CS 340
Computer Systems

#12: Networking: OSI Model and HTTP

Feb. 23, 2023 · Wade Fagen-Ulmschneider

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.

OSI Layer 1: _____

OSI Layer 2: _____

OSI Layer 3: _____

```
00  4500 00c6 1e1f 4000  4006 152e ac16 b4a3
10  12dc 95a6                           ...
```

IPv4, Packet Length: 0x00c6 (198 bytes); Source IP: ac.16.b4.a3 (172.22.180.163); Destination IP: 12.dc.95.a6 (18.220.149.166)

OSI Layer 4: _____

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

Port :0xbafa (47866) connecting to Port :0x0050 (80); Checksum 0x079e; Timestamp: 0x814630a0 (2168860832)

OSI Layer 5, 6, and 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
```

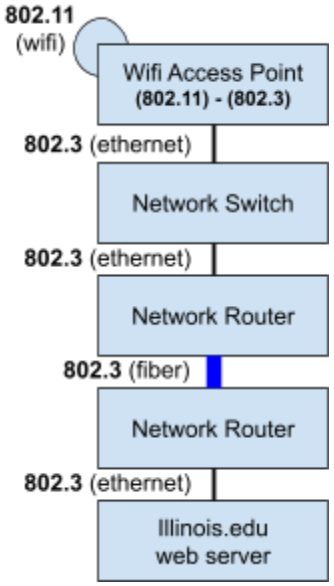
```
GET / HTTP/1.1\r\n
User-Agent: Wget/1.20.3
(linux-gnu)\r\n
Accept: */*\r\n
Accept-Encoding:
identity\r\n
Host:
waf.cs.illinois.edu\r\n
Connection: Keep-Alive\r\n
\r\n
```

Full Packet Journey

Consider an HTTP request you are making from your browser to **waf.cs.illinois.edu** (just as I did using **`tcpdump`**). Assuming we start from your laptop on a WiFi network:

Your Laptop:

802.11 Header	IP Header	TCP Header	HTTP Header	HTTP Content



Network Layer (Layer 3) Protocol: Internet Protocol (IP)

- The **network layer** provides _____ communication.
- When on the Internet, every host relies on the **IP protocol**:
  - IP (IPv4) Address:
  - IPv6 Addresses:

Transport Layer (Layer 4) Protocols:
Two protocols for _____ communications:

1.

2.

Application Layer Protocols:
When a protocol runs on "TCP/IP', that information alone tells us the lower-level protocols used. The top-most layers are the Application Layer, and will be application-specific.

MP4 Protocol
Some protocols are extremely simple, like the MP4 protocol you're working on right now:

1	>	GET midnights\n
2		0\n
3	>	MOD midnights 5\n
4		5\n
5	>	MOD midnights 10\n
6		15\n
7	>	GET midnights\n
8		15\n

HTTP Web Services
One of the primary ways that processes will communicate is via "web services" -- applications that communicate using the HTTP protocol.

The **HTTP protocol** has two parts:

Protocol Part #1: _____

R	1	POST /extract HTTP/1.1\r\n
E	2	Host: localhost:5000\r\n
Q	3	User-Agent: curl/7.68.0\r\n
U	4	Accept: */*\r\n
E	5	Content-Length: 3046796\r\n
S	6	\r\n
T	…	{ 3,046,796 bytes payload }

Request Packet Organization:
- Line Delineation:
- Start Line (Line 1): HTTP method (verb), target, and version
- Request Headers (Lines 2+):
- Payload (or sometimes just the "Data"):

Protocol Part #2: _____

R	1	HTTP/1.0 200 OK\r\n
E	2	Content-Length: 3044143\r\n
S	3	Content-Type: image/gif\r\n
P	4	Last-Modified: Mon, 28 Sep 2022 21:16:13\r\n
O	5	Cache-Control: public, max-age=43200\r\n
N	6	Expires: Tue, 22 Mar 2023 09:16:12 GMT\r\n
S	7	ETag: "1601327773.0845277-3044143-32865"\r\n
E	8	Server: Werkzeug/0.16.1 Python/3.8.2\r\n
	9	Date: Thu, 22 Feb 2023 21:16:12 GMT\r\n
	10	\r\n
	…	{ 3,044,143 bytes of content }

In general, the request and response follows the same format with only one major exception:
- Response "Status Line" (Line 1):

HTTP Status Codes

1xx Informational	2xx Success	3xx Redirection	4xx Client Error	5xx Server Error
100: Continue ...	200: OK 201: Created ...	304: Not Modified ...	400: Bad Request 404: File Not Found ...	500: Internal Server Error ...