TDC 375
Network Protocols

TCP/IP Suite Overview
Internet Standards Publications

- Internet-Drafts
- RFCs
  - Proposed, Draft or Internet Standard
  - Informational
  - Historical
  - Experimental
  - Best Common Practice (BCP)
  - For Your Information (FYI)
IPv4

Version | IHL | DiffServ + ECN (formerly ToS) | Total Length
Identification | Flags | Fragment Offset
Time to Live | Protocol | Header Checksum
Source Address
Destination Address
Options | Padding
**ARP**

<table>
<thead>
<tr>
<th>HARDWARE ADDRESS TYPE</th>
<th>PROTOCOL ADDRESS TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>HADDR LEN</td>
<td>PADDR LEN</td>
</tr>
<tr>
<td>SENDER HADDR (first 4 octets)</td>
<td></td>
</tr>
<tr>
<td>SENDER HADDR (last 2 octets)</td>
<td>SENDER PADDR (first 2 octets)</td>
</tr>
<tr>
<td>SENDER PADDR (last 2 octets)</td>
<td>TARGET HADDR (first 2 octets)</td>
</tr>
<tr>
<td>TARGET HADDR (last 4 octets)</td>
<td></td>
</tr>
<tr>
<td>TARGET PADDR (all 4 octets)</td>
<td></td>
</tr>
</tbody>
</table>
**DHCP**

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>OP</td>
<td>Transaction identifier</td>
</tr>
<tr>
<td>HTYPE</td>
<td>Hardware type</td>
</tr>
<tr>
<td>HLEN</td>
<td>Hardware length</td>
</tr>
<tr>
<td>HOPS</td>
<td>Hardware options</td>
</tr>
<tr>
<td>SECONDS ELAPSED</td>
<td>Seconds elapsed</td>
</tr>
<tr>
<td>FLAGS</td>
<td>Flags</td>
</tr>
<tr>
<td>CLIENT IP ADDRESS</td>
<td>Client's IP address</td>
</tr>
<tr>
<td>YOUR IP ADDRESS</td>
<td>Your IP address</td>
</tr>
<tr>
<td>SERVER IP ADDRESS</td>
<td>Server's IP address</td>
</tr>
<tr>
<td>ROUTER IP ADDRESS</td>
<td>Router's IP address</td>
</tr>
<tr>
<td>CLIENT HARDWARE ADDRESS</td>
<td>Client's hardware address</td>
</tr>
<tr>
<td>(16 OCTETS)</td>
<td></td>
</tr>
<tr>
<td>SERVER HOST NAME</td>
<td>Server's host name</td>
</tr>
<tr>
<td>(64 OCTETS)</td>
<td></td>
</tr>
<tr>
<td>BOOT FILE NAME</td>
<td>Boot file name</td>
</tr>
<tr>
<td>(128 OCTETS)</td>
<td></td>
</tr>
<tr>
<td>OPTIONS (VARIABLE)</td>
<td>Options (variable)</td>
</tr>
</tbody>
</table>
ICMP

- Primarily used for error and status messages
- All ICMP messages have 3 common fields: TYPE, CODE, CHECKSUM
- Otherwise ICMP messages can vary widely
- Common uses
  - ICMP ECHO Request (aka PING)
  - Destination unreachable (e.g. PMTU discovery)
UDP

| bit | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 |
|-----|---|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
|     | Source Port |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|     | Destination Port |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|     | Length |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|     | Checksum |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|     | Data |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|     | ... |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
Routing Protocols

- RIP
- OSPF
- IS-IS
- IGRP/EIGRP
- BGP
IP Multicast

• Senders address packets to a group address
  • i.e. 224.0.0.0/4 in IPv4
• Never a source from a multicast address
• IGMP to manage group membership in IPv4
  • MLD, subset of ICMPv6 in IPv6
• Routers forward to where there are group members
• IP multicast routers maintain significant “state”
DNS

End User (stub resolver)

2. Local Caching Servers (full resolver)

4. ask an edu. server

6. ask a depaul.edu. server

8. ask a cti.depaul.edu. server

9. 140.192.32.137 TTL=3600
10. cti.depaul.edu server (and authoritative for cdm.depaul.edu.)

11. 140.192.32.137 TTL=3600
Applications, Management and Security

• SMTP, POP, IMAP
• TELNET, SSH
• TFTP, FTP, SCP, SFTP
• HTTP, HTTPS
• SSL/TLS
• syslog, SNMP, NetFlow, NETCONF
• NTP
• RADIUS / TACACS
...and many more

- For a sample, see:
  - Internet protocols (IP) /etc/protocols
  - Network applications (TCP/UDP) /etc/services