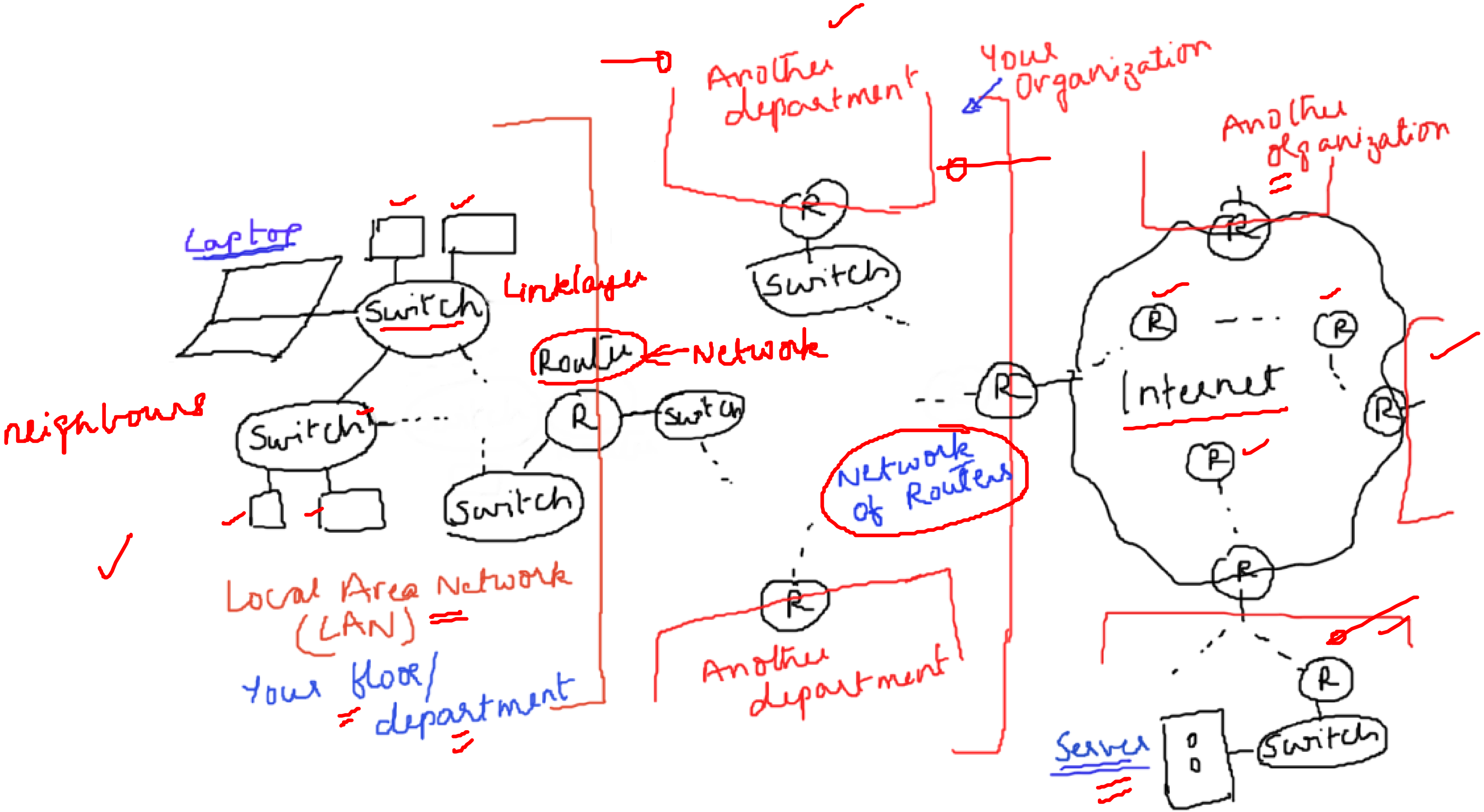
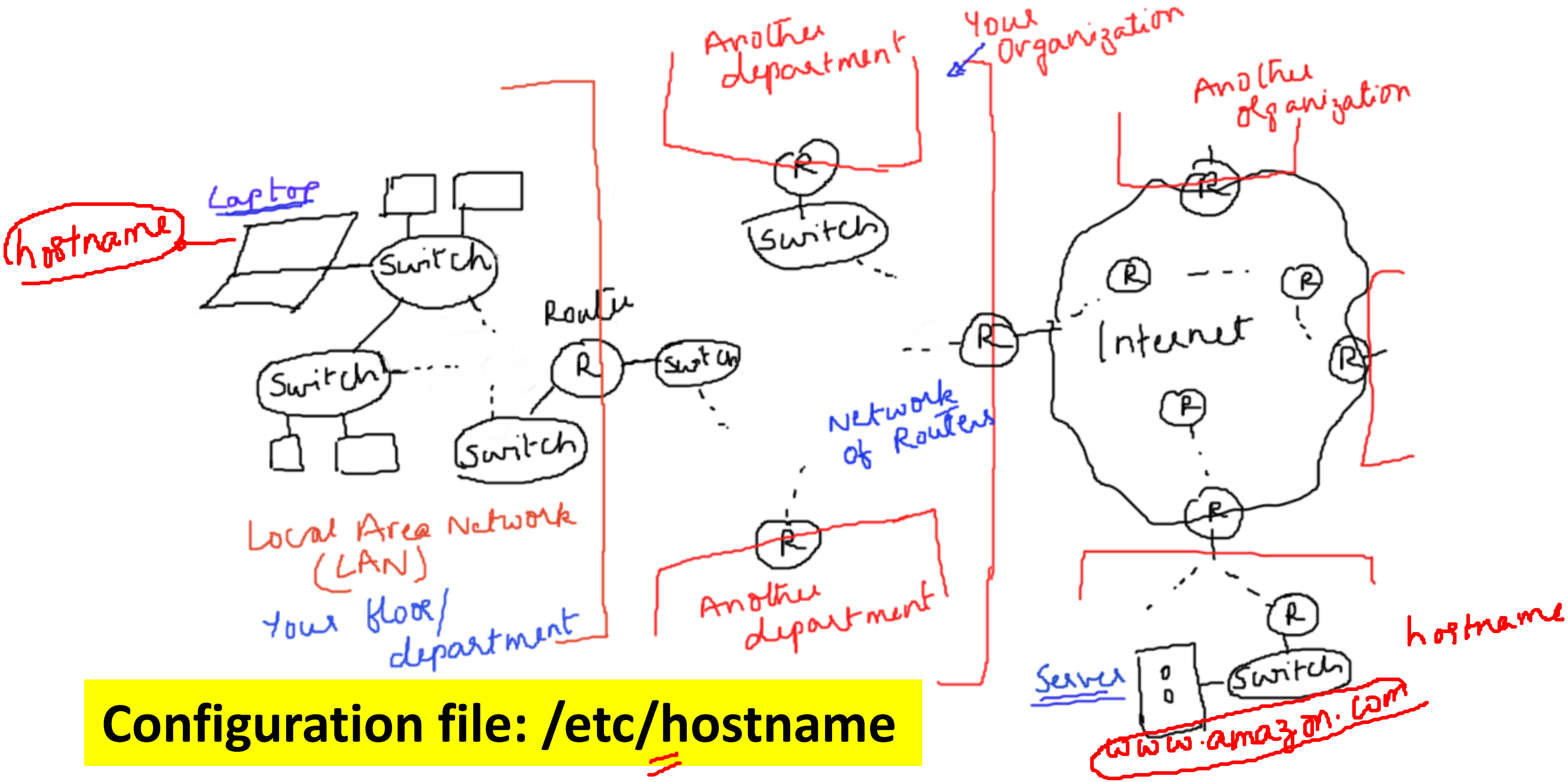
Tool Set-1: Action at a Host (Computer Networks Lab)

Kameswari Chebrolu

High Level Picture



Know thy machine!



Configuration file: /etc/hostname

Application Layer:

- You enter URL in browser software
  - e.g. https://www.amazon.in/
- Which server to contact?
  - Server hostname to IP address (DNS service)

- Command: host amd Configuration file: /etc/hosts

[illegible] → IP

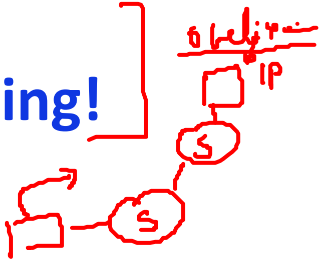
- What port is the server listening on?

- Configuration File: /etc/services

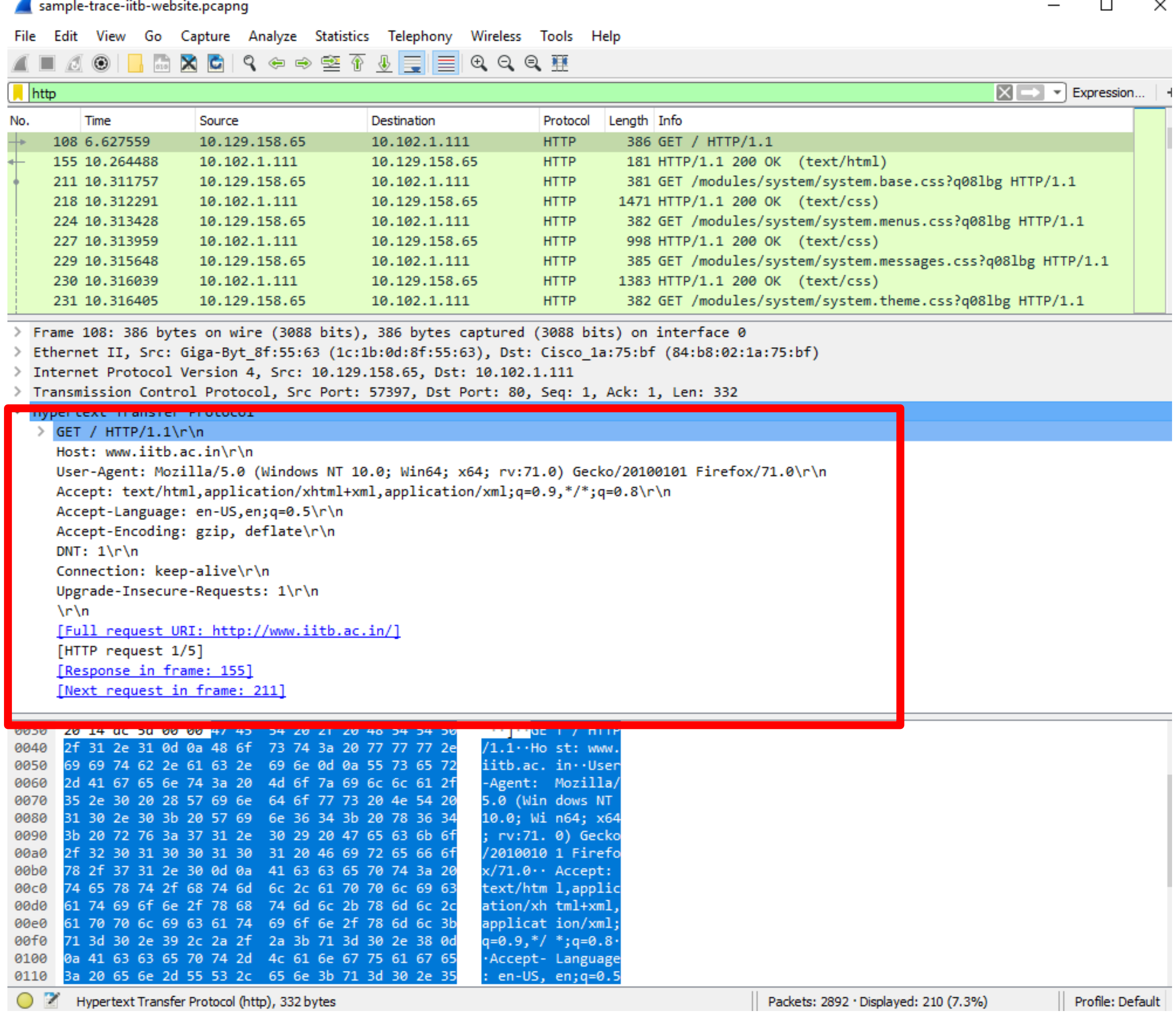
fixed

web - 80
ssh - 22

Will cover application development as part of socket programming!



Application Layer



sample-trace-iitb-website.pcapng
File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help
http
Expression...

```
No.   Time       Source          Destination     Protocol  Length  Info
  108 6.627559   10.129.158.65   10.102.1.111    HTTP       386 GET / HTTP/1.1
  155 10.264488  10.102.1.111    10.129.158.65   HTTP       181 HTTP/1.1 200 OK  (text/html)
  211 10.311757  10.129.158.65   10.102.1.111    HTTP       381 GET /modules/system/system.base.css?q08lbg HTTP/1.1
  218 10.312291  10.102.1.111    10.129.158.65   HTTP      1471 HTTP/1.1 200 OK  (text/css)
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  230 10.316039  10.102.1.111    10.129.158.65   HTTP      1383 HTTP/1.1 200 OK  (text/css)
  231 10.316405  10.129.158.65   10.102.1.111    HTTP       382 GET /modules/system/system.theme.css?q08lbg HTTP/1.1
```

```
> Frame 108: 386 bytes on wire (3088 bits), 386 bytes captured (3088 bits) on interface 0
> Ethernet II, Src: Giga-Byt_8f:55:63 (1c:1b:0d:8f:55:63), Dst: Cisco_1a:75:bf (84:b8:02:1a:75:bf)
> Internet Protocol Version 4, Src: 10.129.158.65, Dst: 10.102.1.111
> Transmission Control Protocol, Src Port: 57397, Dst Port: 80, Seq: 1, Ack: 1, Len: 332
v Hypertext Transfer Protocol
  > GET / HTTP/1.1\r\n
    Host: www.iitb.ac.in\r\n
    User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64; rv:71.0) Gecko/20100101 Firefox/71.0\r\n
    Accept: text/html,application/xhtml+xml,application/xml;q=0.9,*/*;q=0.8\r\n
    Accept-Language: en-US,en;q=0.5\r\n
    Accept-Encoding: gzip, deflate\r\n
    DNT: 1\r\n
    Connection: keep-alive\r\n
    Upgrade-Insecure-Requests: 1\r\n
    \r\n
    [Full request URI: http://www.iitb.ac.in/]
    [HTTP request 1/5]
    [Response in frame: 155]
    [Next request in frame: 211]
```

```
0030  20 14 dc 3d 00 00 47 45  54 20 2f 20 48 54 54 50   ··]··GE T / HTTP
0040  2f 31 2e 31 0d 0a 48 6f  73 74 3a 20 77 77 77 2e   /1.1··Ho st: www.
0050  69 69 74 62 2e 61 63 2e  69 6e 0d 0a 55 73 65 72   iitb.ac. in··User
0060  2d 41 67 65 6e 74 3a 20  4d 6f 7a 69 6c 6c 61 2f   -Agent:  Mozilla/
0070  35 2e 30 20 28 57 69 6e  64 6f 77 73 20 4e 54 20   5.0 (Win dows NT 
0080  31 30 2e 30 3b 20 57 69  6e 36 34 3b 20 78 36 34   10.0; Wi n64; x64
0090  3b 20 72 76 3a 37 31 2e  30 29 20 47 65 63 6b 6f   ; rv:71. 0) Gecko
00a0  2f 32 30 31 30 30 31 30  31 20 46 69 72 65 66 6f   /2010010 1 Firefo
00b0  78 2f 37 31 2e 30 0d 0a  41 63 63 65 70 74 3a 20   x/71.0·· Accept: 
00c0  74 65 78 74 2f 68 74 6d  6c 2c 61 70 70 6c 69 63   text/htm l,applic
00d0  61 74 69 6f 6e 2f 78 68  74 6d 6c 2b 78 6d 6c 2c   ation/xh tml+xml,
00e0  61 70 70 6c 69 63 61 74  69 6f 6e 2f 78 6d 6c 3b   applicat ion/xml;
00f0  71 3d 30 2e 39 2c 2a 2f  2a 3b 71 3d 30 2e 38 0d   q=0.9,*/ *;q=0.8·
0100  0a 41 63 63 65 70 74 2d  4c 61 6e 67 75 61 67 65   ·Accept- Language
0110  3a 20 65 6e 2d 55 53 2c  65 6e 3b 71 3d 30 2e 35   : en-US, en;q=0.5
```

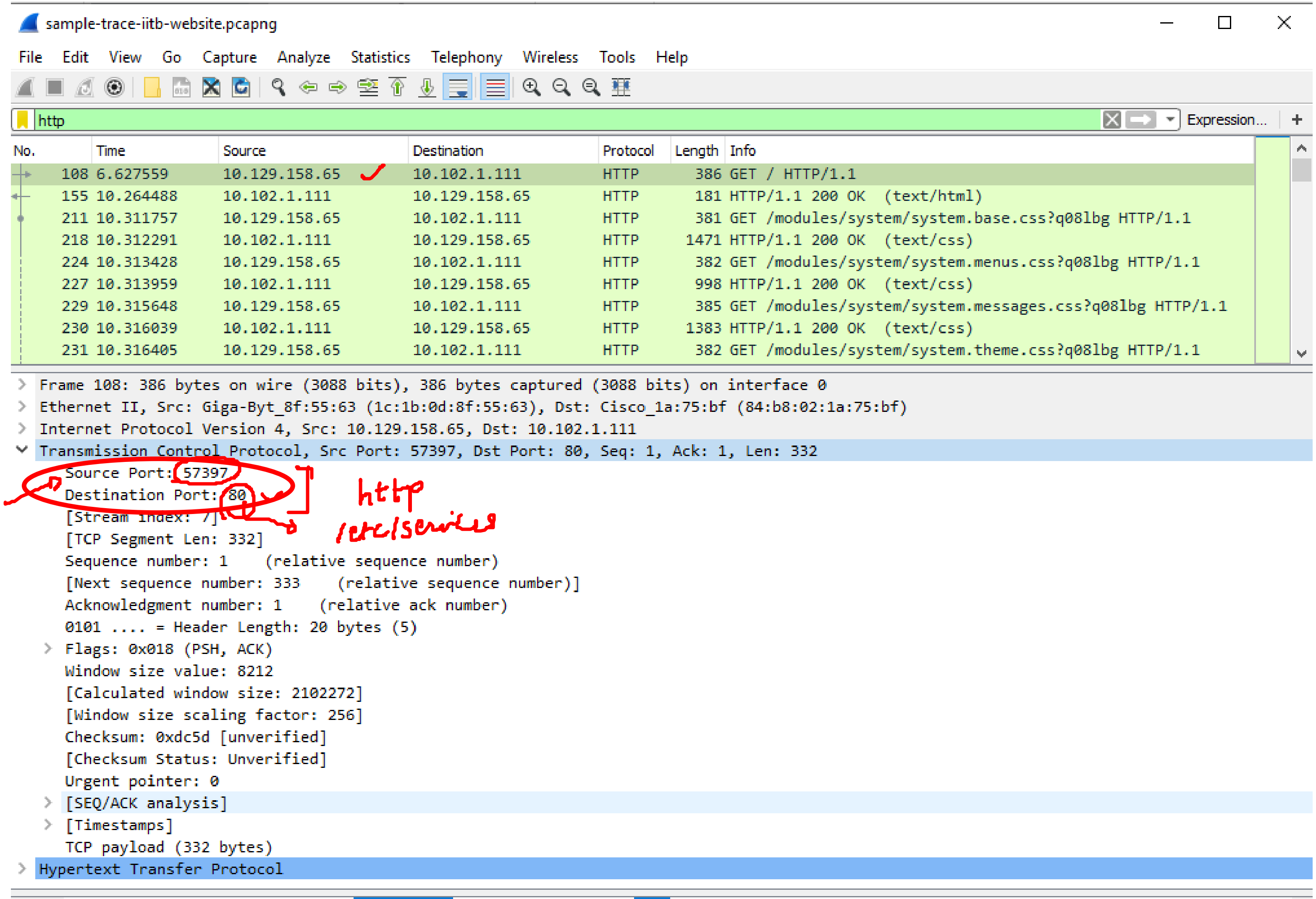
Hypertext Transfer Protocol (http), 332 bytes | Packets: 2892 · Displayed: 210 (7.3%) | Profile: Default

Transport Layer

TCP

0 4 10 16 31

<table>
<tr><td colspan="8">Source Port ✓</td><td>Destination Port ✓</td></tr>
<tr><td colspan="9">Sequence Number</td></tr>
<tr><td colspan="9">Acknowledgment</td></tr>
<tr><td>Hdr Len</td><td>0</td><td>U</td><td>A</td><td>P</td><td>R</td><td>S</td><td>F</td><td>Advertised Window</td></tr>
<tr><td colspan="8">Checksum</td><td>Urgent Pointer</td></tr>
<tr><td colspan="9">Options (Variable)</td></tr>
<tr><td colspan="9">Data</td></tr>
</table>



http

```
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> Internet Protocol Version 4, Src: 10.129.158.65, Dst: 10.102.1.111
v Transmission Control Protocol, Src Port: 57397, Dst Port: 80, Seq: 1, Ack: 1, Len: 332
    Source Port: 57397
    Destination Port: 80
    [Stream index: 7]
    [TCP Segment Len: 332]
    Sequence number: 1    (relative sequence number)
    [Next sequence number: 333    (relative sequence number)]
    Acknowledgment number: 1    (relative ack number)
    0101 .... = Header Length: 20 bytes (5)
  > Flags: 0x018 (PSH, ACK)
    Window size value: 8212
    [Calculated window size: 2102272]
    [Window size scaling factor: 256]
    Checksum: 0xdc5d [unverified]
    [Checksum Status: Unverified]
    Urgent pointer: 0
  > [SEQ/ACK analysis]
  > [Timestamps]
    TCP payload (332 bytes)
> Hypertext Transfer Protocol
```

http

/etc/services

Socke

Network Layer

TCP

IPv4

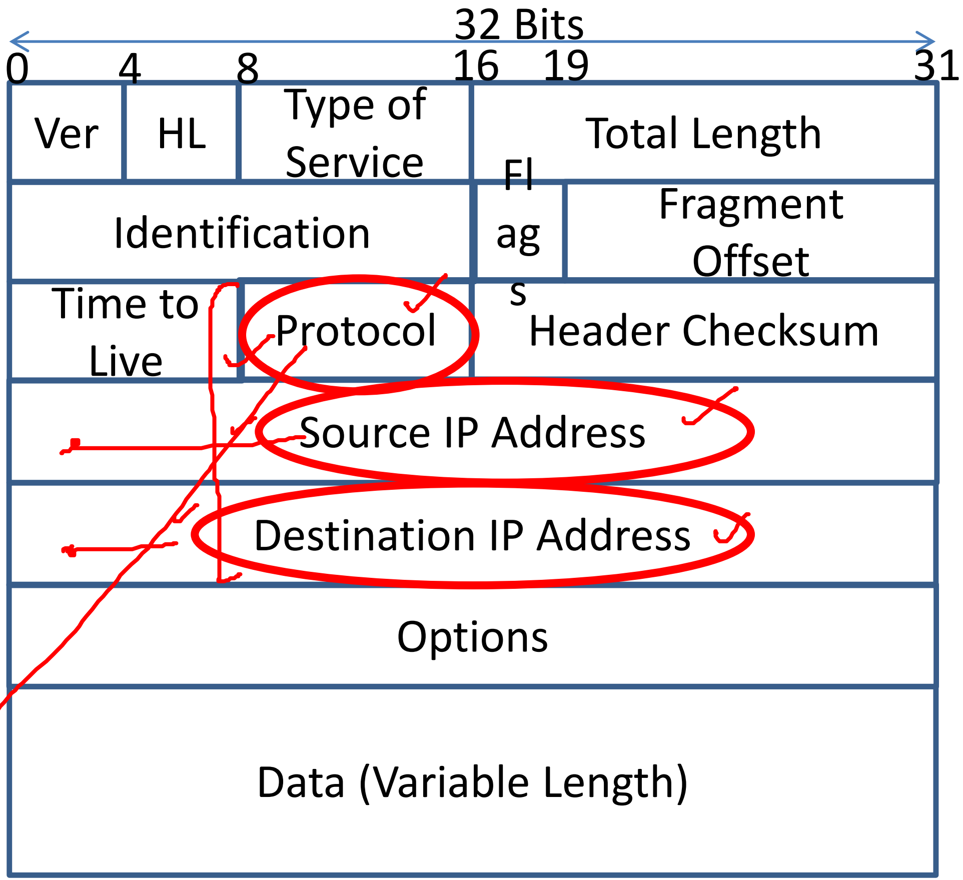
- Source IP
  - Command: ip addr
- Destination IP
  - Saw earlier (Command: Host)

DNS

- Protocol

- Configuration File: /etc/protocols ✓

Transport



32 Bits

0 4 8 16 19 31

Ver | HL | Type of Service | Total Length

Identification | Flags | Fragment Offset

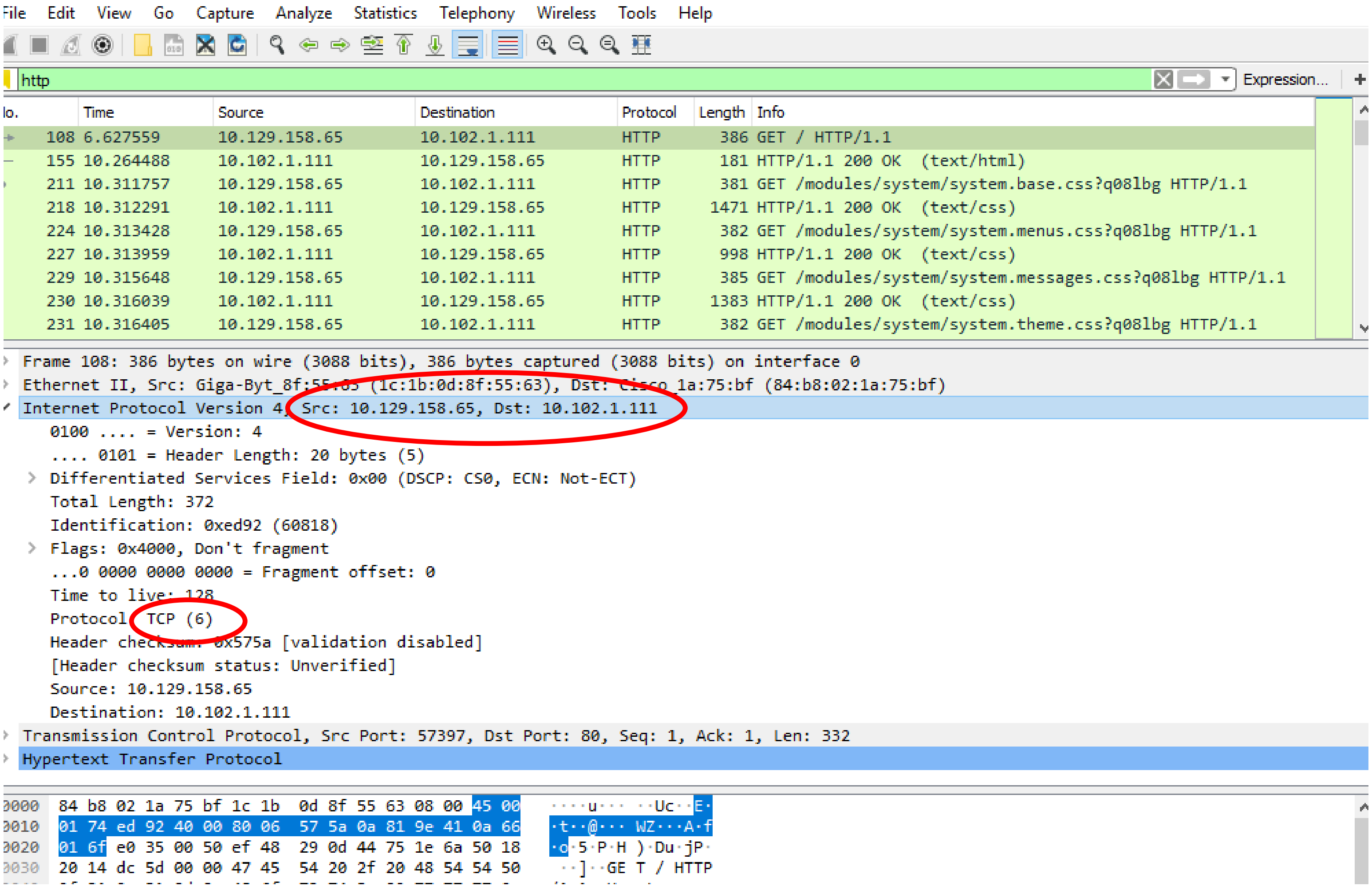
Time to Live | Protocol ✓ | Header Checksum

Source IP Address ✓

Destination IP Address ✓

Options

Data (Variable Length)



http

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> Ethernet II, Src: Giga-Byt_8f:55:63 (1c:1b:0d:8f:55:63), Dst: Cisco_1a:75:bf (84:b8:02:1a:75:bf)
v Internet Protocol Version 4, Src: 10.129.158.65, Dst: 10.102.1.111
    0100 .... = Version: 4
    .... 0101 = Header Length: 20 bytes (5)
  > Differentiated Services Field: 0x00 (DSCP: CS0, ECN: Not-ECT)
    Total Length: 372
    Identification: 0xed92 (60818)
  > Flags: 0x4000, Don't fragment
    ...0 0000 0000 0000 = Fragment offset: 0
    Time to live: 128
    Protocol: TCP (6)
    Header checksum: 0x575a [validation disabled]
    [Header checksum status: Unverified]
    Source: 10.129.158.65
    Destination: 10.102.1.111
> Transmission Control Protocol, Src Port: 57397, Dst Port: 80, Seq: 1, Ack: 1, Len: 332
> Hypertext Transfer Protocol
```

```
0000  84 b8 02 1a 75 bf 1c 1b  0d 8f 55 63 08 00 45 00   ····u··· ··Uc··E·
0010  01 74 ed 92 40 00 80 06  57 5a 0a 81 9e 41 0a 66   ·t··@··· WZ···A·f
0020  01 6f e0 35 00 50 ef 48  29 0d 44 75 1e 6a 50 18   ·o·5·P·H )·Du·jP·
0030  20 14 dc 5d 00 00 47 45  54 20 2f 20 48 54 54 50    ··]··GE T / HTTP
```

IP addr - Network

MAC addr - Network interface embed

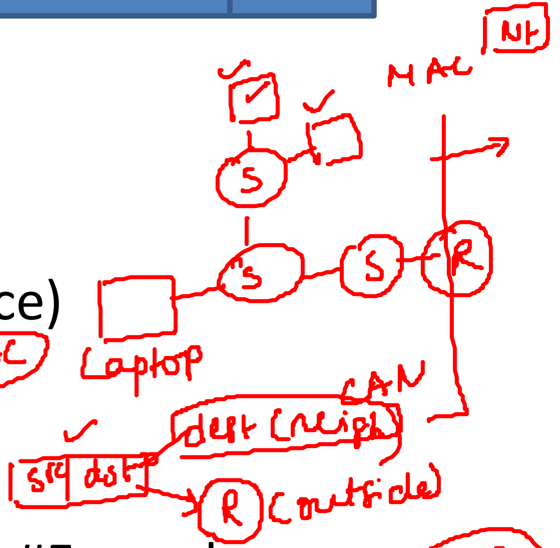
src

Link Layer

Preamble	SFD	Dest address	Src address	Type	Data	CRC
		✓	✓	✓		

- Source MAC Address ✓
  - Command: ip addr (previous: ifconfig)
- Destination MAC address? (need to use ARP service)
  - Command: ip route (previous: route)
  - Command: ip neigh (pervious: arp)
  - Command: arping ip-addr
- Type: See https://en.wikipedia.org/wiki/EtherType#Examples

IP<->MAC



IP<->MAC ARP cache ✓

Router - IP address

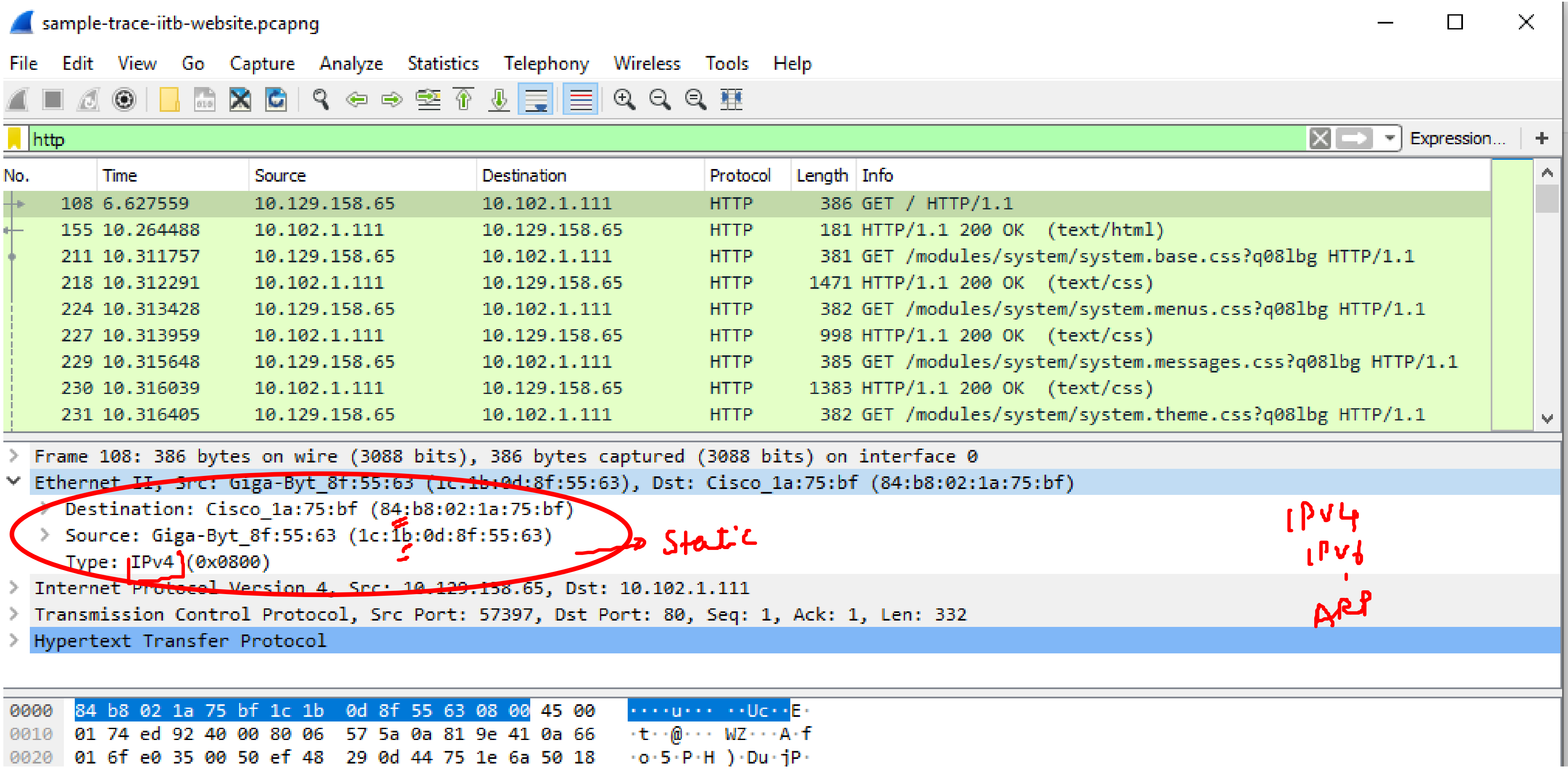
ip

IP -> host, DNS
Router, DHCP

DHCP

IP add

default R



sample-trace-iitb-website.pcapng

http

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    > Destination: Cisco_1a:75:bf (84:b8:02:1a:75:bf)
    > Source: Giga-Byt_8f:55:63 (1c:1b:0d:8f:55:63)
      Type: IPv4 (0x0800)
> Internet Protocol Version 4, Src: 10.129.158.65, Dst: 10.102.1.111
> Transmission Control Protocol, Src Port: 57397, Dst Port: 80, Seq: 1, Ack: 1, Len: 332
> Hypertext Transfer Protocol
```
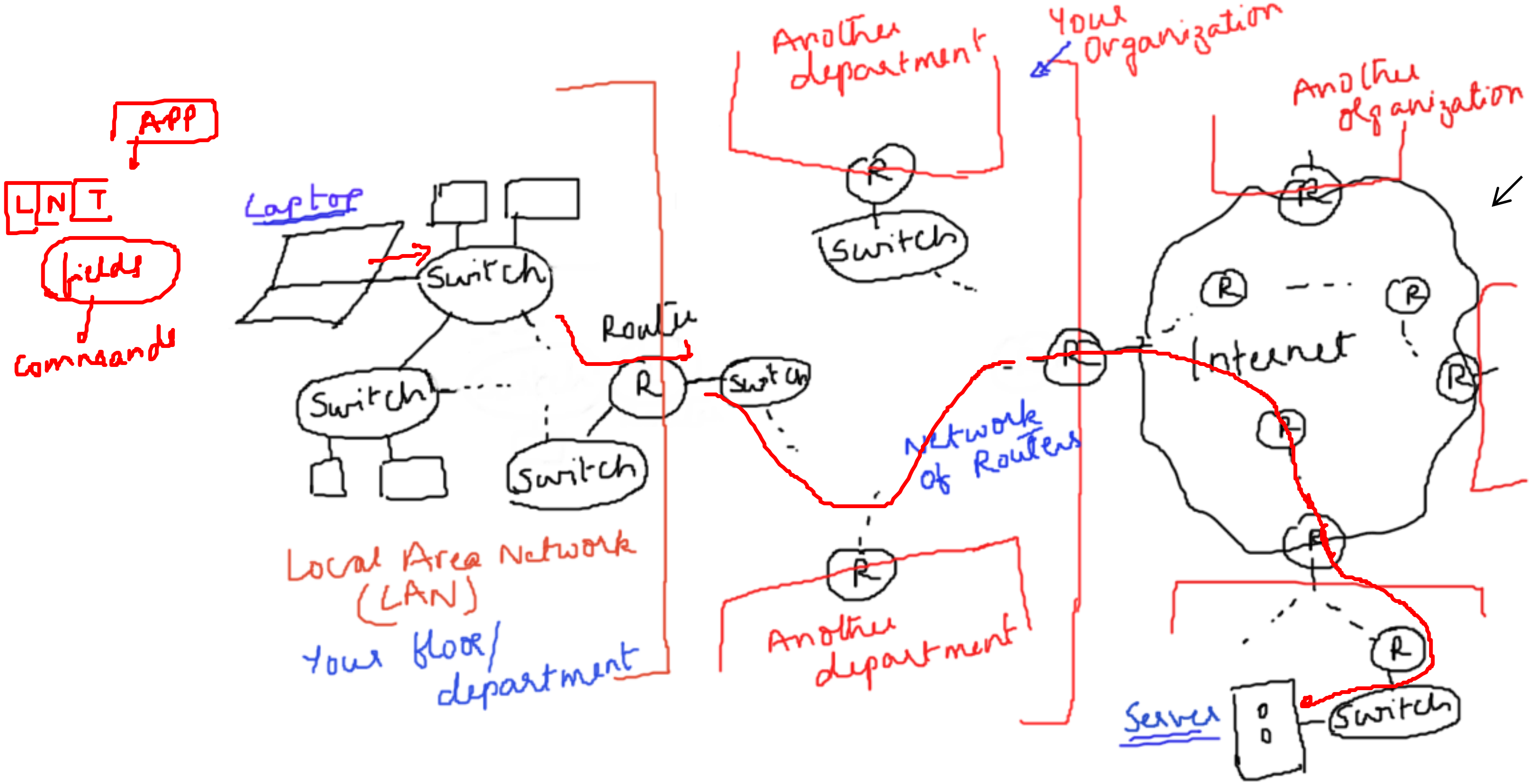

```
0000  84 b8 02 1a 75 bf 1c 1b  0d 8f 55 63 08 00 45 00   ····u··· ··Uc··E·
0010  01 74 ed 92 40 00 80 06  57 5a 0a 81 9e 41 0a 66   ·t··@··· WZ···A·f
0020  01 6f e0 35 00 50 ef 48  29 0d 44 75 1e 6a 50 18   ·o·5·P·H )·Du·jP·
```

Static

IPv4
IPv6
ARP

Journey of this packet



Summary

Concepts: Layering; Encapsulation/De-capsulation via Headers; Demultiplexing; Addressing

Type, Protol, Port

IP

MAC

- Host: /etc/hostname
- Application Layer: /etc/services, /etc/hosts and host
- Transport Layer: /etc/services
- Network Layer: ip addr; host; /etc/protocols
- Link Layer: ip addr; ip route; ip neigh; arping

References

- “man” pages of commands
  - Example: “man host”; “man ip”
- IP command cheat sheet (https://access.redhat.com/sites/default/files/attachments/rh_ip_command_cheatsheet_1214_jcs_print.pdf)