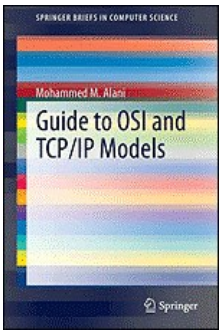

Guide to OSI and TCP/IP Models

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Chapter 1: What are Computer Networks?

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Overview

Abstract This chapter starts by defining networks and their uses. The reasons behind using a computer network are also introduced in this chapter. This is followed by definitions of the most commonly used terms that a starter needs to know. The first section ends with an introduction to the three modes of communication; simplex, half-duplex and full-duplex. At the end of the chapter, the reasons behind studying networks as a layered model are identified.

Keywords Network • Full-duplex • Half-duplex • Simplex • Protocol • Layers

1.1 What is a Computer Network?

A computer network can be defined as a group of hosts connected together to accomplish a certain task. The host can be a computer, a network printer, a server, or any other device that can communicate within the network. To keep everything in order, this network has to be governed by one or more protocols. A protocol is a set of rules governing the communication between two or more hosts.

The big question that pops up is why we would need a computer network. The answer is simpler than you think; it is to share resources. These resources may vary from information displayed on a web page, to just an empty space on a server's hard drive, to a printer, to anything that is on one host that can be useful to someone else. So, it is all about the resources.

> A Protocol is a set of rules that govern the communication between two or more entities.

In order to operate properly, the computer network needs some supporting devices. Devices such as hubs, switches, and routers utilize the operation of a network to make accessing the services easy and consistent. Sometimes these devices are also used to control the network operation to guarantee that the network services will be used in the right manner and by the right people. Some other times these devices are used to monitor the network operation to detect any unwanted activity.

Networks may vary in size from a small office network with four or five computers to millions of computers, such as the *Internet*. This variation of size gives a wide variation of the services introduced. You can connect to a network to copy a small daily report to your boss's computer and you can also connect to a network to have a video conference with a colleague in the other half of the world.

> A common misunderstanding is that the World-Wide Web (WWW) is the Internet. The WWW, or the webpages, is only one of tens of services provided by the Internet.

As networks develop rapidly, new services also evolve, but also new challenges arise. These challenges can be the lack of bandwidth, new security threats, or merely the need for a new more powerful hardware.

It would be out of sense if we talk about computer networks without mentioning the largest network in the world; the Internet. The Internet is basically a huge network that consists of a large number of smaller networks. It connects millions of hosts together. Many people think that the World Wide Web (WWW) is the Internet. Well, they are wrong. The WWW is only one service of the many services the Internet provides. Examples of these services are electronic mail, file transfer, voice transmission, and many more.

The following sections will introduce basic definitions of what you need to know before going further into the network models.

1.2 Definitions

Now we will go through few simple definitions of some terms that we will be using later:

- Bandwidth: The maximum possible rate of data transmitted over a channel. This rate is measured by bits per second (bps) and its multiples, Kilobits per second (kbps), Megabits per second (Mbps), and Gigabits per second (Gbps).
- Throughput: The actual rate of data transferred between two hosts in a network without errors. Throughput is measured in the same units of bandwidth. Throughput of a certain network can not be greater than the bandwidth of that network.
- Host: A device that can communicate with a network. This device can be a computer, a server, a printer, or any other

device that has the capability to communicate with a network and has the required set of protocols.

- Internetwork: A relatively large network that is a product of connecting two or more smaller networks.
- Local Area Network (LAN): A network that connects a group of hosts within a limited geographic area.
- Wide Area Network (WAN): A network that connects hosts over a large geographic scope. This type of networks usually uses carriers to deliver data from one host in the network to the other.
- Network device: A device that supports the network operation and helps in transporting the data correctly from one host to another. Examples of network devices are repeaters, hubs, switches, and routers.
- Link: A physical connection between two or more devices. If the link is between two devices only, it is called a dedicated link or point-to-point link. And if the link is between more than two devices, it is called a shared link or a broadcast link.
- Network Medium: A physical medium connecting hosts and networking devices. The medium can also be dedicated between two or shared among more than two entities. Examples of the medium are Unshielded Twisted-Pair (UTP) cables, fiber cables, and even the air (and the void space) is considered the medium for the wireless networks.

1.3 Communication Modes

There are basically three modes of communication in all communication systems; simplex, half-duplex, and full-duplex (sometimes full-duplex is referred to as duplex). Figure 1.1 shows the three modes of communications.

Simplex communication involves the transmission of data in one direction all the time. An example is listening to a radio station. The data flows only from the station transmitter antenna into you radio device, but you can not send data in the opposite direction.

In *half-duplex* communication, the two parties share the same communication channel to send and receive data, but on time-sharing basis, i.e. when X sends data to Y, Y can not send data to X at the same time. Y will have to wait until X is done and the communication channel is free to send data to X. So, the data flows in one direction only at a certain time. An example of this mode of communication can be seen in walky-talkies, or two-way radios. Only one user can send data at a certain time, and the other user can send data when the channel becomes free.

Full-duplex communication uses two separate channels for transmission and reception at each end. This means that data can flow in both directions at the same time. The telephone is a clear example of full-duplex communication as voice signals pass in both directions at the same time.

Fig. 1.1: Communication modes: **a** Simplex, **b** half-duplex, **c** full-duplex

1.4 Why a Layered Model?

Computer networks are complicated, and they require harmony between different elements in order to operate smoothly. Some of these elements are hardware elements and others are software elements.

The network can be divided into parts to ease the understanding of its operation. In order to make these parts comprehendible and interconnected, this division needs to be functional division not physical division. The following points summarize the reasons behind going into a layered model:

1. To simplify understanding the network model.

2. Layering the network based on functions makes it easier to implement, because the functions of each layer are distinct and consistent. Preparing the right software and hardware based on functions is much easier.

3. To simplify the troubleshooting of the network. With each layer's functions being distinct, the problem can be easily isolated and the error can be corrected without disturbing other network functions.

4. Layering the network makes it easier to develop. Development goes better and more focused when it goes in separate modules and protocols. When each layer has its own protocols, this layer's duties can be focused on and the protocols designed for this specific layer can perform their duties in a more efficient way.

5. The layered model guarantees better consistency in functions and protocols.