

Lab 4.5.3 Building Straight-Through and Crossover UTP Cables

Objective

- Build and test straight-through and crossover Unshielded Twisted Pair (UTP) Ethernet network cables.

Background / Preparation

In this lab you will build and terminate Ethernet straight-through patch cables and crossover cables. With a straight-through cable, the color of wire used by pin 1 on one end is the same color used by pin 1 on the other cable end, and similarly for the remaining seven pins. The cable will be constructed using either TIA/EIA T568A or T568B standards for Ethernet, which determine which color wire is used on each pin. Straight-through patch cables are normally used to connect a host directly to a hub or switch or to a wall plate in an office area.

With a crossover cable the second and third pairs on the RJ-45 connector at one end of the cable are reversed at the other end. The pinouts for the cable are the T568A standard on one end and the T568B standard on the other end. Crossover cables are normally used to connect hubs and switches or can be used to directly connect two hosts to create a simple network. This is a two-part lab that can be done individually, in pairs, or in groups.

The following resources will be required:

- Two 0.6 to 0.9m (2 to 3 ft.) lengths of cable, Category 5 or 5e
- A minimum of four RJ-45 connectors (more may be needed if mis-wiring occurs)
- An RJ-45 crimping tool
- An Ethernet cable tester
- Wire cutters

T568A Standard			
Pin No.	Pair No.	Wire Color	Function
1	2	White/Green	Transmit
2	2	Green	Transmit
3	3	White/Orange	Receive
4	1	Blue	Not used
5	1	White/Blue	Not used
6	3	Orange	Receive
7	4	White/Brown	Not used
8	4	Brown	Not used

T568B Standard			
Pin No.	Pair No.	Wire Color	Function
1	2	White/Orange	Transmit
2	2	Orange	Transmit
3	3	White/Green	Receive
4	1	Blue	Not used
5	1	White/Blue	Not used
6	3	Green	Receive
7	4	White/Brown	Not used
8	4	Brown	Not used

Part A: Build and test an Ethernet straight-through patch cable

Step 1: Obtain and prepare the cable

- a. Determine the length of cable required. This could be from a device such as a computer to the device to which it connects (like a hub or switch) or between a device and an RJ-45 outlet jack. Add at least 30.48 cm (12 in.) to the distance. The TIA/EIA standard states the maximum length is 5 m (16.4 ft.). Standard Ethernet cable lengths are usually .6 m (2 ft.), 1.83 m (6 ft.), or 3.05 m (10 ft.).
- b. Which length of cable did you choose and why did you choose this length?

- c. Cut a piece of cable to the desired length. Stranded UTP cable is commonly used for patch cables (the cables between an end network device such as a PC and an RJ-45 connector) because it is more durable when bent repeatedly. It is called stranded because each of the wires within the cable is made up of many strands of fine copper wire, rather than a single solid wire. Solid wire is used for cable runs that are between the RJ-45 jack and a punch-down block.
- d. Using wire strippers, remove 5.08 cm (2 in.) of the cable jacket from both ends of the cable.

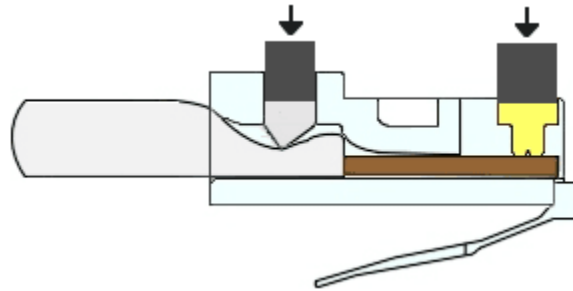
Step 2: Prepare and insert the wires

- a. Determine which wiring standard will be used. Circle the standard.
[T568A | T568B]
- b. Locate the correct table based on the wiring standard used.
- c. Spread the cable pairs and arrange them roughly in the desired order based on the standard chosen.
- d. Untwist a short length of the pairs and arrange them in the exact order needed by the standard. **It is very important to untwist as little as possible. The twists are important because they provide noise cancellation.**
- e. Straighten and flatten the wires between your thumb and forefinger.
- f. Ensure the cable wires are still in the correct order as the standard.
- g. Cut the cable in a straight line to within 1.25 to 1.9 cm (1/2 to 3/4 in.) from the edge of the cable jacket. If it is longer than this, the cable will be susceptible to crosstalk (the interference of bits from one wire with an adjacent wire).
- h. The tang (the prong that sticks out from the RJ-45 connector) should be on the underside pointing downward when inserting the wires. Insert the wires firmly into the RJ-45 connector until all wires are pushed as far as possible into the connector.

Step 3: Inspect, crimp, and re-inspect

- a. Visually inspect the cable and ensure the right color codes are connected to the correct pin numbers.
- b. Visually inspect the end of the connector. The eight wires should be pressed firmly against the end of the RJ-45 connector. Some of the cable jacket should be inside the first portion of the connector. This provides strain relief for the cable. If the cable jacket is not far enough inside the connector, it may eventually cause the cable to fail.

- c. If everything is correctly aligned and inserted properly, place the RJ-45 connector and cable into the crimper. The crimper will push two plungers down on the RJ-45 connector.



- d. Visually re-inspect the connector. If improperly installed, cut the end off and repeat the process.

Step 4: Terminate the other cable end

- a. Use the previously described steps to attach an RJ-45 connector to the other end of the cable.
- b. Visually re-inspect the connector. If improperly installed, cut the end off and repeat the process.
- c. Which standard [T568A | T568B] is used for patch cables in your school? _____

Step 5: Test the cable

- a. Using a cable tester, test the straight-through cable for functionality. If it fails, repeat the lab.
- b. (Optional) Use the cable to connect a PC to a network.
- c. (Optional) Click the **Start** button and select the **Run** option.
- d. (Optional) Type **cmd** and press **Enter**.
- e. (Optional) From the command prompt, type **ipconfig**.
- f. (Optional) Write down the default gateway IP address. _____
- g. (Optional) From the command prompt, type **ping** followed by the default gateway IP address. If the cable is functional, the ping should be successful (provided that no other network problem exists and the default gateway router is connected and functional).

Part B: Build and test an Ethernet crossover cable

Step 1: Obtain and prepare the cable

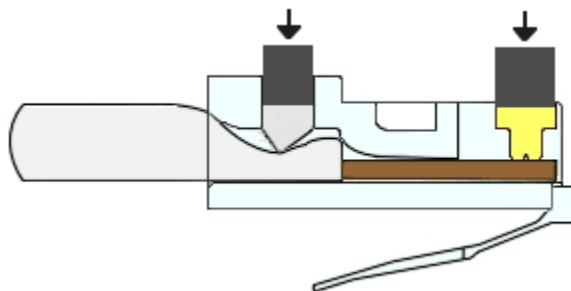
- a. Determine the length of cable required. This could be from a hub to a hub, hub to switch, switch to switch, computer to router, or from one computer to another computer. Add at least 30.48 cm (12 in.) to the distance. Which length of cable did you choose and why did you choose this length?
- b. Cut a piece of cable to the desired length and, using wire strippers, remove 5.08 cm (2 in.) of the cable jacket from both ends of the cable.

Step 2: Prepare and insert the T568A wires

- a. Locate the T568A table at the beginning of the lab.
- b. Spread the cable pairs and arrange them roughly in the desired order based on the T568A standard.
- c. Untwist a short length of the pairs and arrange them in the exact order needed by the standard. It is very important to untwist as little as possible. Twists are important because they provide noise cancellation.
- d. Straighten and flatten the wires between your thumb and forefinger.
- e. Ensure the cable wires are in the correct order based on the standard.
- f. Cut the cable in a straight line to within 1.25 to 1.9 cm (1/2 to 3/4 in.) from the edge of the cable jacket. If it is longer than this, the cable will be susceptible to crosstalk (the interference of bits from one wire with an adjacent wire).
- g. The tang (the prong that sticks out from the RJ-45 connector) should be on the underside pointing downward when inserting the wires. Insert the wires firmly into the RJ-45 connector until all wires are pushed as far as possible into the connector.

Step 3: Inspect, crimp, and re-inspect

- a. Visually inspect the cable and ensure the right color codes are connected to the correct pin numbers.
- b. Visually inspect the end of the connector. The eight wires should be pressed firmly against the RJ-45 connector. Some of the cable jacket should be inside the first portion of the connector. This provides for cable strain relief which can eventually cause the cable to fail.
- c. If everything is correctly aligned and inserted properly, place the RJ-45 connector and cable into the crimper. The crimper will push two plungers down on the RJ-45 connector.



- d. Visually re-inspect the connector. If improperly installed, cut the end off and repeat the process.

Step 4: Terminate the T568B cable end

- On the other end, use the previously described steps (but use the T568B table and standard) to attach an RJ-45 connector to the cable.
- Visually re-inspect the connector. If improperly installed, cut the end off and repeat the process.
- Which standard [T568A | T568B] would you rather use at home if you have or would like to have a home network?

Step 5: Test the cable

- Using a cable tester, test the crossover cable for functionality. If it fails, repeat the lab.
- Use the cable to connect two PCs.
- On both computers, click the **Start** button and select **Run**.
NOTE: If the **Run** command is unavailable on your PC, visually check the LED status lights on the NIC card. If they are on (usually green or amber) the cable is functional.
- On both computers, type **cmd** and press **Enter**.
- On both computers from the command prompt, type **ipconfig**.
- Write the IP address of both computers.
Computer 1: _____
Computer 2: _____
- From the command prompt of one computer, type **ping** followed by the IP address of the other computer. If the cable is functional, the ping should be successful. Do the ping on the other computer as well.
NOTE: The Windows Firewall on the target computer must be temporarily disabled for the ping to be successful. Refer to Lab 3.1.5 if you need help with this. If you disable the firewall, be sure to re-enable it.

Step 6: Reflection

- Which part of making these cables did you find the most difficult? Compare your views with a classmate.
- Are all four pairs of cables twisted the same amount? Discuss the reasons why or why not.
- Ask a local business or check a site such as <http://www.workopolis.com/> to see how much a beginning cable installer earns and which criteria they look for in a cable installer. Write the information you discover in the space provided.

- Many technicians keep a crossover cable in their toolkit. When do you think that you would use a crossover cable and when do you think a network technician would use this cable?
