



**Course Booklet**

**CCNA Discovery**

**Designing and Supporting  
Computer Networks**

**Version 4.0**

# CCNA Discovery Course Booklet Designing and Supporting Computer Networks, Version 4.0

Cisco Networking Academy

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# Course Introduction

## Welcome

Welcome to the CCNA Discovery course, Designing and Supporting Computer Networks. The goal of this course is to assist you in developing the skills necessary to design small Enterprise LANs and WANs. The course provides an introduction to collecting customer requirements, translating those requirements into equipment and protocol needs, and creating a network topology which addresses the needs of the customer. It will also familiarize you with how to create and implement a design proposal for a customer. This course prepares you with the skills required for entry-level Pre-Sales Support and entry-level Network Design jobs.

## More than just information

This computer-based learning environment is an important part of the overall course experience for students and instructors in the Networking Academy. These online course materials are designed to be used along with several other instructional tools and activities. These include:

- Class presentation, discussion, and practice with your instructor
- Hands-on labs that use networking equipment within the Networking Academy classroom
- Online scored assessments and grade book
- Packet Tracer 4.1 simulation tool
- Additional software for classroom activities

## A global community

When you participate in the Networking Academy, you are joining a global community linked by common goals and technologies. Schools, colleges, universities and other entities in over 160 countries participate in the program. You can see an interactive network map of the global Networking Academy community at <http://www.academynetspace.com>.

The material in this course encompasses a broad range of technologies that facilitate how people work, live, play, and learn by communicating with voice, video, and other data. Networking and the Internet affect people differently in different parts of the world. Although we have worked with instructors from around the world to create these materials, it is important that you work with your instructor and fellow students to make the material in this course applicable to your local situation.

## Keep in Touch

These online instructional materials, as well as the rest of the course tools, are part of the larger Networking Academy. The portal for the program is located at <http://cisco.netacad.net>. There you will obtain access to the other tools in the program such as the assessment server and student grade book), as well as informational updates and other relevant links.

## Mind Wide Open®

An important goal in education is to enrich you, the student, by expanding what you know and can do. It is important to realize, however, that the instructional materials and the instructor can only facilitate the process. You must make the commitment yourself to learn new skills. Below are a few suggestions to help you learn and grow.

1. Take notes. Professionals in the networking field often keep Engineering Journals in which they write down the things they observe and learn. Taking notes is an important way to help your understanding grow over time.
2. Think about it. The course provides information both to change what you know and what you can do. As you go through the course, ask yourself what makes sense and what doesn't. Stop and ask questions when you are confused. Try to find out more about topics that interest you. If you are not sure why something is being taught, consider asking your instructor or a friend. Think about how the different parts of the course fit together.
3. Practice. Learning new skills requires practice. We believe this is so important to e-learning that we have a special name for it. We call it e-doing. It is very important that you complete the activities in the online instructional materials and that you also complete the hands-on labs and Packet Tracer® activities.
4. Practice again. Have you ever thought that you knew how to do something and then, when it was time to show it on a test or at work, you discovered that you really hadn't mastered it? Just like learning any new skill like a sport, game, or language, learning a professional skill requires patience and repeated practice before you can say you have truly learned it. The online instructional materials in this course provide opportunities for repeated practice for many skills. Take full advantage of them. You can also work with your instructor to extend Packet Tracer, and other tools, for additional practice as needed.
5. Teach it. Teaching a friend or colleague is often a good way to reinforce your own learning. To teach well, you will have to work through details that you may have overlooked on your first reading. Conversations about the course material with fellow students, colleagues, and the instructor can help solidify your understanding of networking concepts.
6. Make changes as you go. The course is designed to provide feedback through interactive activities and quizzes, the online assessment system, and through interactions with your instructor. You can use this feedback to better understand where your strengths and weaknesses are. If there is an area that you are having trouble with, focus on studying or practicing more in that area. Seek additional feedback from your instructor and other students.

## Explore the world of networking

This version of the course includes a special tool called Packet Tracer 4.1®. Packet Tracer is a networking learning tool that supports a wide range of physical and logical simulations. It also provides visualization tools to help you to understand the internal workings of a network.

The Packet Tracer activities included in the course consist of network simulations, games, activities, and challenges that provide a broad range of learning experiences.

## Create your own worlds

You can also use Packet Tracer to create your own experiments and networking scenarios. We hope that, over time, you consider using Packet Tracer – not only for experiencing the activities included in the course, but also to become an author, explorer, and experimenter.

The online course materials have embedded Packet Tracer activities that will launch on computers running Windows® operating systems, if Packet Tracer is installed. This integration may also work on other operating systems using Windows emulation.

# Characterizing the Existing Network

## Introduction

Refer to  
**Figure**  
in online course

### 3.1 Documenting the Existing Network

Refer to  
**Figure**  
in online course

#### 3.1.1 Creating a Network Diagram

Typically, the first step in installing a new network is to take a detailed look at the existing network. The NetworkingCompany designer examines the existing network to:

- Determine if the design goals are realistic and feasible
- Determine if the existing network meets the expectations for scalability, availability, security, and manageability
- Identify where new equipment, infrastructure upgrades, and new services can be integrated
- Ensure that old and new network devices, media, and functions can work together

#### Upgrading the Stadium Network

Like most organizations, the stadium has a pre-existing network. The management wants to install a new network to:

- Better manage its existing voice, video, and data networks
- Improve customer service
- Reduce costs

Refer to  
**Figure**  
in online course

The NetworkingCompany designer reviews the existing network documentation. The stadium IT department network documentation contains most of the information that the designer needs concerning network organization and services.

The network documentation should include:

- Logical and physical diagrams of the network
- Floor plans showing the location of wiring closets and wiring runs
- Inventory lists of installed network equipment
- Current network configuration files
- Inventory lists of network applications

### Producing a Network Topology Map

As is the case with many businesses, the StadiumCompany's network documentation is not up-to-date. A new diagram will need to be created of the network as a whole, as well as the different segments that comprise it.

Network management programs collect information and produce a diagram of the current network. Cisco Network Assistant and CiscoWorks are two examples of network management programs.

Cisco Network Assistant is used to obtain the information necessary to produce a diagram of the stadium network.

Refer to  
Figure  
in online course

### Obtaining Information About Devices and Data Routes

The NetworkingCompany staff can now log in to various network devices. The network designer uses standard Cisco IOS commands to obtain information about the devices and the routes that data takes through the network.

The Cisco IOS software offers useful commands to gain information from a router to create a network diagram. Some of these commands are:

- **show version**
- **show running-config**
- **show ip route**
- **show cdp neighbors detail**
- **show controllers**
- **show tech-support**

The **show tech-support** command can collect a large amount of information about a router. The output from this command varies depending on the router or switch platform and configuration.

Many of these same commands are used to gain information on a Cisco switch. Other useful switch commands include:

- **show vlan**
- **show vtp**
- **show spanning-tree**

Full Page Custom Activity

Refer to  
Interactive Graphic  
in online course.

### Packet Tracer Activity

Use router and switch commands to investigate the existing network devices.

Refer to Packet  
Tracer Activity  
for this chapter

## 3.1.2 Diagramming the Logical Architecture

After the information about the existing network is collected, the next task is to create or update one or more logical network diagrams.

### Creating an Existing Network Overview Diagram

On the stadium network project, the first diagram that the network designer creates is a high-level view of all of the stadium network sites. The diagram shows:

- The main stadium network
- The souvenir shop

Refer to  
Figure  
in online course

- The ticket outlet locations
- Connectivity to remote sites
- Connectivity to business partners

The designer diagrams the **WAN** connections between the networks and the equipment at each location where the WAN terminates.

This network diagram illustrates how the information flows from one area of the network to another. This helps the designer locate problem areas.

### Creating Network Segment Diagrams

Next, the designer creates diagrams for the logical and physical layouts of the networks installed at each of the various sites.

Each diagram shows:

- The location of the network equipment and wiring closets
- The logical addressing information
- The naming information

Using these diagrams, the designer identifies where topology or equipment changes are needed. The designer evaluates the traffic flows and addressing structures.

Refer to  
**Figure**  
in online course

The network installed at the main stadium location is more complex than those at the individual remote sites. The network designer creates a separate logical diagram to illustrate all of the various LAN components and topologies. The diagram shows the traffic flows between the users and the servers.

### Creating a Logical Diagram of the Main Stadium LAN

The designer creates a logical network diagram that shows the major pieces of networking equipment and how they interconnect. This diagram includes:

- Routers and switches
- Wireless Access Points
- Critical telecommunications equipment (CSU/DSU, modems, etc.)
- Firewalls and intrusion detection devices (**IDS**)
- Management stations
- Servers and server farms

All of the servers and services are included on the logical diagram. This is because their location can affect traffic patterns, bandwidth use, and security. The designer labels each of the connections with the bandwidth and type of cable or wireless device that is being used.

Refer to  
**Lab Activity**  
for this chapter

### Lab Activity

Use Cisco Network Assistant and Cisco IOS commands to create a logical network diagram of the FilmCompany network.

## 3.1.3 Developing a Modular Diagram

The stadium network has grown significantly from its initial design. The NetworkingCompany designer takes the logical diagram and organizes the network into a **modular block diagram**.

Refer to  
**Figure**  
in online course

A modular block diagram is a simplified version of the network. The diagram shows the major functions in modular form. It helps the designer to determine the underlying architecture on which the network is built.

The designer compares the block diagram to the ideal network design represented by the Cisco *Enterprise Network Architectures*. The designer identifies areas that must be redesigned or upgraded.

The initial architecture of the stadium network is a large flat network. It has only two physical layers of switches. Some of the switches provide end device connectivity to the network and some interconnect other switches. Both layers are built using Layer 2 switches, which are not segmented by VLANs.

Server locations are at various points within the network.

Internet connectivity is provided through another router. Connectivity is protected by a firewall and IDS. Both of the remote locations connect to the stadium network through VPNs that terminate at the Internet router.

Refer to Packet Tracer Activity for this chapter

### Packet Tracer Activity

Create a modular block diagram of an existing network to help identify weaknesses in the design.

Refer to Figure in online course

## 3.1.4 Strengths and Weaknesses of the Existing Network

The diagrams created by the network designer enable the NetworkingCompany staff to analyze the existing network for strengths and weaknesses.

### Strengths of the Existing Stadium Network

The designer reviews the current voice and video network documentation to determine the locations of equipment and the various groups who use the services.

New Category 5e wiring was recently installed throughout the stadium complex. In addition, new single-mode fiber connects the wiring closets to the main telecommunications room. The available throughput provided by the existing cabling reduces the need for changes to the infrastructure of the stadium network. Additional wiring will only be done if it is required to install the new Access Points.

An area next to the wiring closet is ideally suited for the installation of a new data center to accommodate the server farm.

Refer to Figure in online course

After reviewing the diagrams and the existing equipment inventories, the network designer lists the strengths and weaknesses of the current stadium network:

#### Strengths:

- New wiring and adequate wiring closets
- Adequate space for a new data center
- Servers and PCs are current models and will not need to be replaced
- Some existing network switches and routers can be used in the new design

#### Weaknesses:

- Flat network design
- No Distribution Layer
- No true Core Layer

- Servers poorly located
- Multiple networks that can be difficult to maintain
- Inadequate IP addressing structure
- No dedicated bandwidth for WAN connectivity
- Poorly-implemented wireless
- Limited security implementations

### Overcoming Weaknesses in Preparation for the Network Upgrade

The designer focuses on finding ways to overcome the weaknesses of the existing network. The designer proposes updating the network design with the necessary enhancements.

Equipment that will not be replaced during the upgrade is also evaluated. It is important to know that the hardware is working properly and that the software is up-to-date to ensure easy integration of new features into the network.

Refer to Packet Tracer Activity for this chapter

### Packet Tracer Activity

Investigate the existing network and develop a list of strengths and weaknesses.

## 3.2 Updating the Existing Cisco IOS

### 3.2.1 Cisco CCO Features and Navigation

Refer to Figure in online course

The Cisco.com web site offers tools and online resources to help the NetworkingCompany staff obtain information about the stadium network equipment. The web site can help to resolve common technical problems. The tools and resources include the following:

- **Documentation** - Hardware and software configuration and verification, as well as troubleshooting Cisco products and technologies
- **Tools** - Troubleshooting, installation, assessment, and service requests
- **Downloads** - Software, specific file releases, and technical support applications
- **Communities and Training** - Information on the Networking Professionals Connection, attending Technical Support Seminars, and other training opportunities
- **News** - Current topics reported in the Cisco Technical Support Newsletter

Access to many of the features available on Cisco.com requires the creation of a Cisco.com registered user account. The level of access depends upon the type of user account and whether the user has a current SMARTnet maintenance contract.

### 3.2.2 Investigating the Installed Cisco IOS Software

Refer to Figure in online course

Before using the tools at Cisco.com, the NetworkingCompany staff requires the following information from the equipment inventory list:

- Model and type of device
- Installed memory
- Interfaces and slots

- Optional installed modules
- Current IOS software version and file name

The NetworkingCompany staff uses this information to determine which Cisco IOS software version is appropriate and which hardware options can be installed.

### Using the `show version` Command

The technicians use the `show version` command on each device to verify that the inventory list is correct. The command will also help them to obtain any missing information.

The network designer then sends the staff a list of new features. These are features that the designer believes will be needed to support the expanded stadium network capabilities. Evaluating the new features list helps the staff to select an IOS software version that is appropriate for the new network.

Refer to  
**Lab Activity**  
for this chapter

### Lab Activity

Use `show version` to fill out an inventory sheet for a Cisco switch and router.

Refer to  
**Figure**  
in online course

The NetworkingCompany staff and the stadium IT manager discuss how to upgrade the current network equipment with minimal disruption of day-to-day operations. They agree that the network switches and routers can be upgraded during scheduled maintenance on Sunday morning from 2:00 a.m. to 8:00 a.m. However, because of the large number of installed devices, the upgrade may take more than one Sunday morning to complete.

In the stadium network, three types of network devices will be included in the new design:

- 16 Cisco 2960 switches
- 1 Cisco 1841 router
- 3 non-Cisco routers

After the NetworkingCompany staff determines which Cisco IOS software versions and hardware components need to be installed, they are able to estimate the time necessary for the upgrades of the Cisco equipment. The non-Cisco routers will be updated at a later time.

### IOS Software File Naming Conventions

IOS files need to be kept up-to-date to prevent security risks and to implement bug fixes. Some of the installed devices on the stadium network have outdated IOS versions.

*IOS file naming convention*s provide the version number and feature set of the IOS.

Refer to  
**Figure**  
in online course

When the Cisco IOS software on a switch or router is upgraded, the device needs to be rebooted. This process takes the device out of service for a short period of time. As with any upgrade, unforeseen problems may arise after the new hardware or IOS is loaded. Upgrades should be planned carefully. This will ensure that the network is not disrupted during normal operating hours.

### Testing the Upgrade Process

To avoid as many problems as possible, the NetworkingCompany obtains a 2960 switch and an 1841 router. They use these devices to test the upgrade process before they attempt to upgrade the stadium equipment. Testing is a good practice, because there can be significant differences from one IOS version or hardware component to another.

Using test equipment enables the NetworkingCompany staff to verify that the updated system will operate as expected. They will be better able to estimate the length of time it will take to perform each upgrade.

### 3.2.3 Choosing an Appropriate Cisco IOS Image

Refer to  
Figure  
in online course

The NetworkingCompany staff needs to determine whether the current devices can support a Cisco IOS version with the necessary new network features. This is an important step in the upgrade process.

#### Using Feature Navigator

The Cisco.com web site provides tools to assist the NetworkingCompany staff in choosing the right IOS version. *Feature Navigator* is a web-based tool that helps to determine which features are supported by a specific IOS software image. Feature Navigator can also be used to find which IOS software images support a specific feature.

Feature Navigator allows searches by feature or release version. Under the release version section, the staff compares release versions side-by-side. Registered Cisco.com users can access Feature Navigator at <http://www.cisco.com/go/fn>.

IOS software is packaged in feature sets that support specific switch and router platforms. The staff uses Cisco Feature Navigator to determine which IOS releases are appropriate for the installed equipment. They use the inventory list and the list of necessary features that the network designer provided.

Refer to  
Lab Activity  
for this chapter

#### Lab Activity

Use Feature Navigator to select the correct Cisco IOS software for the FilmCompany network, and check that the device has enough *DRAM* and *flash memory* to support it.

Refer to  
Figure  
in online course

The NetworkingCompany staff identifies an appropriate Cisco IOS software image release. Having done so, the staff must check that each device has enough flash memory and *RAM* to support the new IOS files. If not, memory upgrades must be done before the new IOS can be installed.

The stadium company has a maintenance agreement that enables staff members to download the new IOS versions for their Cisco equipment. The NetworkingCompany staff asks the stadium management to ensure that they are in compliance with Cisco licensing agreements. They must verify that each Cisco device is included in the maintenance agreement.

The NetworkingCompany staff downloads the new IOS versions from Cisco.com. They can then be stored on a Trivial File Transfer Protocol (*TFTP*) server. Storing the files on a TFTP server enables the staff to load the software easily onto the routers and switches for the upgrade.

The `copy` command is used to transfer files from a TFTP server to a router or switch.

### 3.2.4 Download and Install Cisco IOS Software

Refer to  
Figure  
in online course

The stadium router and switches do not have a current Cisco IOS version. The necessary upgrades must be done manually by performing the following steps:

#### Step 1: Select a IOS Software Image

The first step in the upgrade procedure is to select an appropriate IOS software image version and feature set. The following factors need to be considered when selecting an IOS version:

- **Memory Requirement** - Ensure that the router has enough disk or flash memory to store the IOS. The router also needs sufficient memory (DRAM) to run the IOS. If the router does not have enough memory, the router may have problems when it boots under the new IOS.
- **Interface and Module Support** - Ensure that the new IOS supports all the current and new interfaces and modules to be installed in the router.

- **Software Feature Support** - Compare the new IOS features with those used with the old IOS. Any new features required for the network upgrade need to be included.

The NetworkingCompany staff uses Feature Navigator to find the appropriate IOS versions for the installed equipment. They download and copy the IOS files to the download directory on the TFTP server. They also read the [release notes](#) to ensure that there are no unexpected changes or known issues with the release.

Refer to  
Figure  
in online course

### Step 2: Identify the Device File System to Copy the Image

The NetworkingCompany staff uses the **show file systems** command output to locate the Cisco IOS files or images. Either this command or the **dir [file\_system]** command can be used to find the free space available to store the new IOS images. If the devices do not have enough flash memory, memory upgrades should be implemented before the new IOS can be installed.

### Step 3: Verify that the TFTP Server Has IP Connectivity to the Device

The TFTP server must have a network connection to the device. It must be able to ping the IP address of the device targeted for a TFTP software upgrade. To achieve this connection, the device interface and the TFTP server must have either an IP address in the same range or a default gateway configured.

Refer to  
Figure  
in online course

### Step 4: Back Up the Current Configurations to Prepare for the Upgrade

The configuration files and current IOS from the router should be backed up before upgrading the Cisco IOS. The running configuration should be copied to the startup configuration. The startup configuration and the current IOS image should be backed up to a TFTP server. Some of the IOS releases add default configurations. These new configuration items may conflict with the current configuration.

### Step 5: Copy the IOS Image to the Device

After the NetworkingCompany staff pings between the TFTP server and the device, they are ready to copy the IOS software image into flash memory. Before copying the image, the staff ensures that the TFTP server software is running. They confirm that the IOS image is in the appropriate TFTP server directory.

To upgrade the IOS from a TFTP server, the staff uses the **copy tftp flash** command.

The copy process takes several minutes. The **dir flash** command is used to check that the file has been transferred successfully.

To complete the upgrade, the NetworkingCompany staff reboots the device and observes the device bootup process.

The staff performs the upgrade on the test network devices. After completing the upgrade, they compare the resulting configurations to the saved configurations. The staff ensures that any differences between the configurations do not affect the stadium network operation.

Refer to Packet  
Tracer Activity  
for this chapter

### Packet Tracer

Download the correct Cisco IOS and transfer the file to the Cisco router or switch using a TFTP server.

Refer to  
Lab Activity  
for this chapter

### Lab Activity

Prepare a router to receive a new Cisco IOS and transfer the IOS to the router from a TFTP server.

## 3.2.5 The Router Startup Process

Refer to  
Figure  
in online course

The *bootup process* has three stages:

### 1. Performing the POST and Loading the Bootstrap Program

The power-on self test (*POST*) is a process that occurs on almost every computer when it boots. The POST is used to test the router hardware.

After the POST, the bootstrap program is loaded. The bootstrap program locates the Cisco IOS and loads it into RAM.

### 2. Locating and Loading the IOS Software

The location of the IOS file is specified by the value of the configuration register setting. The bits in this setting can instruct the device to load the IOS file from the following locations:

- Flash memory
- A TFTP server
- Another location indicated in the startup configuration file

To load the IOS normally from flash, the configuration register setting should be set to 0x2102.

### 3. Locating and Executing the Startup Configuration File or Entering Setup Mode

After the IOS is loaded, the bootstrap program searches for the startup configuration file (startup-config) in *NVRAM*. This file contains the previously saved configuration commands and parameters, including:

- Interface addresses
- Routing information
- Passwords
- Other configuration parameters

If no configuration file is located, the router prompts the user to enter setup mode to begin the configuration process.

If a startup configuration file is found, a prompt containing a hostname will display. The router has successfully loaded the IOS and the configuration file. The NetworkingCompany staff can begin using IOS commands on the router.

Refer to  
Lab Activity  
for this chapter

### Lab Activity

Observe the startup process on an 1841 router.

## 3.3 Upgrading Existing Hardware

### 3.3.1 Investigating Installed Hardware Features

Refer to  
Figure  
in online course

After updating the Cisco IOS versions, the network designer needs to know what hardware upgrades can be performed on the existing devices so that they meet the new requirements. Upgrades may be needed that include high-speed or high-density modules and other available hardware options, such as rack mount kits.

Cisco.com offers datasheets for all of the devices that are installed in the stadium network. The NetworkingCompany staff uses these datasheets to create a list of the possible options for each device.

The staff uses the 1841 router datasheet to see what modules and interfaces are available for that model. A number of different types of modules fit the two option slots on the 1841, including:

- WAN interface cards (*WICs*)
- High-speed WAN interface cards (*HWICs*)
- Voice/WAN interface cards (*VWICs*)
- Wireless WICs that can function as Access Points
- Gigabit Ethernet HWICs to provide fiber connectivity

The designer uses this list to determine which options are needed to meet the requirements of the new network.

### 3.3.2 Investigating Appropriate Hardware Options

Hardware devices come with different capabilities. It is important to understand which technology and media a module in a given router would support. The network designer notes the technologies that are likely to be applicable in the new design for the stadium network.

To support the voice, video, and data traffic on the new network, the designer makes the following list of technologies and media:

- Gigabit Ethernet using fiber at the Core and Distribution Layers
- 100 Mbps connectivity using copper wire at the Access Layer
- Gigabit Ethernet using either copper or fiber in the data center
- High-speed serial connections to the two WAN sites
- High-speed digital subscriber line (*DSL*) to connect to the Internet

The designer compares this list to the list of available options in the documentation for the 1841 router on Cisco.com. The existing 1841 can support the necessary modules to connect to the WAN site and to the Internet.

**Full/Screen Activity**

**Lab Activity**

Investigate the hardware options available on the 1841 Integrated Services Router.

### 3.3.3 Installing a New Hardware Option

**Installing Option Interface Cards in an 1841 Router**

The NetworkingCompany staff goes to Cisco.com to locate the instructions for installing the option interface cards. The procedure to install these cards is as follows:

**Step 1: Turn Off Power to the Router**

The 1841 router option slots do not support *hot-swappable* option interface cards, which can be changed with the power on.

**Step 2: Remove the Blank Faceplate from the Slot**

Refer to  
**Figure**  
in online course

Refer to  
**Interactive Graphic**  
in online course.

Refer to  
**Lab Activity**  
for this chapter

Refer to  
**Figure**  
in online course

Use either a Number 1 Phillips screwdriver or a small flat-blade screwdriver to unscrew the captive screws. Then remove the blank *faceplate* from the chassis slot.

### Step 3: Install the Option Module

- To minimize the risk of static discharge and damage to equipment during the installation process, use a properly grounded antistatic wrist strap when working with electronic equipment.
- Handle the card by the edges to reduce the risk of damage from static discharge.
- Align the card with the guides in the chassis walls or slot divider and slide it gently into the slot.
- Push the card into place until the edge connector is secure. The faceplate should touch the chassis rear panel.
- Tighten the captive screws on the faceplate.

### Step 4: Turn on Power to the Router and Check the New Configuration

- Connect a PC to the console port of the router and observe the initialization process.
- Check that the router recognizes the new option interface card.
- Note the interface designation that is given to the new device on the inventory sheet and the existing topology diagram.

Refer to **Packet Tracer Activity** for this chapter

### Packet Tracer Activity

Add an option interface card to an 1841 router and observe the router startup and new interface designations.

## 3.4 Performing a Wireless Site Survey

### 3.4.1 Visiting the Customer Site

Refer to **Figure** in online course

The next step in characterizing the existing network is to evaluate the wireless LAN (WLAN) deployment in the stadium. Because of differences in the configurations, Access Point (AP) placement, and the physical environment, every WLAN is a unique installation.

Before the wireless network design is finalized, the NetworkingCompany staff performs a site survey to determine the best use and placement of the wireless networking components. The survey provides information needed to assist the network designer in determining the type, placement, and coverage areas for WLAN Access Points.

Wireless site surveys require that NetworkingCompany staff enter public spaces, offices, and other locations where business is being conducted.

Whenever the NetworkingCompany staff is on the stadium site, they are representing their company. When visiting a customer site, professional behavior and appropriate dress are important. The behavior and professionalism of the staff reflects positively on the ability of the NetworkingCompany to install the upgrade.

Refer to **Figure** in online course

When preparing for a wireless site survey, the NetworkingCompany staff should follow the NetworkingCompany guidelines.

These guidelines were prepared for the sports stadium site survey:

#### Preparation

- Schedule the site survey with the customer.
- Dress appropriately for the task.
- Wear or carry company credentials.
- Bring the proper equipment (create a standard checklist to ensure that all necessary materials are included).
- Notify stadium personnel when the staff will arrive and how long the site survey should take.

### Site Survey

- Check in with the proper staff upon entry into the stadium.
- Work quickly and professionally to instill a sense of confidence in the customer.
- Answer questions politely and as completely as possible.
- Write down any questions that must be answered by other staff members.
- Inform the customer of the survey procedures.
- Report back to the customer staff before leaving the premises to inform them of the successful completion of the survey.

### Security

Many companies have their own uniformed security guards who need to be aware of any visit. Businesses typically require a visitor to check in at the main office before accessing other areas. In high-security areas, it is extremely important to gain security clearance and be escorted if needed. High-security areas include government, aviation, and military locations.

### Safety Guidelines

- Follow the recommended safety guidelines to ensure proper operation and safe use of the wireless devices.
- Obtain customer approval before touching or attaching devices to any existing networking equipment.

Refer to  
Figure  
in online course

When the NetworkingCompany schedules a wireless site survey, the customer may have site visit requirements for the staff to meet. Some companies may not have site visit requirements established if vendors do not routinely visit their locations. In this case, the NetworkingCompany technician must ask specific questions to help determine the site visit requirements when making the appointment.

Some site visit requirements may include:

- Access restrictions
- Clothing
- Safety equipment
- Identification Badges
- Hours of operation
- Security
- Prohibited items

Refer to  
**Lab Activity**  
for this chapter

Customer requirements may vary from site to site. NetworkingCompany staff must comply with customer requirements when preparing for a site visit.

### Lab Activity

Set up an appointment to perform a wireless site survey.

Refer to  
**Figure**  
in online course

## 3.4.2 Physical Network Considerations

The stadium network is currently providing limited wireless access through two Access Points (APs). One AP is in the team office area. This AP is actually a small wireless router that was purchased by the team management. The other AP, an inexpensive older Cisco Aironet AP, is located in the stadium press box. This AP provides wireless access for the reporters.

In the proposed network design, the stadium network requires additional wireless hotspots in the stadium restaurant and luxury suites. In both locations, the stadium management plans to offer unsecured wireless access to the Internet.

The network designer has identified a list of possible sources of interference and some physical stadium infrastructure issues that might affect the RF coverage areas. During the site survey, the NetworkingCompany staff can check these areas to determine the actual impact on the wireless signals.

Areas of concern to the designer include:

- The many microwave ovens that are located in the concession areas and the luxury boxes
- Wireless telephones and headsets that are used by the reporters and newsmen
- Elevator shafts that are located near the outer areas of the restaurant and the luxury suites
- Thick concrete pillars and walls between the luxury suites

Refer to  
**Interactive Graphic**  
in online course.

Full Page Activity

## 3.4.3 Wireless Site Survey and Planning

Performing a site survey consists of the following steps:

### Step 1: Define Customer Requirements

The stadium may want to advertise the availability of wireless hotspots. The NetworkingCompany staff needs to determine the service level expectations. They also need to determine whether the stadium wants to support advanced wireless technologies, such as wireless IP phones.

### Step 2: Identify Coverage Areas

The NetworkingCompany staff estimates the number of potential users in each coverage area. More importantly, the staff determines the expected peak usage during major events.

### Step 3: Determine Preliminary AP Locations

The staff reviews the stadium plans and suggests possible AP locations. Then they determine how coverage can be provided, which areas need power, and how the APs will connect to the wired network.

### Step 4: Measure Signal Strength

The staff temporarily installs an AP in a proposed location. Then they measure the received RF strength and possible causes of interference.

Refer to  
**Figure**  
in online course

Refer to  
**Figure**  
in online course

The NetworkingCompany staff installs a temporary AP in the center of the restaurant, away from the kitchen. The AP does not need to be attached to the stadium network because only the wireless coverage is being tested.

The staff uses a laptop computer equipped with a site survey utility on a wireless NIC to perform the test.

The NetworkingCompany staff performs the following steps:

**Step 1:** Measure the signal strength and speed of a link as they walk away from the AP.

**Step 2:** Record the readings and measure the distances to the AP when the quality or link speed changes.

**Step 3:** Mark the areas where signals are acceptable on a floor plan.

The network designer uses the marked floor plan to determine the location of the APs and the wired network jacks that connect them to the network. Upon completing the third step, the designer must ensure compliance with all local, state, and national fire and electrical codes.

Refer to **Packet Tracer Activity** for this chapter

### Packet Tracer Activity

Using a diagram that includes a floor plan of the FilmCompany, place APs at different locations.

Refer to **Lab Activity** for this chapter

### Lab Activity

Perform a wireless site survey using an AP and the wireless NIC.

Refer to **Interactive Graphic** in online course.

Full Screen

Play the Cisco Wireless Explorer Game.

## 3.5 Documenting Network Design Requirements

### 3.5.1 Creating a Network Design Requirements Document

Refer to  
**Figure**  
in online course

The NetworkingCompany staff has now completed the Prepare and Plan phases of the network upgrade lifecycle. They are ready to create a Design Requirements document and begin the design of the new stadium network.

A Design Requirements document is a summary of all the major business and technical requirements for the new network design.

Much of the information needed to complete the Design Requirements document can be found in the Request for Proposal (RFP). The Design Requirements document contains the specifications for the proposed network upgrade.

The first two sections of the Design Requirements document are the Overall Project Goal and the Project Scope.

#### Overall Project Goal

This section states the overall goals of the upgrade. It also specifies how this upgrade will help the stadium management company become more successful.

#### Project Scope

This section outlines the physical areas, applications, and user groups affected by the network upgrade. It may list components of the network that are beyond the scope of the network upgrade, such as server or application updates.

Refer to  
**Figure**  
in online course

Two other important sections of the Design Requirements document are Network Requirements and Current State of the Network.

### Network Requirements

This section details all of the business goals and technical requirements, constraints, user groups, and applications that influence the design of the proposed stadium network.

### State of the Network

This section details the existing network and includes the following information:

- Logical and physical diagrams
- Equipment lists
- Applications
- Strengths and weaknesses

Refer to  
**Figure**  
in online course

The network designer needs to be aware of the existing network. This enables the designer to address its weaknesses and build on its strengths more efficiently.

The NetworkingCompany reviews the Design Requirements document in conjunction with the stadium management. They do this to ensure that there are no misunderstandings before proceeding with the design project.

## 3.5.2 Overall Project Goal

Refer to  
**Lab Activity**  
for this chapter

When writing an overall project goal, it is important to think about the primary purpose of the network design project. The overall goal needs to relate to the goals of the business, which are designed to make the business more successful.

In this section of the document, the NetworkingCompany designer describes the overall project goal of the stadium network upgrade. The designer takes into account all of the information obtained from interviews with the StadiumCompany president and discussions with other members of the stadium staff.

The NetworkingCompany obtains agreement from the stadium management on the overall goal of the project.

### Lab Activity

Create an overall project goal statement for the FilmCompany.

Refer to  
**Figure**  
in online course

## 3.5.3 Project Scope

The second section of the Design Requirements document outlines the project scope. It details how much of the network is affected or changed as a result of the project.

It also defines the parts of the existing network that are not within the areas covered by the project. These out-of-scope areas are defined so that there is no misunderstanding between the NetworkingCompany and the StadiumCompany management.

The NetworkingCompany designer looks at the existing network topology and the services that it provides. The overall goal indicates that both the LAN and the WAN networks will need to be upgraded. The scope of this project impacts all of the users at the main stadium facility and at the two remote locations.

Refer to  
**Interactive Graphic**  
in online course.

### Activity

Determine the scope of various network upgrade scenarios.

Refer to  
**Lab Activity**  
for this chapter

### Lab Activity

Create a scope statement for the FilmCompany.

## 3.5.4 Business Goals and Technical Requirements

Refer to  
**Figure**  
in online course

The first two sections of the Design Requirements document are usually short and do not contain much detail. In contrast, the Network Requirements section is very detailed. This section helps drive the network design and implementation of new technologies.

The Network Requirements section has the following four subsections:

- Business Goals
- Technical Requirements
- Users
- Applications

### Business Goals

The NetworkingCompany designer lists the goals in order of priority. The most important goals are listed first.

Refer to  
**Figure**  
in online course

### Technical Requirements

The NetworkingCompany designer evaluates each of the business goals. The designer then determines the technical requirements to meet the goals. These requirements are outlined in the Technical Requirements section under the properties of scalability, availability, security, and manageability.

- **Scalability-** A business goal is to add new services, new users, and voice and video capability to the network. The network must be able to scale easily without a major redesign or disruption to services. The designer discusses and documents possible growth estimates with the stadium management.
- **Availability-** The addition of voice, security, video, and online ticketing requires the network to be available to users at all times. New applications need to be accessible to the remote sites and the main stadium location. The new ticketing and entry applications require very short transaction times. The addition of voice and video require that the network support QoS.
- **Security-** A primary goal of all network upgrades is to improve security. The proposed stadium network will include firewalls, filtering, and an intrusion detection system (IDS) to protect it from access by unauthorized users. The services will be protected using a data center server farm.
- **Manageability-** The stadium management company does not want to increase the number of IT personnel to support the new network. Therefore, the network must be easy to manage and maintain. A network is easier to manage when networking standards are used during the design and installation. A management application is needed to provide the IT department with reports and alerts to help it support the network. Additionally, training for the stadium IT staff is required to manage and maintain the proposed network.

Refer to  
**Figure**  
in online course

## Users

In this section of the Design Requirements document, the different user groups and their access requirements are listed. The stadium management company plans for customers, vendors, team personnel, and remote workers to access the network. It makes similar provisions for the on-site management company personnel. Each of these groups may have specific requirements for network services. It is important to document these requirements so that they are considered in the network design.

## Applications

The network traffic characteristics and requirements of various applications affect the design of the network. This section of the document describes the types of applications the network must support. Any specific network traffic requirements are listed as well.

Refer to  
**Interactive Graphic**  
in online course.

## Activity

### Lab Activity

Develop a Network Requirements section for the FilmCompany Design Requirements document.

Refer to  
**Lab Activity**  
for this chapter

## 3.5.5 Existing Network Characterization

### State of the Existing Network

The final section of the Design Requirements document includes the following information:

- All of the network diagrams that the NetworkingCompany creates to illustrate the existing network
- The names and IP addresses of servers and important networking components
- The existing network strengths and weaknesses and how they impact the business goals

The network designer creates a chart that lists each of the identified weaknesses, which business or technical goal is impacted, and how the weakness can be eliminated in the proposed network design.

The NetworkingCompany staff reviews the completed Design Requirements document. A meeting is then set up with the stadium management company officials. The purpose of the meeting is to obtain their agreement and authorization to continue with the design of the upgrade.

Refer to  
**Figure**  
in online course

Refer to  
**Interactive Graphic**  
in online course.

## Activity

### Lab Activity

Analyze the existing FilmCompany network in relation to its business goals and technical requirements.

Refer to  
**Lab Activity**  
for this chapter

## Summary

Go to  
the online course  
to take the quiz.

## Quiz

Take the chapter quiz to check your knowledge.

## Your Chapter Notes