accounts for less than 5% of the total hours Americans spend consuming media.

Figure 28 shows the growth of the total gaming population by segment, for the years 2008-2015. Overall the US gaming population grew from 169 million in 2008 to an estimated 222 million in 2013, an annual growth rate of 5.6% (CAGR). Total annual hours for each gaming segment is shown in **Figure 29**. In terms of the absolute number of gaming hours played, the 29.5 million Avid PC gamers playing an average of 26 hours a week totaled more than the 37.5 million Family Gamers playing an average of seventeen and a quarter hours per week, but the rate of growth in hourly usage was higher for Family Gamers than for Avid PC gamers. From 2008-2012, Family Gamers increased their weekly time usage from 15 hours per week to 17 hours and 15 minutes per week, and average yearly growth rate of 4%. Avid PC gamers, on the other hand, increased their weekly usage only marginally, from 25 hours per week to 25 hours and 55 minutes per week, a CAGR of under 1% a year.

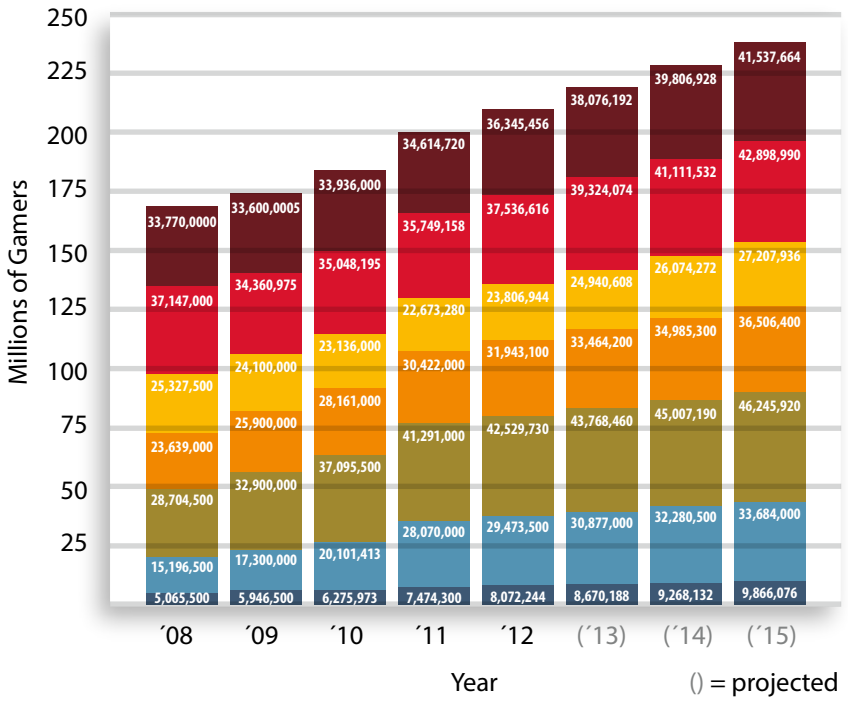
Note that in general **Figure 29** shows that traditional desktop computer gaming is slowing, social and family gaming hours are growing, and hard core and online PC gamers are also growing in hours, but their respective totals are less than three-fifths of total family gaming hours. And despite sharply declining growth, we project modest increases in total console usage going forward, based on new console announcements made by Sony (Playstation 4) and Microsoft (Xbox One), and the growing capability of the new machines to switch between games, videos, music and live TV using, in Xbox One's case, voice commands. Whereas most console use in the past has been offline, increasingly users are playing games over the network, and the fine line that has divided online and off-the-Net gaming is rapidly fading.

If we look more closely at the rate of growth in mobile gaming, **Figure 30** shows total annual mobile hours for viewing video on a mobile phone, accessing the Internet (text applications), and mobile gaming for the years 2008-2015 (this includes all mobile devices, including cell phones, tablet computers and portable gaming devices). Note that while mobile video is barely 4% of total annual hours in 2012 (mobile internet is 70%, mobile gaming is 26%), its rate of growth is 55% per annum for the years 2008-2012 (that is, a doubling every 24 months) compared with a CAGR of 44% per annum for mobile Internet, and 51% for mobile gaming.

If we look at the rate of growth in mobile bytes however, a slightly different picture emerges. **Figure 31** shows total annual bytes for all mobile devices, for video, Internet and mobile gaming, for the years 2008-2015. Note the rate of growth in gaming bytes is the highest, a CAGR of 118% per year (that is, doubling every year), mobile video is growing at a CAGR of 70% a year (doubling every 18 months), and mobile Internet is growing at a rate of 50% a year (doubling every other year). By 2014, we project that mobile gaming and mobile Internet will each consume over a zettabyte of data, reflecting the impacts of tablet computers and portable gaming devices on our throughput calculations.[30]

Based on the data above, it appears that the big story in gaming is again gaming. That is, our data and growth projections correlate with industry data showing the pervasive adoption of gaming applications on mobile devices, and high usage numbers such as the finding that gaming is two-thirds of all application use on tablet computers. Likewise on smartphones, gaming use is now 40% of all cell phone application use, and headed towards half.[31] It should be noted that the percentages for tablet users reflect

Figure 28: Growth in US Gaming Population by Segment, 2008-2015



Sources: NPD, Neilsen, analysts and company disclosures.

Figure 29: Growth in Gaming Hours by Segment, US 2008-2015

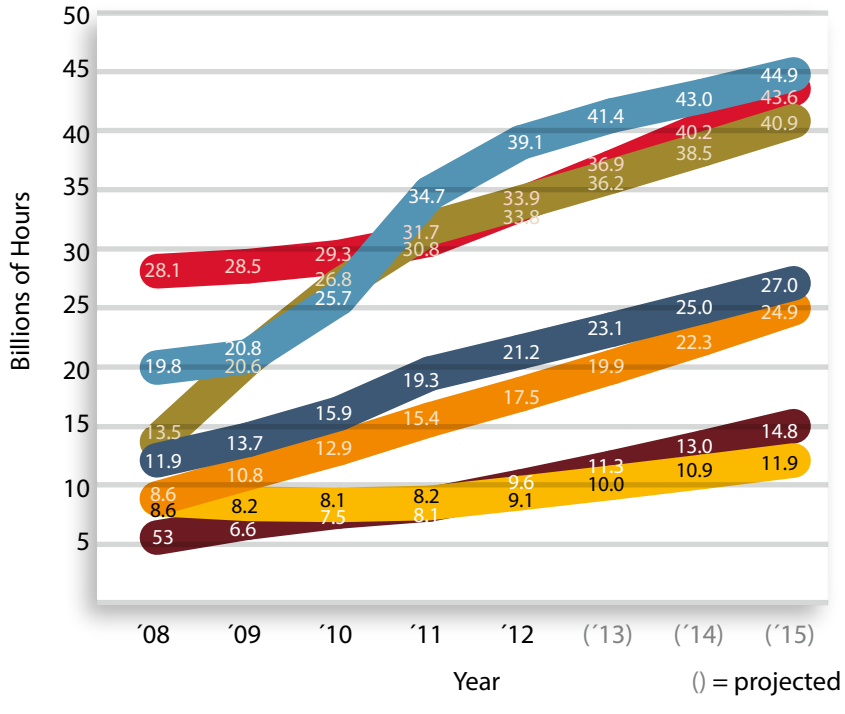
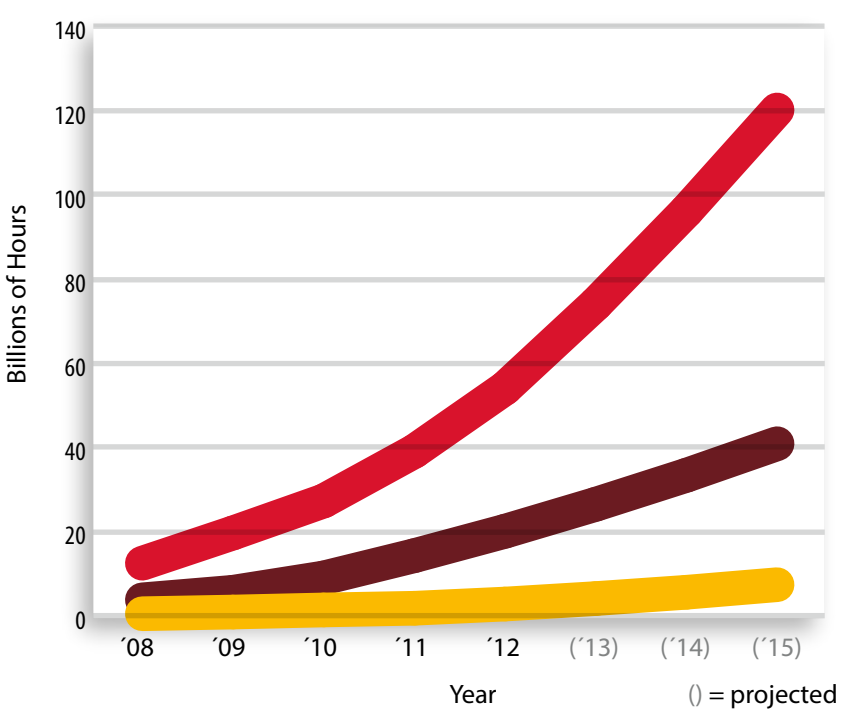
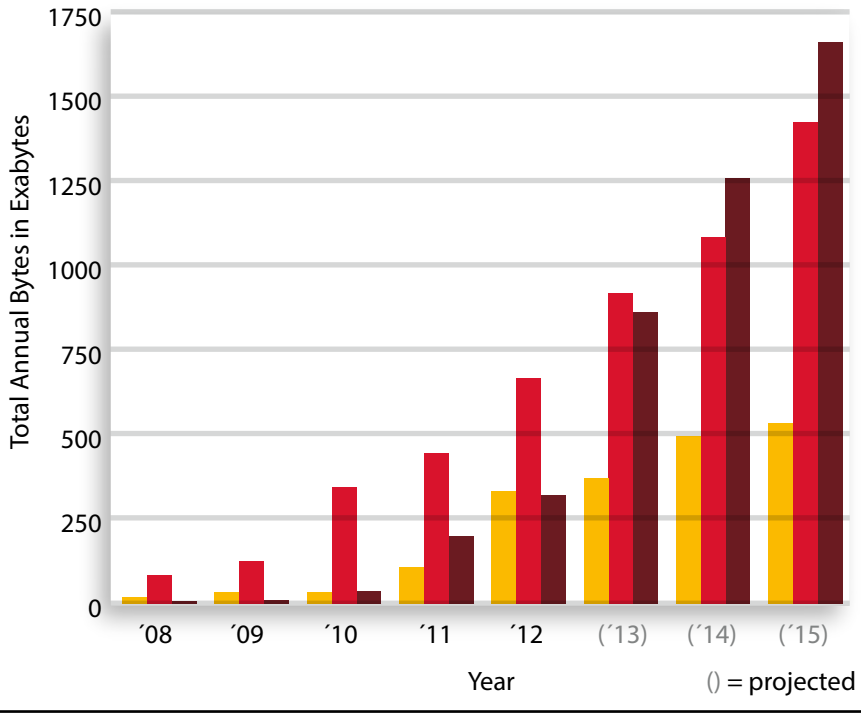


Figure 30: Total Annual Hours, Mobile Video, Internet, Gaming, All Devices 2008-2015



Note: All mobile devices including cell phones, tablet computers and portable gaming devices.

Figure 31: Total Annual Bytes, Mobile Video, Internet, Gaming, All Devices 2008-2015



Note: All mobile devices including cell phones, tablet computers and portable gaming devices. Numbers are compressed bytes.

early adopters, and as the number of tablet users continues to grow, there is no reason to postulate that new users will similarly allocate two-thirds of their hourly usage to game-play, it could easily as much be more or less, the current percentage is not predictive in that sense.

A nascent and important contributing factor is the observation that viewer engagement (uninterrupted viewer time) is generally higher for mobile devices than for desktop computers for online video. A recent industry study found that viewers watch videos nearly 30% longer on tablet computers than on desktops.[32] In terms of long-form videos, the study found that desktop and laptop computers were more likely to be used to view short-form video clips, whereas videos that were 10 minutes or longer made up 30% of the hours watched on mobile devices, over 40% of the hours watched on tablet computers, and almost 75% of the hours watched on gaming consoles and connected TV devices. The study did not examine the kind of video content nor the location of viewer engagement in tabulating this data, but adding location helps the reported data make more sense. If tablet usage is much more likely to be in the family room alongside a television, we would expect longer viewer segments rather than short-form video segments, and the opposite for desktop computers. The latter are much more likely to be located in a computer room or home office, with usage hours spaced more evenly across the work day, with video content more likely to be news or information oriented. These factors would help explain the reported percentages for cell phones and tablets. However, whatever the relative importance of these and other contextual factors in video usage, mobile devices and tablets are increasingly shaping (and changing) viewer behaviors.

In the end, one of the most important changes brought on by mobile gaming may be our concept of the (traditional) computer gamer – the high-tech, self-proclaimed nerd who bests gaming opponents with a formidable mix of computer engineering and masterful game play. Our numbers show that this cadre is still out there alive and well. But growth in the leisure / diversion side of gaming – social gaming, family gaming – is the bigger story in gaming today. We are seeing the shift in gaming devices and in the sheer number of gaming software downloads on cell phones and other mobile devices. Estimates vary, but there are at least 211 million Americans who routinely play some kind of game on a computer or mobile device in 2012. And based on current growth rates, we project that number to increase to 240 million Americans by 2015.

4 FUTURE MEDIA, BIG MEDIA

A key question prompted by our findings is simply: if supply is growing at an average of 30% a year, and demand is growing at 5% a year, what happens to media attention and consumption as the gap widens? To rephrase the question, how will consumers find value in media growth, and how will industry continue to produce and grow that value? We now consider four special topics prompted by our assumptions and results: changing media measurement, media supply and demand, media flow versus media storage, and life without media.

4.1 Measuring Media: Industry Transition

Our report amasses data on hourly usage, one variable in thinking about attention, and bytes, one variable in thinking about the intensity of interaction. Taken together and compared across media types, they provide insight into how different media rank against each other on these criteria. For several media types – social media or email for example – we converted measures of activity to their estimated time equivalents. For example, we converted the total number of text messages received and sent in a week to the estimated time it took to compose, read and process those messages.[33] Extending this simple activity-to-time conversion one step further, industry practice is to infer that higher rates of activity, all other things being equal, correlate with higher rates of attention to that activity. But herein lies a key difference between traditional and digital media measurement – the former, for the most part, is consumed passively – we sit and watch TV or listen to radio – while the latter, typically, requires interaction. Different measurements have resulted. Traditional

media measurement has tracked usage, audience and content attributes (content type, hit shows, etc.), and over time a deep experience base has developed in collecting and interpreting this data. Computer-based media measurement has evolved measures of activity and interaction, the great majority of which are engineering driven. The art of web analytics is a good example. Off-site web analysis refers to general measures of a website's audience, share (visibility), and currency ("buzz"). On-site analytics measures a visitor's activity on a website. Both metrics infer behavior from patterns of activity. For example, a small subset of activity measures include: number of unique visitors / unique users, page views per average session, page visibility time, page view duration, session duration; single page visits, bounce rates, exit rates, average page depth, click paths and site overlays, to name just a few. Again, the critical assumption is that patterns revealed in the analysis of these metrics measure viewer engagement.

Where appropriate, our methodology has converted activity data to usage data, specifically in categories including social media, communications (email and messaging), and social media (webpage search and posting activity). Our conversion factors are based on averages and are subject to change based on improved methodology and better data. Our data conversion is a small-scale example of a very large-scale industry transition. Traditional measurement companies (Neilsen, Arbitron, ComScore) have been testing new digital metrics for years, and are gradually supplementing and/or replacing old measures with newer ones. On the other end of the measurement industry spectrum, media analytics is a hot market, and firms large and small are leveraging access to "big data" and trumpeting new algorithms for analyzing that data. It is too early to posit the likely outcome(s) of the changes taking place. But whatever the industry and economic outcomes, we are in a critical transition period in media measurement and the transition period is likely to be lengthy – we are still trying to sort out how best to measure interactive behaviors, a necessary step before analysis of aggregate behavioral changes that can impact markets.

For our purposes here, we have used both measurement systems and have done our best to translate between them. As new metrics are debated in industry and introduced, they will be incorporated into future versions of this report.

4.2 Media Supply and Demand 1960 - 2012

For most primary digital media (mobile internet, social media, gaming), for the period 2008-2012, our data shows growth in bytes (throughput) ranging between 20% and 50% a year, or a doubling rate of every two to four years. However, if we dial back to 1980, in previous work we estimated that the average American received 9.8 gigabytes of media data per day, almost all of it coming from television and radio broadcasting. By 2012, American media consumption has increased to 63 gigabytes per person per day, a six-fold increase. While impressive, this works out to be a CAGR of 6% a year, far less than other measures of information technology based on Moore's Law: the number of transistors on an integrated circuit doubles approximately every two years.[34]

If we dial back even further to the 1960s, Neuman and colleagues (2005, 2012) have calculated the number of media minutes available to an average American household in 1960, and compared it with the same measure for an average American household in 2005: the ratio of supply to demand was 82:1; that is, the number of media minutes available divided by the number of actual consumption minutes.[35] Their analysis does take into account the large differences in the installed base of media devices in 1960 versus 2005. In 1960 for example, the average American home had 3.4 television stations available, 8.2 radio stations, 1.1 newspapers, 1.5 recently purchased books and 3.6 magazines.

By 2005, the benefits of Moore's Law had taken the form of more choices of what to consume.[36] The number of TV channels per average household had risen to 130, of which the average household viewed 18, but actually watched fewer than that with any regularity. With satellite and Internet radio, the number of stations available to radio listeners was in the hundreds, but again, most listeners tuned in to just a few stations on a daily basis. Taking these factors into account, Neuman et. al. calculated that by 2005 the ratio of supply to demand had increased to 884:1, or almost a thousand minutes of mediated content available for every minute of consumption – a ten-fold increase. This growth is an example of a more general phenomenon, what we can refer to as "media entropy" – the ratio of media data available to data consumed grows over time.

For this report we did not have all the data in place to calculate Neuman's ratio. We did not cover non-digital sources of media, for example, such as

print or postal mail. But even given our restricted sample, the ratio for 2012 would be well over twice as large as Neuman's 2005 ratio, as growth rates in primary digital media (computer gaming, mobile data, social media) are in the 25-50% a year range, and these sources comprise over a third of usage time and two-thirds of the bytes. Lesk has commented that with all this growth in media volume, a key question to ask is what will happen to all of the media people will never see? Answer: some of it will go into automated systems (example: your car's GPS navigation system), some of it will be sent to other machines instead of to people (example: Google's experimental automated car), and some of it will undoubtedly just pile up (example: the current attention to "big data" overwhelming traditional data processing systems – that will happen in the home too).

Having documented the estimated magnitude of media abundance, what are we to make of it? Going forward, the ratio of supply to demand can only increase. It has been argued that we are now living through a critical inflection point in media distribution, ranging in its effects, but one where a critical change is the major transition from push to pull media – that is, in the simplest case, from traditional broadcast and publishing media where the audience simply accepts the fact that the content and programming timetable are pushed (set) by the industry, to one where user interaction pulls the appropriate media stream to the device. In the traditional push system, Downton Abbey is broadcast Thursday evenings at 8 pm; American Idol is on Tuesdays at 9 pm, and so on. But with user choice and access increasing over time, audiences will be less likely to wait passively until the day and evening program hour – rather, they will use evolving technologies to pull what they want to watch or read at the time best suited to their needs. Much has been made of the new behavioral changes possible with younger generations of media consumers, but in many respects the "new" behaviors appear to boil down simply to key transitions in choice (more), access (more) and access time (when I want to consume it).

This is of course, the logic of search (Google, Bing and Yahoo!) and social media (Facebook and Twitter, and before that MySpace and Instant Messaging). The concepts are out there – and have been out there for many years - and we are in the midst of a continuing transition. Our data suggests that the majority of these transitions will take longer than most predict. The data shows that while digital is growing, and some of digital is growing rapidly, fully two thirds of media volume in U.S. households is still traditional media. People certainly are adopting new media platforms - the data is likewise clear on this - but the direct substitution of "new" for "traditional" media – I "watch" my tablet instead of my TV – is much more difficult to measure empirically and form judgments on hard data. For example, media substitution is not the same as the concurrent adoption of an additional screen, which is strongly suggested in current tablet data. Some of tablet usage is undoubtedly substituting for TV viewership, and some of it is certainly not – we just don't know with any reliable precision how much. And we have a decade of time-use data from the Labor Department on when (what time) in the day people access media – when of course, strongly correlates with where they access it. While "anywhere anytime" media access is the future, the hours most Americans watch, listen to, or interact with daily media remains highly correlated with the time patterns of the typical household: kids to school, morning commute, spouses to work, one spouse leaves for home to receive kids returning from school, evening dinner and leisure time and homework. American Idol is broadcast in the 7 to 9 pm evening time slot for a reason. "Anywhere Anytime" media follows the contours of the time availability of consumers to access it, not the other way around.

4.3 Media Flow versus Media Storage

As noted earlier, we are reporting on media flow data, created for use by people. Whereas machine to machine (M2M) data flows are arguably increasing at rates greater than that for consumer media data, M2M is another topic. Focusing on consumer flows brings with it some advantages and some limitations. Perhaps the most important limitation is that our results underestimate the total volume of digital activity in U.S. households, a complete "census" of media so to speak. A census accounting of "all media" would need to include stored data on consumer storage devices, a rapidly growing consumer hardware category.[37]

Of course, the majority of consumer media use is transient: data is streamed into the home, viewed and quickly thrown away without ever being stored. More precisely, it is created (for example,

in a computer game) or received from a remote site (TV), "stored" for a few milliseconds while it traverses through the display electronics, is then presented for consumption and then discarded. An example is a video game, where each frame is "stored" for only 33 milliseconds in the frame buffer of a graphics card before it is overwritten by new data.[38] The way this works in data measurement is that stored data and flow data are measured using different units. Stored data is normally measured in bytes at a snapshot in time, while data flows are measured in bytes over time.

The primary consumer storage media include books, DVDs, CDs, MP3 players, computer hard drives, external hard disk drives, and increasingly, higher capacity hard disk drives in digital video recorders (DVRs). The total amount of nonvolatile storage worldwide at the end of 2008 was roughly 200 exabytes. American consumers owned approximately 10% of it. In other words, the 20 exabytes of home digital storage, if it were all used, would be enough to hold only about two days of consumer data flow. Equivalently, the storage could act as a two-day buffer on incoming data. Digital video recorders, for example, work this way, as they automatically overwrite old TV programs when space is needed for new ones.[39]

The prospect of storing all of one's home digital data – text, pictures, audio and video – has expanded in recent years to include "cloud storage" of consumer data – that is, a data storage service that can be accessed over the Internet. Of course consumers have been using public cloud storage for years. Anyone with an email account on Yahoo! or Google, or use Facebook, YouTube or Tumblr, or any Apple iPhone or iTunes user – all use some form of cloud storage whether recognized by the user or not. The business conundrum comes not so much from the growth of current practice (essentially small file storage in the form of text, pictures and most MP3 audio files), but in the case of video and the very large file sizes it presents. The prospect of the average American consumer uploading large numbers of home video files given current network speeds does not appear to be very attractive in the near term future. Why? In a word, *time*. For example, if a consumer wanted to upload a 2 hour high-definition video of a family wedding, assuming the wedding video was about 2 gigabytes of data, it would take an hour at the current U.S. average connection speed of 5.8 Mbps. If we lived in South Korea, the country with the highest average connection bandwidth to the Internet (17.5 Mbps) as well as the highest average peak bandwidth (47.9 Mbps), the upload would still require over 20 minutes, to say nothing of cost. On the other hand, a typical MP3 song download would take less than three and half seconds.[40] What this is saying is that some media applications will continue to migrate to the cloud, in the simplest case more of what has already been taking place. But storing home video, or video gameplay in a cloud service, presents very different requirements for IT resources (as evidenced in the reported size of new datacenters being constructed by Google, Facebook, Microsoft and Amazon).[41]

In future versions of this report, we will include consumer storage and cloud services in out analysis.

4.4 Life without Media

In the coming years, many of the most important changes in media will come from television and the viewing of TV content on other devices. There is little mystery in this fact, TV is the largest media source, and stands to be affected the most by alternate distribution platforms. We have already noted the changes in the delivery of television from 2005 to today, including the shift to digital broadcasting, the mass market acceptance of high definition TV sets and digital video recorders (DVRs), and increasing content (channel) choice. On the other hand, actual video quality has not grown nearly as fast as a simplistic theory of technological progress (Moore's Law) would seemingly predict.

Two nascent developments may cause significant dislocations going forward: mobile television (example: MobiTV), and video over the Internet (examples: YouTube, Hulu). To date mobile TV has low utilization and can be classified as a niche product. On the other hand, video over the Internet is widespread and growing, but to date more as a complement rather than a substitute for conventional TV program delivery. YouTube and its cousins have made a large variety of novel and specialized video material available to anyone with a mediocre broadband connection. Hulu is doing the same at the higher end of the market. However, the constraints on the market growth of these services may be more a function of policy than technology. A minimum standard definition TV signal requires a bandwidth of 4 Mbps, and a "medium" version of HDTV requires double or triple that. Akamai's latest 2012 State of the Internet report lists the

average U.S. Internet connection speed at 5.9 Mbps, well below that needed for high definition.

At the end of the day, whether the media category is TV or computer media, the data reported here shows the tremendous volume of media activity Americans have grown to accept and to depend on, even if they can consume only a small fraction of it. Given all of the bits and bytes flying around, it appears safe to say that consumption in hours and in text-based activities such as email and reading, constrained by human physical limits, are destined to continue their slow growth, never exceeding a few percent per year.

The growth in media supply however, is not so constrained, and volumes – media entropy - will continue to grow. We are already at a scale - zettabytes – that is difficult to visualize (the number of stacked books leading into outer space or the depth of sand spread across the planet doesn't quite capture it). In future work, we will continue to track media consumption by people, constrained by people's time, attention and needs. Later we will include machine-to-machine data – the data that people don't see, but is collected by devices (sensors, meters, smartphones) and translated by applications into meaningful information for people.M2M data growth is not constrained by the number of households or by people's time and attention, only by the numbers and capacities of machines and data networks, which double every couple of years.

END NOTES

1. US Bureau of Labor Statistics, American Time Use Study. According to the BLS, employed Americans ages 25 to 54, who live in households with children under 18, spent an average of 8.8 hours working or in work-related activities, 7.6 hours sleeping, 2.5 hours doing leisure and sports activities, and 1.2 hours caring for others, including children on an average workday.
http://www.bls.gov/tus/charts/home.htm

2. W. Russell Neuman, Yong J. Park, Elliot Panek, "Tracking the Flow of Information into the Home: An Empirical Assessment of the Digital Revolution in the United States, 1960–2005," International Journal of Communication 6 (2012), 1022–1041.

3. There are different estimates for the U.S. "digital population" for different age groups and households. For our purposes, we used data from the U.S. Census, combining data compiled for 18+, 12+, and 2+ age groups where available and appropriate.

4. In other words, we do not adjust for double counting in our analysis. If someone is watching TV and using the computer at the same time for one hour, our data sources record this as two hours of consumption. This method is consistent with most industry measurements. Note, however, that this means there are theoretically more than 24 hours in an information day. The use of multiple simultaneous sources of information and how much people really use the media is analyzed extensively in the Middleton Media Studies (Papper, Holmes, & Popovich, 2004).

5. Teenage viewing is covered closely by media measurement firms including Neilsen and ComScore, and research foundations such as PEW. Annual data is reported in Neilsen sources including Television Audience, and State of the Media: The Cross-Platform Report. Specialized studies include How Teens Use Media: A Neilsen report on the myths and realities of teen media trends, Neilsen Report, June 2009, and the Video Consumer Mapping Study Appendix, Additional Findings & Presentation Materials, The Council for Research Excellence, 2010.

6. According to some estimates, the total amount of hard disk storage worldwide at the end of 2008 was roughly 200 exabytes. In other words, the 3.6 zettabytes of information used by Americans in their homes during 2008 was roughly 20 times more than what could be stored at one time on all the hard drives in the world.

7. Neilsen's average daily TV viewer time (usage) has remained remarkably stable over the last eight years. In 2008, Neilsen reported average daily viewer time of 4:44 (4 hours and 44 minutes); in 2010 4:38; and in 2012 4:39. Neilsen does not report confidence intervals for this data. However, by inspection this data looks to be within the margin of error for each year – e.g., essentially the same. See State of the Media: The Cross-Platform Report, Q3 2012 US, and Free to Move Between Screens: The Cross-Platform Report, March 2013.

8. In 2009 all US broadcasters shifted from analog to digital broadcasting. Some cable companies and most satellite broadcasters made the shift years before, but there are still some cable signals that are analog. In any case, digital TV signals can have a number of different resolutions, so whether a show is high definition does not depend on whether it is broadcast in digital or analog.

9. Brian Stelter, "Ownership of TV Sets Falls in US," New York Times, May 3, 2011.

10. Source: Neilsen, A2/M2 Three Screen Report, January 2009. U.S. viewers watched an average of 151 hours per month. This number has some seasonality in it.

11. Bill Carter, "DVR, Once TV's Mortal Foe, Helps Ratings," New York Times November 1 2009.

12. Neilsen, Free to Move Between Screens: The Cross-Platform Report, March 2013, p. 9.

13. Ulla Foehr, "Media Multitasking among American Youth: Prevalence, Predictors and Pairings," The Henry J. Kaiser Family Foundation, December 2006.

14. Brasel, S. Adam and James Gips, "Media Multitasking Behavior: Concurrent Television and Computer Usage," Journal of Cyberpsychology, Behavior and Social Networking, September 14(9) 2011: 527-534.

15. Data on text messaging behavior was found in automotive insurance studies which track the effects of text messaging on driver behavior. Primary source: Transport Research Laboratory, RAC Foundation, "The Effect of Text Messaging on Driver Behavior: A Simulator Study," by N. Reed & R. Robbins (TRL). Published Project Report PPR 367. Also UMTS Forum Report 44, "Mobile traffic forecasts 2010-2020 Report." Published by UMTS Forum Secretariat, Russell Square House, 10-12 Russell Square, London WC1B 5EE, UK.

16. Andrew Odlyzko, "The Volume and Value of Information," International Journal of Communication 6 (2012), 920–935.

17. Since 1998, American households went from less than 10 percent of homes owning a personal computer, to over 80 percent of homes having personal computers wired with Internet access. In High Definition television, homes that are HD capable has risen from a quarter of all US households in 2007, to 67% of American homes in 2012. Sources: Neilsen, State of the Media: U.S. Digital Consumer Report, 2012; US Census, "Computer and Internet Use in the United States: 2003" October 2005; Neilsen Wire, "Household TV Trends Holding Steady: Neilsen's Economic Study 2008" February 24th, 2009; ComScore, "Key Trends in Mobile Content Usage & Mobile Advertising," Feb 12, 2009.

18. In 2008, fewer than 60 percent of adult Americans had broadband connections at home, and a considerable amount of computer time was spent locally, without going online except perhaps to send an email. Off-line use included activities such as updating a resume, editing photos, or running a household finance program. However, as we move forward to 2012, time-use statistics for off-Internet, non-gaming computer use are no longer reported by U.S. government or industry sources. We consulted partial data provided by the American Time Use Study (ATUS) conducted by the Bureau of Labor Statistics (BLS), and time-of-use studies published by the Center for Research in Information Technology and Organization (CRITO) at the University of California, Irvine. For 2008, we estimate that non-Internet, non-gaming home computer use was widespread, but averaged

only 17 minutes per day for the average American. Because these applications are primarily text based, they add up to only 0.7 exabytes per year. Given these use statistics and the declining availability of reliable data, we have not updated this category in this report.

19. Studies showing that the average user processes 30 to 60 emails an hour, involving a sequence of read, respond, assign, delay or delete actions for each message. Microsoft email productivity consultants state that effective email users can view and handle (read, respond, assign, delay, or delete) 30% of their incoming email box in 2 minutes, based on Microsoft Productivity Study (MPS) statistics. MPS statistics show that on average, people can process up to 60 e-mail messages an hour, where "process" means to complete the full action necessary (not just scan/read).
Sources:
http://office.microsoft.com/en-us/help/HA011464801033.aspx;
http://www.microsoft.com/atwork/manageinfo/email.mspx;
http://www.mcgheeproductivity.com/library/index.html

20. Studies show that people cycle quickly through Web sites and doing searches to find content, and they estimate that most users spend only 8-9 seconds looking at most Web pages. They tend to continue this behavior until they find the page of interest, change their minds, get bored or shift to another task. Web pages generally include both photos and text, and rapid browsing behavior creates delays as each page is loaded. Studies of web behavior and navigation find high variability of document display and view time. For example, Weinreich et. al. report: "Our data confirms the rapid interaction behavior with heavy tailed distributions already reported in previous studies [Catledge and Pitkow 1995; Cockburn and McKenzie 2001; Cunha et al. 1995]: participants stayed only for a short period on most pages. 25% of all documents were displayed for less than 4 seconds, and 52% of all visits were shorter than 10 seconds (median: 9.4s). However, nearly 10% of the page visits were longer than two minutes. **Figure 4** shows the distribution of stay times grouped in intervals of one second. The peak value of the average stay times is located between 2 and 3 seconds; these stay times contribute 8.6% of all visits." (page 5:18)
Source: Weinreich, H. et al., "Not Quite the Average: An Empirical Study of Web Use" ACM Transactions on the Web (TWEB) archive Volume 2, Issue 1 (February 2008), page 5:18. ISSN: 1559-1131 p. 5:18.

21. For text based Internet applications, we assumed an average speed of 100-200k bits per second, which gave an estimated total of 28 exabytes in 2008. By 2012, we assumed a rough tripling of the 2008 rate, which gave an estimated total of 92 exabytes of data for the year, about 1.35% of total annual bytes.

22. Depending on who is counting, Hulu had either 9 million or 42 million viewers in May 2009. Brian Stelter, "Hulu Questions Count of Its Audience" New York Times May 14, 2009. ComScore Video Metrix reported reported that Hulu's audience had grown to 31.3 million unique viewers in November 2011, up from up from 29.2 million in October, and 27.1 million in September 2011. However, Wedbush Securities and comScore data, covered by Radio & Television Business Report, said the number of hours people spent watching video on Hulu fell 58 percent to 65 million hours viewed in August 2012; in March, the figures showed 156 million hours. Neilsen reported that Hulu alone--without subscription-based Hulu Plus--experienced a 7 million drop in unique monthly viewers in August 2012, from a high of 19 million in December of 2011. There is seasonality in these numbers, but as this data shows, the reported viewer numbers are unstable.

23. According to A.C. Neilsen, M:Metrics and other industry sources, the active population of smartphone users in the United States was 40 million in mid-2008, with much of the growth driven by the introduction of the iPhone in late 2007. In particular, the iPhone's touchscreen interface made it possible to scroll through entire Web pages (rather than the slimmed-down data pages that were displayed by previous feature phones). As a result, mobile browsing of Web content had a year-to-year increase of 89% from 2007 to 2008, with page views increasing 127 percent. In May 2008, M:Metrics reported that mobile Web consumption was quickly evolving from brief transactions, such as checking the weather or the status of a flight, to more time-intensive viewing and interaction with mobile social networks, including Facebook and MySpace. M:Metrics reported the average mobile user browsed the Internet an average of more than 4.5 hours per month. Source: M:Metrics "Social Networking And Commerce Draw Consumers Into The Mobile Web: Americans Spend More Than 4.5 Hours Per Month Browsing On Smartphones, Nearly Double The Rate Of The British," May 21, 2008.

24. Note that voice call length, messaging and music play time are roughly the same weekly hours of use for both smartphones and feature phones. Why is this? We hypothesize that for most users, these applications run in similar fashion on both phones (no significant differences in service quality). However, we will continue to investigate.

25. Industry and analyst projections for tablet computers, notebook and desktop computers could be wildly wrong. First, there is usually the assumption that the next sample of purchasers of tablet computers, notebook computers or desktops is highly correlated with the previous sample of purchasers. This is a big assumption which may work in relatively stable market conditions, but in rapidly changing markets introduces unknown errors. Second, without a study of the installed base of digital devices in the home, there are numerous assumptions made regarding the substitutability of device and application usage. Third, early data on the decline of notebook and desktop computer sales due to tablets was oversimplified – the assumption was made that purchasers were substituting devices, rather than elongating the replacement cycle for current devices. Fourth, data on what people are actually doing with their new devices is still embryonic, and the application / functionality mix is changing rapidly. These factors are often underplayed in sales analyses. 2013 and 2014 data should provide much better data for analytics on device purchases, substitutability and replacement.

26. Peter Fango, "The Truth About Cats and Dogs: Smartphone vs Tablet Usage Differences," The Flurry Blog, October 29, 2012.

27. See Fango above. The high percentage of social gaming behavior for second and third screen devices looks suspect, especially given time use studies conducted by the Bureau of Labor Statistics (which show declining leisure time). There is probably a sampling issue here.

28. Estimates vary, but approximately 70 million Americans played one or more social games in 2012. Top social gaming titles include FarmVille, Zuma Blitz, Words with Friends, Mafia Wars, Angry Birds Friends, Zynga Slingo, and SongPop. Aggregate social media statistics are reported in different industry sources. See Neilsen, State of the Media: The Social Media Report, Q3 2011 for aggregate data.

29. Our 7 category gaming classification was adapted from several gaming sources including NPD's annual gaming reports, summaries of which are publicly reported in NPD Press Releases published on the company website. The 7 categories are: (1) Extreme Gamer. In 2012,

they play over 50 hours a week, 25 hours on consoles, 16.5 hours on high specification PCs, and 8.5 hours on portables. This is a heavy male cluster, with an average age of 25. (2) Avid PC. This category plays just under 26 hours a week on Hi and Lo-Spec PCs (14 hours and 8 hours per week respectively). The category includes consoles in some households, played just under 4 hours a week. (3) Console Gamer. This is the largest gamer population, an estimated 42.5 million gamers in 2012. They play just over 15 hours a week. A large percentage (over a quarter) own more than one console machine. (4) Online PC. Approximately half of gamers in this category own a console or portable gaming machine, but most of their time is spent playing PC games online (10.5 hours a week in 2012). (5) Offline PC. This is an older PC gamer segment, trending male, who play more "classic" PC games offline. In 2012 they played just over 7 hours and 15 minutes a week. The numbers in this category are declining. (6) Family Gamers. This is the youngest age segment, and the second largest (estimated) in numbers in 2012, with 37.5 million gamers. They play mostly on portable gaming devices (26 million gamers), averaging 9 and a quarter hours a week. The other 10 million gamers play on PCs and consoles approximately 4 hours a week. (7) Casual Gamers. This is the third largest gaming segment, with over 36.3 million gamers in 2012. As a population they do not have a preferred gaming device, using consoles, PCs and portables as desired. In 2012 they averaged just over 5 hours a week. The segment is over half female, and trending female.

30. Our gaming throughput numbers, including compression assumptions, are estimates based on interviews with gaming experts and our own judgment. Specialists and gaming hobbyists will know that average estimates spanning multiple gaming devices, gaming software and gaming modes (offline, online, etc) require many assumptions. These assumptions can be complex and drive results. A separate, technical working paper is in preparation covering our throughput and compression assumptions in detail, including those pertaining to gaming.

31. Peter Fango, "The Truth About Cats and Dogs: Smartphone vs Tablet Usage Differences," The Flurry Blog, October 29, 2012.

32. Analysis is based on ComScore, "comScore Releases September 2011 U.S. Online Video Rankings," October 21, 2011. See Rip Empson, "People Now Watch Videos Nearly 30 Percent Longer on Tablets than Desktops," Techcruch.com, Nov. 12, 2011.

33. See discussions in endnotes 15, 19, 20 and 21 above. Activity-time conversions are included in a separate, technical working paper in preparation.

34. William D. Nordhaus, "Two Centuries of Productivity Growth in Computing," The Journal of Economic History, Vol. 67, No. 1 (March 2007). Tables 5 and 6.

35. W. Russell Neuman, Yong J. Park, Elliot Panek, "Tracking the Flow of Information into the Home: An Empirical Assessment of the Digital Revolution in the United States, 1960–2005," International Journal of Communication 6 (2012), 1022–1041.

36. Some of the benefit of cheaper information technology has been in the form of more choices of what to consume. The number of TV channels per average household has now reached about 130, of which the average household actually watches 18. Both numbers are considerably higher than they were in 1980. This is an example of a more general phenomenon, that the ratio of information available to information consumed grows over time. The additional channels of TV, however, have come at a cost: higher compression and therefore lower video resolution for the channels we receive. The issue is straightforward technically: bandwidth costs money (all those transistors). For a fixed budget, a cable TV company, and especially a satellite TV company, can have only a fixed total capacity in megabits per second. Suppose the total is 600 Mbps. They can choose to divide this capacity into 130 channels, in which case they can provide an average bandwidth of 4.6 megabits per second. This total bandwidth can also be split between high definition channels (at roughly 12 Mbps each) and standard definition channels (4 Mbps each), but in this case most of the 130 channels will have to be standard definition. Or, the companies could provide half as many channels, and double the average bandwidth, or any other combination as long as the total is 600 Mbps.

37. Measuring home digital storage can quickly get complicated. For example, say your home DVR has a capacity of 200GB, and is set to automatically delete saved programs when they are over two weeks old. Assume further that you save 10GB of media content a week for delayed viewing. Therefore, on an annual basis you are saving 520GB, but at any one snapshot in time, your DVR storage is utilized at some capacity less than 200GB. If you then ask how much stored data do you have on your home DVR, is the answer 520GB annually, or the average capacity utilization at some snapshot in time (which would be less than 200GB), or something else (perhaps some kind of weighted average). There is no single answer to this question. Industry practice is to state the total capacity of the storage media available, and the average utilization rate of that capacity. However, defining average utilization, which can vary greatly, is itself complicated.

38. Frame buffers are made out of dynamic random access memory (DRAM), a common type of semiconductor chip; digital TVs use similar technology. DRAM and other volatile memory are so fast that they are not generally classified as storage media.

39. Roger Bohn and James Short, "Measuring Consumer Information," International Journal of Communication 6 (2012), 980-1000.

40. Data on average connection speeds, mobile connectivity, and other network metrics is taken from Akamai's State of the Internet reports, published quarterly. These can be found at: http://www.akamai.com/stateoftheinternet/

41. Estimates vary widely on the size, number of servers, and power required of new datacenters being constructed by Facebook, Google, Amazon and Microsoft, as these companies do not disclose specifics. Industry estimates can be found on websites such as Data Center Knowledge and Gigaom:
http://www.datacenterknowledge.com/archives/2012/08/15/estimate-facebook-running-180000-servers
http://gigaom.com/2012/08/17/a-rare-look-inside-facebooks-oregon-data-center-photos-video/

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