Objectives

• Explain virtualization and identify characteristics of virtual network components
• Create and configure virtual servers, adapters, and switches as part of a network
• Describe techniques for incorporating virtual components in VLANs
• Explain methods for remotely connecting to a network, including dial-up networking, virtual desktops, and thin clients
Objectives (cont’d.)

• Discuss VPNs (virtual private networks) and the protocols they rely on
• Identify the features and benefits of cloud computing and NaaS (Network as a Service)
Virtualization

• Emulation of a computer, operating system environment, or application:
  – On a physical system
• Virtual machines (VMs)
  – Virtual workstations
  – Virtual servers
  – Can be configured to use different types of:
    • CPU
    • Storage drive
    • NIC
Virtualization (cont’d.)

• VM appears to user no different than physical computer:
  – Running the same software
• Host
  – Physical computer
• Guest
  – Virtual machines
• Hypervisor
  – Manages virtual machines
Figure 10-1 Elements of virtualization

*Courtesy Course Technology/Cengage Learning*
Virtualization (cont’d.)

• Advantages of virtualization
  – Efficient use of resources
  – Cost and energy savings
  – Fault and threat isolation
  – Simple backups, recovery, and replication

• Disadvantages
  – Compromised performance
  – Increased complexity
  – Increased licensing costs
  – Single point of failure
Virtual Network Components

• Virtual network
  – Can be created to consist solely of virtual machines on a physical server
• Most networks combine physical and virtual elements
Virtual Machines and Adapters

• Virtualization program
  – Assigns VM’s software and hardware characteristics
  – Often easy to use, step-by-step wizard

• Operating system images
  – Available for download online
    • Or on disc from software vendors

• Network connection
  – Requires virtual adapter (vNIC)
Figure 10-2 Specifying a VM’s memory in VMware

Courtesy Course Technology/Cengage Learning
Figure 10-3 Customizing vNIC properties in VMware

_Courtesy Course Technology/Cengage Learning_
Virtual Switches and Bridges

• Virtual bridge or switch
  – Created when first VM’s NIC is selected
  – Connects VM with host
  – Resides in RAM

• Virtual switch
  – Logically defined device
  – Operates at Data Link layer
  – Passes frames between nodes

• Virtual bridge
  – Connects vNICs with a network
Figure 10-4 Virtual servers on a single host connected with a virtual switch

*Courtesy Course Technology/Cengage Learning*
Figure 10-5 Virtual switches exchanging traffic through routers

*Courtesy Course Technology/Cengage Learning*
Network Connection Types

• Must identify networking mode vNIC will use
• Frequently-used network connection types
  – Bridged
  – NAT
  – Host-only
• Bridged
  – vNIC accesses physical network using host machine’s NIC
  – Obtains own IP address, default gateway, and netmask from DHCP server on physical LAN
Figure 10-6 vNIC accessing a network in bridged mode

*Courtesy Course Technology/Cengage Learning*
Figure 10-7 Selecting the Bridged option for a vNIC in VMware

_Courtesy Course Technology/Cengage Learning_
Network Connection Types (cont’d.)

• NAT
  – vNIC relies on host to act as NAT device
  – Obtains IP addressing information from host
  – Virtualization software acts as a DHCP server
  – Default network connection type in VMware, VirtualBox, and KVM

• Host-only
  – VMs on one host can exchange data with each other and the host
  – Cannot communicate with nodes beyond the host
  – Never receive or transmit data with host’s physical NIC
Figure 10-8 vNIC accessing a network in NAT mode

*Courtesy Course Technology/Cengage Learning*
Figure 10-9 Selecting the NAT option for a vNIC in VirtualBox

*Courtesy Course Technology/Cengage Learning*
Figure 10-10 Host-only network configuration

Courtesy Course Technology/Cengage Learning
Virtual Appliances

• Alternative to test servers for new software
• Virtual appliance includes:
  – Image of operating system, software, hardware specifications, and application configuration
• Most commonly virtual servers
• Popular functions
  – Firewall
  – E-mail solutions
  – Network management
  – Remote access
Virtual Networks and VLANs

• Virtual network
  – Refers to how VMs connect with other virtual and physical network nodes

• Virtual network management
  – Nearly identical to physical network management

• To add VMs to a physical VLAN:
  – Modify virtual switch’s configuration
    • Steps vary for different virtualization programs
Figure 10-11 Multiple virtual servers connected to multiple VLANs

Courtesy Course Technology/Cengage Learning
Remote Access and Virtual Computing

• Remote access
  – Allows user to connect with LAN or WAN in different geographical location
  – Allows access to shared resources as any other client on LAN or WAN
  – Requires transmission path and appropriate software

• Popular remote access techniques
  – Dial-up networking
  – Microsoft’s Remote Access Service (RAS)
    • Or Routing and Remote Access Service (RRAS)
  – Virtual Private Networks
Dial-Up Networking

- Dialing directly into private network’s or ISP’s remote access server
- Usually refers to connection using PSTN
- Remote access server attached to group of modems
- Client must run dial-up software
- After authentication, user allowed access
- Remote access server can serve multiple users
- Low throughput
- Less popular today
Remote Access Servers

• Accepts connections regardless of Internet connection type
• RRAS (Routing and Remote Access Service)
  – Microsoft’s remote access software
  – Available with Server 2003, 2008, 2008 R2, XP, Vista, and 7 operating systems
  – Enables server to act as a router
  – Includes multiple security provisions
Figure 10-12 Clients connecting with a remote access server

*Courtesy Course Technology/Cengage Learning*
Remote Access Protocols

• SLIP (Serial Line Internet Protocol)
  – Earlier and less sophisticated than PPP
  – Can only carry IP packets
  – Requires significant amount of setup
  – Does not support data encryption
  – Asynchronous transmission

• PPP (Point-to-Point Protocol)
  – Known as PPPoE when used over Ethernet
  – Standard for connecting home computers to ISP
    • Via DSL or broadband cable
Remote Virtual Computing

- Allows workstation to remotely access and control another workstation
- Host may allow clients a variety of privileges
- Can send keystrokes and mouse clicks to the host
  - Receive screen output in return
- Thin client
  - Workstation that uses such software to access LAN
  - Requires very little hard disk space or processing power
Figure 10-13 Protocols used in a remote access Internet connection

*Courtesy Course Technology/Cengage Learning*
Remote Virtual Computing (cont’d.)

• Advantages
  – Simple to configure
  – Runs over any connection type
  – Single host can accept simultaneous connections from multiple clients

• Popular programs
  – Microsoft Remote Desktop
  – VNC (Virtual Network Computing)
  – ICA (Independent Computing Architecture)
Remote Virtual Computing (cont’d.)

- Remote desktop
  - Comes with Windows client and server operating systems
- VNC (Virtual Network Computing)
  - Open source system
- ICA (Independent Computing Architecture)
  - Citrix System’s XenApp
  - Can work with virtually any operating system or application
  - Easy to use
VPNs (Virtual Private Networks)

- Logically defined networks over public transmission systems
  - Isolated from other traffic on same public lines
- Requires inexpensive software
- Important considerations
  - Interoperability
  - Security
- Types
  - Site-to-site
  - Client-to-site
Figure 10-14 Site-to-site VPN

*Courtesy Course Technology/Cengage Learning*
Figure 10-15 Client-to-site VPN

Courtesy Course Technology/Cengage Learning
VPNs (cont’d.)

• Enterprise-wide VPN
  – Can include elements of client-to-site and site-to-site models
• VPNs tailored to customer’s distance, user, and bandwidth needs
• Two major types of tunneling protocols
  – PPTP (Point-to-Point Tunneling Protocol)
  – L2TP (Layer 2 Tunneling Protocol)
Cloud Computing

- Internet frequently pictured as a cloud
- Cloud computing
  - Flexible provision of data storage, applications, and services
    - To multiple clients over a network
- Cloud computing distinguishing features
  - Self-service and on-demand
  - Elastic
  - Supports multiple platforms
  - Resource pooling and consolidation
  - Metered service
Figure 10-16 Example of cloud computing

*Courtesy Course Technology/Cengage Learning*
Cloud Computing (cont’d.)

• Can provide virtual desktops
  – Operating environments hosted virtually
  – Different physical computer than one user interacts with

• NaaS (Network as a Service)
  – Service provider offers customers complete set of networking services

• Types of delivery
  – Public cloud
  – Private cloud
Summary

- Virtualization: emulation of a computer, operating system environment, or application on a physical system
- VMs exist as files on physical computer’s hard disk
- Hypervisor software manages resource allocation and sharing among virtual machines
- Virtual switch allows VMs to communicate with each other and with nodes on a physical LAN or WAN
- Different methods of remote user access exist
- Cloud computing provides storage, applications, or services over a network