What Customers Want: Beyond Technical Know-How

Core 2 Objective

- 4.7

  Given a scenario, use proper communication techniques and professionalism.

Probably the most significant indication that an IT technician is doing a good job is that customers are consistently satisfied. In your career as an IT support technician, commit to providing excellent service and to treating customers as you would want to be treated in a similar situation. One of the most important ways to achieve customer satisfaction is to do your best by being prepared, both technically and personally. Being prepared includes knowing what customers want, what they don't like, and what they expect from an IT technician.

Equally important to being prepared technically is knowing how to work effectively with people in a technical world, which is one of the most sought-after skills in today's service-oriented work environments. An employer once told me, "It's not hard to find technically proficient people these days. But it's next to impossible to find people who know how to get along with others and can be counted on when managers are not looking over their shoulders." I could sense his frustration, but I also felt encouraged to know that good social skills and good work ethics can take you far in today's world. My advice to you is to take this part of the module seriously. It's important to be technically proficient, but the skills learned in this part of the module just might be the ones that make you stand out above the crowd to land that new job or promotion.

Note 1

People respond reciprocally to the position of your facial muscles. Try smiling when you greet someone and see what happens.

11-1a Become a Competent and Helpful Support Technician

Core 2 Objective

- 4.7

  Given a scenario, use proper communication techniques and professionalism.

The following traits distinguish a competent and helpful technician from a technician who is incompetent or unhelpful in the eyes of the customer:

- **Be dependable and reliable.** Customers appreciate and respect those who keep their word. If you promise to be back at 10:00 the next morning, be there on time. If you cannot keep your appointment, never ignore your promise. Call, apologize, explain what happened, and reschedule your appointment. Also, do your best to return phone calls the same day and return email within two days.

Note 2

Quote from R.C., an employer: "When I choose a person to work for me, in a lot of cases, I choose based on their past dependability or attendance. I am less concerned about a person's ability because I can train anyone to do a specific job. I cannot, however, train anyone to do anything if they are not present for me to train. Being dependable and reliable has a profound impact on customer relationships as well."

- **Keep a positive and helpful attitude.** This helps establish good customer relationships. You communicate your attitude in your tone of voice, the words you choose, how you use eye contact, your facial expressions, how you dress, and in many other subjective and subtle ways. Generally, your attitudes toward your customers stem from how you see people, how you see yourself, and how you see your job. Your attitude is a heart issue, not a head issue. To improve your attitude, you must do it from your heart. That's pretty subjective and cannot be defined with a set of rules, but it always begins with a decision to change. As you work with customers or users, make it a habit not to patronize or talk down to them. Don't make customers or users feel inferior. People appreciate it when they feel your respect for them, even when they have made a mistake or are not knowledgeable about the issue you are trying to resolve. If a problem is simple to solve, don't make other people feel they have wasted your time. Your customer or user should always be made to feel that the problem is important to you.

Applying Concepts

Customer Service

- **Est. Time:** 15 minutes
- **Objective:** 4.7

Josie walked into a computer parts store and wandered over to the cleaning supplies looking for Ace monitor wipes. She saw another brand of wipes, but not the ones she wanted. Looking around for help, she noticed Mary stocking software on the shelves in the next aisle. She walked over to Mary and asked for help finding Ace monitor wipes. Mary put down her box, walked over to the cleaning supply aisle without speaking, picked up a can of wipes, and handed them to Josie, still without speaking a word. Josie explained she was looking for Ace wipes. Mary yelled over three aisles to a coworker in the back room, "Hey, Billy! This lady

says she wants Ace monitor wipes. We got any?" Billy came from the back room and said, "No, we only carry those," pointing to the wipes in Mary's hand, and returned to the back room. Mary turned to Josie and said, "We only carry these," and then put the wipes back on the shelf. She turned to walk back to her aisle when Josie said to Mary, "Well, those Ace wipes are great wipes. You might want to consider carrying them." Mary said, "I'm only responsible for software." Josie left the store.

Discuss this situation in a small group of students and answer the following questions:

1. If you were Josie, how would you feel about the service in this store?
2. What would you have expected to happen that did not happen?
3. If you were Mary, how could you have provided better service?
4. If you were Billy, is there anything more you could have done to help?
5. If you were the store manager, what principles of good customer service would you want Billy and Mary to know that would have helped them in this situation?
    - **Listen without interrupting your customer.** When you're working with or talking to a customer, focus on them. Don't assume you know what your customer is about to say. Let them say it, listen carefully, and don't interrupt (see Figure 11-1). Make it your job to satisfy this person, not just your organization, your boss, your bank account, or the customer's boss.

      Figure 11-1

      Learn to listen before you decide what a user needs or wants

    - **Use proper and polite language.** Speak politely and use language that won't confuse your customer. Avoid using slang or jargon, which is technical language that only technical people understand. Avoid acronyms (initial letters that stand for words). For example, don't say to a nontechnical customer, "I need to ditch your PCIe 16 card," when you could explain yourself better by saying, "I need to replace the circuit board inside your computer that controls video."
    - **Show sensitivity to cultural differences.** Cultural differences between people from different countries and communities can result in different sets of expectations when it comes to customer service. For example, culture can affect our degree of tolerance for uncertainty. Some cultures are willing to embrace uncertainty, and others strive to avoid it. Those who tend to avoid uncertainty can easily get upset when the unexpected happens. For these people, you need to make special efforts to communicate early and often when things are not going as expected.
    - **Express patience and honor to those with physical disabilities.** For the physically disabled, especially the hearing- or sight-impaired, communication can be more difficult. It's your

responsibility in these situations to do whatever is necessary to find a way to communicate. It's especially important to have an attitude that expresses honor and patience, which you will unconsciously express in your tone of voice, your choice of words, and your actions.

Note 3

Employers look for technicians with good social skills and work ethics because they realize that technicians with these skills are good for business.

- **Take ownership of the problem.** Taking ownership of the customer's problem means accepting the problem as your own. Doing that builds trust and loyalty because the customer knows you can be counted on. Taking ownership of a problem also increases your value in the eyes of your coworkers and manager. People who don't take ownership of the problem at hand are likely to be viewed as lazy, uncommitted, and uncaring. One way to take ownership of a problem is not to engage your manager in unproductive discussions about a situation they expect you to handle on your own.

Applying Concepts

Self-Control

- **Est. Time:** 15 minutes
- **Objective:** 4.7

Jack had a bad day on the phones at the networking help desk in Atlanta. An electrical outage coupled with a generator failure had caused servers in San Francisco to be down most of the day. The entire help desk team had been fielding calls all day explaining to customers why they did not have service and giving expected recovery times. The servers were finally online, but it was taking hours to get everything reset and functioning. No one had taken a break all afternoon, but the call queue was still running about 20 minutes behind. JinHee, the help desk manager, had asked the team to work late until the queue was empty. It was Jack's son's birthday, and Jack's family was expecting him home on time. Jack moaned as he realized he might be late for Tyler's party. Everyone pushed hard to empty the queue. As Jack watched the last call leave the queue, he logged off, stood up, and reached for his coat.

And then another call comes in. Jack is tempted to ignore it, but decides he needs to answer it. It's Lacy, the executive assistant to the CEO (the chief executive officer over the entire company). When Lacy calls, all other priorities yield to her, and Lacy knows it. The CEO is having problems printing to the laser printer in his office. Would Jack please walk down to his office and fix the problem? Jack asks Lacy to check the simple things: "Is the printer turned on? Is it plugged in?" Lacy gets huffy and says, "Of course, I've checked that. Now come right now. I need to go." Jack walks down to the CEO's office, takes one look at the printer, and turns it on.

He turns to Lacy and says, "I suppose the on/off button was just too technical for you." Lacy glares at him in disbelief. Jack says, "I'll be leaving now." As he walks out, he begins to form a

plan as to how he'll defend himself to his manager in the morning, knowing the inevitable call to JinHee's office will come.

In a group of two or four students, one student should play the role of Jack and another the role of JinHee. Discuss these questions:

1. JinHee is informed the next morning of Jack's behavior, and calls Jack into her office. She likes Jack and wants him to be successful in the company. Jack is resistant and feels justified in what he did. As JinHee, what do you think is important that Jack understand? How can you explain this to Jack so he can accept it? What would you advise Jack to do?
2. Switch roles or switch team members and replay the roles.
3. What are three principles of relating to people that would be helpful for Jack to keep in mind?
    - **Portray credibility.** Convey confidence to your customers. Don't allow yourself to appear confused, afraid, or befuddled. Troubleshoot the problem in a systematic way that portrays confidence and credibility. Get the job done, and do it with excellence. Credible technicians also know when the job is beyond their expertise and when to ask for help.
    - **Work with integrity and honesty.** Don't try to hide your mistakes from your customer or your manager. Everyone makes mistakes, but don't compound them by a lack of integrity. Accept responsibility and do what you can to correct the error.
    - **Know the law with respect to your work.** For instance, observe the laws concerning the use of software. Don't use or install pirated software.
    - **Behave professionally.** A professional at work knows not to allow his emotions to interfere with business relationships. If a customer is angry, allow the customer to vent, keeping your own professional distance. (You do, however, have the right to expect a customer not to talk to you in an abusive way.)
    - **Dress professionally.** Dress appropriately for the environment. Take a shower each day, and brush your teeth after each meal. Use mouthwash. Iron your shirt. If you're not in good health, try as best you can to take care of the problem. Your appearance matters. Match your attire to the requirements of your environment:
        - **Business casual.** For men, **business casual** is neutral-colored dress slacks, khakis, polo shirt, tailored shirt, sweater, dark socks, dress shoes, and/or optional sports coat and tie. For women, business casual is a blouse, tasteful sweater, simple dress or skirt, slacks, closed-toe shoe, and tasteful jewelry. For both men and women, T-shirts, jeans, and shorts are usually not included. In a typical IT workplace, assume business casual until your boss says otherwise.

- **Business formal.** To shine at a job interview, always dress business formal. Business formal might also be appropriate at work when you attend an upper-level management meeting or event. For men, **business formal** includes matching jacket and slacks, shirt, and tie with dark socks and dress shoes. For women, business formal is a dress pant or skirt with matching jacket. Skirt lengths should be at or just above the knee. Make sure your blouse is not so short it shows your stomach and not so long it covers the hem of your skirt. Wear closed-toe shoes and tasteful jewelry.

- **Control your words.** Don't gossip. Coworkers might listen attentively to your negative gossip about others, but they will now probably suspect that you'll gossip about them when their backs are turned. Your credibility and trustworthiness suffer when you gossip. And finally, don't use rough language; it is never appropriate.

Note 4

Your customers might never remember what you said or did, but they will always remember how you made them feel.

11-1bPlan for Good Service

Core 2 Objective

- 4.7

Given a scenario, use proper communication techniques and professionalism.

Your customers can be internal, meaning you work for the same company and might consider the customers colleagues, or they can be external (they come to you or your company for service). Customers can be highly technical or technically naive, represent a large company or simply own a home computer, be prompt or slow at paying their bills, want only the best (and be willing to pay for it) or be searching for bargain service, be friendly and easy to work with or demanding and condescending. In each situation, the keys to success are always the same: Don't allow circumstances or personalities to affect your commitment to excellence, and treat the customer as you would want to be treated.

Exam Tip

The A+ Core 2 exam expects you to know that when serving a customer, you should be on time, dress appropriately, avoid distractions, set and meet expectations and timelines, communicate the status of the solution with the customer, and deal appropriately with customers' confidential materials.

First impressions are often lasting, so let's start there.

Initial Contact With a Customer

Your initial contact with a customer might be when the customer comes to you (such as in a retail setting), when you go to the customer's site, when the customer calls you on the phone, when the customer reaches you by chat or email, or when you are assigned a **ticket** (sometimes called an incident) already created when another person made initial contact and entered the request in a tracking system of customer calls. In each situation, always follow the specific guidelines of your employer. Let's look at some general guidelines for handling first contact with customers.

When you answer the phone, identify yourself and your organization. (Follow your employer's guidelines on what to say.) Follow company policies to obtain specific information when answering an initial call, such as name (get the right spelling), phone number, and business name. For example, your company might require that you obtain a licensing or warranty number to determine whether the customer is entitled to receive your support. After you have obtained the information you need and confirmed you are authorized to help the customer, open up the conversation for the caller to describe the problem.

Prepare for on-site visits by reviewing information given to you by the person who took the call. Know the problem you are going to address, the urgency of the situation, and what computer, software, and hardware need servicing. Arrive with a complete set of equipment appropriate to the visit. That might include a toolkit, flashlight, multimeter, ESD strap and mat, and bootable media.

When you arrive at the customer's site, greet the customer in a friendly manner, and shake hands (see Figure 11-2). Use terms such as Mr. or Ms. and Sir or Ma'am when addressing the customer unless you are certain the customer expects you to use their first name. If the site is a residence, you should *not* remain there when only a minor is present. If a minor child answers the door, ask to speak with an adult, and don't allow the adult to leave the house with only you and the child present.

Figure 11-2

If a customer permits it, begin each new relationship with a handshake

After initial greetings, the first thing you should do is listen and ask questions. As you listen, it's fine to take notes, but don't start the visit by filling out your paperwork. Save the paperwork for later, or have the essentials already filled out before you reach the site.

Interview the Customer

Troubleshooting begins by interviewing the user. Take notes as you ask the user questions, and keep asking questions until you thoroughly understand the problem. Have the customer reproduce the problem, and carefully note each step taken and its results. This process gives you clues about the problem and the customer's technical proficiency, which helps you know how to communicate with the customer.

Exam Tip

The A+ Core 2 exam expects you to be able to clarify customer statements by asking open-ended questions to narrow the scope of the problem and by restating the issue or question.

Use diplomacy and good manners when you work with a user to solve a problem. For example, if you suspect that the user dropped the computer, don't ask, "Did you drop the laptop?" Put the question in a less accusatory manner: "Could the laptop have been dropped?"

Set and Meet Customer Expectations

Professional technicians know that it is their responsibility to set and meet expectations with a customer. It's important to create an expectation of certainty with customers so they are not left hanging without knowing what will happen next.

Part of setting expectations is to establish a timeline with your customer for the completion of a project. If you cannot solve the problem immediately, explain to the customer what needs to happen, and outline the likely timeline for a solution. Then keep the customer informed about the progress of the solution. For example, you can say to a customer, "I need to return to the office and research the cost of parts that need replacing. I'll call you tomorrow before 10 a.m. with an estimate." If you later find out you need more time, call the customer before 10 a.m., explain your problem, and give him a new time to expect your call. This kind of service is very much appreciated by customers, and if you are consistent, you will quickly gain their confidence.

Another way to set expectations is to give customers an opportunity to make decisions about repairs to their equipment. When explaining to the customer what needs to be done to fix a problem, offer repair or replacement options if they apply (see Figure 11-3). Don't make decisions for your customer. Explain the problem and what you must do to fix it, giving as many details as the customer wants. When a customer must make a choice, state the options in a way that does not unfairly favor the most lucrative solution for you as the technician or for your company. For example, if you must replace a motherboard (a costly repair in parts and labor), explain the total cost of

repairs, and then help the customer decide if it's better to purchase a new system or repair the existing one.

Figure 11-3

Advise and then allow a customer to make repair or purchasing decisions

Work With a Customer on Site

As you work with a customer on site, avoid distractions. Don't accept personal calls or texts on your cell phone, and definitely don't check social media sites when you're on the job. Most organizations require that you answer calls from work while on site, but keep them to a minimum. Be aware that the customer might be listening, so be careful not to discuss problems with coworkers, your manager, or other situations that might put the company, its employees, or products in a bad light with the customer. If you absolutely must excuse yourself from the on-site visit for personal reasons, explain the situation to the customer, and return as soon as possible.

When working at a user's desk, follow these general guidelines:

1. As you work, be as unobtrusive as possible. Consider yourself a guest in the customer's office or residence. Don't make a big mess. Keep your tools and papers out of the customer's way. Don't pile your belongings and tools on top of the user's papers, books, and so forth.
2. Protect the customer's confidential and private materials. For example, if you are working on the printer and discover a budget report in the out tray, quickly turn it over so you can't read it, and hand it to the customer. If you notice a financial spreadsheet is displayed on the customer's computer screen, step away and ask the user if they want to first close the spreadsheet before you work with the computer. If sensitive documents are on the customer's desk, you might let them know and ask if they would like to put them out of your view or in a safe place.
3. Don't take over the mouse or keyboard from the user without permission.
4. Ask permission again before you use the printer or other equipment.
5. Don't use the phone without permission.
6. Accept personal inconvenience to accommodate the user's urgent business needs. For example, if the user gets an important call while you are working, don't allow your work to interfere. You might need to stop work and perhaps leave the room.

7. Also, if the user is present, ask permission before you make a software or hardware change, even if the user has just given you permission to interact with the computer.
8. Don't disclose information about a customer on social media sites, and don't use those public outlets to complain about difficulties with a customer.

In some IT support situations, it is appropriate to consider yourself a support to the user as well as to the computer. Your goals can include educating the user as well as repairing the computer. If you want users to learn something from a problem they caused, explain how to fix the problem, and walk them through the process if necessary. Don't fix the problem yourself unless they ask you to do so. It takes a little longer to train a user, but it is more productive in the end because the user learns more and is less likely to repeat the mistake (see Figure 11-4).

Figure 11-4

Teaching a user how to fix a problem can prevent it from reoccurring

Work With a Customer on the Phone

Phone support requires more interaction with customers than any other type of IT support. To understand customers' problems and give clear instructions, you must be able to visualize what customers see at their computer. Patience is required if the customer must be told each key to press or command button to click.

Help desk support requires excellent communication skills, good phone manners, and lots of patience (see Figure 11-5). As your help desk skills improve, you will learn to think through the process as though you were sitting in front of the computer yourself. Drawing diagrams and taking notes as you talk can be very helpful. In some cases, help desk support personnel might use software, such as Freshdesk by Freshworks (freshdesk.com), that enables the remote control of customers' computers. Always communicate clearly with customers when using this type of software so they understand what type of access they are allowing you to have on their computers.

Figure 11-5

Learn to be patient and friendly when helping users

If your call is accidentally disconnected, call back immediately. Don't eat or drink while on the phone. If you must put callers on hold, tell them how long

it will be before you get back to them. Speak clearly and don't talk too fast. Don't complain about your job, your boss, coworkers, your company, or other companies or products to your customers. A little small talk is okay and is sometimes beneficial in easing a tense situation, but keep it upbeat and positive.

Deal With Difficult Customers

Most customers are polite and appreciate your help. If you make it a habit to treat others as you want to be treated, you'll find that most of your customers will tend to treat you well, too. However, you occasionally will have to deal with a difficult customer. In this section of the module, you learn how to work with customers who are not knowledgeable, who are overly confident, and who complain.

When the Customer Is Not Knowledgeable

When on site, you can put a computer in good repair without depending on a customer to help you. But when you are trying to solve a problem over the phone, with a customer as your only eyes, ears, and hands, a computer-illiterate user can present a challenge. Here are some tips for handling this situation:

- Be specific with your instructions. For example, instead of saying, "Open Explorer," say, "Using your mouse, right-click the Start button, and click File Explorer from the menu."
- Don't ask the customer to do something that might destroy settings or files without first having the customer back them up carefully. If you think the customer can't handle your request, ask for some on-site help.
- Frequently ask the customer what is displayed on the screen to help you track the keystrokes and action.
- Follow along at your own computer. It's easier to direct the customer keystroke by keystroke if you are doing the same things.
- Give the customer plenty of opportunity to ask questions.
- Genuinely compliment the customer whenever you can to help the customer gain confidence.
- If you determine that the customer cannot help you solve the problem without a lot of coaching, you might need to tactfully request that the caller have someone with more experience call you. The customer will most likely breathe a sigh of relief and have someone take over the problem.

Note 5

When solving computer problems in an organization other than your own, check with technical support within that organization instead of working only with the user. User might

not be aware of policies that have been set on their computers to prevent changes to the OS, hardware, or applications.

When the Customer Is Overly Confident

Sometimes customers might want to give advice, take charge of a call, withhold information they think you don't need to know, or execute commands at the computer without letting you know so that you don't have enough information to follow along. A situation like this must be handled with tact and respect for the customer. Here are a few tips:

- When you can, compliment the customer's knowledge, experience, or insight.
- Slow the conversation down. You can say, "Please slow down. You're moving too fast for me to follow. Help me catch up."
- Don't back off from using problem-solving skills. You must still have the customer check the simple things, but direct the conversation with tact. For example, you can say, "I know you've probably gone over these simple things already, but could we just do them again together?"
- Be careful not to accuse the customer of making a mistake.
- Even though the customer might be using technical jargon, keep to your policy of not using jargon back to the customer unless you're convinced they truly understand you.

Exam Tip

The A+ Core 2 exam expects you to know that it is important not to minimize a customer's problem and not to be judgmental toward a customer.

When the Customer Complains

When you are on site or on the phone, a customer might complain to you about your organization, products, or service or the product and service of another company. Consider the complaint to be helpful feedback that can lead to a better product or service and better customer relationships. Here are a few suggestions that can help you handle complaints and defuse customer anger:

- Be an active listener, and let customers know they are not being ignored. Look for the underlying problem. Don't take complaints or anger personally.
- Give the customer a little time to vent, and apologize when you can. Then start the conversation by asking questions, taking notes, and solving problems. Unless you must have the information for problem-solving, don't spend a lot of time finding out exactly who the customer dealt with and what happened to upset the customer.
- Don't be defensive. It's better to leave the customer with the impression that you and your company are listening and willing to

admit mistakes. No matter how much anger is expressed, resist the temptation to argue or become defensive.

- Know how your employer wants you to handle a situation where you are verbally abused. For example, you might say something like this in a calm voice: "I'm sorry, but my employer does not require me to accept this kind of talk."
- If the customer is complaining about a product or service that is not from your company, don't start by saying, "That's not our problem." Instead, listen to the customer complain. Don't appear as though you don't care.
- If the complaint is against you or your product, identify the underlying problem if you can. Ask questions and take notes. Then pass these notes on to people in your organization who need to know.
- Sometimes simply making progress or reducing the problem to a manageable state reduces the customer's anxiety. As you are talking to a customer, summarize what you have both agreed on or observed so far in the conversation (see Figure 11-6).

Figure 11-6

When a customer is upset, try to find a place of agreement

- Point out ways that *you* think communication could be improved. For example, you might say, "I'm sorry, but I'm having trouble understanding what you want. Could you please slow down, and let's take this one step at a time?"

Applying Concepts

Culture of Honor

- **Est. Time:** 15 minutes
- **Objective:** 4.7

Gawin is one of the most intelligent and knowledgeable support technicians in his group at CloudPool, Inc. He is about to be promoted to software engineer, and today is his last day on the help desk. Simone, a potential customer with little computer experience, calls asking for help in accessing the company website. Gawin says, "The URL is www dot cloud pool dot com." Simone responds, "What's a URL?" Gawin's patience grows thin. He's thinking to himself, "Oh, help! Just two more hours and I'm off these phones for good." In a tone of voice that makes it clear Gawin thinks she's an idiot, he says to Simone, "You know, lady! That address box at the top of your browser. Now enter www dot cloud pool dot com!" Simone gets flustered and intimidated and doesn't know what to say next. She really wants to know what a browser is, but instead she says, "Wait. I'll just ask someone in the office to help me," and hangs up the phone.

Discuss the situation with others in a small group and answer these questions:

1. If you were Gawin's manager and overheard this call, how would you handle the situation?
2. What principles of working with customers does Gawin need to keep in mind?

Two students sit back to back, one playing the role of Gawin and the other playing the role of Simone. Play out the entire conversation. Others in the group can offer suggestions and constructive criticism.

The Customer Decides When the Work Is Done

When you think you've solved the problem, allow the customer to decide if the service is finished to their satisfaction. For remote support, the customer generally ends the call or chat session, not the technician. If you end the call too soon and the problem is not completely resolved, the customer can be frustrated, especially if it is difficult to contact you again.

For on-site work, after you have solved the problem, complete these tasks before you close the call:

1. If you changed anything on the computer after you booted it, reboot one more time to make sure you have not caused a problem with the boot.
2. Allow the customer enough time to be fully satisfied that all is working. Does the printer work? Print a test page. Does the network connection work? Can the customer sign in to the network and access data on it?
3. If you backed up data before working on the problem and then restored the data from backups, ask the user to verify that the data is fully restored.
4. Review the service call with the customer. Summarize the instructions and explanations you have given during the call. This is an appropriate time to fill out your paperwork and explain to the customer what you have written. Then ask if they have any questions.
5. Explain preventive maintenance to the customer, such as deleting temporary files from the hard drive or cleaning the mouse. Most customers don't have preventive maintenance contracts for their computers and appreciate the time you take to show them how to take better care of their equipment. One technician keeps a pack of monitor wipes in his toolkit and ends each call by cleaning the customer's monitor screen.

To demonstrate a sincere concern for your customer's business and that you have owned the problem, it's extremely important to follow up later with the customer. Ask if they are still satisfied with your work, and ask if they have any more questions. For example, you can say to the customer, "I'll call you on Monday to make sure everything is working and you're still satisfied with the work." On Monday, make that call. As you do, you're building customer loyalty.

Exam Tip

The A+ Core 2 exam expects you to know to follow up with the customer at a later date to verify their satisfaction.

Sometimes You Must Escalate a Problem

You are not going to solve every computer problem you encounter. Knowing how to **escalate** a problem properly so it is assigned to people higher in the support chain is one of the first things you should learn on a new job. Know your company's policy for escalation. What documents or entries in the ticketing system software do you use? Who do you contact? How do you pass the problem on—do you use email, a phone call, or an online entry in a database? Do you remain the responsible "support" party, or does the person now addressing the problem become the new contact? Are you expected to keep in touch with the customer and the problem, or are you totally out of the picture?

When you escalate, let the customer know. Tell the customer you are passing the problem on to someone who is more experienced or has access to more extensive resources. If you check back with the customer only to find out that the other support person has not called or followed through to the customer's satisfaction, don't lay blame or point fingers. Just do whatever you can to help within your company guidelines. Your call to the customer will go a long way toward helping the situation.

Working With Coworkers

Learn to be a professional when working with coworkers. A professional at work is someone who puts business matters above personal matters (see Figure 11-7). **In big bold letters, I can say the key to being professional is to learn not to be personally offended when someone lets you down or does not please you**. Remember, most people do the best they can considering the business and personal constraints they are up against. Getting offended leads to becoming bitter about others and about your job. Learn to keep negative opinions to yourself, and to expect the best of others. When a coworker starts to gossip, try to politely change the subject.

Figure 11-7

Coworkers who act professionally are fun to work with

Know your limitations, and be willing to admit when you can't do something. For example, Larry's manager stops by his desk and asks him to accept one more project. Larry already is working many hours overtime just to keep up. He needs to politely say to his boss, "I can accept this new project only if you relieve me of some of these tasks."

Applying Concepts

Active Learning

- **Est. Time:** 15 minutes
- **Objective:** 4.7

Ray was a new member of a corporate help desk team that supported hospitals across the nation. He had only had a couple of weeks of training before he was turned loose on the phones. He was a little nervous the first day he took calls without a mentor sitting beside him. His first call came from Fernanda, a radiology technician who was trying to sign in to the network to start the day. When Fernanda entered her network ID and passcode, an error message stated her user account was not valid. She told Ray she had tried signing in several times on two different computers. Ray checked his database and found her account, which appeared to be in good order. He asked her to try again. She did and got the same results. In his two weeks of training, this problem had never occurred. He told her, "I'm sorry, I don't know how to solve this problem." She said, "Okay, well, thank you anyway," and hung up. She immediately called the help desk number back and the call was answered by Jackie, who sits across the room from Ray. Fernanda said, "The other guy couldn't fix my problem. Can you help me?"

"What other guy?" Jackie asked.

"I think his name was Ray."

"Oh, him! He's new and he doesn't know much. Besides that, he should have asked for help. Tell me the problem." Jackie reset the account and the problem was solved.

In a group of three or more students, discuss and answer the following questions:

1. What mistake did Ray make? What should he have done or said?
2. What mistake did Jackie make? What should she have done or said?
3. What three principles of relating to customers and coworkers would be helpful for Ray and Jackie to keep in mind?

11-2 Documentation and Support Systems

Core 2 Objectives

- 4.1

  Given a scenario, implement best practices associated with documentation and support systems information management.

- 4.2

  Explain basic change-management best practices.

Well-run IT departments rely on good documentation and support systems to keep up with all the information surrounding IT operations in the entire organization. In this part of the module, you learn about the types of documentation and support systems you might encounter in your IT career and what is generally expected of you as an IT technician to follow these best practices and policies.

11-2a Types of Documents and Support Systems

Core 2 Objective

- 4.1

Given a scenario, implement best practices associated with documentation and support systems information management.

Some examples of documents and systems an IT technician might encounter in an organization are:

- **Knowledge base.** A **knowledge base** is a collection of articles containing text, images, or video that give information about a network, product, or service. Here are two examples of how a knowledge base might be used:
  - **Customer service.** To better support customers, a company might publish a knowledge base about its products or services on its website. Technical support specialists usually have access to a knowledge base to aid in helping customers during support calls; the knowledge base might be integrated into a ticketing system.
  - **IT training and troubleshooting.** As IT personnel install, configure, and troubleshoot devices and software, the information they learn can be documented in the IT department's knowledge base so it's readily available for future troubleshooting and for training new IT personnel.
- **Asset management. Asset management** tracks physical and digital assets, including end-user devices, network devices, IP addresses, software licenses, and related licenses. These inventory lists are typically maintained by software such as IT Asset Management by Alloy Software (alloysoftware.com). The application might track equipment by using an **asset tag** with an ID and a theft-prevention plate, such as the one shown in Figure 11-8. These tags and plates contain **barcodes** that are easily read by a laser scanner. Asset tracking software can scan the barcodes to report on existing

inventory, track equipment, report needed maintenance, and help with identifying and returning stolen property.

Figure 11-8

The print on this tag is embedded under a protective surface so it can't be easily damaged

Source: MyAssetTag.com

The software and hardware inventory lists might be maintained in a database system that includes information used to manage the assets, such as the following:

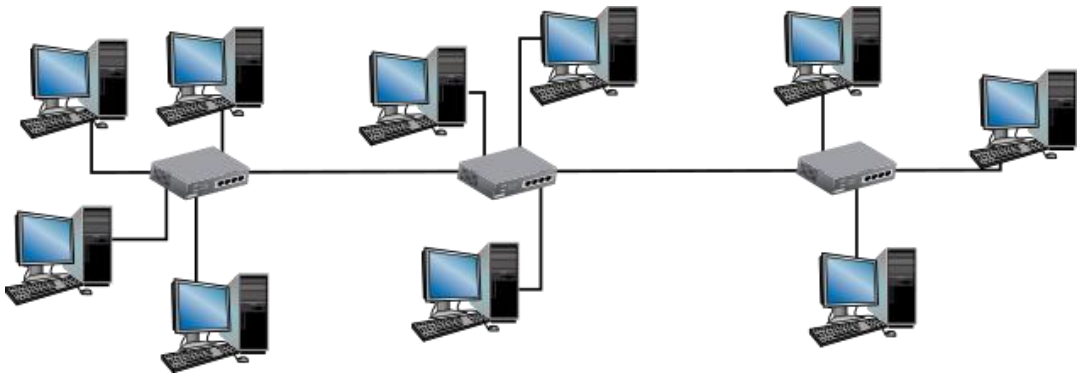
- The **asset ID** used to identify hardware equipment tracked in the system.
- **Procurement life cycle** data needed to replace an aged asset. The procurement life cycle data might include information on suppliers for the asset, contract terms for preferred suppliers, purchase orders, invoices, payment processing, and delivery data.
- Warranty and licensing information, such as terms of warranty for a hardware device or licensing terms for an application or other software.
- Users who are authorized to use an asset. For example, when a laptop is checked out to an employee, the employee's name and information is recorded in the asset management system.
- Auditing trails. Asset management might be audited, and the system should be able to provide trails for noncurrent activity such as who has had the laptop checked out to them since it was purchased.

- **Password policy.** In the module "Securing and Sharing Windows Resources," you learn what is required to create a strong password and best practices for passwords (for example, allowing one to expire so that the user must occasionally change it). These requirements are sometimes documented as a password policy.
- **Network topology diagrams.** Network documentation should contain a map of a network's topology, which is called a **network topology diagram**. In networking, **topology** refers to the pattern in which devices on a network are connected with each other. For

example, devices connected in a line are using a bus topology, and devices connected to a single, centralized device are using a star topology. As described in the module "Networking Fundamentals," most Ethernet networks today use a design called a star bus topology, which means that nodes are connected to one or more centralized devices that are connected to each other (see Figure 11-9).

Figure 11-9

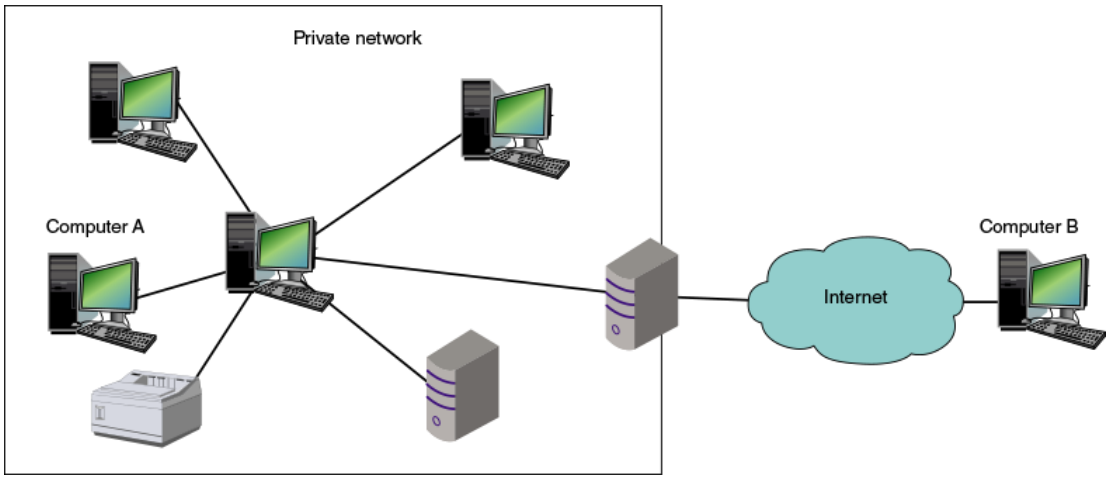
A star bus network formed by nodes connected to multiple switches



A network topology diagram might show how nodes on a network are physically connected, such as the one in Figure 11-9, or it might show the logical network topology. For example, Figure 11-10 shows the logical connection among clients and servers to indicate how data flows among them.

Figure 11-10

A logical network topology showing how data flows among computers

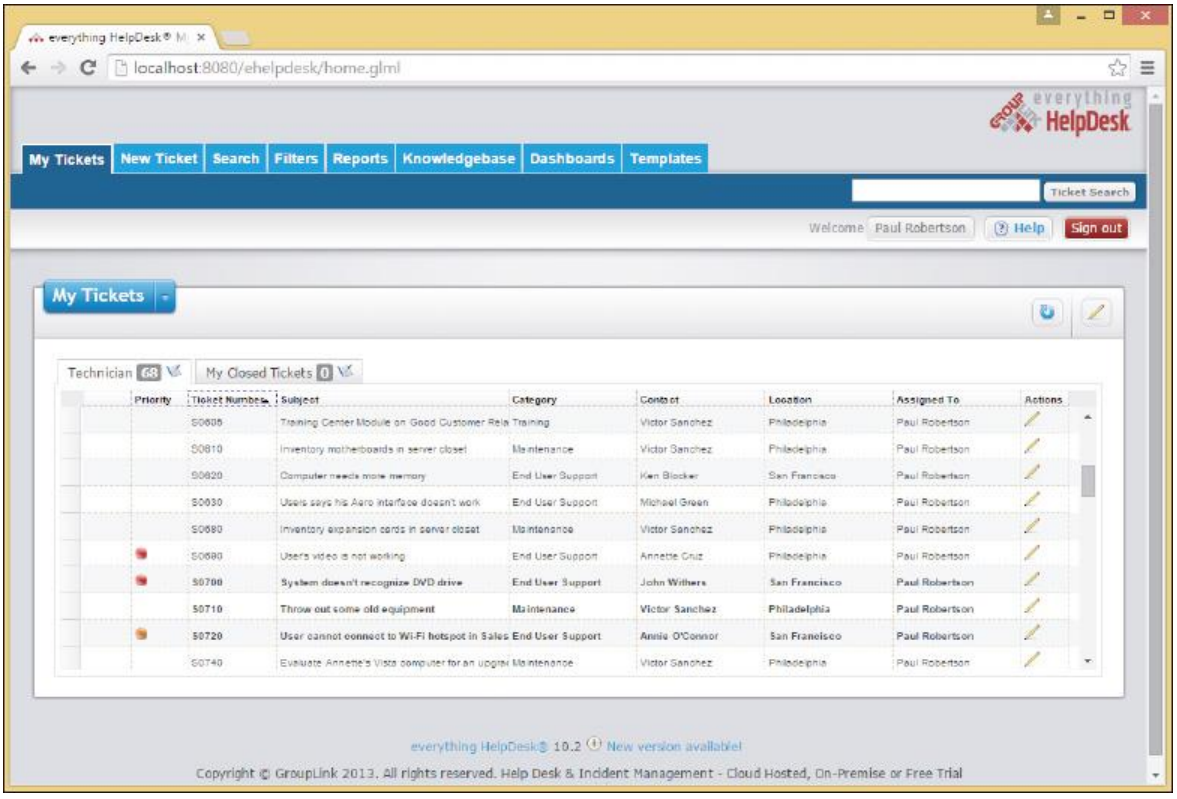


On small networks, a network topology diagram can be hand drawn, but for larger networks, inventory data is usually compiled automatically through network scans. For example, Spiceworks (spiceworks.com) offers a free network inventory product that probes devices on the network and presents a list of detected devices along with any available information, such as IP addresses, installed operating systems, and shared folders.

- **Ticketing systems.** One of the first systems you'll learn to use in an IT organization is its **ticketing system** used to track support calls and give technicians a place to keep their call notes. Figure 11-11 shows a window in a popular ticketing-system application called everything HelpDesk.

Figure 11-11

Ticketing system software allows you to create, edit, and close tickets used by technicians



When someone initiates a call for help, whoever receives the call starts the process by creating a ticket, which is a record of the request and what is happening to resolve it. The ticketing system might track (1) user information, (2) device information, (3) description of the problems, (4) categories for tickets (for example, by incident type, deadlines, or type of problem), (5) severity of the problem or situation, (6) escalation levels, (7) who is currently assigned and who has been assigned to the ticket, and (8)

clear and concise written communication about the problem. These notes should include progress notes, who did what and when, and how the problem was resolved.

Exam Tip

The A+ Core 2 exam requires you to know the type of information that is tracked in a ticketing system.

The ticket is entered into the call tracking system and stays open until the issue is resolved. Support staff assigned to the ticket document their progress under this ticket in the call tracking system. As an open ticket ages, more attention and resources are assigned to it, and the ticket might be escalated until the problem is finally resolved and the ticket closed. Help desk personnel and managers acknowledge and sometimes even celebrate those who consistently close the most tickets!

As you support customers and solve computer problems, it's very important to include detailed information in your call notes so you have the information as you solve the problem or when faced with a similar problem later. Sometimes another person must pick up your open ticket, and they should not have to waste time finding out information you already knew. Also, tracking-system notes are sometimes audited.

Exam Tip

The A+ Core 2 exam requires you to understand the similarities and differences among various types of documentation, including network topology diagrams, knowledge base articles, regulatory and compliance policies, acceptable use policies, ticketing systems, and inventory management documentation. All are discussed in this module.

- **Acceptable use policies.** An **acceptable use policy (AUP)** documents a code of conduct for employees when using corporate resources. For example, the AUP may prohibit an employee from accessing pornographic material on company computers, using company computers and time for personal shopping, or installing pirated software on company computers.
- **Standard operating procedures.** When you start in a new position, your job training will cover **standard operating procedures** that detail how to function in the organization, including how to perform basic procedures such as recording your overtime hours as well as more advanced procedures such as performing custom installations of software packages. For example, operating procedures for custom software installations might include recording the software package in the asset management system along with information on the licensing agreement and which computers in the organization received the installation. As with many employee tasks, it's not so important to

know all these procedures as it is to know how to find a procedure when you need one.

- **New-user setup checklist and end-user termination checklist.** Carefully following the **new-user setup checklist** and the **end-user termination checklist** is essential for good security of the resources managed by the IT department. These hardware and digital resources include the network, devices, software, and data. The checklists are likely documented among the standard operating procedures for the IT department.
- **Regulatory compliance requirements.** An organization is required by law to comply with relevant laws and other regulations. The IT department is particularly responsible to meet these **regulatory compliance requirements** such as how personal identity data can be kept and used. For example, your manager might ask you to verify that a **splash screen**, also called a launch screen (the first screen a user sees when they open an app), is compliant by protecting customer data and displaying how that data can be used. On the screen, you see the user's email address and realize that the splash screen is not compliant. However, the screen is compliant in that it details what happens to the user data. You learn more about regulatory compliance in the module "Security Strategies."

One more type of documentation covered in this module is that used in change management best practices, which is discussed next.

11-2b Change Management

Core 2 Objective

- 4.2

Explain basic change-management best practices.

As an IT support technician, you will undoubtedly be involved in new projects, such as installing hardware or software, upgrading networks, moving IT operations from on-site services to cloud-based services, rolling out virtualized desktops across the organization, implementing a VoIP communication platform, and much more. A project is temporary—it has a beginning, an end, and a singular, well-defined goal. A successful project depends on expert project management to direct a project team through specific tasks and deliver results on time, within the agreed-to budget, and with complete customer satisfaction.

Exam Tip

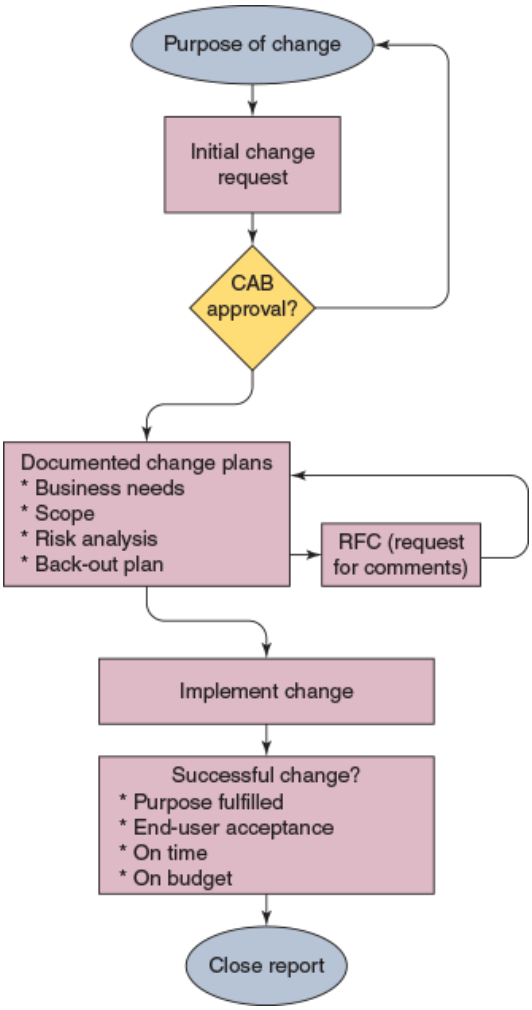
The A+ Core 2 exam will give you a scenario and expect you to apply the basic principles of change management, including documenting business processes, purpose of change, scope of change, risk analysis, end-user acceptance, change boards, rollback plans, and the need to document change.

When a project is implemented, change happens. Change managed well means that people affected by the change can make a smooth transition from their current state to the project goal or end result. In most situations, **change management** is closely integrated with project management and often involves the same teams. For example, a project manager works with a team to plan, develop, test, and implement new software. A change manager might work with the same team to define how the software will affect people and manage all communication, scheduling, training, and support required so the affected people accept and embrace the end result.

A high-level change process is diagrammed in Figure 11-12. Know, however, that change processes vary widely. Next, we'll look at the basic elements of change management and how they might relate to you as an IT support technician.

Figure 11-12

The general flow of change management



Documented Business Processes

A business is complex, and leaders of well-run organizations know they must understand and document their core business goals and processes. **Documented business processes** are related activities that lead to a desired business goal, such as an efficient and cost-effective service, excellent customer satisfaction, or a superior product. For example, if customer satisfaction is a defined business goal, IT operational processes might describe how customers are taken care of, support tickets are documented, and customer satisfaction is measured.

As change happens, be aware of how this change affects documented business processes. For example, suppose help desk software is changed so the customer's electronic signature is required when a ticket is closed. If you forget the electronic signature, your company may not be able to collect payment or follow up with the customer for a satisfaction survey.

Purpose of Change

The starting point for every proposed change is a clear and concise purpose for the change. What will change? What is the current situation and expected outcome? Why is the change needed? What happens if the organization does not initiate this change? How will the success of the change be measured?

Note 6

IT technicians often communicate with people impacted by change. Therefore, it's important that you have a firm understanding of the purpose for the change so you can maintain a positive, helpful attitude.

A proposed change is formally submitted using a change request process. A change **request form** states what needs to be updated or changed but does not indicate how the change will be executed. A simple change request might require only preapproval from a manager. Complex changes, with higher impact and risks, are submitted to a change advisory board. The **change advisory board (CAB)** meets on a regular basis to assess, prioritize, authorize, and schedule changes. The change manager and other representatives approve changes based on the recommendations of the change advisory board.

Change Plan and Scope

The change plan defines the **scope of change**, which may outline the following:

- The purpose of the change, including key components of the change and how they will be addressed
- Skill sets, tasks, and activities required to carry out the change
- Staff member responsible for the managing the change
- Individuals or departments that will participate in the change
- Systems that will be affected by the change and the impact on those systems
- The date and possibly even the time the change will be implemented
- How the success of change is measured and when the change is completed

The scope of change defines your responsibilities in the change plan. It's important that you understand exactly your assignment for planning, implementing, and supporting the change and then work within these boundaries, which is called working "in scope." The scope of change might evolve through the feedback process of change management, but until the scope changes, it's important to work in scope. Although it might be tempting to perform yet one more step while implementing a change, don't make out-of-scope modifications, which might result in major disruption. Also, a project's purpose might expand as the project progresses, which is

sometimes called scope creep. Too much scope creep can jeopardize the success of the entire change.

Risk Analysis

Change almost always involves risk, which refers to a problem (event, situation, or condition) that may or may not occur as a result of the change. Possible risks include the possibility the budget is inadequate, alienating customers, not finishing on time, not delivering the intended results, the number of employees affected, and downtime for the network or other systems. **Risk analysis** is the process of identifying potential risks and deciding if the risks are worth the change.

Sometimes a numeric value or **risk level** from 5 (highest risk) to 1 (lowest risk) is assigned to each risk. To determine these values, each administrator affected by the potential risk may be asked to assign a risk level to that risk. Change management software might receive all this input to calculate an overall risk level for the change.

As an IT technician, you need to be aware of the risks involved and how to execute the response plan if the problem actually happens.

Rollback Plan

What if a change goes bad—really bad? Suppose all users lose network connectivity for hours or all database servers that log all online sales orders spontaneously crash. The **rollback plan**, also called the back-out plan, defines the activities needed to recover to the original state in the event of an aborted or failed change implementation. The rollback plan is created and sometimes tested even before the change starts, and it includes detailed steps to restore service to users. Obviously, you need to be aware of the rollback plan prior to implementing a change.

End-User Acceptance

Recall that change management is responsible for ensuring that people impacted by change are able to make a smooth transition during the change. End-user acceptance to change often fails because the focus of the change is on the technical side rather than the people side. To gain end-user acceptance, users must know

1. The purpose of the change, especially the business reasons for the change
2. That the leadership of the company agrees with the change
3. How the change will affect them and their job
4. How to get their individual concerns and questions answered and how their voices will be heard

5. That they will receive end-user training for the changes that impact them. For software changes, training often allows users to practice using the new software in a **sandbox**, which is an environment in which users can practice with data and processes that don't affect the real data and where mistakes have little consequence. (Technicians also use sandboxes to test software to make sure it works as designed.)

Before a change begins, an organization might request user feedback to the change in a **request for comments (RFC)**. Technical users often have valuable input in the RFC process that may affect the entire change process. IT technicians often play a major role in end-user acceptance. Users who struggle with change will appreciate your empathetic and positive outlook. When a proposed change has been clearly communicated and users understand "what's in it for them," you have made a significant contribution to a successful change.

Document Changes

No part of change management should rely on spoken communication. Everything related to changes must be documented, including how the change management process itself works. Change plans are documented and updated throughout the entire change management process. Many larger organizations use change management software, such as ChangeGear by SunView (sunviewsoftware.com), to manage all stages of change management from the change request form to the final close report. Smaller organizations may manually document change using Microsoft Word or Excel documents or database software. Regardless of the size of the organization, you will be expected to maintain proper documentation for all stages of a change in which you participate.

11-3 Working in Diverse Software Environments

Core 2 Objectives

- 1.8

  Explain common OS types and their purposes.

- 1.9

  Given a scenario, perform OS installations and upgrades in a diverse OS environment.

In the diverse world of IT, an IT support technician encounters a wide variety of hardware platforms, operating systems, and applications. In this

section, we focus on what all operating systems have in common as well as the diversity you might encounter among operating systems.

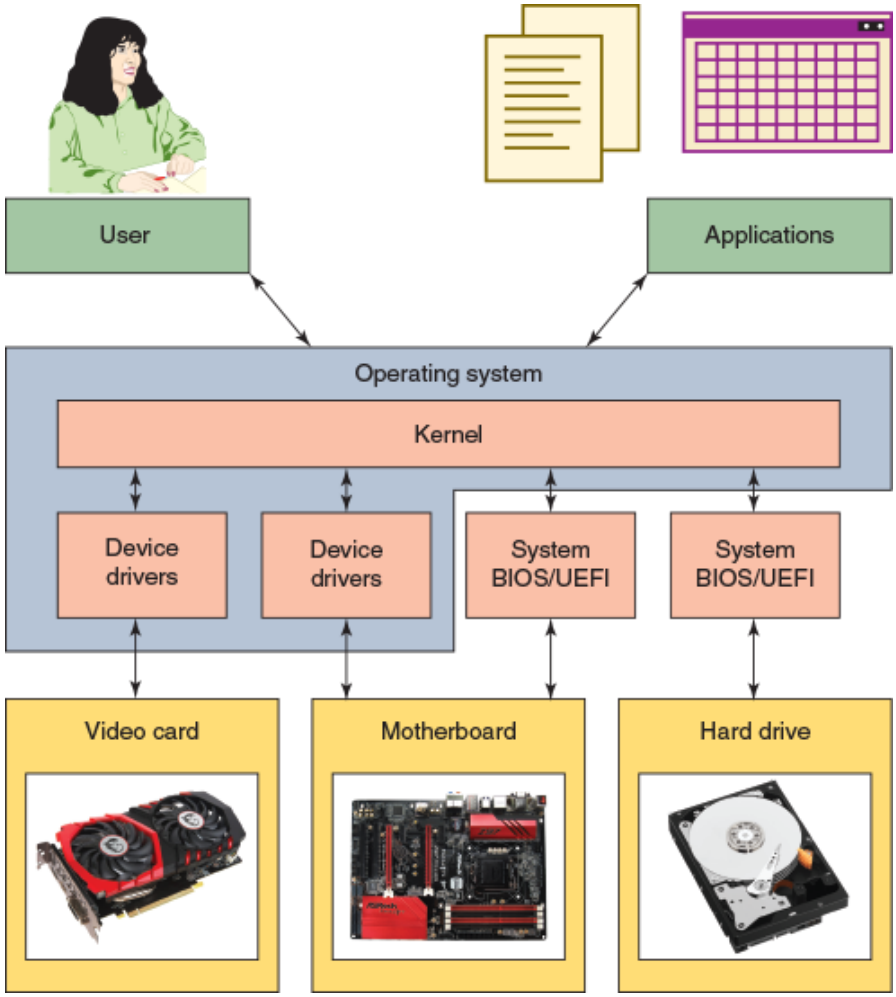
11-3a What All Operating Systems Do

Core 2 Objective

- 1.8

Explain common OS types and their purposes.

An **operating system (OS)** is software that controls a computer, and all operating systems have common functions. In general, you can think of an operating system as the middleman between applications and hardware, the between user and



hardware, and between the user and applications, as shown in Figure 11-13. (Individual components of an OS also shown in the figure are discussed later in this module.) **Figure 11-13** Users and applications depend on the OS to relate to all applications and hardware components

Several applications might be installed on a computer to meet various user needs, but a computer really needs only one operating system. Although there are important differences among them, all operating systems share the following four main functions:

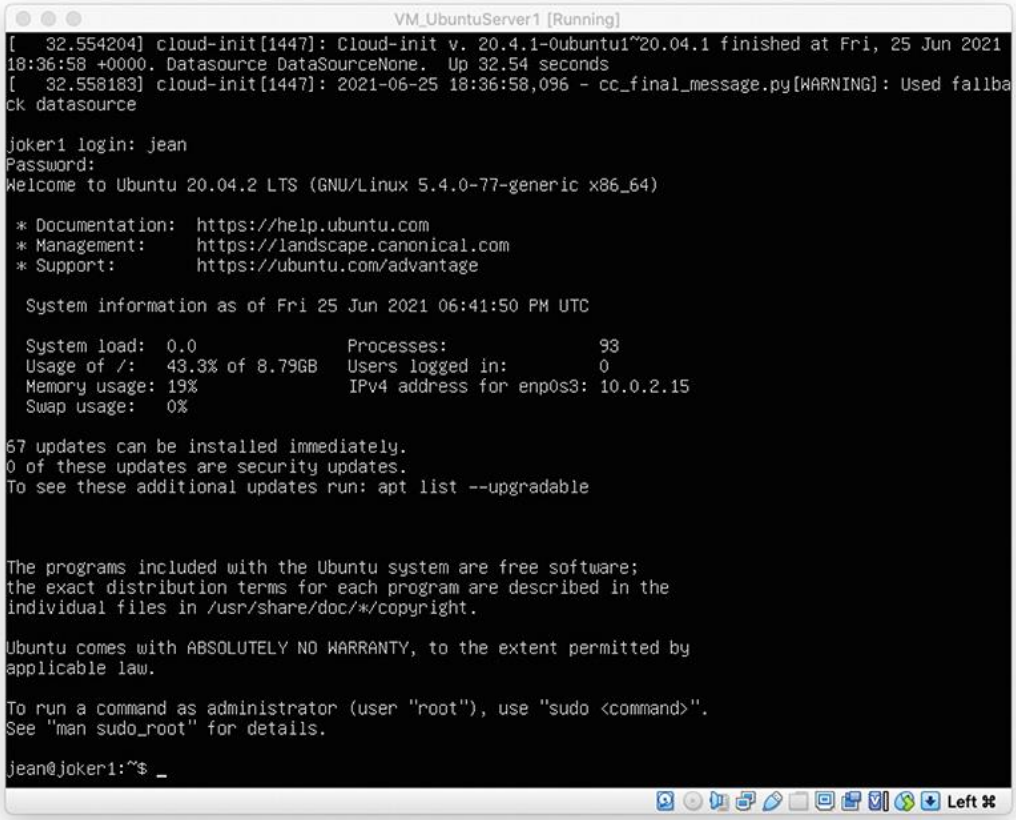
- **Function 1:** Provide a user interface
    - Performing storage and housekeeping procedures requested by the user, such as reorganizing a hard drive and changing display settings
    - Providing a way for the user to manage the desktop, hardware, applications, and data
- **Function 2:** Manage files
    - Managing files on hard drives, DVD drives, CD drives, USB flash drives, and other drives
    - Creating, storing, retrieving, deleting, and moving files
- **Function 3:** Manage hardware
    - Interface with the BIOS/UEFI, which are programs permanently stored on hardware devices
    - Managing memory, which is a temporary place to store data and instructions as they are being processed
    - Diagnosing problems with software and hardware
    - Interfacing between hardware and software (that is, interpreting application software needs to the hardware and vice versa)
- **Function 4:** Manage applications
    - Installing and uninstalling applications
    - Running applications and managing the interface to the hardware on behalf of an application

Every OS offers a command-driven interface for the user, and almost every OS also offers one or more **graphical user interface (GUI**; pronounced "GOO-ee"). Workstation OSs always provide a graphical interface. Because server computers normally have little direct human interaction, their OSs, such as Linux Ubuntu Server, don't always require a graphical interface. IT technicians must be comfortable using both interfaces and also supporting users learning to use a graphical interface. The Windows graphical interface, called the desktop, is shown in Figure 11-14. Figure 11-15 shows a command-driven interface in a Linux server.

Figure 11-14

The Windows 10 desktop with browser, Control Panel, and File Explorer open

Figure 11-15 The command-driven interface for Ubuntu Server



11-3b Popular Operating Systems

Core 2 Objective

- 1.8

  Explain common OS types and their purposes.

  As an IT technician, you might be called on to help a customer decide which type of OS to use in a given situation. Organizations often have a mix of several operating systems in use. The four most popular operating systems for workstations are Windows, macOS, Linux, and Chrome OS. Here's an overview of each OS:

  - **Windows** by Microsoft (Microsoft.com) is the most popular workstation OS and installs on almost all desktops and laptops. The current version is Windows 11, which was an upgrade to Windows 10, which was an upgrade to Windows 8.1, which was preceded by Windows 7. Every IT support technician needs to be a power user of Windows.

Exam Tip

The A+ Core 2 exam covers Windows 10 as the primary version of the Windows operating system.

- **macOS** by Apple (apple.com) is extremely easy to use, and its desktop interface is intuitive and beautiful. macOS comes installed on Apple desktops and laptops. Because Apple is able to control the hardware used by macOS, the OS is stable and reliable. Windows and macOS are the most popular OSs for workstations, and people tend to have strong opinions about which they prefer. It often boils down to user preference when deciding between the two OSs. Figure 11-16 shows the macOS desktop.

Linux is a secure and extremely stable OS that doesn't take up much space on the hard drive. In fact, it takes up so little space that you install it on a USB drive and run the OS from the drive. The main advantage of Linux is that most distributions are free. Some disadvantages to Linux are that it requires more technical knowledge to use and support it, it doesn't have as many applications made for it as does Windows or macOS, and it doesn't support as many hardware peripherals. Linux comes in many distributions, also known as distros or flavors, such as Ubuntu, Linux Mint, Debian, Fedora, Red Hat, CentOS, and Puppy Linux. Figure 11-17 shows the desktop for Ubuntu Desktop.

- **Chrome OS** by Google (google.com) is a relatively simple OS that works on personal devices including tablets and laptops, called Chromebooks (see Figure 11-18), and desktops, called Chromeboxes (see Figure 11-19). Google calls its Chromebook a Google Pixelbook. Chrome OS apps are available from the Chrome Web Store. Chrome OS can also run Android apps, available from Google Play. Full applications, such as Microsoft Word, are not available for the Chrome OS. Chrome OS and its devices are relatively inexpensive compared to other personal devices, and they have traditionally been marketed to the education market as a more affordable solution when heftier computing capabilities are not required.

11-3c How an OS Manages Hardware

Core 2 Objectives

- 1.8

  Explain common OS types and their purposes.

- 1.9

  Given a scenario, perform OS installations and upgrades in a diverse OS environment.

Looking back at Figure 11-13, notice that the OS **kernel** is the part of the OS that is responsible for relating to hardware by way of device drivers and/or firmware on the hardware. In this section, we see how both methods work.

Device Drivers

Device drivers are small programs stored on the hard drive that tell the OS how to communicate with a specific hardware device such as a printer, network card, or scanner. These drivers are installed on the hard drive when the OS is first installed or when new hardware is added to the system. A device driver is written to work for a specific OS, such as Windows, macOS, or Linux.

In addition to the device drivers that are installed at the time the OS is installed, other drivers are provided by the manufacturer of each hardware device. When you purchase a printer, video card, digital camera, scanner, or other hardware device, a CD or DVD that contains the device drivers is usually bundled with the device along with a user manual (see Figure 11-20). You can also download the drivers for a device from the manufacturer's website. Before you install a new OS, be sure you have the correct device drivers for all your critical devices, such as your network card or motherboard.

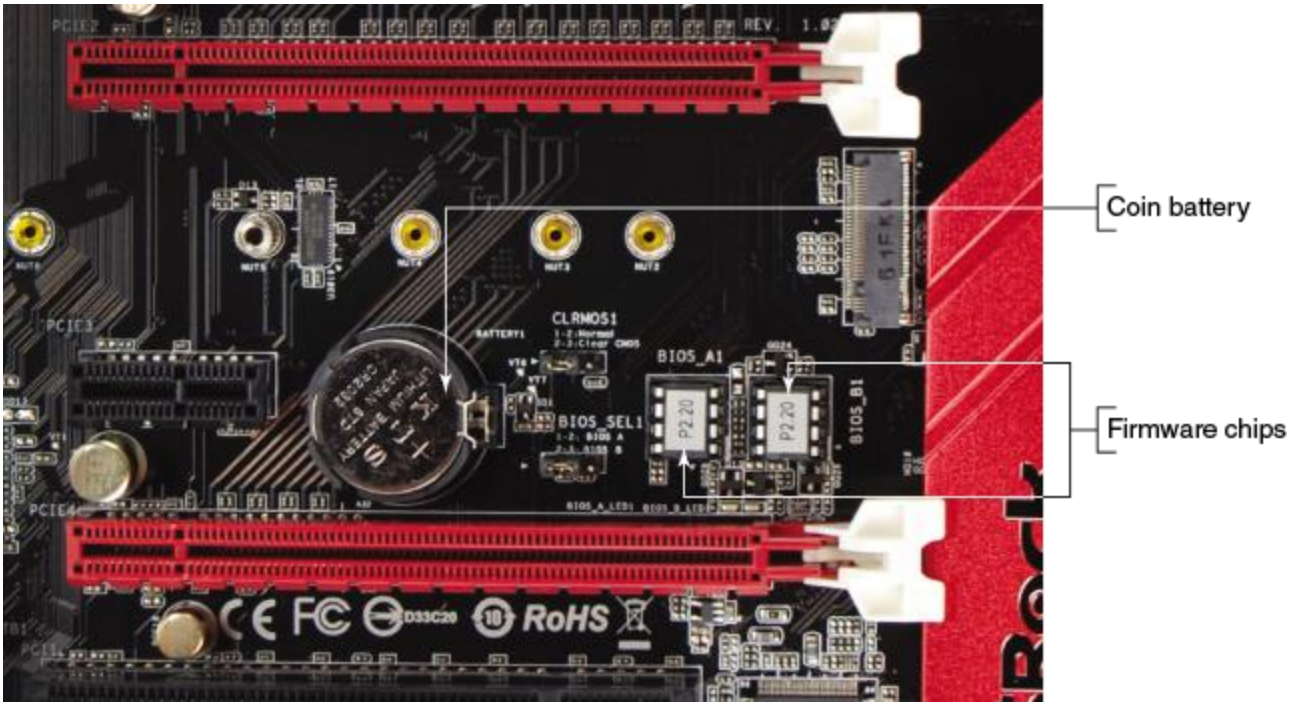
Older CPUs processed only 32 bits at a time, but all modern CPUs process 64 bits and can handle 32-bit processing for backward compatibility with older operating systems. An operating system is also designed to process 32 or 64 bits. When selecting device drivers, make sure you choose 32-bit drivers for a 32-bit OS (a really old OS) and 64-bit drivers for a 64-bit OS (most likely situation).

Firmware on the Motherboard

The most important hardware component in a computer is the motherboard, and every motherboard has firmware that controls it and interfaces with the OS. This firmware is stored on microchips on the board (see Figure 11-21). When a computer is first turned on, firmware on the motherboard starts up the computer, verifies essential hardware devices (such as memory and a CPU) are present, and then starts the process of searching for and loading an operating system.

Figure 11-21

Chips on a motherboard contain firmware used to start the computer, hold motherboard settings, and run essential devices; the chips retain power from a nearby coin battery when the computer is turned off



All modern motherboards use firmware called **UEFI (Unified Extensible Firmware Interface)**. UEFI is a much-improved replacement for **BIOS (basic input/output system)** and offers legacy support for BIOS compatibility. BIOS stores its setup information on the motherboard, while UEFI stores its setup information, along with some drivers, on the motherboard and the hard drive. The motherboard BIOS/UEFI provides three main functions:

- The **system BIOS/UEFI** contains instructions for running essential hardware devices before an operating system is started. After the OS is started, it might continue to use system BIOS/UEFI or use device drivers to communicate with these devices.
- The **startup BIOS/UEFI** starts the computer and finds a boot device that contains an operating system. Boot devices that a system might support include an internal or external hard drive, a CD or DVD drive, a bootable USB flash drive, and the network. After it finds a boot device, the firmware turns the startup process over to the OS.

Note 7

When choosing a boot device, consider that solid-state drives are faster than magnetic hard drives because they have no moving parts. USB flash drives are also solid-state devices. Some hard drives might be hot-swappable, which means they are inserted into an easily accessible hot-swap bay and can be exchanged without powering down the system.

- The **setup BIOS/UEFI** is used to change motherboard settings. You can use it to enable or disable a device on the motherboard (for example, the network port, video port, or USB ports), change the date and time that is later passed to the OS, and select the order of boot devices for startup BIOS/UEFI to search when looking for an operating

system to load. This order of boot devices is called the **boot priority order**.

Before you learn how the boot priority order is determined, you need to know a little about how the OS manages hard drives where the OS, applications, and data are normally stored.

11-3dHow an OS Manages a Hard Drive

Core 2 Objectives

- 1.8

Explain common OS types and their purposes.

- 1.9

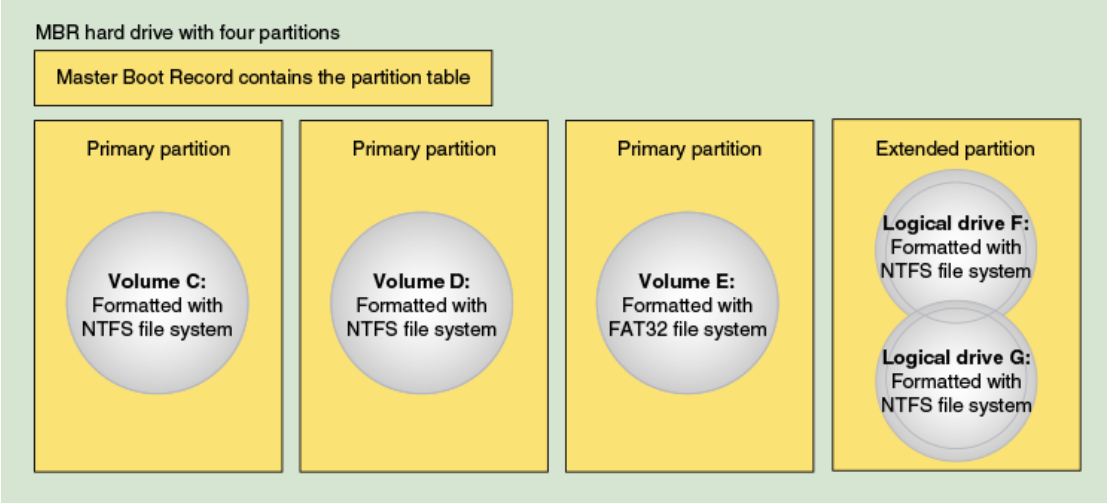
Given a scenario, perform OS installations and upgrades in a diverse OS environment.

Total capacities for today's hard drives are measured in GB (gigabytes, roughly one million bytes) or TB (terabytes, roughly one trillion bytes). Before a hard drive leaves the factory, a process called **low-level formatting** organizes all bits into a long series of logical blocks; this is called logical block addressing (LBA). Groups of bits are referred to as LBA 1, LBA 2, and so forth. Before an OS can use a hard drive, it first organizes these LBAs into one or more partitions using one of two partitioning systems:

- **MBR partitions.** The **Master Boot Record (MBR)** partitioning system keeps a map of partitions in a **partition table** stored at the beginning of the hard drive called the MBR. The MBR partition table can track up to four partitions on a drive. A drive can have one, two, or three **primary partitions**, also called volumes. The fourth partition is called an **extended partition** and can hold one or more volumes called **logical drives**, which are tracked in their own partition table separately from the primary partitions. Figure 11-22 shows how an MBR hard drive is divided into three primary partitions and one extended partition. Because of the limited number of bits used for the MBR, this partitioning system can handle only four partitions and up to 2.2 TB drives.

Figure 11-22

A hard drive using the MBR partitioning system, with four partitions; the fourth partition is an extended partition containing two logical drives



Exam Tip

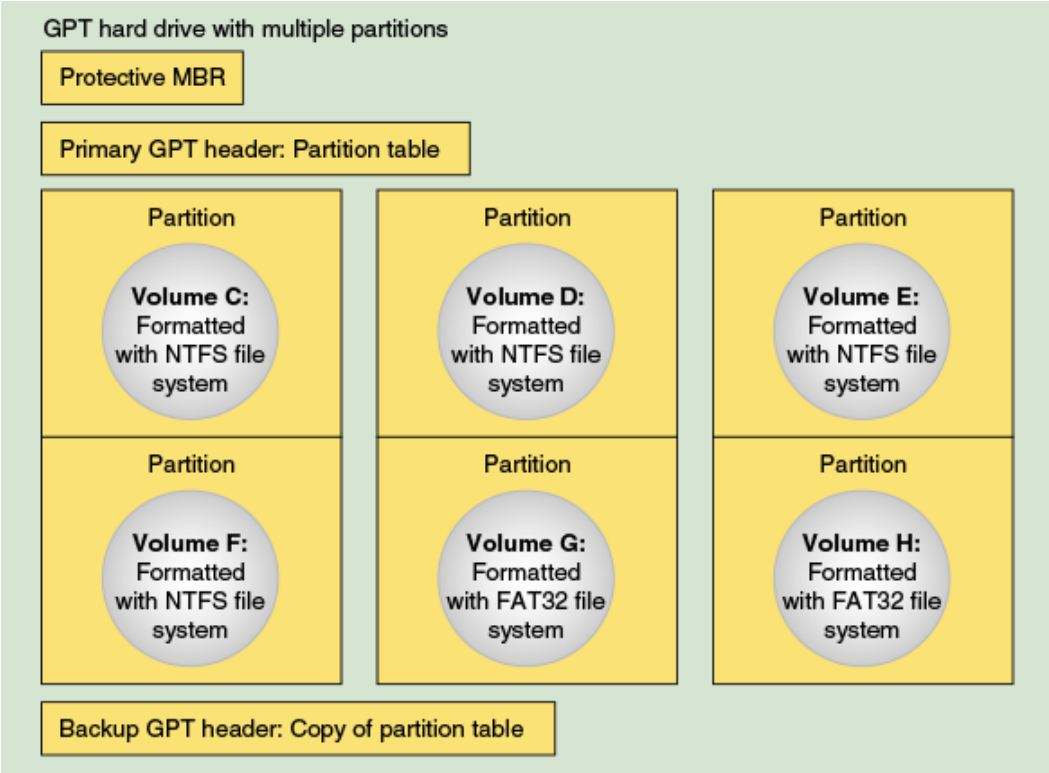
The A+ Core 2 exam expects you to know the difference between a primary and extended partition and between a volume and logical drive on an MBR hard drive.

- **GPT partitions.** The newer **Globally Unique Identifier Partition Table (GUID or GPT)** partitioning system can support up to 128 partitions and is required for drives larger than 2.2 TB. GPT requires a 64-bit operating system and UEFI firmware, and it is needed to use Secure boot, a feature of UEFI and the OS that adds security to the boot process. Most new computers sold today use the GPT system and UEFI firmware.

The first sector of a hard drive in a GPT system contains the protective MBR, which provides information to legacy software that doesn't recognize GPT systems so the legacy software will not attempt to repair or install an MBR system on the drive. GPT tracks all partitions in a single partition table, which it stores in the GPT header immediately following the protective MBR. GPT systems also back up the partition table at the end of the disk (see Figure 11-23).

Figure 11-23

A hard drive using GPT partitioning with six partitions



11-3e How File Systems Work

Core 2 Objective

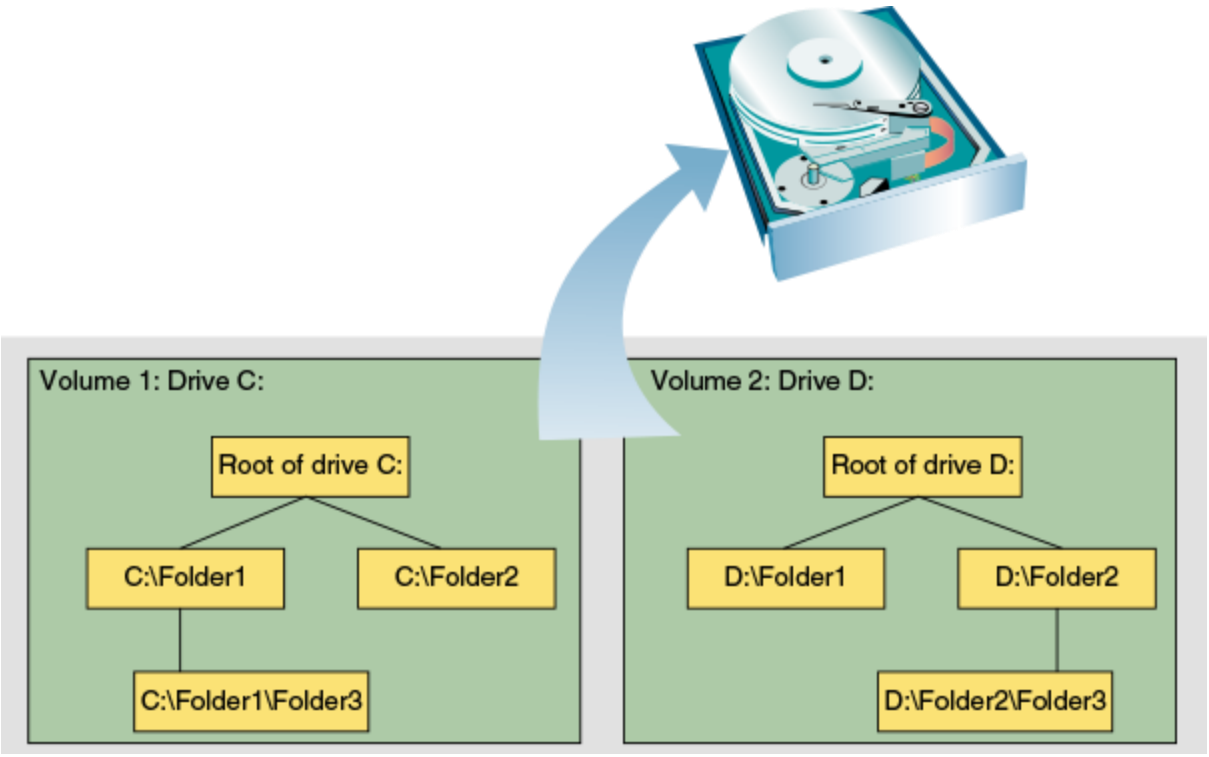
- 1.8

  Explain common OS types and their purposes.

Before a partition can be accessed, it must have a **file system** installed. The file system is the overall structure an OS uses to name, store, and organize files and folders on any storage device, including hard drives. For Windows, a hard drive partition or other storage device is assigned a drive letter (such as C: or D:) and is then called a **volume**. For a hard drive with multiple partitions, each partition is a volume that must be formatted with its own file system. See Figure 11-24. Installing a file system on a volume is called **formatting** the drive or **high-level formatting**. This **drive format** can happen during the OS installation or after the OS is installed. All USB flash drives, DVDs, smart cards, partitions on a hard drive, and other storage devices are formatted with a file system before they can be used.

Figure 11-24

A hard drive can be divided into one or more partitions; each becomes a volume and receives its own file system



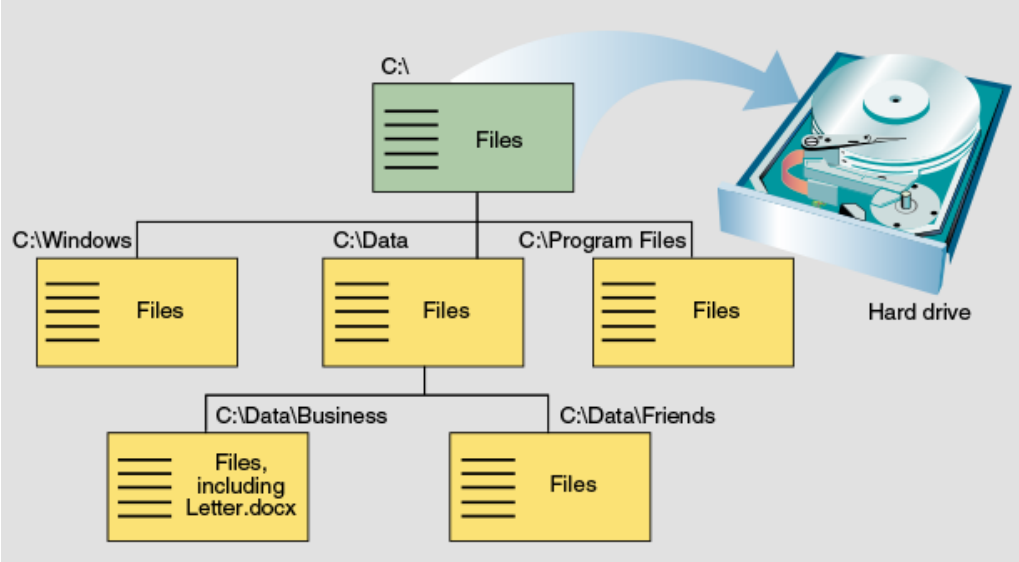
Next, let's see how files and directories are organized and accessed on any storage device.

Directory Hierarchical Structure of a File System

Every OS manages a storage device by using **directories** (a directory is also called a **folder**), **subdirectories** (also called **child directories**), and files. The drive or volume is organized with a single **root directory** at the top of the hierarchical structure of subdirectories, as shown in Figure 11-25 for Windows. For a Windows volume, such as drive C:, the root directory is written as C:. Each volume has its own root directory and hierarchical structure of subdirectories.

Figure 11-25

Storage devices in Windows—such as a USB drive, DVD, or hard drive—are organized into directories and subdirectories that contain files



Any directory can have files and other subdirectories listed in it; for example, Figure 11-25 shows that one file on drive C: is C:\Data\Business\Letter.docx. In this path to the file, the C: identifies the volume and is called the drive letter. Drive letters used for a hard drive, CD, USB drive, or DVD are C:, D:, E:, and so forth.

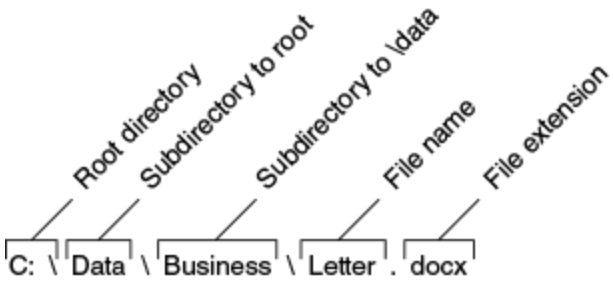
Note 8

In Windows, the backslash is used in directory paths to separate items in the path: C:\Data\Business\Letter.docx. However, in macOS, Linux, and Chrome OS, the slash is used for the same purpose: /home/user2/Business/Letter.odt.

The drive and directories that point to the location of a file are called the **path** to the file. See Figure 11-26 for Windows. The first part of the name before the period is called the **file name** (Letter), and the part after the period is called the file extension (.docx). A **file extension** indicates how the file is organized or formatted, the type of content in the file, and what program uses the file. For example, the .docx file extension identifies the file type as a Microsoft Word document file.

Figure 11-26

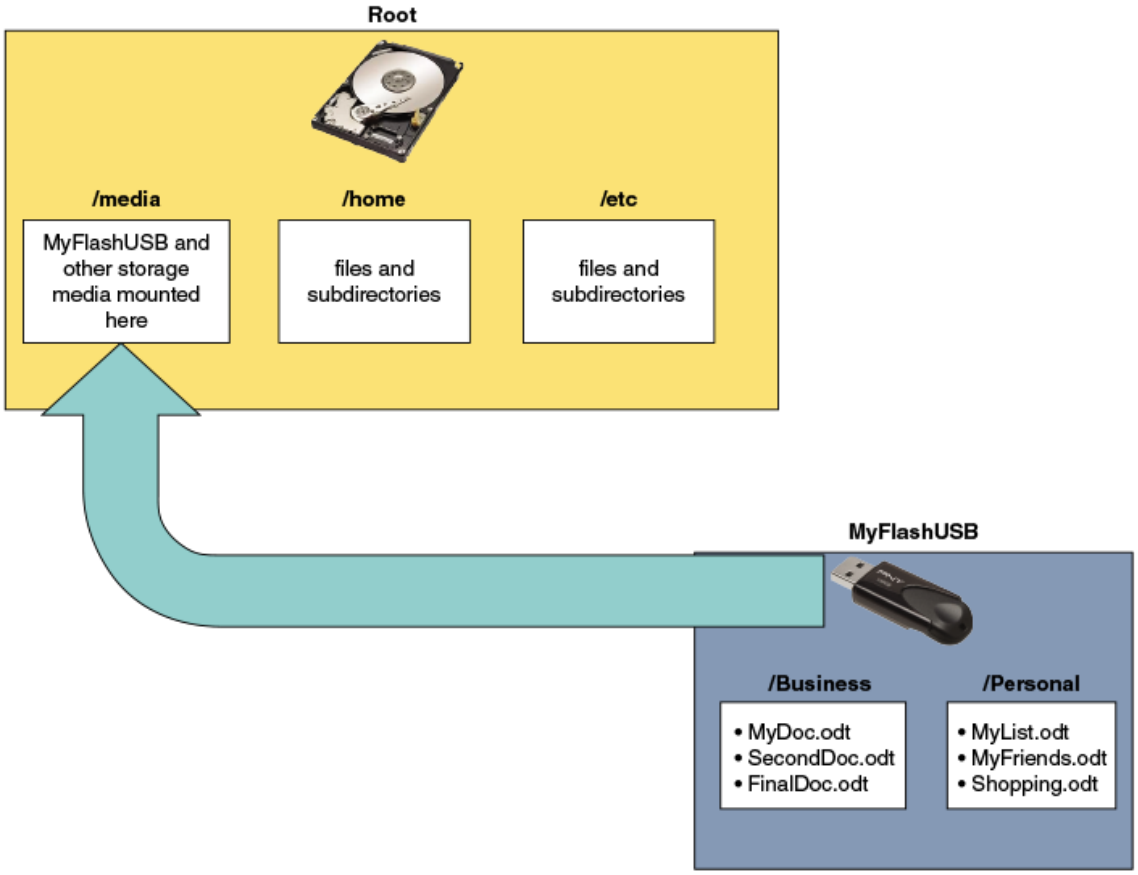
In Windows, the complete path to a file includes the volume letter, directories, file name, and file extension; the colon, backslashes, and period are required to separate items in the path



Linux-based OSs, including macOS, Chrome OS, and all Linux distributions, such as Ubuntu, organize their file systems differently than does Windows. A Linux-based OS uses a single root directory indicated by a slash (/) for all hard drives, partitions, and other storage media. Think of this root directory as the highest level in the hierarchy for all storage media connected to the system. See Figure 11-27. The root contains directories—such as /home and /etc in the figure—that hold the Linux installation and other storage on the hard drive. The root also contains the /media directory that is the access point to the volumes on other storage devices, such as the USB flash drive in the figure. In Linux terms, a subdirectory in the /media directory is called the **mount point** for the flash drive, and the flash drive is mounted to the system. Before a device can be mounted, it must be formatted with a file system; therefore, in effect, the file system on the device is mounted to the system.

Figure 11-27

In Linux-based OSs, storage media other than the media on which the OS is installed are mounted to a directory under the root



In Figure 11-27, you see a USB flash drive named MyFlashUSB that has a directory named /Business, which contains a LibreOffice Writer document file MyDoc with an .odt file extension. The path to this document file is

```
/media/MyFlashUSB/Business/MyDoc.odt
```

To find any media (USB flash drive, second hard drive, DVD, and so forth), look in the /media directory to find a subdirectory for the given media. This subdirectory (MyFlashUSB in our example) contains the contents of the storage device.

These same hierarchical directory structures for organizing directories and files are used by all file systems. Here is a list of file systems you are expected to know about for the A+ Core 2 exam:

- **NTFS.** For most editions of Windows, **NTFS (New Technology File System)** is required for the volume on which Windows is installed. NTFS was designed to replace the older FAT32 file system; it is more reliable, efficient, and secure than FAT32. NTFS supports encryption, disk quotas (limiting the hard drive space available to a user), and file and folder compression. If you boot the system from another boot medium such as a DVD, you can access a volume using a FAT file system. If the volume uses NTFS, an administrator password is required to gain access.

- **FAT32.** Use **FAT32** for small hard drives or USB flash drives because it does not have as much overhead as NTFS, and it is supported by macOS, Linux, Chrome OS, and other OSs. FAT32 uses 32 bits to address each unit of data on the volume.
- **exFAT.** Choose the **exFAT** file system for large external storage devices that you want to use with other operating systems. For example, you can use a smart card formatted with exFAT in a Mac or Linux computer or in a digital camcorder, camera, or smartphone. The exFAT file system uses the same structure as the older FAT32, but with a 64-bit-wide file allocation table (FAT). exFAT does not use as much overhead as the NTFS file system and is designed to handle very large files, such as those used for multimedia storage.
- **ext3.** The file system **ext3 (third extended file system)** was invented by Linux developers and was the first to support journaling, which is a technique that tracks and stores changes to the hard drive and helps prevent file system corruption.
- **ext4.** The current Linux file system is **ext4 (fourth extended file system)**, which is used by default when the OS is installed and another file system is not in place. It improved on ext3 with better performance and support for larger volumes. Similar to FAT32 and exFAT, ext3 used 32-bit addressing and ext4 uses 64-bit addressing, thus allowing for larger volumes.
- **APFS. APFS (Apple File System)** is the default file system for macOS. APFS allows multiple volumes on a single partition and can allocate free space as needed for each volume in the partition. In Apple terminology, a partition is sometimes called a container. APFS requires the GPT (also called GUID) partitioning system. APFS is compatible with the older Mac OS Extended file system, also called HFS+ (Hierarchical File System Plus), but it is not compatible with some earlier versions of macOS.

Exam Tip

The A+ Core 2 exam expects you to know about the NTFS, FAT32, ext3, ext4, APFS, and exFAT file systems, including which is appropriate to use in a given scenario.

Note 9

Windows installs on an NTFS volume, but if a second volume on the drive is formatted using the FAT32 file system, you can convert that volume to NTFS. For large drives, NTFS is more efficient, and converting might improve performance.

Compatibility between Operating Systems

Table 11-1 summarizes the types of partitioning and file systems supported by each operating system. Modern motherboards support UEFI firmware; to take advantage of this modern firmware, the hard drive must use a GPT partition to hold the operating system used to boot the computer. For this

reason, new installations of one of the OSs in the table will not install on MBR partitions, although older installations might be using MBR. You can use MBR or GPT on any partition or storage device that is not used for the boot.

Table 11-1

Operating Systems, Partitioning Systems, and File Systems

Operating System	Partitioning System		File System					
	MBR	GPT	NTFS	FAT32	ext3	ext4	APFS	exFAT
Windows	Yes	**Yes, required for boot**	**Yes, required for boot**	Yes	Read only with third party	Read only with third party	Read/write with third party	Yes
macOS	Yes	**Yes, required for boot**	Read only	Yes	Read/write with third party	Read/write with third party	**Yes, required for boot**	Yes
Linux	Yes	**Yes, preferred**	Yes	Yes	Yes	**Yes, preferred**	Read/write with third party	Yes
Chrome OS	Yes	**Yes, preferred**	Yes	Yes	No	No	No	Yes

You can also use **third-party drivers** to allow an OS that does not support a particular file system to read data on a computer using that file system. For example, Paragon Software (paragon-software.com) offers APFS for Windows, which installs in Windows to read/write to APFS partitions on macOS computers on the network.

Table 11-2 summarizes the tools and commands each OS uses to manage hard drives. Because macOS and Chrome OS are both built on a Linux foundation, they have some commands in common, as you will see in later modules when we cover several tools and commands.

Table 11-2

OS Primary Tools and Commands to Manage Hard Drives

☒	Graphics Tools	Commands
Windows	Disk Management	diskpart, format
macOS	Disk Utility	diskutil
Linux	GNOME Disks	parted, fdisk, fstype
Chrome OS	Partitioner, Format Device	NA

11-3f Types of OS Installations and Upgrades

Core 2 Objective

- 1.9

Given a scenario, perform OS installations and upgrades in a diverse OS environment.

An IT technician is often involved in installing, upgrading, and repairing an operating system. When it's time to install or upgrade any OS you support, you'll need to understand what type of installation you are performing, how the installation begins, and where the OS installation files are stored. All these topics are covered next.

Clean Install, Upgrade, or Repair

If you are installing an OS on a new hard drive, you must perform a clean install. If an OS is already installed on the hard drive, you have three choices:

- **Clean install.** You can perform a **clean install**, overwriting the existing operating system and applications. For Windows, the setup program calls a clean install a **custom installation**. The main advantage of a clean install is that problems with the old OS are not carried forward, and you get a fresh start. During the installation, you will have the option to reformat the hard drive, erasing everything on it. If you don't format the drive, data will still be on it. After the OS is installed, you will need to install third-party drivers and applications.

Note 10

For a Windows clean install, the previous Windows settings and user profiles are collectively stored in the **Windows.old folder** that setup creates on the hard drive. After you're sure the new installation is working as expected, you can delete the Windows.old folder to save space on the drive. Windows automatically deletes most of the content of this folder 10 days after the installation.

- **Upgrade.** If the upgrade path allows it and the OS is healthy enough, you can perform an upgrade installation. An upgrade is always started from within the existing operating system. Launch the OS and then launch the upgrade process. The upgrade carries forward user settings and installed applications from the old OS to the new one. An upgrade is faster than a clean install and is appropriate if the system is generally healthy and does not have problems. Before you start an upgrade, be sure to back up data stored on the hard drive. Here's the breakdown of how to start an upgrade for each OS:

- **Windows upgrade.** Windows calls an upgrade an **in-place upgrade** because the old OS is already *in place*. To perform an in-place upgrade, Microsoft requires that certain editions and versions of Windows are already installed and running the latest version of either Windows 8.1 or Windows 7 with Service Pack 1 installed. These qualifying OSs are called **upgrade paths**. Table 11-3 outlines the acceptable upgrade paths for Windows 10 compatibility. To upgrade from an earlier edition of Windows to Windows 10, you'll need to purchase the product key from the Microsoft Store and download the installation files. To start a Windows in-place upgrade, launch Windows and follow the procedures you learn about in the module "Installing Windows" to perform the upgrade.

Table 11-3

In-Place Upgrade Paths to Windows 10

Windows 8		Windows 7	
From OS	**To OS**	**From OS**	**To OS**
Windows 8.1	Windows 10 Home	Windows 7 Starter ☒	Windows 10 Home or Windows 10 Pro
		Windows 7 Home Basic	
		Windows 7 Home Premium	
Windows 8.1 Pro	Windows 10 Pro	Windows 7 Professional	Windows 10 Pro or Windows 10 Enterprise
Windows 8.1 Pro for Students		Windows 7 Ultimate	

Note 11

A 64-bit version of Windows can only be upgraded to a 64-bit OS. A 32-bit OS can only be upgraded to a 32-bit OS. If you want to install a 64-bit version of Windows on a computer that already has a 32-bit OS installed, you must perform a clean install.

- **macOS upgrade.** The latest edition of macOS is macOS Monterey. You can download and install a free upgrade if your Apple computer hardware qualifies for the OS. If you're currently running macOS Mojave or later, you can start the upgrade from System Preferences. If you're running an older version of macOS, use the App Store to start the upgrade. To know which OS is installed, click the apple, click **About This**

Mac, and then select the **Overview** tab. You can also upgrade from this window. See Figure 11-28. A macOS upgrade takes a long time, and the system reboots several times, but you don't need to interact with the installation.

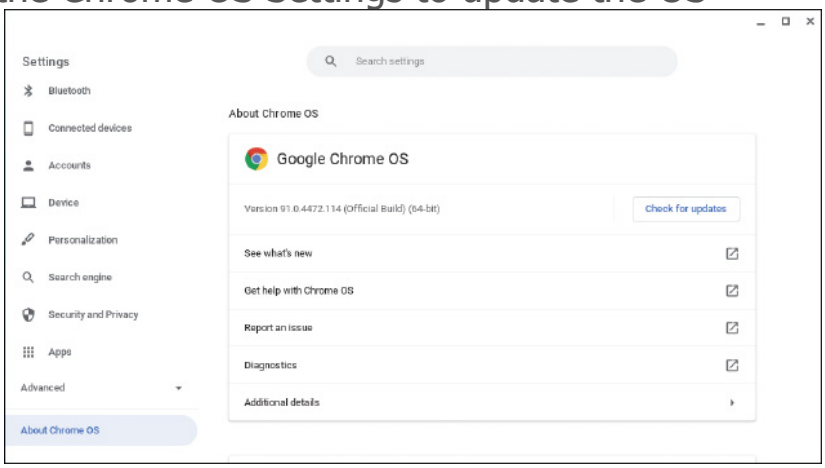
Figure 11-28

Use the About This Mac windows to find out which edition of macOS is installed, and upgrade to the latest macOS

- **Linux upgrade.** When you first log on to Linux, a list of available updates displays. To apply these updates, you use the apt-get and do-release-upgrade commands. How to use these commands is covered in the module "Linux and Scripting." Linux updates are free.
- **Chrome OS upgrade.** To upgrade to the latest Chrome OS, in the **Settings** app, open **About Chrome OS**, and click **Check for updates**. See Figure 11-29. If updates are available, they start to download automatically.

Figure 11-29

Use the Chrome OS Settings to update the OS



- **Repair.** Each OS has various tools and commands you can use to repair a corrupted installation, which you learn about in later modules. For laptop computers and brand name desktops, sometimes the hard drive contains a **recovery partition** that can be used to restore the computer back to its state when first purchased. How to use this partition is covered in the module "Troubleshooting Windows Startup."

Boot Methods

To perform a clean install, upgrade, or some OS repairs, you'll need the installation files provided by the OS manufacturer. In most cases, you download these files from the manufacturer website and store them on a device such as a USB solid-state flash drive or solid-state external hard drive, optical media (DVD), the network, and external or internal hot-swappable hard drive, or a second partition on the main internal hard drive. Sometimes you can perform the installation without downloading all files first, as the setup program can access files stored online.

For a new or corrupted hard drive, the storage device holding the installation files must be bootable, which means it can be accessed by BIOS/UEFI to launch an operating system. After the OS is running, it then launches the setup program to install the new OS. In later modules, you learn how to make this installation media bootable for each OS.

Applying Concepts

Selecting the Boot Priority Order

- **Est. Time:** 15 minutes
- **Objective:** 1.8

To boot from a media other than the hard drive, you can use BIOS/UEFI setup to change the boot priority order. See the motherboard documentation to find out how to access and use BIOS/UEFI setup. Here are steps for one system:

1. 1
   Insert your bootable media, such as the DVD in the optical drive or a USB flash drive in a USB port.

2. 2
   To access BIOS/UEFI setup, press a key such as **Del** or **F2** early in the boot process before the OS starts to load. When the BIOS/UEFI setup screen appears, look for a screen to manage the boot. For example, the Boot screen for one motherboard's firmware is shown in Figure 11-30.

Figure 11-30

The Boot screen for BIOS/UEFI setup

Source: American Megatrends, Inc.

3. 3

Normally, BIOS/UEFI is set to boot first from the internal hard drive. To boot from another device, look for a Boot screen or menu. For the system shown in Figure 11-31, boot options are the DVD drive, hard drive, and network port. Also, know that sometimes the DVD drive is labeled CD-ROM in BIOS/UEFI setup.

Figure 11-31

Set the boot priority order in BIOS/UEFI setup

Source: American Megatrends, Inc.

4. 4

   Make your change and then use the Exit menu to save your changes and restart the system. The system should restart and look to your bootable media to launch an OS. Then the setup program on your bootable media should launch.

In a corporate or enterprise environment, automated methods might be in place to install a fresh copy of the OS on a workstation from deployment servers on the network. To use this method, you configure BIOS/UEFI setup to boot from the network and locate a deployment server to install the OS. How to do that is covered in the next module.

Note 12

In most situations, you use the GPT partitioning system for the hard drive. If you must use the MBR system, in BIOS/UEFI setup, change the mode to CSM (Compatibility Support Mode), which supports MBR.

11-3gVendor End-of-Life Limitation and Product Life Cycle

Core 2 Objective

- 1.8

  Explain common OS types and their purposes.

In practice, computers and their operating systems might stay in service long after manufacturer support for the OS has ended. However, it's important that you know when an OS will no longer be supported by its manufacturer and what to expect during the life cycle of the product. Here is the rundown:

- **Windows.** In the past, Microsoft released a new version of Windows about every three years, but with Windows 10, it seems to be extending the life of a Windows version by providing incremental **feature updates** to the OS, called Windows as a Service (WaaS). Windows 10 has been the current Windows version since 2015, and Windows 11 is scheduled to be released near the beginning of 2022. Feature updates, which are incremental releases of new versions of Windows 10, happen about every six months, and minor security and nonsecurity updates happen weekly. Windows 7 and Windows 8.1 are no longer supported or updated by Microsoft. It is expected that Windows 10 will be supported long after Windows 11 is released.
- **macOS.** Over the past 20 years, Apple has released versions of Mac OS X about once a year; it was renamed macOS in 2016. The OS version a Mac can support depends on the age of the Mac. For example, a MacPro made in 2013 or later should support Big Sur, a current macOS release, and a MacBook Air made in 2015 or later should support Monterey, the latest macOS release. Apple releases updates to the current OSs about every two to three months. Each version of macOS is supported with security updates for about three years after its release.
- **Linux.** How long a Linux distribution is supported depends on the developer. For example, Canonical (canonical.com), which makes Ubuntu Desktop and Ubuntu Server, releases a new distribution of Ubuntu about every two years and provides support of that release for about five years.
- **Chrome OS.** Google releases a complete Chrome OS update about every six weeks. Minor updates are released about every two or three weeks. Because Chrome OS is a relatively new OS, the updates are less regular than more mature OSs, and sometimes the updates have significant bugs. For best results, keep automatic updates turned on.

Applying Concepts

Get to Know the Chrome OS

- **Est. Time:** 15 minutes
- **Objective:** 1.8

We end this module with a quick look at the Chrome OS. In later modules, you learn about Windows, macOS, Linux, and also iOS and Android, the two most popular mobile operating systems.

Chrome OS is deeply integrated with Google's Chrome browser: Most of Chrome OS's native apps open directly in the Chrome browser and rely heavily on having an active Internet connection. While there are some apps that will function offline—such as Gmail, Docs, and Calendar—functionality is limited to data that is temporarily stored on the Chromebook until it can again be synced with the user's online account. Chrome OS functions exclusively on Chromebooks and Chomeboxes, although many manufacturers build and sell these laptops, tablets, and desktops. See Figure 11-32.

Figure 11-32

A Chromebook can be a lightweight laptop, a tablet, or a hybrid laptop-tablet

First Look at a Chromebook

Chromebooks and Chromeboxes come with a variety of external ports, depending on the manufacturer and model. Many feature USB and USB-C ports as well as HDMI. Some include SD card slots for adding extra storage space. The keyboard on a Chromebook (see Figure 11-33) looks similar to the typical laptop keyboard, with a few notable differences. The unique keys mostly run along the top of the keyboard and include these keys: search, previous and next pages, refresh, immersive mode (hides tabs and launcher), and overview mode (shows all open apps). Keyboard shortcuts, a popular feature with Chromebooks, use combinations of key presses to accomplish tasks such as opening a new Chrome window (**ctrl+n**) or tab (**ctrl+t**), taking a screenshot (**ctrl+overview**), locking the screen (**search+L**), and showing all keyboard shortcuts (**ctrl+alt+/**).

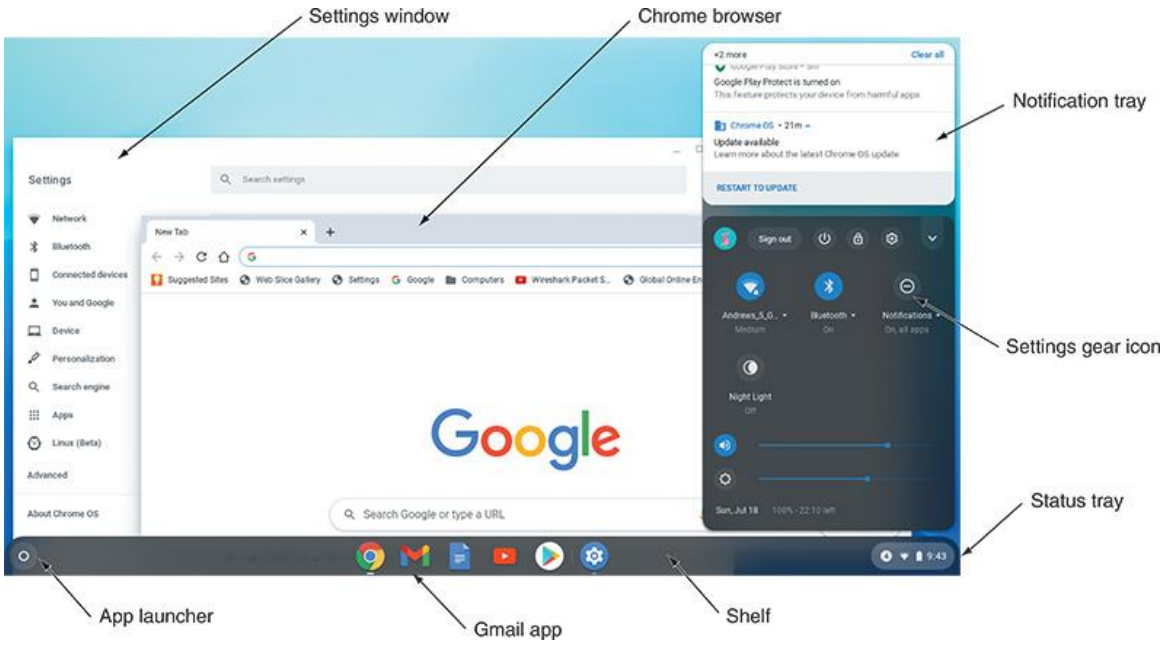
Figure 11-33

A Chromebook keyboard

You sign in to Chrome OS using a Google Gmail email address and password. Google Drive, Gmail, and other Google apps are deeply integrated into the Chrome OS experience. Figure 11-34 shows the Chrome OS desktop with the Settings app, Chrome browser, and Notification Tray open. Also notice the shelf on the bottom and the status tray on the bottom right of the screen. The app launcher is in the shelf. To open the Settings app, click anywhere in the status tray, which opens the Notification tray, and then click the **Settings app** gear icon, which is labeled in Figure 11-34. Alternatively, you can click the App launcher and then click Settings.

Figure 11-34

The Chrome OS desktop



Chrome OS includes some significant security measures to protect the computer from malware, including built-in virus protection. Google took a four-pronged approach to security with Chrome OS:

- **Sandboxing.** To help secure the system, each tab in the Chrome browser is isolated from the underlying OS and from processes in other tabs.
- **Verified boot.** Similar to the Windows Secure boot, it protects the OS from changes being made to its underlying system files, automatically entering recovery mode if modifications are detected.
- **Power washing.** The user can perform a simple and quick reset to factory settings in the event a malware infection does manage to take hold or the system otherwise becomes unstable. To start a power wash, press **Ctrl+Alt+Shift+r**, select **Restart**, and then click **Powerwash**. All data on the hard drive is lost in a power wash.
- **Quick updates.** The OS updates itself in the background without user intervention about every six weeks. If an update is needed for a security patch, it can happen within 48 hours.

The end effect is a very stable and secure OS that even security professionals rely on when traveling to techie, hacker, or security conferences, where the persistent threat of hacking attacks is an integral part of the overall experience.

Chrome OS Apps

The Chrome OS shelf contains icons for important apps; tap an icon to open the app. To view and open any installed app, tap the app launcher icon in the shelf (refer back to Figure 11-34), and tap an app in the launcher (see Figure 11-35). Most apps open in the Chrome browser, and several apps offer Chrome extensions that add functionality to the Chrome browser even when the app is not open. Users can get more apps through the Chrome Web Store app, or they can download Android apps through the Google Play Store app.

Figure 11-35

App launcher shows two apps used to download other apps

Caution

Know that if you download Android apps to the Chromebook and then turn off the Play Store app, you'll lose all the Android apps' data and settings from the Chromebook.

Module Review

11-4a Module Summary

What Customers Want: Beyond Technical Know-How

- Customers want more than just technical know-how. They want a positive and helpful attitude, respect, good communication, sensitivity to their needs, ownership of their problem, dependability, credibility, integrity, honesty, and professionalism.
- Customers expect their first contact with you to be professional and friendly, and they expect that your first priority will be listening to their problem or request.
- Know how to ask penetrating questions when interviewing a customer about a problem or request.
- Set and meet customer expectations by using good communication about what you are doing or intending to do and by allowing the customer to make decisions where appropriate.
- Dress professionally and match your attire to the requirements of your environment.
- Deal confidently and gracefully with customers who are difficult, including those who are not knowledgeable, are overly confident, or complain.
- When you first start a new job, find out how to escalate a problem you cannot solve.

Documentation and Support Systems

- Expect to find documentation in an IT environment about knowledge bases, asset management, password policies, network topology diagrams, ticketing systems, acceptable use policy, standard operating procedures, new-user and end-user termination checklists, regulatory compliance requirements, and the documentation needed for change management.
- Change management includes identifying the purpose and scope of change, developing a change plan, performing risk analysis, creating a rollback plan, getting approval from a change board, acquiring end-user acceptance, and documenting the entire change process.

Working in Diverse Software Environments

- An operating system manages hardware, runs applications, provides an interface for users, and stores, retrieves, and manipulates files.
- Popular operating systems for workstations are Windows, macOS, Linux, and Chrome OS.
- An OS interfaces with hardware via device drivers and firmware on the device.
- Motherboard firmware includes BIOS and UEFI, which together control the startup process and interface with components on the motherboard.
- A hard drive contains one or more partitions or volumes and can use the MBR or GPT partitioning system. Using GPT requires UEFI firmware and a 64-bit OS. Drives larger than 2.2 TB must use GPT.
- A file system is installed on storage devices to name, store, and organize files and folders on the device.
- File systems include NTFS, FAT32, exFAT, ext3, ext4, and APFS. Windows installs on the NTFS file system; MacOS installs on APFS, and Linux and Chrome OS install on ext4. FAT32 file system can be used by all these OSs to read and write data.
- An operating system can be installed as a clean installation or an in-place upgrade; sometimes an OS can be repaired without being reinstalled.
- An OS can be installed from the installation files stored on a USB solid-state flash drive or solid-state external hard drive, optical media (DVD), the network, and external or internal hot-swappable hard drive, or a second partition on the main internal hard drive.
- To boot the system from a media other than the primary hard drive, you can use BIOS/UEFI setup to change the boot priority order.
- When supporting an OS, you need to understand the product life cycle and the vendor's end-of-life limitation for the product.
- Chrome OS is designed solely for use on a Chromebook—which is a tablet, lightweight laptop, or convertible laptop-tablet—or a Chromebox, a desktop computer that uses the Chrome OS. Many manufacturers make Chromebooks and Chromeboxes.
- Chrome OS relies heavily on the Chrome browser and an active Internet connection. Chrome OS apps are distributed through the Chrome Web Store, and apps for the newer Chromebooks are distributed from the Google Play Store.

Module Review

11-4c Thinking Critically

These questions are designed to prepare you for the critical thinking required for the A+ exams and may use information from other modules and the web.

1. Suppose you are a customer who wants to have a computer repaired. List five main characteristics that you would want to see in your computer repair person.
2. When you receive a phone call requesting on-site support, what is one thing you should do before you make an appointment?
3. You make an appointment to do an on-site repair, but you are detained and find out that you will be late. What is the best thing to do?
4. When making an on-site service call, what should you do before making any changes to software or before taking the case cover off a computer?
5. What should you do after finishing your computer repair?
6. What is a good strategy to follow if a conflict arises between you and your customer?
7. You have exhausted your knowledge of a problem, and it still is not solved. Before you escalate it, what else can you do?
8. If you need to make a phone call while on a customer's site and your cell phone is not working, what do you do?
9. What is one thing you can do to help a caller who needs phone support and is not a competent computer user?
10. Describe what you should do when a customer complains to you about a product or service that your company provides.

11. While working in a call center, you receive a call from Latisha, who says she can no longer access the online reporting application for her weekly reports through her web browser. You ask your manager, and she tells you that the server team changed the application's URL during an upgrade over the weekend. She asks you to make sure all the other technicians are aware of this change. What is the best way to share this information?

    1. Print a flyer with the new URL, and post it on the wall in the call center.
    2. Send out a mass email with the new URL to all the technicians.
    3. Update the knowledge base article that contains the application's URL in the ticketing system application.
    4. Yell the new URL to all technicians sitting in the call center.

12. Your manager asks you to work through the weekend to install new software on the applications server that serves up applications to 20 users. The following Monday, all users report they cannot open their data files. After speaking with technical support for the new application, you discover it is not compatible with the old data files. Which type of documentation should you refer to first to address this problem?

    1. Risk analysis documents
    2. Rollback plan documents
    3. Change management documents
    4. Scope of change documents

13. Your manager asks you to set up an environment for user training on the payroll system. What is included in this environment? (Choose all that apply.)

1. A sandbox
2. Live data
3. Dummy data
4. Access to the company payroll database

14. Which OS is most appropriate to support a web server on the Internet?

1. Windows 10 Pro
2. Ubuntu Server
3. Chrome OS
4. macOS

15. Which statements are false about the GPT partitioning system? (Choose all that apply.)

1. It supports up to 128 partitions.
2. It contains the legacy MBR system for backward compatibility.
3. It can only be installed on drives that are larger than 2 TB.
4. It keeps a backup copy of the GPT table.

16. Your organization has several Mac and Windows laptops that all access data on a file server on the local network. Which file system on the Linux file server is best suited to this situation, and how do you best set it up?

1. ext4; on the same partition that holds the Linux installation
2. APFS; on a different partition than the one that holds the Linux installation
3. FAT32; on a different partition than the one that holds the Linux installation
4. NTFS; on the same partition that holds the Linux installation

17. Which of the following statements is false?

1. In Ubuntu Server, the mount point for an external hard drive is in the /media directory.
2. In Windows, before you can use a smart card, it must have a drive letter assigned.
3. In macOS, the mount point for removable media is the /Volumes directory.
4. In Ubuntu Desktop, a USB flash drive must have a drive letter assigned before you can access it.

18. Which Chromebook security feature ensures that malware can't change the OS's system files?

1. Quick updates
2. Power washing
3. Sandboxing
4. Verified boot