CHAPTER TWO: NETWORK PLANNING

2.1 Gathering Requirements

Every organization has unique needs for which they would require a network. There are several factors to consider when gathering requirements:

- Identify the nature and volume of data and how it is used within and outside the organization.
- Determine how the network will be used and by whom which often dictates the topology you use. Location of data with respect to users is also critical here.
- Decide the types of devices for interconnecting computers and sites
- The type and usage level of network resources dictates how many serversyou need and where to place servers.

2.2 Selecting a topology

Most new network designs come down to only one choice: How fast should the network be?

This will be guided by the needs identified earlier, in particular the location of sites, volume of data and nature of existing equipment and consideration for futureexpansion.

In most cases the physical topology will almost certainly be a star, and the logical topology is almost always switching. Ethernet switches are typically used on a LAN,but you might consider other logical topologies for reasons such as:

- Use of legacy equipment – such as token ring
- Network size – using hub-based bus topology
- Cost restrictions – using hub instead of switch
- Difficulty to run cables – consider wireless ?

2.3 Conducting site Survey

The purpose of a site survey is to understand the nature of the business premises interms of how the building, office space and electrical wiring

are set up. It helps answer whether or not the type of network requested can be supported by the organization of the building. It also helps estimate how much material will be required to layout the network.

2.4 Capacity Planning

Capacity planning involves trying to determine the amount of network bandwidthnecessary to support an application or a set of applications.
A number of techniques exist for performing capacity planning, including linear projection, computer simulation, benchmarking, and analytical modeling.
Linear projection involves predicting one or more network capacities based on thecurrent network parameters and multiplying by some constant.
A computer simulation involves modeling an existing system or proposed systemusing a computer-based simulation tool.
Benchmarking involves generating system statistics under a controlled environmentand then comparing those statistics against known measurements.
Analytical modeling involves the creation of mathematical equations to calculatevarious network values.

2.5 Creating a Baseline

Involves the measurement and recording of a network‘s state of operation over agiven period of time.

A baseline can be used to determine current network performance and to helpdetermine future network needs.
Baseline studies should be ongoing projects, and not something started and stoppedevery so many years.
To perform a baseline study, you should:

- Collect information on number and type of system nodes, includingworkstations, routers, bridges, switches, hubs, and servers.
- Create an up-to-date roadmap of all nodes along with model numbers,serial numbers and any address information such as IP or Ethernet addresses.

- Collect information on operational protocols used throughout the system.
- List all network applications, including the number, type and utilizationlevel.
- Create a fairly extensive list of statistics to help meet your goals. Thesestatistics can include average network utilization, peak network utilization, average frame size, peak frame size, average frames per second, peak frames per second, total network collisions, network collisions per second, total runts, total jabbers, total CRC errors, and nodes with highest percentage of utilization.

2.6 Designing the Network

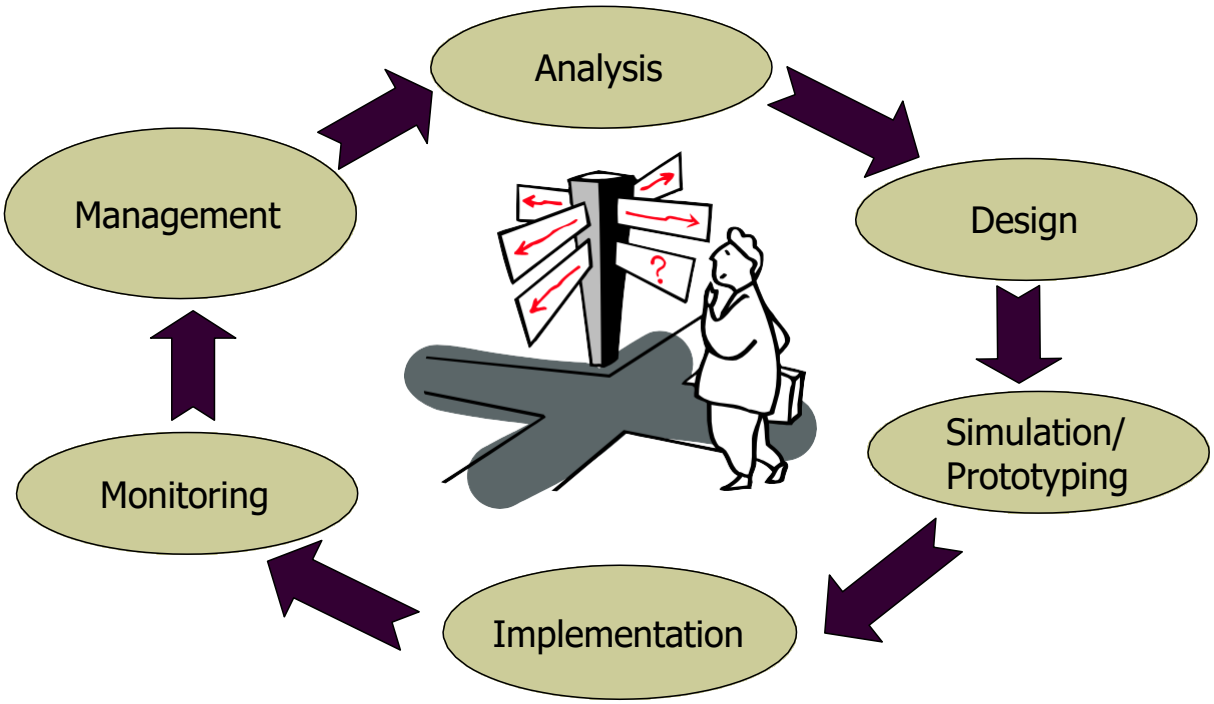
A network design must be documented, and network diagram must be kept up todate.

Some useful questions to be answered before drawing the diagram:

- How many client computers will be attached?
- How many servers will be attached?
- Will there be a connection to the Internet?
- How will the building‘s physical architecture influence decisions, suchas whether to use a wired or wireless topology, or both?
- Which topology or topologies will you use?

2.7 Network Development Life Cycle(NDLC)

The NDLC is a model that summarizes the network design process, from initial problem/needs assessment to implementation.



2.7.1 Analyze requirements

A network cannot very well provide effective solutions to problems that have not been clearly defined in objective terms. To attempt to implement networks beforeeveryone agrees to (buy-in) the exact nature of the problem to be solved is somewhat akin to hitting a moving target. The network will never satisfy all constituencies‘ needs because no one agreed what those needs were in the first place. All network development efforts start with a problem as perceived by someone, be they management or end-users. At some point, management agrees that a problem exists that is worth expending resources to at least investigate. Theresponsibility for conducting the investigation may be given to in-house personnel or to an outside consultant or facilitator.

- Interviews with users and technical personnel
- Understand business and technical goals for a new or enhanced system
- Characterize the existing network: logical and physical topology, andnetwork performance
- Analyze current and future network traffic, including traffic flow andload, protocol behavior, and QoS requirements

2.7.2 Develop the logical design

An IP network has two very important resources, its IP addresses and the corresponding naming structure within the network. To provide effective communication between hosts or stations in a network, each station must maintaina unique identity. In an IP network this is achieved by the IP address. The distribution and management of these addresses is an important consideration in anIP network design. IP addresses are inherently not easy to remember. People find itmuch easier to remember names and have these names related to individual machines connected to a network. Even applications rarely refer to hosts by their binary identifiers; in general they use ASCII strings such as polo@mku.ke. These names must be translated to IP addresses because the network does not utilize identifiers based on ASCII strings. The management of these names and the translation mechanism used must also be considered by the IP network designer.

2.7.3 Develop the physical design

Specific technologies and products to realize the logical design are selected. Theinvestigation into service providers must be completed during this phase.

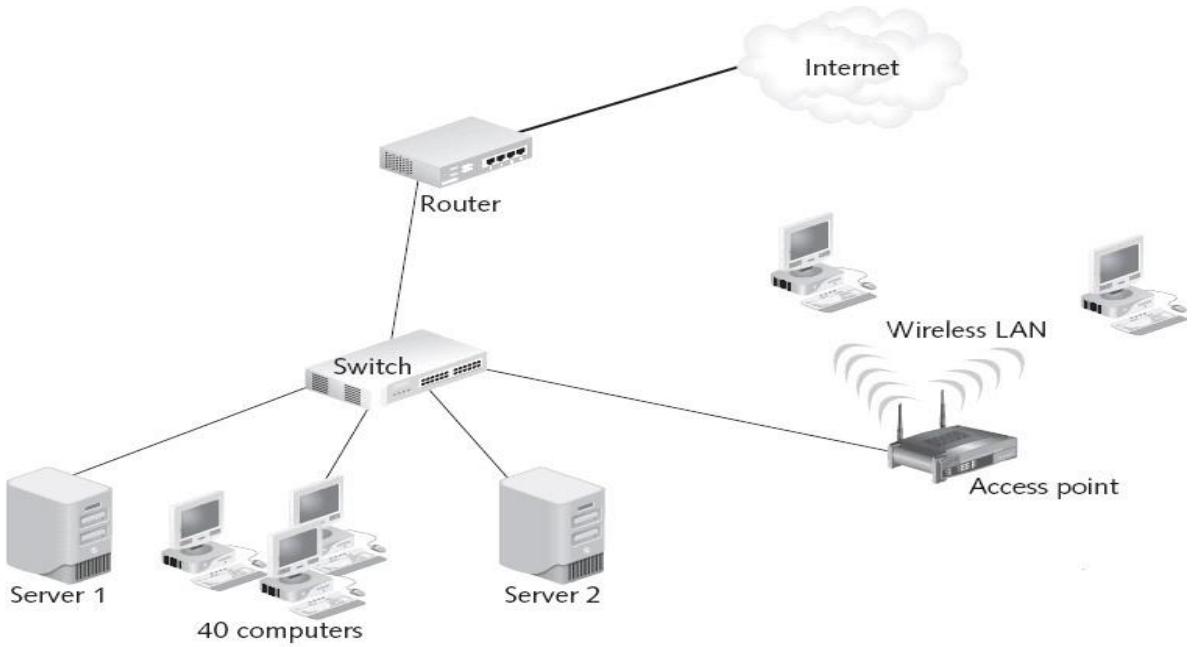


Figure 2-13 A simple network layout diagram

Network Layout Diagram

2.7.4 Factors That Affect a Network Design

Designing a network is more than merely planning to use the latest gadget in themarket. A good network design takes into consideration many factors:

Size Matters

At the end of the day, size does matter. Designing a LAN for a small office with afew users is different from building one for a large company with two thousand users. In building a small LAN, a flat design is usually used, where all connecting devices may be connected to each other. For a large company, a hierachical approach should be used.

Geographies

The geographical locations of the sites that need to be connected are importantin a network design. The decision making process for selecting the right technology and equipment for remote connections, especially those of
cross-country nature, is different from that for a LAN. The tariffs, local expertise,quality of service from service providers, are some of the important criteria.

Politics

Politics in the office ultimately decides how a network should be partitioned.

Department A may not want to share data with department B, while department Callows only department D to access its data. At the network level, requirements such as these are usually done through filtering at the router so as to direct trafficflow in the correct manner. Business and security needs determine how information flows in a network and the right tool has to be chosen to carry this out.

Types of Application

The types of application deployed determines the bandwidth required. While a text-based transaction may require a few kbps of bandwidth, a multimedia help

2.8 IP Addresses and Address Classes

An IP address is defined in RFC 1166 - Internet Numbers as a 32-bit numberhaving two parts:

IP address = <network number><host number>

The first part of the address, the network number, is assigned by a regional authority and will vary in its length depending on the class of addresses to which it belongs. The network number part of the IP address is used by the IP protocol to route IP datagrams throughout TCP/IP networks. These networks may be within your enterprise and under your control, in which case, to some extent, you are freeto allocate this part of the address yourself without prior reference to the Internet authority, but if you do so, you are encouraged to use the private IP addresses thathave been reserved by the Internet Assigned Number Authority (IANA) for that purpose.

However if your routing may take you into networks outside of your control, usingfor example, the worldwide services, it is imperative that you obtain a unique IP address from your regional Internet address authority.

The second part of the IP address, the host number, is used to identify the individual host within a network. This portion of the address is assigned locally within a network by the authority that controls that network. The length of this number is, as mentioned before, dependent on the class of the IP address being used and also on whether subnetting is in use. (subnetting is beyond the scope ofthis course).

The 32 bits that make up the IP address are usually written as four 8-bit decimal values concatenated with dots (periods). This representation is commonly referred to as a dotted decimal notation. An example of this is the IP address 172.16.3.14. In this example the 172.16 is the network number and the 3.14 is thehost number. The split into network number and host number is determined by the class of the IP address.

Class A addresses have the first bit set to 0. The next 7 bits are used for the network number. This gives a possibility of 128 networks (2^7). However, it should be noted that there are two cases, the all bits 0 number and the all bits 1 number,which have special significance in

classes A, B and C.

The remaining 24 bits of a Class A address are used for the host number. Once again, the two special cases apply to the host number part of an IP address. EachClass A network can therefore have a total of 16,777,214 hosts (224 -2). Class A addresses are assigned only to networks with very large numbers of hosts (historically, large corporations). An example is the 9.0.0.0 network, which is assigned to IBM.

The Class B address is more suited to medium-sized networks. The first two bitsof the address are predefined as 10. The next 14 bits are used for the network number and the remaining 16 bits identify the host number. This gives a possibility of 16,382 networks each containing up to 65,534 hosts.

The Class C address offers a maximum of 254 hosts per network and is thereforesuited to smaller networks. However, with the first three bits of the address predefined to 110, the next 21 bits provide for a maximum of 2,097,150 such networks.

The remaining classes of address, D and E, are reserved classes and have a special meaning. Class E addresses are reserved for future use while Class D addresses are used to address groups of hosts in a limited area. This function isknown as multicasting.