CHAPTER

Chapter 4

BASIC NE INFRASTRUCTURE

UNDERSTANDING THE NE TECHNOLOGICAL INFRASTRUCTURE

Why do managers need to understand the underlying technology of the NE (r)evolution? Isn't this "technical" stuff something you hire others to know about for you if you are a high level manager? It turns out that good managers must have a base level appreciation of what technology can and cannot do in order to even begin to strategize. So this chapter attempts to create a more level playing field between non-technical persons who have set their sights on managerial positions and those who are already well versed in NE technology.

LEARNING OBJECTIVES FOR THIS CHAPTER

C *CASE STUDY 1-1*

NET SOLUTIONS

1 INTRODUCTION

This chapter will discuss the basic infrastructure of enabling networks connections between firms, and network connections between individuals. Most of the stress will be on publicly-accessible networks, i.e., the Internet. However, there will be some discussion of private networks, both point-to-point and broadcast networks. The computers that run the network, and those that interpret and display and store information will also be discussed, both from a s/w and h/w perspective.

2 LEVELS OF TECHNOLOGY

There are three levels of technology that together describe NE technology. They are:

1. Basic NE infrastructure
2. NE Middleware
3. NE Applications

In this chapter we are considering infrastructure. The other topics will be covered in the next chapter.

What is the essential difference between these levels? One metaphor that is sometimes used is plumbing. In a home bathroom, the pipes that snake through the walls and floors of the home are part of the infrastructure that bring water from the city or rural sources and take away the refuse. The sinks and bathtubs, etc. are the middleware between you as a user and the infrastructure. They make it possible to use the infrastructure. Thus, they serve as an *interface* that allows you to perform various functions in the facility.

What would be the metaphorical equivalent of applications in a bathroom? Let us think about what you use a bathroom for? As can be seen quickly in Figure 4.1, you may use the bathtub to take a nice soaking bath and relax after a hard day. If there is a whirlpool application available in your tub, you may decide to turn that on. Or you may be in a hurry and decide to take a quick shower.

Figure 4.1 Bathrooms as Infrastructure, Middleware, and Applications

In the language of computing, the infrastructure includes the connections that route signals from one node computer on the network to another, or internally between sub-nodes. It may also include parts of the processors that are designed to interpret the protocols.

A fuller discussion of the nature of middleware and applications will take place in Chapter 5. It is sufficient for the moment that you understand the essential difference between these technological levels or layers.

3 TELECOMMUNICATIONS INFRASTRUCTURE

The basic infrastructure of a public telecommunications network depends on a combination of physical and microwave connections, as shown in Figure 4.2. To communicate either through voice or data between Miami and Los Angeles may involve a number of message switches and transmission through other cities (unlikely to be as many as are shown here, but the route of the message is determined according to available connections and capacity). Figure 4.2 illustrates many of the possible media. Cell or PCS transmission within a city and infrared transmission within a local area network (LAN) are also possibilities unrepresented in this diagram. Access to the Internet via cell phones is popular in Europe and growing slowing in popularity in the US. In Chapter 5, more will be said about this topic, which is also known as m-commerce, for mobile-commerce.

With respect to computer data and the Internet, this telecommunications backbone operates via a set of translations from one medium to the next since some of the media work with frequencies (either digital or analogue), some work with analogue signals, some with voltages (digital only), etc.. Information about these translations is carried along with the messages that carry Internet content. In this way a message that is carried digitally through a LAN running Ethernet can be transferred over to a telephone wire through an analogue signal. Naturally, there must be computer hardware devices and network software that implement this transformation at each point that the medium changes.

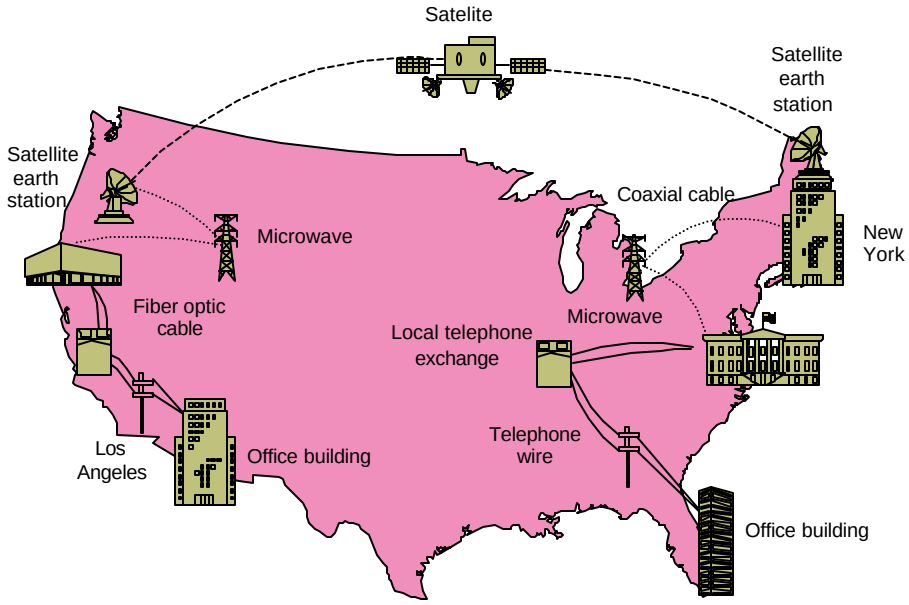

Figure 4.2 Physical and Microwave Connections in a Typical Telecommunications Connection

Most individuals come in contact with the issues having to do with basic infrastructure when they become involved in investment decisions, either organizationally or individually. The decision parameters are not terribly dissimilar and so we will explore this issue through an individual decision.

Suppose you want to access the Internet from home. The simplest connection would likely be use of a dial-up connection to an Internet Service Provider or a value-added service like AOL. A firm that provides you only with access to the Internet does not add value to your use. AOL, on the other hand, has a software interface and offers email, community activities, news channels, and connections to preferred vendors. Value-Added Networks are sometimes referred to as VANs.

In order to complete your connection to the Internet, you need a device that changes the high and low voltages that represent digital bits in your computer into the analogue signals that will be sent to the ISP or VAN over your voice-grade telephone line. The speed with which the computer can upload or download information from the Internet depends in major part on the ability of your computer's hardware (modem) and software (Dial-Up Adapter in Windows 95-ME, 2000, and XP) to complete this translation. In the year 2001, the typical dial-up connection operates at about 56K baud, or 56 bits per second. Since there are 8 bits in a byte, and a byte is used to represent an alphanumeric character, a 56K connection will be able to maximally upload or download about 3-6K characters per second.

3.1 TCP/IP

The translation mechanism that currently characterizes the Internet and, increasingly, LANs, is known as Transmission Control Procedure/Internet Protocol, or popularly TCP/IP. Messages need to be sliced into certain sizes for transmission purposes. They also need to have header and trailing information that tells computers on the receiving end how to properly translatethe message,

Known as a “protocol,” IP was the original set of specifications designed for the Internet. It specified how information needed to be formatted in order for it to be interpretable at the receiving end. Unfortunately, the IP protocol did not have methods for dealing with errors in the traansmission. TCP was, therefore, added to the IP protocol to handle errors.

As Figure 4.3 shows, data to be transmitted may be throught of as travelling in units known as “packets.” These boxes of data are transmitted to router computers or nodes which are then sent on to other nodes until they finally reach the intended recipient. Nodes on the Internet are able to dynanically re-route packets if a node connection is lost or down. Each node maintains a database of possible intermediary nodes to which it can re-route the packet so that the loss of a single or even multiple links does not incapacitate the entire system. This is why people say that the Internet is a “robust” network.

Data contents are labelled in the protocol with IP addresses so that the destination is known to all the network nodes that receive and forward the packet. IP addresses are actually sets of numbers identifying the computer (also known as “nodes” or routers) that originated the packet (the sender) and the computer intended to be the destination (the receiver). Figure 4.3 illustrates this as a “data” mesage being placed within an envelope that has “From” and “To” addresses.

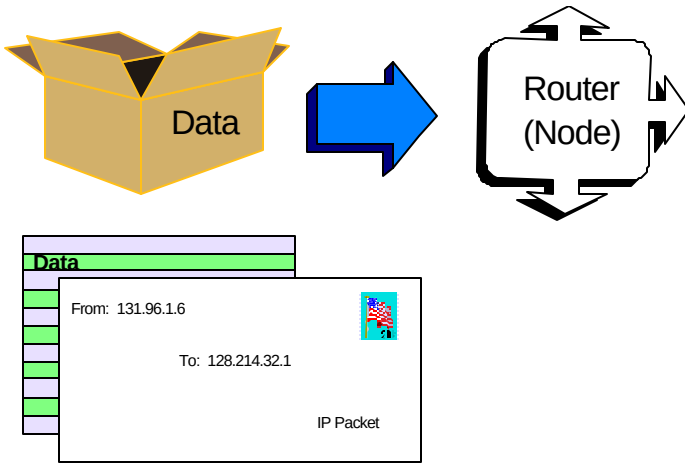

Figure 4.3 Data Packets and IP Addressing on the Internet

As strings of numbers, IP addresses are not user-friendly, so “domain names” in alphanumeric Roman script were assigned to computer nodes as well as the numeric IP address. In the commercialization of the Internet using the WWW, these domain names were critical so that users could locate nodes that held the information they were seeking.

One feature of TCP/IP was extremely important in the development of the Internet as a medium of communication. It was designed and implemented as an “open” protocol, available freely for use to any organization, institution, or person. There were many protocols in networking before TCP/IP. Most were “closed” systems in that they were owned and sold by commercial interests. IBM/s networking protocol in this era was SNA (Systems Network Analysis, for instance.

Why is this fact critical in the evolution of the Internet? Begun as a “network of networks,” its origin was in academic and defense circles for the free exchange of scientific information. By adopting a protocol that was freely available, the spread of the Internet was not hampered by commercial profiteering. It was readily adopted by all because of this openness.

4 WORLD WIDE WEB (WWW)

Using TCP/IP as a basis, a graphical interface was created to be built on top of TCP/IP. The purpose of this interface known as Mosaic was to permit an easy-to-use means of interacting foir users. It supported multimedia for richer content and hyperlinks that encouraged simple choices through mouse clicks and radio buttons, selection boxes, and down-down lists.

Hypertext/hypermedia required its own freely available protocol, layered on top of TCP/IP. It is known as http, or “hypertext transmission prototcol.” With this protocol in place, software at the receiving end can ensure that hypertext and hypermedia can be displayed and “played” properly. We will discuss the software that sits in the middle between the http infrastructure and the user applications in the mext chapter. The software that interprets http is known as a browser.

The combination of the Internet running on TCP/IP, the http infrstructure, and browser software constitutes what is known as the World Wide Web, abbreviated as the “Web.” The WWW was the basic infrastructure (and middleware) that eventually allowed the development of commercial sites.

With the evolution of the WWW, domain names were associated with numeric IP addresses and these easy-to-remember addresses became one of the reasons for the enormous success of the Internet. amazon.com is simple to remember comapred to a series of meaningless numbers.

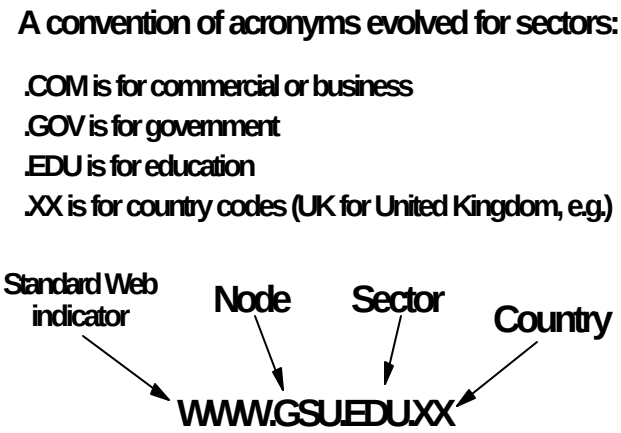

Figure 4.4 Internet IP Addresses as Domain Names

Not only are domain names like amazon.com helpful in commercial situations, but Web servers, the computers that store and deliver the "Web pages" back to the client requesting the page, can also reinterpret the immediate URL placed in the locator line in the browser. As Figure 4.5 indicates, the amazon.com server reinterprets "www.amazon.com" to send back a page located on a subdirectory of the amazon servers.

Figure 4.5 Reinterpreted Domain Names at the Web Server Infrastructural Layer

5 CLIENT-SERVER NETWORK MODEL OF 'NET'-ENABLED COMMERCE

Servers respond to requests from clients for Web pages. As Figure 4.6 shows, the request is sent through the nodes of the Internet and answered in the same manner. From the standpoint of the client, the request is "uploaded." Again, from the standpoint of the client, the Web pages is downloaded, and the time to download is known as delay or wait time.

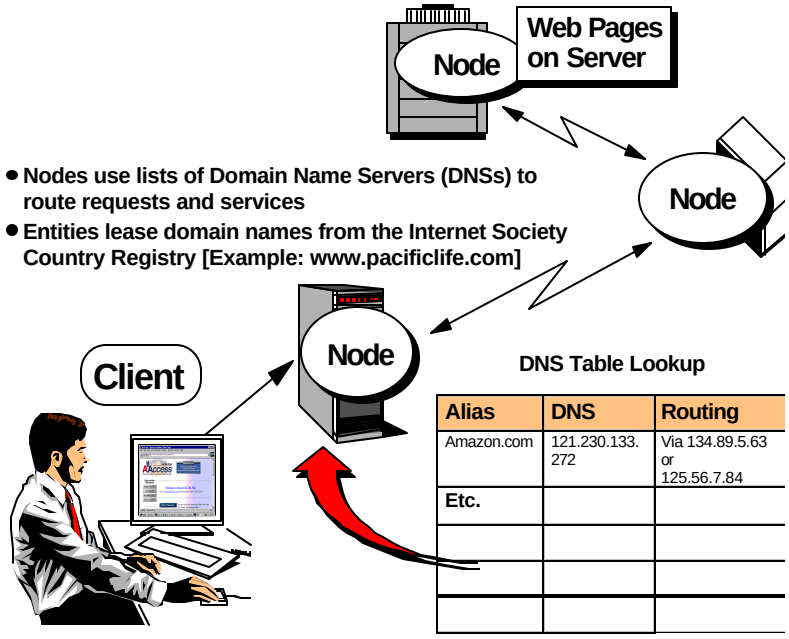

Figure 4.6 Client-Server Model and DNS Look-Ups

How does a node know where the requested Web page is sitting? Each node on the Internet has a table of DNSs or Domain Name Servers. These are listed by number and by alias, and a "table look-up" can check to find where the Web page is sitting. It also holds a routing that will eventually movethe request to the destination. If that route is "broken" or "lost," it has alternate routes that can be used.

The availability of the alternative routes is why people say that the Internet is a "robust" network. Many links between nodes can be out-of-commission and the Internet will still function.

Clients and servers are the NE software elements that utilize the various networks. Naturally, each also requires hardware, and this hardware can beoptimized for the particular function of each. So one tends to purchase heavy duty computing h/w for servers that are expected to enagage in high volumes. Nevertheless, just to illustrate that clients and servers are primarily software, it is possible to set up a client and a server on the same piece of hardware and to actually access one's own node through the Internet. It is important for

managers to recognize that software drives the development of NEOs. Hardware is primarily a comodity, with higher performance and lower costs with each generation. So the focus on NE development in firms should be on software rather than the latest hardware innovations.

6 ISPS AND COMMON CARRIERS

ISPs are the Internet Service Providers who maintain large server nodes on the Internet and sell access to individual and firms. Cable companies provide this kind of service to be accessed through their cable modems, and former Baby Bells in the US are frequently ISPs. Finally, many other firms have entered this market to provide Internet access and value-added services. In the latter category are Earthlink, AOL, and the like.

Common carriers are the old AT&T companies, also known as the Baby Bells. Through ordinary twisted pairs of copper wire phone lines, they are now providing Internet access to customers from SMEs (small- and medium-sized enterprises) to large firms. Naturally, they also service the residential market. All-digital services include the older ISDN (Integrated Service Digital Network) and ADSL or DSL ([Advanced] Digital Services Line). ISDN operates in the 124K bps (bits per second or baud) range whereas DSL has a baud rate in the megabits.

6.1 EDI, EFT, and Proprietary Networks

It needs to be noted that some network applications between organizations run on proprietary networks and not on the Internet. EDI, which stands for Electronic Data Interchange, is a decades-old technology/protocol that allows firms to send transactions directly over the network and to bypass physical processes. A firm that has established an EDI link with its suppliers can receive invoices over the 'Net' and pay them the same way. EFT or Electronic Funds Transfer is another older technology that has been used for decades by banks to move money around electronically .

While these connections will be discussed in chapters below, it is important that readers know that they currently provide a great deal of the connectivity that is driving the 'Net'-enabled evolution away from physical connections. Over time, it is fairly clear that these connections will take place over the Internet. For the moment they are point-to-point dedicated connections for which firms pay service fees to the NE infrastructure telecomm firms. There are security implications with respect to dedicated lines that will be discussed in subsequent chapters, but for the present, it is sufficient to note that as popular as the Internet is, it does not fully describe the activitiy that has come to be known as e-business activity. Decades of sending messages

6.2 "Open" versus "Closed" Networks

Figure 4.8 illustrates the difference between open and closed systems and networks. Point-to-point connections are closed in that no one other than the two parties involved in the

transaction has access to what is, in effect, a private network. This is costly and difficult administratively since each link needs to be established beforehand.

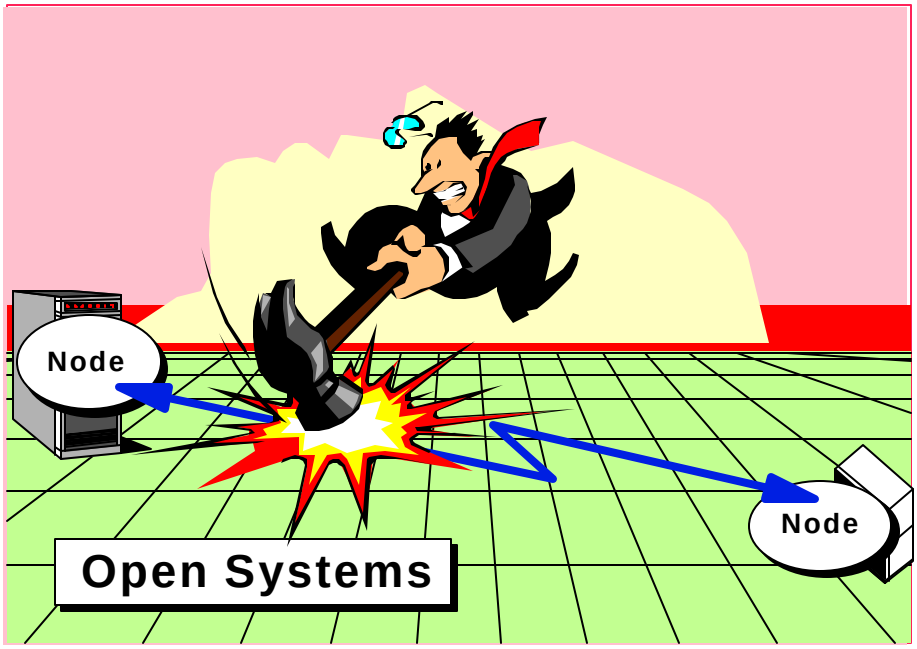

Figure 4.8 NEOs Smashing the "Closed," Proprietary Links

Breaking away from closed systems means that NEOs will adopt an open systems architecture. There are many, many nodes on the Internet and so a particular line does not need to be established in advance. In the chapter on security, we will see how firms use this basic infrastructure to create networks links that act as if they were private, one-to-one links.

1.12 Summary

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