CS 5523 Lecture 4: Network Overview

- *Questions on Laboratory 1*
- *Catch up from Lectures 2 and 3*
- *Questions from Chapter 2*
- *Emphasis of network overview*
- *Network models*
- *Overview of routing*

Discussion Questions from CDK Chapter 2

[CDK 2.4]

A search engine is a web server that responds to client requests to search in its stored indexes and (concurrently) runs several web crawler tasks to build and update the indexes. What are the requirements for synchronization between these concurrent activities?

Discussion Questions from CDK Chapter 2

[CDK 2.9]

Distinguish between buffering and caching.

Discussion Questions from CDK Chapter 2

[CDK 2.12]

For each of the factors that contribute to the time taken to transmit a message between two processes over a communication channel, state what measures would be needed to set a bound on its contribution to the total time. Why are these measures not provided in current general-purpose distributed systems?

Discussion Questions from CDK Chapter 2

[CDK 2.14]

Consider two communication services for use in asynchronous distributed systems. In service A, messages may be lost, duplicated or delayed and checksums apply only to headers. In service B, messages may be lost, delayed or delivered too fast for the recipient to handle them, but those that are delivered arrive with the correct contents.

- *Describe the classes of failure exhibited by each service.*
- *Classify their failures according to their effect on the properties of validity and integrity.*
- *Can Service B be described as a reliable communication service?*

Discussion Questions from CDK Chapter 2

[CDK 2.15]

Consider a pair of processes X and Y that use the communication service B from Exercise 2.14 to communicate with one another. Suppose that X is a client and Y a server and that an invocation consists of a request message from X to Y, followed by Y carrying out the request, followed by a reply message from Y to X. Describe the classes of failure that may be exhibited by an invocation.

Napster versus Gnutella

Napster and Gnutella are "peer-to-peer" applications.

- *What services do they provide?*
- *Do they work the same way?*
- *In what sense are they peer-to-peer?*
- *What architectural models do they use?*

If you are interested in reading more ---

- *Peer-to-peer: Harnessing the Power of Disruptive Technologies ed. by Andy Oram, O'Reilly Press, 2001.*
- *www.napster.com*
- *www.gnutella.com*

What are we going to emphasize?

- *This is not a networks course*
- *Quick run-through of CDK Chapter 3*
- *CDK Chapter 3 provides some networking terminology*
- *Emphasize services built on TCP and UDP*
- *What are consequences to the application?*

Basic terminology:

- *Communication subsystem*
- *Host - devices that use a network for communication*
- *Node - any computer or switching device on a network*
- *Subnet - (CDK's definition) set of interconnected nodes that employ same technology to communicate among themselves.*

(Not a standard definition of subnet - which usually denotes an organization of IP addresses and a physical location for routing.)

What are the network issues?

- *Performance*
- *Scalability*
- *Reliability*
- *Security*
- *Mobility*
- *Quality of service*
- *Multicasting*

Why are these network issues important for operating systems?

Performance:

- *Message transmission time:*

  latency + length/data transfer rate

  (assuming no message fragmentation)
- *Total system bandwidth:*

  Total volume of traffic that can be transferred across the network in a given time

What factors influence total system bandwidth?

Figure 3.1 (CDK)
Network types

	Range	*Bandwidth (Mbps)*	*Latency (ms)*
LAN	1-2 kms	10-1000	1-10
WAN	worldwide	0.010-600	100-500
MAN	2-50 kms	1-150	10
Wireless LAN	0.15-1.5 km	2-11	5-20
Wireless WAN	worldwide	0.010-2	100-500
Internet	worldwide	0.010-2	100-500

Implementation details:

- *Packet transmission*
- *Switching schemes*
- *Protocols*
- *Routing*
- *Congestion control*
- *Internetworking*

Switching schemes:

- *Broadcast*
- *Circuit switching*
- *Packet switching*
- *Frame relay*

What are these schemes and how do they differ?

Protocols:

CDK:

> *… a well-known set of rules and formats to be used for communication between processes...*

Protocols specify both data format and the exchange mechanism.

What is the difference between a protocol layer and a protocol suite?

Figure 3.2 (CDK)
Conceptual layering of protocol software

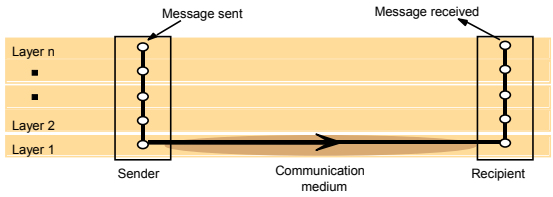


Figure 3.3 (CDK)
Encapsulation as it is applied in layered protocols

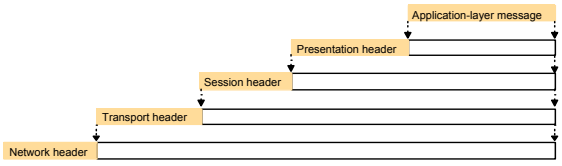


Figure 3.4 (CDK)
Protocol layers in the ISO Open Systems Interconnection (OSI) model

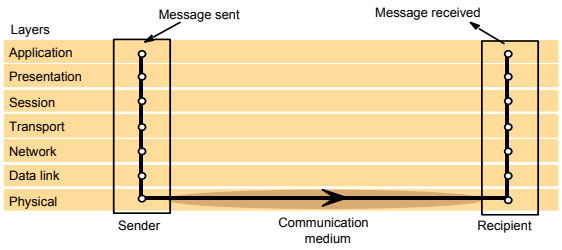
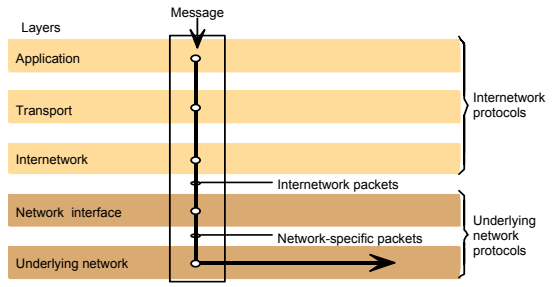


Figure 3.5 (CDK)
OSI protocol summary

Layer	*Description*	*Examples*
Application	Protocols that are designed to meet the communication requirements of specific applications, often defining the interface to a service.	HTTP, FTP , SMTP, CORBA IIOP
Presentation	Protocols at this level transmit data in a network representation that is independent of the representations used in individual computers, which may differ. Encryption is also performed in this layer, if required.	Secure Sockets (SSL),CORBA Data Rep.
Session	At this level reliability and adaptation are performed, such as detection of failures and automatic recovery.	
Transport	This is the lowest level at which messages (rather than packets) are handled. Messages are addressed to communication ports attached to processes, Protocols in this layer may be connection-oriented or connectionless.	TCP, UDP
Network	Transfers data packets between computers in a specific network. In a WAN or an internetwork this involves the generation of a route passing through routers. In a single LAN no routing is required.	IP, ATM virtual circuits
Data link	Responsible for transmission of packets between nodes that are directly connected by a physical link. In a WAN transmission is between pairs of routers or between routers and hosts. In a LAN it is between any pair of hosts.	Ethernet MAC, ATM cell transfer, PPP
Physical	The circuits and hardware that drive the network. It transmits sequences of binary data by analogue signalling, using amplitude or frequency modulation of electrical signals (on cable circuits), light signals (on fibre optic circuits) or other electromagnetic signals (on radio and microwave circuits).	Ethernet base- band signalling, ISDN

Figure 3.6 (CDK)
Internetwork layers



Packet assembly:

- *Transport layer usually handles assembly and reassembly*
- *Packets consist of a header and a data.*
- *If the data > MTU (maximum transfer unit), must be divided into multiple packets.*
- *A transport address is network address of host + port number.*

Packet delivery:

Two approaches to delivery in the network layer

- *Datagram delivery*
- *Virtual circuit packet delivery*

Are these the same as connectionless and connection-oriented protocols?

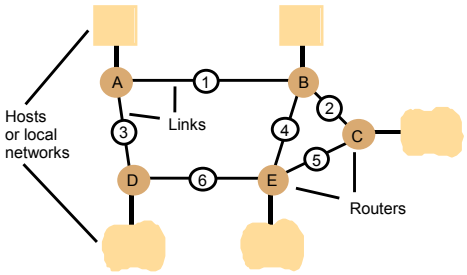
Routing:

- *decide the route for each packet*
- *update knowledge of the network*

Link-state algorithm:

- *keep a distance vector for destinations in routing table*
- *send a summary of routing table to neighbors using RIP (router information protocol)*
- *read tables from neighbors and update as needed*

Figure 3.7 (CDK)
Routing in a wide area network



Internetworking terminology:

- *router*
- *bridge*
- *hub*
- *switch*
- *tunnel*

How do these differ?

Figure 3.10 (CDK)
Simplified view of the QMW Computer Science network

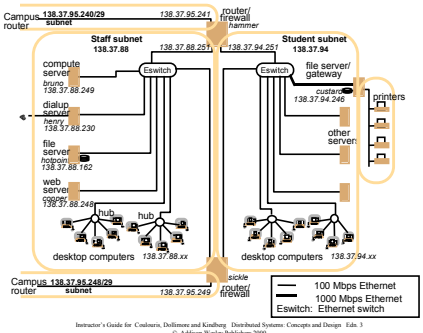


Figure 3.11
Tunnelling for IPv6 migration

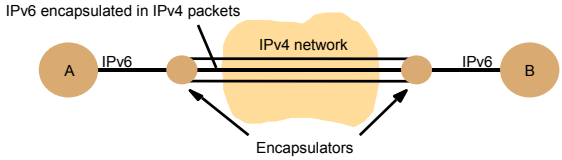
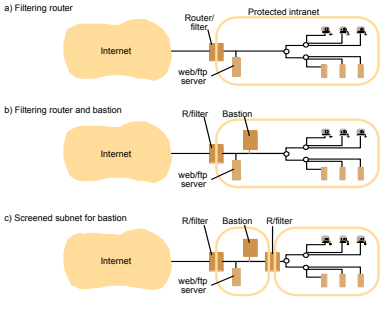


Figure 3.20
Firewall configurations



For next time:

- *Read Stevens Vol. I Chapters 1 and 2*
- *Read Core Java Vol II Networking Chapter (particularly pages 197-209)*