# **Chapter 2**

# **Network Infrastructure and Documentation**

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| At a Glance |

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## Overview

This chapter details the structural hardware necessary to connect and support these hosts, routers, and switches and connect them to the outside world. Students will learn about cabling, racks,

equipment that monitors the environment, and other equipment that supports the

physical network in a building or on a campus. They will also learn how critical it is to maintain good network documentation, so you can keep track of the complexities of a typical modern network. Finally, they’ll learn how to implement clear policies for managing changes to a network.

## Chapter Objectives

After reading this chapter and completing the exercises, the student will be able to:

* Identify and describe network and cabling equipment in commercial buildings and work areas
* Create and analyze network diagrams
* Explain operating procedures, inventory management, labeling conventions, and business documents for a typical network
* Track the progress of changes made to a network

## Teaching Tips

#### Components of Structured Cabling

1. Describe the TIA/EIA-568 Commercial Building Wiring Standard, also known as structured cabling. Explain that structured cabling is based on a hierarchical design and assumes a network is based on the star topology.

**From the Demarc to a Workstation**

1. Use Figure 2-1 to illustrate the different components of structured cabling in an enterprise network.
2. Use Figure 2-2 to illustrate how structured cabling appears within a building.
3. The next section of the text outlines a tour of the physical network illustrated in Figure 2-1. Point out that a network begins at the demarcation point in the entrance facility. The tour covers three stops:
   1. Entrance facility in Building A
   2. Data room in Building B
   3. Work areas in all three buildings
4. Review the components of the tour outlined in the text:
   1. Entrance facility
   2. demark (demarcation point)
   3. MDF (main distribution frame/facility)
   4. data room
   5. racks
   6. patch panel
   7. VoIP telephone equipment
   8. IDF (intermediate distribution frame)
   9. Work area
   10. wall jacks
5. Use Figures 2-11 and 2-12 to discuss racks used for attaching devices such as routers, servers, switches, patch panels, audiovisual equipment, or telephony equipment.
6. Explain to students that rack system provide mounting hardware for network equipment to optimize the use of square footage in equipment rooms and ensure adequate spacing, access, and ventilation for these devices.
7. Mention that racks may be wall- or ceiling-mounted, or freestanding on the floor.
8. Explain that racks are measured in rack units (RU or U), with the standard being 42U tall (6 feet).
9. Point out that hardware should be installed as close to the front of the rack as possible to allow for proper airflow in the back.
10. Use Figure 2-14 to discuss hot aisle/cold aisle rack layout.
11. Discuss the three basic types of cable installations allowed by structured cabling standards:
    1. patch cable
    2. horizontal cabling
    3. backbone cabling
12. Use Figure 2-15 to illustrate a horizontal wiring configuration.
13. Use Figure 2-16 to illustrate a cable installation using UTP from the data room to the work area.
14. Discuss the various cable installation tips that will help prevent Physical layer failures:
    1. termination
    2. bend radius
    3. verify continuity
    4. cinch cables loosely
    5. protect cables
    6. avoid EMI
    7. plenum cabling
    8. grounding
    9. slack in cable runs
    10. cable trays
    11. patch panels
    12. company standards and stock
    13. documentation

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| ***Teaching***  ***Tip*** | Emphasize the vast knowledge required when specializing in cable installation, design, or maintenance, and the importance of investing in a reference dedicated to this topic. |

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| ***Teaching***  ***Tip*** | Students may find more information on Cable Considerations for Network Installations at <http://www.cablinginstall.com/articles/print/volume-6/issue-9/contents/design/network-design-and-installation-considerations.html> |

#### Monitoring the Environment and Security

1. Explain that due to the sensitive nature of the equipment mounted on racks, environmental and security monitoring are critical preventative measures.
2. Point out that data rooms are often serviced by HVAC systems that are separate from the rest of the building.
3. Explain that specialized products are available that monitor the critical factors of a data closet’s environment.

#### Quick Quiz 1

1. Which of the following terms best describe the first point of interconnection between an organization’s LAN or WAN and a service provider’s facility?
2. data room
3. MDF
4. IDF
5. work area

Answer: B

1. The area above the ceiling tile or below the subflooring is known as which of the following?
   1. crosstalk
   2. cable trays
   3. plenum
   4. grounding

Answer: C

1. True or False: A VoIP gateway device converts signals from a campus’s analog phone equipment into IP data that can travel over the Internet.

Answer: True

1. How wide is a standard data equipment rack?
   1. 42”
   2. 12”
   3. 23”
   4. 19”

Answer: D

1. Which of the following terms best describe the cables or wireless links that provide interconnection between the entrance facility and MDF?
   1. backbone
   2. patch
   3. demarc
   4. horizontal

Answer: A

#### Network Documentation

**Network Diagrams**

1. Define and describe network diagrams. Point out that these diagrams may show physical layout, logical topology, IP address reserves, names of major network devices, and types of transmission media. Use Figures 2-21 and 2-22 in your discussion.
2. Explain that a network diagram can be created as a product of network mapping, which is the process of discovering and identifying the devices on a network.
3. Introduce students to Nmap, which is a simple and popular tools used to detect, identify, and monitor devices on your network. Point out that the GUI version is called Zenmap.
4. Use Figure 2-25 to illustrate a network diagram using Cisco symbols.
5. Direct students to Table 2-1, which shows several of the most common network topology icons. Point out that students can download a copy of all these symbols from Cisco’s website at <cisco.com/c/en/us/about/brand-center/network-topology-icons.html>
6. Define and describe a wiring schematic.
7. Use Figure 2-29 to illustrate a wiring schematic.
8. Explain that another diagram that students may come across is a rack diagram, which show the devices stacked in a rack system. Point out that these diagrams are typically drawn to scale. Use Figure 2-30 in your discussion.

**Operating Procedures**

1. Explain that essential documentation covers:
   1. logical and physical connections on a network
   2. inventory management
   3. IP address utilization
   4. vendors
   5. internal operating procedures, policies, and standards
2. Use Table 2-2 to describe items to consider covering in network documentation. Point out that as information is compiled, it should be organized into a database that can be easily updated and searched.

**Inventory Management**

1. Define system life cycle as the process of designing, implementing, and maintaining an entire network. Point out that a major part of this process is the removal and disposal of outdated assets and the addition of compatible, updated devices.
2. Explain that inventory management refers to the monitoring and maintaining of all the assets that make up a network.
3. Point out that the first step in inventory management is to list all the components on the network, which include:
   1. hardware – configuration files, model number, serial number, location on the network, and technical support contact
   2. software – version number, vendor, licensing, and technical support contact
4. Mention that inventory documentation provides network administrators with information about the costs and benefits of certain types of hardware or software.

**Labeling and Naming Conventions**

1. Discuss the importance of establishing a naming convention when labeling devices. Further discuss the importance of labeling those devices with those names.
2. Discuss the naming convention tips outlined in the text:
   1. Use names that are as descriptive as possible
   2. Only include fields that are absolutely essential in identifying the device
   3. Don’t overcomplicate the name with useless or redundant information
   4. Pay attention to any established naming convention already in use by the employer
   5. Think big-picture-down-to-details when designing device name fields
   6. Consider any security risks from the details you might include in your naming convention
3. Discuss these tips for labeling:
   1. Use color-coded cables for different general purposes
   2. Label ports and jacks that cables connect to
   3. Where labels won’t fit on devices, draw a simple diagram of the device that indicates the purpose of each port, slot, and connector (see Figure 2-32)
   4. Use a portable label maker

**Business Documents**

1. Explain to students that there are certain business documents that network professionals should be familiar with. Discuss the purpose and structure of the following:
   1. RFP (request for proposal)
   2. MOU (memorandum of understanding)
   3. SOW (statement of work)
   4. SLA (service-level agreement)
   5. MSA (master service agreement)
   6. MLA (master license agreement)

#### Change Management

1. Explain why managing change while maintaining a network’s efficiency and availability requires good planning.
2. Introduce change management and techniques for approaching the most common types of software and hardware changes, from installing patches to replacing a network backbone.

##### Software and Hardware Changes

1. Point out that an important part of keeping a system running optimally is upgrading its software.
2. Describe the four common software change types:
   1. patch
   2. upgrade
   3. rollback
   4. installation
3. Review the general steps involved in implementing software changes on a network.
4. Emphasize that generally, upgrading or patching software according to a vendor’s recommendations is a good idea and can often prevent network problems.
5. Explain that most technicians will encounter a situation when you must roll back changes.
6. Use Table 2-3 to summarize some basic options to reverse a software upgrade.
7. Discuss the change management principles that apply to any type of change:
   1. Process all changes through the proper channels
   2. Minimize negative impacts on business processes
   3. Plan thoroughly to maximize the chances of a successful change on the first attempt
   4. Document each change throughout the process

#### Change Management Documentation

1. Point out that generally, the larger an organization, the more documentation is required when making hardware and software changes.
2. Explain that required processes and how these processes are documented are designed to protect the person making the change, users, managers, and the organization so that changes do not disrupt normal work flow.
3. Discuss the list of what to expect when managing hardware or software changes:
4. Submit a change request document
5. Understand and follow the approval process
6. The change is project-managed
7. Provide additional documentation
8. Close the change

## Quick Quiz 2

1. Which of the following terms best describe the process of discovering and identifying the devices on a network?
2. network diagram
3. wiring scheme
4. network mapping
5. network graphing

Answer: C

1. A graphical representation of a network’s wired infrastructure is known as a \_\_\_\_\_\_\_\_\_.

Answer: wiring schematic

1. True or False: The first step in inventory management is to determine the cost and benefits of certain types of hardware and software.

Answer: False

1. What type of document outlines the intentions of two or more parties to enter into a binding agreement, or contract, and is sometimes used between an informal handshake and the legally binding signatures on contracts?
   1. RFP (request for proposal)
   2. MOU (memorandum of understanding)
   3. SOW (statement of work)
   4. SLA (service-level agreement)

Answer: B

1. Which of the following terms best describe a major change to a software package that enhances the functionality and features of the software, while also correcting bugs and vulnerabilities?
2. service pack
3. rollback
4. backlevel
5. upgrade

Answer: D

## Class Discussion Topics

1. As a class, discuss how long an upgraded hardware and software components should be stored in case there is a need to back out and reinstall. What considerations should be taken into account when determining the appropriate time to discard old or upgrade equipment?
2. Documenting a network is essential in troubleshooting and support. Discuss the security implications in keeping such documentation. How should an organization balance access to the documentation against protecting the network from intentional hacking, compromise or damage?

## Additional Projects

1. Have the student research companies that specialize in the physical removal or destruction of data on hard disks. The research report should include information on three such companies including the company name, accurate Web site address (if available), physical location, services, and costs.
2. Have the student research network diagramming products on the market and write a report of their findings. The research should include three products and a comparison of the technical specifications, ease of use (if available), price, availability, and product ratings (if available).

## Additional Resources

1. Designing a Structured Cabling System

<http://www.cablinginstall.com/articles/print/volume-4/issue-1/contents/design/designing-a-structured-cabling-system-for-voice-and-data.html>

1. Cisco Network Icons

[cisco.com/c/en/us/about/brand-center/network-topology-icons.html](file:///C:\Users\Julie\Dropbox\InstructorResources\Network+\IM\New\cisco.com\c\en\us\about\brand-center\network-topology-icons.html)

1. Technology Asset Management

<http://www.tam-inc.com/>

1. TIA/EIA 568 Wiring Standard

<https://www.utm.edu/staff/leeb/568/568.htm>

1. Five Free Apps for Diagraming a Network

https://www.techrepublic.com/blog/five-apps/five-free-apps-for-diagramming-your-network/

## Key Terms

**For definitions of key terms, see the Glossary near the end of the book.**

* **110 block**
* **66 block**
* **crosstalk**
* **demarc (demarcation point)**
* **EIA (Electronic Industries Alliance)**
* **EMI (electromagnetic interference)**
* **entrance facility**
* **fiber-optic cable**
* **IDF (intermediate distribution frame)**
* **inventory management**
* **KVM (keyboard, video, and mouse) switch**
* **licensing restrictions**
* **MDF (main distribution frame or main distribution facility)**
* **MLA (master license agreement)**
* **MOU (memorandum of understanding)**
* **MSA (master service agreement)**
* **network diagram**
* **Nmap**
* **patch**
* **patch management**
* **patch panel**
* **plenum**
* **punchdown tool**
* **PVC (polyvinyl chloride)**
* **rack diagram**
* **RFP (request for proposal)**
* **rollback**
* **SLA (service-level agreement)**
* **SOW (statement of work)**
* **STP (shielded twisted pair)**
* **structured cabling**
* **system life cycle**
* **TIA (Telecommunications Industry Association)**
* **upgrade**
* **UTP (unshielded twisted pair)**
* **VoIP (Voice over IP)**
* **VoIP endpoint**
* **VoIP gateway**
* **VoIP PBX (private branch exchange)**
* **wiki**
* **wiring schematic**