Panel 1

**Last time:**

- IP header format
- IP addressing details
- Special servers on a LAN:
  - DHCP
  - Gateway
  - DNS
  - Firewall
- network-level protocols
  - DHCP, DNS, ARP, RARP, ICMP, BOOTP

Panel 2

**Group 1:** Internet

- Yuri Aleshkin

**Group 2:** DNS

- Anthony McBride
- Chris Dula

**Group 3:** DHCP

- Frank Counselo
- Jeff Johnson
- Michael Malenkov
- Steven Malinelli
- Ed Mikutowski

**Group 4:** ICAP

**Group 5:** ARP + RARP

- Thomas Ogunsola
- Stefano Polo
Panel 3

New Protocol needed

- IP v4 has several limitations
  - Addresses space: \(2^{32} \approx 4\) Billion
  
  compare with IPv6: \(2^{128} \approx 2^{200}\) 000 000 000 000 000

- New goals:
  - Support more hosts
  - Reduce size of routing tables
  - Simplify protocol for faster processing
  - Better security
  - Differentiation of service
  - Inheriting and extending support
  - Compatibility with old IPv4

Panel 4

IP v6

Header format: IPv6 -> IP v6

- 32 bits

- Version, Precedence, Flow label

- Payload length, Next header, Hop limit

- 10 hops

- Source 4 x 4 bytes

- Destination 4 x 4 bytes

- No header checksum -> faster processing
Panel 5

\[ 20 = 4 \times 5 \text{ Style IP/4} \]

<table>
<thead>
<tr>
<th>Source</th>
<th>IP/ICMP</th>
<th>Total Length</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID/seq</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to live, Protocol, Header checksum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Destination address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Options</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Panel 6

\[ 40 = 4 \times 10 \text{ Style IP/6} \]

<table>
<thead>
<tr>
<th>Source</th>
<th>IP/ICMP</th>
<th>Flow Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Payload length, Hop limit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Source address</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dest. address</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Flow label: experimental, hard to setup

Virtual circuit

Priority: 0-2 for

Resource reservation

Flow control: 0-15

for congestion control

and link scheduling (with potential loss) QoS
Panel 7

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>4</td>
<td>64</td>
</tr>
</tbody>
</table>

Payload length: how many bytes follow header

**Hop Limit:** same as TTL (Time to Live)

```
2^{32} \text{ maximum of } 2^{16} \text{ address length}
```

Source:

```
2^{48} \quad 00000000000000000000000000000000
```

Dest:

```
2^{48} \quad 00000000000000000000000000000000
```

Panel 8

**IP v6 address**

8 groups of 4 hex-coded digits will come as:

```
0000:0000:0000:0000:0000:0000:0000:0000
```

```
0000:0000:0000:0000:0123:4567:89ab:cdde
```

32 hex values = 32 x 4 bits = 128 bits

- Leading zeros in a group can be omitted
- One or more groups of 4 zeros can be replaced by pair of colons

```
0000::123...
```

c) IP v4 addresses were pre-filled with 0’s:

```
192.168.53.101 = :: 149...
```
Panel 9

Extension Headers
Options can immediately follow header

Controversio
Many documents preceded IPv6 with 20 byte header
Hop count: 255 is worldwide?
Max packet size - jumbo-frames via extensions
CRC checksum - remove break from core
But stall in data link layer
Security: in network layer would be convenient, but
not very would rely on it for real?
What type of DES? DES?

Panel 10

The Transport layer

Provide reliable, cost-effective data transport
from source to destination.

Network: routing + addressing
Transport: reliable

Transport Protocol Data Unit

TDPDU header
Transport Service Primitives

- reliable - connection oriented
  - Berkeley UNIX for TCP socket primitives

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOCKET</td>
<td>create new comm. endpt.</td>
</tr>
<tr>
<td>BIND</td>
<td>attach local address to socket</td>
</tr>
<tr>
<td>LISTEN</td>
<td>willingness to accept connections</td>
</tr>
<tr>
<td>ACCEPT</td>
<td>block until connect attempt arrives</td>
</tr>
<tr>
<td>CONNECT</td>
<td>attempt to establish connection</td>
</tr>
<tr>
<td>SEND</td>
<td>send data</td>
</tr>
<tr>
<td>RECEIVE</td>
<td>receive data</td>
</tr>
<tr>
<td>CLOSE</td>
<td>release connection</td>
</tr>
</tbody>
</table>