Understanding Wired and Wireless Networks

Lesson 3

MVA Microsoft Virtual Academy

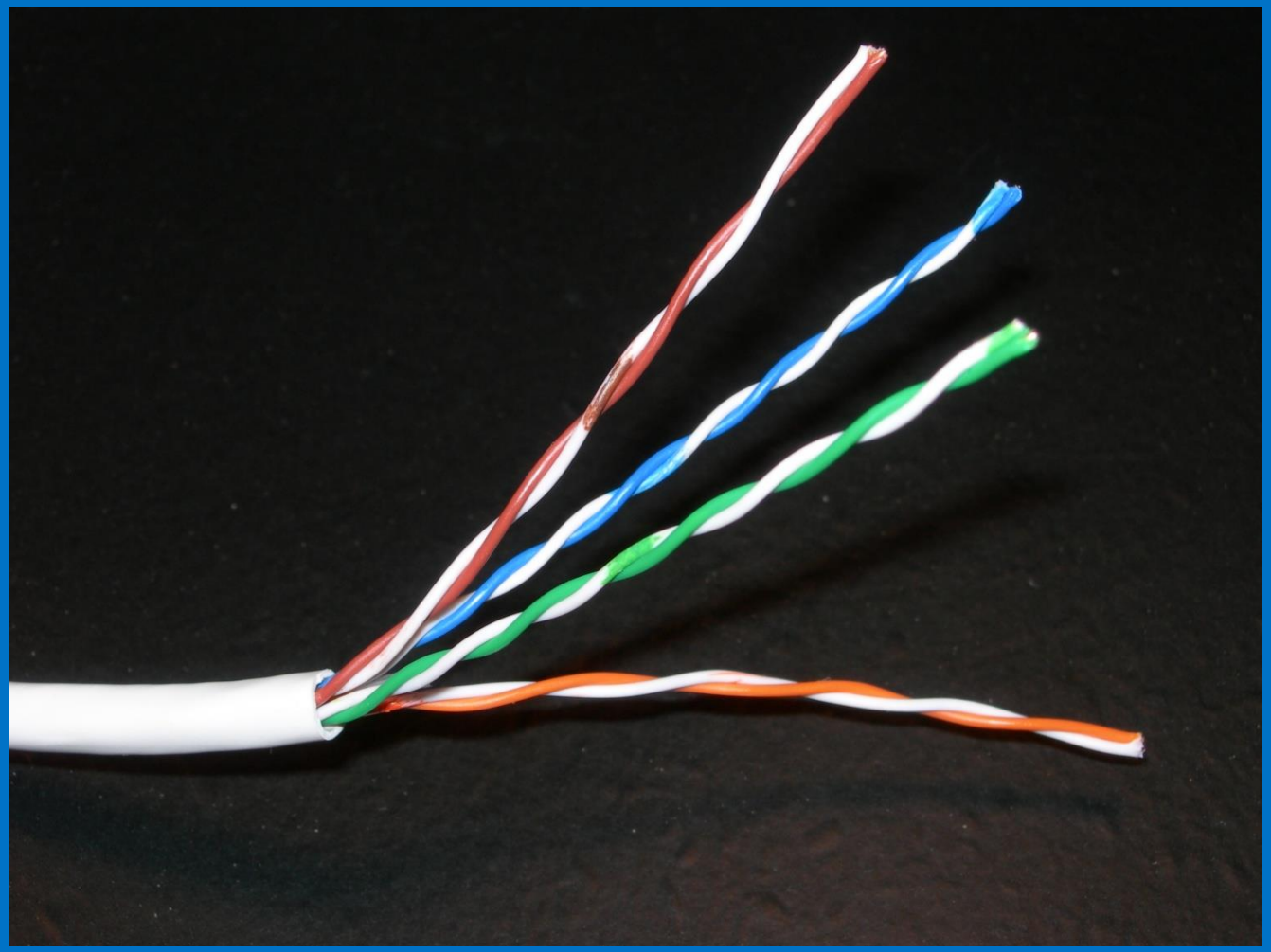
Objectives

Skills Concepts	Objective Domain Description	Objective Domain Number
Recognizing Wired Networks and Media Types	Understand Media Types	2.3
Comprehending Wireless Networks	Understand Wireless Networking	1.4

Twisted-Pair Cable

- the most commonly used cable type in local area networks
- relatively easy to work with, flexible, efficient, and fast
- contains eight wires grouped into four twisted pairs, typically blue, orange, green, and brown
- The twisted wires reduce crosstalk and interference

Twisted-Pair Cable with the Wires Exposed



Twisted Pair Categories

- Twisted-pair cables are categorized according to the frequency at which they transmit signals and their data transfer rate

Cable Type	Speed
Category 3 (Cat-3)	10 Mbps
Category 5 (Cat-5)	100 Mbps
Category 5e (Cat-5e)	100 Mbps and 1000 Mbps+
Category 6 (Cat-6)	1000 Mbps+

Tools For Twisted Pair Cables

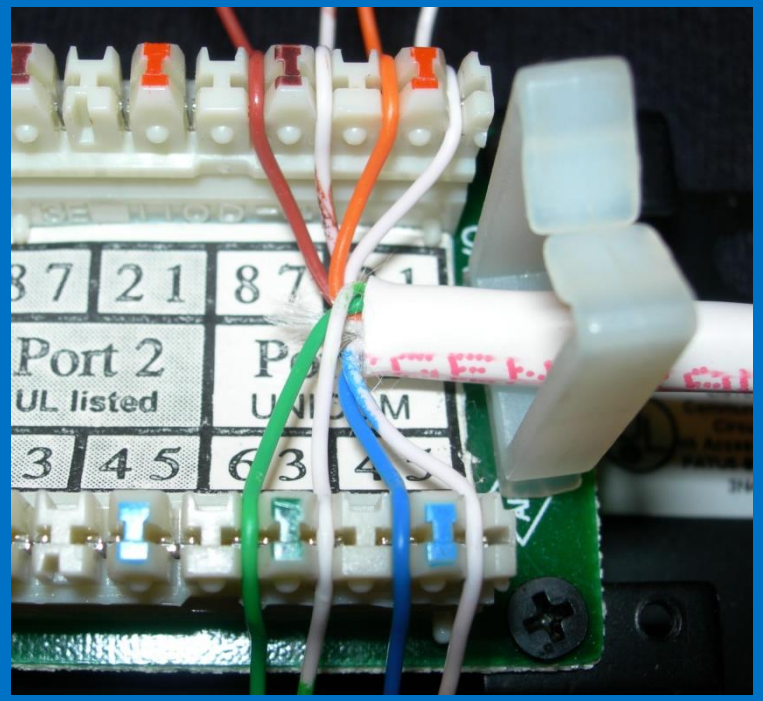
Types of Patch Cables

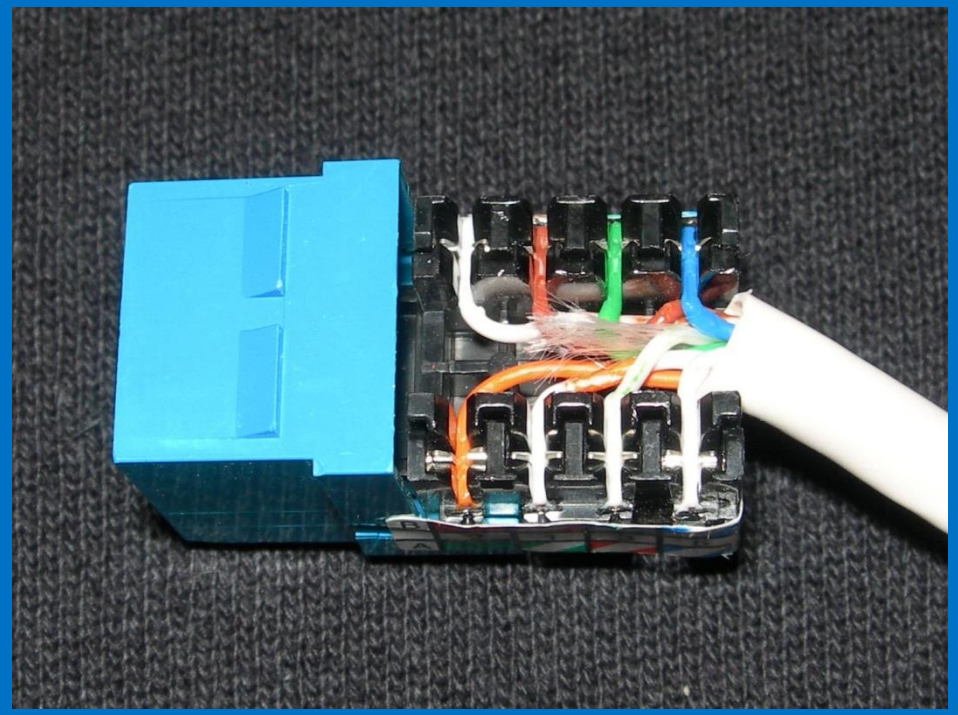
- Straight through cable
  - Most common type of patch cable
  - Used to connect a computer to a central connecting device like a switch
- Crossover cable
  - Used to direct connect similar devices without the use of a hub

MDI and MDI-X Ports

- Medium dependent interface (MDI) is a type of Ethernet port connection using twisted pair cabling
- For computers to communicate with other devices, the wires have to cross somewhere
- Instead of using crossover cables to connect computers to central connecting devices such as switches, these central connecting devices are equipped with *MDI-X* ports (medium dependent interface crossover), which take care of the cross

Patch Panel and RJ45 Wall Jack





Tools

- The tools necessary to make the connections between patch panels and RJ45 jacks include a cutting tool, a wire stripper, a ***punch down tool***, and a testing device known as a ***continuity tester***, which tests all of the pins of a connection one by one.

Attenuation:

The quantity of information reaching the receiver as compared to the transmitted quantity of information

- Measured in decibels (dB)
- According to the IEEE 802.3 standard, twisted-pair cables can be run 100 meters. Beyond this the signal degrades to such a point that it cannot be interpreted by the destination host.
- A signal repeater, a hub, or switch can be used If a cable needs to be run farther

Interference:

anything that disrupts or modifies a signal that is traveling along a wire

- Electrical Sources
  - Lights
  - Electrical Outlets
  - Motors
  - Appliances
- Copper-based cables and network devices should be kept away from these electrical devices and cables if at all possible

Electromagnetic Interference (EMI)

- Electromagnetic Interference (EMI) disturbance can affect electrical circuits, devices, and cables due to electromagnetic conduction and possibly radiation
- Any type of electrical device causes EMI: TVs, air conditioning units, motors, unshielded electrical cables (Romex)
- Copper-based cables and network devices should be kept away from these electrical devices and cables to prevent network communication issues

Radio Frequency Interference (RFI)

- This is interference that can come from AM/FM transmissions and cell phone towers
- It is often considered part of the EMI family and is sometimes even referred to as EMI
- Filters can be installed on the network to eliminate the signal frequency being broadcast by a radio tower, although this will usually not affect standard wired Ethernet networks

Crosstalk

When the signal that is transmitted on one copper wire or pair of wires creates an undesired effect on another wire or pair of wires

- When it comes to twisted-pair cabling, crosstalk is broken down into two categories:
  - ***Near end crosstalk*** (NEXT) occurs when there is measured interference between two pairs in a single cable, measured on the cable end nearest the transmitter.
  - ***Far end crosstalk*** (FEXT) occurs when there is similar interference, measured at the cable end farthest from the transmitter.

Shielded Twisted-Pair (STP) Cables

- STP cables have an aluminum shield inside the plastic jacket that surrounds the pairs of wires

Plenum-Rated

- Cables installed inside walls or above drop ceilings where they cannot be accessed by sprinkler systems in the case of a fire should be plenum-rated or low-smoke rated
- Plenum-rated cables have a Teflon coating that makes them more impervious to fire
- They are used in these situations because standard twisted-pair cables have a PVC jacket, which can emit deadly gas into the air

Fiber Optic Cable

transmits light (photons) instead of electricity over glass or plastic "fibers"

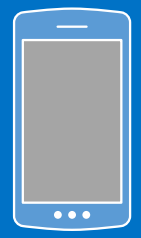
- Very good for high-speed, high-capacity data transmission due to lack of attenuation
- Single-mode
  - meant to carry a single ray of light—one ray of light, one mode
  - This type of cable is normally used for higher-bandwidth, longer-distance runs, generally 10-80 km
  - More expensive equipment
- Multi-mode
  - Cable with a larger fiber core, capable of carrying multiple rays of light.
  - This type of cable is used for shorter distance runs, up to 600 meters.
  - Though much shorter than single mode fiber runs, this is still six times the distance of twisted-pair cable runs.
  - Less expensive equipment

Fiber Optic Cables

Cabling Standard	Medium	Maximum Distance
100BASE-FX	Mutli-mode fiber Single-mode fiber	Half duplex: 400 meters; full duplex: 2 km Full duplex: 10 km
100BASE-SX	Multi-mode fiber	550 meters
100BASE-BX	Single-mode fiber	40 km
100BASE-LX10	Single-mode fiber	10 km
1000BASE-SX	Multi-mode fiber	550 meters
1000BASE-LX	Multi-mode fiber	550 meters
1000BASE-LX	Single-mode fiber	5 km
1000BASE-LX10	Single-mode fiber	10 km
1000BASE-ZX	Single-mode fiber	Up to 70 km
1000BASE-BX10	Single-mode fiber	10 km
10GBASE-SR	Multi-mode fiber	26–82 meters
10GBASE-LR	Single-mode fiber	10–25 km
10GBASE-LRM	Multi-mode fiber	220 meters
10GBASE-ER	Single-mode fiber	40 km

Wireless Networks

- Enables connection to the network without using a wired connection
- Provide a degree of portability
- Extend connectivity to a pre-existing wireless network and could be used to connect entire local area networks to the Internet
- Some wireless devices can be connected directly to each other in a point-to-point fashion

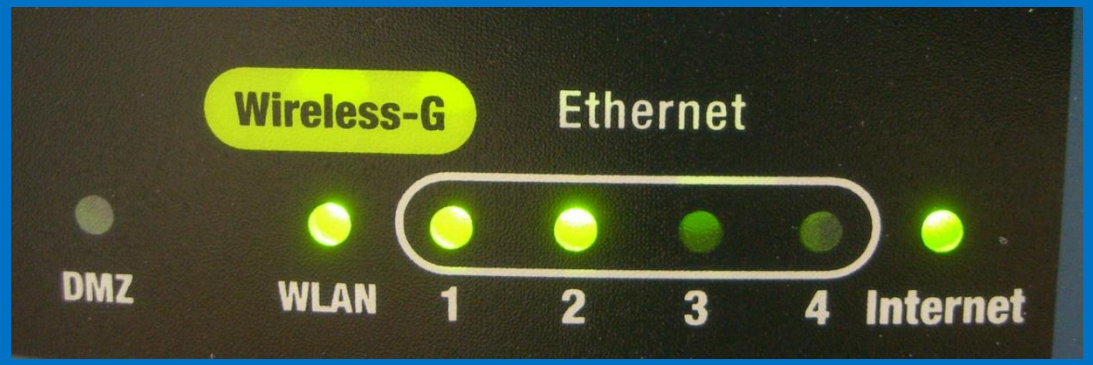


Wireless Network Adapters

- Wireless network adapters enable connectivity between a desktop computer or laptop and the wireless access point
- These network adapters come in a variety of shapes and sizes, including USB, PC Card, and as an internal PCI or PCI Express adapter card

Wireless Access Point

- A wireless access point (WAP) enables wireless devices to connect to a wired network
- A wireless router can also acts as a router, firewall, and IP proxy



Wireless Modes

- There several different methods to connect to a wireless network
  - Infrastructure – the mode used when wireless clients connect to and are authenticated by a wireless access point
  - Ad-hoc – used when all of the clients communicate directly with each other

Wireless LAN (WLAN)

- Wireless LAN or WLAN is a network composed of at least one WAP and a computer or handheld device that connect to the WAP
- Usually these networks are Ethernet based, but they can be built on other networking architectures
- In order to ensure compatibility, the WAP and other wireless devices must all use the same IEEE 802.11 WLAN standard
- Wireless Fidelity (WiFi) is a trademark to brand products that belong to the category of WLAN devices

Other wireless devices

- Wireless Repeater
  - used to extend the coverage of a wireless network
- Wireless Bridge
  - A wireless bridge is similar to a wireless repeater, but the bridge can connect different 802.11 standards together; this is known as bridge mode.

WLAN Standards

IEEE 802.11 Standard	Data Transfer Rate (Max.)	Frequency
802.11a	54 Mbps	5Ghz
802.11b	11 Mbps	2.4Ghz
802.11g	54 Mbps	2.4Ghz
802.11n	600 Mbps	2.4Ghz and 5Ghz
802.11ac	866.7 Mbps	5Ghz

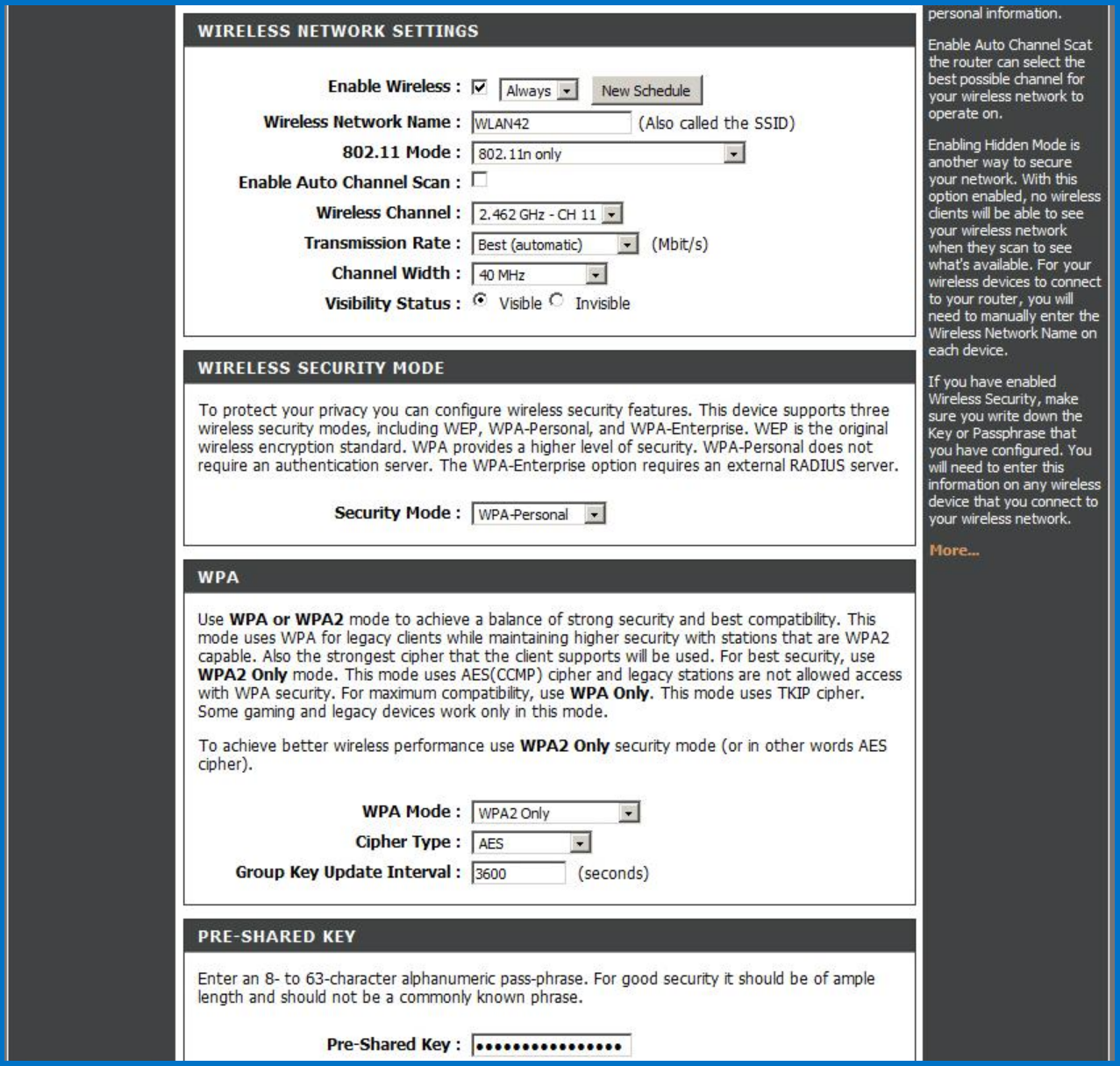
Wireless Encryption Options

Wireless Encryption Protocol	Description	Encryption Level (Key Size)
WEP	Wired Equivalent Privacy	64-bit
WPA & WPA2	Wi-Fi Protected Access	256-bit
TKIP	Temporal Key Integrity Protocol	128-bit
AES	Advanced Encryption Standard	128-, 192- and 256-bit

Service Set Identifier (SSI)

- When utilizing infrastructure mode, the base unit (normally a WAP) will be configured with a service set identifier (SSID)
- The SSID is the name of the wireless network, and it is broadcast over the airwaves
- When clients want to connect to the WAP, they can identify it by the SSID
- For security, the SSID can be hidden from public discovery

Wireless Settings



Summary

- To recognize wired networks and media types. This includes identifying twisted-pair cable, cabling tools, and testers. You also learned what can interfere with twisted-pair cabling and how to avoid it, and about a slew of wiring standards you should know for the real world. You also learned some of the basics about fiber optic cabling and some of the standards attached to these extremely quick cables.
- To comprehend wireless networks. This included wireless devices, wireless settings and configurations, wireless standards, and encryption protocols.

Additional Resources & Next Steps

Instructor-Led Courses

- 40033A: Windows Operating System and Windows Server Fundamentals: Training 2-Pack for MTA Exams 98-349 and 98-365 (5 Days)
- 40349A: Windows Operating System Fundamentals: MTA Exam 98-349 (3 Days)
- 40032A: Networking and Security Fundamentals: Training 2-Pack for MTA Exams 98-366 and 98-367 (5 Days)
- 40366A: Networking Fundamentals: MTA Exam 98-366

Books

- Exam 98-366: MTA Networking Fundamentals (Microsoft Official Academic Course)

Exams & Certifications

- Exam 98-366: Networking Fundamentals

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