Chapter 5

Custom Configurations

THE FOLLOWING COMPTIA A+ 220-801 OBJECTIVES ARE COVERED IN THIS CHAPTER:

✓ **1.9 Evaluate and select appropriate components for a custom configuration, to meet customer specifications or needs.**

- Graphic / CAD / CAM design workstation
  - Powerful processor
  - High-end video
  - Maximum RAM
- Audio/Video editing workstation
  - Specialized audio and video card
  - Large fast hard drive
  - Dual monitors
- Virtualization workstation
  - Maximum RAM and CPU cores
- Gaming PC
  - Powerful processor
  - High-end video/specialized GPU
  - Better sound card
  - High-end cooling
- Home Theater PC
  - Surround sound audio
  - HDMI output
  - HTPC compact form factor
  - TV tuner

- Standard thick client
  - Desktop applications
  - Meets recommended requirements for running Windows
- Thin client
  - Basic application
  - Meets minimum requirements for running Windows
- Home Server PC
  - Media streaming
  - File sharing
  - Print sharing
  - Gigabit NIC
  - RAID array

Not all computers are right for every situation. There are small netbooks that are ideal for portability but that would fail miserably when used for mathematical modeling of complex systems. Supercomputers that are up to the modeling task would have to be completely disassembled to be transported anywhere. While these are extreme examples, dozens more exist that shine the light on the need for custom configurations to perform specific jobs.

This chapter introduces you to some of the custom configurations that have become so popular that they are tantamount to standards, enough so that they can be discussed in a finite way. Such concepts have become requisite knowledge for the A+ certified technician. The following specialized systems are covered in the sections presented in this chapter:

- Graphic and CAD/CAM design workstations
- Audio/video editing workstations
- Virtualization workstations
- Gaming PCs
- Home theater PCs
- Standard thick clients
- Thin clients
- Home server PCs

The topics in the following list are related to the systems discussed in this chapter and are divided into families that sometimes tie many of the custom configurations together. Other of these topics are so specialized that they apply only to a single custom configuration from the previous list. The following major topics are discussed in the sections to come:

- CPU enhancements
- Video enhancements
- Maximized RAM
- Specialized audio
- Specialized drives
- NIC enhancements
- Additional considerations
    - Enhanced cooling
    - Special chassis
    - TV tuner requirement
    - Application specifics

Graphic and CAD/CAM Design Workstations

Workstations used in the design of graphical content place a heavy load on three primary areas of the system:

- CPU enhancements
- Video enhancements
- Maximized RAM

CPU Enhancements

Sometimes it's a matter of how powerful a computer's CPU is. Other times, having multiple lesser CPUs that can work independently on a number of separate tasks is more important. Many of today's PCs have either of these characteristics or a combination of both. Nevertheless, there are enough computers being produced that have neither. As a result, it is necessary to gauge the purpose of the machine when choosing the CPU profile of a computer.

Graphic design workstations and *computer-aided design/computer-aided manufacturing (CAD/CAM) workstations* are computers used for similar yet distinct reasons. Graphic design workstations are used by desktop publishers in the creation of high-quality copy consisting of professional text and graphical images. This output is used in advertising, marketing, and other forms of specialized documentation. CAD/CAM workstations are used in the design of engineering and architectural documentation, including blueprints in both two and three dimensions. Such systems place quite a load on their CPUs. Systems with average CPUs can become overwhelmed by the amount of processing required by professional graphical software. For this reason, such systems must be designed with CPUs of above-average performance.

Graphic Design Workstations

Computers used by graphic-design artists must process a constant flow of colors and detailed shapes, the combination of which can put a strain on the CPU, RAM, and video components.

CAD/CAM Workstations

CAD/CAM systems can carry the designer's vision from conception to design in a 100 percent digital setting. Three-dimensional drawings are also common in this technology. These designs drive or aid in the production of 3D models. Software used for such projects requires a high number of CPU cycles during the rendering of the designs before display on the monitor or output to a printer or plotter. Such systems have been used for decades by professionals in the architecture, surveying, and engineering fields as well as by design engineers in manufacturing firms.

The output of computerized numerical control (CNC) systems used in the manufacturing process following the use of CAD/CAM workstations in the design phase is far different from displays on monitors or printouts. CNC systems take a set of coded instructions and render them into machine or tool movements. The result is often a programmable cutting away of parts of the raw material to produce a finished product. Examples are automotive parts, such as metallic engine parts or wheel rims, crowns and other dental structures, and works of art from various materials.

Video Enhancements

Possibly an obvious requirement for such systems, graphics adapters with better graphics processing units (GPUs) and additional RAM on board have the capability to keep up with the demand of graphic design applications. Such applications place an unacceptable load on the CPU and system RAM when specialized processors and adequate RAM are not present on the graphics adapter.

Maximized RAM

Although such systems take advantage of enhanced video subsystems, all applications still require CPUs to process their instructions and RAM to hold these instructions during processing. Graphics applications tend to be particularly CPU and RAM hungry. Maximizing the amount of RAM that can be accessed by the CPU and operating system will result in better overall performance by graphic design workstations.

Audio/Video Editing Workstations

Professionals that edit multimedia material require workstations that excel in three areas:

- Video enhancements
- Specialized audio
- Specialized drives

The following sections assume the use of nonlinear editing (NLE) schemes for video. NLE differs from linear editing by storing the video to be edited on a local drive instead of editing being performed in real time as the source video is fed into the computer. NLE requires workstations with much higher RAM capacity and disk space than does linear editing. Although maximizing RAM is a benefit to these systems, doing so is considered secondary to the three areas of enhancement mentioned in the preceding list.

Video Enhancements

Although a high-performance video subsystem is a benefit for computer systems used by audio/video (A/V) editors, it is not the most important video enhancement for such systems.

Audio/video editing workstations benefit most from a graphics adapter with multiple video interfaces that can be used simultaneously. These adapters are not rare, but it is still possible to find high-end adapters with only one interface, which are not ideal for A/V editing systems.

When editing multimedia content, or even generalized documents, it is imperative that the editor have multiple views of the same or similar files. The editor of such material often needs to view different parts of the same file. Additionally, many A/V editing software suites allow, and often encourage or require, the editor to use multiple utilities simultaneously. For example, in video editing, many packages optimize their desktop arrangement when multiple monitors are detected, allowing less horizontal scrolling through timelines. The ability to extend the Desktop across multiple monitors is valuable in such a situation. For more on setting up this feature, see the section “Multiple Displays” in Chapter 4, “Display Devices.”

To improve video-editing performance, insist on a graphics adapter that supports CUDA and OpenCL. CUDA is Nvidia’s Compute Unified Device Architecture, a parallel computing architecture for breaking down larger processing tasks into smaller tasks and processing them simultaneously on a GPU. Open Computing Language (OpenCL) is a similar, yet cross-platform, open standard. Programmers can specify high-level function calls in a programming language they are more familiar with instead of writing specific instructions for the microcode of the processor at hand. The overall performance increase of macro-style application programming interfaces (APIs) like these is an advantage of the technologies as well. The rendering of 2D and 3D graphics occurs much more quickly and fluidly with one of these technologies. CUDA is optimized for Nvidia GPUs, while OpenCL is less specific, more universal, and perhaps, as a result, less ideal when used with the same Nvidia GPUs that CUDA supports.

Furthermore, depending on the visual quality of the content being edited, the professional’s workstation might require a graphics adapter and monitor capable of higher resolutions than are readily available in the consumer marketplace. If the accuracy of what the editor sees on the monitor must be as true to life as possible, a specialty CRT monitor might be the best choice for the project. Such CRTs are expensive and are available in high definition and widescreen formats. These monitors might well provide the best color representation when compared to other high-quality monitors available today.

Specialized Audio

The most basic audio controllers in today’s computer systems are not very different from those in the original sound cards from the 1980s. They still use an analog codec with a simple two-channel arrangement. Editors of audio information who are expected to perform quality work often require six to eight channels of audio. Many of today’s motherboards come equipped with 5.1 or 7.1 analog audio. (See the section “Analog Sound Jacks” in Chapter 3, “Peripherals and Expansion.”) Although analog audio is not entirely incompatible with quality work, digital audio is preferred the vast majority of the time. In some cases, an add-on adapter supporting such audio might be required to support an A/V editing workstation.

Specialized Drives

Graphics editing workstations and other systems running drive-intensive NLE software benefit from uncoupling the drive that contains the operating system and applications from the one that houses the media files. This greatly reduces the need for multitasking by a single drive. With the data drive as the input source for video encoding, consider using the system drive as an output destination during the encoding if a third drive is not available. Just remember to move the resulting files to the data drive once the encoding is complete.

Not only should you use separate drives for system and data files, you should also make sure the data drive is large and fast. SATA 6Gbps drives that spin at 7200rpm and faster are recommended for these applications. Editors cannot afford delays and the non-real-time video playback caused by buffering due to inefficient hard-drive subsystems. If you decide to use an external hard drive, whether for convenience or portability or because of the fact that an extremely powerful laptop is being used as an A/V editing workstation, use an eSATA connection when possible. Doing so ensures no loss in performance over internal SATA drives due to conversion delays or slower interfaces, such as USB 2.0.

If you cannot find a drive that has the capacity you require, you should consider implementing RAID 0, disk striping without parity. Doing so has two advantages: You can pay less for the total space you end up with, and RAID 0 improves read and write speeds because multiple drives are active simultaneously. Don't confuse spanned volume sets with RAID 0. Simple volume sets do not read and write to all drives in the set simultaneously; data simply spills over to the next drive when the preceding one is full. The only advantage volume sets share with RAID 0 is the ability to store files larger than a single drive. Consult Chapter 2, "Storage Devices and Power Supplies," for more information on SATA and various RAID levels.

If you would also like to add fault tolerance and prevent data loss, go with RAID 5, which has much of the read/write benefit of RAID 0 with the assurance that losing a single drive won't result in data loss. RAID should be implemented in hardware when possible to avoid overtaxing the operating system, which has to implement or help implement software RAID itself.

Virtualization Workstations

Hardware virtualization has taken the industry by storm and has given rise to entire companies and large business units in existing companies that provide software and algorithms of varying effectiveness for the purpose of minimizing the hardware footprint required to implement multiple servers and workstations. Although virtualization as a technology subculture is discussed in greater detail later in this book, you are ready to investigate the unique requirements for the workstation that will host the guest operating systems and their applications.

Virtualization workstations must exceed the specifications of standard servers and workstations in two primary areas:

- CPU enhancements
- Maximized RAM

Depending on the specific guest systems and processes that the workstation will host, it may be necessary to increase the hard drive capacity of the workstation as well. Because this is only a possibility, increased drive capacity is not considered a primary enhancement for virtualization workstations.

Virtual machines (VMs) running on a host system appear to come along with their own resources. A quick look in the Device Manager utility of a guest operating system leads you to believe it has its own components and does not require nor interfere with any resources on the host. This is not true, however. The following list includes some of the more important components that are shared by the host and all guest operating systems:

- CPU cycles
- System memory
- Drive storage space
- Systemwide network bandwidth

CPU Enhancements

Because the physical host's processor is shared by all operating systems running, virtual or not, it behooves you to implement virtual machines on a host with as many CPUs as possible. The operating system is capable of treating each core in a multicore processor separately and creating virtual CPUs for the VMs from them. Therefore, the more CPUs you can install in a workstation, each with as many cores as possible, the more dedicated CPU cycles that can be assigned to each virtual machine.

Maximized RAM

As you create a virtual machine, even before a guest operating system is installed in the VM, you must decide how much RAM the guest system will require. The same minimum requirements for installing an operating system on a conventional machine apply to the installation of that operating system on a virtual machine.

The RAM you dedicate to that VM is not used until the VM is booted. Once it is booted, though, that RAM is as good as unavailable to the host operating system. As a result, you must ensure that the virtualization workstation is equipped with enough RAM to handle its own needs as well as those of all guests that could run simultaneously. As with a conventional system running a single operating system at a time, you generally want to supply each VM with additional RAM to keep it humming along nicely.

This cumulative RAM must be accounted for in the physical configuration of the virtualization workstation. In most cases, this will result in maximizing the amount of

RAM installed in the computer. The maximum installed RAM hinges on three primary constraints:

- The CPU's address-bus width
- The operating system's maximum supported RAM
- The motherboard's maximum supported RAM

The smallest of these constraints dictates the maximum RAM you will be able to use in the workstation. Attention to each of these limitations should be exercised in the selection of the workstation to be used to host guest operating systems and their applications. Considering the limitations of operating systems leads to preferring the use of server versions over client versions and the use of x64 versions over x86 versions.

Real World Scenario

What's It Going to Take?

The folks at a medium-sized organization decided to try their hand at virtualization because the IT manager heard they could save money on future infrastructure and go Green at the same time. They already had all the operating systems they needed; they were currently installed on separate machines. The manager envisioned removing the KVM switch and having a single machine in the server room.

The technician in charge did almost everything right. He chose the company's most powerful server and created five virtual machines. The hard drive was large enough that there was plenty of room for the host operating system and the five VMs. The technician knew the minimum requirements for running each of the operating systems and made sure that each VM was configured with plenty of RAM. The dual-core CPU installed in the system was more than powerful enough to handle each operating system.

After a combination of clean installations and image transfers into the VMs, the server was ready to test. The host booted and ran beautifully as always. The first VM was started and was found to be accessible over the network. It served client requests and created a barely noticeable draw on performance. It was the second VM that sparked the realization that the manager and technician missed a crucial point. The processor and the RAM settings for each individual VM were sufficient for the host and at most one VM, but when any second VM was added to the mix, the combined drain on the CPU and RAM was untenable. "What's it going to take to be able to run these servers simultaneously?" the technician wondered.

The solution was to replace the server motherboard with a model containing dual quad-core Xeon processors and to maximize the RAM based on what the motherboard supported. The result was an impressive system with five virtual servers, each of which displayed impressive performance statistics. Before long, the expense of the server was returned in power savings. Eventually, additional savings will be realized when the original physical hardware for the five servers would have had to be replaced.

Gaming PCs

Early video games designed for the PC market were designed to run on the average system available at the time. As is true with all software, there is a push/pull relationship between PC-based games and the hardware they run on. Over time, the hardware improves and challenges the producers of gaming software. Inspired by the possibilities, the programmers push the limits of the hardware, encouraging hardware engineers to create more room for software growth. Today's PC-based gaming software cannot be expected to run on the average system of the day. Specialized gaming PCs, computers optimized for running modern video games, fill a niche in the marketplace, leading to a continually growing segment of the personal-computer market.

Gaming enthusiasts often turn to specialized game consoles for the best performance, but with the right specifications, a personal computer can give modern consoles a run for their money, possibly even eclipsing their performance. For a computer to have a chance, however, four areas of enhancement must be considered:

- CPU enhancements
- Video enhancements
- Specialized audio
- Enhanced cooling

CPU Enhancements

Unlike with A/V editing, gaming requires millions of decisions to be made by the CPU every second. It's not enough that the graphics subsystem can keep up with the action; the CPU must be able to create that action. Some gamers find that they do fine with a high-end stock CPU. Others require that such CPUs perform above their specified rating. They find that overclocking the CPU by making changes in the BIOS to the clock frequency used by the system gains them the requisite performance that allows them to remain competitive against or to dominate competitors. Overclocking was discussed in Chapter 1, "Motherboards, Processors, and Memory," but to reiterate, it means that you are running your CPU at a clock speed greater than the manufacturer's rating to increase performance.

However, this increased performance comes at a price: Their CPU will almost certainly not live as long as if they had used the default maximum speed determined by the manufacturer and detected by the BIOS. Nothing can completely negate the internal damage caused by pushing electrons through the processor's cores faster than should be allowed. Nevertheless, the CPU would scarcely survive days or even hours with standard cooling techniques. Enhancing the cooling system, discussed shortly, is the key to stretching the CPU's life back out to a duration that approaches its original expectancy.

Video Enhancements

Video games have evolved from text-based and simple two-dimensional graphics-based applications into highly complex software that requires everything from real-time high-resolution, high-definition rendering to three-dimensional modeling. Technologies like Nvidia's SLI and ATI's Crossfire are extremely beneficial for such graphics-intensive applications. SLI was discussed in Chapter 1.

No longer can gaming software rely mostly on the system's CPU to process its code and deliver the end result to the graphics adapter for output to the monitor. No longer can this software store a screen or two at a time in the graphics adapter's memory, allowing for adapters with tens of MB of RAM. Today's gaming applications are resource-hungry powerhouses capable of displaying fluid video at 30 frames per second. To keep up with such demands, the RAM installed on graphics adapters has breached the 1GB mark, a capacity not long ago reserved for primary system memory. In the same way that CUDA- and OpenCL-capable GPUs benefit workstations used for video editing, these same standards are indispensable in the world of modern gaming software. Not all GPUs support these standards. Thus, another selling point emerges for high-end graphics adapters.

Of course, all the internal system enhancements in the world are for naught if the monitor you choose cannot keep up with the speed of the adapter or its resolutions and 3D capability. Quite a bit of care must be exercised when comparison shopping for an adequate gaming monitor.

Specialized Audio

Today's video games continue the genre of interactive multimedia spectacles. Not only can your video work in both directions, using cameras to record the image or motion of the player, but so can your audio. It's exceedingly common to find a gamer shouting into a microphone boom on a headset as they guide their character through the virtual world of high-definition video and high-definition digital audio. A lesser audio controller is not acceptable in today's PC gaming world. Technologies such as S/PDIF and HDMI produce high-quality digital audio for the gaming enthusiast. Of course, HDMI provides for state-of-the-art digital video as well.

Enhanced Cooling

As mentioned earlier, the practices of speed junkies, such as modern PC gamers, can lead to a processor's early demise. Although an earlier end to an overclocked CPU can't be totally guaranteed, operators of such systems use standard and experimental cooling methods to reduce the self-destructive effects of the increased heat output from the CPU. Refer back to the section "Advanced CPU Cooling Methods" in Chapter 1 for more information on cooling techniques that give overclocked CPUs a fighting chance. Of course, experimental cooling techniques such as immersion of the system in mineral oil and indirect application of liquid nitrogen or helium to the CPU continue to garner attention from enthusiasts. It remains to be seen, however, if some of these techniques have a shot at making it in the marketplace.

Today's high-end graphics adapters come equipped with their own cooling mechanisms designed to keep such adapters properly cooled under even extreme circumstances. Nevertheless, the use of high-end adapters in advanced ways leads to additional concerns. Graphics adapters that rob a second slot for their cooling mechanism to have space to exhaust heated air through the backplane might be unwelcome in a smaller chassis that have only a single slot to spare. Also, the gaming-PC builder's election to include two or more ganged adapters in one system (SLI or Crossfire) challenges the engineered cooling circuit. When many large adapters are placed in the path of cooler air brought in through one end of the chassis for the purpose of replacing the warmer internal air of the chassis, the overall ambient internal temperature increases.

Home Theater PCs

Home theater PCs (HTPCs) continue to gain in popularity as a specialized computing appliance. An HTPC might have multiple capabilities, such as storing large amounts of video media and streaming it to an output device, streaming it directly from the Internet, or acting as an A/V tuner and receiver, mating input sources with output devices. The versatility of an HTPC makes it a logical choice for people desiring to exercise more control over their existing set-top boxes, most of which do not even offer the option of flexible storage. HTPCs are personal computers with operating systems that allow easy access to local storage, allowing the user to add whatever media they want whenever they feel the need.

The average PC can be turned into a device with similar functionality, but a computer designed for use as such should be built on a chassis that adheres to the HTPC form factor; the average computer would not. In fact, the following list comprises the specializations inherent in true HTPCs:

- Video enhancements
- Specialized audio
- Special chassis
- TV tuner requirement

Video Enhancements

High-definition monitors are as commonplace as television displays in the home today. HTPCs, then, must go a step beyond, or at least not fall a step behind. Because High-Definition Multimedia Interface (HDMI) is an established standard that is capable of the highest-quality audio, video resolution, and video refresh rates offered by consumer electronics and because HDMI has been adopted by nearly all manufacturers, it is the logical choice for connectivity in the HTPC market. Considering the single simple, small-form factor plug and interface inherent to HDMI, more cumbersome video-only choices, such as DVI and YPbPr component video, lose favor on a number of fronts.

Graphics adapters present in HTPCs should have one or more HDMI interfaces. Ideally, the adapter will have both input and output HDMI interfaces, giving the PC the capability to combine and mix signals as well as interconnect sources and output devices. Additionally, internally streamed video will be presented over the HDMI interface to the monitor. Keep in mind that the monitor used should be state-of-the-art to keep up with the output capabilities of the HTPC.

Specialized Audio

Recall that HDMI is capable of eight-channel 7.1 surround sound, which is ideal for the home theater. The fact that the HTPC should be equipped with HDMI interfaces means that surround-sound audio is almost an afterthought. Nevertheless, high-end digital audio should be near the top of the wish list for HTPC specifications. If it's not attained through HDMI, then copper or optical S/PDIF should be employed. At the very least, the HTPC should be equipped with 7.1 analog surround sound (characterized by a sound card with a full complement of six 3.5mm stereo minijacks).

Special Chassis and TV Tuner

As mentioned earlier, HTPCs have their own specialized computer case form factor. These machines should be able to blend well with other home theater appliances, such as digital video recorders (DVRs) from a cable company or satellite provider, or look totally fine taking their place.

Creating a machine that takes up minimal space (perhaps even capable of being mounted on a wall beside or behind the monitor) without compromising storage capacity and performance requires the use of today's smallest components. The following list comprises some of the components you might use when building your own HTPC from separate parts.

- HTPC chassis, typically with dimensions such as 17×17×7″ and 150W HTPC power supply
- Motherboard, typically mini-ITX (6.7×6.7″) with integrated HDMI video
- HDD or SSD, usually 2½″ portable form factor, larger capacity if storage of multimedia content is likely
- RAM—DIMMs for mini-ITX motherboard; SODIMMs for many pre-built models
- Blu-ray drive, player minimum
- PCIe or USB TV tuner card, optionally with capture feature

Many prebuilt offerings exist with all components standard. You need only choose the model with the specifications that match your needs. Barebones systems exist as well, allowing you to provide your own hard drive and RAM modules. Many such units contain smaller ITX boards, such as nano- or pico-ITX, which are not compatible with most do-it-yourself chassis.

TV tuner cards are available as system add-ons and not commonly as integrated motherboard components. HTPCs that will be used only for streaming video from Internet sources and playing music do not require a TV tuner card. Otherwise, such a card might allow one or more sources, including one source split into two inputs, to be watched or recorded.

Standard Thick Clients

A *standard thick client* is not so much a custom configuration but instead the standard configuration that allows the definition of custom configurations. In other words, a thick client is a standard client computer system, and as such, it must meet only the basic standards that any system running a particular operating system and particular applications must meet. Because it's a client, however, the ability to attach to a network and accept a configuration that attaches it to one or more servers is implied. Although most computers today exhibit such capabilities, they cannot be assumed.

Each operating system requires a minimum set of hardware features to support its installation. Each additional desktop application installed requires its own set of features concurrent with or on top of those required for the operating system. For example, the operating system requires a certain amount of RAM for its installation and a certain amount of hard drive space. A typical application might be able to run with the same amount of RAM but will most certainly require enough additional hard-drive space to store its related files.

Keep in mind that minimum specifications are just that, the minimum. Better performance is realized by using recommended specifications or higher.

Thin Clients

Enterprises interested in saving copious amounts in infrastructure cost sometimes turn to thin clients to achieve their goal. A *thin client* is any machine that divests itself of all or most local storage and varying levels of RAM and processing power without necessarily giving up all ability to process instructions and data. In the extreme, a thin client resembles a dumb terminal, only displaying graphical user interface output to the monitor and relaying input from the mouse and keyboard back to the server. The primary difference between these ultra-thin clients and dumb terminals is that the clients feature a true network connection and contain enough intelligence to locate the server before turning over processing control.

The ramification of having clients with low processing and storage capabilities is that there must be one or more servers with increased corresponding capacities. Unfortunately, this leads to a single or centralized point of failure in the infrastructure that can impact productivity to an unacceptable level. Thin clients have no offline capability, requiring constant network connectivity. Workforces that require employees to be independent or mobile with their computing power lean away from thin clients as well, opting for laptops and similar technology.

Thin clients with local storage and basic applications for local execution must be able to accommodate the storage and processing of such applications and the operating systems for which they are designed, including full versions of Windows. Simple designs featuring flash-based storage and small quantities of small-form-factor RAM exist, reducing the need for such systems to resemble thick clients after all.

Home Server PCs

Essentially powerful client systems with standard, nonserver operating systems, home server PCs differ from enterprise servers to the point that they qualify as custom configurations. For many generations, desktop operating systems have run server services and have been capable of allowing limited access by other clients but not enough access to accommodate enterprise networks. Nevertheless, because the home server PC is the center of the home network, fault tolerance considerations should be entertained, which is decidedly not the case for standard home systems.

Recall that fault tolerance differs from redundancy in that fault tolerance seeks to retain accessibility during the failure while redundancy simply ensures recoverability after the failure. Redundancy, in the form of a data backup, does not ensure the continued accessibility of the data, but RAID, for example, seeks to do so. Even the most basic home system should be backed up regularly to avoid total data loss, but only servers in the home environment should be considered for the added expense of fault tolerance.

Home server PCs can be built from the same components that go into today's higher-performance systems. Attention needs to be paid to certain enhanced features, however. The following list outlines these differences:

- Media streaming capabilities
- File sharing services
- Print sharing services
- Gigabit NIC
- RAID array

Media Streaming Capabilities

A popular use for a home server is to stream music photos and videos to other devices, including those that are not PCs. With Windows 7, you can enable media streaming services and configure the computer to stream media. Of course, third-party applications and utilities are also a possibility.

With Windows 7, Microsoft introduced HomeGroups, which are basically workgroups intended to have a smaller scope. HomeGroups work hand in hand with libraries, another feature new to Windows 7. Anything that can be included in a library (documents, pictures, videos, and music) can be shared among the devices in the password-protected HomeGroup.

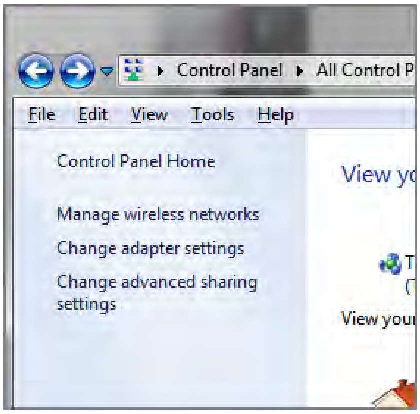
Additionally, HomeGroups can share installed printers among the member computers. Chapter 14, "Working with Windows 7," discusses HomeGroups in more detail.

You can prepare a Windows 7 computer to stream media through Windows Media Player by accessing the media streaming configuration through the advanced settings of the Network And Sharing Center in Control Panel. Exercise 5.1 walks you through the process.

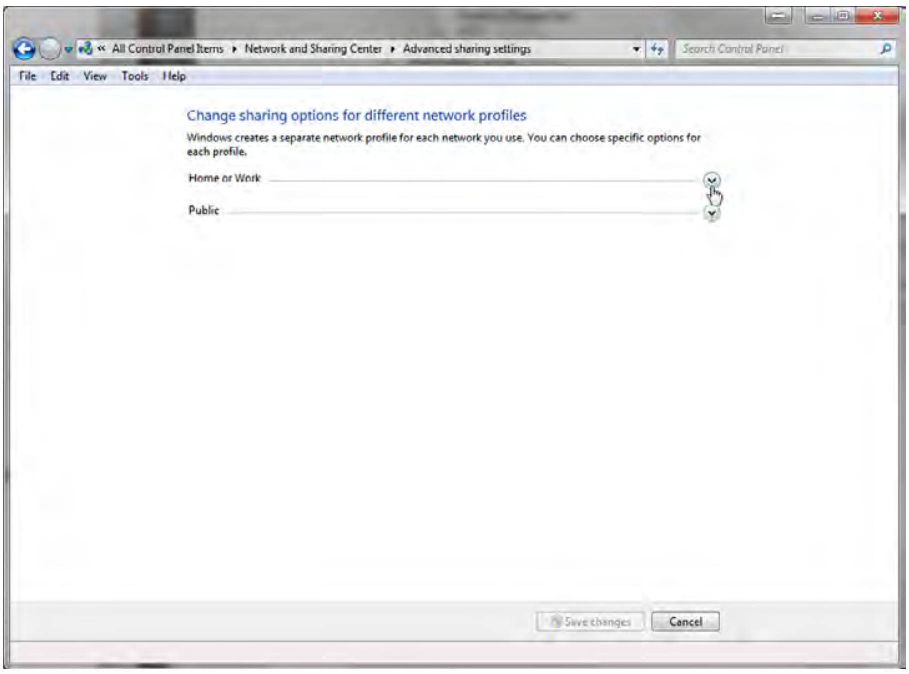
EXERCISE 5.1

Configuring Windows 7 for Media Streaming

1. In Control Panel, run the Network And Sharing Center applet in classic view.
2. Click the Change Advanced Sharing Settings link in the left frame.

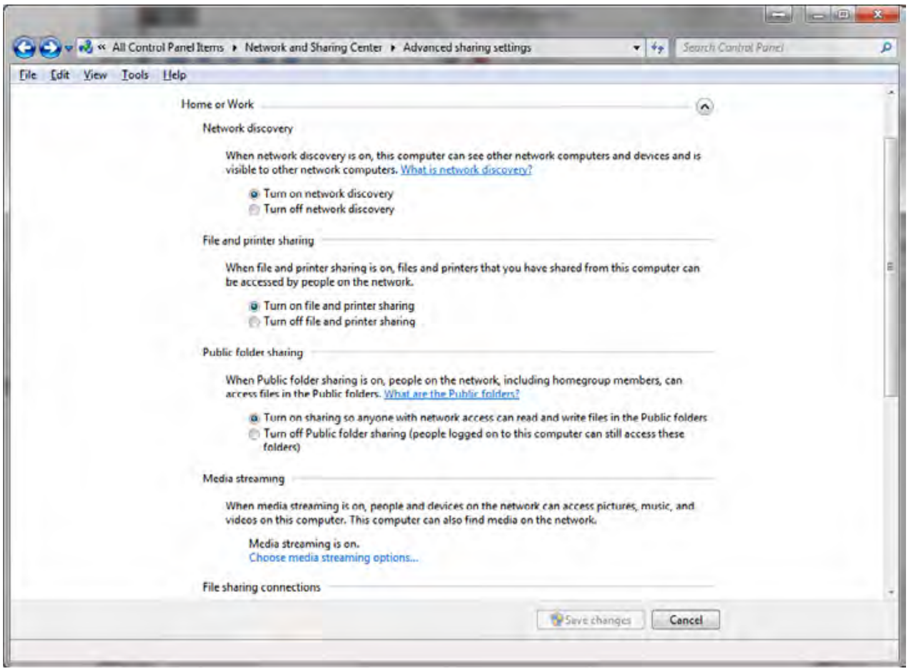


3. Click the down arrow to the right of Home Or Work to expand that configuration section.

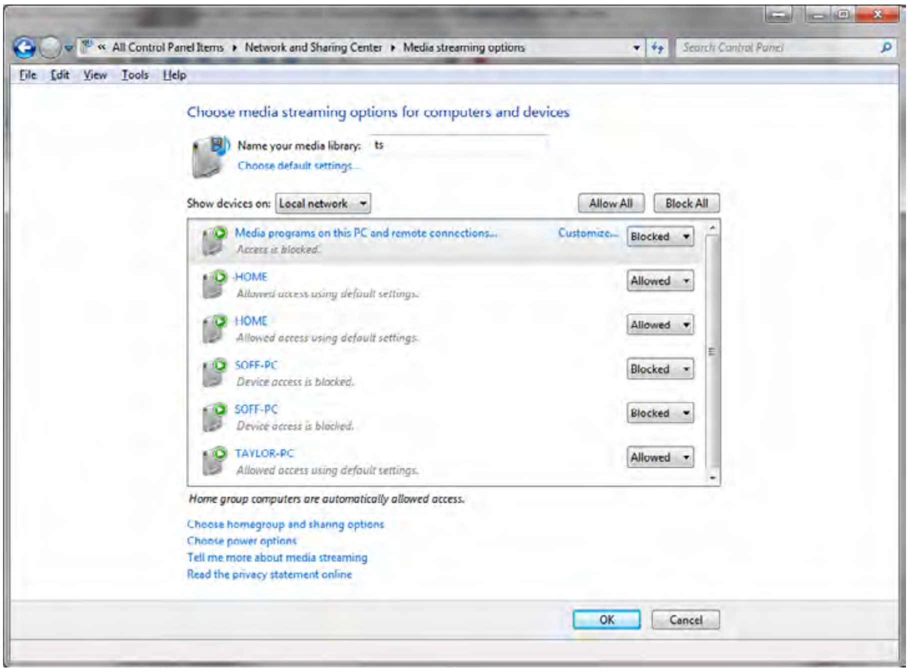


EXERCISE 5.1 *(continued)*

4. In the Media Streaming section, click the Choose Media Streaming Options link.

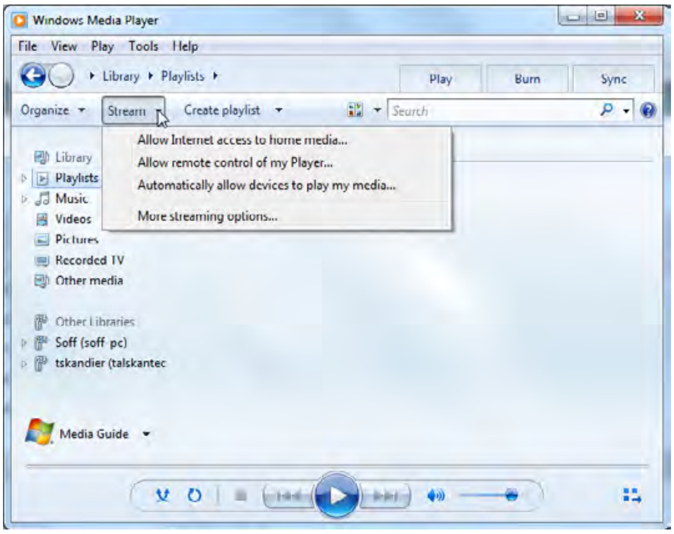


5. In the Media Streaming Options dialog, pull down the buttons labeled Blocked and change them to Allowed for each computer on the network that you want to be able to stream from the local PC.

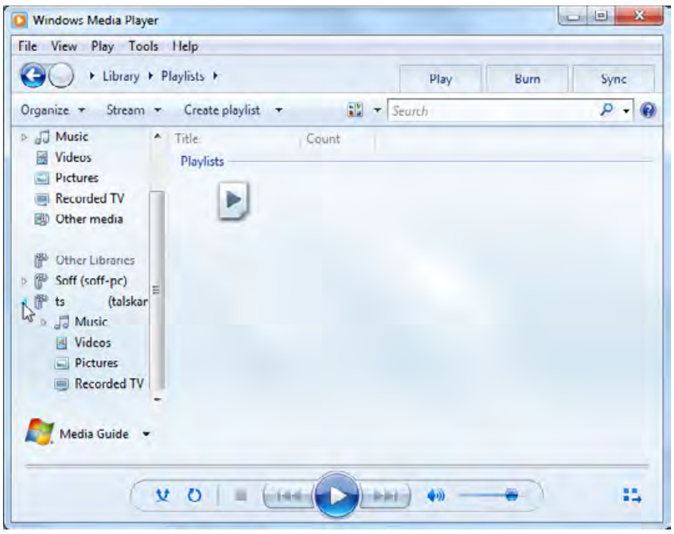


EXERCISE 5.1 *(continued)*

6. Click OK to leave the Media Streaming Options dialog and then close the Network And Sharing Center dialog.
7. Open Windows Media Player (for example, Start ➢ All Programs ➢ Windows Media Player) and switch to Library mode, if necessary (the grid icon with the arrow pointing left in Now Playing mode).
8. Ensure that streaming is enabled by clicking Stream ➢ Turn On Media Streaming. This option is hidden if streaming is already on, as shown here.



9. On one of the remote systems, start Windows Media Player.
10. Scroll down, if necessary, in the left frame until you see Other Libraries.
11. Expand the remote library you just shared and see if you can play music, watch videos or recorded TV, or view pictures.



File and Print Sharing Services

In addition to the ability to stream files to remote machines, home servers are expected to allow the static transfer of files to or from the server's hard drive or array. Streaming and file sharing are similar concepts, but streaming occurs in one direction from the server and does not affect the client's file system. File sharing can go in both directions, and it adds to the client's file system during downloads. The server acts as a repository for uploaded files that can then be downloaded from any other machine in the home network.

The difference between home servers and enterprise servers is that all clients in a home environment tend to have equal access to the file server's data store. Enterprise file servers have data stores that are isolated from users that do not have permission to access them. Print servers in the home and enterprise behave in a similar fashion. Each printer attached to the home server should be accessible to anyone on the home network.

File and print sharing are available through classic file sharing in Windows as well as through the Windows 7 HomeGroup.

Gigabit NIC

The home server should be attached to a wired switched port in an Ethernet switch or in the wireless access point. The NIC and the switch port should be capable of gigabit speeds. Providing such speed ensures that clients attached to 100Mbps Fast Ethernet ports and across the wireless network will not create a bottleneck in their attempt to share the server's resources. Running client NICs at gigabit speeds should be avoided, even though the capability is ubiquitous. Running all devices on the network at such speeds guarantees that each device so attached will attempt to saturate the server's gigabit interface with its own traffic.

RAID Array

Because some of the data stored on a home server represents the only copy, such as data that is streamed to all clients or the data included in a crucial backup of client systems, it must be protected from accidental loss. Because the data that comprises the streaming content, shared data store, and client backup sets can become quite expansive, a large capacity of storage is desirable. Even a recoverable server outage results in a home network that is temporarily unusable by any client, so fault tolerance should be included. RAID provides the answer to all of these needs.

By using a hardware RAID solution in the home server PC, the server's operating system is not taxed with the arduous task of managing the array, and additional RAID levels might also be available. The RAID array can extend to many terabytes in size, many times the size of a single drive, and should include hot-swappable drives so that it can be rebuilt on the fly while still servicing client requests during the loss of a single drive.

Windows Home Server 2011

As a specific example of a home server product, Microsoft has released Windows Home Server (WHS) 2011, an operating system intended to be preinstalled on specialized equipment offered by a variety of vendors around the world. WHS 2011 and the systems on which it is installed feature the components and capabilities in the list of the enhanced features a home server PC should have.

In particular, WHS 2011 systems implement a RAID array, typically with four hot-swappable drives in a compact enclosure that operates off of very little power. With the array, you can back up every computer on your network, including the server, on a daily basis. Restoring information from the backups is easy and flexible. Like with Windows 7, you can choose individual files to restore from a complete backup. Of course, you can restore entire systems as well. The entire server can be readily restored also.

File sharing and streaming is highly flexible with the server. It's a simple task to choose what is shared and what is not. Media can be streamed to any compatible network device, which can include network-enabled televisions, monitors, and game consoles. Data flow goes both ways, though, allowing you to keep an eye on the condition and performance level of all networked computers.

With a properly configured and subscribed Internet link, you can access the server from the Internet using a personalized URL, allowing you to remotely upload and download files and access applications.

Summary

In this chapter, you were introduced to seven systems of specific use and how a standard thick client differs from them. The seven systems are graphic and CAD/CAM design workstations, audio/video editing workstations, virtualization workstations, gaming PCs, home theater PCs, thin clients, and home server PCs.

You learned how some of these systems have very specific needs while others share common requirements for components not found in a standard desktop system. These needs include CPU enhancements, video enhancements, maximized RAM, specialized audio, specialized drives, NIC enhancements, enhanced cooling, special chassis, a TV tuner requirement, and specifics related to applications.

Exam Essentials

Be able to describe graphic and CAD/CAM design workstations and list their components. These workstations require powerful processors, high-end video, and maximum RAM to be able to provide the performance required to allow efficient graphic design and modeling.

Be able to describe audio/video editing workstations and list their components. A/V workstations call for specialized audio and video, large and fast hard drives, and multiple monitors to allow editors to smoothly play back their media while being able to see all the controls of their utilities and applications.