What is a Network?

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Computing Time Line

- 1950's: Setting switches
- 1960's: Computer languages
- 1970's: Time sharing
- 1980's: PC
- 1990's: Graphical User Interface
- Now: Networks

The main focus and concern in the development of computing is constantly shifting. At any given period the pre-occupations of the previous period are taken for granted and the details "hidden" within a "black box".

1950's

Computers initially were "programmed" by setting switches that directly controlled the 0's and 1's in memory locations. There were very few such locations (eg 64 bytes) and the major task was to make everything as short as possible (Y2K!!!)

1960's

Computer languages available. A computer language can be thought of as a program that automatically "sets the switches" according to written instructions. We begin to ignore the precise settings of the switches - focus on the design of the language instead.

1970's

More access - instead of a large computer running a series of jobs from a queue (batch processing, punch cards, paper tape) we began to see terminals (teletype initially) so that many users could share large computers. To regulate this needs an "operating system" (OS)

1980's

More access - how about a computer on everyone's desk? Enter the "personal computer" (PC). The PC "black boxes" (grey boxes??) the entire business of running a computer system - now anyone, supposedly, can do it in their office or living room.

1990's

The text commands needed to control the computer limit who can learn to do it so the graphical user interface becomes pervasive (Macintosh did this in the 80's!). The detailed control of the OS is being black boxed.

Now

The Web, networks, connectivity are becoming the major focus. Entire remote systems are taken for granted.

Network Protocols and Services Unit

- Protocols
  - The languages of the Net
- Services
  - What we want to achieve on the Net

Services – Definition

- The act of helping or doing work for another
- The provision or system of supplying a public need

These are dictionary definitions - not specially related to computing.

Can you think of other aspects of “service” that need to be talked about when we think of computers and networks?

Services – Concepts

- Types of services
  - Generic
  - Specific
- Service providers & consumers
  - Server/client
  - Peer to peer

Generic & specific services

As time progresses a service that once appeared to be “specialised” can be seen as generic. Other services get built on top of it!

Providers & consumers

As we think about a service it is fundamental to identify who is being served and who is doing the serving These roles may be clearly separated between two computers (the client and the file server) or they may shift with a single computer being a provider and a consumer alternately (Windows networking)

Generic Service

- File copying
  - Accuracy of transfer
  - Speed
  - Security

File transfer

Most other services depend on some form of file transfer so we want to be able to black box this as much as possible. In this unit the insides of file transfer will be thoroughly investigated and we will see, in particular, how it is made reliable.

Service Consumers

- Locate the service
  - Look up in a directory?
  - Listen to advertisements
- Make the request
  - Start the conversation
  - Identify yourself
- Respond appropriately
  - Beginnings of a "protocol"

A service consumer (remember this may be a “full-time” consumer - a client - or a “part-time” consumer in a peer-to-peer relation) will have certain things that need to be done.

Service Provider

- Advertise
  - Broadcast
  - Via directories
- Wait for requests
- Respond to requests
  - Handle concurrency
  - Respond appropriately

On the other side of the fence the service provider has to reciprocate.

The key development in this slide and the previous slide is "respond appropriately". Each partner in the relationship must say the right thing at the right time otherwise things will get confused.

As humans we do this innately. We say "hello" at the beginning of conversations and "goodbye" at the end. In very formal situations (eg in a court of law) there are far more rules ("May I approach the bench?")

Client/Server

- Clients are consumers
  - Simple role
- Server is provider
  - Specialised
  - Optimised
- One server - many clients
  - Single point of failure
  - Performance bottleneck
  - Provide redundancy?
- Administration
  - Centralised
  - Secure

Here we look in more detail at the consequences of a sharp and unchanging definition of who is the consumer and who is the provider.

As can be seen there are advantages and disadvantages to this approach.

Peer to Peer

- All nodes are consumers & providers
  - More widespread complexity
  - Higher performance?
  - Distributed administration
    - E.g. Windows 98

Protocol

- The rules, formalities etc of any procedure.
- A defined sequence of interaction
  - Both ends must agree
  - Common standards

So we have seen the need for some rules about communication. This slide shows the dictionary definition of "protocol" and then my definition. "A defined sequence of interaction" means that both parties must agree about what comes next in the "conversation".

Protocol

- Standardisation
  - Standards organisation
  - De facto
- Types of protocol
  - General purpose
  - Specialised

Standardisation

The basis for the agreement may be rules defined by a formal set of committees or ideas may simply "grow" through use and discussion. The latter was the way the Internet arose and grew so rapidly. The committee approach tends to slow things down.

Types of protocol

Like types of service, some protocols underpin all activities whereas some protocols are specific to a single specialised task. Designing a protocol is a good way to get clear about building a new service.

International Standards

- ISO
  - International Standards Organisation
- CCITT/ITU
  - **Originally -** International Telegraph & Telephone Consultative Committee
  - **Now -** International Telecommunications Union
- IEEE
  - Institute of Electrical & Electronic Engineers

Generic Protocols

- Basic communication
  - Deliver a single "packet"
  - In a single network
  - Across multiple networks
- Manage connections
  - Correct errors
  - Control flow of data

All network activity requires protocols that do these things and most of what we now do on the network “black boxes” these activities. Historically though, these too were a major focus and this unit takes inside the protocols that move messages (“packets”) around an extended network (eg the Internet) and on top of that make sure that the flow of packets between two distant computers is properly regulated.

Protocol Families

- TCP/IP
  - TCP (Transmission Control Protocol)
  - IP (Internet Protocol)
  - Defacto standard
  - Open protocol
- Novell
  - Proprietary
  - IPX/SPX (Inter-network Packet Exchange/Sequenced Packet Exchange)
- Appletalk
  - Proprietary
  - DDP (Datagram Delivery Protocol)
- ISO protocols
  - Agreed international standards

Acronyms galore!

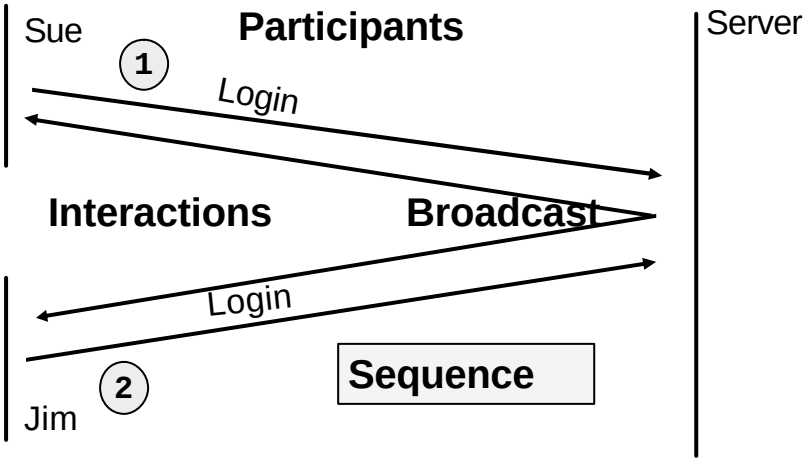
Check the acronym link on the Unit home page. A major challenge in this unit is to become comfortable with these acronyms - there are simply too many words in this field to keep saying entire words all the time!

At the same time remember that it is the underlying concepts that are the real learning task. The acronym is just short-hand, a "handle", that can be used to rapidly refer to something. Focus on understanding the concepts.

In this slide the key distinction is between protocols that are "proprietary" (Novell's IPX/SPX) and "open protocols" (Internet TCP/IP)

Protocols are grouped in "families". The "parent" is often a company or organisation. "Siblings" are designed to work together - to inter-operate. The problem is with "cousins"!

Representing a Protocol



Participants

There will be two (or more) sides to the "conversations" in your protocol. Represent the computers taking part by vertical bars with some identification beside them.

Interactions

The participants send each other messages. These can be represented by arrows with some text attached to indicate what was being said

Sequence

It is important to add numbers to these arrows to show what order things happened. An important part of a protocol is what response is made to a request and the numbers introduce a time axis to your representation.

Broadcast

Many protocols use broadcasts which can be represented by a set of arrows radiating from a single point.