CS 134
Intro to Computer Science

Apr 4, 2016
Lecture 19:
Internetworking

Announcements

Lab 7 is online

Work with partners again (switching is fine).
No Prep!

No homework this week
Midterms are graded

Last Time

Way back on 3/16...

We talked about Switched Networks

Distance

Circuit Switching

WMS
ALB
RPI

D1 = distance from T to WMS
D2 = distance from WMS to ALB
D3 = distance from ALB to RPI
D4 = distance from RPI to B

M = message size
R = trans. rate
C = speed of light

{ } = M/R
{ } = D1/c
{ } = D2/c
{ } = D3/c
{ } = D4/c
{ } = M/R
The Internets

Tubes

The internets

(The internet?)

Today's Plan

Discuss internetworking

What is an internet?
Ethernet Frame Format

<table>
<thead>
<tr>
<th>PREAMBLE</th>
<th>TO</th>
<th>FROM</th>
<th>LENGTH/TYPETE</th>
<th>DATA</th>
<th>ERROR CHECK</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>48</td>
<td>48</td>
<td>16</td>
<td>variable</td>
<td>32</td>
</tr>
</tbody>
</table>
**802.11 (WiFi) Frame Format**

<table>
<thead>
<tr>
<th>Frame Control</th>
<th>Duration</th>
<th>Addr 1</th>
<th>Addr 2</th>
<th>Addr 3</th>
<th>Sequence Control</th>
<th>Addr 4</th>
<th>Data</th>
<th>Error Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>16</td>
<td>16</td>
<td>48</td>
<td>48</td>
<td>48</td>
<td>16</td>
<td>16</td>
<td>32</td>
<td></td>
</tr>
</tbody>
</table>

**Frame Control**
- **Ver**: Version (2 bits)
- **Type**: Frame Type (2 bits)
- **Sub Type**: Sub-Type (2 bits)
- **To DS**: Direction to Destination (1 bit)
- **From DS**: Direction from Destination (1 bit)
- **More Fragments**: More Fragments (1 bit)
- **Retry**: Retry (1 bit)
- **Power mgmt.**: Power Management (1 bit)
- **More data**: More Data (1 bit)
- **WEP**: WEP (1 bit)
- **Order**: Order (1 bit)

**Data** up to 2312 bytes

**Legend**
- **Verizon group**
- **AT&T group**
- **Owest group**
- **Cable companies**
- **Other backbones**
- **other**
Who invented the Internet?

"DURING MY SERVICE IN THE UNITED STATES CONGRESS, I TOOK THE INITIATIVE IN CREATING THE INTERNET."

VINT CERF + ROBERT KAHN

IP = ESPERANTO?

IP Datagram Format

<table>
<thead>
<tr>
<th>4</th>
<th>4</th>
<th>8</th>
<th>16</th>
</tr>
</thead>
<tbody>
<tr>
<td>IP version</td>
<td>Hdr len</td>
<td>Service class</td>
<td>Packet Length</td>
</tr>
<tr>
<td>Packet Number</td>
<td>Fragment Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TTL</td>
<td>Protocol</td>
<td>Error Check</td>
<td></td>
</tr>
<tr>
<td>From Addr</td>
<td>To Addr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DATA (up to 65516 bytes)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Network Applications

Firefox
Mail

OPERATING SYSTEM

WiFi

WIRELESS NETWORK
Midterm Breakdown

Rules:
- Do not panic
- Please double check our math
- If you think we made a mistake, do not get angry. Come talk to us! (but not immediately after class or during lab...)
- If you'd like to go over anything, come talk to us

Midterm Score Breakdown

- 80 - 76  top 15%     (scales to 100 - 95)
- 75 - 72  top 35%     (94 - 90)
- 71 - 63  middle 30%  (89 - 79)
- 62 - 52  next 20%    (78 - 65)
- 51 - 0   lowest 15%  (64 - 0)