CROSSOVER CABLE

Networking Fundamentals
(Estimated time: 50 minutes)

Objectives:

The purpose of this activity is to build a crossover cable to T568-B or T568-A standards for connection from a workstation to workstation or from a switch to a switch.

Background:

In this activity you will learn how to build a Category 5 (CAT5) Unshielded Twisted Pair (UTP) Ethernet crossover network cable and test it for good connections and correct pinouts. This will be a 4 pair (8 wires) "crossover" cable which means that pairs 2 and 3 on one end of the cable will be reversed on the other end. All eight conductors (wires) should be terminated with RJ45 modular connectors.

Tools/Materials Needed:

Prior to starting the activity, the teacher should have a spool of CAT5 Unshielded Twisted Pair (UTP) cable, RJ45 (8-pin) connectors, an RJ45 crimping tool and an Ethernet/RJ45 continuity tester available. The students can work individually or in pairs to accomplish the task.

1. Two to three foot length of CAT5 cabling (one per person or one per team)
2. Four RJ45 connectors (two extra for spares)
3. RJ crimping tools o attach the RJ45 connectors to the cable ends
4. Ethernet cabling continuity tester that can test crossover type cables (T568-A to 568-B)
5. Wire cutters
6. Cable jacket stripper.

Procedures:

Use the following chart and steps to create a crossover cable. One end of the cable should be wired to the T568-A standard and the other end to the T568-B standard. This crosses the transmit and receive pairs (2 and 3) to allow communication to take place.

T568-A Cabling

Pin #	Pair #	Function	Wire Color
1	3	Transmit	White/Green
2	3	Receive	Green/White
3	2	Transmit	White/ Orange
4	1	Not Used	Blue/White
5	1	Not Used	White/Blue
6	2	Receive	Orange/White
7	4	Not Used	White/Brown
8	4	Not Used	Brown/White

T568-B Cabling

Pin #	Pair #	Function	Wire Color
1	2	Transmit	White/ Orange
2	2	Receive	Orange/White
3	3	Transmit	White/Green
4	1	Not Used	Blue/White
5	1	Not Used	White/Blue
6	3	Receive	Green/White
7	4	Not Used	White/Brown
8	4	Not Used	Brown/White

1. Determine the distance between devices, or device and plug, and then add at least 12” to it. The maximum length for this cord is 3m; standard lengths are 6’ and 10’
2. Cut a piece of stranded CAT5 unshielded twisted pair cable to the determined length; you will use stranded cable for patch cables because it is more durable when bent repeatedly. Solid wire is fine for cable runs that are punched down into jacks.
3. Strip 2” of jacket off one end of the cable.
4. Hold the 4 pairs of twisted cables tightly where the jacket was cut away, and then reorganize the cable pairs into the order of the 568-B wiring standard. Take care

to maintain the twists because this provides noise cancellation (orange pair, green pair, blue pair, brown pair)

5. Hold the jacket and cable in one hand, untwist a short length of the green and blue pairs, and reorder them to reflect the 568-B wiring color scheme. Untwist and order the rest of the wire pairs according to the color scheme.
6. Flatten, straighten, and line up the wires, then trim them in a straight line to within ½”-3/4” from the edge of the jacket. Be sure not to let go of the jacket and the wires, which are now in order! You should minimize the length of untwisted wires because excessive, unnecessary length is the primary source of electrical noise.
7. Place an RJ45 plug on the end of the cable, with the prong on the underside and the orange pair at the top of the connector.
8. Gently push the plug onto the wires until you can see the copper ends of the wires through the end of the plug, Make sure the end of the jacket is inside the plug and all wires are in the correct order. If the jacket is not inside the plug, it will not be properly strain-relieved and will eventually cause problems. If everything is correct, crimp the plug hard enough to force the contacts through the insulation on the wires, thus completing the conducting path.
9. Repeat process on the opposite end of the cable using the 568-A scheme to finish the crossover cable.
10. Test the finished product and have the teacher check it.

REMEMBER:

Inspect the cable ends visually. Hold the RJ45 connectors side by side; the same color wire should be on the same pin. This is not a conclusive test but is a good start. You can test the cable with a cable tester to verify the wires have continuity (no breaks) and are not shorted. You can connect your cable from a workstation to a hub and verify that you can see other workstations. The ultimate test but requires more setup and configuration time.

STRAIGHT THROUGH CABLE

Networking Fundamentals
(Estimated time: 50 minutes)

Objective:

Build a straight through Ethernet patch cable to T568-B (or T568-A) standards for connection from workstation to hub/switch or patch panel to hub/switch.

Background:

In this activity you will learn how to build a Category 5 (CAT 5) Unshielded Twisted Pair (UTP) Ethernet network patch cable (or patch cord) and test it for good connections and correct pinouts (correct color wires on the correct pin). This will be 4-pair (8 wires) "straight through" cable, which means that the color of wire on pin 1 on one end of the cable will be the same as pin 1 on the other end. Pin 2 will be the same as pin 2, and so on. It will be wired to EIA/TIA 568-B or A standards for 10base-T Ethernet, which determines what color wire is on each pin. T568-B (also called AT&T specification) is more common, but many installations are also wired to T568-A (also called ISDN).

This patch cable will conform to the structured cabling standards and is considered to be part of the "horizontal" cabling, which is limited to 99 meters total between workstation and hub or switch. It can be used in a workstation NIC to the wall plate data jack, or it can be used in the wiring closet to connect the patch panel (horizontal cross connect) to an Ethernet hub or switch. Patch cables are wired straight thru because the cable from the workstation to the hub or switch is normally crossed over automatically at the switch or hub. Note that the ports on most hubs have an X next to them. This means the send and receive pairs will be crossed when the cabling reaches the switch. The pinouts will be T568-B, and all 8 conductors (wires) should be terminated with RJ45 modular connectors (only 4 of the 8 wires are used for 10/100Base-T Ethernet; all 8 are used for 1000Base-T Ethernet).

Tools/Preparation:

Prior to starting the activity, the teacher should have a spool of Cat 5 Unshielded Twisted Pair (UTP) cable, RJ45 (8pin) connectors, an RJ45 crimping tool and an Ethernet/RJ45 continuity tester available. Work individually or in teams. The following resources will be required:

1. Two to three foot length of Cat 5 cabling (one per person or one per team)
2. Four RJ45 connectors (2 extra for spares)
3. RJ45 Crimping tools to attach the RJ45 connectors to the cable ends
4. Ethernet cabling continuity tester that can test straight through or crossover type cables (T568-A or T568-B)
5. Wire cutters

Procedures:

Use the following tables, diagrams and steps to create a T568-B patch panel cable. (Both cable ends should be wired the same when looking at the connectors. Only four wires are used with 10Base-T or 100Base-TX Ethernet.

T568-B Cabling

Pin #	Pair #	Function	Wire Color
1	2	Transmit	White/Orange
2	2	Receive	Orange/White
3	3	Transmit	White/Green
4	1	Not used	Blue/White
5	1	Not used	White/Blue
6	3	Receive	Green/White
7	4	Not used	White/Brown
8	4	Not used	Brown/White

1. Determine the distance between devices, or device and plug, and then add at least 12” to it. The maximum length for this cable is 3 meters; standard lengths are 6’ and 10’.

2. Cut a piece of Cat 5 unshielded twisted-pair cable to a determined length.

3. Strip 2” off one end of the cable.

4. Hold the 4 pairs of twisted cables tightly where the jacket was cut away, and then reorganize the cable pairs into the order of the 568-B wiring standard. Take care to maintain the twists because this provides noise cancellation (orange pair, green pair, blue pair, brown pair).

5. Hold the jacket and cable in one hand; untwist a short length of the green and blue pairs, and reorder them to reflect the 568-B wiring color scheme. Untwist and order the rest of the wire pairs according to the color scheme.

6. Flatten, straighten, and line up the wires, then trim them in a straight line to within ½" -¾" from the edge of the jacket. Be sure not to let go of the jacket and the wires, which are now in order! You should minimize the length of untwisted wires because overly-long sections that are near connectors are a primary source of electrical noise.

7. Place an RJ45 plug on the end of the cable, with the prong on the underside and the orange pair at the top of the connector.

8. Gently push the plug onto the wires until you can see the copper ends of the wires through the end of the plug. Make sure the end of the jacket is inside the plug and all wires are in the correct order. If the jacket is not inside the plug, it will not be properly installed and will eventually cause problems. If everything is correct, crimp the plug hard enough to force the contacts through the insulation on the wires, thus completing the conducting path.

9. Repeat steps 3-8 to terminate the other end of the cable, using the same scheme to finish the straight through cable.

10. Test the finished cable and have your instructor check it. How can you tell if your cable is functioning properly? _____.

Answers/Hints: <u>There are several methods that can be used to check the cable.</u>

Have the instructor check your cable and verify it by using one or more of these tests:
<u>Visual Test:</u> Inspect the cable ends visually. Hold the RJ45 connectors side by side. The same color wire should be on the same pin. This is not a conclusive test but is a good start.
<u>Cable Test:</u> You can test the cable with a cable tester to verify the wires have continuity (no breaks) and are not shorted.
<u>Functional Test:</u> You can connect your cable from a workstation to a hub and verify that you can see other workstations. This is the ultimate test but requires more setup and configuration time.

ROLLOVER CABLE

Networking Fundamentals
(Grade Level 7-8)

Objective:

The students will build a rollover cable for connection from a workstation to the console port on a router or switch.

Background:

In this activity, the students will build an unshielded twisted pair rollover cable and test it for a good connections and correct pinouts. This will be a 4-pair (8 wires) rollover cable.

It can be used to connect a workstation or dumb terminal to the console port on the back of a router or Ethernet switch in order to be able to configure the router or switch. This cable uses an asynchronous serial interface to the router or switch. Both ends of the cable you build will have RJ45 connectors on them. One end plugs directly into the RJ45 console management port on the back of the router or switch.

A ***rollover cable*** uses 8 pins but is different from a *straight-through cable* or *crossover cable* that you may build. With a rollover cable, pin 1 on one end connects to pin 8 on the other end. Pin 2 connects to pin 7, pin 3 connects to pin 6, and so on. This is why it is referred to as a ***rollover***, because the pins on one end are all reversed on the other end as though one end of the cable was just rotated or rolled over.

Tools and Materials

1. 10 to 20 foot length of CAT cabling (one per team)
2. 4 RJ45 connectors (two extra for spares)
3. RJ45 crimping tools
4. RJ45 to DB9 female terminal adapter
5. Cabling continuity tester
6. Wire cutters

Activity Lab Sheet - Rollover Cable

Procedures: Step One

Directions: Use the following table as reference to answer the following questions and to assist you in assembling a rollover console cable.

1. Which signal on the router port (1st column on table) will be used to transmit data to the PC when the PC is first connected and HyperTerminal is started? (This is what displays the router prompt on the workstation) _____.

2. Which pin is this connected to on the router end of the RJ45 cable? _____.

3. Which pin is this connected to on the other end of the RJ45 cable? _____.

4. Which pin is this connected to in the DB9 connector? _____.

5. Which console device signal does this connect to? _____.

6. What would happen if pin 3 on the left cable end were attached to pin 3 as with a straight-through cable?_____

Rollover Console Cable Table

Router or Switch Console Port (DTE)	RJ45 to RJ45 Rollover Cable (left end)	RJ45 to RJ45 Rollover Cable (right end)	RJ45 to DB9 Adaptor	Console Device (PC workstation serial port)
Signal	From RJ45 Pin #	To RJ45 Pin #	DB9 Pin #	Signal
RTS	1	8	8	CTS
DTR	2	7	6	DSR
TxD	3	6	2	RxD
GND	4	5	5	GND
GND	5	4	5	GND
RxD	6	3	3	TxD
DSR	7	2	4	DTR
CTS	8	1	7	RTS

Acronym Key:

RTS= Request to Send
DTR= Data Terminal Ready
TxD= Transmit Data
GND= Ground (1 for TxD and 1 for RxD)
RxD= Receive Data
DSR= Data Set Ready
CTS= Clear To Send

Rollover Cable Worksheet

Procedures: Step Two (construction of cable)

1. Determine the distance between devices, and add about 12" to it. Make your cable length about 10 feet unless you're connecting to a router or switch from a greater distance. The maximum length for this cable is approximately 25 feet (8m).

2. Next, strip 2" of jacket off one end of the cable.

3. Hold the pairs of twisted cables tightly where the jacket was cut away, and then reorganize the cable pairs and wires into the order of the 568-B wiring standard. You may order them in any sequence but use the 568-B sequence to become more familiar with it.

4. Straighten, flatten, and line up the wires, then trim them in a straight line within ½"-3/4" from the edge of the jacket. Make sure not to go off the jacket and the wires, which are now in order.

5. Place an RJ45 plug on the end of the cable, with the prong on the underside and the orange pair at the top of the connector.

6. Gently push the plug onto the wires until you can see the copper ends of the wires through the end of the plug. Make sure the end of the jacket is inside the plug and all the wires are in correct order. If the jacket is ***not*** inside the plug, it will not be properly strain-relieved and will eventually cause problems. If everything is correct, firmly crimp the plug hard enough to force the contacts through the insulation on the wires, therefore, completing the conducting path.

7. Repeat Steps 2-6 to terminate the other end of the cable, but reversing every pair of wires as indicated in the table above (pin 1 to 8, pin 2 to 7, pin 3 to 6, and so on).

8. Last test the finished cable and have the teacher check it. How can you tell if your cable is functioning properly?

_____

_____

_____

_____

Teacher's Answer Key

Answers to Activity Lab Sheet- Rollover Cable

1. TxD
2. 3
3. 6
4. 2
5. RxD
6. Transmit Data (TxD) from the router would be connected to the Transmit Data (TxD) on the workstation, and they would never communicate.

Procedure: Step Two (construction of the cable)

8. Test the finished cable and have the teacher check to see if the cable is functioning properly. There are several methods below that can be used to check the cable.

*** VISUAL TEST**- the cable ends are clearly and visually inspected and should be wired exactly opposite when looking at the conductors and holding the RJ445 connectors side by side with the clip facing down. If you hold the RJ45 connectors end to end with the clip facing down, the wire colors should match. Pinouts are listed in the table.

***CABLE TEST –**You can test the cable with a cable tester to verify the wires have no breaks and are not shorted.

***FUNCTIONAL TEST-** You can connect your rollover cable to the RJ45-to-DB9 terminal adapter and connect a workstation to the router to verify that you can see the router console prompts. This is the ultimate test and also requires that HyperTerminal be set up properly on the workstation.