LAB 1: Understanding of Network Equipment, Wiring in Details (CAT6 UTP EIA/TIA 568A/B Straight and Cross-Over Wiring and Testing)

Objective(s):

a. To understand the networking equipment (repeater, hub, bridge, switch, router, crimper, UTP, Fiber cable, connectors, patch panel, cable managers, racks, CAT6 straight and crossover wiring standards, LAN meter/tester, RJ-45)
b. To understand the color coding standard of UTP cable
c. To create straight and crossover cable and test/verify its connectivity.

Network Hardware: Crimper/clamper, RJ-45 jack male/female, LAN/Cable tester, UTP, Fiber cable, HUB/Switch/Router/Bridge

a. To understand the networking equipment

Repeaters are simple devices that work at the physical layer of the OSI. They regenerate signals (active hubs does that too).

Hubs are used to build a LAN by connecting different computers in a star/hierarchal network topology, the most common type on LANs now a day. A hub is a very simple (or dumb) device, once it gets bits of data sent from computer A to B, it does not check the destination, instead, it forwards that signal to all other computers (B, C, D….) within the network. B will then pick it up while other nodes discard it. This amplify that the traffic is shared.

There are mainly two types of hubs:

1. Passive: The signal is forwarded as it is (so it doesn't need power supply).
2. Active: The signal is amplified, so they work as repeaters. In fact they have been called multiport repeaters. Hub is a multiport repeater.

Hubs can be connected to other hubs using an uplink port to extend the network. Hubs work on the physical layer (lowest layer). That¡¦s the reason they can¡¦t deal with addressing or data filtering.

Switches on the other hand are more advanced. Instead of broadcasting the frames everywhere, a switch actually checks for the destination MAC address and forwards it to the relevant port to reach that computer only. This way, switches reduce traffic and divide the collision domain into segments, this is very sufficient for busy LANs and it also protects frames from being sniffed by other computers sharing the same segment.

They build a table of which MAC address belongs to which segment. If a destination MAC address is not in the table it forwards to all segments except the source segment. If the destination is same as the source, frame is discarded.

Bridges are used to extend networks by maintaining signals and traffic. Bridges are on the data link layer so in principle they are capable to do what switches do like data filtering and separating the collision domain, but they are less advanced. They are known to be used to extend distance capabilities of networks.

In a comparison with switches, bridges are slower because they use software to perform switching. They do not control broadcast domains and usually come with less number of ports. Multiport bridges are generally termed as switch.

Routers are used to connect different LANs or a LAN with a WAN (e.g. the internet). Routers control both collision domains and broadcast domains. If the packet's destination is on a different network, a router is used to pass it the right way, so without routers, the internet could not functions. Routers use NAT (Network Address Translation) in conjunction with IP Masquerading to provide the internet to multiple nodes in the LAN under a single IP address.

Routers work on the network layer so they can filter data based on IP addresses. They have routing tables to store network addresses and forward packets to the right port.

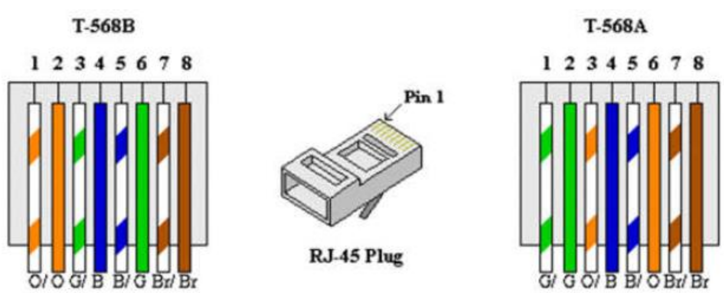
Gateways are very intelligent devices or else can be a computer running the appropriate software to connect and translate data between networks with different protocols or architecture, so their work is much more complex than a normal router. For instance, allowing communication between TCP/IP clients and IPX/SPX or AppleTalk.

Gateways operate at the network layer and above, but most of them at the application layer.

b. To understand the color coding standard of UTP cable

Background: RJ-45 connectors intended for use with CAT-6 cable are larger than their CAT-5 counterparts.

Working from left to right, the order of the wires shall be set with EIA 568 A or B standard as follows:



568 B standards (wiring sequence)	568 A standards (wiring sequence)
Partial Orange (Orange with white stripe), Solid Orange, Partial Green, Solid Blue, Partial Blue, Solid Green, Partial Brown, Solid Brown	Partial Green (Green with white stripe), Solid Green, Partial Orange, Solid Blue, Partial Blue, Solid Orange, Partial Brown, Solid Brown

Remember for normal wiring:

1. Odd Number Always holds the partial color while even number holds the solid color.
2. Only 1-3, 2-6 pair of number required to be adjust for A and B standard. Orange and Green are interchangeable.
3. Color code for number 4, 5, 7 & 8 are always fixed.
4. Standard A starts with Green and Standard B starts with Orange.

c. To create straight and crossover cable and test/verify its connectivity.

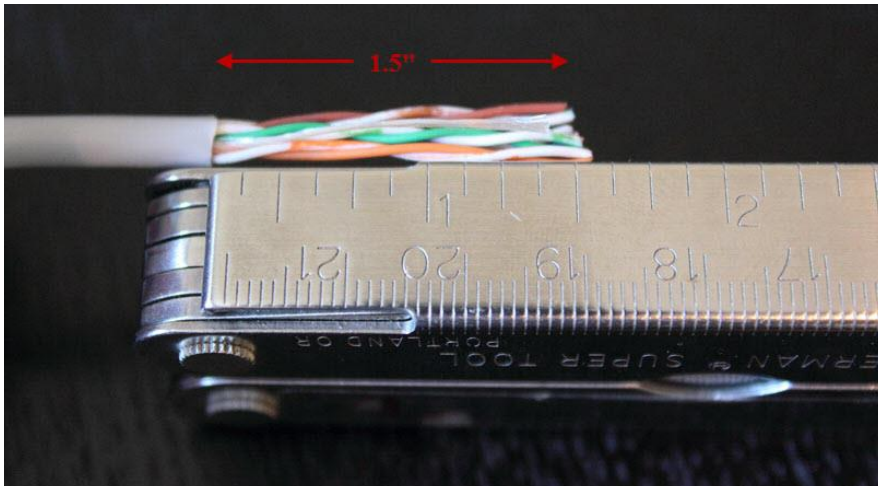
Apparatus: UTP CAT6 cable (1M), Crimper, LAN tester

There are four pairs of wires in an Ethernet cable, and an Ethernet connector (8P8C) has eight pin slots. Each pin is identified by a number, starting from left to right, with the clip facing away from you.

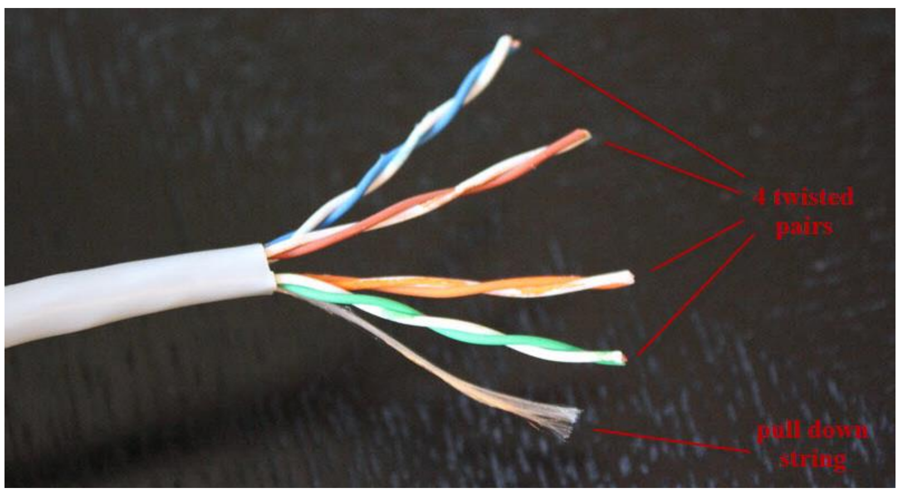
T568A Standard	
Pin 1	White/Green
Pin 2	Green
Pin 3	White/Orange
Pin 4	Blue
Pin 5	White/Blue
Pin 6	Orange
Pin 7	White/Brown
Pin 8	Brown

T568B Standard	
Pin 1	White/Orange
Pin 2	Orange
Pin 3	White/Green
Pin 4	Blue
Pin 5	White/Blue
Pin 6	Green
Pin 7	White/Brown
Pin 8	Brown

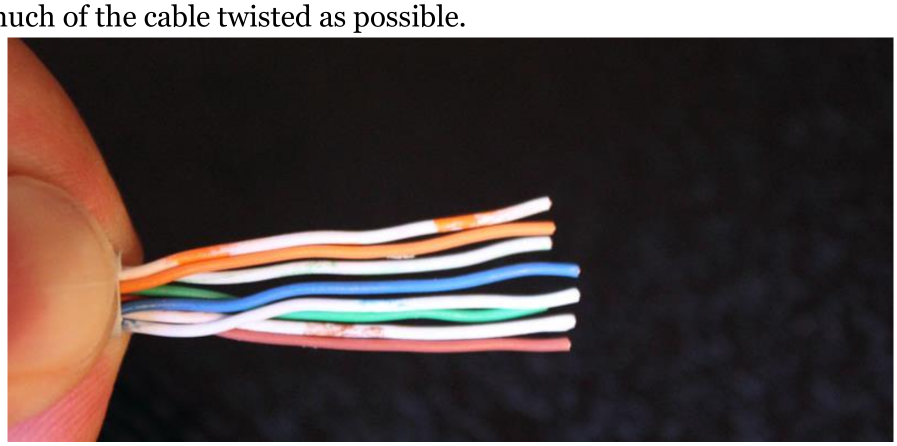
Step 1: Strip the cable jacket about 1.5 inch down from the end.



Step 2: Spread the four pairs of twisted wire apart. For Cat 5e, you can use the pull string to strip the jacket farther down if you need to, then cut the pull string. Cat 6 cables have a spine that will also need to be cut.

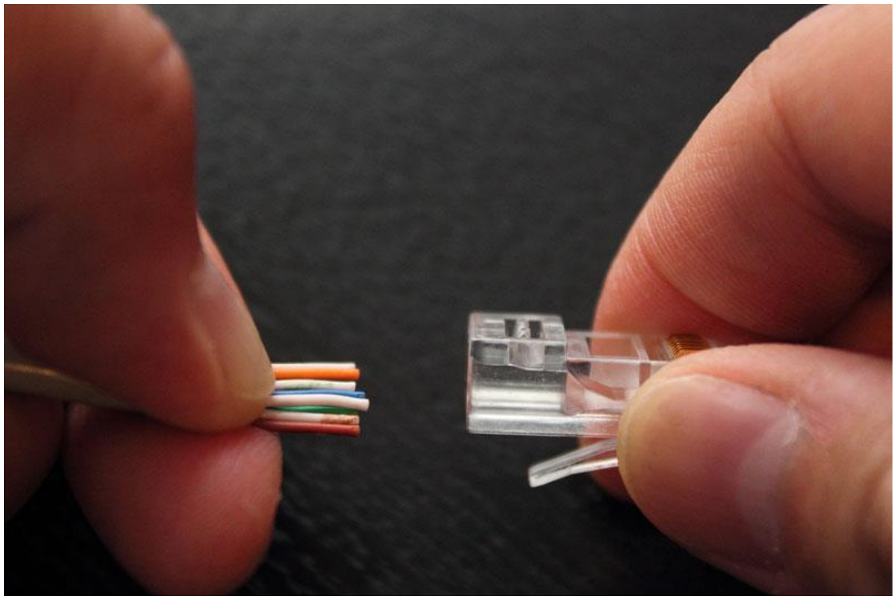


Step 3: Untwist the wire pairs and neatly align them in the T568B orientation. Be sure not to untwist them any farther down the cable than where the jacket begins; we want to leave as much of the cable twisted as possible.



Step 4: Cut the wires as straight as possible, about 0.5 inch above the end of the jacket.

Step 5: Carefully insert the wires all the way into the modular connector, making sure that each wire passes through the appropriate guides inside the connector.

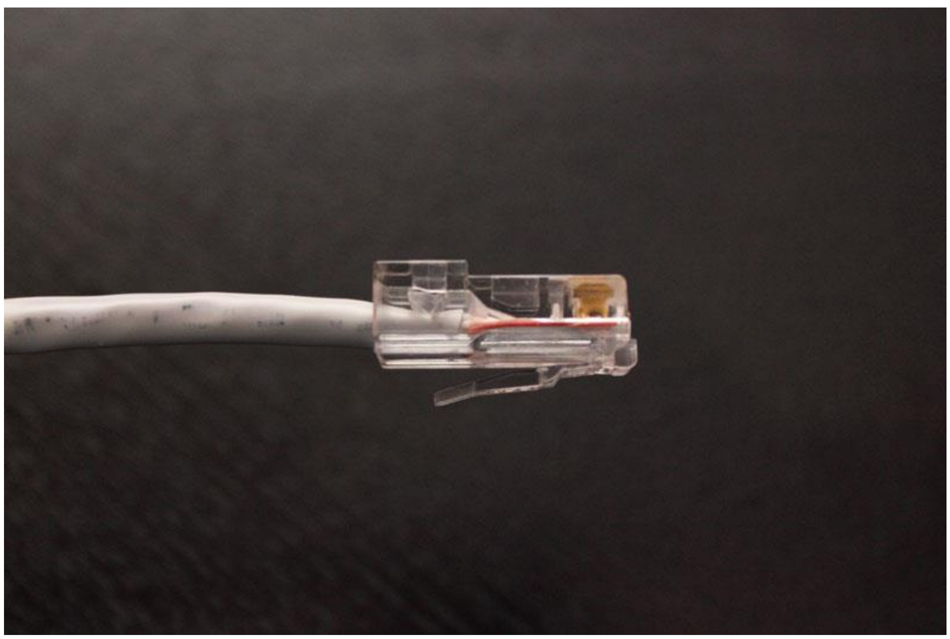


Step 6: Push the connector inside the crimping tool and squeeze the crimper all the way down.

Step 7: Repeat steps 1-6 for the other end of the cable.

Step 8: To make sure you've successfully terminated each end of the cable, use a cable tester to test each pin.

When you're all done, the connectors should look like this:



For crossover cables, simply make one end of the cable a T568A and the other end a T568B. Now you can make Ethernet cables of any length, fix broken connectors, or make yourself a crossover cable.