COMPUTER NETWORKING FOR SOHOs

Set up a wired LAN for your small office

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Computer networking can be defined as "combining more than two computers together in a group to form a network of computers." It is used for sharing information, hardware (like printer and modem), etc within a network.

Computer networking is a vast topic and it's not possible to explain everything here. But if you are well versed with computer operation or are a computer hobbyist willing to make your own network, this article will be a good beginning.

Computer networking can be categorised based on the physical/geographical distance between computers in the network. Local-area network (LAN) is the most common. The other form is the wide-area network (WAN). Here we are concerned with only the wired LAN for small home/office networking.

In a computer network, a computer that can control a group of other computers for sharing information as well as hardware utilities is known as the 'server' and the other computers of the network are known as 'clients.'

The essentials to a computer network are network topology and hardware. Network topology means arrangement of the network in ring, star, bus, tree or other fashion, while hardware refers to computer networking devices like LAN cards, hubs or switches, cables and connectors. In a simple wired network, computers are connected through a LAN card, hub or switch, and Cat-5 cable with RJ-45 connector at both ends.

For long-distance coverage of the network, in place of Cat-5 cable, other cables like coaxial cables or single-mode/multimode fibre-optic cables, repeaters and media converters are used. This is not applicable for wireless networking because wireless networking requires only wireless equipment like wireless access points, wireless LAN cards and drivers. Wireless networking is easy but costly.

Computer networking involves:

1. Setting up of computers and networking hardware
2. Installation of the operating system, drivers and other software

The hardware part covers setting up of computer components and peripherals like CPUs, visual display units (VDUs), keyboards, mice, printers, scanners, laying of network cable for connecting the server with clients through a hub, switch, LAN card, etc.

The software part covers selection of the operating system for the server and clients, followed by installation of operating systems and device drivers for different hardware including LAN card. The installation of software is followed by sharing, mapping and administration of the software.

Here we assume that the computers are complete in hardware and software. Only networking elements and drivers, or networking installation, are required to form a small network.

Preparation

First, prepare cables for connecting the server with clients through a hub/switch and LAN card. Hubs and

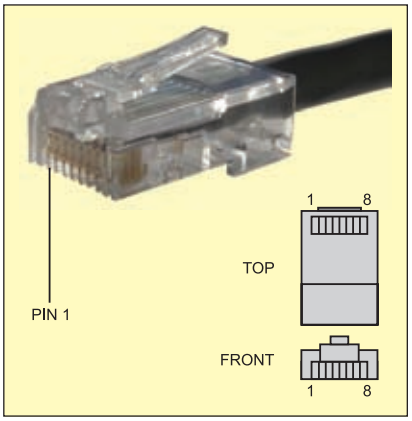

Fig. 1: RJ-45 connector

Fig. 2: Crimping tool

switches are available in 4-port, 8-port, 16-port or other configurations to meet the requirements of different sizes of networks.

Network cabling and connections. The network-adaptor cards of most computers and workstations have interface ports called 'MDI'. 'Uplink' ports on hubs have the same pin assignments. Hubs have MDI-X ports, which use pins 1 and 2 to receive, and pins 3 and 6 to transmit. A straight cable (one that connects pin 1 to pin 1, pin 2 to pin 2, etc) can be used to connect an MDI port (on a computer) to the MDI-X port (on a hub). Obviously, to connect two MDI ports together, cross-over connections (pin 1 to pin 3, pin 2 to pin 6, and so on) are necessary.

The most important part of computer networking is LAN card, hub/switch and connection between computers using Cat-5 cable and RJ-45 connector. An RJ-45 connector is shown in Fig. 1. A crimping tool (Fig. 2) is required for connecting the RJ-45 connector with CAT-5 cable in two formats, crossover and straight-through, as explained below.

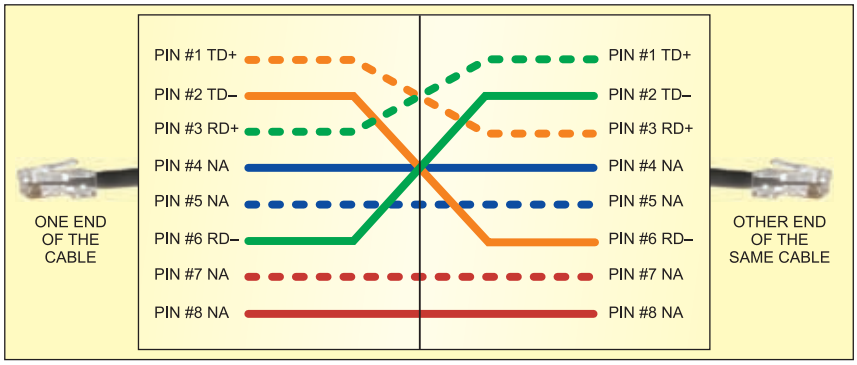

Fig. 3: Wiring of RJ-45 with CAT-5 cable colour code and transmit/receive signals (TD/RD) for crossover connection

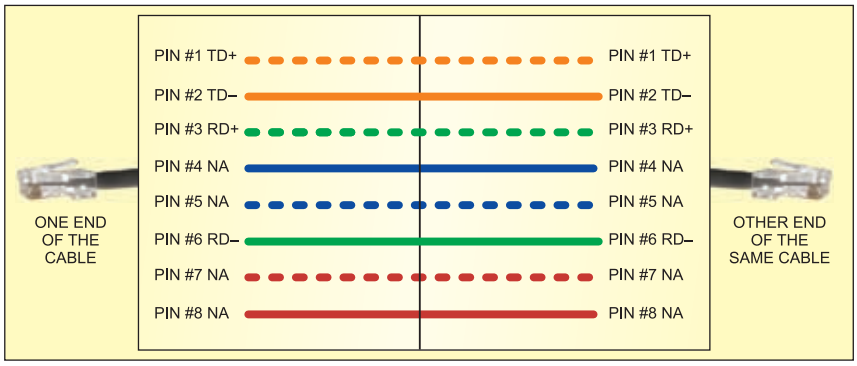

Fig. 4: Wiring of RJ-45 with CAT-5 cable for straight-through connection

TABLE I
EIA/TIA 568B Wiring Standard

Pin wire	Colour
1	White/orange stripe
2	Orange
3	White/green stripe
4	Blue
5	White/blue stripe
6	Green
7	White/brown stripe
8	Brown

TABLE II
EIA/TIA Crossover Cable Wiring

Wire one end using 568B and the other end as follows (swap orange and green pairs):

Pin wire	Colour
1	White/green stripe
2	Green
3	White/orange stripe
4	Blue
5	White/blue stripe
6	Orange
7	White/brown stripe
8	Brown

A crossover cable can be used to connect two computers together without a hub/switch, or to connect two hubs/switches together without using an uplink port. It is also known as '10Base-T crossover' cable. It is necessary to connect pin 1 to pin 3, and pin 2 to pin 6.

Figs 3 and 4 show the wirings for a 10Base-T crossover cable (assuming you're using RJ-45 connectors) and a straight-through cable.

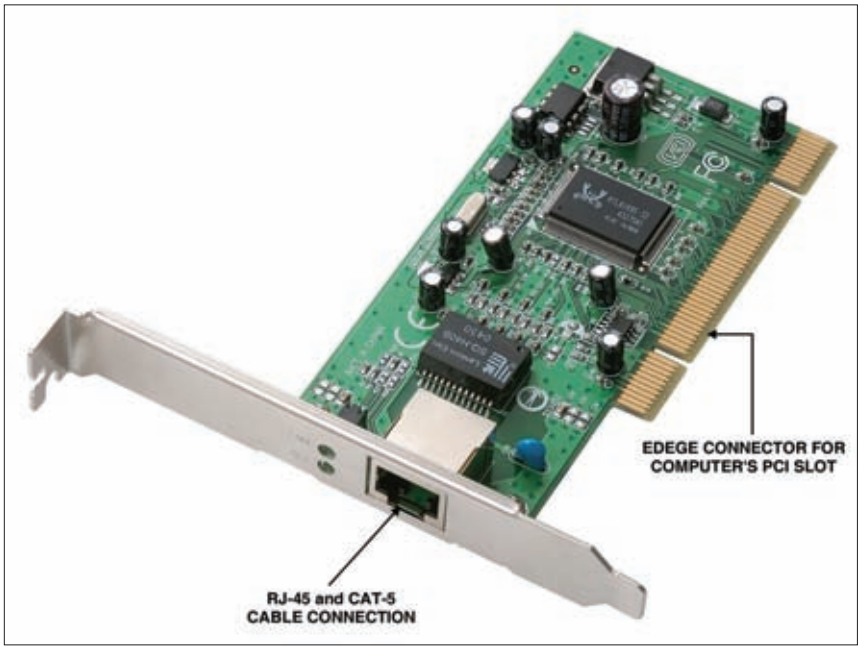

Fig. 5: Internal LAN card

Fig. 6: 8-port 10/100Mbps switch; 1 to 8 are RJ-45 female connectors for computers (server and clients)

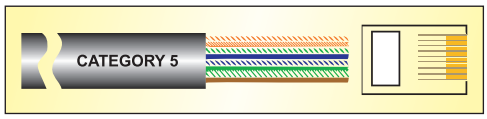

Fig. 7: CAT-5 cable cutting for RJ-45 connection

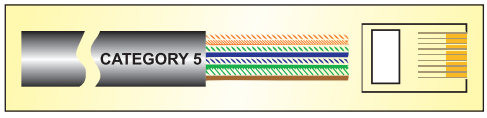

Fig. 8: CAT-5 cable cutting for insertion into RJ-45 connection

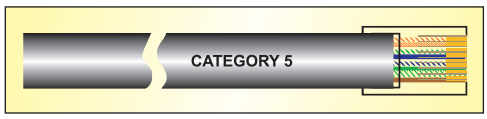

Fig. 9: Clamping of RJ-45 with CAT-5 connection

LAN card and hub/switch. Every computer requires a LAN card to connect through hub/switch with the server and other clients of the local network.

Figs. 5 and 6 show a LAN card and an 8-port 10/100Mbps switch, respectively.

Networking connection

Networking means connecting all the computers containing LAN cards to a hub/switch through Cat-5 cable, with both ends of RJ-45 connected as explained above.

Nowadays computers come with their own LAN card built into the motherboard, and an 8-port hub/switch can form a network of eight computers (one server and seven clients).

If LAN card is not found in any of

the computers, open the computer case and install a LAN card on the spare PCI slot of the computer. Also install a LAN card driver on the same computer to make the LAN card work.

Connect all computers' LAN cards one by one with the 8-port hub/switch through Cat-5 cable with RJ-45 connector in straight-through manner (see Fig. 4) to form a network of eight computers. Any computer can be made to act as a server with the rest of the computers working as clients.

Connect all the hubs/switches together (without using an uplink port) with Cat-5 wired to RJ-45 connector in crossover format (Fig. 3).

RJ-45 wiring pin-outs and CAT-5 colour hints

Wire a 10BaseT or 100BaseT connector with Cat-5 cable and RJ-45 connectors using USOC 568B wiring standards as follows:

1. Cut the outer PVC jacket of the wire 5 to 6 cm from the end. This will give you room to work with the wire pairs. Separate the pairs and align them in the order shown in Fig. 7. Flatten the wires into a ribbon as shown so that it easily slips into the connector and into the individual channeled areas.

2. Once you have all the wires aligned and ready to insert, trim them to approximately 1 cm in order to have as little untwisted wire in the connection as possible. Category-5 specifications require a certain number of twists per inch and even the connector counts.

3. Insert the wires into the connector making sure that each wire goes into its appropriate channel and extends all the way to the end of the connector underneath the gold crimping connectors. You can look at the end of the connector to see the copper wires if you're using a solid copper cable. If the wires don't extend to the end of the connector, the crimp may not make contact.

4. Press the cable and the jacket into the connector firmly so that the jacket is crimped by the plastic wedge near the rear of the connector, insert it into your crimping tool and crimp the cable. Re-crimp the cable to make sure that all connections are made.

5. Repeat steps 1 through 4 for the other end of the cable for a standard Ethernet cable.

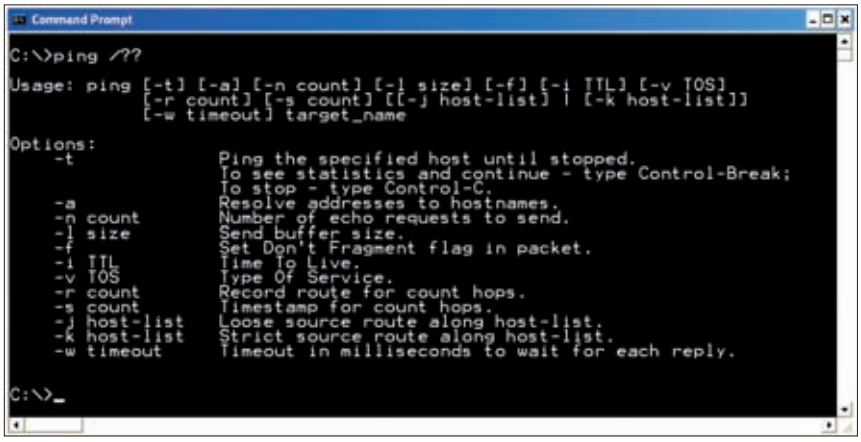

Fig. 10: Ping command

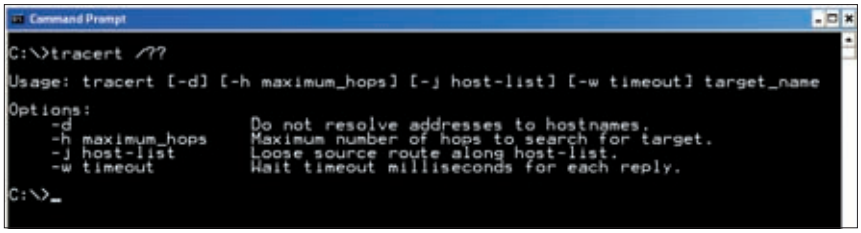

Fig. 11: Tracert command

Network administration

Network administrators perform the following tasks:

1. For smooth running of the total network, create the login for all the users, allot the IP address with proper right for each client, sharing of files, printer, Internet and software, map to a drive and troubleshoot the network problems.

2. Check network connections and communication between the server and clients, troubleshoot the Internet on the LAN, etc.

For troubleshooting, two simple tools are included in Windows operating system:

(i) Ping command: Ping is a basic program that lets you verify that a particular IP address exists and can accept requests.

(ii) Tracert command: If you are facing connectivity problems, you can use the tracert command to check the path to the destination IP address that you want to reach and record the result.

You can use these commands from Windows as follows: click 'Start' followed by 'Run,' type the Ping command with IP address or Tracert command with IP address, then press 'Enter' key. You can also use the DOS Prompt for executing these commands. For help about using Ping and Tracert commands with Windows 98, type the command 'Ping -?' or 'tracert -?'

For ping and tracert commands, the details are shown in Figs 10 and 11, respectively. ●

A crossover cable can be used to connect two computers together without a hub/switch, or to connect two hubs/switches together without using an uplink port.