Some Topics for Course Review

CSC 249
MAY 3, 2017

Comparison of basic protocols:
- Push v. pull protocol
- ASCII v. binary data
- Multiple objects in one message or one object per message
- One v. two connections
- Other comparisons?

Host A
Seq=92, 8 bytes data
ACK=100
loss
time
Cumulative ACK scenario

Host B
X
Seq=100, 20 bytes data
ACK=120
SendBase = 120
What does 'A' do next?

Comparison of congestion in bandwidth:

Cumulative bandwidth

Time
The transport layer services are:

- 
- 
- 
- 

The transport layer does not provide:

- 
- 
- 
- 

TCP Reliability includes:

- 
- 
- 
- 

DHCP server: 223.1.2.5 arriving client
dhcp discover
src: 0.0.0.0, 68
dest: 255.255.255.255, 67
yiaddr: 0.0.0.0
transaction ID: 654
lifetime: 3600 secs
dhcp offer
src: 223.1.2.5, 67
dest: 255.255.255.255, 68
yiaddr: 223.1.2.4
transaction ID: 654
lifetime: 3600 secs
dhcp request
src: 0.0.0.0, 68
dest: 255.255.255.255, 67
yiaddr: 223.1.2.4
transaction ID: 655
lifetime: 3600 secs
dhcp ACK
src: 223.1.2.5, 67
dest: 255.255.255.255, 68
yiaddr: 223.1.2.4
transaction ID: 655
lifetime: 3600 secs

yiaddr = "your internet address"
broadcast address, 255.255.255.255 → sent to every host in the subnet

Create versus use the forwarding table

Address value in arriving packet's header
Routing Algorithm

- Individual routing algorithm is run in *each and every router*.
- Routers interact with each other in "control plane" to compute forwarding tables.
- Traditional approach

Each router contains a *flow table* that is computed and distributed by a *centralized* routing controller.

**Figure 4.2**

Routing algorithms determine values in forward tables.

**Values in arriving packet’s header**

1 2 3

Local forwarding table

<table>
<thead>
<tr>
<th>Header</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>0100</td>
<td>1101</td>
</tr>
<tr>
<td>0110</td>
<td>1101</td>
</tr>
<tr>
<td>0111</td>
<td>0100</td>
</tr>
<tr>
<td>1001</td>
<td>1101</td>
</tr>
<tr>
<td>1101</td>
<td>0100</td>
</tr>
</tbody>
</table>

**Spatial layout of nodes**

- **Collisions can still occur:**
  - propagation delay means two nodes may not hear each other’s transmission

- **Collision:**
  - entire packet transmission time wasted

**Note:**
- role of distance & propagation delay in determining collision probability
Hub

Switch

Router

SDN Packet Switch

Link

Differences from wired link ....

- **decreasing signal strength**: EM signal attenuates as it propagates through matter (path loss)
- **interference from other sources**: wireless network frequencies (e.g., 2.4 GHz) shared by other devices (e.g., phone, microwave)
- **multipath propagation**: EM signal reflects off objects, arriving at destination at slightly different times (like echoing)

... make communication across (even a point to point) wireless link much more error-prone

**network**

Multiple wireless senders and receivers create additional problems (beyond multiple access):

| Layer | Protocols, and their protocols (IP, TCP, UDP) | Frame size | Action caused by IP packet | Action, frame happens to
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Application</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Networks</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Link</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hidden terminal problem

Signal fading

A's signal strength

C's signal strength

A's signal strength
Multimedia applications can be classified into three categories. Name and describe each category.

Streaming video systems can be classified into three categories (three stages in protocol evolution). Name and briefly describe each of these categories.
FEC Discussion Question

1) Simple Forward Error Correction
- For every group of $n$ chunks, create a redundant chunk by exclusive OR-ing $n$ original chunks
- Send $n+1$ chunks, increasing bandwidth by factor $1/n$
- Can reconstruct the original $n$ chunks if at most there is one lost chunk from the $n+1$ chunks sent, with playout delay

2) Piggyback low quality audio
- Each RTP session: typically a single multicast address; all RTP/RTCP packets belonging to session use multicast address
- RTP, RTCP packets distinguished from each other via distinct port numbers
- To limit traffic, each participant reduces RTCP traffic as number of conference participants increases
- Alice’s SIP invite message indicates her port number, IP address, encoding she prefers to receive (PCM µlaw)
- Bob’s 200 OK message indicates his port number, IP address, preferred encoding (GSM)
- SIP messages can be sent over TCP or UDP; here sent over RTP/UDP
- Default SIP port number is 5060

**Example:**
- datagrams from hosts h5 and h6
  - should be sent to h3 or h4
  - via s1 and from there to s2
  - Avoid direct link from s3 to s2

<table>
<thead>
<tr>
<th>match</th>
<th>action</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP Src = 10.3.<em>.</em></td>
<td>forward(3)</td>
</tr>
<tr>
<td>IP Dst = 10.2.<em>.</em></td>
<td>forward(3)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
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<th>action</th>
</tr>
</thead>
<tbody>
<tr>
<td>ingress port 1</td>
<td>forward(4)</td>
</tr>
<tr>
<td>IP Src = 10.3.<em>.</em></td>
<td>forward(4)</td>
</tr>
<tr>
<td>IP Dst = 10.2.<em>.</em></td>
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