

# Networking and HTTP

The background of the slide features a photograph of a large, classical-style statue, likely the 'The Spirit of the Law' statue at the University of Illinois. The statue is set in a park-like environment with trees. The entire image is overlaid with a semi-transparent orange color, which serves as a background for the white text.

**CS 240 - The University of Illinois**

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# Networking

A photograph of a crowd of people gathered around a statue of Alma Mater, overlaid with a semi-transparent orange filter. The word "Networking" is written in large white text across the center of the image. The background shows a large group of people, some looking towards the camera and others looking towards the statue. The statue is a classical-style female figure in a long dress, standing on a pedestal. The overall scene is outdoors, with trees and foliage visible in the background.

```
00 4500 00c6 1e1f 4000 4006 152e ac16 b24c
10 12dc 95a6 bafa 0050 0f60 c9b4 356a 523f
20 8018 01f6 079e 0000 0101 080a 8146 30a0
30 31d4 daac 4745 5420 2f20 4854 5450 2f31
40 2e31 0d0a 5573 6572 2d41 6765 6e74 3a20
50 5767 6574 2f31 2e32 302e 3320 286c 696e
60 7578 2d67 6e75 290d 0a41 6363 6570 743a
70 202a 2f2a 0d0a 4163 6365 7074 2d45 6e63
80 6f64 696e 673a 2069 6465 6e74 6974 790d
90 0a48 6f73 743a 2077 6166 2e63 732e 696c
a0 6c69 6e6f 6973 2e65 6475 0d0a 436f 6e6e
b0 6563 7469 6f6e 3a20 4b65 6570 2d41 6c69
c0 7665 0d0a 0d0a
```

```
00 4500 00c6 1e1f 4000 4006 152e ac16 b24c
10 12dc 95a6 bafa 0050 0f60 c9b4 356a 523f
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60 7578 2d67 6e75 290d 0a41 6363 6570 743a
70 202a 2f2a 0d0a 4163 6365 7074 2d45 6e63
80 6f64 696e 673a 2069 6465 6e74 6974 790d
90 0a48 6f73 743a 2077 6166 2e63 732e 696c
a0 6c69 6e6f 6973 2e65 6475 0d0a 436f 6e6e
b0 6563 7469 6f6e 3a20 4b65 6570 2d41 6c69
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```

```
00 4500 00c6 1e1f 4000 4006 152e ac16 b24c
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80 6f64 696e 673a 2069 6465 6e74 6974 790d
90 0a48 6f73 743a 2077 6166 2e63 732e 696c
a0 6c69 6e6f 6973 2e65 6475 0d0a 436f 6e6e
b0 6563 7469 6f6e 3a20 4b65 6570 2d41 6c69
c0 7665 0d0a 0d0a
```

```
00 4500 00c6 1e1f 4000 4006 152e ac16 b24c
10 12dc 95a6 bafa 0050 0f60 c9b4 356a 523f
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40 2e31 0d0a 5573 6572 2d41 6765 6e74 3a20
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60 7578 2d67 6e75 290d 0a41 6363 6570 743a
70 202a 2f2a 0d0a 4163 6365 7074 2d45 6e63
80 6f64 696e 673a 2069 6465 6e74 6974 790d
90 0a48 6f73 743a 2077 6166 2e63 732e 696c
a0 6c69 6e6f 6973 2e65 6475 0d0a 436f 6e6e
b0 6563 7469 6f6e 3a20 4b65 6570 2d41 6c69
c0 7665 0d0a 0d0a
```

# OSI Model

- The Open Systems Interconnection (OSI) model is a 7-layer view of networking that abstracts and encapsulates the functionality of each component of networking.

# Layer 1:



# Layer 2:

# Layer 3:

```
00  4500 00c6 1e1f 4000 4006 152e ac16 b24c  
10 12dc 95a6
```

- IP Version: 4

```
00 4500 00c6 1e1f 4000 4006 152e ac16 b24c  
10 12dc 95a6
```

- IP Version: 4
- Packet Length: 0x00c6 (198 bytes)

```
00 4500 00c6 1e1f 4000 4006 152e ac16 b24c  
10 12dc 95a6
```

- IP Version: 4
- Packet Length: 0x00c6 (198 bytes)
- Source IP: ac.16.b2.4c (172.22.180.163)

```
00 4500 00c6 1e1f 4000 4006 152e ac16 b24c  
10 12dc 95a6
```

- IP Version: 4
- Packet Length: 0x00c6 (198 bytes)
- Source IP: ac.16.b2.4c (172.22.180.163)
- Destination IP: 12.dc.95.a6 (18.220.149.166)

# Layer 4:

```
10      bafa 0050  0f60 c9b4 356a 523f
20 8018 01f6 079e 0000  0101 080a 8146 30a0
30 31d4 daac
```

- Outbound Port: 0xbafa (47866)



```
10          bafa 0050  0f60 c9b4 356a 523f
20 8018 01f6 079e 0000  0101 080a 8146 30a0
30 31d4 daac
```

- Outbound Port: 0xbafa (47866)
- Inbound Port: 0x0050 (80)

```
10          bafa 0050  0f60 c9b4 356a 523f
20 8018 01f6 079e 0000  0101 080a 8146 30a0
30 31d4 daac
```

- Outbound Port: 0xbafa (47866)
- Inbound Port: 0x0050 (80)
- Checksum: 0x079e
- Timestamp: 0x814630a0 (2168860832)

```
10          bafa 0050  0f60 c9b4 356a 523f
20 8018 01f6 079e 0000  0101 080a 8146 30a0
30 31d4 daac
```

- Outbound Port: 0xbafa (47866)
- Inbound Port: 0x0050 (80)
- Checksum: 0x079e
- Timestamp: 0x814630a0 (2168860832)

# Layer 5/6/7:

```
30      4745 5420 2f20 4854 5450 2f31
40 2e31 0d0a 5573 6572 2d41 6765 6e74 3a20
50 5767 6574 2f31 2e32 302e 3320 286c 696e
60 7578 2d67 6e75 290d 0a41 6363 6570 743a
70 202a 2f2a 0d0a 4163 6365 7074 2d45 6e63
80 6f64 696e 673a 2069 6465 6e74 6974 790d
90 0a48 6f73 743a 2077 6166 2e63 732e 696c
a0 6c69 6e6f 6973 2e65 6475 0d0a 436f 6e6e
b0 6563 7469 6f6e 3a20 4b65 6570 2d41 6c69
c0 7665 0d0a 0d0a
```

**tcpdump -x**  
waf.cs.illinois.edu

```
GET / HTTP/1.1\r\n
User-Agent: Wget/1.20.3 (linux-gnu)\r\n
Accept: */*\r\n
Accept-Encoding: identity\r\n
Host: waf.cs.illinois.edu\r\n
Connection: Keep-Alive\r\n
\r\n
```

```
30      4745 5420 2f20 4854 5450 2f31
40  2e31 0d0a 5573 6572 2d41 6765 6e74 3a20
50  5767 6574 2f31 2e32 302e 3320 286c 696e
60  7578 2d67 6e75 290d 0a41 6363 6570 743a
70  202a 2f2a 0d0a 4163 6365 7074 2d45 6e63
80  6f64 696e 673a 2069 6465 6e74 6974 790d
90  0a48 6f73 743a 2077 6166 2e63 732e 696c
a0  6c69 6e6f 6973 2e65 6475 0d0a 436f 6e6e
b0  6563 7469 6f6e 3a20 4b65 6570 2d41 6c69
c0  7665 0d0a 0d0a
```

```
GET / HTTP/1.1\r\n
```

```
User-Agent: Wget/1.20.3 (linux-gnu)\r\n
```

```
Accept: */*\r\n
```

```
Accept-Encoding: identity\r\n
```

```
Host: waf.cs.illinois.edu\r\n
```

```
Connection: Keep-Alive\r\n
```

```
\r\n
```

```
30          4745 5420 2f20 4854 5450 2f31
40 2e31 0d0a 5573 6572 2d41 6765 6e74 3a20
50 5767 6574 2f31 2e32 302e 3320 286c 696e
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70 202a 2f2a 0d0a 4163 6365 7074 2d45 6e63
80 6f64 696e 673a 2069 6465 6e74 6974 790d
90 0a48 6f73 743a 2077 6166 2e63 732e 696c
a0 6c69 6e6f 6973 2e65 6475 0d0a 436f 6e6e
b0 6563 7469 6f6e 3a20 4b65 6570 2d41 6c69
c0 7665 0d0a 0d0a
```

```
GET / HTTP/1.1\r\n
```

```
User-Agent: Wget/1.20.3 (linux-gnu)\r\n
```

```
Accept: */*\r\n
```

```
Accept-Encoding: identity\r\n
```

```
Host: waf.cs.illinois.edu\r\n
```

```
Connection: Keep-Alive\r\n
```

```
\r\n
```

```
30      4745 5420 2f20 4854 5450 2f31
40 2e31 0d0a 5573 6572 2d41 6765 6e74 3a20
50 5767 6574 2f31 2e32 302e 3320 286c 696e
60 7578 2d67 6e75 290d 0a41 6363 6570 743a
70 202a 2f2a 0d0a 4163 6365 7074 2d45 6e63
80 6f64 696e 673a 2069 6465 6e74 6974 790d
90 0a48 6f73 743a 2077 6166 2e63 732e 696c
a0 6c69 6e6f 6973 2e65 6475 0d0a 436f 6e6e
b0 6563 7469 6f6e 3a20 4b65 6570 2d41 6c69
c0 7665 0d0a 0d0a
```

GET / HTTP/1.1\r\n

User-Agent: Wget/1.20.3 (linux-gnu)\r\n

Accept: \*/\*\r\n

Accept-Encoding: identity\r\n

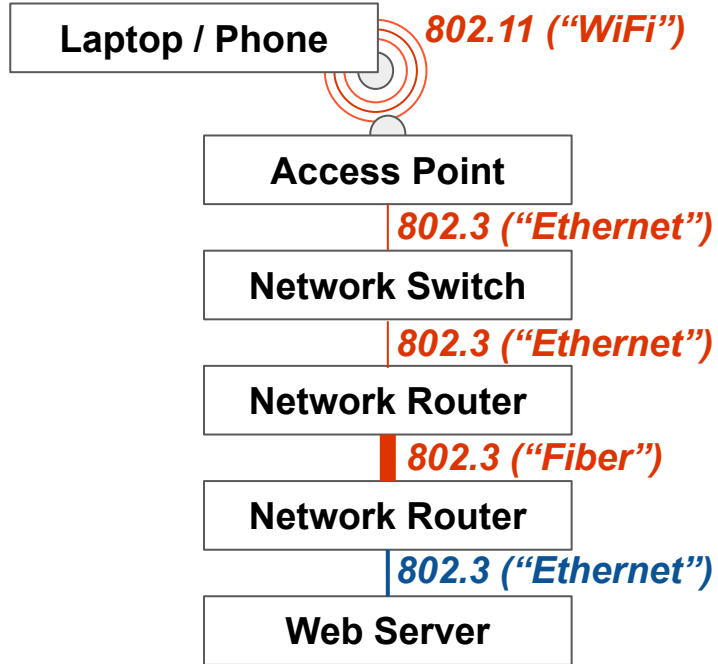
Host: waf.cs.illinois.edu\r\n

Connection: Keep-Alive\r\n

\r\n



# Full Packet Journey:



# Layer 3 Protocols



# Layer 3 Protocols

- Provides “host-to-host” communication.
- The “address” of a host is an IP address:

# Layer 3 Protocols

- IPv4:

# Layer 3 Protocols

- IPv6:

# Layer 4 Protocols

A photograph of a crowd gathered around a statue of Alma Mater, overlaid with a semi-transparent orange filter. The text "Layer 4 Protocols" is centered in white. The background shows a large group of people, mostly seen from the back, looking towards a central statue. The statue is a woman in a long, flowing dress, standing on a pedestal. The scene is outdoors, with trees and a building visible in the background. The overall color scheme is dominated by the orange overlay.

# Layer 4 Protocols

*Provides endpoint-to-endpoint communication.*

Two widely-used protocols:



<b>Feature</b>	<b>TCP</b>	<b>UDP</b>



**HTTP**



# HTTP

One of the primary ways that processes will communicate is via “web services” -- applications that communicate using the **HTTP protocol**.

---

# Packet

# Request Packet

```
1 POST /extract HTTP/1.1\r\n
2 Host: localhost:5000\r\n
3 User-Agent: curl/7.68.0\r\n
4 Accept: */*\r\n
5 Content-Length: 3046796\r\n
6 \r\n
... { 3,046,796 bytes payload }
```

---

# Packet

# Response Packet

```
1 HTTP/1.0 200 OK\r\n
2 Content-Length: 3044143\r\n
3 Content-Type: image/gif\r\n
4 Last-Modified: Mon, 28 Sep 2020 21:16:13\r\n
5 Cache-Control: public, max-age=43200\r\n
6 Expires: Tue, 29 Sep 2020 09:16:12 GMT\r\n
7 ETag: "1601327773.0845277-3044143-32865"\r\n
8 Server: Werkzeug/0.16.1 Python/3.8.2\r\n
9 Date: Mon, 28 Sep 2020 21:16:12 GMT\r\n
10 \r\n
... { 3,044,143 bytes of content }
```

# HTTP Status Codes