CS 580 Client-Server Programming
Fall Semester, 2000
Doc 4 Networks
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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


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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></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Len</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CKS</td>
</tr>
<tr>
<td>Seq</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Data</td>
<td></td>
</tr>
<tr>
<td>Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></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
Addresses and Names

IP address is currently a 32 bit number

IPv6 uses 128 bit numbers for addresses

Machines on a network need a unique IP address

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
## 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 1 - 1023
port numbers used by system 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.isi.edu/in-notes/iana/assignments/port-numbers](http://www.isi.edu/in-notes/iana/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
Things to Try

A
telnet sdsu.edu 13

B
telnet rohan 80
then type
GET /<CR>

C
telnet www-rohan 80
then type:
GET / HTTP/1.0 <CR>
<CR>
<CR>