TCP/IP 通訊協定及應用

Spring 2002
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http://wmlab.csie.ncu.edu.tw/course/tcp

First Week Agenda

- Course Preview
- Basic Understanding of the implementation of TCP/IP
  - The text book describes and presents the source code of the common reference implementation of TCP/IP

Introduction

Introduction

- Introduction:
  - This chapter provides an overview of the TCP/IP protocol suite,to establish an adequate background for the remaining chapters.
- Layering:

Application	Telnet,FTP,e-mail, etc
Transport	TCP,UDP
Network	IP,ICMP,IGMP
Link	device driver and interface card

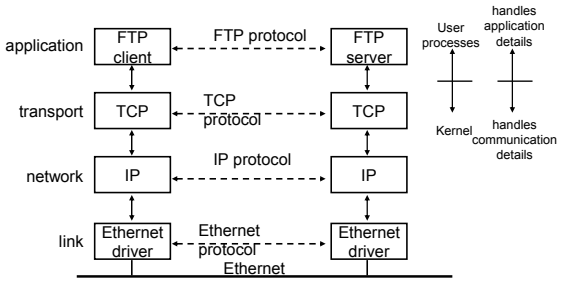
Figure 1.1 The four layers of the TCP/IP protocol suite

Layering

- Each layer's responsibility:
  - The link layer (data-link layer,network interface layer)
    - handle all the hardware details of physically interfacing with the cable
  - The network layer (internet layer)
    - handles the movement of packets around the network
  - The transport layer
    - provides a flow of data between two hosts,for the application layer above
    - TCP => provides a reliable flow of data between two hosts
    - UDP => unreliable => reliability must be added by the application layer
  - The application layer
    - handles the details of the particular application

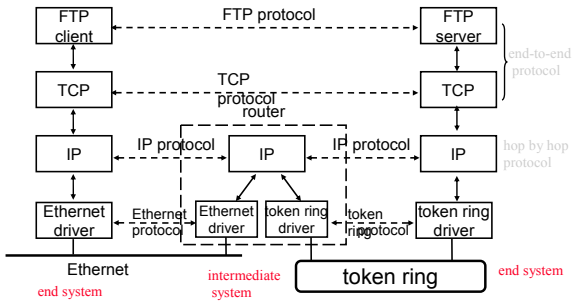
Layering

- Two hosts on a LAN running FTP



Layering

- Two networks connected with a router



Layering

- compare with router and multihomed
  - A router, by definition, has two or more network interface layers
  - Any system with multiple interfaces is called multihomed
  - A host can also be multihomed but unless it specifically forwards packets from one interface to another,it is not called a router => mutihomed=router except above situation
- compare with bridge and router
  - Bridges connect networks at the link layer
  - Routers connect networks at the network layer

TCP/IP Layering

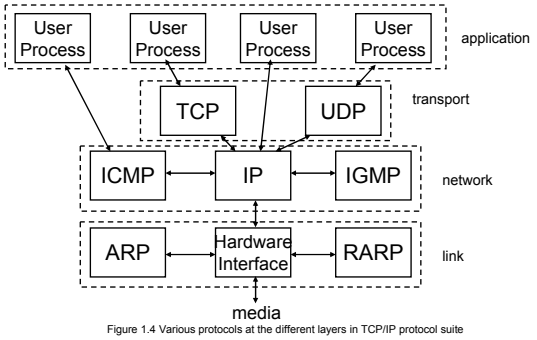


Figure 1.4 Various protocols at the different layers in TCP/IP protocol suite

TCP/IP Layering

- TCP provides a reliable transport layer
  TCP applications:Telnet and Rlogin,FTP,SMP
- UDP is unreliable,sends and receives datagrams for applications UDP applications:DNS,Trivial FTP,Bootstrap Protocol,SNMP
- IP is the main protocol at the network layer An application accessing IP is rare,but possible
- ICMP is used by IP layer to exchange error messages and other vital information with the IP layer in another host or router
- IGMP is used with multicasting:sending a UDP datagram to multiple hosts
- ARP and RARP to covert between the addresses used by the IP layer and the addresses used by the network interface

Internet Addresses

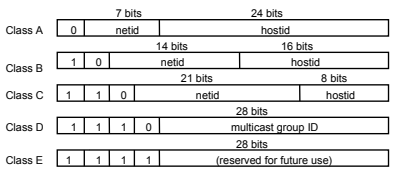


Figure 1.5 The five different classes of Internet addresses

Class	Range
A	**0**.0.0.0 to **127**.255.255.255
B	**128**.0.0.0 to **191**.255.255.255
C	**192**.0.0.0 to **223**.255.255.255
D	**224**.0.0.0 to **239**.255.255.255
E	**240**.0.0.0 to **255**.255.255.255

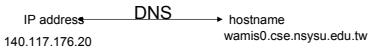
Figure 1.6 Range for different classes of IP addresses.

Internet Addresses

- Internet address
  - also called an IP address,32-bit numbers,unique
- How to differentiate between the different classes of addresses?
  - look at the first number of a dotted-decimal address
- Multihomed host will have multiple IP address
- Who allocating these unique IP address?
  - InterNIC(Internet Network Information Center)
- Three types of IP addresses
  - unicast (destined for a single host)
  - broadcast (destined for all hosts on a given network)
  - multicast (destined for a set of hosts that belong to a multicast group)

The Domain Name System

- Domain Name System (DNS)
  - is a distributed database that provides the mapping between IP addresses and hostnames



- Encapsulation
  - Each layer adds information to the data by prepending headers (and sometimes adding trailer information) to data that it receives
  - What's difference if we use UDP protocol
    - UDP passes to IP is called a UDP datagram, and the size of the UDP header is 8 bytes

Encapsulation

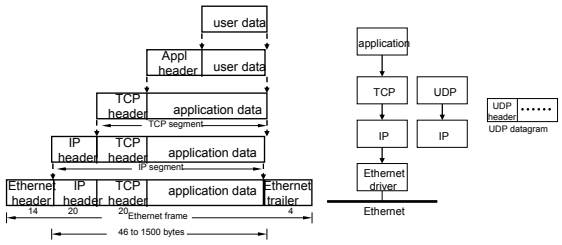


Figure 1.7 Encapsulation of data as it goes down the protocol stack

Demultiplexing

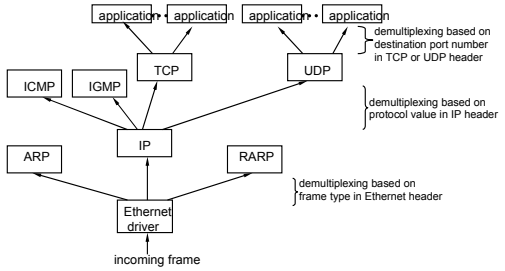


Figure 1.8 The demultiplexing of a received Ethernet frame

Client-Server Model

- Two classes of servers
  - iterative
    - I1. Wait for a client request to arrive
    - I2. Process the client request
    - I3. Send the response back to the client that send the request
    - I4. Go back to step I1
  - concurrent
    - C1. Wait for a client request to arrive
    - C2. Start a new server to handle this client's request. This may involve creating a new process, task, or thread, depending on the operating system. This new server handles this client's entire request. When complete, this new server terminates
    - C3. Go back to step C1

Port Numbers

- TCP servers are concurrent,UDP servers are iterative,but there are a few exceptions
- How are port numbers chosen?
  - Servers are normally known by their well-known port number
    - FTP server is on TCP port 21
    - Telnet server is on TCP port 23
    - TFTP is on UDP port 69
    - Rlogin is on TCP port 513
  - Client port number are called ephemeral ports (i.e., short lived)
    - certain of port number is unique,exists only as long as user running the client needs its service
    - ephemeral port numbers between 1024 and 5000
  - well-known port numbers are in /etc/services on most Unix system

Standardization Process

- Reserved Ports
  - Unix systems have the concept of reserved ports. Only a process with superuser privileges can assign itself a reserved port
- Who controls the TCP/IP protocol suite,approves new standards?
  - The Internet Society (ISOC)
  - The Internet Architecture Board (IAB)
  - The Internet Engineering Task Force (IETF)
  - The Internet Research Task Force (IRTF)
    - Both the IRTF an the IETF fall under the IAB
- RFCs
  - All the official standards in the internet community are published as Request for Comment (RFC)

Standard,Simple Services

- TCP and UDP port number
  - When the same service is provided using both TCP, and UDP, both port numbers are normally chosen to be the same
- Why the port numbers most are odd numbers?
  - Because they are derived from the NCP port numbers
    - An even-odd pair of port numbers was reserved for each application

Name	TCP port	UDP port	RFC	Description
echo	7	7	862	Server returns whatever the client sends.
discard	9	9	863	Server discards whatever the client sends.
daytime	13	13	867	Server returns the time and date in a human-readable format.
chargen	19	19	864	TCP server sends a continual stream of characters, until the connection is terminated by the client. UDP server sends a datagram containing a random number of characters each time the client sends a datagram.
time	37	37	868	Server returns the time as a 32-bit binary number. This number represents the number of seconds since midnight January 1,1900, UTC.

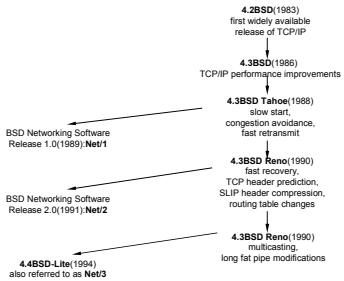
Figure 1.9 Standard,simple services provided by most implementations.

The Internet

- What's the difference between internet and Internet
  - internet means multiple networks connected together, using a common protocol suite.
  - Internet refers to the collection of hosts (over one million) around the world that can communicate with each using TCP/IP
- Implementations
  - The standard for TCP/IP implementations is the one from the Computer Systems Research Group at the University of California at Berkely
  - SunOS 4.x,SVR4, and AIX 3.2 that were originally developed from the Berkeley sources.These implementations have much in common, often including the same bugs!

Implementations

- Various BSD release with important TCP/IP features.



Application Programming Interfaces

- Two popular application programming interfaces (APIs):
  - sockets
    - developed by Berkeley,sometimes called "Berkeley sockets"
  - TLI (Transport Layer Interface)
    - developed by AT&T,sometimes called "XTI" (X/Open Transport Interface)
- Summary
  - distinction between the network layer and the transport layer
    - network layer (IP) provides a hop-by-hop service
    - transport layers (TCP and UDP) provide an end-to-end service
  - Internet is an internet that spans the globe and consists of more than 10,000 networks and more than one million computers
  - servers use well-known ports while clients use ephemeral ports

Test Network

- Test network used for all the examples in the text. All IP addresses begin with 140.252.