Today’s lecture

- IPv6
- Source routing
- Connection oriented networks
  - ATM

IP version 6

- Proposed successor of IPv4
- Uses 128 bit addresses

<table>
<thead>
<tr>
<th>3</th>
<th>m</th>
<th>n</th>
<th>e</th>
<th>p</th>
<th>12S</th>
<th>m</th>
<th>n</th>
<th>e</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>RegistryID</td>
<td>ProviderID</td>
<td>SubscriberID</td>
<td>SubnetID</td>
<td>InterfaceID</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- IP address includes 48 bit MAC address
- Renumbering still necessary when network moves to different provider
- Simplifies header to allow more efficient packet processing at routers
Today’s lecture

• IPv6
• Source routing
• Connection oriented networks
  – ATM

Source routing

• Source puts in each packet all routers on the path to destination
  – Much control for source
  – Source needs to know topology
  – Forwarding is simple
• Loose source routing
  – Only specify some routers the packet has to go through
• Part of IP protocol
  – Implemented with options
  – Usually turned off at routers – easily misused
Forwarding architectures

- Datagram
  - Based on globally unique destination address
  - Longest prefix match
- Source routing
  - Source specifies full path in each packet
- Virtual circuits
  - Based on locally unique (link local) virtual circuit identifier
  - Exact match

Sharing in data networks

<table>
<thead>
<tr>
<th>Network service</th>
<th>Internet</th>
<th>Phone network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multiplexing ex.</td>
<td>IP datagrams</td>
<td>Calls</td>
</tr>
<tr>
<td>Good for voice</td>
<td>Statistical</td>
<td>TDM</td>
</tr>
<tr>
<td>Good for data</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Forwarding</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Network service</th>
<th>Internet</th>
<th>Phone network</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data</td>
<td>Complex</td>
<td>Simple</td>
<td></td>
</tr>
</tbody>
</table>

Control plane versus data plane

- Datagram model
  - Data plane – forwarding
  - Control plane – routing
- Virtual circuits
  - Data plane – switching
  - Control plane – circuit setup (and teardown)
- Control and data plane present in higher layers also (e.g. TCP)
Datagram vs. virtual circuit

Virtual circuit forwarding

- Very simple (in hardware)
- Virtual circuit identifier smaller than globally unique endhost addresses
- If any switch on the path fails, circuit is gone
  - Can “reboot” control plane only
- Easier to provide quality of service (QoS)

<table>
<thead>
<tr>
<th>Forwarding table for switch 1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Incoming</strong></td>
</tr>
<tr>
<td>Interface</td>
</tr>
<tr>
<td>2</td>
</tr>
</tbody>
</table>

ATM (Asynchronous Transfer Mode)

- Technology used since late 80s for telephony
  - Used for data (layer 2 for IP backbones)
- Uses small fixed size “cells” – 48 bytes of payload
- Identifier divided into two:
  - Virtual path identifier (a path bundles many circuits)
  - Virtual circuit identifier
  - Some switches only look at VPI
- Segmentation and reassembly done at ends of VCI
- ATM switches were faster and cheaper than IP routers