CS 348: Computer Networks

- Switching; 30th Aug 2012

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Switched networks
Multiplexing

Need to *multiplex* links among multiple flows.
Statistical multiplexing

• Reschedule link on a per-packet basis; Packets from different sources interleaved on the link

• Buffer packets that are contending for the link; Packet queue may be processed FIFO, but not necessarily

• Buffer overflow is called congestion
Statistical multiplexing
Switching Strategies

- Circuit Switching: dedicated circuit; send/receive samples
- Packet Switching: deal with packets
  - Datagram Switching
  - Virtual Circuit Switching
Circuit switching

- Moving 8-bit samples from an input port to an output port
- Samples have no headers
- Destination of sample depends on *time* at which it arrives at the switch
- Path is determined at the time of connection establishment

- resources are reserved; only propagation delays
- unused bandwidth on an allocated circuit is wasted
Packet switching

- store-and-forward; send/receive packets
- Packets are forwarded one hop at a time
- Packets carry destination field
- Need to lookup destination for each packet (datagram or cell)

- greater network utilization, multiplexing possible

- typically "best-effort" service; may face congestion
Switch constraints

• Circuit switch must reject call if can’t find a path for samples from input to output
  • goal: minimize call blocking

• Packet switch must reject a packet if it can’t buffer the packet until it can be sent on output link
  • goal: minimize packet loss
### Switching elements

<table>
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<th>Connectionless (router)</th>
<th>Connection-oriented (switching system)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packet switch</td>
<td>Internet router</td>
<td>ATM switching system</td>
</tr>
<tr>
<td>Circuit switch</td>
<td></td>
<td>Telephone switching system</td>
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- Packets have headers; circuit samples don’t
- Connection-oriented has a setup phase; handled in **control plane by switch controller**
Packet Switching: Datagram v/s Cell

• Datagram
  • lookup based on entire destination address (larger packets)
  • Routing decisions for each packet

• Cell
  • lookup based on VCI (VC Identifier)
  • Connection setup phase to establish VCI tables
  No re-routing possible
Port mappers

- Look up output port based on destination address

- Easy for VCI:
  - Refer to table entry made during connection setup

- Harder for datagrams:
  - Find *longest prefix match*
Generic Switch

Latency: Time a switch takes to figure out where to forward a data unit