



**THE BEHAVIOR OF PC OEMS AND GROWTH OF
SERVER/NETWORK COMPUTING FIVE YEARS
AFTER THE FINAL JUDGMENTS IN
*U.S. V. MICROSOFT***

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Summary

The Final Judgments in *U.S. v. Microsoft* and *New York et al. v. Microsoft* contained a number of provisions designed to remedy the violations of the Sherman Act found by the District Court and upheld by the D.C. Circuit Court of Appeals. The Final Judgments also included other provisions sought by the plaintiffs that were designed to help reduce barriers to entry in Personal Computer (PC) operating systems by ensuring that non-Microsoft servers could work with Windows PCs in client-server computing. This study has examined various aspects of the computer software business to assess the extent to which the goals of the Final Judgments have been achieved as of the middle of 2007.

We have found that:

- Computer manufacturers (known as Original Equipment Manufacturers, or “OEMs”) routinely install and promote products and services that compete with Microsoft’s products, including components of Windows defined as “middleware” and other platform software. Sections III.A-C and III.H.1 of the Final Judgments were designed to ensure that OEMs would be free to install and promote non-Microsoft middleware and other products that compete with Microsoft software. We find that leading OEMs install and promote many third party software products and other applications and services that compete with Microsoft’s products, thus meeting the goals of these parts of the Final Judgments.
- Many new applications are being written to run primarily on servers connected to the Web. Using a growing array of industry standards rather than proprietary communications protocols, these applications can communicate with PCs and other clients, and with applications running on other servers, without regard to the operating systems or hardware used by the computers involved. As a result, they are helping to weaken the “applications barrier to entry” that the Court found protected Windows from serious competition. Section III.E of the Final Judgments was designed to foster the development of server/network-based alternatives to Windows. That development is proceeding in the marketplace today.

Computer Manufacturers

To gain a more detailed understanding of the extent to which OEMs install and promote non-Windows software on new PCs, we examined PCs from the seven leading OEMs, which together account for more than three-quarters of U.S. PC sales for home and small office computers. In each case we purchased a relatively inexpensive PC. We then assessed each PC to identify the software that had been installed on it and the ways in which the OEM promoted third-party software and services.

We found that these OEMs had installed an average of 35 non-Microsoft software applications per PC. Key findings include the following:

- Non-Windows applications included media players (often two or more), anti-virus and security software, and image editing software, in addition to games and utilities.
- Five of the seven OEMs included Sun’s Java Virtual Machine on their PCs.
- Six of the seven OEMs chose to make a non-Microsoft web search service the default service on their PCs: three Google, two Yahoo, and one AOL.
- Those same six OEMs included the corresponding third-party toolbar in the web browser. These toolbars provide a query box for the relevant search service, but also include other features linked to the toolbar provider (such as its email or instant messaging services).
- The six OEMs also made Google, AOL, or Yahoo the default home page for the web browser; the seventh (the smallest of them) made Windows Live the default. This is the page that opens every time the web browser is launched and provides a portal to the website owner’s other services and advertising.
- The three OEMs that made Google the default web search service also installed the Google Desktop, which includes desktop search capabilities.
- Across the OEMs, more than 70 percent of the desktop icons did not correspond to Windows features or other Microsoft products or services. The OEMs promoted non-Microsoft software and services in various other ways as well. All of the OEMs added icons to the new Windows Welcome Center, with Sony and HP adding the largest numbers. Three of the OEMs installed Google “gadgets” (small applications) for use with the new Sidebar option on the Windows Desktop.
- None of the OEMs chose to remove end-user access to any of the Microsoft middleware products defined in the Final Judgments. Many, however, reassigned file associations from Microsoft middleware products or other components of Windows to third-party products.

Communications Protocols and Web-Based Computing

The Final Judgments adopted the protocol licensing provision to ensure that other vendors of server operating systems could use Microsoft’s proprietary client-server communications protocols to communicate natively with Windows PCs and provide them with various services via software running on their servers. The goal was to help ensure that “client/server” computing—in which most of the computing would take place on servers, not PCs—could become a stronger competitor to Windows as a software platform for applications.

A total of 41 parties have licensed the protocols for use in a variety of different products, including file servers, media servers, and various types of network security devices. However, the greatest challenge to Windows has come not from traditional client-server models that use proprietary or operating system-specific protocols, but from web-based applications in which the server(s) running the application communicates with the client computer using HTML and other industry-standard Internet protocols. Most of these web-based applications do virtually all of the computing on servers. Most use standard HTML to provide a user interface. As a result, users of these applications rarely are aware of the operating system on which the server runs and have no reason to care. These applications usually work with multiple web browsers, running on various PC operating systems, or even on non-PC clients such as smart phones.

Web-based applications include new applications that do not have PC predecessors, such as web search engines (e.g., Ask.com) and social networking websites (e.g., MySpace.com). They also include web-based counterparts to traditional PC applications such as email, word processing, spreadsheets, and tax preparation programs. Google is one of the leaders in offering web-based applications including word processors and spreadsheets. Generally Google gives these applications away for free but expects to earn a financial return through advertising on them. Today, Google dominates on-line advertising.

Many web-based applications also serve as specialized platforms, exposing APIs that allow developers to write new applications that rely on the services made available through the APIs. Generally these APIs are accessed using industry-standard protocols developed for these purposes by various organizations the members of which include leading companies in the computer industry such as IBM, Microsoft, and Sun. As a result, access to Windows and other client operating systems does not require using a particular server operating system, and the various components of a distributed application can run on servers that use different types of operating systems running on different types of hardware. Moreover, the components can be written in different programming languages and operate in different run-time environments, yet still exchange information and interoperate smoothly. Indeed, to use APIs based on Web Services standards, the developer of an application need not know any of the details of how the application was written or the operating system on which it is running.

The Web and these industry-standard protocols function as a kind of meta-platform; so long as the computer running an application is connected to the Web, the application can obtain services exposed through APIs on the Web. Many companies also use these industry-standard web-focused protocols for internal distributed applications that combine information and processing from multiple applications. These applications may include older ones run on a single mainframe, designed originally to have at most very limited communication with other applications. The increasing use of web based applications has increased competition for Windows as a development platform.

I. Introduction

This study assesses the extent to which the marketplace reflects the goals of the Final Judgments in *U.S. v. Microsoft*¹ and *New York et al. v. Microsoft* in two key areas.² First, the Final Judgments ensured the right of computer manufacturers (called OEM or Original Equipment Manufacturers in the trade) to preinstall and promote competing software and services. We document how large OEMs are preinstalling and promoting numerous third-party software and services on new PCs with Windows installed. This distribution channel, which the Court of Appeals characterized as one of the two most important for products referred to in the Final Judgments as “middleware”, such as Netscape Navigator and Sun’s Java Virtual Machine,³ is readily available to and heavily used by competitors of Microsoft.

Second, the Final Judgments required Microsoft to license the protocols it uses for “native” communication between Windows PC operating systems (running on the “client” computers that people use) and Windows server operating systems (used on the “server” computers in networks that provide services to client computers and to each other). The stated purpose of Section III.E was to ensure that client-server interoperability issues would not hinder the emergence of platform alternatives to Windows at the server level—running on non-Microsoft as well as Windows server operating systems. We document how the rise of web-based computing appears to be accomplishing this goal, although perhaps not exactly in the way that was anticipated in 2001 when Section III.E was negotiated. Most of the applications running on the Web require only a standards-compliant web browser to provide the user interface. Many of those applications also expose APIs that other web applications can use to obtain services. Web-based applications are competing with Windows as a PC platform in at least three ways: (1) some web-based applications are direct substitutes for conventional PC applications; (2) other web-based applications are new uses that compete with conventional Windows applications for users’ time; and (3) they attract developers of new applications who might otherwise have written the application only for Windows. Each of these mechanisms reduces the “applications barrier to entry” the Court found protected Windows from competition from other PC operating systems.

II. The OEM-Focused Remedies: Preinstallation and Promotion of Third-Party Software and Services

The Final Judgment guaranteed OEMs the right to install third-party products, to configure them to operate by default in lieu of corresponding Windows functionality, to promote them in various ways, and to remove direct end-user access to corresponding Windows functionality. This section explores the extent to which OEMs have exercised these rights. To do so, we reviewed information available on the OEMs' websites and purchased a sample of PCs for detailed examination.

We found that major OEMs install considerable third-party software, most of which competes with components of Windows or other products and services offered by Microsoft. Moreover, these third-party products often receive prominent placement on the Windows desktop or other locations, and in many cases they, rather than the corresponding Windows feature or other Microsoft products/services, are made the default handlers of various file types or tasks.

We also found that none of the PCs we reviewed removed end-user access to the parts of Windows referred to as "middleware" in the Final Judgments.⁴ OEMs apparently want to provide consumers a choice between third-party alternatives and the corresponding functionality included in Windows, rather than only the third-party alternative.

A. Study methods

1. Selection of OEMs

We considered PCs that are sold to homes and small businesses, which are the most attractive PCs for both OEMs and third-party vendors on which to preinstall and promote software products and computer or Internet-related services.⁵ Larger organizations, such as businesses, governments and educational institutions, usually standardize on applications they select. Most set up the desktop and other elements of the PCs they purchase in prescribed ways before new computers are distributed to employees. Third-party vendors therefore realize little value from persuading OEMs to preinstall their software on PCs sold to larger organizations,

and the OEMs have limited or negative incentives to install extra software that these larger organizations most likely will erase or ignore.⁶

We also focused our study on major OEMs, which account for the preponderance of PCs targeted to home and small office customers. We chose the seven OEMs, listed in Table 1, that each accounted for at least 1 percent of overall U.S. sales in the home and small office segments according to IDC data for 2006.⁷ In total, these seven OEMs accounted for 77 percent of all U.S. sales of PCs to home and small office customers in 2006. Other OEMs are quite small: the next ten largest OEMs accounted for a total of only 2 percent of sales of PCs to home and small office customers in 2006, and the OEMs who collectively provide the last 20 percent of PC sales number in the thousands.⁸

Table 1. OEMs Selected for Study

OEM	2006 SOHO Sales in U.S.	
	Millions	Share (%)
HP	7.70	26.7%
Dell	7.44	25.8%
Gateway	3.70	12.8%
Toshiba	2.02	7.0%
Sony	0.61	2.1%
Acer	0.38	1.3%
Lenovo	<u>0.31</u>	<u>1.1%</u>
Total	28.85	76.9%

Note: Shares are of all home and small office unit sales. Excludes PCs made by Apple and “PC servers”
Source: IDC PC Tracker Database, accessed on April 26, 2007.

2. Selection and Purchase of PCs

LECG researchers working under our supervision inspected the OEMs’ websites and purchased the PCs during May 2007. Where possible, we purchased directly from the manufacturer via the Web.⁹ For each OEM, we purchased the least expensive home or small office model that was readily available, subject to the system including certain features: (1) Windows Vista Home Premium;¹⁰ (2) a minimum of 1 GB of memory, and (3) a combination read-write CD and read DVD drive (standard on even basic models from most vendors).¹¹ Five of the systems were desktops. We bought laptops for Toshiba (which sells only laptops in the United States) and Sony (which does not sell ordinary desktops in the United States¹²).

For some of the PCs purchased over the Internet, the OEM offered various options for third-party software. In no case did we choose software titles that were extra-cost options. In some cases, the OEM offered options for free third-party software or services. For example, Dell offered free trials for Internet access with EarthLink or AOL, a choice between McAfee and Norton anti-virus products, and the choice not to have certain free software installed. In such cases, we used the OEM’s default choices.

Table 2. PCs Purchased in May 2007

Summary of PCs Purchased				
Brand	Model	Form Factor	Place of Purchase	Price
Acer	Aspire E380	Desktop	pcconnection.com	\$681.45
Dell	Dimension C521	Desktop	dell.com	\$502.95
Gateway	GT 5428	Desktop	Best Buy store, Cambridge, MA	\$587.99
HP	Pavilion a6000y	Desktop	shopping.hp.com	\$399.99
Lenovo	ThinkCentre A60 Tower	Desktop	shop.lenovo.com	\$405.00
Sony	FE PCG-7V2L	Laptop	Sony Style store, Boston, MA	\$1,312.49
Toshiba	Satellite A200-ST2041	Laptop	ToshibaDirect.com	\$791.20

Note: Desktop prices do not include monitors.
Source: Invoices from sellers of PCs.

3. Examination of Purchased PCs

Under our control and direction, LECG researchers examined each purchased PC and used a consistent set of procedures to determine the relevant information. All of the information reported below was obtained before the PCs were connected to the Internet to ensure that the software found by the researchers was preinstalled rather than automatically downloaded from the Internet. The researchers took screen shots to document the software and installations on the machine as well as other pertinent details. They recorded any promotions made during the first boot-up of the computer (i.e., the first time it was turned on), the “gadgets” (small programs) running in the new Windows Sidebar, and the icons displayed on the Windows Desktop, on the Start Menu, and in the Welcome Center. They also identified what other third-party applications were installed, which file types were associated with each application (e.g., which media application was set as the default to play audio files saved in the very popular MP3 format) and the default settings for various options (e.g., the default home page and search service for the Search Box in Internet Explorer).

B. Results

1. Applications installed

As summarized in Table 3, each of the PCs came with between 19 and 58 applications preinstalled that are not provided to OEMs with Windows. Of the total of 255 applications (an average of 35 per PC), 241 were from vendors other than Microsoft and 14 were from Microsoft, of which 9 were Microsoft Works or trial versions of Microsoft Office.¹³

Two Adobe products—Acrobat Reader (used to view files in the ubiquitous PDF format) and Flash Player—were found on every PC. The PDF format competes with the new XPS functionality in Windows. Microsoft has never shipped Acrobat Reader with Windows, but many OEMs have preinstalled it since at least 2002.¹⁴ The Flash Player shipped with Windows XP, but is not included with Windows Vista. Nonetheless, all seven OEMs chose to preinstall it on their systems running Windows Vista. This player can be used to play animations created using Adobe’s Flash developer tools. In addition, since the release of version 6 in 2002,¹⁵ Flash has become widely used as a streaming media player that competes with Windows Media Player. It is available in versions that run on various PC operating systems, including Windows, Apple’s OS X, Linux, and Sun’s Solaris.¹⁶ A “lite” version of Flash is also widely used on handheld devices.¹⁷ Sites using Flash to stream media include all of the leading sites that allow users to upload and share their own videos—most prominently YouTube, Google Video and Dailymotion.¹⁸ Other well-known websites that use Flash for video include ABC News, AOL Music, Disney, ESPN, ITV, Le Monde, Movies.com, MTV, NASCAR, Sky Sports, and Warner Brothers.¹⁹

Table 3. Summary of non-Windows Applications Preinstalled

Application	Acer	Dell	Gateway	HP	Lenovo	Sony	Toshiba	Total
Adobe Acrobat Reader	1	1	1	1	1	1	1	7
Gadgets		5	5		1		15	26
Games		11	11	27			11	60
Images	1	2	1		1	3		8
Multimedia								
Adobe Flash Player	1	1	1	1	1	1	1	7
Other Media Players		1	1	2		3	2	9
Media Creation/Editing	3	1	1	2		3	2	12
Other Media Software	3			1		5	2	11
Productivity Applications								
<i>Microsoft Office (Trial)</i>			1	1	1	1	1	5
<i>Microsoft Works</i>		1	1	1		1		4
Security	1	1	2	1	1	1	2	9
Utilities								
OEM-branded	7	5	1	6	11	14	14	58
Other	1	3	3	2	4	2	1	16
Web & Search								
Google Desktop		1	1				1	3
Internet Tools		2					2	4
Java Runtime Environment		1	1		1	1	1	5
Toolbars								
AOL Toolbar						1		1
Google Toolbar		1	1				1	3
<i>Windows Live Toolbar</i>					1			1
Yahoo! Toolbar	1			1				2
Other Applications			2			1	1	4
Total Applications	19	37	34	46	23	38	58	255

Note: The italicized applications are published by Microsoft, but not included as part of Windows: (1) Microsoft Office, (2) Microsoft Works, (3) Microsoft Money (“Other Applications” on Gateway and Toshiba), (4) Microsoft Digital Image (“Images” on Gateway), (5) Windows Live Toolbar (“Toolbars” on Lenovo) and (6) Windows Media Encoder 9 Series (on Toshiba). All other software was published by a vendor other than Microsoft.

Source: Examination of PCs listed in Table 2.

In addition to Flash, five of the PCs included one or more additional media players. Two (Dell and Toshiba) had the Yahoo! Music Jukebox (formerly Musicmatch Jukebox). The HP system included both RealPlayer and the Rhapsody player for RealNetworks’ download music service. None of the PCs had the popular Apple iTunes player. We suspect that Apple did not find it worth paying fees to or sharing revenues with OEMs of Windows PCs because iTunes is easily downloaded, and it is required to use Apple’s market-leading iPod, which accounts for 72 percent of sales of portable digital media players,²⁰ and the iTunes Music store, which leads with 85 percent of music sold on the Web for download.²¹ For a time, Apple had an agreement with HP to sell HP-branded iPods, and during that time HP preinstalled the

iTunes Player on its PCs and promoted the iTunes Music Store.²² Despite having little distribution with Windows PCs (iTunes is distributed with Macintosh computers), use of the iTunes player has grown dramatically, from 2 percent of U.S. media-player users in January 2004 to 34 percent of them in June 2007.²³

In addition to media playback software, four of the seven PCs included third-party software to edit or create multimedia files or to capture digital images from external devices. Four also included digital image editing/organizing software: two (Dell and Sony) included Corel products, one (Lenovo) included Google's Picasa, and one (Gateway) included a trial version of Microsoft's Digital Image product.

Every OEM included at least one web- or browser-related application and installed a browser toolbar. Six of the seven toolbars were from non-Microsoft vendors: three from Google, two from Yahoo, and one from AOL. One OEM, Lenovo (the smallest of the seven), included the Windows Live Toolbar. Such toolbars make it easier to use the provider's search service and may also allow a user to preview email, bookmark pages, enable/disable pop-ups, get news updates, or check spelling. The three PCs with the Google Toolbar also included Google's Desktop software, which includes desktop search and Google's sidebar and gadgets, described below.²⁴

Five of the PCs (all but Acer and HP) included Sun's Java Virtual Machine and class libraries.

All of the PCs included at least one third-party anti-virus/Internet security product. Four had a Symantec/Norton product while three had the McAfee service center installed.²⁵ None had Microsoft's Windows Live OneCare service installed. The security vendors make money when PC purchasers choose to pay to extend their subscriptions for virus updates. Security vendors compete for preinstallation on new PCs, in part by including trial subscriptions to their update services, which makes the PCs more attractive to OEMs' customers, and in part, we believe, by payments of various kinds to OEMs.²⁶

Four of the PCs (Dell, Gateway, HP, and Toshiba) included an OEM-branded "game console" developed by WildTangent that contains trial versions of games from WildTangent, Sony, Atari/Funkitron, and three other vendors.

Last, all of the PCs included miscellaneous utilities. Three (Lenovo, Sony and Toshiba) included 10 or more such utilities, each of which generally performs some narrow function, such as assisting with network connectivity problems, managing passwords and security settings, or notifying the user of product-related updates (e.g. critical issues and updates for drivers, BIOS, and software on the computer).

Our analysis of the purchased PCs indicates that large OEMs were preinstalling numerous applications and services on their new home and small office PCs as of May 2007. OEMs include these “free” offerings for two primary reasons.

Some of these offerings are simply intended to increase demand for the OEMs’ machines. That is clearly the case for OEM-branded utilities—such as HP Update, which periodically checks for updates of software on the machine, and Toshiba Speech System Applications, which include software for speech recognition and for text-speech conversion. It is also true for third-party offerings that many consumers want, such as Adobe Reader, which consumers need to read PDF files, which have become widely used for distributing electronic documents.

In addition to the increased value associated with some products, which increases demand for the OEM’s PCs, it is widely believed that vendors often compensate OEMs through various fees, which may be upfront or contingent on such measures as the number of additional subscribers recruited for anti-virus updates.²⁷ Third-party vendors, such as Yahoo with its Music Jukebox media player, have various incentives to pay to have their “free” software installed and promoted on new PCs. In some cases, third-party software vendors pay OEMs to include trial (e.g., Intuit QuickBooks) or basic (e.g., Corel Snapfire) versions of software that the vendor hopes will yield additional sales of regular versions of the product at positive prices. In other cases, the third-party software vendor encourages the OEM to include the client-side components of a larger platform that generates profits on sales of software development tools or server-side software; that is the case for Adobe Reader and Flash Player, which are always available to end users for free to help generate sales of content creation and software development tools.²⁸ In still other cases, third-party vendors encourage OEMs to include software that will generate additional users of web-based services that profit from advertising

sales; that is particularly the case with toolbars associated with the various search services, such as those from Google and Yahoo.

2. Promotion of preinstalled software and services

We also examined the ways in which OEMs promoted non-Microsoft products and services in various locations, including the Windows Desktop.

a. Windows Desktop

Table 4 reports our findings concerning the placement of desktop icons. On average, OEMs put slightly more than 10 icons on their desktops (a total of 72 icons for the seven PCs). Gateway had the fewest icons (5) while Toshiba had the most (18).

Table 4. Icons on the Desktops of New PCs

Category	Acer	Dell	Gateway	HP	Lenovo	Sony	Toshiba	Total
OEM (Utilities, Help, Accessories, etc.)	2	1		3	2	2	6	16
Third Party, Software	3	2	1	3	1	2	5	17
Third Party, Internet Service Offers		2	1	4	2	1	1	11
Third Party, Links to Websites			1	2		3	2	8
Microsoft			1	2	1	2	3	9
Windows	1	3	1	3	1	1	1	11
Total	6	8	5	17	7	11	18	72

Source: Examination of PCs listed in Table 2.

More than 70 percent of the icons on the desktops were for non-Microsoft products or services. Icons for preinstalled third-party software (e.g., security/antivirus software and media players) accounted for about 24 percent, followed closely at 22 percent by OEM-branded utilities and services (e.g., help and support, registration, and links to offers for additional accessories or extending warranties). About 15 percent of the icons were for Internet-related services, including AOL-related icons on five of the desktops, icons for Internet access through Earthlink on two desktops, and two icons for offers from multiple Internet access providers. Finally, a little over 11 percent of the icons were links to other types of websites, such as AOL Instant Messenger service, AOL pictures and video sites, CNN Pipeline (a streaming video news site), and eBay’s auction site.

Of the total of 72 icons on the seven desktops, only 11 were “Windows” icons: all 7 desktops had the Recycle icon and two (Dell and HP) also had icons for Internet Explorer and Windows Media Center. Five of the desktops had a total of nine icons for Microsoft products

that are not part of Windows, including five for trial editions of Office and two for its online component, Office Live.

b. Sidebar “Gadgets”

Windows Vista includes a new optional feature, the “Sidebar,” that occupies a vertical slice at the far right of the screen. The Sidebar is used to display “gadgets,” which are small applications that provide ongoing updates on screen (e.g., the time or breaking headlines downloaded from the Web). Microsoft supplies 11 standard gadgets with Windows Vista, but third parties offer their own as well. These gadgets often retrieve updated information from the Web (e.g., weather conditions) at regular intervals.

Table 5 summarizes which gadgets the OEMs had installed on each PC and which they had running by default. Two of the PCs came with Microsoft’s Sidebar turned off. One (Toshiba) instead displayed Google’s Sidebar-equivalent, populated with six running Google gadgets. Two other PCs had several Google gadgets preinstalled (as part of the Google Desktop), but did not display them; one of those (Gateway) also had the Windows Sidebar turned off, but the other (Dell) had the Windows Sidebar displayed with Microsoft gadgets running. The other four PCs each displayed the Sidebar with three Windows gadgets running. The Lenovo system also used the Sidebar to display a Lenovo gadget.

Table 5. Gadgets Installed and Running on the PCs

	Acer	Dell	Gateway	HP	Lenovo	Sony	Toshiba	Total
Windows								
Running	3	3		3	3	3		15
Installed only	8	8	11	8	8	8	11	62
Google								
Running							6	6
Installed only		5	5				9	19
Lenovo								
Running					1			1

Source: Examination of PCs listed in Table 2.

c. Welcome Center

Vista also comes with a “Welcome Center” that by default (it can be turned off) opens each time the system is turned on. The display has two sections. The first is for icons determined by Microsoft; all of the systems had the same 13 icons and all but the Lenovo

system had another for Windows Media Center.²⁹ The second section is controlled by the OEM.

Table 6 summarizes the icons placed in that second section for each PC from the seven OEMs. On average there were about seven non-Microsoft icons (50 icons for seven PCs). Many of the icons were the same as those on the desktop, but Sony included a folder that held icons for a dozen third-party services and applications, including trials for half a dozen online games at sonypictures.com and links to third-party offers in games, other services, and software.

Table 6. Summary of Icons Added to the Welcome Center

Type of Icon	Acer	Dell	Gateway	HP	Lenovo	Sony	Toshiba	Total
OEM (Utilities, Help, Accessories, etc.)	1	2	2	5		4	3	17
Third Party, Software	1	3	3			4	1	12
Third Party, Internet Service Offers			1	2		1	1	5
Third Party, Links to Websites				1		13	2	16
Microsoft		1				2	1	4
Windows				2				2
Total	2	6	6	10	0	24	8	56

Note: This tabulation is for Section (2) of the Welcome Center. The first section of all Welcome Centers—the Windows section—contained the same 14 Windows icons on all PCs except Lenovo, which did not have a Windows Media Center icon because it came with Windows Vista Home Basic, which does not include that feature.

Source: Examination of PCs listed in Table 2.

3. Default File Associations

When Microsoft supplies Windows Vista to OEMs, the operating system is set up so that it will perform a particular function if it is capable of doing so. For example, if a user clicks on an Internet link, the operating system will connect to the Internet and display the web page. At a technical level, this means that Windows is configured to launch software to handle a particular file type if it is capable of doing so. For example, Windows Media Player is set as the default for various types of media files, including Windows Media Audio (WMA), Windows Media Video (WMV), and the common MP3 audio format. The OEM (or later the user) can change these associations, and when applications are installed they often register to be the default handler of various file types, including some previously assigned to a component of Windows.

Table 7 provides examples of the changes made by OEMs for the multimedia file extensions that Windows Vista by default assigns to Windows Media Player.³⁰ Three of the

seven OEMs reassigned several multimedia file extensions to Yahoo! Music Jukebox or to Rhapsody. In all three cases, the file types reassigned included Microsoft's WMA format and the popular MP3 format. On these PCs, if a user opens a WMA or MP3 music file, Windows will automatically launch competing software, rather than Windows Media Player, to play the song.

Table 7. Examples of File Types Reassigned from Windows Media Player to Third-Party Media Players

File extension(s)	Type	Reassigned to	PCs
.aif, .aifc, .aiff	audio	Yahoo! Music Jukebox	Dell , Toshiba
.au, .snd	audio	Yahoo! Music Jukebox	Dell , Toshiba
.cda	audio CDs	Rhapsody	HP
.m3u	playlists	Yahoo! Music Jukebox	Dell , Toshiba
		Rhapsody	HP
.mid, .midi	audio (electronic music)	Yahoo! Music Jukebox	Dell , Toshiba
.mp3	audio	Yahoo! Music Jukebox	Dell , Toshiba
		Rhapsody	HP
.mpa	audio	RealPlayer	HP
.wav	audio	Yahoo! Music Jukebox	Dell , Toshiba
		Rhapsody	HP
.wma	audio (Windows Media)	Yahoo! Music Jukebox	Dell , Toshiba
		Rhapsody	HP

Source: Examination of PCs listed in Table 2.

Table 8 shows similar results for digital image file types. Two OEMs reassigned several widely used digital image file types from Windows Photo Gallery to one of the Corel products they had preinstalled on their machines.

Table 8. Examples of File Types Reassigned from Windows Photo Gallery to Third-Party Photo Applications

File extension(s)	Type	Reassigned to	PCs
.bmp	Windows bit map	Corel Paint Shop Pro Photo	Dell, Sony
.jpg	images (photos)	Corel Snapfire	Dell, Sony
.png	graphics and photos on Web	Corel Paint Shop Pro Photo	Dell, Sony
.tiff	digital images	Corel Paint Shop Pro Photo	Dell, Sony

Source: Examination of PCs listed in Table 2.

4. Other Browser-Related Defaults and Settings

Many consumers access the Internet and related applications using the Internet Explorer component of Windows. By default in Windows Vista, the home page (the first page visited

when the web browser opens) is Windows Live. Similarly, when users type a query into the search box in Internet Explorer, the default search service used in Windows Vista is Windows Live. Microsoft has specified in its agreements with OEMs, however, that they are free to control these and other settings for the web browser and OEMs have exercised that control as shown in Table 9. The first section of the table shows that on six of the seven PCs, OEMs changed the default home page to a non-Microsoft web portal. Google, AOL, and Yahoo were each selected by two OEMs.³¹ Only one of the OEMs—the smallest, Lenovo—selected Windows Live as the home page for the web browser.

Table 9. Browser Defaults and Settings

Browser Defaults and Settings								
	Acer	Dell	Gateway	HP	Lenovo	Sony	Toshiba	Total
Home Page								
OEM	■ ²	■ ²			■ ²			3
AOL				■ ³		■ ³		2
Google		■	■ ³					2
Windows Live					■			1
Yahoo!	■						■ ³	2
Search Default								
AOL						■		1
Google		■	■				■	3
Windows Live					■			1
Yahoo!	■			■				2
Favorites Added¹								
OEM's website		4		12	7	10	4	37
Microsoft						2	1	3
Other - Games			1			7	1	9
Other - Music/Video			1			3		4
Other - Software						2		2
Other				1		2	1	4

¹ All PCs also came with the following Microsoft Favorites: Microsoft Websites folder (6 links), MSN Websites folder (6 links), and Windows Live folder (4 links).

² Website is home for second tab.

³ Redirected from OEM web page.

Source: Examination of PCs listed in Table 2.

Windows Live fared no better in the OEMs' selections for default search service; as with home pages, only Lenovo chose the Windows Live search service. Three chose Google, two chose Yahoo, and one chose AOL (which actually uses Google's search engine and advertising platform). Each PC also had the corresponding browser toolbar installed.

OEMs added a total of 59 entries under “Favorites,” on top of the 16 standard ones included by Microsoft.³² Most (63 percent) of these links are to pages on the OEMs’ own websites. Dell added four favorites, all on Dell’s website. At the other end of the spectrum, Sony added 26 links, 16 of which were third-party websites, including games, online services, software, and music/video content.

C. Conclusions Regarding OEM Preinstallation and Promotion of Third-Party Software and Services

The Final Judgments guarantee OEMs the right to install and promote non-Microsoft software and services and prohibit Microsoft from retaliating against OEMs who exercise those rights. Our study shows that major OEMs routinely exercise those rights. They preinstall and promote non-Microsoft software products, including media players, photo editing and organizing software, and antivirus software. Microsoft’s largest online competitors—Google, Yahoo, and AOL—all secure ready distribution of their software and services with OEMs, including the very largest. In most cases the software and services for these competitors are much more readily available to purchasers of new PCs than the competing software and services marketed under Microsoft’s Windows Live or MSN brands.

OEMs also widely promote third-party products and services in various locations on PCs running Windows Vista, including the Windows Desktop and the Welcome Center. OEMs have not chosen to remove access to Internet Explorer and other Windows components referred to in the Final Judgments as middleware. But OEMs have widely promoted non-Microsoft software and services and have made non-Microsoft software the defaults for various file types and non-Microsoft services the default for services such as search. Notably, only the smallest of the seven OEMs (Lenovo, which accounts for barely more than 1 percent of U.S. sales of home and small office PCs) chose Windows Live as the default home page and search service for Internet Explorer. The other six all chose various combinations of Google, Yahoo, and AOL, with Google predominating. For example, Google was the search default on three of the PCs (Dell, Gateway, and Toshiba), the manufacturers of which sold a total of roughly 40 times as many home and small office PCs in the U.S. as Lenovo did in 2006. The OEMs of the two PCs (HP and Acer) on which Yahoo was the default search service accounted for about 25 times as many sales as Lenovo.³³ Competitors and potential competitors of Microsoft that find it

valuable to have their software and services preinstalled and promoted on new PCs running Windows have no difficulty doing so.

III. Growth of Server/Web-Based Computing

The Court found that although “server/network computing ... does not function precisely as ‘middleware’ has throughout this proceeding, the platform threat it poses to Microsoft’s dominance in the monopoly market is both real and similar to the threats posed by Navigator and the Java technologies.”³⁴ The Court noted that “inasmuch as a server operating system serves as a platform for applications running ‘for’ the PC, in a manner similar to true middleware, the server operating system can be said to ‘compete’ with Microsoft’s PC operating system software.”³⁵ The purpose of the mandatory licensing of Windows client-server communications protocols was to:

advance the ability of non-Microsoft server operating systems to interoperate, or communicate, with the ubiquitous Windows PC client. Advancement of the communication between non-Microsoft server operating systems and Windows clients will further the ability of these non-Microsoft server operating systems to provide a platform which competes with Windows itself.³⁶

Section III.E of the Final Judgments requires that Microsoft license all communications protocols used for “native” communication between Windows clients and Windows servers, and that it do so on reasonable and non-discriminatory (RAND) terms. As of June 2007, a total of 41 parties had licensed the specifications for Microsoft’s communications protocols or some subset of them.³⁷ Licensees are using these specifications to create various types of server products, including file servers, security-related products, and digital media streaming software.

This section looks beyond the specifics of the protocol licensing program to see the extent to which “server/client computing” is emerging as a competitor to Windows as a platform for developing applications. We find that the Web, where most of the computing takes place on servers, is becoming an increasingly important platform that competes with Windows (and other PC operating systems) for the attention of both users and developers, thus successfully competing with PC operating systems as software development platforms, and thereby reducing the “applications barrier to entry.”³⁸

Web-based applications challenge the Windows platform in several ways. Some web-based applications are direct substitutes for conventional applications (such as word processors or email programs), the vast majority of which run on Windows. Web-based applications make it possible to obtain similar functionality using a non-Windows PC, thus weakening the applications barrier to entry. Other web-based applications are not direct substitutes for conventional applications, but account for increasingly large fractions of the time users spend using their PCs. Web-based applications like photo sharing or online encyclopedias thus compete with conventional Windows applications for users choosing a PC operating system. Many other web-based applications expose APIs that other applications can call upon, thus making it easier for developers to create new web-based applications and competing with Windows for developers' attention.

Web use has risen greatly since 2001, when the settlement was negotiated. ComScore estimates indicate that Americans spent almost three times as many hours online in January 2007 as in February 2001.³⁹ ComScore estimates that about 179 million Americans used the Web in June 2007, which translates to about 5.7 billion hours.⁴⁰

The remainder of this section consists of three subsections. We begin by examining how the Web has become more standards based, rather than less so, and how in that environment, proprietary protocols have become less important over time. We then present examples of various types of web-based applications—some of which are substitutes for PC applications and others of which are new uses for PCs that compete with conventional applications for users' time. The final section explores ways in which many web-based applications strengthen the Web as a platform by exposing APIs that attract developers to write additional web-based applications.

A. Overview of Standards-Based Computing on the Internet and Other Networks

Fears that the Web would become more proprietary as Internet Explorer became the most widely used web browser have proved misplaced, despite the fact that Internet Explorer attained very high levels of use over the past half-dozen years. Most sources put its share around 95 percent from 2002 to 2004.⁴¹ Its share has declined since then with the entry of the open-source FireFox web browser, although the share of Internet Explorer remains large.⁴²

Internet explorer will face further competition with the release of a Windows version of Apple's Safari web browser.⁴³ In any event, the very high usage rates for Internet Explorer over the past five or six years have not led to a Web dominated by proprietary technologies from Microsoft. Instead, the Web operates primarily using industry-standard protocols, including a large and growing number of protocols that facilitate communications among applications running on different servers and client computers connected by the Internet.

Many different organizations—including the Worldwide Web Consortium (W3C), the Web Services Interoperability organization (WS-I), the Internet Engineering Task Force (IETF), the Organization for the Advancement of Structured Information Standards (OASIS), and ECMA International—have been responsible for the wide array of standards that apply to different parts of the Web and associated technologies. Major software and hardware vendors—including Hewlett-Packard, IBM, Intel, Microsoft, Oracle, SAP, and Sun—are leading members of these groups, but they also include many smaller companies, and, in some cases, end-user organizations and universities.

There has been an important consequence of standardization of communications over the Web: software developers can write software that runs on a server with any operating system they choose and that software can use web-based standards to communicate with Windows PCs, or any other client device with a web browser compliant with key industry standards. Software developers can also use industry standards that allow their application to obtain services from – or provide services to – applications running on other servers without regard to the operating systems used by those other servers.

The number and variety of web-based applications has grown sharply along with the expansion of the Internet itself and the development of new standards and programming techniques. Users can access most web-based applications using any standards-compliant web browser, not just Internet Explorer, and can do so from PCs (and in some cases other devices, such as smart phones, most of which run non-Microsoft operating systems) that do not run Windows. As a recent Gartner report puts it:

Web technologies have evolved substantially during the past decade. Web sites no longer consist of static Web pages or even streaming media. Now, a Web site can contain a mixture of content and applications of varying levels of

sophistication and personalization, and the Web browser is simply a generic client, usable for a wide variety of different applications.⁴⁴

Developers of web-based applications have near-complete freedom to choose the server platform for which they develop based on relative costs, the availability of development tools, and other factors, without having to worry that their choice of server operating system will limit the client operating systems with which their web-based applications can interoperate. The user generally does not know or care whether the server is using Windows, Linux, some flavor of Unix (such as Sun's Solaris or IBM's AIX), or Apple's OS X as its operating system. If the web-based application employs a user interface that runs within a web browser window and is based on industry standards, such as HTML, the client computer can run any operating system that supports a standards-compliant web browser. Moreover, different parts of the application can run on different servers that have different operating systems, with those various parts communicating with one another using industry-standard protocols.

Many distributed applications, particularly older ones, run only within closed networks and rely on largely platform-specific methods for communication among different modules of the distributed application. Windows applications generally used COM (including its variants, such as DCOM), Unix applications mostly used CORBA, and Java applications used Remote Method Invocation (RMI) and JavaBeans. Interoperability through various software "bridges" was possible, but the simplest approach was to have the various modules of a distributed application all running on the same platform.

Web Services standards have broken down these obstacles. They make it possible for distributed applications to be built from components written in different programming languages and running on servers using different hardware and operating systems to work together to deliver services to other applications and to end users. The eXtensible Markup Language (XML) provides the foundation for machine-to-machine communication in much the same way that HTML (Hypertext Markup Language) provides the foundation for machine-to-human interface communication on the Web. SOAP (originally Simple Object Access Protocol) provides the basic protocol for exchanging XML messages. The Web Services Description Language (WSDL) is another important standard that provides a model for describing, in a manner that other software can understand, the specific services provided by a particular software module and how applications running on other computers (client or server) can obtain

those services. In addition, various groups are developing industry-specific XML-based markup languages. For example, OASIS has technical committees for standardizing metrics for raw manufacturing materials, developing schemas for collaborative planning and scheduling in manufacturing, and defining a common XML library of business documents (purchase orders, invoices, etc.); the nonprofit ACORD develops standards for the insurance, reinsurance and related financial services industries; Health Level Seven produces standards for healthcare; and the U.S. Department of Justice sponsors a standard for use within the justice and public safety communities.⁴⁵

Microsoft's .NET platform uses Web Services protocols as its "native" method of communication among software modules running on different computers. But those same protocols can be used to communicate with a Java module, because Java now also implements Web Services standards, or with any other platform or application that supports Web Services standards and protocols. For example, an October 2005 article in *IT Architect* stated: "The platform independence of Web Services means developers can develop in .NET, tap into data in a J2EE platform, and use a wealth of third-party management and deployment tools."⁴⁶ That same article predicted that "Web services will eventually be the norm in business application development." A month later, *CIO* published an article ".Net, Web Services, and the End of the Vendor Era," which stated:

If your native tongue is .Net or J2EE, C# or Java, WebLogic or WebSphere, Windows or Linux, or anything else, all countries are starting to communicate using the lingua franca of XML and associated specs like UDDI, WSDL and SOAP.⁴⁷

For these kinds of distributed applications, proprietary protocols are not used for communication whether the applications are running on Windows, another platform, or a mix of different platforms.

B. Examples of Web-Based Applications

An increasingly broad array of applications are running on the Web. Some of these applications are effectively new types of applications that did not exist before as standalone applications. They include online search, video sharing, and social networking. Others have become more popular than their corresponding standalone PC applications, such as

encyclopedias and other electronic reference books and consumer mapping applications. Still others compete with standalone PC applications such as word processors and spreadsheets or with conventional client-server applications that use vendor-specific protocols, such as email and calendaring

At some level, all websites are “web-based applications” in the sense that they involve software running on servers providing services to PCs and other client computers. Here we focus on types of applications that (1) are actual or potential substitutes for conventional PC applications or client-server applications that rely on platform-specific client software, (2) are new uses that compete for the time users spend on their PCs, or (3) provide not only a human user interface, but also expose their services through APIs that other applications can call over the Web, thus providing a platform for applications similar to operating systems or middleware. These categories are not mutually exclusive. In many cases, applications that fit in the first or second category also fall into the third by exposing APIs. Many web applications are a mix of the first and second categories because some of their functions substitute for PC applications (e.g., editing functions on photo sites) and some are new ones made possible by the Web (e.g., the ability to share photos with others on the Web). The types of applications discussed below are illustrative, not exhaustive.

1. Web-based Productivity Applications

Web-based versions of word processors, spreadsheets, and other “productivity” applications have been around for some time, but they have attracted far more attention since Google launched Google Docs & Spreadsheets in 2006. These web-based applications provide basic word processing and spreadsheet functions and can be accessed using Firefox, Mozilla and Netscape browsers, as well as Internet Explorer.

Google also offers Docs & Spreadsheets as part of Google Apps, which includes email, calendaring, instant messaging, and an application for creating web pages. The basic version is free, supported by advertising. The Premium version costs \$50 per year; among other features, it includes better support, more online storage, and provides APIs that companies can use to better integrate the applications into their existing infrastructures.⁴⁸ When the company announced the release of Google Apps, an analyst at Forester Research characterized it as “direct shot at Microsoft Office,” which had fewer features but was much less expensive.⁴⁹

Broadening its suite, Google is creating a presentation program.⁵⁰ Google recently increased the threat to Microsoft Office by including Sun's StarOffice (which normally costs \$70) in its free downloadable "Google Pack" software bundle.⁵¹

Although web-based "office" applications are offered by several vendors, Google's applications have attracted the most notice in the press and, it appears, from potential users. In February 2007, Nielsen-NetRatings reported that during October-December 2006, Google's Docs & Spreadsheets had roughly 425,000-450,000 unique visitors per month.⁵² Other vendors, some of which have been in business for five or more years, include ThinkFree (word processor, spreadsheet, and presentation program) and Zoho (which includes the three basic applications plus several others). In addition, Writeboard offers a word processor and EditGrid and NumSum offer spreadsheets. All of these applications work with multiple browsers (FireFox and IE in all cases, plus Apple's Safari, Netscape, Mozilla, or Opera in some).⁵³

2. Email and Calendaring

Most people now access their personal email through a web browser interface, rather than a conventional application running on a PC.⁵⁴ Leading providers of web-based email include Yahoo, Microsoft and Google.⁵⁵ Those same three vendors (and others) also offer online calendars, which users can share with others to coordinate activities. The advantage of Web access is that users can manage their email or calendar from any computer that connects to the Web and has a basic web browser installed. This fact makes web access especially convenient for individuals who access their email or calendar from multiple locations, such as hotels and airports. These applications generally are supported by advertising and are free to users, although in some cases paid versions without advertising are available.⁵⁶

Most larger businesses continue to rely on conventional client-server email and calendaring solutions, which use platform-specific client software. Microsoft (Outlook-Exchange) and IBM (Lotus Notes-Domino) are the leading vendors. However, the mix is changing, and the flexibility of web access has led both vendors to offer such access to their communications servers, either as a supplementary method or as the only method of access.⁵⁷ Web access reduces the importance of the PC operating system, because the user interface is essentially the same regardless of the operating system and the computing associated with composing, editing, and organizing email is done on the server, not the PC. For example, even

if an employee uses Outlook on a Windows PC at work, there is no obstacle to accessing the same information on an Exchange Server via the Web using a Macintosh or Linux PC (or a Sony PlayStation or other device that supports web browsing) at home or while traveling.

IDC recently estimated that whereas only 13 percent of North American corporate email boxes were accessed primarily using web browsers in 2000, 35 percent will do so in 2007.⁵⁸ The share accessed primarily using proprietary protocols (mostly those associated with Microsoft Outlook-Exchange and IBM/Lotus Notes-Domino) fell from 72% to 47%, while the share accessed by conventional client software using standard protocols (POP and IMAP) rose slightly, from 15 to 18 percent. IDC predicts that web access to corporate email will pass proprietary access by 2010.⁵⁹ Overall, combining corporate and personal email boxes, IDC estimates that web access already accounts for the majority of North American email boxes, having reached 50 percent by 2004.⁶⁰

One of the less attractive aspects of web-based interfaces for such applications as email has been that the user interface may be relatively slow to update when new information arrives. New programming techniques, however, make it easier to create web-based interfaces that rival desktop applications in their speed and smoothness of operation, without the need for running separate client applications on the PC (such as Java applets or Active-X controls in Windows). An IDC paper reports that “Google’s calendar is able to mimic applications that run from user PCs. Making use of Ajax programming gives Gmail and Google Calendar the look and feel of desktop applications.”⁶¹

At a June 2007 panel discussion of Microsoft and IBM’s offerings in communication and collaboration software, the director of Microsoft’s Office business platform group characterized Google as “a great competitor in this space.” IBM’s representative on the panel noted that Google is a “key partner” of IBM’s, but stated that “I also fully expect them to become a competitor to us in the business space.”⁶² On July 9, 2007, Google announced that it would pay \$625 million to acquire Postini, which offers software technology to enforce companies’ communications policies.⁶³

3. Instant Messaging

Instant messaging has long been a popular method of communication over the Internet. Many of the providers of the most popular instant messengers have created web-based versions

of their products. America Online released a fully web-based version of its popular desktop instant messaging software, AOL Quick Buddy, in January 2000.⁶⁴ In 2004, MSN launched a web-based version of its MSN Messenger.⁶⁵ Some web-based instant messaging applications are integrated into web-based email programs, which enables users to use their email address book as an instant messaging contact list. Gmail Chat has been offered within Gmail since February 2006.⁶⁶ Yahoo began to offer web-based instant messaging as part of its Yahoo Mail in February 2007.⁶⁷ These programs run in a variety of web browsers. Aim Express, MSN Web Messenger, Yahoo Messenger for the Web, and Gmail Chat all advertise compatibility with three or more web browsers.⁶⁸

4. Mapping

Mapping is also a common web-based application, one that has become much more popular than its Windows-based counterparts. Several vendors—including Google, MapQuest, Microsoft, and Yahoo—provide services that allow users to see maps of virtually any area in the United States (and some other countries) and to obtain directions on how to get from one location to another. Most of these applications expose APIs that allow other sites to refer users to them to obtain directions to, for example, the first site's (physical) location.⁶⁹ Such services generally support themselves through advertising, although they also offer services to corporate customers at positive prices.⁷⁰

Google Earth and Microsoft Virtual Earth both offer more sophisticated mapping features that include satellite photographs and other images. In both cases the basic versions are free, supported by advertising, but more advanced services require payment.⁷¹ Google Earth requires installation of client software, which is available for Windows, Apple's OS X, and Linux. On the client side, Microsoft's Virtual Earth is accessible from Internet Explorer or Firefox browsers, running on either Windows or OS X. Microsoft provides a software development kit (SDK) for developers interested in making use of the services provided by Microsoft Virtual Earth from within other applications. Such applications can use standard Web Services protocols (including SOAP) and run on any platform that supports those protocols. The map control user interface runs in a web browser window and can be accessed using Ajax programming techniques. Applications that use these APIs must be licensed at the server level and on a user or transaction basis. Google does not offer a specific SDK for its

Google Earth program, but it does offer an application and documentation of its format so that developers can enhance images from Google Earth in their own applications or display their own data in the Google Earth application.⁷²

5. Banking and Finance

Many banks now offer customers web-based access to their account information and the ability to transfer funds among accounts (e.g., from checking to a credit card account) and to pay bills from third parties. These services can work with traditional PC personal finance applications (such as Intuit's Quicken or Microsoft Money),⁷³ but typically also provide a web-based interface that can be used without PC applications.⁷⁴

Mutual funds and securities brokers also offer online access and services for customers and sometimes the public. Such web-based applications generally work through a web browser interface that is independent of the underlying operating system. Fidelity, for example, provides a Contribution Calculator which charts the potential values of a retirement plan account for each contribution rate the user enters.⁷⁵ Merrill Lynch provides a variety of tools that assist customers in managing their finances, including the ability to compare a portfolio to various investment allocation models. Salesforce.com, well-known for its web-based customer relations management (CRM) services for businesses, recently initiated a new "Wealth Management Edition" targeted at financial advisors. That service is decidedly not free, with monthly fees starting at \$500.⁷⁶

Businesses often use web-based applications to allow employees to view and change such items as health insurance elections and contributions to 401K retirement plans. Often businesses pay for a hosted service, rather than buying and maintaining their own software and hardware.⁷⁷ The applications can typically be used from any computer with a basic web browser.

Users of tax-preparation software can choose between conventional desktop applications and web-based applications, some of which are offered by the same vendors as the packaged desktop applications (such as Intuit Turbo Tax or H&R Block TaxCut) and some of which are offered only online (such as Rapidtax).⁷⁸ Some basic services are free, but others have costs comparable to standalone PC software.⁷⁹

6. Photo/Video editing/sharing

As more and more people use digital cameras and camcorders, there has been an increase in the amount of user-created digital content available on the Internet. Many websites allow users to edit and post their photos and videos online for viewing by others by invitation or, in some cases, by the general public. Photo websites like Snapfish, Kodak Easy Share Gallery, and Shutterfly allow users to edit their photos by cropping them to various sizes, removing red eye, changing coloration, and adding borders, providing many of the features available in standalone applications like Adobe's Photoshop Elements or Windows Photo Gallery.⁸⁰ Users then can put together slideshows to share over the Internet. A company called Picnik is currently offering a beta version of its photo editing software that uses Adobe's Flash Player in its web browser interface.⁸¹ A July 26, 2007 column in the *Wall Street Journal* cited Picnik as an example of the "dramatic improvement" in web-based applications, making newer ones "so fast, rich and smooth they can hardly be distinguished from standard programs."⁸²

Video websites like YouTube allow users to post their digital videos for streaming over the Internet. YouTube was started in April 2005, and by the end of 2006 it had over 100 million videos with users adding another 70,000 each day.⁸³ Google acquired YouTube in October 2006.⁸⁴ In June 2007, almost 58 million users visited YouTube.com.⁸⁵ YouTube also provides code so that users can easily embed links to their videos in other web pages. Beyond allowing makers of videos to post their movies and link to them, YouTube offers its APIs to developers to create applications and devices that make use of videos posted on YouTube.⁸⁶ For example, one company has created a device using the YouTube APIs that allows users to browse through YouTube videos on a television set using the television's remote control.⁸⁷

7. Online Searches and Advertising

Online searches are one of the most widely used types of web-based applications. Users enter their query into a search box on a web page or in a search box in a web browser (or elsewhere on their computer), and the results are returned in a web page. In between entry of the query and reporting of the results, intensive computing using complex algorithms takes place on the search service's network of servers. Google, for example, had an estimated 450,000 servers in its network worldwide as of May 2007, virtually all of them running

Linux.⁸⁸ The numbers of servers and the operating systems they run are not apparent to the end user.

Search engines provide a convenient interface for finding information and, in many cases, launching other web-based applications. For example, typing a company's stock-ticker symbol (e.g., "GOOG" for Google or "MSFT" for Microsoft) in one of the major search engines yields information on the company's stock price and links to sites with other financial information on the company. Typing "pizza" yields listings that include listings of local pizza parlors and links to applications on the sites of pizza chains that let the user order online or find the closest location.

Searches of the Web have grown dramatically, whether measured by number of searches or the amount of associated advertising revenues. ComScore estimates that by August 2006, individuals were performing over 18 billion searches per month worldwide, up from about 10 billion per month two years earlier, an increase of 76 percent. Just six months later, in February 2007, the monthly total was up another 20 percent, to 22 billion. In that same month, Google led with 66 percent of searches, followed by Yahoo with 20 percent and Microsoft with 8 percent. Google's share has risen significantly since ComScore started tracking searches in August 2004, when its share was 48 percent.⁸⁹

In the early days of search services, advertisements generally were not related to the user's query; they were ordinary "display" or "banner" advertisement that functioned in much the same way as television or magazine advertisements. Several search providers, including Google, started making the advertisements shown contingent on each specific query, with advertisers bidding on various search terms and ranked on the search results page(s) by their adjusted bids.⁹⁰ Advertisers on search sites pay based on the number of users who click through to the advertisers' websites, not simply on the number of users who view pages with the advertisements (the usual metric for offline advertisement and for display advertisements online). Revenues from advertising on search services was \$100 million in 1999, grew to \$2 billion by 2003,⁹¹ and is expected to reach \$7.8 billion in 2007.⁹² Advertising is the source of virtually all search-related revenues; for example, it accounted for 99 percent of Google's revenues each year from 2004 to 2006.⁹³ Many large web sites (and their applications) now

obtain significant referral fees from Google for including the Google search toolbar and driving traffic through Google's search engine.

8. Social Networking

Social networking sites like MySpace, Facebook, and Friendster have become important platforms for Internet users, especially younger people, to communicate with each other. These sites allow a user to create a profile that can be viewed by other members of the social network. Members can post contact information, photos, and videos on their profile pages. Members of these sites can become "friends" with other users, causing links to those friends to be added to the user's profile page. Users send each other messages via internal email systems, posts on message boards, or instant message systems. Users also can create groups that members join so they can discuss similar interests.

Friendster has 45 million users worldwide, and MySpace has 183 million registered users.⁹⁴ Facebook has amassed 27 million members since its founding in 2004.⁹⁵ In May 2007, Facebook made its APIs available so that developers can create applications to run on its platform.⁹⁶ A Reuter's story called the release of these APIs part of Facebook's plan to "become a kind of software operating system for Internet media."⁹⁷ Facebook initially signed up 65 partners, including Microsoft, Amazon.com, and Photobucket. Developers have already created applications for accessing user profiles from mobile devices, adding music to a profile, and rating movies.⁹⁸

9. Consumer Transactions Platforms

Online retail sales have grown dramatically in recent years, topping \$100 billion in 2006 after at least six years of annual growth of 20 percent or more.⁹⁹ The two best-known sites are eBay.com and Amazon.com. In 2006, eBay handled \$52.2 billion in merchandise and Amazon reported total sales of \$10.7 billion.¹⁰⁰ eBay reported at the end of 2006 that it had 222 million registered users, of whom 89 million were active.¹⁰¹ On a single day in December 2005, eBay attracted 12.4 million visitors and Amazon attracted 6.1 million.¹⁰² eBay does not sell products to consumers directly, but rather provides a platform that sellers can use to list their items (for auction or sale at a fixed price) and that buyers can use to locate and bid on or purchase items. In contrast, Amazon primarily sells goods directly to consumers. However, it

also provides a platform for third parties to sell their products using Amazon's technology; such third-party sales accounted for 28 percent of total sales on Amazon in 2006.¹⁰³

Both companies rely on complex software systems that run on servers and that are accessed over the Web by buyers, sellers, and other interested parties. eBay's software reportedly has over 6 million lines of code written using Java 2 Enterprise Edition.¹⁰⁴ In addition to providing human interfaces (e.g., shopping carts for users or forms for offering products for auction), both companies expose APIs that allow developers to write applications that rely on services provided by the sites' platforms. eBay provides a "Solutions Directory" of applications designed to work with its platform. As of early August 2007, it included over 290 different third-party software solutions that are listed in 23 categories.¹⁰⁵ Amazon listed more than 150 third-party solutions that relied on its APIs in 10 categories.¹⁰⁶

C. The Web and Web Applications as Platforms

As noted above, some web-based applications expose APIs so that other applications (web-based or conventional client or server) can make use of their services. In some cases, vendors have released broader sets of APIs and tools that allow developers to create new applications that interact with the vendors' web-based services. Salesforce.com, for example, recently announced the availability of its Apex platform for "customizing and integrating CRM, as well as developing and deploying brand-new applications."¹⁰⁷ Other vendors of web-based applications and services also offer platform services through APIs and attempt to woo developers. For example:

1. eBay.com started its developers' program in 2000.¹⁰⁸ It provides development kits and other services for developers, including a "sandbox" in which developers can test applications. In 2006, 2,300 registered applications made 40 billion calls to eBay's APIs. One-third of eBay's listings come from these third-party applications.¹⁰⁹ eBay offers various "Dev Centers" that provide assistance (and in many cases software developer kits) for developers using different platforms or languages (including Java, .NET, Flash, and various web scripting languages) for their applications that call eBay's APIs.¹¹⁰
2. Amazon.com provides Web Services to developers in 10 categories.¹¹¹ Like eBay, it provides information to developers on how to use those APIs in applications written using various platforms and languages. At the end of 2006, Amazon reportedly had 200,000 active users of those services.¹¹²

3. Yahoo offers APIs so that developers can write applications that interact with various web-based applications, such as Yahoo Mail, Yahoo Maps, Yahoo Search, and Yahoo Messenger.¹¹³ Its Advertiser Web Services application offers APIs that advertisers and others can use to write software to manage their advertising campaigns on Yahoo.¹¹⁴
4. Google started publishing APIs in 2002, and they now are available for a wide range of Google services/Web applications, including Maps, Search, Desktop, AdWords, Calendar, and Checkout.¹¹⁵ Google's first developer day, held in 10 locations in May 2007, attracted about 5,000 participants.¹¹⁶
5. Microsoft offers APIs for its Windows Live services, such as Live Search, Live ID, Live Maps, Live Alerts and Live Messenger (also Windows Live Contacts, Virtual Earth Map, MapPoint, Live Data, adCenter, Custom Domains, Live Expo, Live Spaces, Live Toolbar, and Live Writer). Most of the 16 sets of APIs listed also have a software development kit available.¹¹⁷ The use of these APIs is not limited to applications running on Windows operating systems, nor do they require the use of Microsoft proprietary protocols.

In a survey conducted in 2006, Evans Data Corporation asked developers who were engaged in Web Services development whether they were integrating their services with any of 14 listed online sites. Roughly 30 percent checked at least one site, and on average respondents in that group checked more than two sites. The six most popular sites were Google (73 percent of respondents checking at least one site), Yahoo (26 percent), PayPal (24 percent, owned by eBay), eBay (22 percent), Amazon (18 percent), and MSN (18 percent).¹¹⁸

The growing importance of Web Services is suggested by the fact that in a 2005 survey of developers and IT managers, primarily in corporations developing applications for their own use (which is where most developers work and where most expenditures on development take place), Computerworld found that 58 percent reported using Web Services in their projects and another 15 percent were doing pilot projects, while 12 percent said they were actively interested.¹¹⁹ Asked about their companies' "preferred development frameworks or APIs," 51 percent said .NET (which uses Web Service standards as its native protocols), compared to 42 percent that listed the traditional Microsoft framework of the Win32 APIs and COM/DCOM (multiple answers were allowed). J2EE (Java 2 Enterprise Edition) and Unix/Linux also were each listed by 42 percent. Respondents were also asked, between .NET and Java, which one their companies use "mostly": 37 percent said Java, 26 percent said .NET, and 25 percent reported using both, including 1 percent each that were moving back to one after trying the other. The final 12 percent gave an "other" response.

One can think of web-based platforms as a kind of “middleware” that provide various kinds of services for applications. The Web itself, with its industry standards, then provides a more general or “meta” platform on which the “middleware” and applications run. In some ways, the Web is thus akin to a general purpose operating system that sits on top of server and client computers running a mix of operating systems, in much the same way that an operating system runs on top of different types of hardware, serving as an intermediary between applications and the hardware. And just as operating systems provide ways for applications to communicate with one another and to obtain services from the operating system and “middleware”, the Web and associated standards provide a conceptually similar infrastructure. The Web makes it much easier for developers to use multiple specialized platforms because they do not have to worry about whether the code supporting the APIs they use will be present on a user’s computer when needed. This distinguishes web-based applications from conventional desktop applications, which usually are dependent on the underlying operating system.

IV. Concluding Remarks

The goal of the Final Judgments of ensuring that Microsoft’s competitors have unfettered access to distribution and promotion of their software products and services via new PCs has been achieved. Major PC OEMs ship computers with many different software applications and links to Web Services installed and promoted. The seven PCs we purchased distributed many products and services that compete with features in Windows or other Microsoft products. Leading OEMs also promoted third-party software and services with icons in various prominent locations, including the Windows Desktop and the Welcome Center. Although none chose to disable end user access to the corresponding Windows features defined as “middleware” in the Final Judgments, some OEMs reassigned file types from Windows components to third-party alternatives, and all but one OEM (the smallest of the six) set Google or another non-Microsoft service as the default search provider.

The objective of Section III.E is also being achieved. Under the MCPP, companies that wish to use Microsoft’s communications protocols to facilitate interoperability between non-Microsoft server software and Windows can license them at reasonable royalties (in some cases

free), and 35 have done so.¹²⁰ More broadly, the notion that servers could serve as a platform for running software that would compete with Windows has come to pass as well, although, as detailed above, the industry (including Microsoft) largely chose industry-standard protocols over Microsoft's proprietary client/server protocols. The Web provides an increasingly sophisticated platform to support web-based applications that are generally indifferent to the operating systems running on the client computer. The new platform provided by the Web also allows applications to be distributed across servers running different operating systems and types of hardware. Like conventional operating system platforms, many websites like Google and Yahoo expose APIs through which applications can obtain platform services.

Endnotes

¹ *United States of America vs. Microsoft Corporation*, Civil Action No. 98-1232 (CKK).

² *State of New York et al v. Microsoft Corporation*, Civil Action No. 98-1233 (CKK).

³ "...having an OEM pre-install a browser on a computer is one of the two most cost-effective methods by far of distributing browsing software." United States Court of Appeals for the District of Columbia, Opinion, *United States v. Microsoft Corp.*, June 28, 2001, at p.29.

⁴ We understand that Microsoft is not aware of any OEM that has chosen to disable access.

⁵ Small office and home users are referred to as the SOHO segment.

⁶ The IT departments of large organizations often erase all files on the hard disk of newly purchased computers and then install a standard "image" that includes the software on which they have standardized, sometimes including a particular "build" of the operating system. Sometimes, IT departments do not erase the hard disk completely, but install whatever software the organization has selected for its employees and establish standardized settings.

⁷ We relied on IDC's PC Tracker database, which does not report the operating systems installed. We excluded PC shipments from Apple, but had no way of excluding the relatively small number of PCs that come with Linux or other non-Windows operating systems installed.

⁸ Third-party vendors of software are unlikely to it cost-effective to negotiate arrangements to install their software with OEMs that have relatively small sales.

⁹ We purchased the Sony from the Sony store in Boston. We originally ordered the Gateway model directly, but when the delivery times proved too slow to meet our deadlines, we purchased one from the Best Buy store in Cambridge Massachusetts. Because Acer does not sell directly to consumers, we ordered it from a major online retailer listed as one of Acer's "distribution partners." We checked to make sure that the machines purchased were current and not discontinued models.

¹⁰ The Lenovo system was ordered with the Home Basic edition of Vista because none of its models came with the Home Premium Edition of Vista as the standard operating system, and the researcher failed to find the option that allowed an upgrade to the Premium Edition. On one of Lenovo's two lines of "home office" desktop computers, the default operating system was still Windows XP in early May 2007. Lenovo, the smallest of the OEMs evaluated, does not offer the usual home-style computers that emphasize such activities as editing and organizing photos, playing audio and video content (including TV in many cases), or playing games. Instead, its non-business PCs are all listed under "Home Office."

¹¹ The Sony drive could also write DVDs.

¹² Sony offers "All-in-One" PC-TV combinations (starting at \$1700) and a "digital living system" that combines a computer and entertainment center, at prices starting at \$3300. See "VAIO® Desktops", <http://www.sonymstyle.com/webapp/wcs/stores/servlet/CategoryDisplay?catalogId=10551&storeId=10151&langId=->

[1&categoryId=16155&SR=nav:electronics:computers:desktop_computers:shop_compare:ss&ref=http%3A//www.sony.com/index.php](http://www.sonymstyle.com/webapp/wcs/stores/servlet/CategoryDisplay?catalogId=10551&storeId=10151&langId=-1&categoryId=16155&SR=nav:electronics:computers:desktop_computers:shop_compare:ss&ref=http%3A//www.sony.com/index.php), (downloaded August 17, 2007).

¹³ OEMs license Microsoft Works separately from Windows for a positive fee. The trial versions of Microsoft Office are distributed separately from Windows; our understanding is that Microsoft, like other software vendors offering trial versions on new PCs, compensates the OEMs that preinstall the software.

¹⁴ "Declaration of Kevin M. Murphy in Support of Microsoft's Opposition to Sun Microsystems, Inc.'s Motion for Preliminary Injunction," *Sun Microsystems, Inc. v. Microsoft Corporation*, Case No. C02-01150 RMW (PVT), July 3, 2002, ¶ 70-74.

¹⁵ "Macromedia, Inc. Ships Macromedia Flash MX", Reuters, March 15, 2002.

¹⁶ All except Solaris are supported by version 9. Solaris is supported by version 7. Adobe, "Adobe Flash Player: System Requirements," <http://www.adobe.com/products/flashplayer/productinfo/systemreq/> (downloaded June 22, 2007).; Adobe, "Adobe Flash Player 7: System Requirements,"

<http://www.adobe.com/products/flashplayer/productinfo/systemreq/flashplayer7/> (downloaded June 22, 2007).

¹⁷ Adobe Press Release, "Flash Enabled Mobile Devices Pass 200 Million," February 12, 2007, <http://www.adobe.com/aboutadobe/pressroom/pressreleases/pdfs/200702/0212073GSM.pdf> (downloaded June 22, 2007).

¹⁸ See daliymotion.com, video.google.com, and youtube.com, all accessed in May 2007.

¹⁹ See abcnews.go.com, music.aol.com, disney.go.com, espn.go.com, itv-boxing.com, lemonde.fr, movies.go.com, mtv.com, nascar.com, home.skysports.com, and noreservationsmovie.warnerbros.com, all accessed in May 2007.

²⁰ This is the iPod's share of both flash based and hard drive based players. Apple's share of players with hard drives is 89 percent. David Ho, "Digital Music Rivals Try To Emerge From Apple's Shadow," Cox News Service, March 11, 2007; Robert Andrews, "Apple Earnings 2: Annual iTunes Store Revenue Grows 35 Percent By Q2," Paidcontent.org, April 25, 2007, <http://www.paidcontent.org/entry/419-earnings-apple-annual-itunes-store-revenue-grows-35-percent-by-q2/> (download May 29, 2007).

²¹ Id.

²² Ina Fried, "HP to stop selling Apple's iPod," CNET, July 29, 2005, http://news.com.com/HP+to+stop+selling+Apples+iPod/2100-1047_3-5810643.html (downloaded June 5, 2007).

²³ Nielsen/Netratings Netview Combined Audience January 2004 and June 2007. The unique users of iTunes and Apple's other media player, QuickTime, comprised a combined 41 percent of media player users in June 2007.

²⁴ Google, "Google Desktop Features," <http://desktop.google.com/features.html> (downloaded June 4, 2007). It also includes a Google toolbar for Microsoft Outlook to make it easier to use Google to conduct searches from within Outlook.

²⁵ The Dell machine had McAfee installed (the default), but customers could select Symantec/Norton at no extra cost at the time of order.

²⁶ Larry Seltzer, "The Google Crapplet," eWEEK, May 25, 2007; Ryan Naraine "McAfee Scores Gateway Anti-Virus Bundling Deal," eWEEK, October 26, 2005.

²⁷ Kim Peterson, "Computer makers cut down on desktop clutter," The Seattle Times, November 19, 2006. This article also discusses some of the reasons that pre-installation of software and promotion of software and services are not costless for OEMs.

²⁸ The content creation half of the Adobe Reader is Adobe's full Acrobat program (Adobe, "Adobe Acrobat 8 Professional," <http://www.adobe.com/products/acrobatpro/>, downloaded June 5, 2007) and related products. The content creation half of the Flash Player is Flash CS3 (Adobe, "Flash CS3 Professional," <http://www.adobe.com/products/flash/>, downloaded June 5, 2007), and related products. Use of Flash Player also stimulates sales of the Adobe Flash Media Server 2 (Adobe, "Flash Media Server 2," <http://www.adobe.com/products/flashmediaserver/> (downloaded June 5, 2007))

²⁹ The Lenovo system did not have this icon because it had Vista Home Basic Edition installed, which does not have the Windows Media Center feature.

³⁰ These examples do not include the numerous cases where a file type is not normally assigned to Microsoft Middleware, but is assigned to third-party software only when it is installed. Examples include the various proprietary audio and video formats from RealNetworks.

³¹ In some of these cases, as indicated in the notes to the table, the link on the PC was to an OEM Web page that automatically redirected the browser to a third-party Web site (e.g., Google). Compared to a direct link to the third-party Web site, this approach has the advantages that the OEM can change the indirect link without having to change the software images it installs on new PCs, saving costs, and changes also affect PCs sold earlier, enabling OEMs to offer a larger audience if it strikes a new deal with a different third party. This approach may also facilitate compensation schemes based on the number of users who visit a site via links on the OEM's PCs.

³² Of these 16 links, 6 are for Microsoft.com (IE toolbars from various vendors, product features, tips, etc.), 6 are for MSN.COM (various pages, such as sports and entertainment), and 4 are for Windows Live services.

³³ IDC, PC Tracker Database, accessed on April 26, 2007.

³⁴ *State of New York et al v. Microsoft Corporation*, Civil Action No. 98-1233 (CKK), Memorandum Opinion, Colleen Kollar-Kotelly, November 1, 2002, pp. 76-77.

³⁵ *State of New York et al v. Microsoft Corporation*, Civil Action No. 98-1233 (CKK), Memorandum Opinion, Colleen Kollar-Kotelly, November 1, 2002, p. 148.

³⁶ *State of New York et al v. Microsoft Corporation*, Civil Action No. 98-1233 (CKK), Memorandum Opinion, Colleen Kollar-Kotelly, November 1, 2002, p. 70.

³⁷ “Joint Status Report on Microsoft’s Compliance with the Final Judgments,” *United States of America vs. Microsoft Corporation*, Civil Action No. 98-1232 (CKK), June 19, 2007, <http://www.microsoft.com/presspass/download/legal/SettlementProceedings/06-26-07StatusReport.pdf> (downloaded June 22, 2007).

³⁸ United States Court of Appeals for the District of Columbia, Opinion, *United States v. Microsoft Corp.*, June 28, 2001, at p.20.

³⁹ ComScore estimated that Americans spent 97.7 billion minutes, or 1.6 billion hours, online in February 2001 (ComScore, “Jupiter Media Metrix Announces U.S. Top 50 Web And Digital Media Properties For February 2001,” March 13, 2001, <http://www.comscore.com/press/release.asp?press=239>, downloaded July 27, 2007). For January 2007, ComScore estimated 153 million users and an average of 31.6 hours per month (ComScore, “Worldwide Internet Audience has Grown 10 Percent in Last Year, According to comScore Networks,” March 6, 2007, <http://www.comscore.com/press/release.asp?press=1242>, downloaded July 27, 2007), for a total of 4.8 billion hours.

⁴⁰ For June 2007, ComScore estimated 178.8 million users, but its press release does not include hours of use (ComScore, “comScore Media Metrix Releases Top 50 Web Rankings for June,” July 16, 2007, <http://www.comscore.com/press/release.asp?press=1528>, downloaded July 27, 2007). Applying the 31.6 hour average from January 2007 yields the estimate in the text.

⁴¹ WebsideStory had IE with a market share of over 90% worldwide from January 2002 to February 2005. WebsideStory found that in the US alone IE’s market share was above 90% from June 2002 to February 2005. WebsideStory Data, last updated August 2005.

⁴² Although WebsideStory still placed IE’s market share above 80 percent in December 2006, Net Applications recently found that IE’s share had dropped below 80%. “Opera Software Releases New Browser,” Associated Press Newswires, December 18, 2006; Gregg Keizer, “IE7 Interest: Flat,” *Computerworld*, May 7, 2007, <http://www.pcworld.com/article/id,131600-c.internetexplorer/article.html> (downloaded June 2, 2007).

⁴³ “So what we’ve got is the most innovative browser in the world. But we’ve also got the fastest browser on Windows,” Apple CEO Steve Jobs said about the Windows version of Safari. *Macworld*, “Macworld: News: WWDC Live Keynote Coverage,” <http://www.macworld.com/news/2007/06/11/livekeynote/index.php> (downloaded June 22, 2007).

⁴⁴ Gartner, “Market Overview: Web Hosting, Application Hosting and Utility Computing,” February 10, 2006.

⁴⁵ OASIS, “OASIS Committees by Category,” http://www.oasis-open.org/committees/tc_cat.php?cat=schain (downloaded June 25, 2007); ACORD, “Who We Are,” <http://www.acord.org/about/whoarewe.aspx> (downloaded June 25, 2007); Health Level Seven, “About Health Level Seven,” <http://www.hl7.org/about/> (downloaded June 25, 2007); U.S. DoJ Office of Justice Programs, “Global Justice XML Data Model,” <http://www.it.ojp.gov/jxdm/> (downloaded June 25, 2007).

⁴⁶ David Greenfield, “The Adolescent Web Services,” *IT Architect*, October 1, 2005. All of the specifications listed in the quote are part of “Web Services” standards.

⁴⁷ Scott Berinato, “.Net, Web Services, and the End of the Vendor Era,” *CIO*, November 1, 2005. J2EE stands for Java 2 Enterprise Edition, C# is the variant of the C language in Microsoft’s .NET system, and Web Logic and Web Sphere are Java application servers from BEA and IBM, respectively.

⁴⁸ “Google Introduces New Business Version of Popular Hosted Applications,” *Google*, February 22, 2007 http://www.google.com/intl/en/press/pressrel/google_apps.html (downloaded June 22, 2007).

⁴⁹ Jon Brodtkin, “Microsoft, IBM feel heat from Google Apps,” *Network World*, June 20, 2007, <http://www.networkworld.com/news/2007/062007-microsoft-ibm-google-apps.html> (downloaded June 21, 2007).

⁵⁰ Elinor Mills, “Google treads on PowerPoint turf,” *CNET*, April 20, 2007, http://news.com.com/2100-1032_3-6176889.html (downloaded July 17, 2007).

⁵¹ Thomas Claburn, “Google Pack Picks Up Free Office Suite”, *InformationWeek*, August 13, 2007, available at <http://www.informationweek.com/shared/printableArticleSrc.jhtml?articleID=201500216> (downloaded August 17, 2007).

⁵² Nielsen/NetRatings Press Release, “Google Docs and Spreadsheets Dominate Web-based Productivity Tools Since October,” February 20, 2007, http://www.nielsen-netratings.com/pr/pr_070220.pdf (downloaded June 4, 2007).

⁵³ Google Docs & Spreadsheets, “Which browsers are supported?,” <http://docs.google.com/support/bin/answer.py?answer=37560&topic=8613> (downloaded May 4, 2007);

ThinkFree, "Getting Started," <http://www.thinkfree.com/support/supportcenter.tfo?method=getListbyCategory> (downloaded May 4, 2007); Zoho, "Zoho Writer Frequently Asked Questions," <http://writer.zoho.com/public/help/zohowriterfaq/fullpage> (downloaded May 21, 2007); (Although there are no separate FAQs specifically for Zoho Sheet, and Zoho Show inspection of these programs shows they work in both IE and Firefox). Edit Grid, "Supported Browsers," <http://www.editgrid.com/book/print?id=41348> (downloaded May 21, 2007); Writeboard, "Write, Share, Revise, Compare," <http://www.writeboard.com/> (downloaded May 21, 2007); NumSum, "The Num Sum FAQ" <http://numsum.com/help/faq> (downloaded May 21, 2007).

⁵⁴ IDC estimates that in 2007, 68 percent of non-corporate email boxes were accessed primarily via web browsers. (IDC #206038, "Worldwide Email Usage 2007–2011 Forecast: Resurgence of Spam Takes Its Toll," March 2007) calculated using differences between estimates for all email boxes (Table 7) and corporate email boxes (Table 8).

⁵⁵ In some cases, including Windows Live, the services also offer downloadable software that users can use to compose or read email offline.

⁵⁶ Google, "Welcome to Google Calendar," <http://www.google.com/intl/en/googlecalendar/overview.html> (downloaded June 22, 2007). Google offers a version of its Calendar programming without advertising as part of its Google Apps Premium suite. Google, "Google Introduces New Business Version of Popular Hosted Applications," February 22, 2007, http://www.google.com/intl/en/press/pressrel/google_apps.html (downloaded June 22, 2007). Microsoft, "MSN Calendar Fact Sheet," July 2002, <http://www.microsoft.com/presspass/newsroom/msn/factsheet/calendar.msp> (downloaded June 22, 2007). Yahoo, "How Much Does it Cost?," <http://help.yahoo.com/help/in/cal/cal-04.html> (downloaded June 22, 2007).

⁵⁷ Microsoft's client access licenses for Exchange include Web access, but not a license for the Outlook PC client, which must be licensed separately (most often as part of Microsoft Office). IBM offers licenses for its Domino server in different editions that include just Web access, or (at higher cost) both Web access and Notes. *See* "Microsoft Exchange Server: Exchange Server 2007 Editions," <http://www.microsoft.com/exchange/evaluation/editions.msp> (downloaded June 4, 2007); "IBM Lotus Notes and Domino individual client license options," <http://www-142.ibm.com/software/sw-lotus/products/product4.nsf/wdocs/notesdominoclientlic> (downloaded June 4, 2007).

⁵⁸ IDC #206038, "Worldwide Email Usage 2007–2011 Forecast: Resurgence of Spam Takes Its Toll," March 2007, Table 8.

⁵⁹ *Id.*

⁶⁰ *Id.*, Table 7.

⁶¹ IDC #201650, Insight, "Google Calendar: A Step Toward an Online Collaboration Suite?," May 2006. Ajax, which stands for "Asynchronous JavaScript and XML," refers to a set of methods for developing interactive web applications. Its features include the ability to update information displayed in a browser window without having to refresh the whole screen, which makes updates faster and smoother when, for example, the user makes a change that results in new numerical results in a table.

⁶² Jon Brodtkin, "Microsoft, IBM feel heat from Google Apps," Network World, June 20, 2007 <http://www.networkworld.com/news/2007/062007-microsoft-ibm-google-apps.html> (downloaded June 26, 2007).

⁶³ Renee Ferguson, "Google's Postini Buy Threatens Microsoft," eWeek, July 9, 2007, <http://www.eweek.com/article2/0,1895,2156182,00.asp?kc=EWKPLEDP071007A> (downloaded July 10, 2007).

⁶⁴ Jim Hu, "AOL quietly relaunches flagship Web site," CNET, January 11, 2000, <http://news.com.com/2100-1023-235532.html> (downloaded June 26, 2007).

⁶⁵ Matt Hicks, "MSN Tests Web-Based IM Client," eWEEK, August 5, 2004.

⁶⁶ Elinor Mills, "Google merges Gmail with chat," CNET, February 6, 2007, http://news.com.com/Google+merges+Gmail+with+chat/2100-1032_3-6035898.html (downloaded June 26, 2007).

⁶⁷ Elinor Mills, "Yahoo Mail integrates IM," CNET, February 12, 2007, http://news.com.com/Yahoo+Mail+integrates+IM/2110-1032_3-6158571.html?tag=item (downloaded June 26, 2007).

⁶⁸ AOL, "AIM Express," <http://www.aim.com/aimexpress.adp> (downloaded June 26, 2007). MSN, "MSN Web Messenger," <http://webmessenger.msn.com/> (downloaded June 26, 2007). Yahoo, "Yahoo Messenger for the Web," <http://messenger.yahoo.com/webmessenger.php> (downloaded June 26, 2007). Google, "Does Google Mail support my browser," <http://mail.google.com/support/bin/answer.py?answer=6557&topic=1524> (downloaded June 26, 2007).

⁶⁹ “Get A Map On Your Site,” InformationWeek, July 4, 2005.

⁷⁰ MapQuest offers Mapquest Mobile, which will send interactive maps and directions to a user’s mobile phone for about four dollars per month. Mapquest, “MapQuest Mobile,” http://www.mapquest.com/features/main.adp?page=slashmobile_mobile (downloaded June 27, 2007).

⁷¹ The free version of Virtual Earth is accessible through ‘Windows Live Search Maps’. See <http://maps.live.com/> (accessed June 8, 2007); Microsoft, “How to Buy Virtual Earth Platform Services,” <http://www.microsoft.com/virtualearth/products/webservice/howtobuy.aspx> (downloaded June 8, 2007); Google, “Google Earth,” <http://earth.google.com/index.html> (downloaded June 8, 2007).

⁷² Elinor Mills, “Google Earth Zooms In,” CNET, June 12, 2006, http://news.com.com/Google+Earth+zooms+in/2100-1032_3-6082960.html (downloaded June 25, 2007); Google, “Google SketchUp,” <http://www.sketchup.com/> (downloaded June 25, 2007). Google, “Google Earth KML Tutorial,” http://code.google.com/apis/kml/documentation/kml_21tutorial.html (downloaded June 25, 2007).

⁷³ Intuit, “Quicken Basic 2007,” <http://quicken.intuit.com/personal-finance/basic-personal-budget.jhtml> (downloaded June 5, 2007); Microsoft, “Microsoft Money: Compare Prices & Products,” http://www.microsoft.com/money/ProductDetails.aspx?pid=004&active_tab=Compare (downloaded June 5, 2007).

⁷⁴ Bank of America, “Account Management Features: What You Can Do with Online Banking from Bank of America,” http://www.bankofamerica.com/onlinebanking/index.cfm?template=what_you_can_do (downloaded June 25, 2007); WaMu, “The Benefits of Online Banking,” <http://www.wamu.com/personal/onlinebanking/overview.asp> (downloaded June 25, 2007); Wachovia, “Wachovia Online Services,” <http://www.wachovia.com/personal/page/0,,10,00.html> (downloaded June 25, 2007); Wells Fargo, “Wells Fargo Online,” <https://www.wellsfargo.com/wfonline/> (downloaded June 25, 2007).

⁷⁵ Fidelity, “How to use the Contribution Calculator,” http://wps.fidelity.com/401k/tools/contribution_help.htm (downloaded June 5, 2007).

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