
Chapter 2. Network Applications and Network Usage

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Introduction to Network Applications and Network Usage

Context

This unit follows on from unit 1 by completing the introduction to the module with a complementary treatment of the application and usage of networks.

Introduction

This unit continues the introduction to the module by introducing matters relating to the application and usage of networks. Starting from the idea that networks are fundamentally intended for communication and sharing, precisely what it is that may be communicated and shared is discussed. It is pointed out that all networks provide basic services for these purposes, in the guise of, for example, electronic mail and file transfer. Specific examples are provided.

The information needs of various groups, ranging from a small group of people in close proximity to each other, to a large group that is widely scattered, are considered. The emergence of different types of networks to meet these various needs is demonstrated, as is the way in which the networks operate to satisfy the respective requirements. Ideas such as pattern of communication and information flow are introduced as ways of examining the match between what the users of a network need from it and what it offers to them. Information networking, with which the use of a network is sufficient to meet all the needs of an information worker, is used as a way of summarising and encapsulating the requirement / provision issue.

Finally, following Stefik, various ways in which a network may be (or need to be) perceived by its users are outlined. These include: the network as a communication network, the network as a digital library and the network as a market place.

Objectives

At the end of this module, you should be able to:

- describe the basic application of computer networks;
- appreciate the range of uses, both actual and potential, of computer networks;
- begin to assess the match between user requirements and network provision
- be aware of the different guises in which network-supported applications can present themselves.

Application and Usage

We know from the previous unit that computer networks are intended to enable communication and sharing. We also know that these capabilities are provided in the form of services. On the Internet, for example, a communication capability is provided by the e-mail service and, although this is probably the primary communication service, many others are also available. Resource sharing is enabled by using:

- The file transfer protocol (FTP) to transfer files and so share anything that can be stored in a file, including information, expertise, images, software, etc.
- Telnet, to log in to another computer and make use of it. This service enables the user of one Internet computer to, in effect, take over another and to use it or any of its peripheral devices. Of course, permission to do this must be granted in advance.

- The World Wide Web, to access the data stored in the Web, and also to provide a common means of access to the other services, including file transfer, e-mail, etc. In fact, the basic World Wide Web activity is essentially a file transfer: the entering of, for example, <http://www.cs.uct.ac.za/about.html> is a request for a specific file (about.html) on a named computer (www.cs.uct.ac.za).

Just about all computer networks will provide some comparable services for the basic activities of communicating and sharing. On some networks, these services will be used as building blocks for the construction of higher-level services to support, for example, group activity, and co-operation between various users of the network.

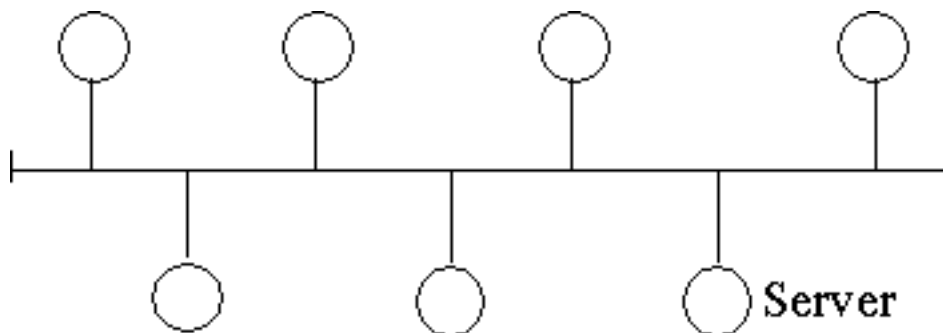
To Do

Now carry out Activities 1 and 2, as well as do Review Questions 1, 2 and 3

Meeting User Requirements

In this section, we consider the requirements of groups of people who have to work together, and consider the ways in which a network may or may not meet their needs. We first consider a small group of people located in close proximity to each other, and then look at a group that can be scattered across the globe. After examining these two extreme situations, some conclusions can be drawn.

By considering the needs of a small group of people working as members of a group in the same location, it is possible to draw out some of the requirements of a network intended to support their activities. First, the network must provide them with connectivity, and we saw in the previous unit that this can be done by linking their computers to a length of cable.



When connected in this way, they can obviously communicate with each other, perhaps by using e-mail. They also have the wherewithal to share resources. The sharing of software and information will be facilitated by the presence on the network of a server. This can be used to store the items of software that are used in common by some or all of the members of the group, so that it is only necessary to purchase one copy of the software for the server rather than multiple copies, one for each machine. This is also a way of ensuring that the same version of each item of software is used by everyone, thereby avoiding any problems stemming from the possible incompatibility of different versions of the software. The server can also be used to store information to be shared by members of the group. At its simplest, the originators of information store it on the server, and those wishing to share it retrieve it from there. From these basic capabilities, more sophisticated facilities tailored to the needs of the group can be constructed. For example, the server can support an electronic bulletin board on which members of the group can post notices, and it can provide a facility for arranging meetings at times that suit all those concerned. It can also run software to support group activities such as the production of a document as a joint activity to which several members of the group contribute in some way: this can be supported not only by the provision of a suitable environment but also by attending automatically to the more mundane administrative details of matters such as version control.

The group can also share hardware. It is possible, for example, for a network to have a printer server, that is, a computer that holds the printing resources needed by other computers. The printer server will be a computer that is attached to the network and also has a printer attached to it: any files to be

printed will be sent to this computer and it will cause them to be printed on its printer. In this way, one high-quality printer can be shared by all the members of the group attached to the network rather than providing a number of printers so that each can have their own.

Turning now to groups of people scattered as widely as possible across the face of the earth, we can examine the extent to which their needs are met by the Internet.

The Internet's provisions for communication, in the form of e-mail, and sharing of information, software and so on, in the form of file transfer and the World Wide Web, allow it to meet these aspects of the needs of any group. In terms of sharing hardware, the Internet offers the widest possible choice in terms of the computers themselves: the location of a computer becomes immaterial on a world-wide level when it can be given a task and it can return the result. Similarly, it offers a wider choice of peripherals, although it is clearly no point in sharing a printer that is located on the other side of the world!

With its basic infrastructure for communication and sharing, the Internet can support things like bulletin boards and facilities for the arrangement of meetings as effectively as a local network. It can also support group activities. In general, it is in a position to support groups whose members can be drawn in an extremely flexible fashion from anywhere in the world. It turns out that this is not simply a possibility but also a useful possibility in that it has been found that 'meetings' held by electronic mail can be more fruitful in several respects than face-to-face meetings. Given the logistical problems of arranging meetings for a group of people scattered round the world, this represents a considerable contribution to the viability of such groups.

One may conclude from this that a computer network that provides adequate connectivity and appropriate services is in a position to satisfy many of the major needs of a user community regardless of its size and the extent to which it is dispersed. Restrictions imposed by distance between members of the community only come into play when physical activities such as printing on paper or placing a document in a scanner are involved in the requirements.

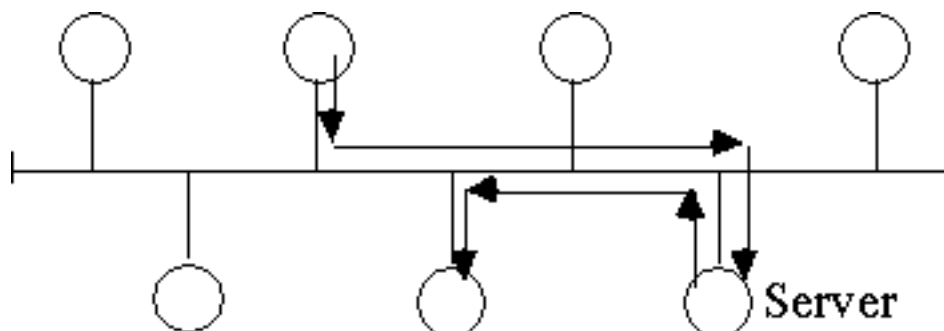
To Do

Now do Review Questions 4, 5 and 6.

Judging the Effectiveness of Network Provision

Taking the point of view that a network is provided to meet the needs of a community of users, it is important to be able to judge the effectiveness of the a network in meeting this need. Concepts that help in making such a judgement include examination of the patterns of communication supported by the network and of the information flow through the network.

If the patterns of communication supported by the network reflect those required by the users of the network, then the network will be able to satisfy their communication needs. On a local network, for example, typical patterns of communication include sending an item to the server and retrieval from the server, as illustrated in figure 2.2. A comparison of the network's repertoire of communication patterns with those implied by the users' communication needs will reveal the extent of the adequacy of the network in this respect.



It is important that a network support the flow of information required by its user community. Whether being communicated or shared, information must be able to flow from where it is held to where it is needed. In a business organisation, for example, once an order is received, the information it contains must be passed on so that its receipt can be acknowledged, it can be checked for correctness, the item ordered can be picked from the warehouse if it is in stock or ordered if it is not, and so on. In other words, the receipt of an order, in common with the receipt of other information-bearing items, triggers the need for information to flow to other parts of an organisation from where, in turn it must flow to other parts in an ever-lengthening chain. The network must be able to support these information flows by providing the necessary paths. To do this it must provide not only the required connectivity but also the necessary capacity.

In fact, ideas such as these, together with the need to be able to judge the effectiveness of a network, lead to a procedure for the design of an effective network which may be summarised in this way:

1. List requirements.
2. List equipment needed.
3. Determine appropriate means of interconnection and interworking for the network.
4. Construct the network.
5. Match the performance of the network against the requirements given at stage 1.
6. Until the network satisfies the requirements on it, go back to stage 2.

To Do

Now do Review Questions 7, 8 and 9 as well as Activities 3 and 4.

Information Networking

One generic network application is worth distinguishing at this point both for its general importance in business and commerce and for the part it plays in all the major specific applications of computer networks such as those described in the next section. It is information networking.

Information networking can be described as making use of a network, and all the information resources it provides, in a way that meets all the needs of an information worker. These needs include:

- information discovery,
- information retrieval,
- information filtering,
- information refinement,
- information processing,
- information management,

and more.

The computers on a network can be used to provide the basic facilities needed, such as storage and processing, as well as tools such as search capabilities and management functions. The connectivity of the network gives access to these facilities regardless of where they are located.

With a large network, such as the Internet, the sheer amount of information and information resources available present the information worker with a formidable task in coming to terms with them. One way of dealing with this is for the network itself to provide help. In the case of the Internet, help has

been provided in various ways that include search engines and forms of assistance based on the use of mobile agents.

The way in which assistance is conceived, and the technology used to implement it, lead to different styles of working. When minimal assistance is available, information workers have to 'pull' the information they need out of the network. Certain forms of assistance, including that based on the use of agents, can result in the network automatically pushing information of a specified kind out to them.

To Do

Now carry out Activity 5.

Points of View

Any network is multi-faceted: some are also large while the Internet is also world wide. To begin to come to terms with such complex artefacts, it helps to have ways of thinking about them. Following Stefik, we can think of a network as:

an e-mail network	This stresses the communications role of the network and the ways it can be used to advantage as a medium for communication. E-mail can be used for one-to-one communication, in the same way as conventional mail usually is, but its electronic nature makes other patterns of communication, including one-to-many and many-to-one, equally feasible. These other patterns of communication lead to uses for e-mail that are not practicable or achievable with conventional mail.
a digital library	A digital library is a repository for the storage of digital resources that are then available to the members of the community with access to the supporting network. Items in a digital library supported by the Internet are available to be shared across the world. As a collection of digital objects, items can be added to the collection of a digital library and retrieved from it in direct analogy to the corresponding activities in real-world libraries. Digital libraries gain over real-world libraries in that their resources can be copied indefinitely so that they are never 'out of stock'. In addition, the items can be anything that can be digitised, including audio and video, by contrast with the conventional library's usual emphasis on books.
a market place	By linking together producers and consumers (sellers and buyers) world-wide, and providing facilities for them to interact, the Internet provides an unprecedented forum for business activities. Anyone connected to the network can come to the market place as either a buyer or a seller. The communications aspect of the supporting network provides for connectivity and interaction, while the computer aspect supports the storage of sharable information and the processing needed to deal with the transactions that take place in the market place.

Stefik also distinguishes the Internet as a supporter of:

digital worlds	A network can also support virtual worlds/virtual realities/digital worlds to provide a context for the activities that take place there. These activities may involve communication, relate to a library or market, or include a combination. The digital world constructed to provide an environment for a networked activity inevitably affects the way that activity is conceived and performed. In this way, some digital worlds can encourage and enhance the activity they support, whereas others can obscure and enfeeble it. The crucial aspect of a digital world, or cyberspace, may well be not so much its nearness to reality as its appropriateness to the activity it is intended to 'house'.
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These ways of thinking about networks are elaborated in subsequent units of the module.

To Do

Now do Review Question 10.

Activities>

Activity 1 - File Transfer

Make sure that you know how to transfer a file, whether by using FTP itself or by taking advantage of one of the alternatives given in the answer to Review Question 3.

Activity 2 - Telnet

Make sure that you are familiar with Telnet and its use.

Activity 3 - Network design

With reference to the design procedure given above, fill out the first two categories (requirements and equipment) either as you think they should have been for a specific network or as you would for a network that you were designing.

You can find a discussion of this activity at the end of the chapter.

Activity 4 - Conflicts

You have seen in Review Question 9 that some of the requirements placed on networks can conflict. They include:

- the need for wide access and security,
- the need for standardised operation and the desire to take advantage of the latest developments, and
- the availability of a wide range of applications and the provision of a good user interface.

Now answer the following questions>

1. Explain exactly how these pairs of requirements conflict.
2. How can these conflicts be resolved in coming to a design for a network?
3. What will be the consequence of resolving the conflicts?

You can find a discussion of this activity at the end of the chapter.

Activity 5 - Information networking

Describe, from your point of view as a student, the requirements for a network intended to provide a successful information networking environment.

Review Questions>

Review Question 1

The main uses of a computer network are communication and sharing. Services are provided to support them. How must these basic services be enhanced so that the requirements of group work, including collaboration and co-operation, are supported?

You can find an answer/comment for this review question at the end of the chapter.

Review Question 2

What sort of interface should be provided for the users of groupware? Is a presentation in the form of an enhanced ("bigger, better") single computer useful? Is it sustainable? Can you think of a better form of presentation?

You can find an answer/comment for this review question at the end of the chapter.

Review Question 3

It is arguable that FTP, as a separate service, is no longer needed. Can you make the case for this?

You can find an answer/comment for this review question at the end of the chapter.

Review Question 4

On a local network with a server, how would you decide whether to allow computers to communicate directly or through the server?

You can find an answer/comment for this review question at the end of the chapter.

Review Question 5

Other than a printer server, what other kinds of specific server could be placed on a local network with benefit? Which of them would be unsuitable for use on a large network?

You can find an answer/comment for this review question at the end of the chapter.

Review Question 6

Describe a procedure with which a computer on a mesh network could construct a description of the connectivity of the network.

You can find an answer/comment for this review question at the end of the chapter.

Review Question 7

Describe some of the patterns of communication that might be expected on the Internet.

You can find an answer/comment for this review question at the end of the chapter.

Review Question 8

Describe the information flows required in:

1. a large retailing chain as a result of selling an item (it may help to start from the electronic tills in the stores, and to think about stock control, warehousing, deliveries, ordering and re-ordering, etc.),
2. a bank's Automatic Teller Machine (ATM) system.

You can find an answer/comment for this review question at the end of the chapter.

Review Question 9

Some of the requirements placed on networks can conflict with each other. Can you think of any?

You can find an answer/comment for this review question at the end of the chapter.

Review Question 10

What is the relation between the view of the Internet, distinguished by Stefik, as a supporter of digital worlds and the other views he distinguishes?

You can find an answer/comment for this review question at the end of the chapter.

Discussion Topics

1. Discuss the differences between the requirements of a group and those of an individual concerning, first, information networking and, second, an environment for information networking.
2. Discuss the aspects of the Internet that act to support the formation of communities. Presumably, the possibility of 'interaction' comes into this in some way. Can you expand on this? Which services and network-supported activities enable this community formation?
3. From the points of view of the various interested parties, including users, manufacturers, service providers, etc., which Internet services are the most valuable?
4. If connectivity is the key to enabling interconnection, what is the key to enabling interworking?

Answers and Comments

Activity 3

Items to be placed under 'Requirements' will include, for example, range of uses, functions to be provided, ease of use, access requirements, performance requirements, cost requirements, security requirements, requirements regarding standardisation, and so on.

Items placed under 'Equipment' will include work stations, processors, servers, storage devices, other peripherals, and so on.

Activity 4

The listed pairs all conflict in that they express mutually incompatible requirements. For example, a need for security implies controlled and restricted access, which is incompatible with widespread access.

The conflicts will have to be resolved by taking a view on the relative importance of the conflicting requirements, and coming to some accommodation that favours one at the expense of the other. For example, if the need for security is paramount, open access simply cannot be offered.

The consequence of taking such views will be to give the network a specific character and, as far as its users are concerned, a particular 'feel'.

Review Question 1

The communication and sharing ought to be integrated within some environment that also supports ways of integrating and presenting the information and documents to which different people are contributing.

Review Question 2

This is not an easy question. There are more options to present to the user, but presenting them all at once in a way that clutters up the screen will not be helpful. Some kind of hierarchical approach

may help, in which a top-level task is selected first, after which the key services necessary during its execution are presented, followed by the presentation of the more specialised services as required.

When several people are working on the same document at the same time, the sections being worked on can be colour coded to indicate their authors. This can be effective with a small number of contributors but, again, can cause a cluttered screen when the number rises.

Review Question 3

E-mail, with its file attachment capability, can be used to transfer a file in a straightforward fashion. In addition, the Web, in retrieving a Web page from a server, effectively achieves a file transfer. The Web can, in fact, be used as an interface to FTP: it will accept an entry such as: *ftp://computer-name/path/file*

Review Question 4

You might have to decide, as a purely practical matter, because of the way the available software operates. Given the need to make a choice, matters such as the capabilities of the users' machines and the amount of network traffic generated come into play.

Review Question 5

Other servers could include file servers, archive servers, spare-processor allocation servers and back-up servers. Servers that deal only with data that is communicated over the network can be used on a network of any scale, where as a server that deals with information that is committed to some physical medium at some point is not. The latter category includes printer servers, graph plotter servers and scanner servers.

Review Question 6

First, all the computers on the network compile a list of their neighbouring computers. Then the computer constructing the description tells each neighbour to forward its list and to ask its neighbours to do the same.

This procedure needs tidying up a little, not least so that it will stop.

Review Question 7

One typical pattern is the request going from a client machine to a Web server and the Web page being returned from the server to the client in the course of a session on the Web.

Review Question 8

1. If we start from a till, when a sale is made, information must flow from the till to the stock control computer. At some point stock will have to be replaced, and so information needs to flow from the stock control computer to the warehouse where it is used to pick replenishment stock. Stock will also have to be re-ordered, and when a re-order level is reached, information will need to flow from the stock control computer to the ordering system, or perhaps directly to suppliers. Further flow may also be needed. It may help to draw a diagram of the system that you think such an organisation would have and to record information flows on it.
2. Information clearly needs to flow back and forth between the ATM and the bank's computer that holds the relevant customer information. First, the customer needs to be authenticated, and then a cash withdrawal (or whatever the customer wants) can be approved so that cash can be dispensed locally.

Review Question 9

Some requirements that conflict are:

- the need for wide access and security,
- the need for standardised operation and the desire to take advantage of the latest developments, and
- the availability of a wide range of applications and the provision of a good user interface.

Review Question 10

As a supporter of digital worlds, the Internet can provide interfaces to and environments for the activities carried out in its other roles, such as supporting a market place, and so on.