

CS 580 Client-Server Programming
Spring Semester, 2004
Doc 13 Networks
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References

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Unix Network Programming by W. Richard Stevens, 1990, selected pages

Internetworking with TCP/IP Volume 1 Principles, Protocols, and Architecture, Third Edition, by Douglas E. Comer, selected pages

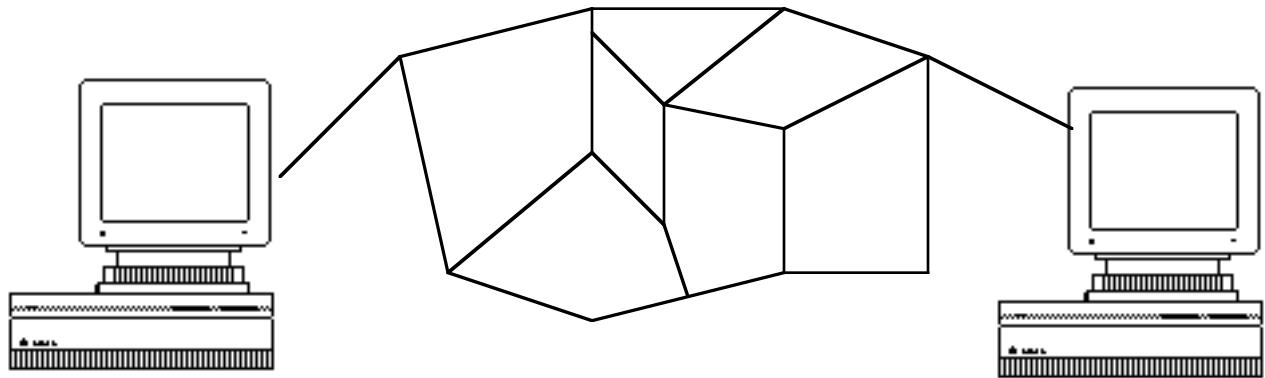
Computer Networks and Internets, Comer, 1997

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Networks

Communication Network

A set of communication nodes that are interconnected to permit the exchange of information



How information is transmitted in a network

Information is transformed into electrical or optical signals

All signals are corrupted during transmission

Transmission adds **noise** to the signal

Digital data helps overcome noise

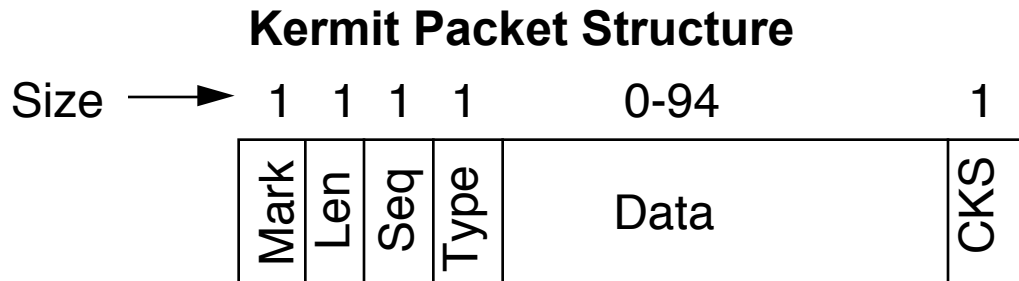
Slightly corrupted 1's are distinguishable from slightly corrupted 0's

Digital data allows for error-control

Dynamic data like audio or video normally requires continuous transmission

Packets

Stream of bits is divided into separate packets



Classes of Communication Services

End-to-end services as seen by the users:

Synchronous communications

Bit stream is delivered with a fixed delay and given error rate

Each bit reaches the destination with the same time delay after leaving the source

Asynchronous communications

Bit stream is divided into packets

Packets are received with varying delays, so packets can arrive out of order

Some packets are not received correctly

Connection-oriented

Packets are delivered in order

System confirms delivery and put packets in order

Error free

Connectionless

Packets are treated individually

Program has to worry about order, error and lost packets

Expedited Data

Faster delivery than normal

Our View of Network Communication with TCP/IP

TCP - Connection-oriented

UDP - Connectionless

TCP gives us a "pipe" between machines to allow us to send messages between machines

UDP

Fast

Client & Server must handle

- Lost packets
- Packets arriving out of order

Used by:

- Games
- NFS

TCP

Handles

- Lost packets
- Packet order

Receiver acknowledges each packet

Sender resends packet if it is lost

TCP has delays in

- Startup of connection
- Closing of connection

Addresses and Names

IP address is currently a 32-bit number

130.191.3.100 (Four 8 bit numbers)

IPv6 uses 128 bit numbers for addresses

105.220.136.100.0.0.0.0.0.0.18.128.140.10.255.255

69DC:8864:0:0:0:1280:8C0A:FFFF

69DC:8864::1280:8C0A:FFFF

Machines on a network need a unique IP address

127.0.0.1 (localhost)

Common loopback address

Refers to the current computer

Messages sent to 127.0.0.1 to not reach the network

Domain Name System (DNS)

Maps machine names to IP addresses

rohan.sdsu.edu <-> 130.191.143.100

Unix "host" command

- Shows mapping between machine names and IP address

```
->host rohan.sdsu.edu  
rohan.sdsu.edu has address 130.191.3.100
```

```
->host 130.191.3.100  
100.3.191.130.IN-ADDR.ARPA domain name pointer rohan.sdsu.edu
```

Top Level Domains Current TLD

Domain Names	Meaning
COM	Commercial organizations
EDU	Educational institutions
GOV	Government institutions
MIL	Military groups
NET	Major network support groups
ORG	Organizations not list above
ARPA	obsolete
INT	International organizations
CN,IN,MX,US	Country Codes
biz	Business
info	Information
name	For individuals
pro	For professionals
aero	For aviation
coop	For cooperatives
museum	For museums

More top level domains will be added later this year
Dealing for applications is March 15, 2004 at 23.59 UTC

Internet Corporation for Assigned Names and Numbers
(ICANN <http://www.icann.org/>) oversees assigning TLDs

Ports

TCP/IP supports multiple logical communication channels called ports

Ports are numbered from 0 - 65535

A connection between two machines is uniquely defined by:

- Protocol (TCP or UDP)
- IP address of local machine
- Port number used on the local machine
- IP address of remote machine
- Port number used on the remote machine

Well known ports

1 - 1023

Registered Ports

1024 - 49151

Dynamic/Private ports

49152 - 65535

Some Interesting Server Port Numbers

Service	Port Number
echo	7
discard	9
daytime	13
character generation	19
ftp	21
ssh	22
telnet	23
smtp	25
time	37
http	80
nntp	119
https	443
doom	666
mysql	3306
postgresql	5432
gnutella	6346, 6347

For a local list of services

<file://rohan.sdsu.edu/etc/services>

For a complete list see:

<http://www.iana.org/assignments/port-numbers>

See IANA numbers page <http://www.iana.org/numbers.html> for more information about protocol numbers and assignment services

Telnet is Your Friend

Telnet & port 23

A server is running on port 23 on rohan

The server asks you log in

Telnet Client and other ports

Can send ASCII to a server

Examples to Try

Day Time

Type:

```
telnet sdsu.edu 13
```

Course Web Site

Type

```
telnet www.eli.sdsu.edu 80
```

then type:

```
GET /courses/spring04/cs580/index.html HTTP/1.0 <CR>  
<CR>
```

Note <Cr> indicates where you need to hit return