CS 580 Client-Server Programming  
Fall Semester, 2002  
Doc 8 Networks  

Contents

References ..............................................................................................................1  
Networks .............................................................................................................2  
   How information is transmitted in a network ..................................................3  
Classes of Communication Services ...............................................................5  
Our View of Network Communication with TCP/IP ......................................6  
Ports ...................................................................................................................12

References

Dr. Vinge's CS580 class notes, Spring 2000, http://www-rohan.sdsu.edu/faculty/vinge/courses/spring00/cs580/

Unix Network Programming by W. Richard Stevens, 1990, 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

**Kermit Packet Structure**

<table>
<thead>
<tr>
<th>Size</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>1</th>
<th>0-94</th>
<th>1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mark</td>
<td>Len</td>
<td>Seq</td>
<td>Type</td>
<td>Data</td>
<td>CKS</td>
<td></td>
</tr>
</tbody>
</table>

.
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:8864:0:0:1280:8C0A: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

<table>
<thead>
<tr>
<th>Domain Names</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>COM</td>
<td>Commercial organizations</td>
</tr>
<tr>
<td>EDU</td>
<td>Educational institutions</td>
</tr>
<tr>
<td>GOV</td>
<td>Government institutions</td>
</tr>
<tr>
<td>MIL</td>
<td>Military groups</td>
</tr>
<tr>
<td>NET</td>
<td>Major network support groups</td>
</tr>
<tr>
<td>ORG</td>
<td>Organizations not list above</td>
</tr>
<tr>
<td>ARPA</td>
<td>obsolete</td>
</tr>
<tr>
<td>INT</td>
<td>International organizations</td>
</tr>
<tr>
<td>CN,IN,MX,US</td>
<td>Country Codes</td>
</tr>
</tbody>
</table>

More top level domains will be added later this year

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

TCP/IP supports multiple logical communication channels called ports

Ports are numbered from 0 - 65536

A connection between two machines is uniquely defined by:

the protocol (TCP or UDP)
the IP address of local machine
the port number used on the local machine
the IP address of remote machine
the port number used on the remote machine

reserved port numbers
port numbers used by system

1 - 1023
1024 - 5000
### Some Interesting Server Port Numbers

<table>
<thead>
<tr>
<th>Service</th>
<th>Port Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>echo</td>
<td>7</td>
</tr>
<tr>
<td>discard</td>
<td>9</td>
</tr>
<tr>
<td>character generation</td>
<td>19</td>
</tr>
<tr>
<td>daytime</td>
<td>13</td>
</tr>
<tr>
<td>time</td>
<td>37</td>
</tr>
<tr>
<td>telnet</td>
<td>23</td>
</tr>
<tr>
<td>gopher</td>
<td>70</td>
</tr>
<tr>
<td>WWW</td>
<td>80</td>
</tr>
</tbody>
</table>

See [file://rohan.sdsu.edu/etc/services](file://rohan.sdsu.edu/etc/services) for a local list of services

See [http://www.iana.org/assignments/port-numbers](http://www.iana.org/assignments/port-numbers) for more complete list

See IANA numbers page [http://www.iana.org/numbers.html](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/fall02/cs580/index.html HTTP/1.0 <CR><CR>

Note <Cr> indicates were you need to hit return