CSE 461: Computer Networks

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Course Webpage

Cs.washington.edu/461
Textbook

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Grading

- Midterm (15%)
- Final (20%)
- Assignments (20%) – A recurring SDN programming assignment
- Surprise Quizzes (10%)
- 3 projects (10%+10%+15%)
Protocols and Layers

- Protocols and layering is the main structuring method used to divide up network functionality
  - Each instance of a protocol talks virtually to its peer using the protocol
  - Each instance of a protocol uses only the services of the lower layer
Protocols and Layers (3)

• Protocols are horizontal, layers are vertical
Protocols and Layers (4)

- Set of protocols in use is called a protocol stack
Protocols and Layers (6)

- Protocols you’ve probably heard of:
  - TCP, IP, 802.11, Ethernet, HTTP, SSL, DNS, ... and many more

- An example protocol stack
  - Used by a web browser on a host that is wirelessly connected to the Internet

```
Browser
  HTTP
  TCP
  IP
  802.11
```
Encapsulation

- **Encapsulation** is the mechanism used to effect protocol layering
  - Lower layer wraps higher layer content, adding its own information to make a new message for delivery
  - Like sending a letter in an envelope; postal service doesn’t look inside
Encapsulation (3)

- Message “on the wire” begins to look like an onion
  - Lower layers are outermost
Encapsulation (4)
Advantage of Layering

• Information hiding and reuse
Advantage of Layering (2)

- Information hiding and reuse

![Network Diagram]

- Browser
  - HTTP
  - TCP
  - IP
  - 802.11

- Server
  - HTTP
  - TCP
  - IP
  - 802.11

- Browser
  - HTTP
  - TCP
  - IP
  - Ethernet

- Server
  - HTTP
  - TCP
  - IP
  - Ethernet
Advantage of Layering (3)

- Using information hiding to connect different systems
Advantage of Layering (4)

• Using information hiding to connect different systems
Disadvantage of Layering

• ??
Internet Reference Model

• A four layer model based on experience; omits some OSI layers and uses IP as the network layer.

<table>
<thead>
<tr>
<th>Layer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Application – Programs that use network service</td>
</tr>
<tr>
<td>3</td>
<td>Transport – Provides end-to-end data delivery</td>
</tr>
<tr>
<td>2</td>
<td>Internet – Send packets over multiple networks</td>
</tr>
<tr>
<td>1</td>
<td>Link – Send frames over a link</td>
</tr>
</tbody>
</table>
Internet Reference Model (3)

- IP is the “narrow waist” of the Internet
  - Supports many different links below and apps above

```
1 Link
  Ethernet  3G
  Cable     DSL  802.11

2 Internet
  IP

3 Transport
  TCP       UDP

4 Application
  SMTP      HTTP  RTP  DNS
```
Layer-based Names (2)

- For devices in the network:

  - Repeater (or hub): Physical | Physical
  - Switch (or bridge): Link | Link
  - Router: Network | Network | Link | Link
Layer-based Names (3)

- For devices in the network:

  Proxy or middlebox or gateway

  But they all look like this!