Under the Hood Investments for Hardware and Performance

Published: October 2010

Table of Contents

Abstract

This whitepaper highlights the broad range of hardware supported by Microsoft® Office 2010 and describes the significant improvements in performance available in Office 2010. Results from internal testing by Microsoft are included to demonstrate the measurable performance gains users can experience when performing common tasks using different Office 2010 applications. These results indicate that in some cases uses can expect performance gains of 90% or higher compared with using corresponding Office 2007 applications.

The Need for Pushing the Office Performance Envelope

Business and home users alike rely on Microsoft Office productivity applications more than ever before. Some examples of Office usage statistics include the following:

- As of June 2010 over 750 million people worldwide now use Microsoft Office.
- From July 2008 through June 2009 there were over 23 million trial downloads of Office 2007.
- Office 2007 Home and Student edition has been the top selling PC software title at US retail outlets for the past two years. [1]
- The Office 2010 Beta program was the largest Microsoft Beta program in history with over 9 million customer downloads prior to launch.

At the same time that market penetration has been increasing, organizations which deploy and use Office are facing many new challenges:

- Recessionary pressures are forcing many businesses to further delay their desktop computer refresh cycles.   This may hinder them from adopting the latest version of Office, since in the past each new version of Office has had roughly double the hardware requirements as the previous version.
- IT departments increasingly need to support a broad population of users who run Office running on different types of hardware.   This broad population includes mid-range desktop PCs, high-end workstations, laptops and even netbook computers.
- Financial organizations and engineering companies are increasingly working with larger and more complicated spreadsheets. Recalculation of these spreadsheets can sometimes be exceedingly slow, which can be frustrating to those working with them.

---

[1] See the Microsoft Office 2010 Engineering Blog at
http://blogs.technet.com/b/office2010/archive/2009/10/07/new-ways-to-try-and-buy-microsoft-office-2010.aspx

- Business professionals are creating larger and more complex Microsoft PowerPoint® presentations, and presenters and audiences alike are sometimes frustrated by delays and hangs while presenting. This is particularly true when rendering slides that have complex graphics and charts embedded in them. Presenters would also like to be able to embed large video files and add spectacular animations to maintain audience interest and communicate more effectively.
- Today's knowledge workers face steadily increasing volumes of information they must assimilate and manage. Workers who rely on Microsoft OneNote® for collecting, organizing and sharing information need greater flexibility and responsiveness from OneNote, so they can continue to cope with the rising tide of information.
- Businesses in today's competitive global marketplace feel pressured to execute faster and more efficiently. Business users who rely on Microsoft Outlook® as a key productivity application thus require greater responsiveness from Outlook so they can be more productive in the workplace.
- More and more businesses are utilizing cloud services as a back end for their messaging and collaboration infrastructure. Users who work remotely over network connections that are slow or unreliable can experience long delays when documents are opened from or saved to sites hosted in corporate datacenters.

Because of these and other challenges faced by organizations which deploy and use Office, Microsoft has responded by investing heavily in engineering efforts to improve the performance and hardware support in Office 2010. This whitepaper describes the broad range of hardware supported by Office 2010 and highlights some of the key performance improvements found in the platform.

Enabling a Broader Range of Hardware

One of the main design tenets of Office 2010 was to provide a quality end-user experience across a broad spectrum of hardware.   This hardware spectrum ranges from legacy 32-bit PCs, to popular small-format netbooks, to the latest high-end 64-bit multi-core systems. Numerous under-the-hood architectural improvements were implemented by the Office engineering team in order to achieve this goal, including the following:

- More robust thread pool management now enables more efficient use of multi-core systems. The result is that CPU usage is less likely to "peg" or max out than in previous versions of Office, while foreground tasks in Office such as dialog boxes that require a response from the user are less likely to appear to freeze or hang when other tasks are being performed in the background.
- A completely redesigned Microsoft Excel® calculation engine now allows even very large and complex spreadsheets to be recalculated much more quickly than with previous versions of Office.   Spreadsheet recalculation was a specific customer concern that the Office team targeted for improvement in Office 2010, and the internal test results shown later in this paper show the significant gains that have been achieved in this area.   In most cases, we see up to 90% improvements in recalculation times.
- Redesigned PowerPoint presentation capabilities can now leverage DirectX® capabilities and the power of graphics processors to enable 3D animations and transitions, embedded media, and other exciting slide show features. These capabilities are described in more detail later in this section.
- Various optimizations and changes now result in faster startup and shutdown of Office applications, especially Outlook 2010. A later section of this paper examines these Outlook performance improvements in detail, along with the customer pain points that Office 2010 has addressed.
- Numerous other targeted optimizations provide improved performance and an improved user experience across the hardware spectrum, even when Office 2010 applications are running on older versions of Microsoft Windows®.

The rest of this section examines in more detail the Office 2010 support for different hardware platforms and devices.

Supporting Legacy PCs

A major customer pain point has been the fact that minimum hardware requirements have essentially doubled with the release of each successive version of Office.   For example, Figure 1 shows the minimum CPU and RAM requirements for three earlier versions of the product:

- Office XP running on Windows 2000 Professional
- Office 2003 running on Windows XP Professional
- Office 2007 running on Windows XP Professional or later

	Office XP	Office 2003	Office 2007
Minimum RAM (MB)	64	128	256
Minimum CPU (MHz)	133	233	500
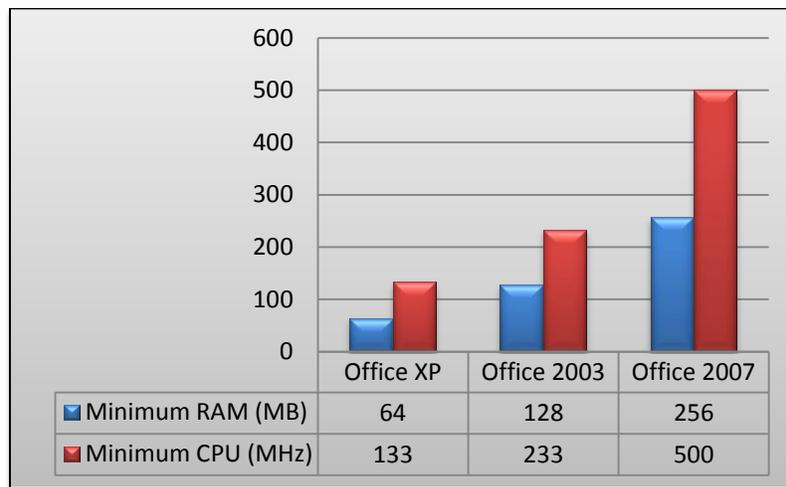
Figure 1: Minimum CPU and RAM requirements for earlier versions of Office.

As a result of these escalating system requirements, customers sometimes complained that they were unable to deploy the latest version of Office in their environment unless they committed a significant portion of their IT budget to upgrading their existing PCs, or purchasing brand-new PCs if upgrading their existing systems wasn't feasible. For businesses that don't have the budget or IT staff resources to upgrade or replace their PCs every few years, these escalating system requirements can become a major factor blocking them from deploying the latest version of Office.

To address these customer concerns, Office 2010 was specifically engineered so that its minimum CPU and RAM requirements are identical to those of the previous version Office 2007 (see Figure 2).[2]

	Office XP	Office 2003	Office 2007	Office 2010
Min. RAM (MB)	64	128	256	256
Min. CPU (MHz)	133	233	500	500
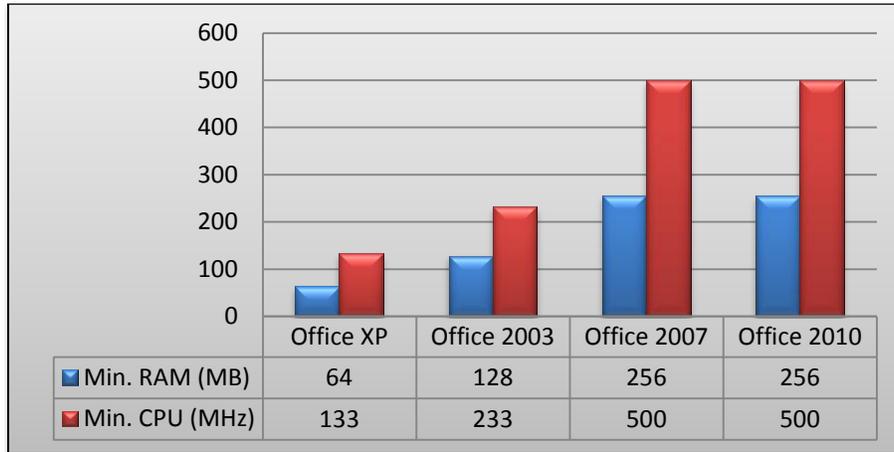
Figure 2: Minimum CPU and RAM requirements for Office 2010 are the same as for Office 2007.

The result of these engineering efforts means that upgrading to Office 2010 does not require new hardware if you're currently using Office 2007. Customers who upgrade from Office 2007 can thus quickly benefit from the many new productivity-enhancing features of Office 2010 without the need of having to purchase new PCs for their users.

Finally, while Office 2010 is designed to be usable on legacy PCs for performing basic tasks such as editing 20-page documents in Word or creating and formatting charts in Excel, users will naturally have an even better experience when using newer PCs with faster CPUs and additional RAM.

---

[2] See http://office.microsoft.com/products/microsoft-office-2010-system-requirements-HA101810407.aspx for full system requirement details.

Supporting Smaller Laptops & Netbooks

The market for low-cost, small form factor, mini-notebooks and "netbooks" has grown significantly over the last several years. With 36.3 million netbooks sold in 2009[3] and sales of small form factors expected to remain strong, it's clear that many end users still want portable devices that can do more than consume media or browse the Web—they want lightweight yet fully-functional computers that can run rich applications like Microsoft Office.

Office 2010 has been specially engineered to meet the needs of users of such low-cost, small form factor PCs. For example, the typical netbook has at least a 1 GHz processor and 1 GB of RAM. Such hardware is well above the minimum CPU and RAM requirements stated above, and internal testing confirms that most Office 2010 tasks will run between 60 to 80 percent faster on a typical mini-notebook computer than on a legacy PC that just meets the minimum hardware requirements for running Office 2010.

In the past, a key problem with running rich applications like Word or Excel on a small form factor PC was the small screen size, particularly the vertical display resolution. Most netbooks have a screen resolution of 1024 x 600, but the minimum display resolution for Office 2007 is 1024 x 768. As a result, the user experience of running Office 2007 on such devices can sometimes be frustrating, since some user interface elements won't fit on the screen.

To overcome this problem, many Office 2010 applications were redesigned to require a minimum vertical resolution of only 576 pixels. Combined with an easily collapsible Ribbon, the result is that all of the user interface elements of these applications can now be displayed in their entirety on the limited screen real estate of such computers. So while the minimum display resolution requirements of Office in the past have also increased steadily from version to version similar to how the CPU and RAM requirements have grown, this latest version of Office has been engineered to have *lower* minimum display requirements than Office 2007, as Table 1 below shows.

---

[3] Market figures published online by ABI Research at http://www.abiresearch.com/press/1656-2009+Netbook+Shipments+Pass+Expectations%2C+58+Million+Forecast+for+2010.

Table 1: Evolution of minimum display requirements for Microsoft Office versions.

Office Version	Minimum Display Resolution
Office XP	640 x 480
Office 2003	800 x 600
Office 2007	1024 x 786
Office 2010	1024 x 576 (Professional SKU)

Thus, the Office Professional 2010 suite of applications has been designed to meet the needs of the vast majority of users who perform light work on their small laptops and netbooks, such as editing a Word document, performing spreadsheet calculations using Excel, sending and receiving email messages using Outlook, and other common tasks.

Supporting Mid-Range Systems

While organizations with legacy PCs and netbook enthusiasts can benefit from Office 2010, the vast majority of businesses and home users who decide to deploy or upgrade to Office 2010 are likely to be running mid-range systems a couple of years old. The hardware profile for a standard mid-range system is highly variable, but a typical example might look like this:

- 2 GHz 64-bit dual core processor
- 2 GB of 667 MHz DDR2 RAM
- 500 GB hard drive
- Integrated video with 64 MB shared memory

Two key characteristics of many mid-range systems are the same: the presence of both a multi-core processor and a graphics chip set (either dedicated or integrated) that supports hardware accelerated graphics.

Previous versions of Office were not designed to take direct advantage of multi-core processors or to leverage the power of hardware accelerated graphics. Office 2010, has been engineered to provide direct benefit from these two capabilities in the following ways:

- **Multi-core Processing**   In addition to the more robust thread pool management and task throttling described previously, the Office engineering team also made other targeted improvements that enable certain Office 2010 applications to effectively take advantage of the additional processing power provided by multi-core processors. For example, the sorting engine has been redesigned in Excel 2010 so that cell table sorting (general sorting) is now multithreaded. Other Excel 2010 capabilities that can now leverage multi-core processing include:
  - Native PivotTable Refresh of external data can utilize up to 2 cores if available to Excel.
  - Native PivotTable Sort can utilize as many cores as are available to Excel
  - Summing Row Heights can utilize as many cores as are available to Excel
  - BestFit, which involves PivotTable Refresh, PivotTable Style, PivotTable Update, and so on can utilize as many cores as are available to Excel.

  These and other under-the-hood improvements in Office 2010 are designed to provide better performance on multi-core systems as compared to single-core systems with CPUs running at similar clock speeds.

- **Hardware Accelerated Graphics**   Office 2010 applications such as Word, Excel and PowerPoint have been engineered to take advantage of the additional graphics rendering capabilities provided by graphics processing units (GPUs).[4] Specifically, these applications have been designed to leverage the power of GPUs that at a minimum are DirectX 9.0c compliant and have at least 64 MB of

---

[4] Office 2010 does not differentiate between motherboard-integrated or physically discrete graphics cards.

shared or dedicated video memory.[5] Office 2010 was specifically designed this way since most mid-range PCs newer than a few years old meet or exceed these specifications. The results are easily seen when performing tasks like drawing charts in Excel 2010, or rendering animations and displaying embedded videos in PowerPoint 2010, which can now utilize the Direct3D low-level graphics API for composition and rendering. Not only are Excel charts rendered and restyled faster and PowerPoint animations smoother, new features such as the new 3D slide transitions in PowerPoint leverage hardware assisted graphics to provide more compelling user experiences. More details concerning some of these performance improvements in Excel and PowerPoint are provided later in this paper.

Note that multi-core processors and DirectX-capable graphics are not *required* for using Office 2010. If your systems lack these capabilities, Office 2010 will still perform acceptably and provide excellent quality user experience. By engineering Office 2010 to take advantage of GPUs that support DirectX 9.0c and have 64 MB of video memory, businesses and home users whose systems support such capabilities (and most do today) can have an even more compelling experience when using Office 2010.

Supporting High-End Hardware

At the top end of the range of currently available systems are the state-of-the-art systems that are just beginning to appear in the marketplace. Many include smart features that help tune processor performance to match the machine's workload while providing low energy consumption to facilitate "green" computing initiatives. Fast bus speeds coupled up to 48 GB of fast DDR3 SDRAM enables multiple rich applications to run simultaneously at impressive speeds. Solid state hard drives can provide an even greater performance boost by removing the main bottleneck to application performance—traditional hard disk drives. Advanced graphics processors with 1 GB or more of video memory support the latest DirectX version and can make animations run

---

[5] Office 2010 does not leverage DirectX 10 or higher even if the graphics processor supports this, but it can take advantage of additional video memory to do more at the same time.

smoothly at high frame rates even at maximum display resolution on high definition (HD) monitors.

Not only can Office 2010 take advantage of the powerful capabilities of the top systems presently available, it should also provide excellent performance on any new system hardware that might come to market anytime during the Office 2010 product lifecycle. If you are interested in using state-of-the-art systems or plan on purchasing some of them in the near future, you will likely be able to get even better performance out of Office 2010 than on currently available systems.

Considerations for Deploying 64-bit Office

An important question to consider with high-end systems is whether you should deploy a 32-bit or 64-bit version of Office 2010. That's because Office 2010 is the first version of Microsoft Office available in both 32- and 64-bit versions (previous versions of Office were available in a 32-bit version only).

From a performance and usability perspective, the advantages of installing 64-bit Office mainly revolve around the ability of individual Office applications to utilize the additional physical memory that can be present on 64-bit systems. With 32-bit Windows, the maximum amount of physical memory in the system is 4 GB. However, 32-bit applications are limited to using no more than 2 GB of RAM each at any time, and this can constrain some Office users with limitations on how they can perform their work. For example, the maximum size of a spreadsheet is 2 GB when the 32-bit version of Excel 2010 is being used. However, if you run the 64-bit version of Excel 2010 (which requires 64-bit Windows Vista with SP1 or a later OS), the maximum size of a spreadsheet you can create and manipulate is limited only by the amount of physical memory present. So if you have a specific business need to work with very large spreadsheets, long, complex Word documents larger than 2 GB in size, or extremely large PowerPoint presentations, then using a 64-bit version of Office 2010 may be the way for you to go.

What complicates this picture, however, are the possible downsides of running 64-bit Office, which include but are not limited to the following:

- ActiveX® controls and COM add-ins created for 32-bit Office will not work with 64-bit Office, so if your organization has invested heavily in creating and using

such controls, migrating from Office 2007 to a 64-bit version of Office 2010 is not recommended until those controls and add-ins have been validated.

- Because the default browser on 64-bit versions of Windows Vista and later is the 32-bit version of Windows Internet Explorer®, certain client-side control functionality such as Edit in Datasheet view is not available when running 64-bit Office on such systems.
- If you've created custom solutions using Visual Basic® for Applications (VBA) using Office 2007, some of your VBA code may need to be rewritten to work properly when you migrate to a 64-bit version of Office 2010.
- MAPI applications that were developed for Outlook 2007 may need to be rewritten before they can run with the 64-bit version of Office 2010.

Because of these and other considerations, most organizations today will probably want to deploy a 32-bit version of Office 2010 on most of their PCs, even if these systems have 64-bit Windows 7 installed. By default the, 32-bit version of Office will be installed even when installing Office 2010 on a system that has a 64-bit version of Windows. Most important to understand however is that with this first release of 64-bit Office, Microsoft is investing in the future and organizations who are investing in 64-bit technology can be confident that Office will be there with them.

Experiencing Office 2010 Performance Improvements

So far we've seen that Office 2010 has been engineered to work on a wide variety of hardware, ranging from legacy PCs to netbooks to mid-range and leading edge systems. But how well does Office 2010 actually perform when compared with previous versions of Microsoft Office? To gain the insight necessary to answer this question, the Office team conducted a series of automated tests comparing the performance of Office 2010 applications with Office 2007 SP2 applications on commonly available customer-representative hardware[6] running Windows XP with Service Pack 3.[7] The test metrics collected by the team included the time taken for Office applications to boot up and the time taken for file open/save operations to complete.

The sections below summarize the performance improvements measured for Word, Excel and PowerPoint. Because Outlook is usually deployed in conjunction with Microsoft Exchange, a comparison of Outlook 2010 performance relative to Outlook 2007 SP2 requires special consideration and is described later in this paper.

Boot Experience

Application boot experience entails how much time it takes for the application to initialize and present a fully working user interface. Figure 3 shows measured boot times in seconds for Word, Excel and PowerPoint from Office 2010 and Office 2007 SP2.[8]

---

[6] The actual hardware used for performing the tests was a Dell OptiPlex 745 Core 2 Duo E6400 2.13GHz system with 3.0 GB Non-ECC 667MHz DDR2 RAM, GMA3000 Integrated Video and 500 GB SATA 7200 RPM 16 MB buffer hard drive.

[7] This configuration is representative of many users' configurations today.

[8] Times measured are from application boot to system idle with no add-ins being loaded. Excel times are for booting into Normal view.

|	Word	Excel	PowerPoint
Office 2007	0.42	0.25	0.36
Office 2010	0.29	0.19	0.19
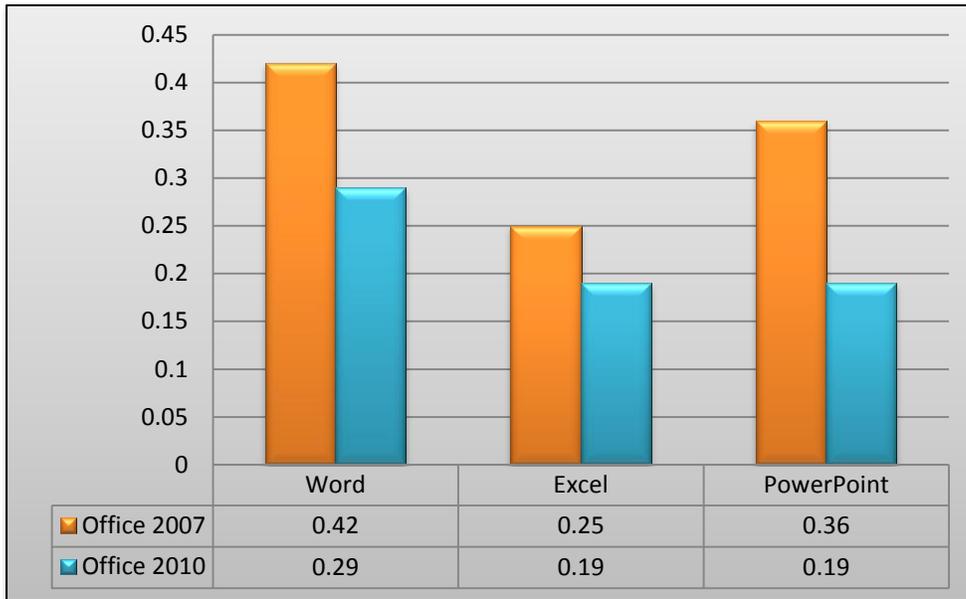
Figure 3: Comparison of boot time in seconds for Office 2010 vs. Office 2007 versions of Word, Excel and PowerPoint.

These results indicate that:

- Word 2010 can boot about 30 percent faster than Word 2007
- Excel 2010 can boot almost 25 percent faster than Excel 2007
- PowerPoint 2010 can boot almost 50 percent faster than PowerPoint 2007

While these across the board boot time improvements for Office 2010 applications are real and therefore significant, users may notice only a slight improvement in application boot time since these measured time differences are of the order of a tenth of a second. More noticeable from an end user perspective however is the time it takes to open an Office document or save it, and improvements in these areas are discussed next.

File Open and Save

File open and save operations are important performance-wise since users often grow impatient when opening or saving a file when it takes too long to complete, and benchmark tests performed by the Office team indicate significant improvements in

these areas as well. A number of factors can influence the time it takes to open or save a Word document, Excel workbook or PowerPoint presentation including the size of the file, its complexity, the Office file format (XML or binary) used for saving the file, and the presence of various add-ins.

Because of these various factors, it isn't possible to summarize Office 2010 file open and save improvements in a simple chart the way boot improvements were summarized above. However, internal testing by Microsoft has identified clear performance improvements in file open and save operations using Office 2010 applications compared with the corresponding Office 2007 SP2 applications. Some examples of these measured improvements include:

- Complex Word documents can now be saved up to 45 percent faster.
- Very large Excel spreadsheets can now be opened up to 21 percent faster.
- Typical PowerPoint presentations can now be opened up to 62 percent faster.

Microsoft internal testing has indicated that almost all file open and save operations for Word 2010, Excel 2010 and PowerPoint 2010 show measureable and often significant improvement over performing these operations using the corresponding Office 2007 SP2 versions of these applications. In the very few instances where a regression was observed during testing, the actual time differences measured were less than 50 milliseconds and are therefore highly unlikely to be perceived by end users. However, other improvements in Office 2010 can make opening and saving files seem faster because of how end users *perceive* the performance of applications, which is discussed next.

Perceived vs. Actual Performance for File Open/Save

A major factor in how a user perceives application performance is the presence of helpful progress information during file open operations. In this regard, the Office 2010 experience has been significantly improved over previous versions of Office, as Office 2010 applications now display an animated startup screen when opening files. If the file open process is not almost instantaneous, this startup screen will display detailed progress information that catches the user's attention and informs about the progress of the operation. The result is that opening files with Office 2010 applications can often feel significantly faster than with the corresponding Office 2007 applications even when the actual time difference is very small.

For example, if a large spreadsheet containing several million cells of data is opened with Excel 2007, the user sees a quick splash screen and then is subjected to a long wait that might lead them into believing the application or computer has stopped working. With Excel 2010, Excel may take several seconds to open, but the startup screen is displayed immediately and shows updated progress information during the time it takes to open the file (see red arrow in Figure 4 below).[9]

Figure 4: Startup screen displayed when Excel is started by double-clicking on a large spreadsheet.

This has two effects on the user: first, it helps to assure the user that something is actually happening with Excel and the application hasn't hung; and second, it makes time seem to pass more quickly for the user because the user's attention is focused on something that is happening.   Furthermore, if the user accidentally opened this large

---

[9] This startup screen is displayed when booting an Office application or opening an Office file using the application, which can be helpful for users who are running Office on slower hardware. Another advantage of this boot time startup screen is that when a particular aspect of application startup is slow (for example, loading an add-in), the startup screen can provide the user with information they can use to take corrective action.

file, they now have the ability to cancel opening the file directly from the splash screen (see the Cancel button in the bottom right corner of Figure 4 and also the Close gadget in the top right corner of the figure). This capability of cancelling boot and file open operations at any time is new in Office 2010. In addition, users can now move the startup screen around or even minimize it in order to get it out of the way so they can continue being productive and perform other tasks while opening large Office data files in the background.

Excel Recalculation

Some of the biggest gains in performance in Office 2010 can be seen in the areas of Excel recalculation and charting. A frequent complaint from users of previous versions of Excel is that recalculating large spreadsheets often takes very long, and the Excel team invested heavily in efforts to redesign the Excel calculation engine in order to significantly reduce the amount of time needed to perform such operations. The dramatic performance gains resulting from this effort are shown in Figure 5 below, which summarizes recalculation times for a very large spreadsheet that models a Monte Carlo simulation using 4 million cells of data.

	Excel 2003	Excel 2007	Excel 2010
Recalc time (sec)	334.86	67.31	6.74
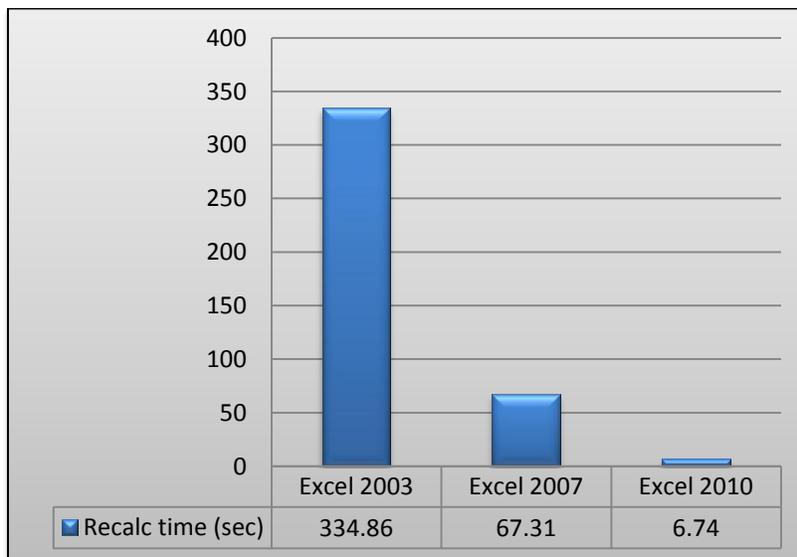
Figure 5: Dramatic gains in Excel recalculation performance across different Office versions.

19

The results are indeed impressive—recalculation is now 90 percent faster on Excel 2010 than it was on Excel 2007, and almost 98 percent faster than on Excel 2003. Stated another way, recalculation in Excel 2010 typically takes about 10 percent as much time as it takes in Excel 2007 and about 2 percent as much time as it takes in Excel 2003. This means that instead of taking minutes or longer to recalculate very large spreadsheets, the operation may complete in only a few seconds. Users who work in the financial and engineering sectors can especially benefit from these improvements as they often work with large spreadsheets that use complex formulas to predict various "what if" scenarios.

Excel Charting

Another major under-the-hood improvement in Excel 2010 is in the area of charting. Creating new charts from spreadsheet data is now much faster in Excel 2010 than in Excel 2007 or Excel 2003. Figure 6 illustrates chart drawing times using data that accurately models a sine wave function.


	Excel 2003	Excel 2007	Excel 2010
Drawing chart (sec)	3.65	44.95	2.37
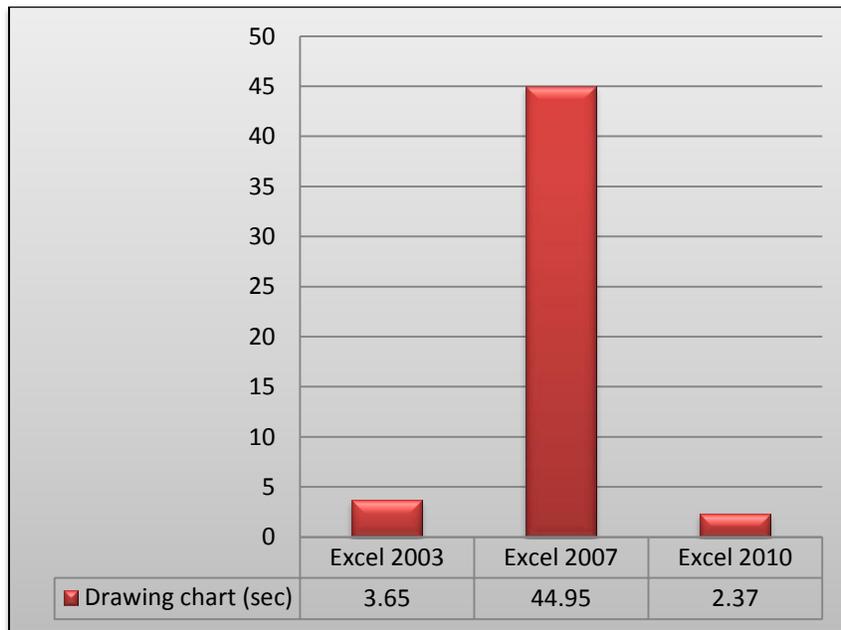
Figure 6: Dramatic gains in chart drawing speed between Excel 2010 and Excel 2007.

The above figure shows that the speed at which charts can be drawn in Excel 2010 is around 95 percent faster than in Excel 2007, or in other words drawing a chart takes only about 5 percent as much time in Excel 2010 as it does in Excel 2007. Interestingly, chart drawing performance is only 35 percent faster in Excel 2010 than in Excel 2003, but this is explained by the much greater complexity of chart types and styles available in Excel 2007 and later, which makes it difficult to make a meaningful comparison of chart drawing speeds between Excel 2010 and Excel 2003.

Users who create complex Excel charts for reports and presentations will especially value this time-saving capability of Excel 2010. And it's not just chart *drawing* that is faster in Excel 2010—equally dramatic charting improvements in performance can be demonstrated for other operations such as change the style of a chart, changing its layout, or modifying special formatting of chart elements. Applying 3D styles to charts was often unusably slow in Excel 2007 but this feature is remarkably fast in Excel 2010.

PowerPoint Improvements

Performance improvements in PowerPoint 2010 can also be dramatic, largely due to under the hood technical improvements centering on the newly included support for DirectX 9.0c in Office 2010. Examples of under the hood improvements that improve PowerPoint performance include:

- Slide transitions, most video playback and the rendering of any 3D OfficeArt content such as beveled shapes and text within any Office 2010 application can now utilize the Direct3D API.
- Composition of the whole window including animation previews during PowerPoint slideshows can also be performed using the Direct3D graphics API.
- Slideshow elements are now rendered as sprites, which are then composited with additional effects such as fades and wipes implemented using Pixel Shader 2.0.

These under-the-hood investments by the Office team have paid off handsomely through the significant performance gains users can now experience when using PowerPoint 2010. For example, thumbnails can now be re-rendered much more quickly after changes are made to existing slides in a presentation.   Slides can also be displayed

much more quickly when selected, making slide show presentations smoother and eliminating awkward pauses as complex slides are being rendered.

In addition to these rendering and slide show improvements, PowerPoint 2010 has also been enhanced with several new features such as stunning new 3D transitions and support for embedding and editing video media within PowerPoint slides. The overall result is an impressive new level of experience, both for users creating PowerPoint decks and for those to whom the slideshows are presented.

As indicated previously, you will need a DirectX 9.0c compliant graphics card with at least 64 MB of video memory to experience the *full* benefit of these new PowerPoint transition, animation, and video embedding features.   Additional video memory will help you get even better performance when using these exciting new features.

OneNote Improvements

Significant investments were also made by the Office team in OneNote 2010 to enhance productivity for users who need to capture, organize and share information at home or work. In addition to OneNote now incorporating Microsoft Office Fluent™ user interface (UI) features like the Ribbon and Backstage view, support for simultaneous editing of OneNote notebooks by multiple users, the ability to sync notebooks to Windows Live, improved integration with Outlook, and various other editing and note-taking improvements, OneNote 2010 also includes several performance improvements including:

- **Faster synchronization of pages**   When multiple people are working on the same page, synchronization of that page is now accelerated so that changes appear to all authors in near real-time.
- **Fast Search for easy navigation**   Because search results now appear as you type, there has never been a faster way to get to the most often used pages in your notebook. In addition to page content, you can now Fast Search to search based on notebook names, section labels, and page titles. Page authors can also quickly search for recently added content (last day, week, month, and so on) or get a quick overview of what's changed on any particular day.

Outlook Improvements

Many business users spend several hours each day working with Outlook as they send and receive email, launch Communicator sessions, schedule meetings and manage their to-do list. Users often leave Outlook running all day on their computers, and when Outlook runs slowly or appears to hang, they often become frustrated because their workflow gets interrupted. Therefore, improving the performance of Outlook 2010 was a major investment for the Outlook team, with the goal of making common user actions quicker than in previous versions and to minimizing the time users have to wait for Outlook to respond before they can perform their next task.

Outlook 2010 succeeded in this goal in many areas. Startup performance has been improved, enabling users to get to their Inbox faster and see new mail right away. Additionally, common operations such as clicking a message to read it, moving messages into folders, switching to other folders, and exiting Outlook are faster than before.

Results from Internal Dogfood Testing

To quantify the results from the above performance investments, Office engineers collected two types of data.[10] First, they collected data from thousands of internal Microsoft users as they "dogfooded" Outlook 2010 (that is, when they used the product while it was still in the development process). During this stage the team monitored the performance of many common actions being performed. The performance information extracted from this collected data is summarized in Table 2 below.

---

[10] The testing methodology used for measuring Outlook performance was different than for other Office applications. This is because Outlook performance can vary greatly between users depending how Outlook is configured and how users work with and maintain their inboxes, folders, calendars, to do lists, and so on.

Table 2: Outlook 2010 performance statistics based on internal "dogfood" testing of Outlook 2010 during the development process.

Outlook operation	Detailed description
Folder Change	90% of 1.9 million folder change actions happened in under 1 second
Switch to Calendar	83% of 235k attempts to open the calendar module occurred in under 1 second
Viewing Mail in Reading Pane	85% of 6.8 million mail views rendered in under 0.5 seconds 93% of 6.8 million mail views rendered in under 1 second
Shutdown	Outlook completely shut down within 4 seconds for 94% of the sessions

Results from Internal Laboratory Testing

Second, during the development process, Office engineers also regularly collected timings of key scenarios in order to monitor for performance improvements and potential regressions. These timings were performed in a lab environment using automated collection tools and carefully standardized system specifications in order to create results that could be easily reproduced for confirmation. Details concerning these specifications are provided in Table 4 and its accompanying footnotes.

Table 3 below shows some of the measurements from these internal tests. These tests were designed to compare the performance of Outlook 2010 RTM with Outlook 2007 SP2 for six common end-user scenarios that were considered representative of business users of Outlook.[11]

---

[11] All mailboxes were hosted on Microsoft Exchange 2003 servers.

Table 3: Results of internal testing comparing Outlook 2010 RTM performance with Outlook 2007 SP2.

	Outlook 2010 RTM	Outlook 2007 SP2	% Improvement
Boot (cold)	7.6 s	10.3 s	26%
Boot (warm)	0.53 s	0.77 s	31%
Synchronize Complete Mailbox: 1GB	12.7 min	18.6 min	32%
Synchronize Complete Mailbox: 2GB	26.8 min	28.3 min	5%
Responsiveness Workflow (number of pauses)	27	41	34%
Shutdown	0.64 s	1.17 s	45%

These significant improvements can help users work more productively when they use Outlook 2010.

Table 4 below highlights additional details concerning the methodology and hardware used for each of the six test scenarios listed above.   Each test scenario had a specific start action defining how to initiate the task and a specific description of the state of the system to identify the conclusion of the task. The footnotes in the last column of this table provide detailed descriptions of the specifications of the reference systems used for performing these tests.

Table 4: Details of Outlook testing methodologies for each scenario tested.

Test Scenario and Description	Start and End of Test Scenario	Setup
Boot (cold) Measures cold boot of Outlook into a 1GB mailbox in a cached exchange profile.[12]	Start: Click the Outlook Icon End: Folders, Mail Content, and Reading Pane are all displayed	• Machine A[13] running Windows XP SP3 • 1GB mailbox on Exchange 2003 server • Navigation Pane, ToDo Bar, and Reading Pane open
Boot (warm) Measures warm boot of Outlook into a 2GB mailbox in a cached exchange profile.[14]	Start: Click the Outlook Icon End: Folders, Mail Content, and Reading Pane are all displayed	• Machine B running Windows 7 • 2GB mailbox on Exchange 2003 server • 3.28GB in local cache • 4 total mail folders • 56,812 total items • Inbox had 43k items, subfolders had 2.5k, 6.7k and 4k items • Navigation Pane, ToDo Bar, and Reading Pane open
Synchronize Complete Mailbox: 1GB Measures the total sync time of a 1GB mailbox on Exchange server to a cached exchange profile in Outlook by first deleting the local cache *.ost file.	Start: Outlook is not running, Delete .ost file, Start Outlook End : Status bar indicates "All folders are up to date"	• Machine A running Windows 7 • 1GB mailbox on Exchange 2003 server • Navigation Pane, ToDo Bar, and Reading Pane open

---

[12] Cold boot means that Outlook is booting for the first time since the machine was restarted.

[13] Machine A had an Intel Pentium 4 CPU @3.0 GHz, 1GB RAM, 160GB HDD (7200RPM) and a 100 Mbit LAN connection while Machine B had an Intel Core 2 6600 CPU @2.40GHz, 2GB RAM, 1 TB HDD (7200RPM) and a 100 Mbit LAN connection.

[14] Warm boot means Outlook has been run before during the session when the machine was last restarted.

Synchronize Complete Mailbox: 2GB Measures the total sync time of a 2GB mailbox on Exchange server to a cached exchange profile in Outlook by first deleting the local cache *.ost file.	Start: Outlook is not running, Delete .ost file, Start Outlook End: Status bar indicates All folders are up to date	• Machine B running Windows 7 • 2GB mailbox on Exchange 2003 server • 3.28GB in local cache • 4 total mail folders • 56,812 total items • Inbox had 43k items, subfolders had 2.5k, 6.7k and 4k items • Navigation Pane, ToDo Bar, and Reading Pane open
Responsiveness Workflow Monitors the Outlook main window every 300 milliseconds. If the main window does not respond within 300 milliseconds, this counts as one pause.	Responsiveness improvements were measured by running Outlook through a 20-step workflow that included reading, sending, and filing mail, using the calendar, switching to mail folders, and changing view arrangements.	• Machine A running Windows XP SP3 • 1.5 GB mailbox on Exchange 2003 server • 114,648 total items • Inbox contains 63k mail items, next largest 3 sub folders had 16k items each • 379 Calendar items, 117 task items • Navigation Pane, ToDo Bar, and Reading Pane open
Shutdown Measures exiting Outlook using a 2GB mailbox in a cached exchange profile.	Start: Click File | Exit End: Outlook.exe process is gone from Windows Task Manager	• Machine B running Windows 7 • 2GB mailbox on Exchange 2003 server • 3.28GB in local cache • 4 total mail folders • 56,812 total items • Inbox had 43k items, subfolders had 2.5k, 6.7k and 4k items • Navigation Pane, ToDo Bar, and Reading Pane open

Finally, In addition to the improved performance of Outlook 2010, new productivity features have been added which also help the user perform common tasks more easily. The new "Conversation View" makes it easier to work with large amounts of mail by providing a threaded view of mail messages stored in any Outlook folder. Additionally, the new "Clean Up" button on the ribbon easily moves older or redundant messages to your Deleted Items folder. The new "Ignore" button moves an entire conversation plus

any future replies to that conversation directly to your Deleted Items folder. The "Quick Steps" feature, allows the user to perform common tasks with fewer mouse clicks. These and other new productivity-enhancing features make the 2010 version of Outlook feel snappier than ever, enabling users to be more productive and get their work done faster. For more information about Conversation View, Quick Steps and other new features in Outlook 2010, see http://technet.microsoft.com/en-us/library/cc179110.aspx in the TechNet Library.

Office 2010 and the Cloud

More and more businesses today are using the cloud to provide messaging and collaboration services for their users. Businesses that want complete control of these services can host them in their own private clouds hosted in the corporate datacenter. Businesses that prefer the flexibility of having others host these services can utilize public clouds hosted by service providers. Either way, document storage living in the cloud is now becoming a primary scenario for many organizations.

Microsoft SharePoint® products are a key enabler for both private and public cloud services as they provide a business platform for enabling users to set up Web sites to share information with other users, manage and store business documents across their lifecycle, collaborate on the creation, reviewing and editing of documents, and publish reports that can be used to enable informed decision making. The popularity of SharePoint as a business collaboration solution is demonstrated by the fact that over 100 million SharePoint Server 2007 licenses have been sold in the enterprise market space.[15]

Because of the growing popularity of SharePoint in the enterprise market, Microsoft has made investments to improve the experience of users who use Microsoft Office to work with documents stored on SharePoint sites. These improvements are desired because business users often work with very large Word documents, Excel spreadsheets or PowerPoint presentations; when these files are stored on a SharePoint site the user experience opening and saving them can sometimes be frustratingly slow, especially when the site is being accessed remotely over a low bandwidth or high latency network connection, such as those a mobile user might experience when accessing the corporate network via a public WiFi hotspot.

The main performance issue when working with the previous versions of Office and SharePoint is that the entire document travels over the wire each time it is opened or saved by the user (see Figure 7). If the user is working over slow network connection

---

[15] Market figures taken from Microsoft News Room press release dated March 2, 2008, see http://www.microsoft.com/presspass/press/2008/mar08/03-02SPPTEnterpriseGrowthPR.mspx.

and the file is large then the Office application may appear to hang during an open or file save operation until the entire file has been downloaded from or uploaded to the cloud.
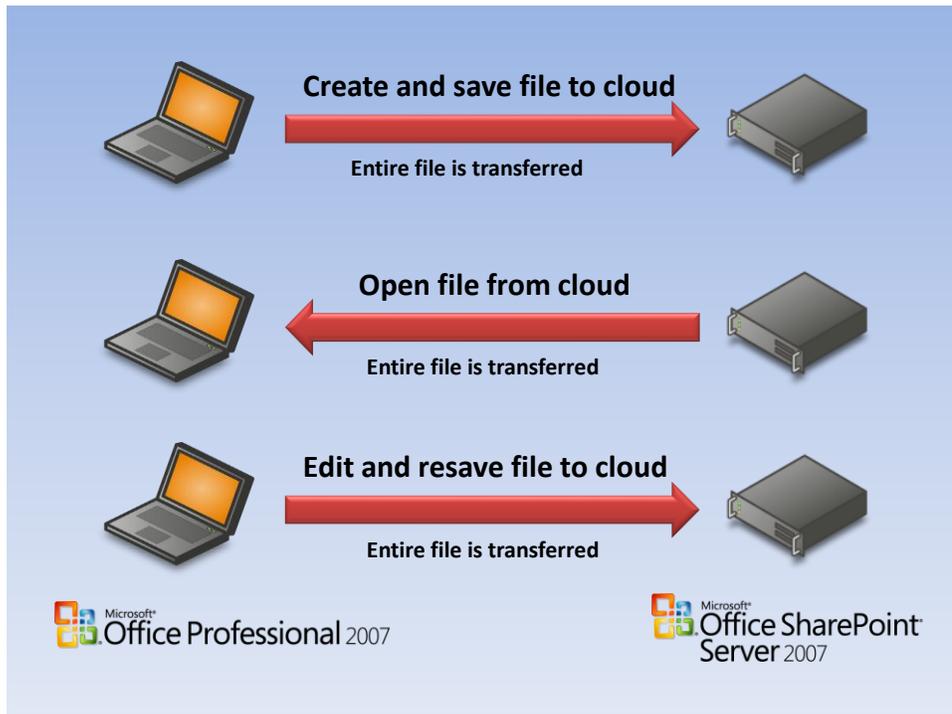

Figure 7: The entire file is transferred between the client and the cloud when the 2007 versions of Office and SharePoint are used.

To overcome this problem, Office 2010 introduces several new features to both Office 2010 and SharePoint 2010:

- **Delta Sync**   This new feature of Office 2010 and SharePoint 2010 transfers only the changes made to a document when it is opened from or saved to a SharePoint 2010 site instead of the entire file. Delta Sync is based on the new Cobalt API, a new file access model in Office 2010 and SharePoint 2010 based

on Simple Object Access Protocol (SOAP) that provides a Web Services-based mechanism for incremental, multi-user file system I/O and storage.[16]

- **Office Document Cache (ODC)**   The ODC acts as a local, always available cache of content from a SharePoint site that enables Office 2010 users to work on documents stored on the site even when they aren't connected to the site.
- **SharePoint Workspace 2010**   Based on the earlier Microsoft Office Groove® 2007 product and available as part of the volume-licensed Office Professional Plus 2010 suite, SharePoint Workspace 2010 synchronizes the ODC on an Office 2010 client with a SharePoint site so that copies of documents stored on the site can be cached locally in the ODC on the client.

The result is that after the initial file open or save operation, subsequent file open and save operations performed by Office 2010 users on documents stored on SharePoint 2010 sites can be as fast as operations performed on files stored on the user's local hard drive. This is because files can be opened from the local ODC cache instead of the cloud, if the copies of the file are identical in both locations. Furthermore, when files are modified on the Office desktop client, only the changes are synchronized with the server – which can take much less time than transferring the entire file.

Figure 8 shows how this can work with file open and save operations between Office 2010 clients and SharePoint 2010 sites in the cloud.

---

[16] This requires using Office 2010 with SharePoint 2010; it will not work with earlier versions of either product.
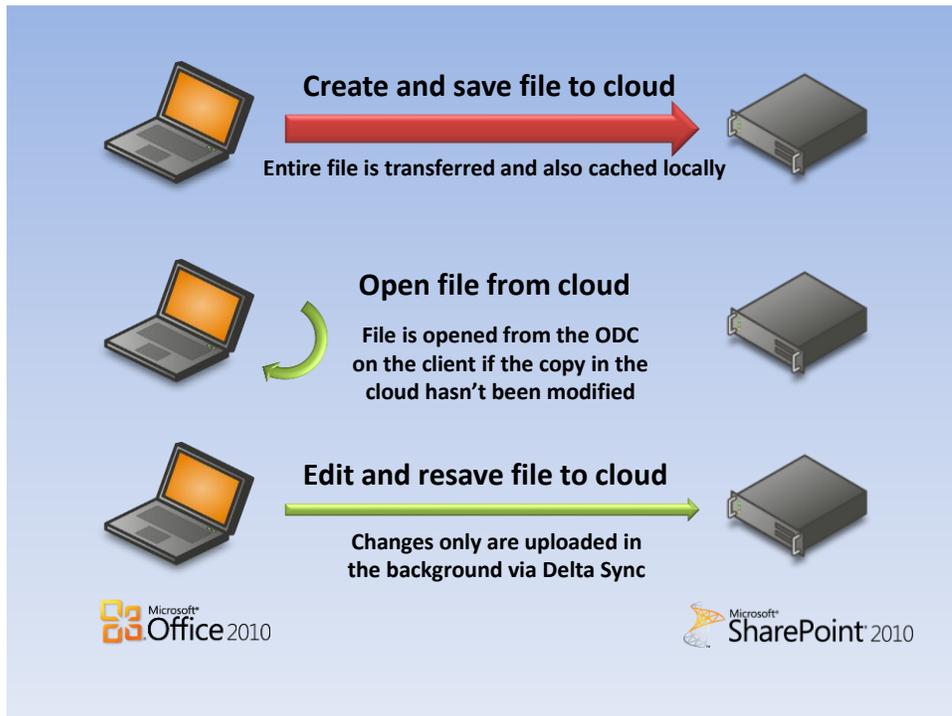
Figure 8: Once the file is in the cloud and cached locally, only changes made to the file are transferred when file open and save actions are performed.

As an example, consider a Word 2010 user whose laptop is initially connected to the corporate LAN. When the user creates and saves a large document to a SharePoint 2010 site, the entire document is uploaded to the site and is also cached locally in the ODC. The user then disconnects his laptop from the LAN and travels to an airport, where he realizes he needs to change the title of the document he created. To fix the mistake, he connects to the Internet using the public Wi-Fi hotspot at the airport, and establishes a VPN connection to the corporate network. He then opens the document from the SharePoint site and finds that it opens almost instantly, because Office has verified that the locally cached version of the document is the same as the version stored on the server. Using Word he then changes the title of the document and clicks Save; the document saves almost instantly since only the changes are transferred to the server, instead of the entire document.

From the end user's perspective, performance of Office 2010 and SharePoint 2010 is improved over the experience with Office 2007 and SharePoint 2007. This performance

boost for file open and save operations between Office 2010 clients and SharePoint sites can be especially beneficial over slow or unreliable or high-latency network connections and is available with any MS-FSSHTTP compliant service, including Windows Live® SkyDrive®. SharePoint 2010 also includes other features such as co-authoring, which allow users to collaborate faster and more productively. Co-authoring enables multiple users to open a Word or PowerPoint file simultaneously, by locking portions of the file instead of the entire file. Specifically, Word 2010 locks at the paragraph level, while PowerPoint 2010 at the slide level. This allows several users to open the same Word document or PowerPoint presentation and work on different portions of the file simultaneously. The overall result of these new features is an improved user experience for Office 2010 users who work with business data stored in the cloud.

Conclusion

Office 2010 clearly helps users perform many common tasks faster than with previous versions of Office, and the increased productivity that can result will benefit businesses considering upgrading to the new version. Performance has been improved in many areas in order to address customer pain points associated with previous versions of Office. Examples of areas where performance has been significantly improved in Office 2010 include file open and save operations in Word and PowerPoint, recalculation of large Excel spreadsheets, drawing and restyling charts in Excel, and thumbnail rendering and slide show performance in PowerPoint. Numerous performance improvements have also been made to Outlook in order to improve the startup/shutdown experience, mailbox synchronization with Exchange Server, and many common workflow tasks in Outlook.

Office 2010 performance improvements can be experienced across the full spectrum of hardware from legacy PCs running Windows XP to typical mid-range systems to the latest cutting-edge hardware. Even netbook enthusiasts can use Office 2010 more easily than Office 2007 as the user interface has been redesigned to fit better on the small real estate of a netbook's screen. And for businesses that need to store documents in the cloud, the combination of Office 2010 and SharePoint 2010 provides an unparalleled user experience even over slow or high latency network connections.

Additional Resources

For detailed system requirements of each Office 2010 version, see http://technet.microsoft.com/en-us/library/ee624351.aspx in the TechNet Library.

For detailed considerations relating to 64-bit versions of Office 2010, see http://technet.microsoft.com/en-us/library/ee681792.aspx in the TechNet Library.

For all other technical documentation concerning Office 2010, see the Office section of the TechNet Library at http://technet.microsoft.com/en-us/library/cc498719.aspx.

For technical documentation concerning SharePoint 2010, see the SharePoint section of the TechNet Library at http://technet.microsoft.com/en-us/library/ee428287.aspx.

For insights into the design process and new functionality available in Office 2010, see the Microsoft Office 2010 Engineering Blog at http://blogs.technet.com/b/office2010/.

To discuss Office deployment and administration issues with other IT Professionals, visit the Office IT Pro Forum Category of the TechNet Forums at http://social.technet.microsoft.com/Forums/en-us/category/officeitpro.