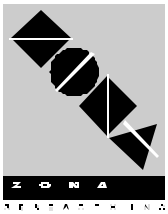
The Economic Impacts of Unacceptable Web-Site Download Speeds

A WHITE PAPER



By
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The Economic Impacts of Unacceptable Web Site Download Speeds

Abstract: *Unacceptably slow Web site download speeds critically impact the performance and productivity of Internet operations. This paper reviews page download times and connection speeds from the standpoint of a typical user, briefly documents the kinds of consumer behaviors that emerge when users are faced with unacceptably slow load speeds, offers an economic model for assessing the financial impacts of unacceptable load speeds, and quantifies the financial impact to Web sites of consumer avoidance behaviors. The report concludes that at a run rate of about $362 million per month, perhaps as much as $4.35 billion in e-commerce sales in the U.S. may be lost each year due to unacceptable download speeds and resulting user bailout behaviors.*

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Introduction

On the Internet, the need for speed is a fact of life. In almost every way imaginable, speed rules. The faster things move, the more gets done—especially when it comes to buying and selling. Indeed, industry feedback from Web users and ecommerce vendors have regularly shown that the amount of time taken for Web pages to load is one of the most critical factors in determining the success of a site and the satisfaction of its users.

The foregoing is so well appreciated among many Internet marketers that the so-called "eight second rule" has become an oft-quoted standard. Though few can remember exactly when or where the term first gained credence, it is now widely believed that if users cannot boot up a Web page within a mere eight seconds, they may be at some risk of taking their business to another Internet destination. Quite simply, point-and-click has made us fickle and Web speed has changed everything.

In this paper, Zona Research investigates the economics of Web speed and puts some meat on the bones of a topic that has too long been undernourished. Through aggregating a handful of disparate facts into a coherent whole, Zona derives a simple economic model that can analyze and project the financial impact to a Web site of unacceptably slow download speeds. This model emerges from our coverage of four basic areas:

- Section One discusses various Web page download times and connection speeds from the standpoint of a typical user;
- Section Two describes the kinds of consumer behaviors that often emerge when users are faced with unacceptably slow download speeds;
- Section Three lays out the economic model and enumerates its inner workings without using linear programming or complex mathematical methods;
- Section Four quantifies the financial impact to Web sites of consumer avoidance behaviors and offers some "what-if" cost-benefit scenarios.

Methodology and Caveat

Economic models come bottled in containers of various sizes and shapes. While the current work is of a modest mathematical vintage, its outputs are no less intoxicating for the issues at hand. Indeed, as the fruits of Web economics begin to ripen over time, we expect that efforts such as this will likewise become more sophisticated. Though this reminds us that the current methodologies of Web economics are as new as the Internet itself, it is not meant to imply that such work is any less robust than any other model. Only real world use can validate a particular predictive approach to problem solving.

In the current work, data were derived from a variety of sources. Proprietary research studies and surveys by Zona Research and its parent Intelliquest Information Group

provided the bulk of the primary data. Other public industry-wide sources were also used for secondary purposes but aggregated in ways exclusively germane to the current needs. Due to non-standardized data for such things as Web page size and graphics, configuration of enabling hardware, device and backbone connection speeds, types of Web sites, and so on, certain assumptions had to be made to even build the current model. Clearly, if other assumptions were made, results would vary though we strongly believe the overall implications of this research would largely be the same: namely, that slow load speeds critically and negatively impact the conduct of business over the Internet.

Section One: Typical Web Page Load Times and Connection Speeds

Internet users access the Web from a host of different devices in a variety of ways at a dizzying range of different speeds. To imply that there are such things as "typical" Web page load times or connection speeds is thus immensely hypothetical at best or downright confusing at worst. Nonetheless, to address the question of the economic impacts of unacceptable load speeds, by definition, one needs to start with some basic understanding of what constitutes "unacceptable."

From a user or demand-side perspective, the larger the pipe, the faster the load time. With the aforementioned "eight second rule" as a guide for acceptability, the data in Figure 1 for a "typical" Web page load time clearly show that anyone using less than a 28.8 modem is at risk for experiencing unacceptable load times. While this is clearly not surprising to anyone familiar with the older 14.4 modems, the radical difference between load times as one progresses up the scale to faster connection speeds bears special notice.

Figure 1:
TYPICAL WEB-PAGE LOAD TIMES

Standard Connection Speeds	Typical Load Time (seconds):
14.4KB or Less	11.70
28.8KB Modem	5.85
56.0KB Modem	2.98
128 KB ISDN	1.32
1.44MB T1 Line	0.12
4.00MB or More	Varies

NOTE: Web page load times are widely affected by size of page number and size of graphic images per page, construction and configuration of enabling hardware, and Internet traffic at any given time of day. They are thus subject to extreme variation. Specified load times are used for modeling purposes only and represent a typical Web site in a large U.S. metropolitan area.

The issue of download times becomes even more complex when the supply side is added to the equation. Then not only is load time a factor of user demand for various page sizes,

graphic complexities, hardware configurations, and modem or line speeds, it also becomes a product of the connection speeds from both the backbone provider and the ISP. The carrying capacity and coping capabilities of any particular backbone and/or any affiliated Internet Service Provider varies widely with Web traffic volumes, technological sophistication, engineering competency, service area, capitalization, and so on.

Figure 2 elucidates such complexities. Using a baseline of a typical 50 Kb home page, this snapshot hints at the general results of comparing load times for 29 Internet backbone providers doing business through 35 agents throughout the U.S. By tracking nearly two million test downloads across 27 American cities, these measurements by Boardwatch and Keynote Systems generate comparative data about the wide diversity of speed in the "typical" backbone connection. From the fastest time of 1.543 seconds to the slowest at 26.767, the range of a 50Kb load time is remarkably wide. Applying our "eight second rule" to the home page used in these tests, we learn that even the aggregated average of all the backbone connectors tested would be considered unacceptable at 9.928 seconds.

Figure 2:
DOWNLOAD TIMES FOR BACKBONE CONNECTION

SPEED AND SERVICE DESCRIPTION	50Kb LOADTIME(Seconds)
Fastest Internet Backbone Connection	1.543
Aggregated Average of All Backbone Connections	9.928
Slowest Internet Backbone Connection	26.767
Average Web Backbone Connect Speed	**5 Kbps**

NOTE: Measurements by Boardwatch and Keynote Systems of 29 backbone providers over 30 days during Spring 1997 representing 1.75 million test downloads of 10 Kb data blocks by 35 agents across 27 U.S. cities. The 50 Kb load times were derived by multiplying 10 Kb downloads by 5 to simulate delivery of a typical home page by the backbone connection.

At first cut, what the numbers from Figures 1 and 2 imply about the economic impacts of unacceptable load speeds seems merely obvious: users with 14.4Kb modems or slower already experience major frustrations and many backbone carriers are already unable to meet the "eight second rule" on a consistent basis. While this is hardly news for anyone who has used older equipment or been serviced in ill-equipped or outlying areas with less than best-of-breed service, it becomes somewhat more illuminating when one remembers that many designers are loading or want to load ever more bit-hungry enhancements to their Web pages.

At a deeper level, the average Web backbone connection speed of 5 Kpbs shown in Figure 2 has significant implications for Web page designers and ecommerce vendors. Assuming the "eight second rule" is valid for a large number of Internet users and that they will move

to other sites for satisfaction if a page does not load within that time, a 5 Kpbs speed suggests that designers are at some risk of losing traffic if they build opening pages larger than 40 Kb (i.e. 5 Kpbs X 8 seconds). When one factors in users who are stuck with 14.4 modems, it becomes apparent that load time frustration is an economically significant event for cutting-edge ecommerce vendors. As we shall soon see, because of traffic volumes, failure rates, and burgeoning Web complexity, such unacceptable load speeds can quickly translate into serious financial impacts even for those vendors with relatively fast connections.

Section Two: Consumer Behaviors When Faced With Unacceptable Load Speeds

To date, there has been little or no economic-based research dealing with the issue of what Web users do when faced with unacceptable load speeds. For this reason, this paper must use as a proxy various documented behaviors for what users do after abandoning online product searches. In a pioneering study in this area, for instance, Zona's 1998 Online Holiday Shopping Study revealed several key facts about such abandonment behavior. Table 1 summarizes a few salient points.

Table 1: Actions Taken After Abandoning Online Search for Products

Demographic (N=208)	Did Not Buy Item	Bought Item at Brand Store	Bought Item at Different Web Site	Bought Item at Discount Store	Bought Item From Paper Catalog
All	34%	24%	14%	13%	7%
Age < 25 years	27%	40%	13%	13%	7%
Age 25 to 34	43%	20%	15%	10%	2%
Age 35 to 44	27%	30%	14%	13%	11%
Age 45 to 49	39%	18%	7%	25%	11%
Age 50 to 54	31%	23%	15%	12%	4%
Age 55+	33%	7%	20%	13%	13%
Male	29%	24%	15%	19%	5%
Female	41%	21%	13%	7%	9%
Annual Income <$35k	38%	16%	19%	16%	5%

Table 1: Actions Taken After Abandoning Online Search for Products					
Demographic (N=208)	**Did Not Buy Item**	**Bought Item at Brand Store**	**Bought Item at Different Web Site**	**Bought Item at Discount Store**	**Bought Item From Paper Catalog**
Annual Income $35k – $49k	37%	34%	10%	7%	5%
Annual Income $50k – $74k	44%	19%	14%	9%	7%
Annual Income $75k – $99k	21%	21%	18%	32%	7%
Annual Income $100k+	27%	24%	12%	12%	12%

While abandonment behaviors are not directly analogous to load speed frustration, in the absence of hard data, they can serve as a proxy measure for gauging what Web users may do when their impatience grows to actionable levels. Thus, key trends from Table 1 reveal that, when frustrated with an online search, over a third of users may simply give up trying to buy an item. Another 44% tend to turn away from their computer to buy from traditional retail sources. Perhaps most important of all, only about one in seven turn to another Web site and keep searching. By extension, one might reasonably conclude from such data that, when load speed frustration builds to serious levels, a valuable portion of Web users will get their needs met elsewhere or use their Web connection only during times when they can afford a more leisurely pace of surfing.

But unlike television, in the world of ecommerce, the primary goal of Internet vendors is not really to get users to watch their story on a static screen. Rather, the objective is to have users behave in useful and profitable ways within an interactive, virtual universe. Web vendors simply get less value when users just watch. What is needed are Web users who act, who manipulate their mouse, who type and click and download ideas, information, and product choices. This means that Web vendors really only win when they get users to play an interactive game that has a high-degree of ultimate success.

What leads to such success is a deep sense of user enjoyment. Whether it is unacceptable download speeds or frustrating product searches or frequent page crashes, the end result for users are encounters that are simply not rewarding. Conversely, if users have enjoyable experiences, research shows that they use the Internet more, buy and sell with greater frequency, and tell their family, friends and colleagues about their Web use, thus helping to the expand the universe of Internet users and Web commerce.

With these thoughts in mind, let us turn briefly to what recent research has shown users enjoy and do not enjoy about their Web experiences:

- Users want usable sites that do not make them constantly hunt for things.

- Users do not enjoy getting lost, having systems lock up, or being tricked.
- Users like to be able to click anywhere at any time and get what they want.
- Users enjoy being in control and having easy navigation and multiple choices.
- Users demand fast-loading pages and go elsewhere if they do not get them.
- Users often cannot see image maps or graphics due to technology limitations.
- Users often dislike clumsy frames and bothersome drop-down menus.
- Users like hypertext links but hate entry tunnels like "click here to enter".
- Users often do not have 256 colors so many graphics look bad in just 16.
- Users say they return to sites that treat them well as a Web customer.
- Users prefer to click through multiple short pages than wait for one long one.
- Users love pictures but prefer being told how big they are so they can decide whether load them or not.
- Users have little idea about how Internet magic works but know instantly which sites they prefer and which they will bookmark for later viewing.
- Users know the Internet is not television, but still expect the Web to grab their attention in engaging, interactive ways.
- Users enjoy being part of an online community so chat features bolted on to a site can triple session lengths, double Kb-per-user and page-impression downloads per session, bolster visit frequency by over 50%, and work a site's servers a great deal harder.
- Most Web users are simply not "cookie monsters" and are turned off if they are constantly being bombarded with them.
- While some users tolerated sites which performed poorly as recently as a year ago, today's users have little patience for sites that simply do not get the basics right—fast, easy click-throughs, dependable fulfillment, customer service, etc.

Given such user preferences, the real question is how do unacceptable download speeds impact online behavior. Fortunately, while full surveys are few and far between, there has been a modest amount of research on what are called "bailout rates", i.e. the percent of users who simply do not wait around for pages to load and instead go to other sites. For instance, on one site with a 70 Kb home page to load, log file research revealed that over half of the visitors bailed out before the first page finished loading.

At another site with an opening page of 40 Kb, a three month log file review showed that the opening page had a 30% bailout rate while every other page at the site had rates in the 6% to 8% range. Since the other pages were in the range of 32-35 Kb, researchers felt troubled by the implication that a mere 5 Kb might have produced such dramatic differences. Given the average connection speed of 5 Kbps cited above, could just a single second of Web waiting account for this difference? To test this assumption, the site tweaked

its opening page down to roughly 34 Kb. Remarkably, it found the bailout rate fell immediately from 30% to 6-8% just because of one tiny second of load time!

Based on the foregoing, it seems abundantly clear that slow download speeds are simply unacceptable for a sizeable percentage of the online population. As we shall see next, this situation has enormous economic implications for Web sites and ecommerce vendors. As it turns out, the Internet is not just capable of moving information and ideas at incredible speeds. It is also able to make and lose money at Web speeds as well.

Section Three: Assessing the Economic Impact of Unacceptable Load Speeds

The current economic model is constructed in three inter-related, but discrete parts. First, we identify the user population by Internet connection speed. Second, we calculate what portion of that population's online spending is at risk because of unacceptable load speeds. Finally, we derive estimates of what portion of that at-risk spending is probably lost either because of sub-standard connection speeds, Web-page download failures, or ISP connection failure rates.

Figure 3 outlines the basic data for step 1; namely user population by typical Internet connection speeds. The user percentages shown here are derived from aggregations of results from several surveys and represent the best available data for online use. Numbers for the projected baseline or total universe of online users is derived from surveys by Intelliquest Information Group of Austin, TX. While many surveys peg the current number of online users somewhere in a range from 40 to 80 million, we have used Intelliquest numbers because they are based on continual, longitudinal sampling of a known universe and thus are likely to be reasonably more accurate.

Figure 3:
ESTIMATED CONNECTION SPEEDS OF U.S. USERS

Typical Connection Speeds	% of U.S. Online Users	Estimated U.S. Users Out of Projected 79M Universe,1999
14.4KB or Less	2.7	2,133,000
28.8KB Modem	32.7	25,833.000
56.0KB Modem	33.8	26,702,000
128 KB ISDN	4.8	3,792,000
1.44MB T1 line	12.8	10,112,000
4.00MBor More	9.4	7,426,000
Unsure of Speed	3.8	3,002,000
TOTAL	**100.0**	**79,000,000**

But while these 79 million users may be connected to the Internet at various speeds, studies have shown that there are a sizeable percentage (15%) who are Web-enabled but do not

make use of their connection (line A of Figure 4). So before we can proceed to derive the estimated amounts potentially at risk due to unacceptable download speeds, we first need to back that 15% out of the population shown in Figure 4. This is done in column B of Figure 5.

Figure 4:
BASELINE DATA FOR MODEL CALCULATIONS

A. Estimated % of Web-enabled users using the Web (Jan 99)	85.0%
B. U.S. Population. Who are Currently Online Users (4Q98)	79.4 Million
C. U.S. Population Who Intend to Be Online w/in12mos(4Q98)	37.5 Million
D. U.S. Population Who Are Online Shoppers (4Q98)	44.1 Million
E. U.S. Population Who Are Online Purchasers (4Q98)	16.1 Million
F. Median Amount Spent Online in Last 30 Days, Age16+ (4Q98)	$200
G. Industry Average of Web-page Download Failures by ISP(May 98)	2.2%
H. ISP Connection Failure Rates, Business Hours (Feb 98)	6.6%
I . ISP Connection Failure Rates, Evening Hours (Feb 98)	10.9%
J. Average ISP Connection Failure Rates, All Hours (Extrapolated)	8.7%

Similarly, not everyone who has online access actually shops or buys online so whatever behaviors they exhibit as a reaction to unacceptable download speeds may be less important in a direct economic sense. As lines B through E in Figure 4 reveal, roughly 16.1 million or 20.27% out of a total online population of 79.4 million are expected to purchase goods or services over the Web in 1999. However, while the remaining roughly 80% may not be expected to figure into the direct estimates of this model at this time, that does not mean they are without economic consequence when it comes to the question of slow download speeds. For instance, it is widely known that many online users "look but don't book" airline tickets directly from Web sites or "spy but don't buy" everything from automobiles to clothes to computer equipment. While the opportunity costs of such lost online sales clearly rise as load speeds become unacceptable and bailout rates increase, for the purposes of the current model, such research-it-over-the-Web-but-buy-it-elsewhere behaviors have not been quantified nor have they been added to our final numbers. However, in subsequent updates of this model, Zona will attempt to also quantify those impacts since they are believed to be considerable.

Now that we have all the pieces in place, we can finally take a look at part 2 of our model: estimates of dollar amounts potentially at risk because of unacceptable load speeds. As seen in Figure 5, for each connection speed we have calculated the Web-enabled 85% of the total population (Column B) and multiplied those users by an average amount spent online each month (Column C from Line F of Figure 4).

[NOTE: At this time, the average amount spent online is shown as equally distributed among all connection speeds. Common sense suggests that this is probably not the case. In future derivations of this model, actual amounts per each connection speed may be achievable.]

Thus the amounts in Column D come to represent the base amount if all Web-enabled users actually bought online each month. But since we know that only about 20.27% actually do purchase online, we need to further reduce these amounts by that amount (Column E) to get more realistic figures. Finally, as the total at the base of Column E shows, we can estimate that something on the order of about $2.7 billion in online sales MAY be at risk from unacceptably slow download speeds. Whether such sales are in fact at risk, is what we shall deal with in the third and final step in our model.

Figure 5: ESTIMATED DOLLAR AMOUNTS POTENTIALLY AT RISK

Column A	Column B	Column C	Column D	Column E
Typical Connection Speeds	**85% of Web-Enabled Who Are Online**	**Mo. Amt. Spent Online**	**Base Amount if All Web-enabled Users Bought**	**Base Adjusted to 20.27% Who Do Buy**
14.4KB or Less	1,813,050	200	362,610,000	73,501,047
28.8KB Modem	21,958,050	200	4,391,610,000	890,179,347
56.0KB Modem	22,696,700	200	4,539,340,000	920,124,218
128 KB ISDN	3,223,200	200	644,640,000	130,668,528
1.44MB T1 Line	8,595,200	200	1,719,040,000	348,449,408
4.00MB or More	6,312,100	200	1,262,420,000	255,892,534
Unsure of Speed	2,551,700	200	510,340,000	103,445,918
TOTAL	**67,150,000**		**$13,430,000,000**	**$ 2,722,261,000**

As we saw earlier, online sales become at risk from slow download speeds when users "bail out" and take their "eyeballs" and Web business elsewhere. There are also other factors that contribute to this situation. First, there are typically a small percentage of Web pages that fail to download properly because of problems at the Internet Service Provider level. As shown at Line G of Figure 4, the industry average for these types of failures recently stood at about 2.2%. Second, the failure rates of the ISP connection itself also impact the ability of users to access the Internet and thus to download any pages at all. As shown at Lines H and I of Figure 4, these averages have been about 6.6% of the time during business hours and 10.9% of the time during evening use hours. To simplify our model, therefore, we will use an extrapolated all-purpose anytime figure of 8.7% (derived by adding 6.6 and 10.9 and dividing by 2, see line J of Figure 4).

Given these failure rates, we are now ready to proceed to a final tabulation of perceived economic losses due to unacceptable download speeds. Recall that in Section One we had essentially two ways of capturing speeds which were "unacceptable", i.e. above the "eight second" threshold. The first way (Figure 1) was for all connection speeds at the rate of 14.4

Kb or less. The second way (Figure 2) was for the aggregated average of all backbone connections (9.928 seconds). Now the real methodological question is how to reconcile those two standards of unacceptability since one deals with modem speed at the user level and the other deals with connection speed by the backbone provider.

Given this model's preference for simplicity, we shall take a methodological leap of faith and, for the time being, attempt to merge the two standards. As shown in Figure 6, we first reconstitute in Column B the at-risk base of 20.27% of online users who are expected to buy during 1999. Then in column C we assume that only those who are connected at speeds of less than 14.4 Kb can be in some way considered lost due to unacceptable load speeds, but make the further assumption that they are totally at risk because of the problem. For the remainder of users at the other connection speeds, we simply calculate the respective losses due to Web page load failures (Column D) and ISP connection failures (Column E) at the rates explained above.

Figure 6: ESTIMATED DOLLAR AMOUNTS LOST DUE TO UNACCEPTABLE LOAD SPEEDS

Column A	Column B	Column C	Column D	Column E	Column F
Typical Connection Speeds	**At Risk Base of 20.27% Who Buy Online**	**Lost Due to Sub-8 Second Loadtime**	**Lost Due to 2.2% Webpage Load Failure**	**Lost Due to 8.7% ISP Connect Failure**	**TOTAL LOSS DUE TO ALL REASONS**
14.4KB or Less	73,501,047	73,501,047			73,501,047
28.8KB Modem	890,179,347		19,583,946	77,445,603	97,029,549
56.0KB Modem	920,124,218		20,242,733	80,050,807	100,293,540
128 KB ISDN	130,668,528		2,874,708	11,368,162	14,242,870
1.44MB T1 Line	348,449,408		7,665,887	30,315,098	37,980,985
4.00MB or More	255,892,534		5,629,636	22,262,650	27,892,286
Unsure of Speed	103,445,918		2,275,810	8,999,795	11,275,605
TOTAL	**$ 2,722,261,000**	**$73,501,047**	**$ 58,272,719**	**$ 230,442,116**	**$ 362,215,882**

Naturally, the internal logic of this model does not account for such complexities as foregone and opportunity costs, the adjusted value of money over significant periods of time, or possibly significant substitution or replacement effects. Nonetheless, within the simplified scope and parameters of this study, we have arrived at the point where we can report that perhaps as much as $362.2 million in ecommerce sales in the United States may be lost per month in 1999 due to unacceptable download speeds.

Section Four: Direct Website Impacts and "What-If" Cost-Benefit Scenarios

While the current model is not yet sophisticated enough to offer us specific lost revenue percentages by marketplace sector, it is perhaps not unreasonable to foresee a day when such a thing will be possible. In the meantime, we can only paint a broad brush across the canvass of direct financial impacts for any particular market segment or Web site.

One way we might begin such a picture is to assume, for instance, that the majority of economic losses from unacceptable download speeds come from the consumer sector. Whereas businesses usually have faster connections and more sophisticated equipment, private residences and the small office/home office (SOHO) market usually have slower connections and often less speedy equipment and software. Similarly, one can imagine behaviors at work where users absolutely need to get through to a particular customer or supplier, for instance, and thus the bailout rate for slow connections would be considerably less than in homes or the SOHO market.

So, purely for the purposes of illustration at this stage of this nascent economic model, let's assume that the entire amount of economic loss we identified in Figure 6 could somehow be apportioned exclusively to the business-to-consumer (B2C) marketplace for the reasons

Figure 7:
POSSIBLE B2C SEGMENT IMPACTS OF LOAD SPEED LOSSES

Calculated Losses from Unacceptable Load Speeds	$ 362,215,882 Per month
Est. Business-to-Consumer Share of Total Web Market	28.3%
Est. Business-to-Consumer Share of Load Speed Loss	$ 102,507,095 Per month

Column A	Column B	Column C	Column D	Column E
Business to Consumer Market Segment	**Percentage of 1997 B2C Market**	**Theoretical Share of Load Speed Losses**	**Monthly Site Avg If 10 Major Sites In Each Segment**	**Annual Average if 10 Sites in Each Segment**
Securities Trading	32.5%	$ 33,314,806	$ 3,331,481	$ 39,977,767
Travel/Tourism	27.4%	$ 28,086,944	$ 2,808,694	$ 33,704,333
Book Publishing	11.4%	$ 11,685,809	$ 1,168,581	$ 14,022,971
Groceries	7.3%	$ 7,483,018	$ 748,302	$ 8,979,621
Personal Finances	3.7%	$ 3,792,763	$ 379,276	$ 4,551,315
Recorded Music	3.5%	$ 3,587,748	$ 358,775	$ 4,305,298
Box Office Receipts	2.8%	$ 2,870,199	$ 287,020	$ 3,444,238
Textiles/Apparel	2.6%	$ 2,665,184	$ 266,518	$ 3,198,221
Other	8.8%	$ 9,020,624	$ 902,062	$ 10,824,749

stated in the previous paragraph. Then, for argument's sake, let's take a further flight of fancy and assume there were, say, ten major Websites in each major B2C segment (naturally there are more or less with greater or lesser market shares). Under such admittedly hypothetical circumstances, we might then be able to discuss the implications of the numbers shown in Figure 7.

If the hypothetical data in Figure 7 represented market segment reality and if a Website could be properly identified with respect to its revenue share of its segment, then one could theoretically identify the direct economic impact to that particular site from the various load speed losses. For instance, in the hypothetical world above, we might say that such losses

represent about $40 million annually to a securities trading firm or $14 million to an online book publisher or $4 million to a music site, etc.

To continue the argument, with such data in hand, Websites would be able to reasonably calculate the base against which upgrades in technology might be compared. If, for instance, an apparel site estimated it was losing $3.2 million a year because of load speed problems, a $1 million investment in upgrading its software and hardware to speed page loading times might be recaptured in a few months. In such an environment, load speed upgrades would become no-brainers rather than the typical budget turf battles they often now become.

Summary and Conclusions

This paper has generated the following insights into the economic impacts of unacceptable Internet download speeds:

- Connection speeds of 14.4 Kb or less are clearly unacceptable given the Internet industry's emerging "eight second rule".
- The aggregated average speed of all backbone connections of 9.928 seconds for a typical 50 Kb opening page also becomes unacceptable in light of the "eight second rule" and consumer behaviors which emerge from it.
- The average connection speed for the Internet backbone as a whole is about 5 Kbps at the present time.
- Web page designers who build opening pages of greater than 40 Kb are at risk of experiencing a significant number of user bailouts from their site.
- When frustrated with an online shopping site, over a third of Web users may simply give up trying to buy an item over the Internet and only one in seven will click through to another Website and keep searching.
- Internet users in large numbers will abandon sites which load too slowly, confuse them, or fail to engage them intelligently.
- Even a one second time savings in download speeds can have large and significant impacts on user loyalty, use, enjoyment, and commerce.
- The large majority of current Internet users access the Web using 28.8 or 56 Kb modems.
- Only about 20.27% of online users are currently Internet buyers.
- Online buyers spend about $200 per month on average at this time.
- Web-page download failures by Internet Service Providers average about 2.2% of current ISP traffic.
- ISP connection failure rates average about 6.6% during business hours and 10.9% during the evening hours.
- At about $362 million per month, perhaps as much as $4.35 billion in ecommerce sales in the U.S. may be lost each year due to unacceptable download speeds and resulting user bailout behaviors.

Based on the above insights, it is demonstrably clear that many of today's Web sites will continue to lose sizeable economic benefits if they fail to correctly address the issues of unacceptable load speeds and user bailouts. While Web page redesigns which bring pages down under 40 Kb can help speed load times and reduce bailouts, ISP download and connection failures will continue to adversely affect Web sites unless additional technological

help is undertaken. Given the substantial sums potentially at risk, Internet vendors of all sizes in all market segments would do well to make this issue a top priority. For serious Web players, anything less than a full and immediate assault on these problems risks letting those ever-illusive Internet profits drift even further away.

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