Computer Networks - Introduction

2017/18 Q2

Jaime Delgado

DAC – UPC

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- The Internet.
- Basic concepts.
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  - Internet.
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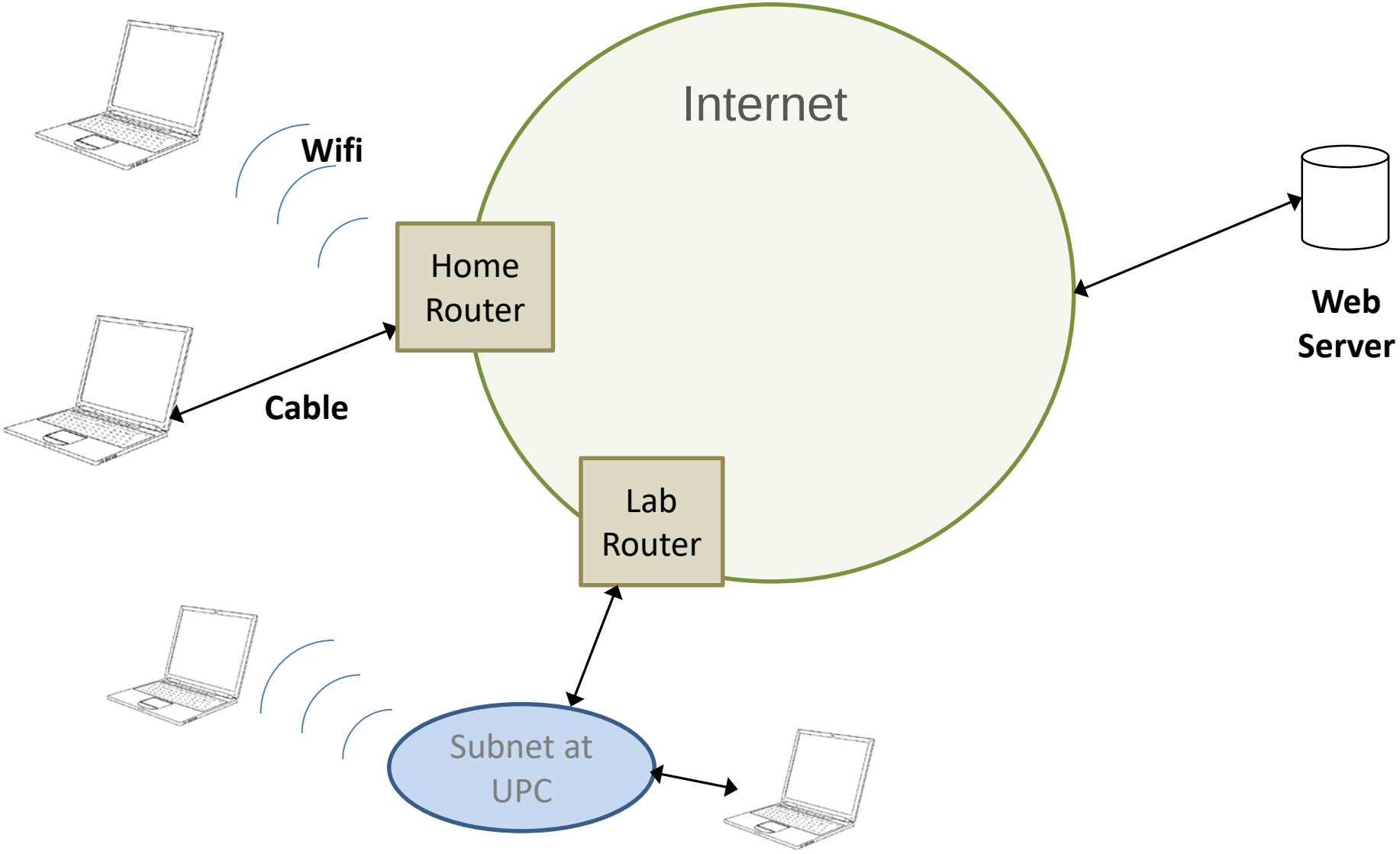
- Information transmission.
- Standardization.

From application to network



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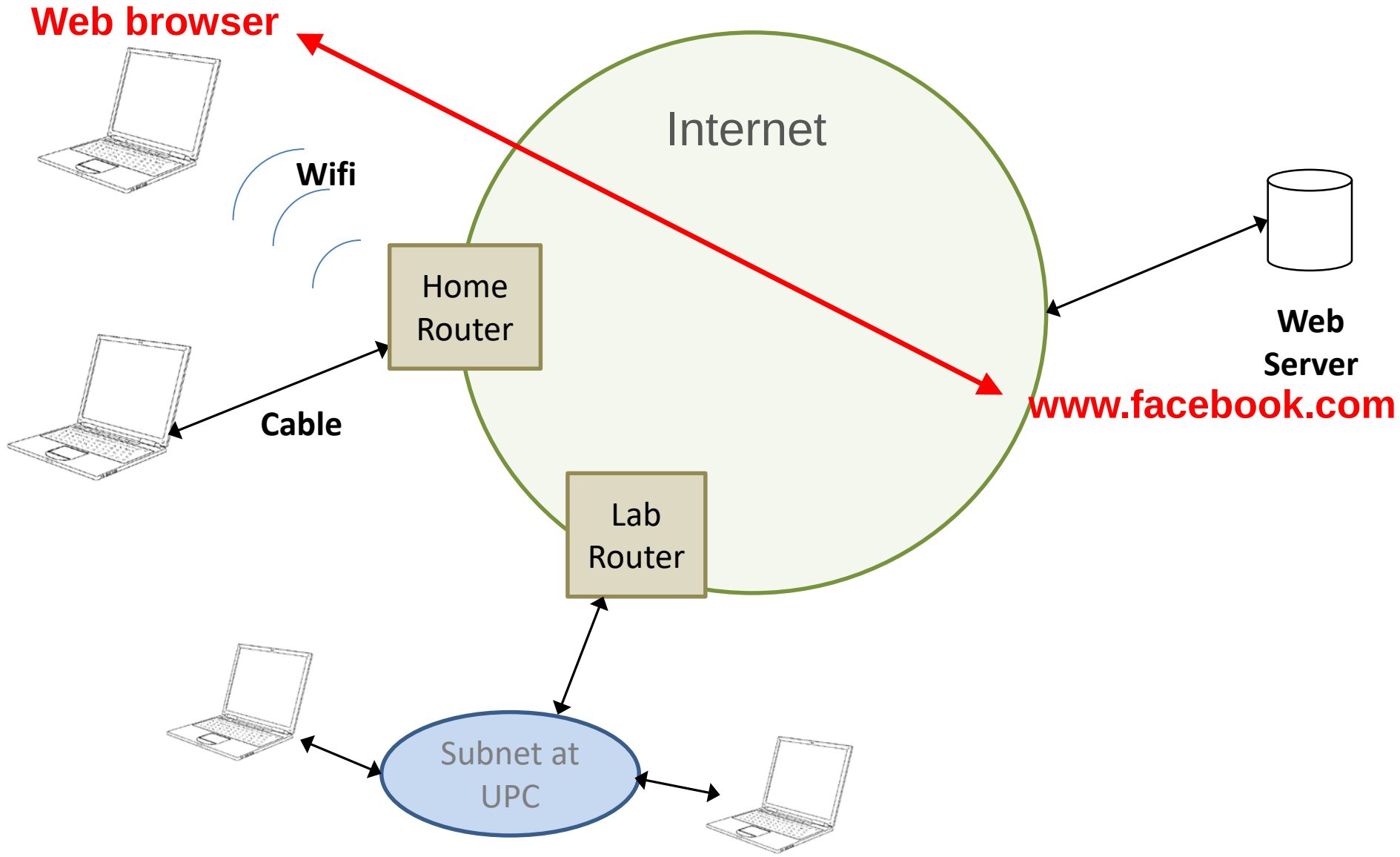

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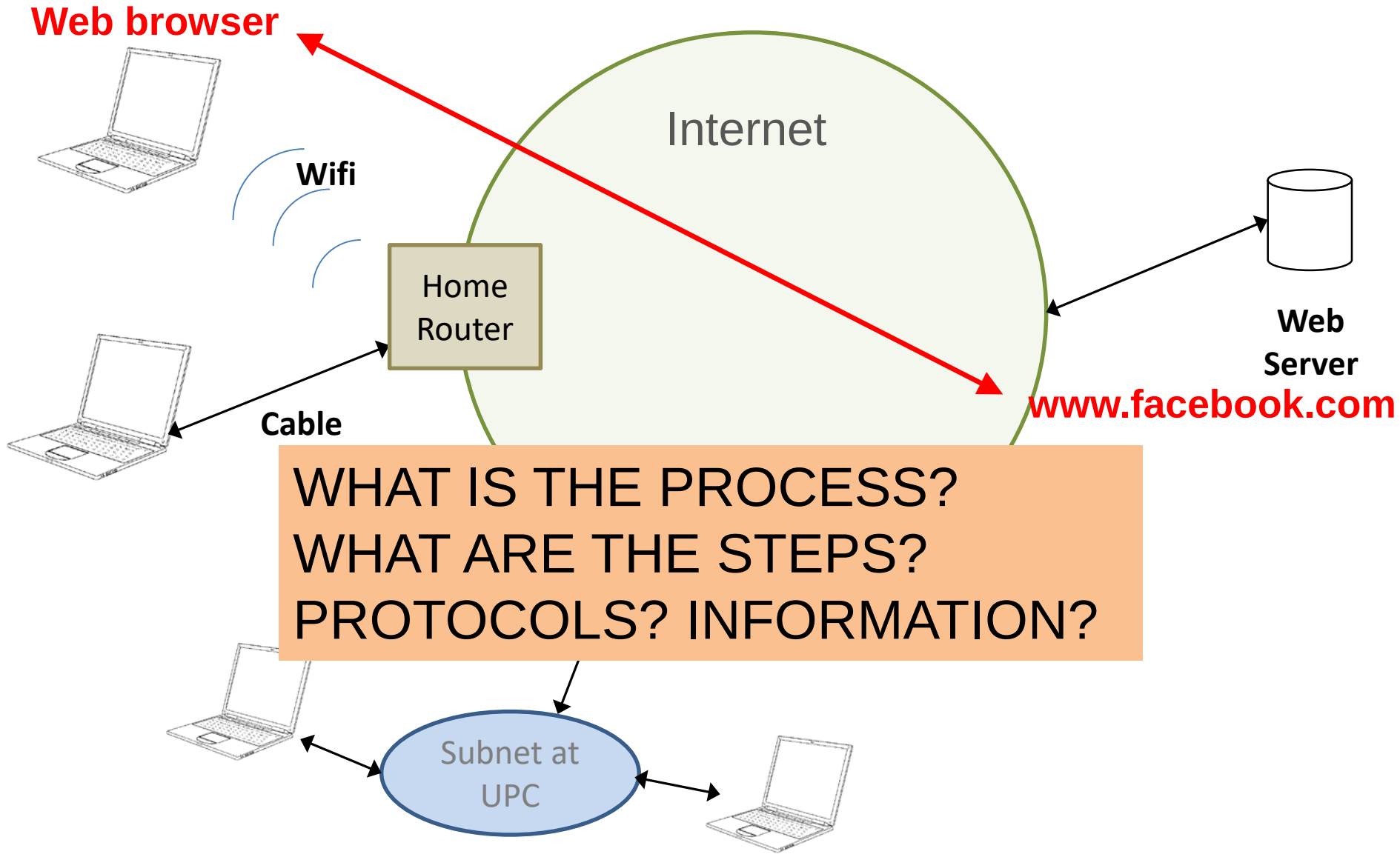
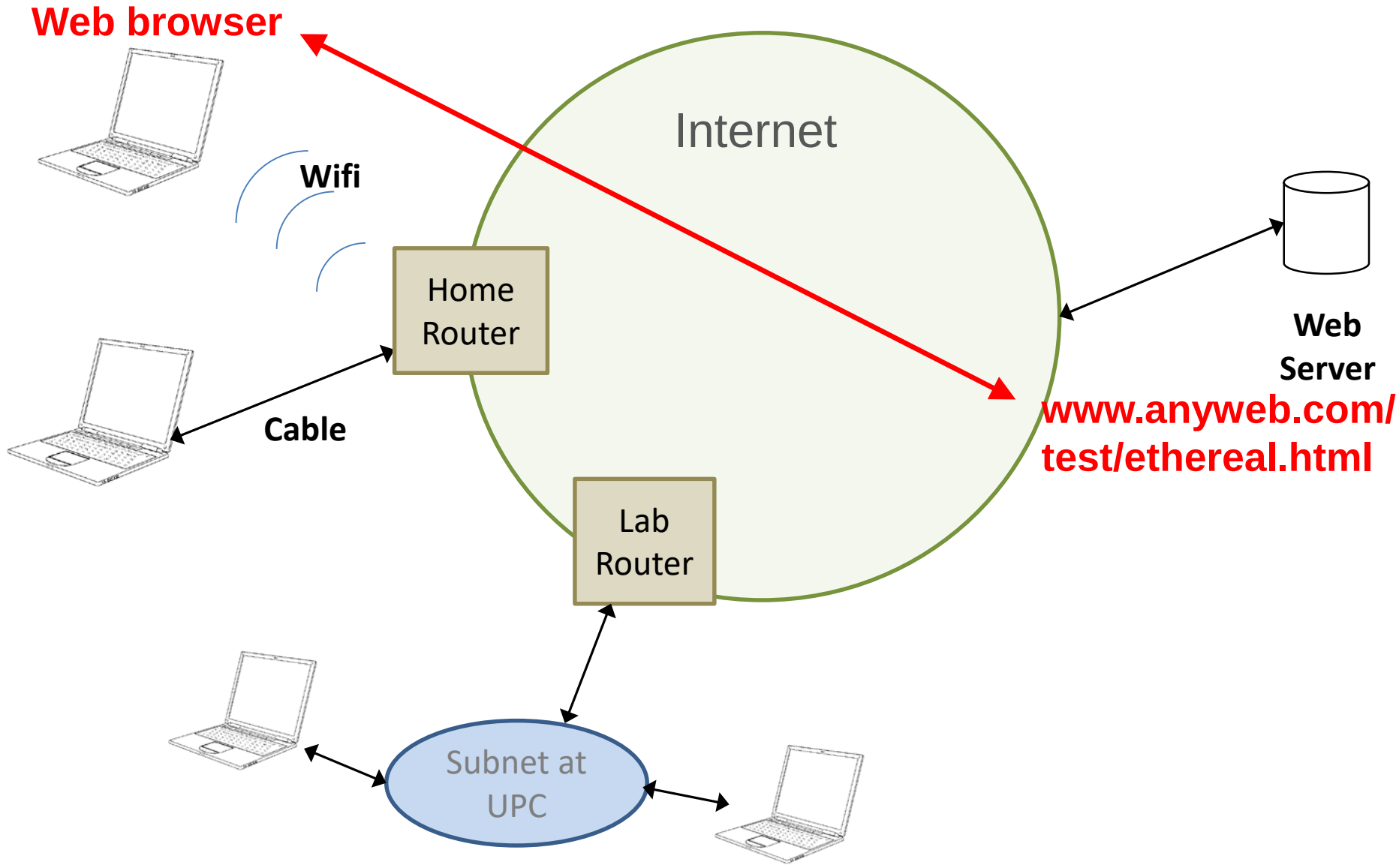
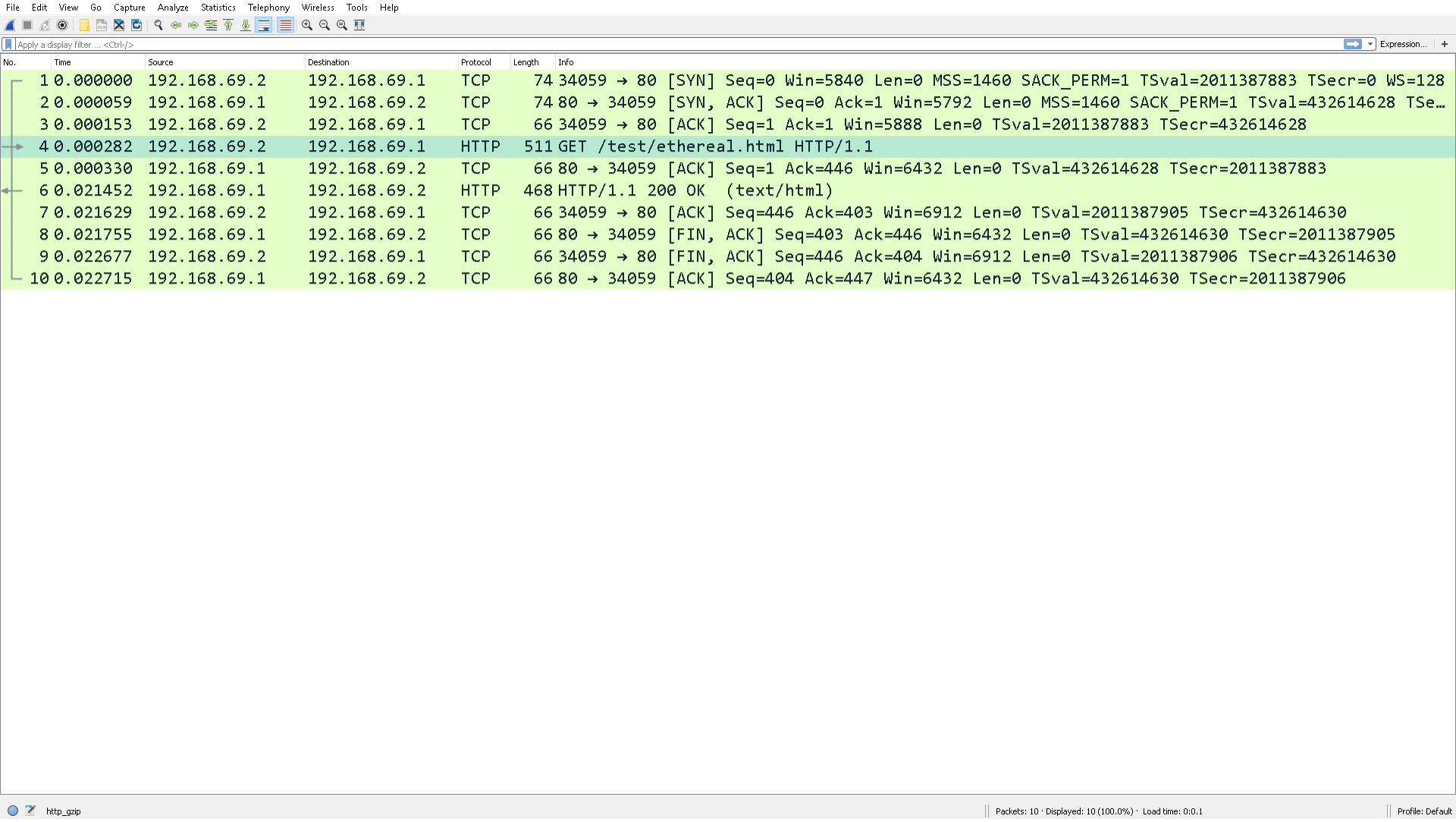


Example (data at Web browser)



Web protocol

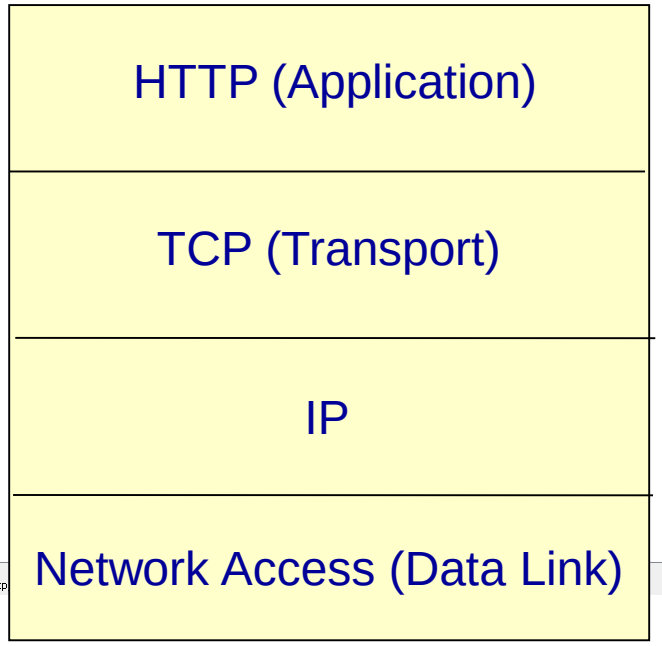


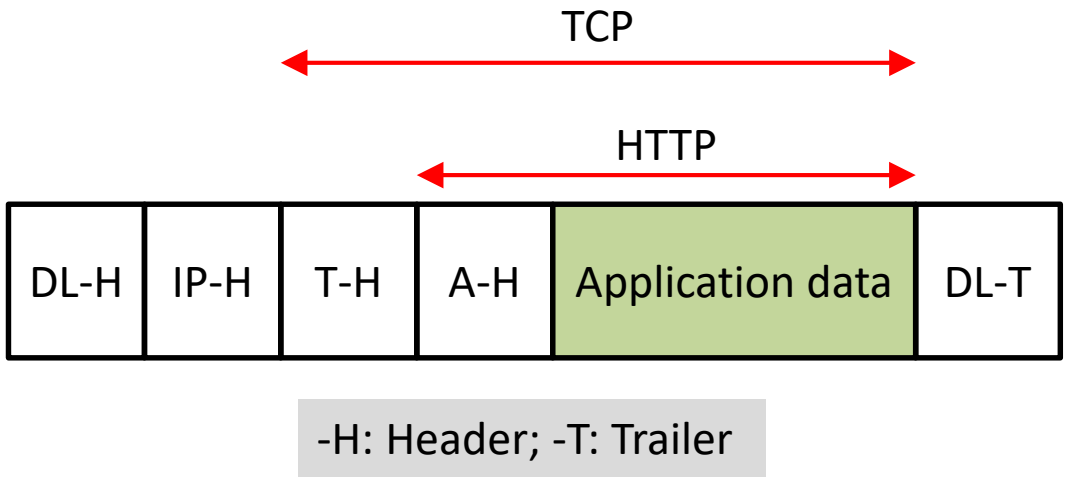
Web protocol - HTTP

File Edit View Go Capture Analyze Statistics Telephony Wireless Tools Help

Apply a display filter ... <Ctrl-/> Expression...

No.	Time	Source	Destination	Protocol	Length	Info
1	0.000000	192.168.69.2	192.168.69.1	TCP	74	34059 → 80 [SYN] Seq=0 Win=5840 Len=0 MSS=1460 SACK_PERM=1 TSval=2011387883 TSecr=0 WS=128
2	0.000059	192.168.69.1	192.168.69.2	TCP	74	80 → 34059 [SYN, ACK] Seq=0 Ack=1 Win=5792 Len=0 MSS=1460 SACK_PERM=1 TSval=432614628 TSe…
3	0.000153	192.168.69.2	192.168.69.1	TCP	66	34059 → 80 [ACK] Seq=1 Ack=1 Win=5888 Len=0 TSval=2011387883 TSecr=432614628
4	0.000282	192.168.69.2	192.168.69.1	HTTP	511	GET /test/ethereal.html HTTP/1.1
5	0.000330	192.168.69.1	192.168.69.2	TCP	66	80 → 34059 [ACK] Seq=1 Ack=446 Win=6432 Len=0 TSval=432614628 TSecr=2011387883
6	0.021452	192.168.69.1	192.168.69.2	HTTP	468	HTTP/1.1 200 OK (text/html)
7	0.021629	192.168.69.2	192.168.69.1	TCP	66	34059 → 80 [ACK] Seq=446 Ack=403 Win=6912 Len=0 TSval=2011387905 TSecr=432614630
8	0.021755	192.168.69.1	192.168.69.2	TCP	66	80 → 34059 [FIN, ACK] Seq=403 Ack=446 Win=6432 Len=0 TSval=432614630 TSecr=2011387905
9	0.022677	192.168.69.2	192.168.69.1	TCP	66	34059 → 80 [FIN, ACK] Seq=446 Ack=404 Win=6912 Len=0 TSval=2011387906 TSecr=432614630
10	0.022715	192.168.69.1	192.168.69.2	TCP	66	80 → 34059 [ACK] Seq=404 Ack=447 Win=6432 Len=0 TSval=432614630 TSecr=2011387906

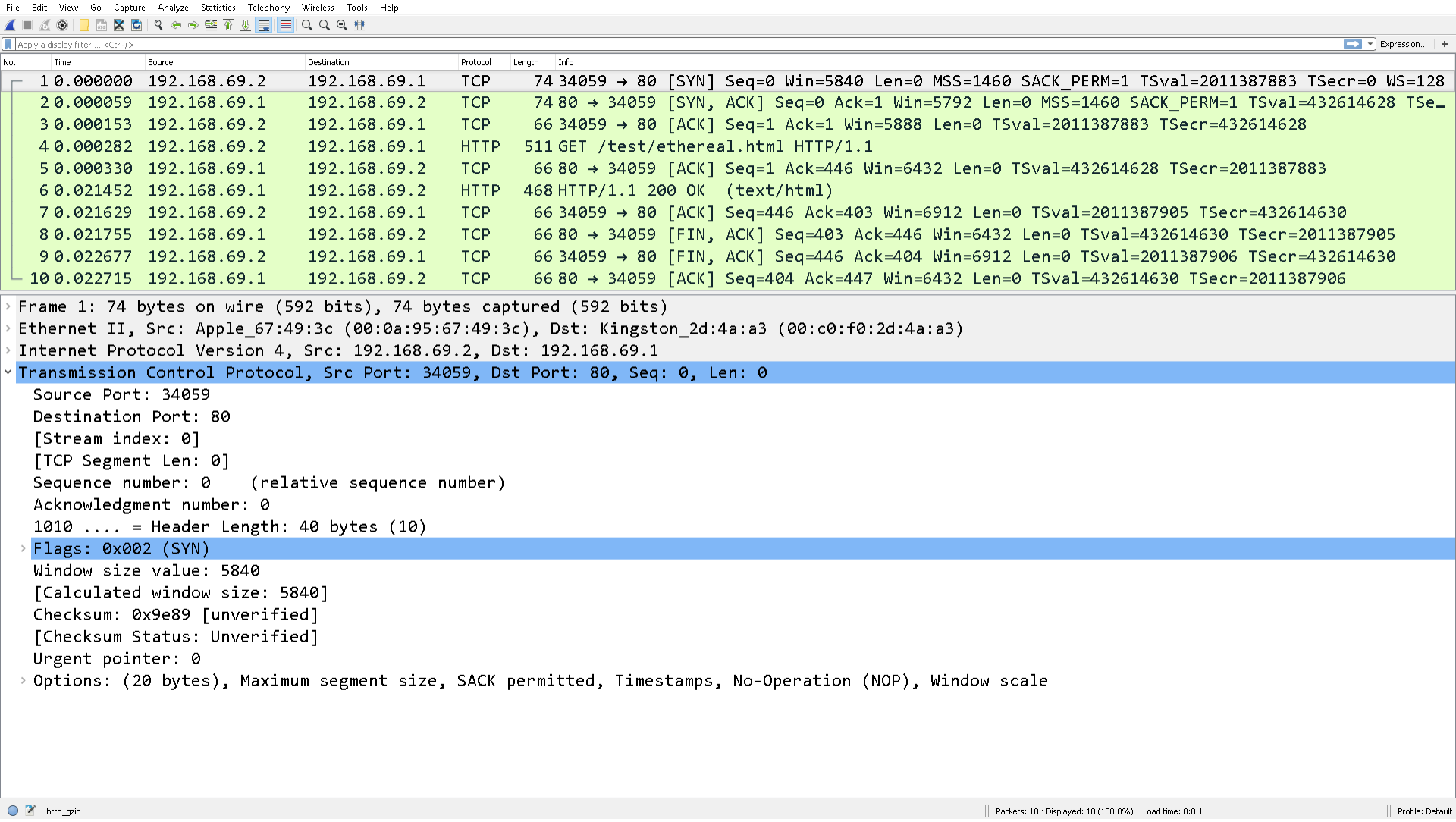




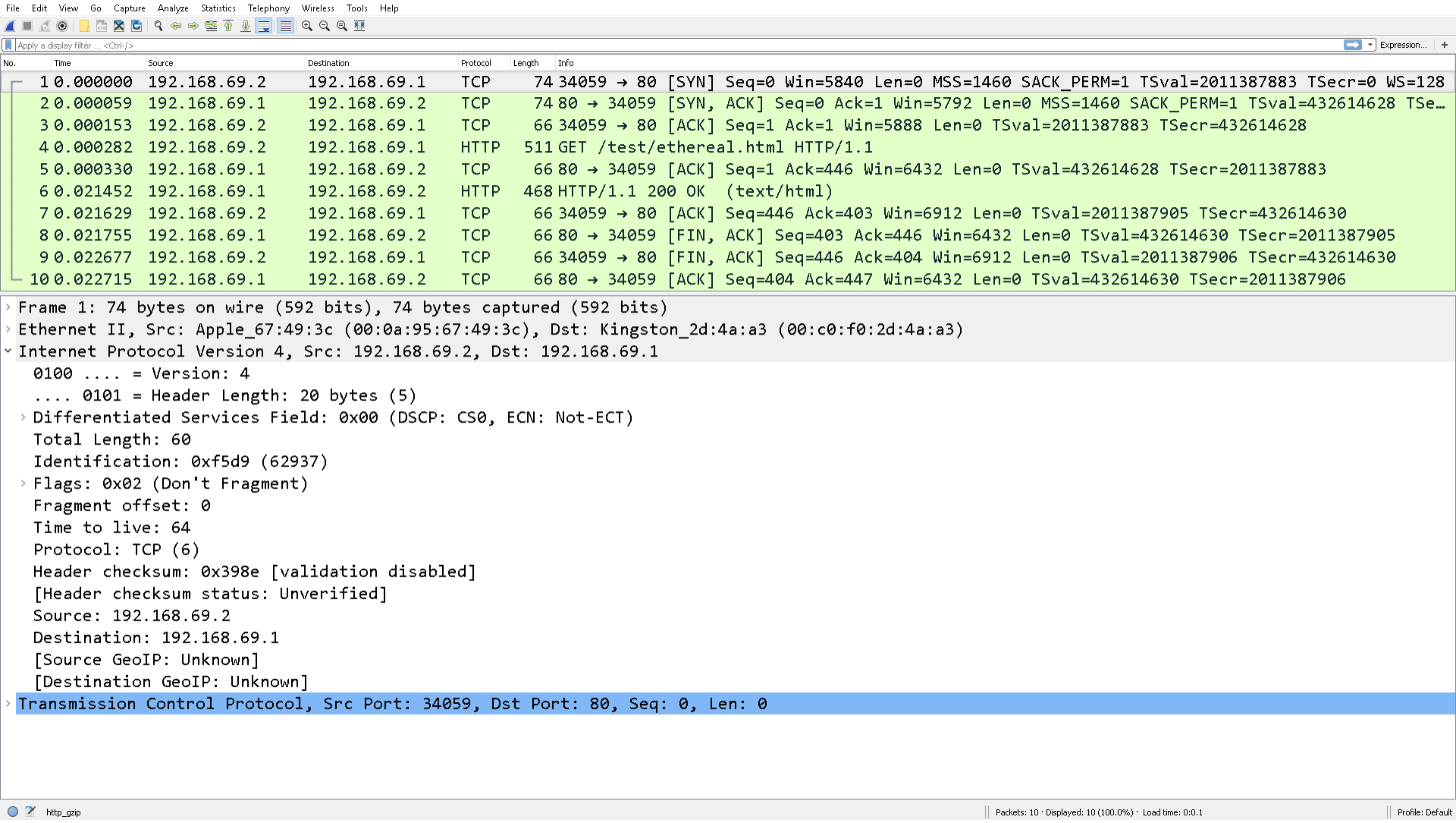
-H: Header; -T: Trailer

http Packets: 10 · Displayed: 10 (100.0%) · Load time: 0:0.1 Profile: Default

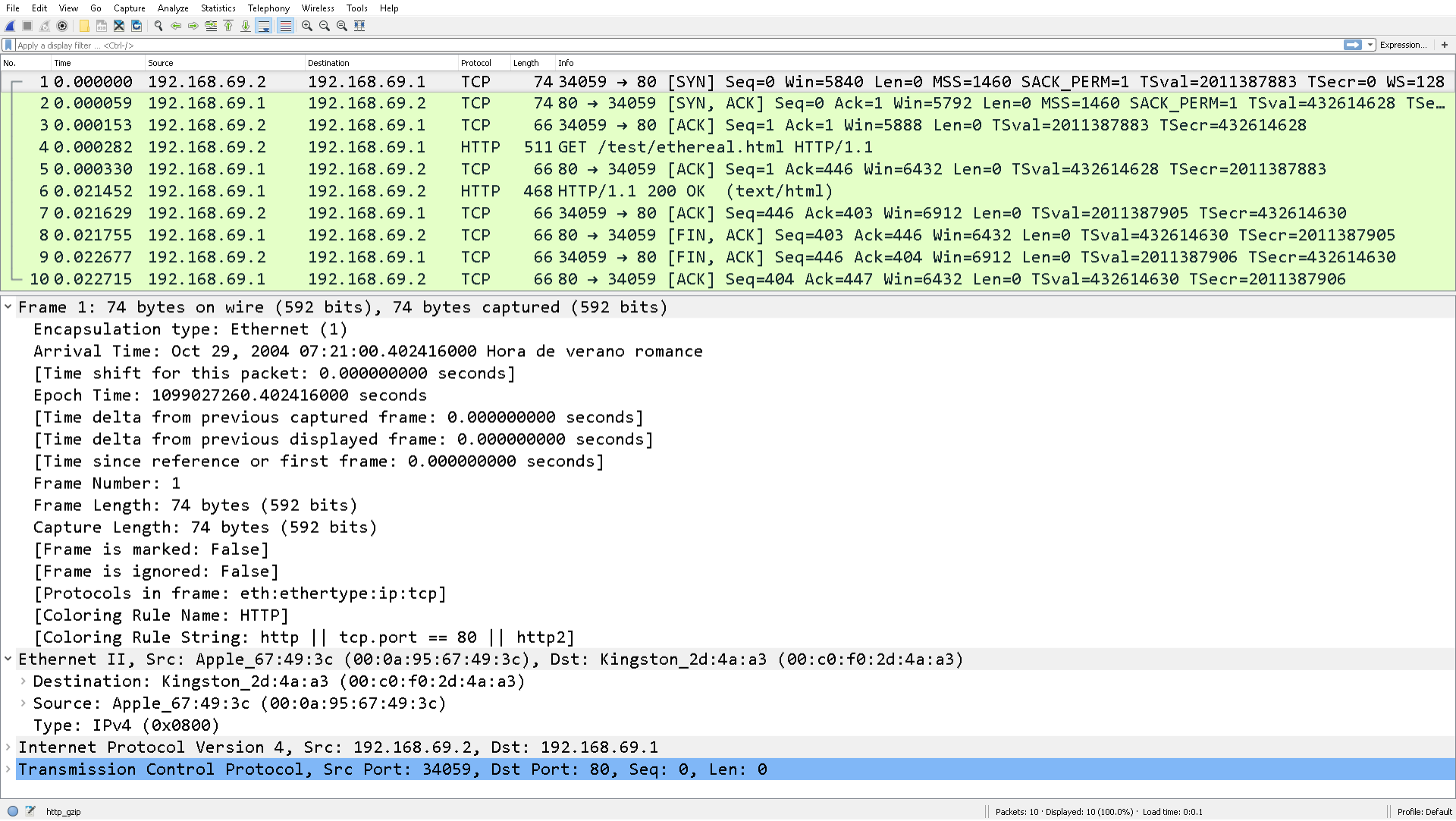
TCP connection



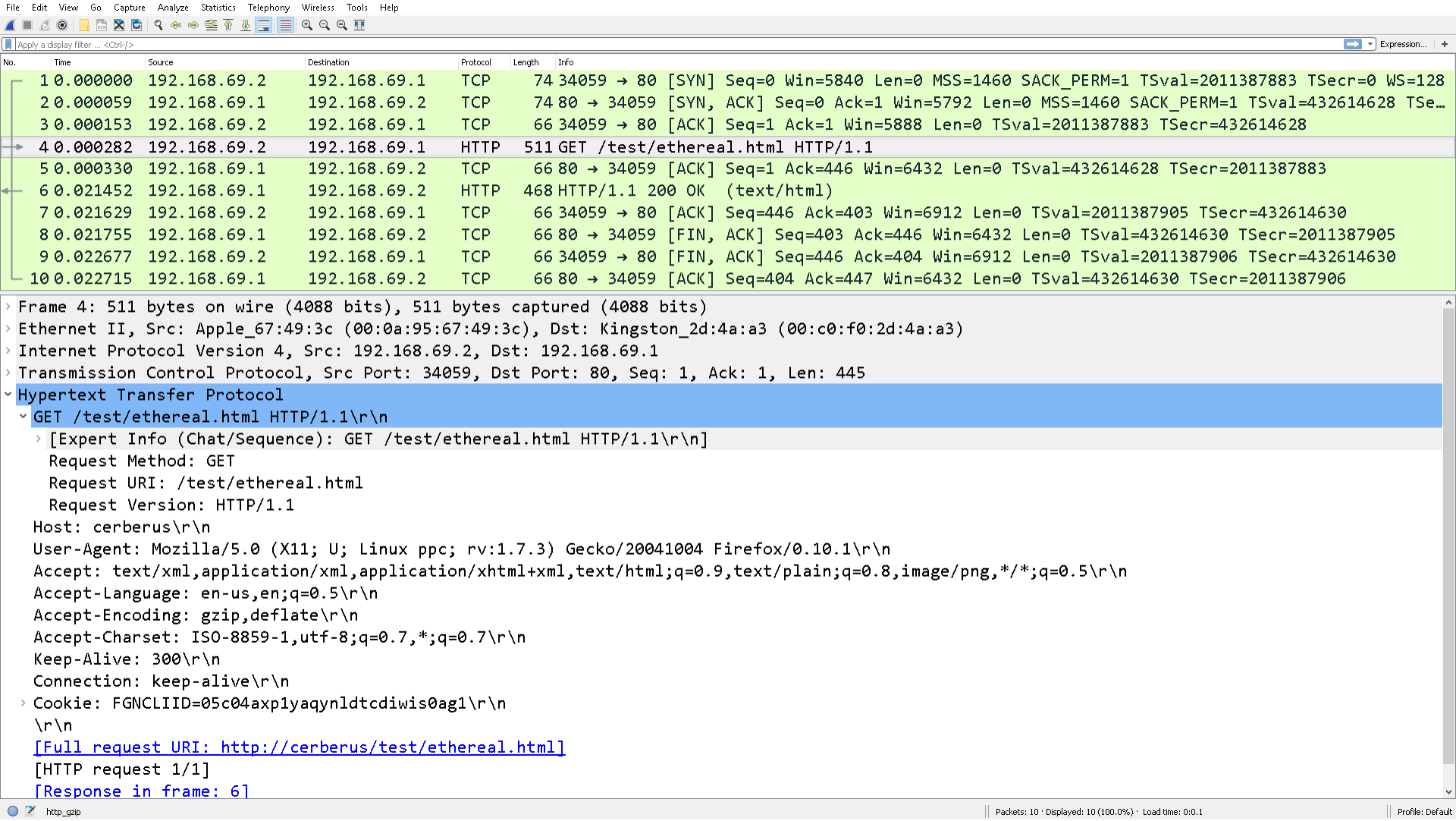
TCP connection - IP



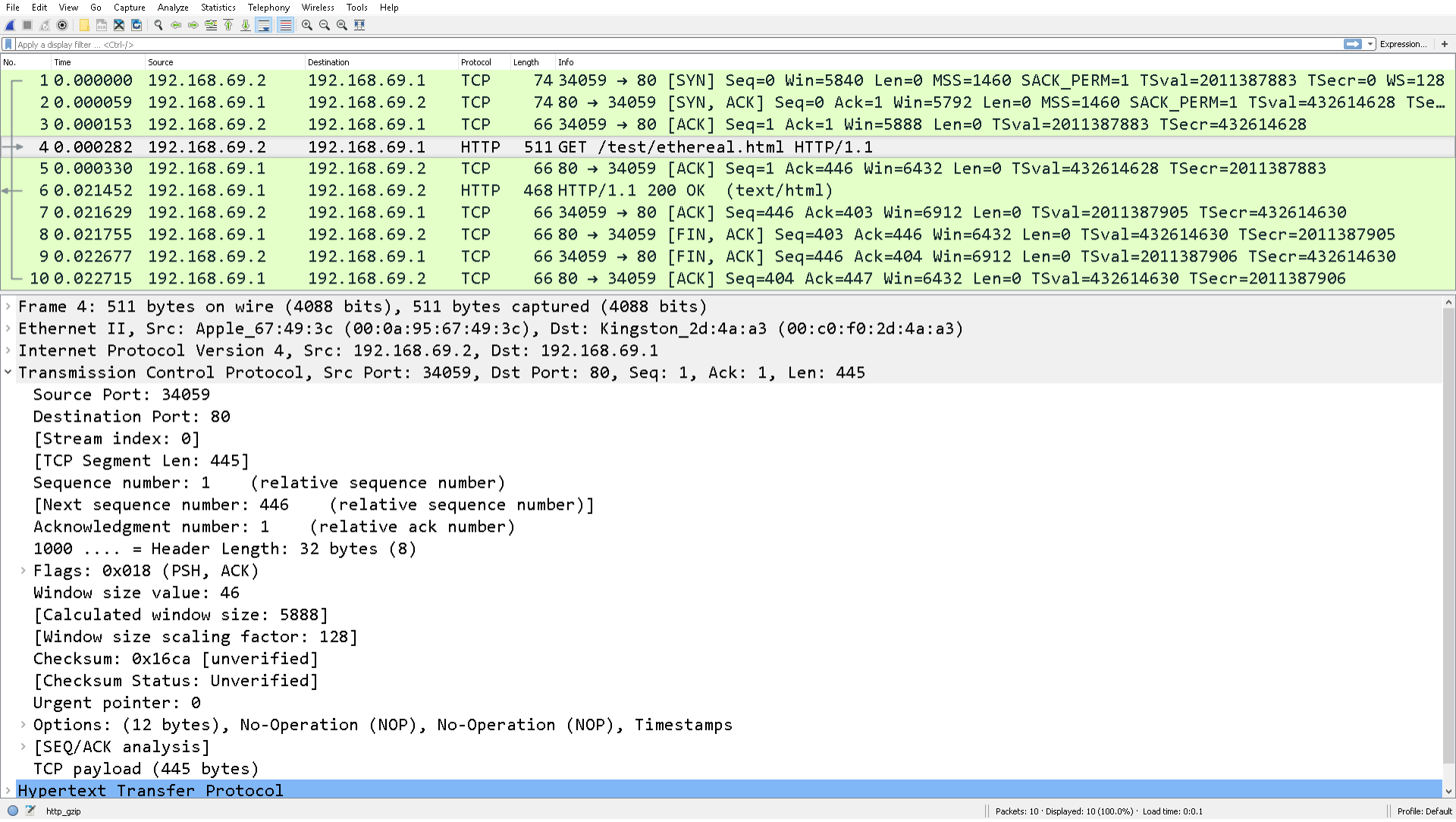
TCP connection – Data link



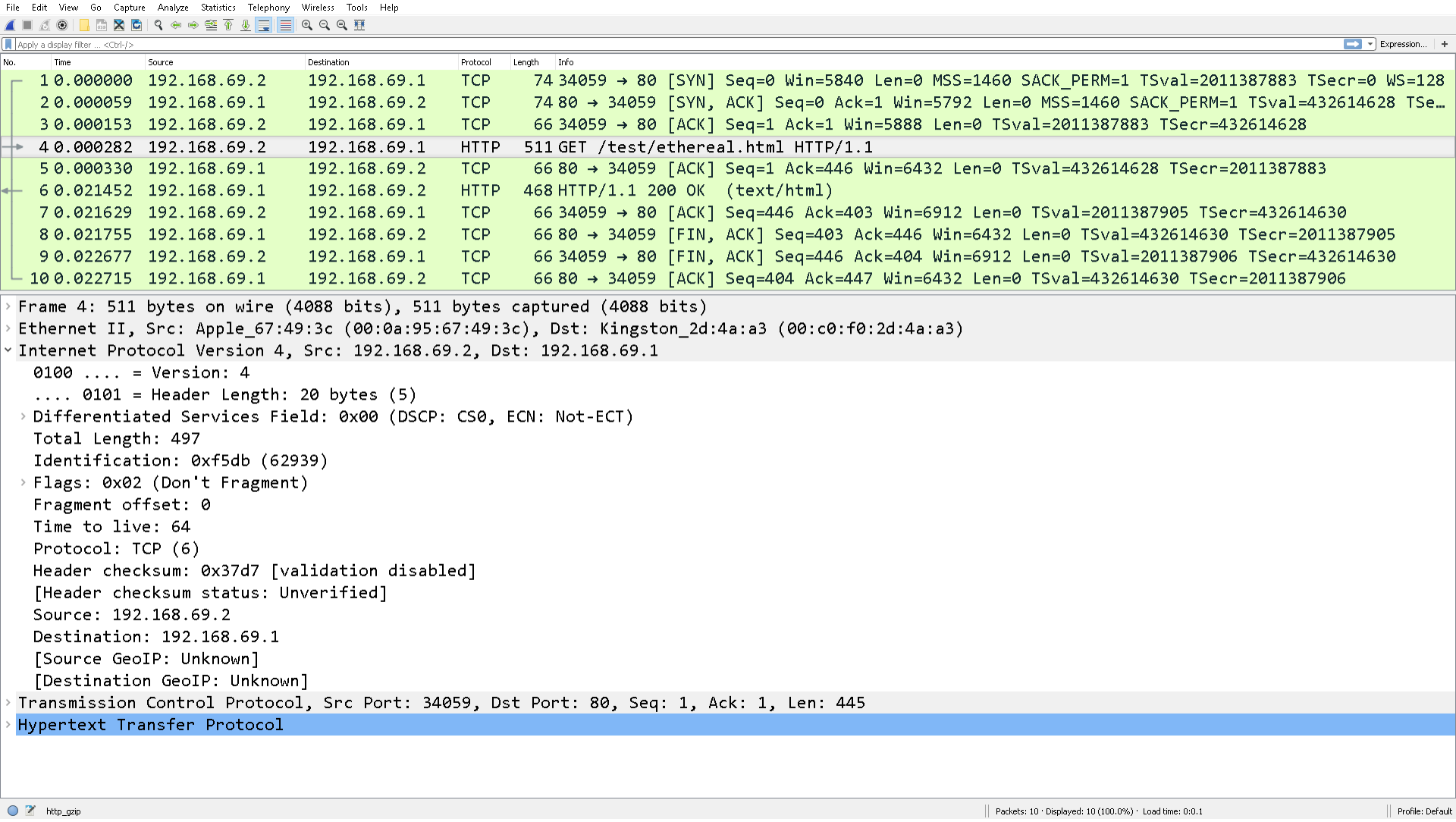
HTTP Request



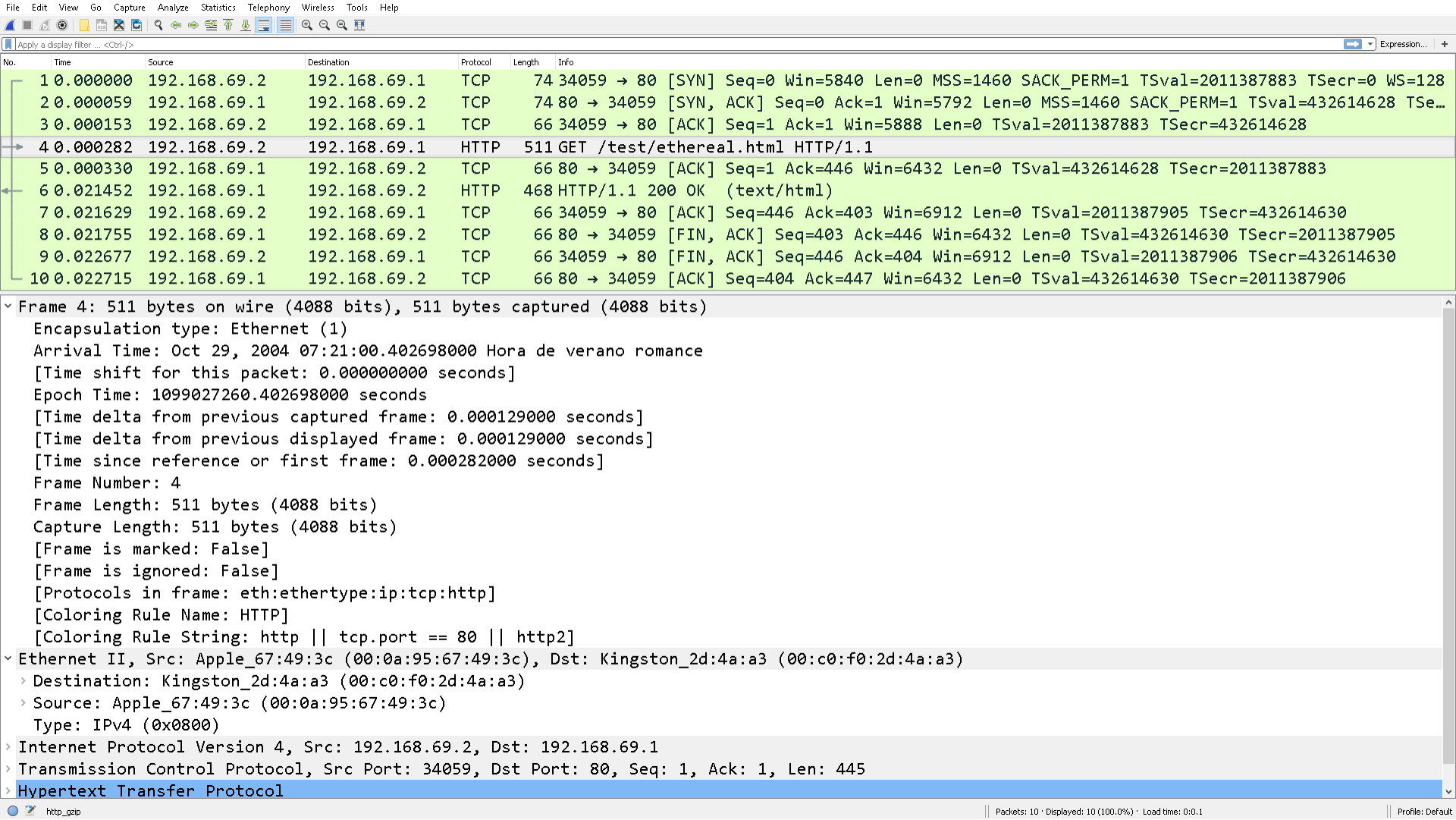
HTTP Request - TCP



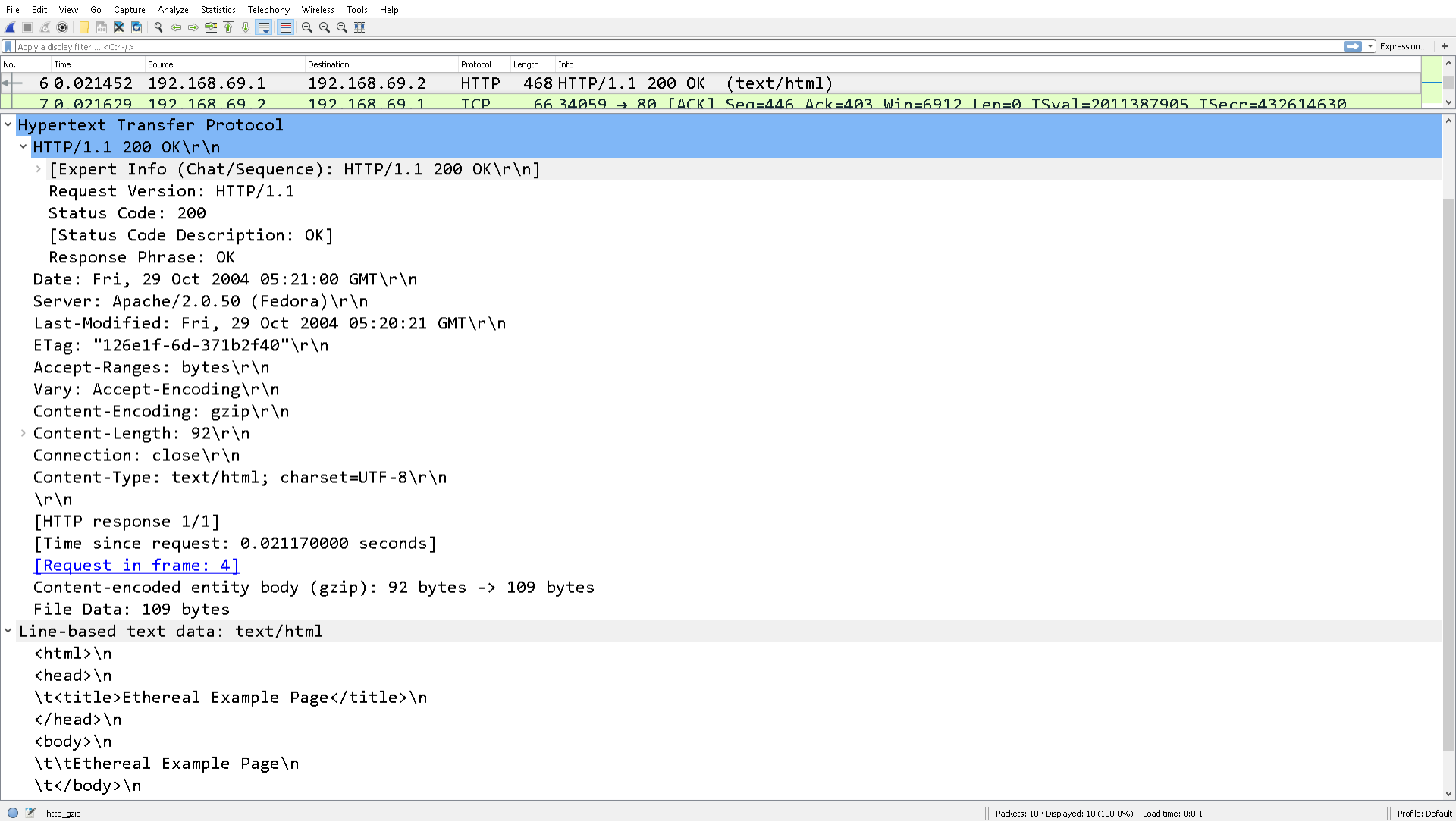
HTTP Request - IP



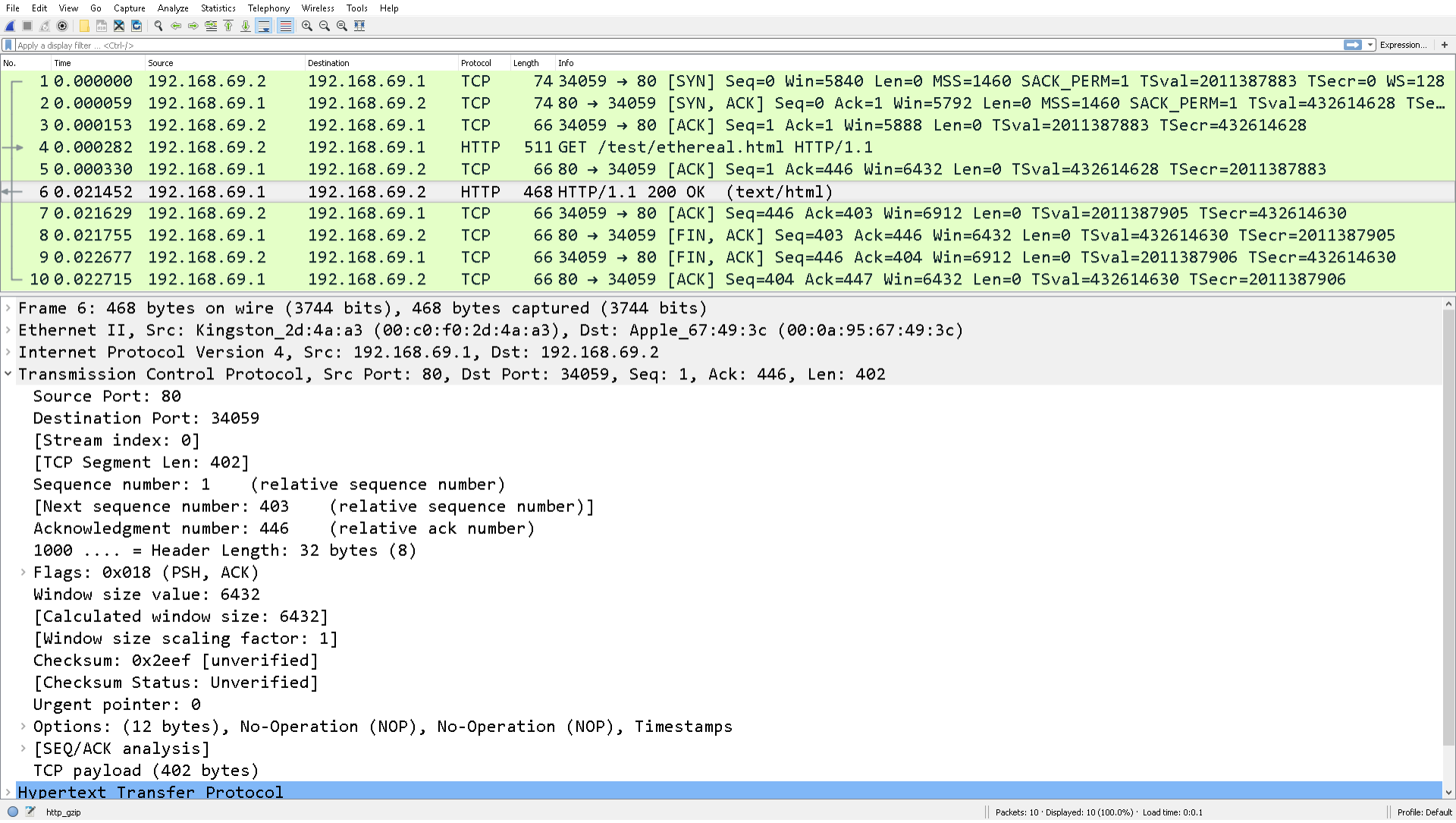
HTTP Request – Data Link



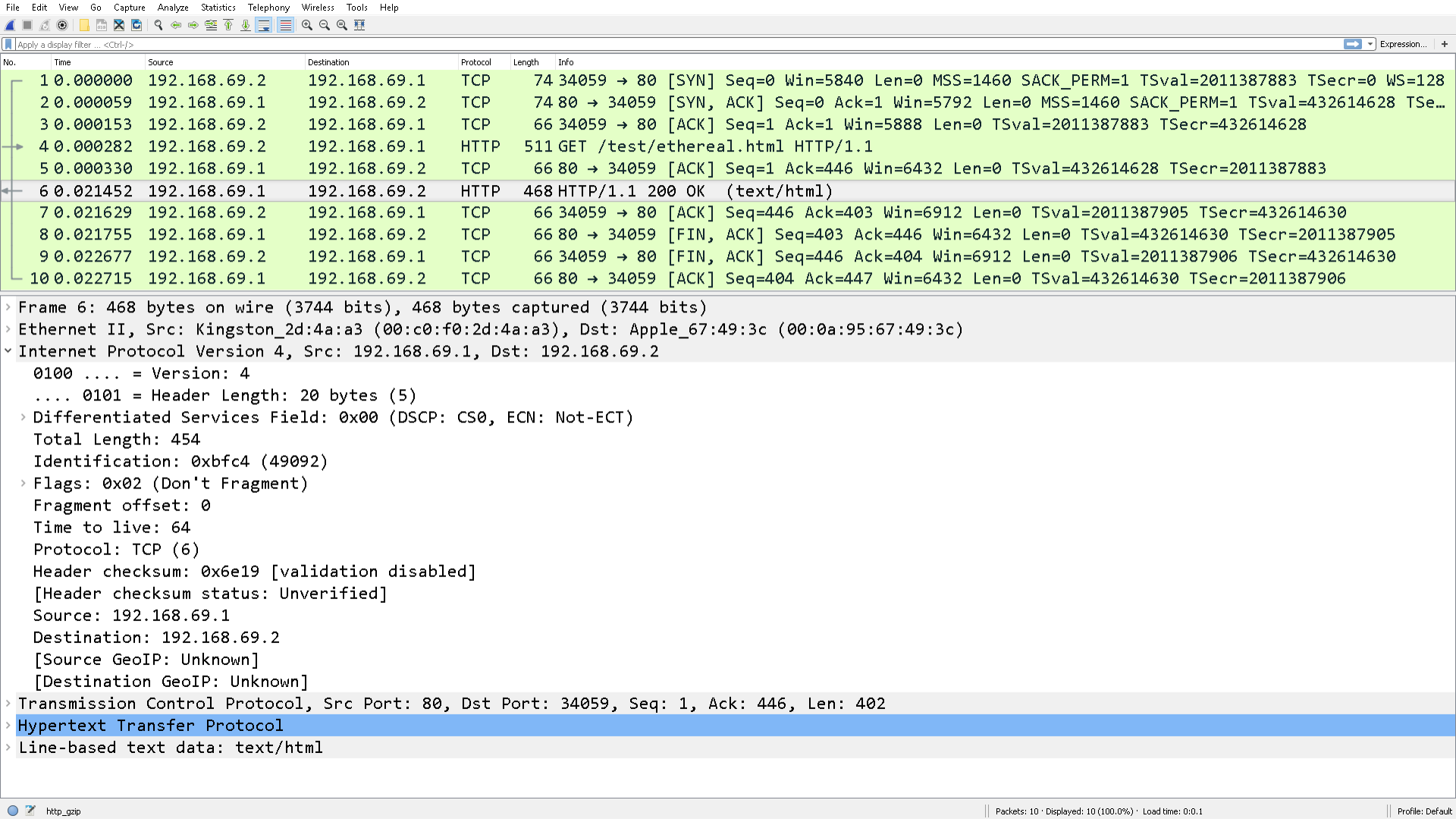
HTTP Response - HTML



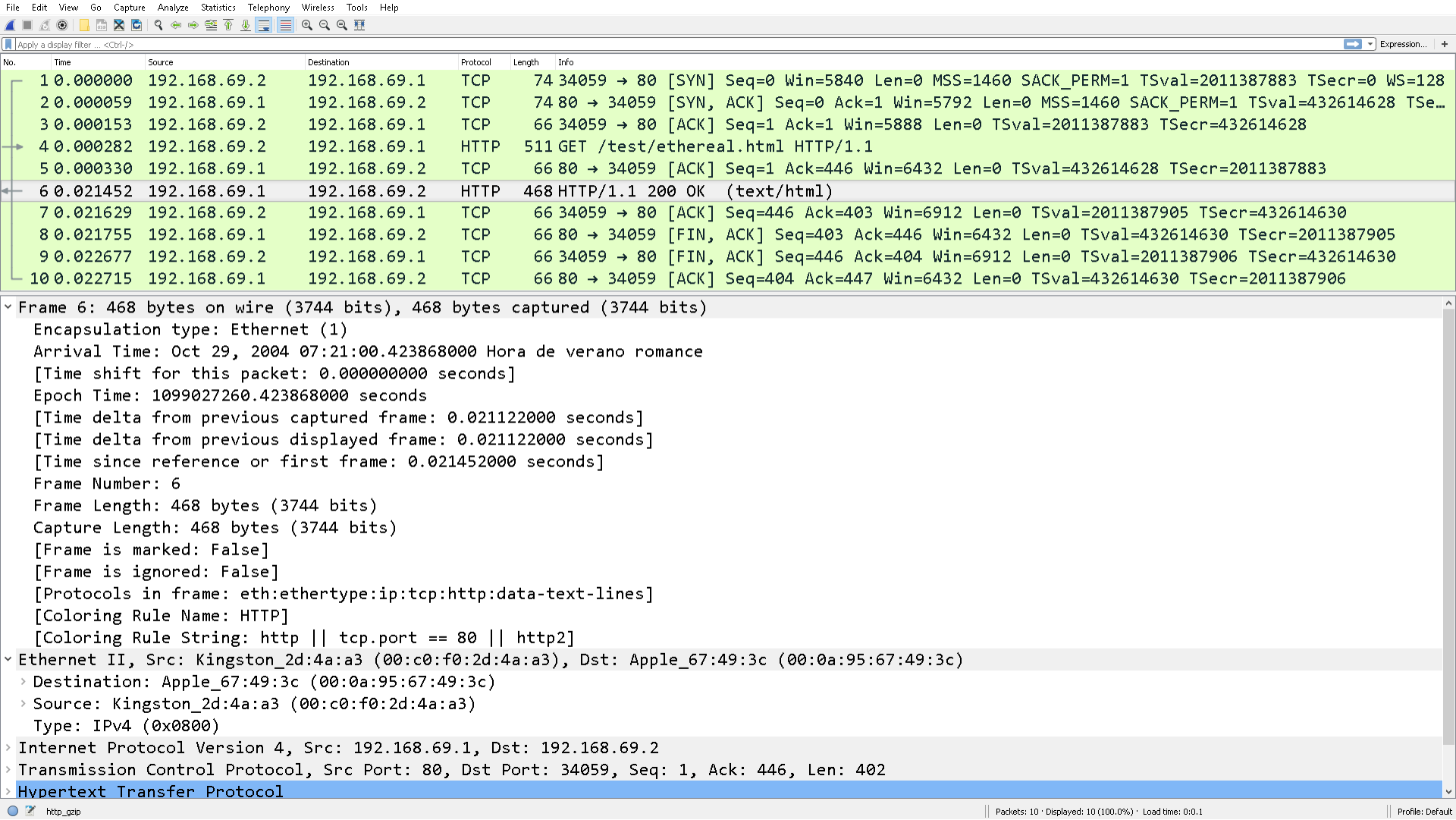
HTTP Response - TCP



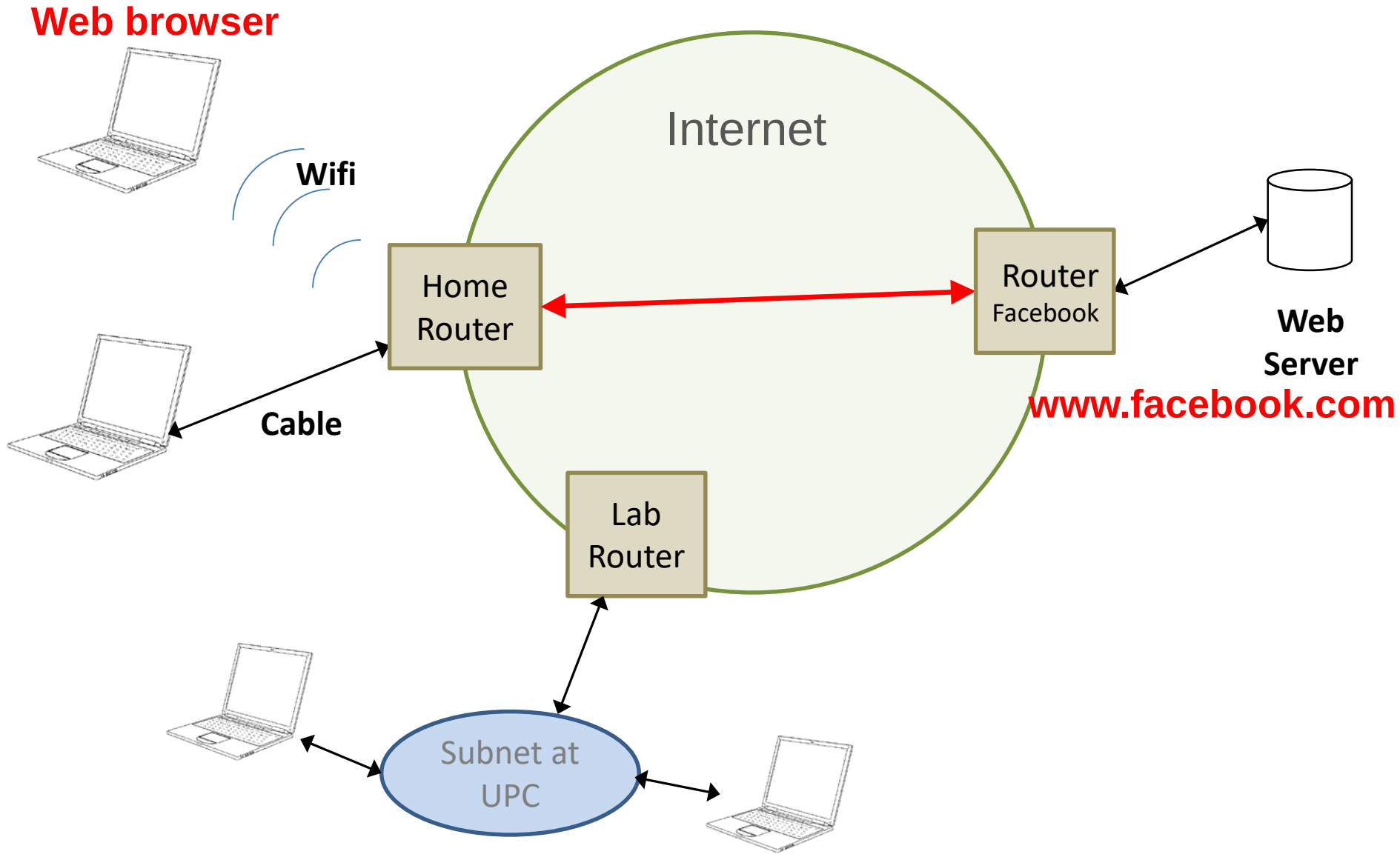
HTTP Response - IP



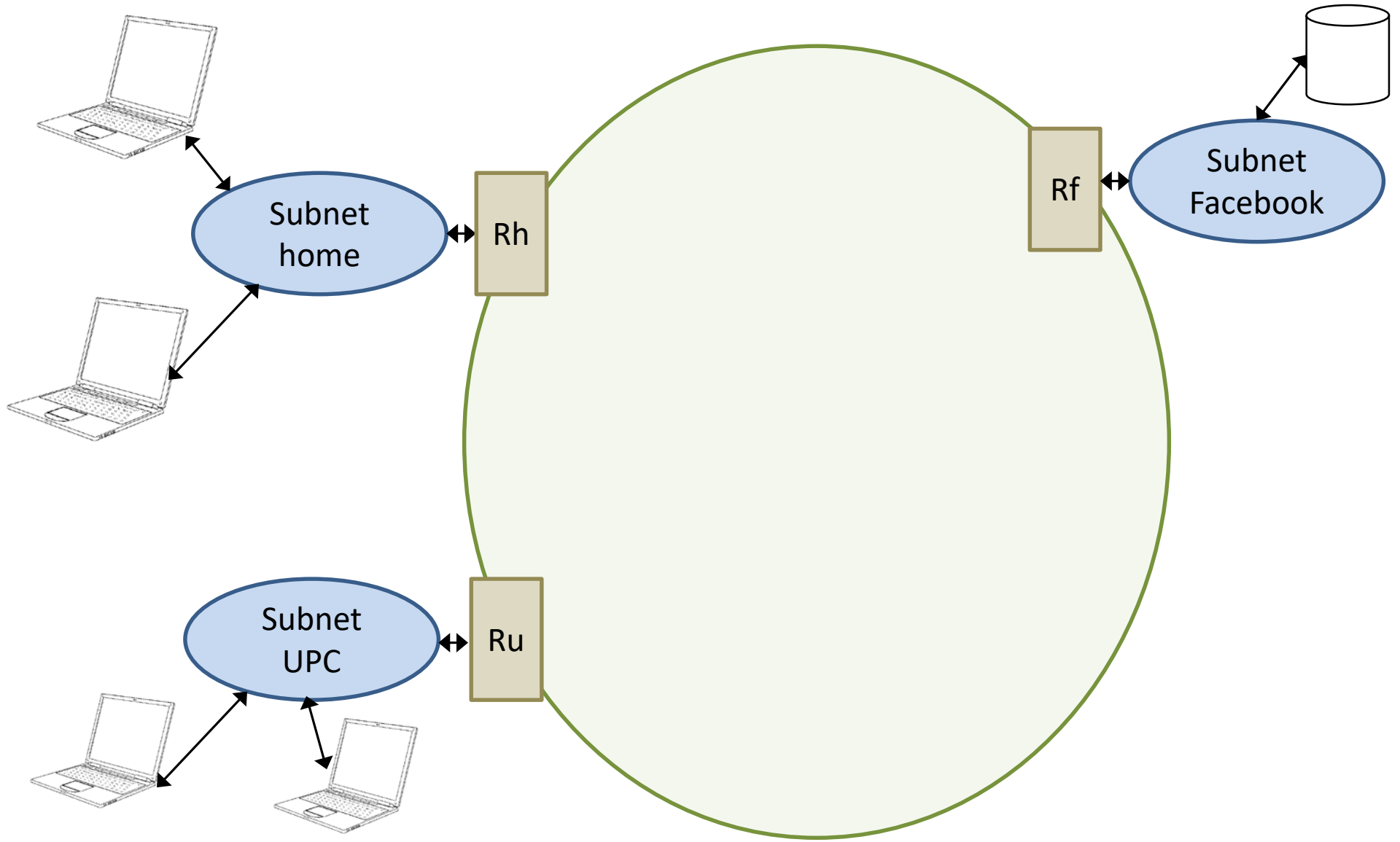
HTTP Response – Data Link



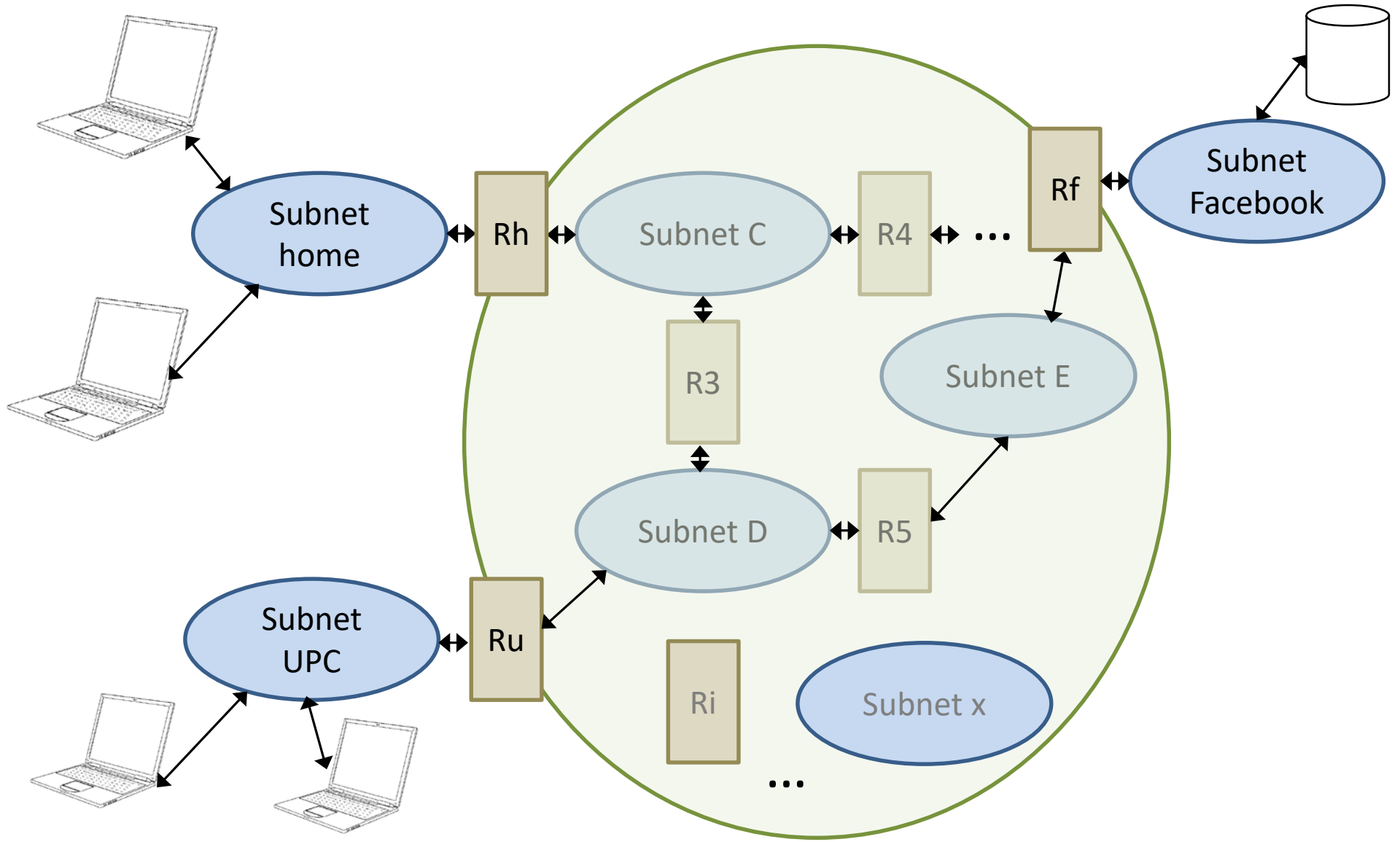
From application to network



The network

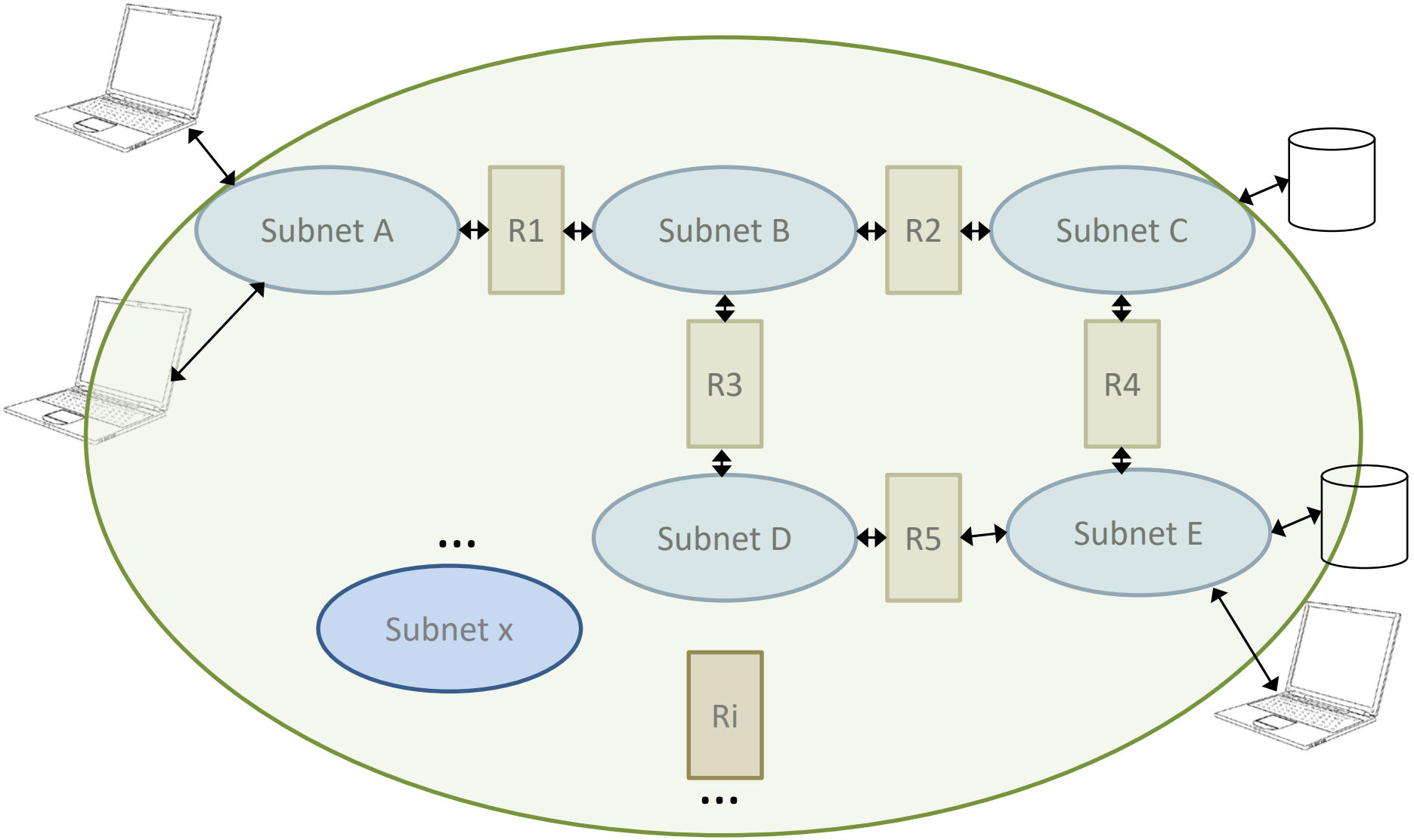


The network


Subnet home
Rh
Subnet C
R4
...
Rf
Subnet Facebook
R3
Subnet E
Subnet D
R5
Subnet UPC
Ru
Ri
Subnet x
...

The Internet

Ri: Router



Basic concepts

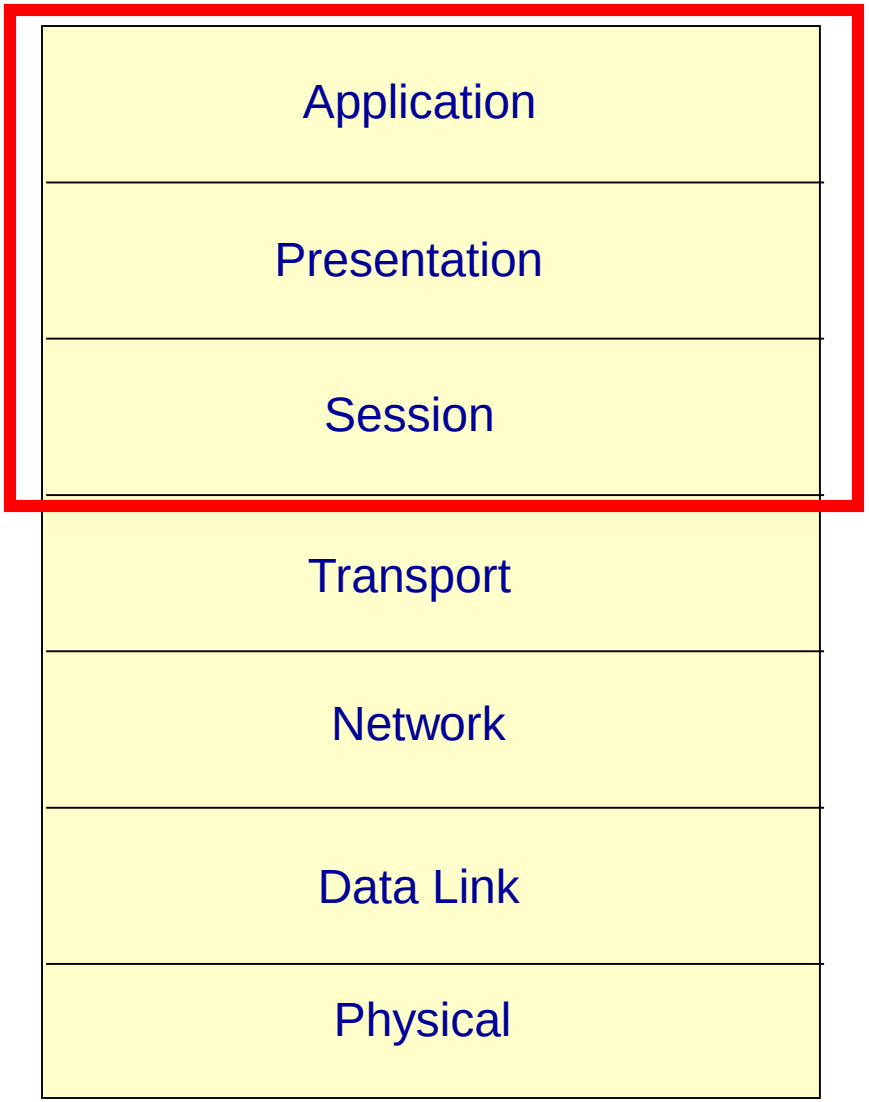
- Host: Computer, Server, …
- Network equipment: Routers, …
- The Internet: Network of (sub)networks.

- How to approach the complexity:
  - Model/Structure with Layers/Levels.

Reference models

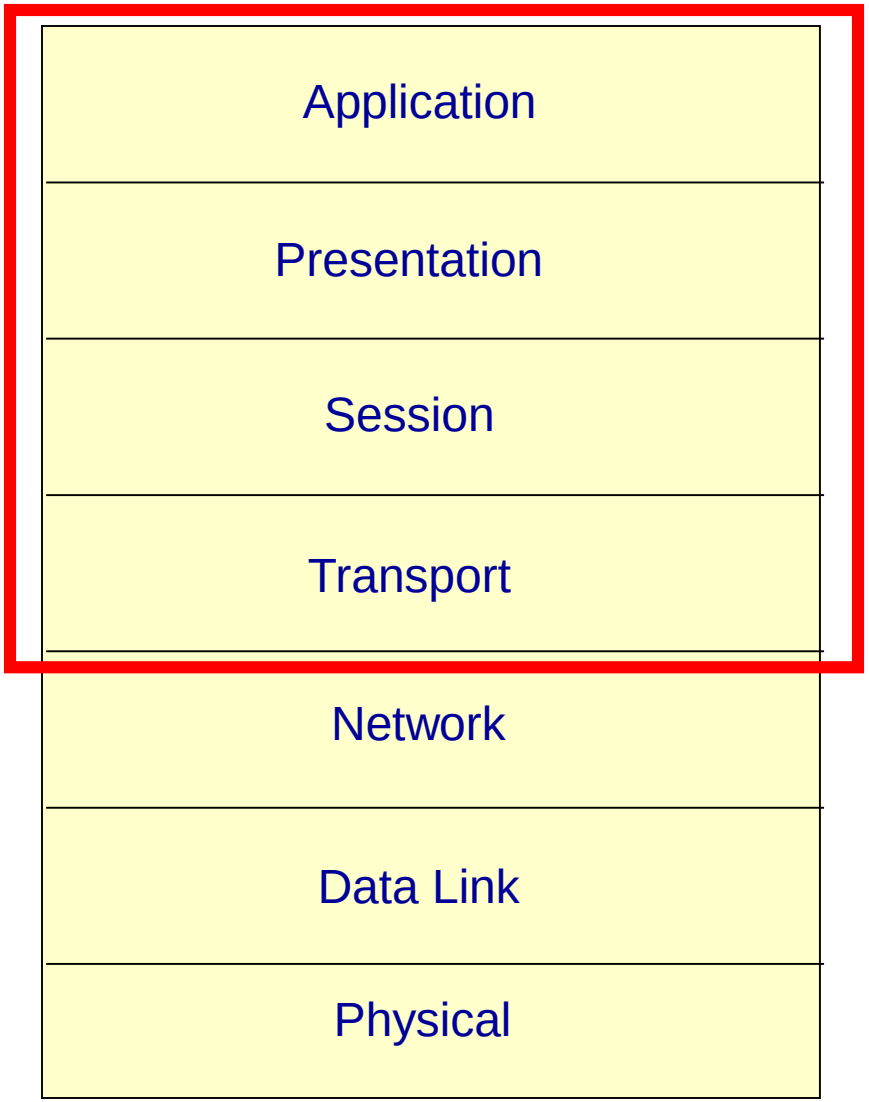
- Model/Structure with Layers/Levels
  → Layer independence.
- Models:
  - "Formal": OSI (Open Systems Interconnection), from ISO.
  - "Informal" model: Internet.
- Service & Protocol:
  - Service: from one layer to the above one.
  - Protocol: between the same layer entities from two remote systems.

OSI model



"Application" layer

OSI model

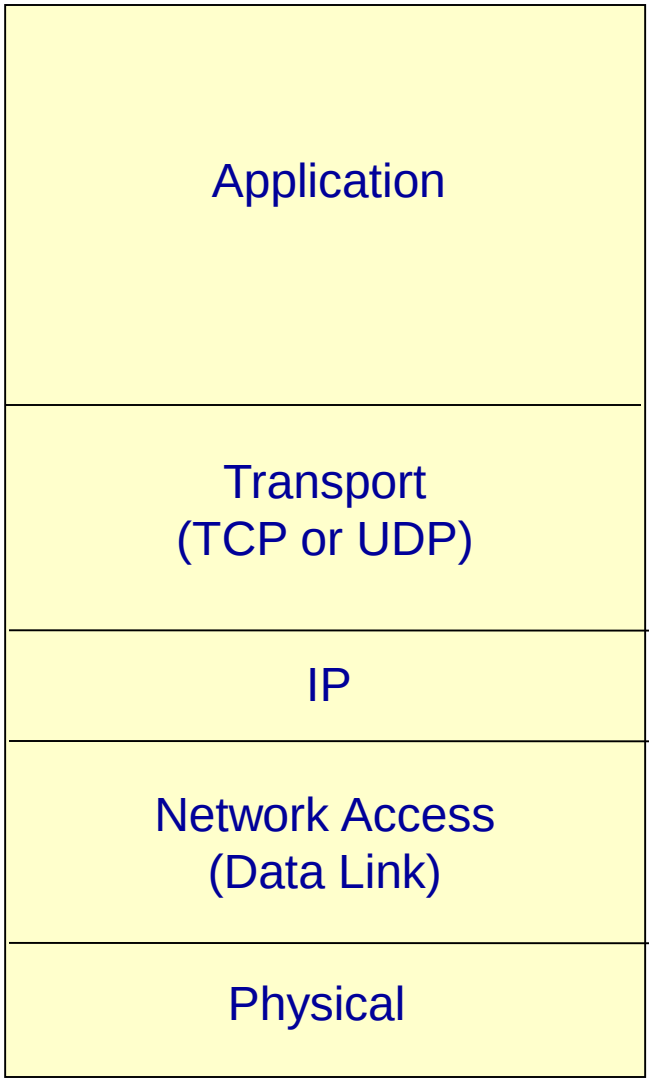


Only in the Computer ("Host")

OSI model

The Network

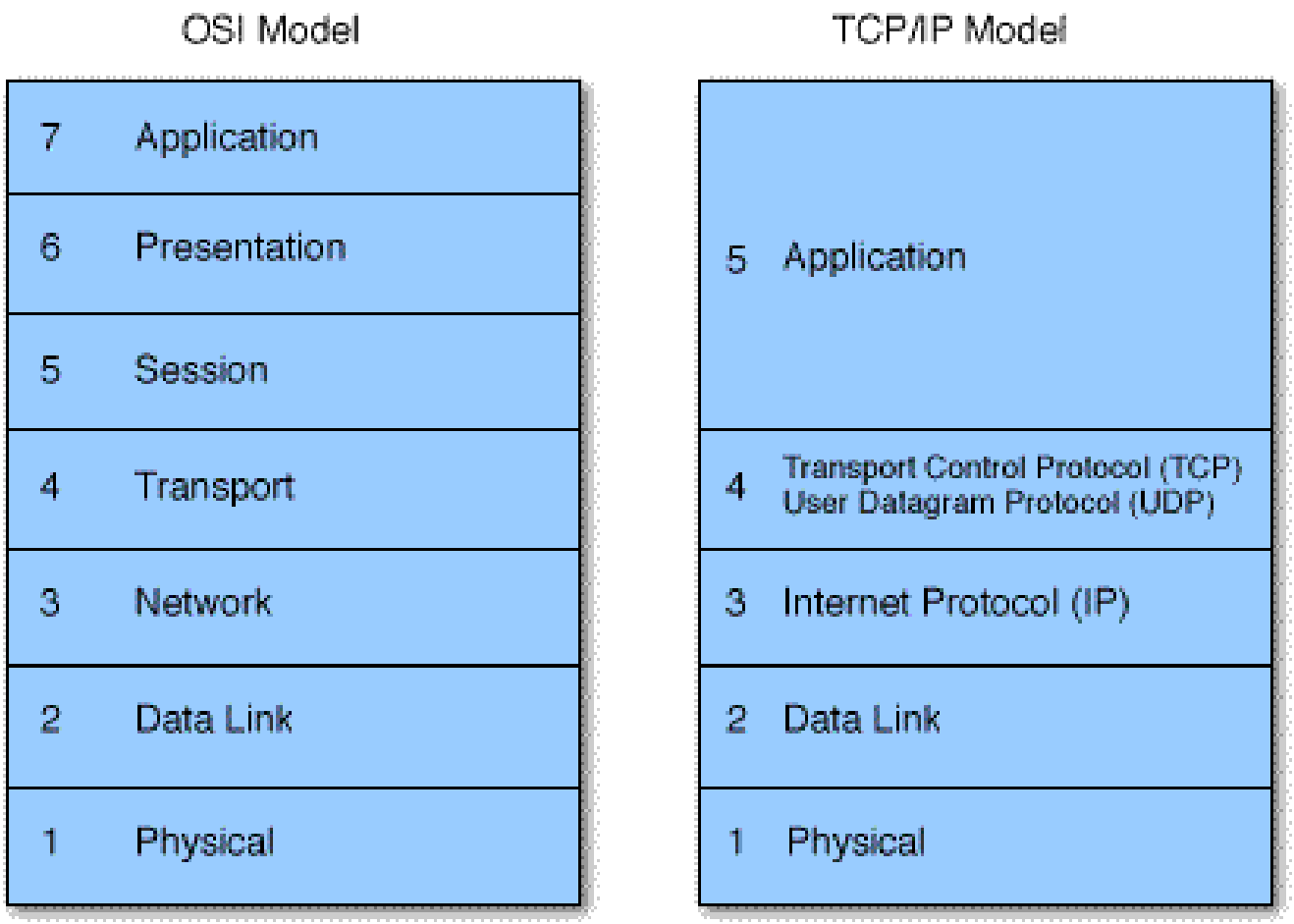
Internet model



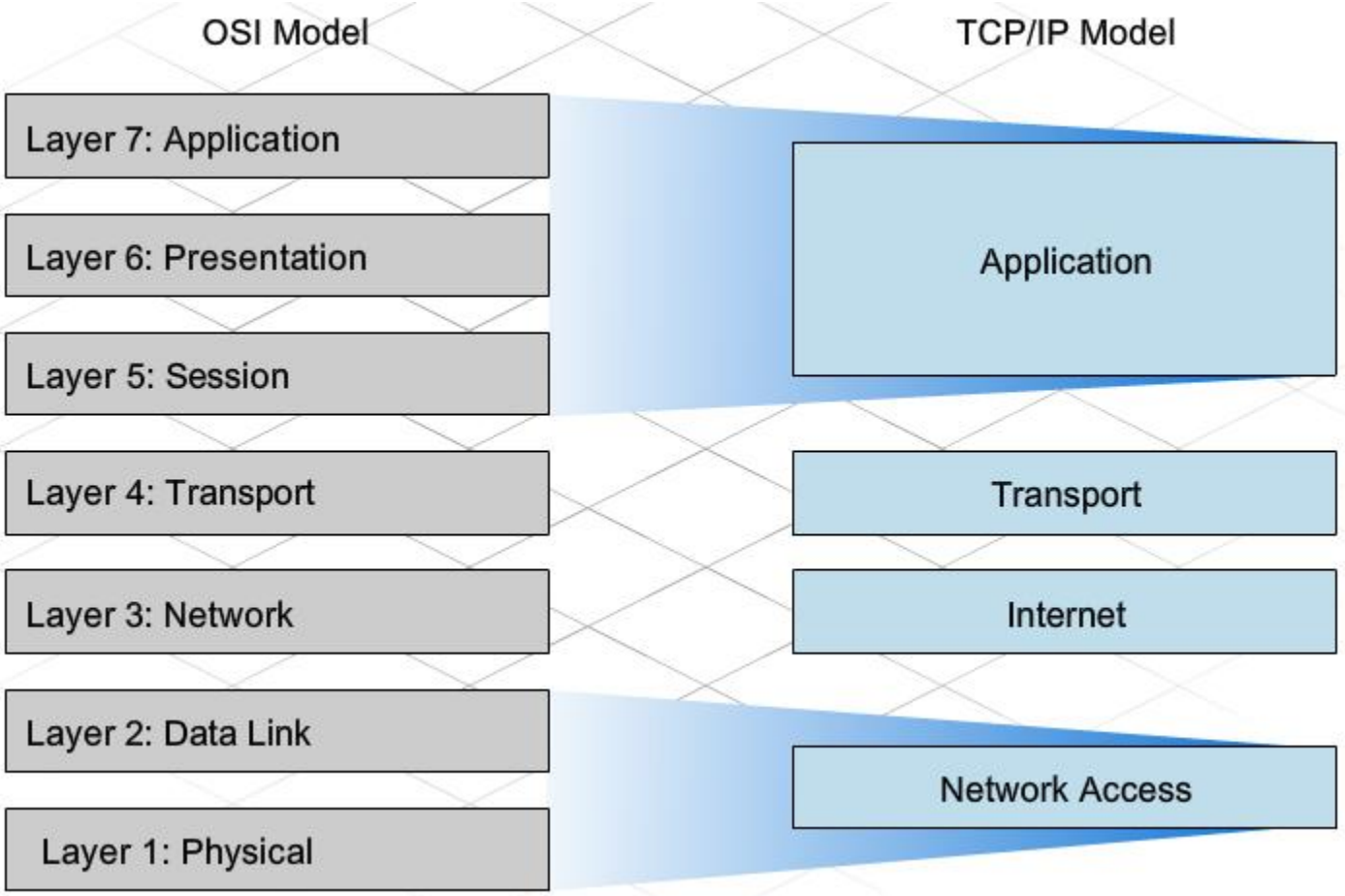
Models comparison

<table>
<tr><td rowspan="3">Application</td><td>Application</td></tr>
<tr><td>Presentation</td></tr>
<tr><td rowspan="2">Session</td></tr>
<tr><td rowspan="2">Transport
(TCP or UDP)</td><td>Transport</td></tr>
<tr><td>IP</td><td rowspan="2">Network</td></tr>
<tr><td rowspan="2">Network Access
(Data Link)</td><td>(Data)Link</td></tr>
<tr><td>Physical</td><td>Physical</td></tr>
</table>

Models comparison

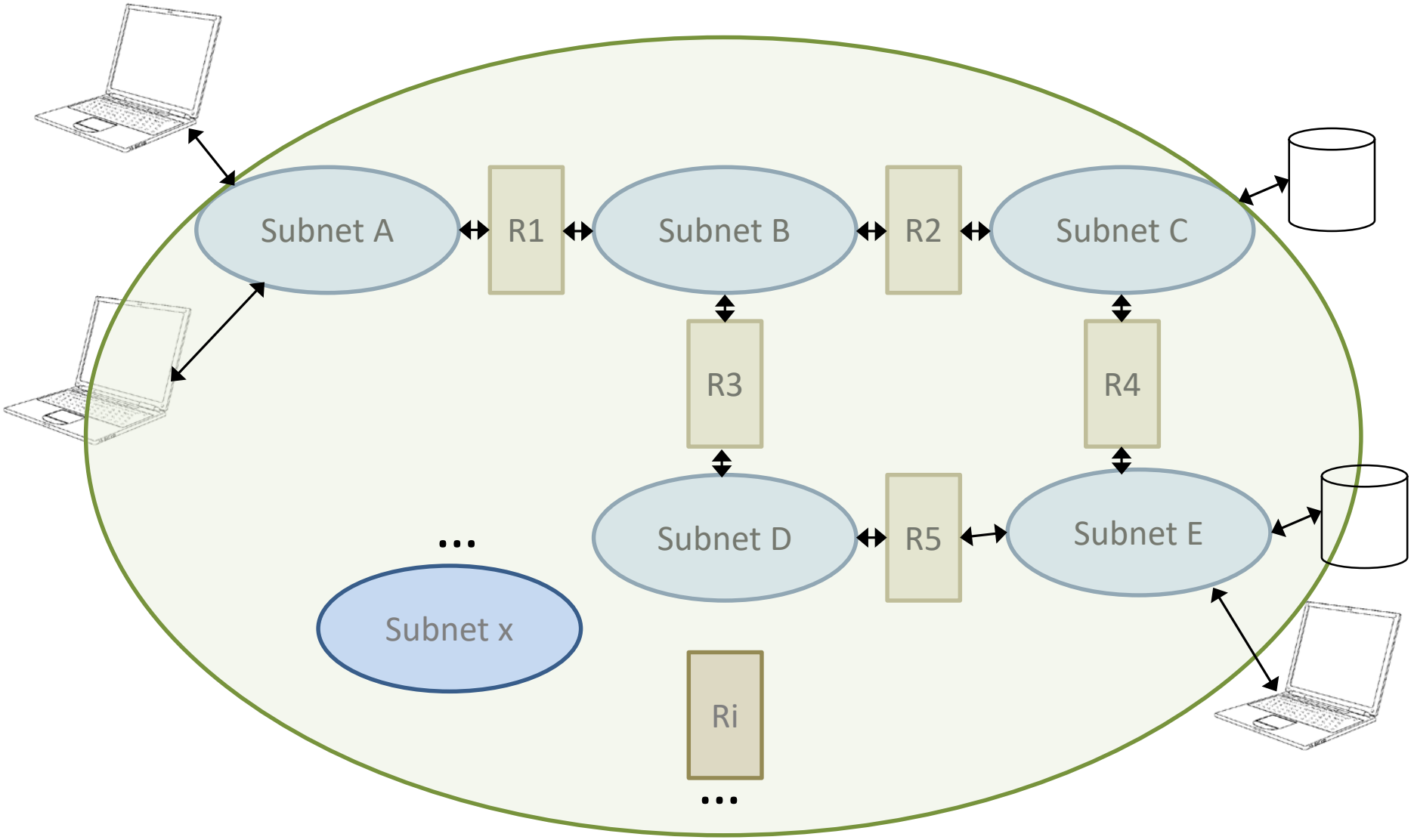


Yet another view



The Internet

Ri: Router



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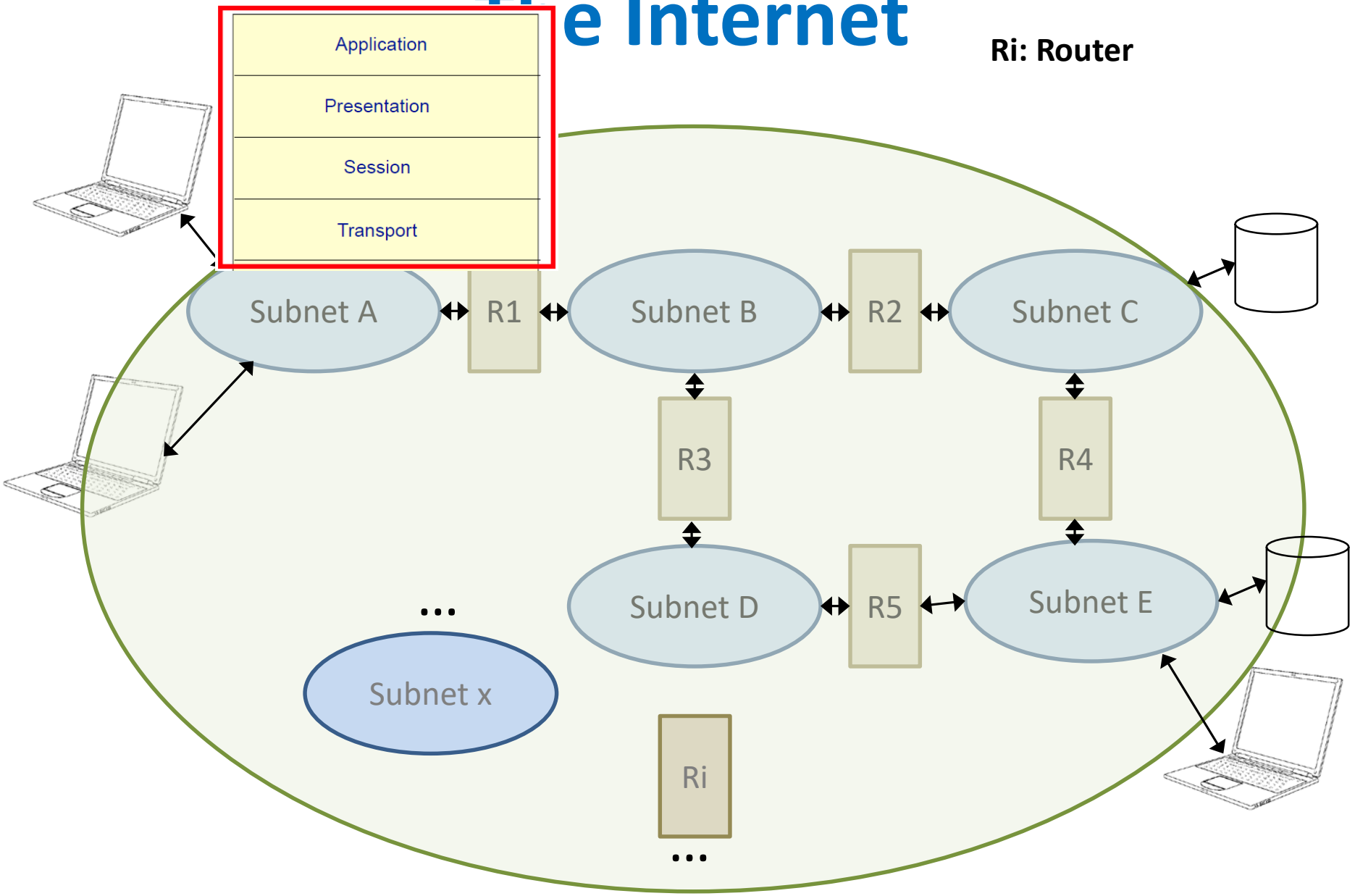

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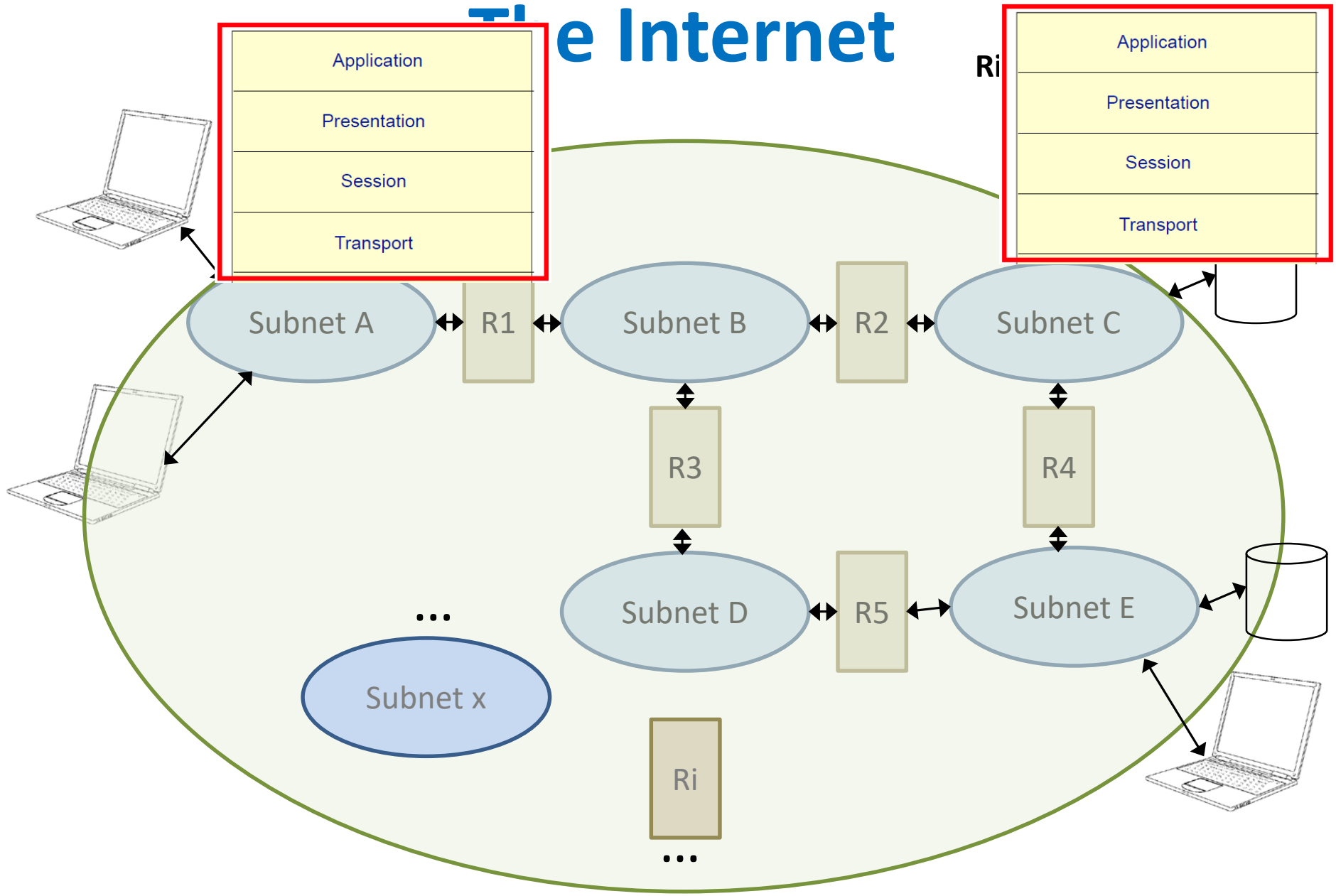

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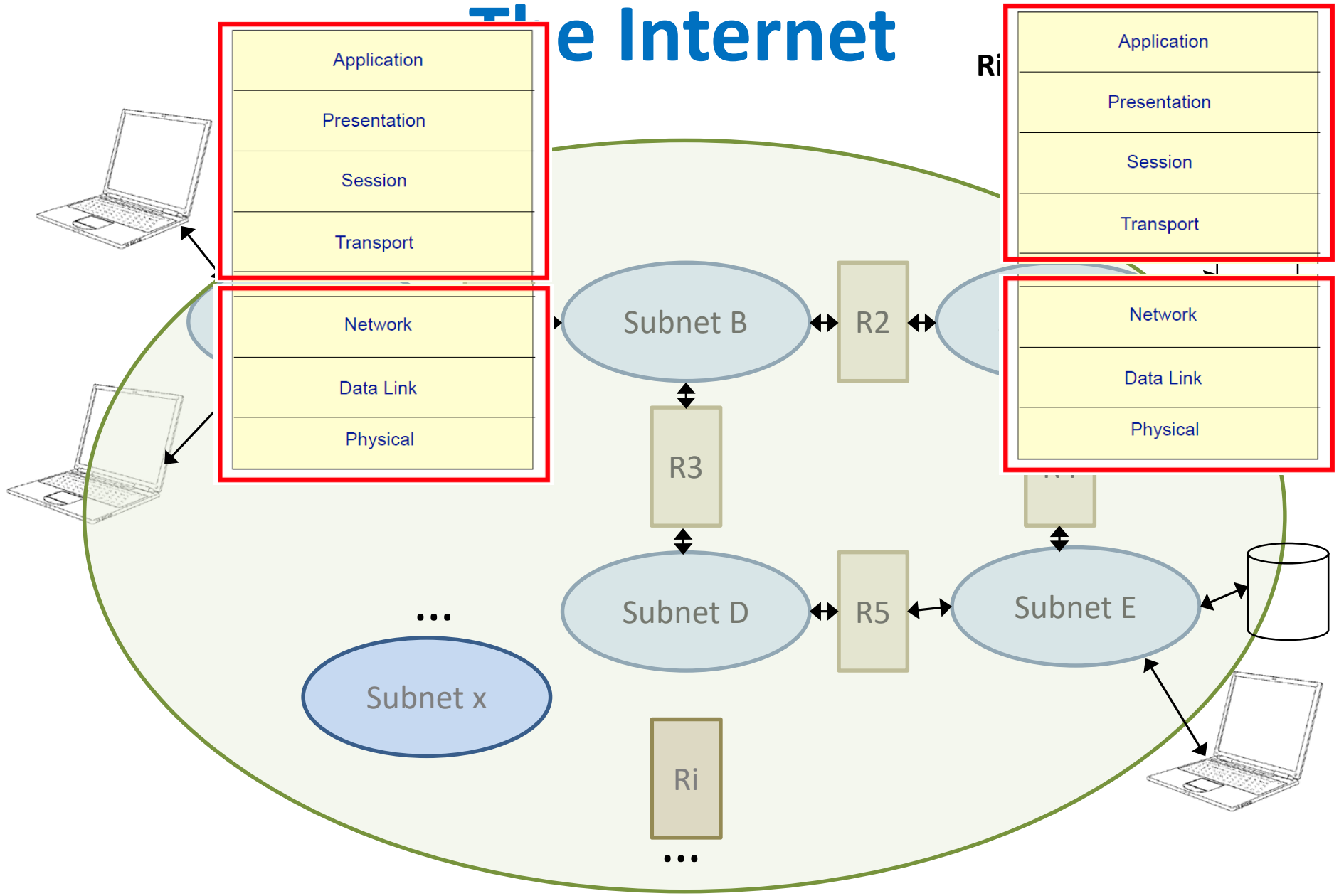

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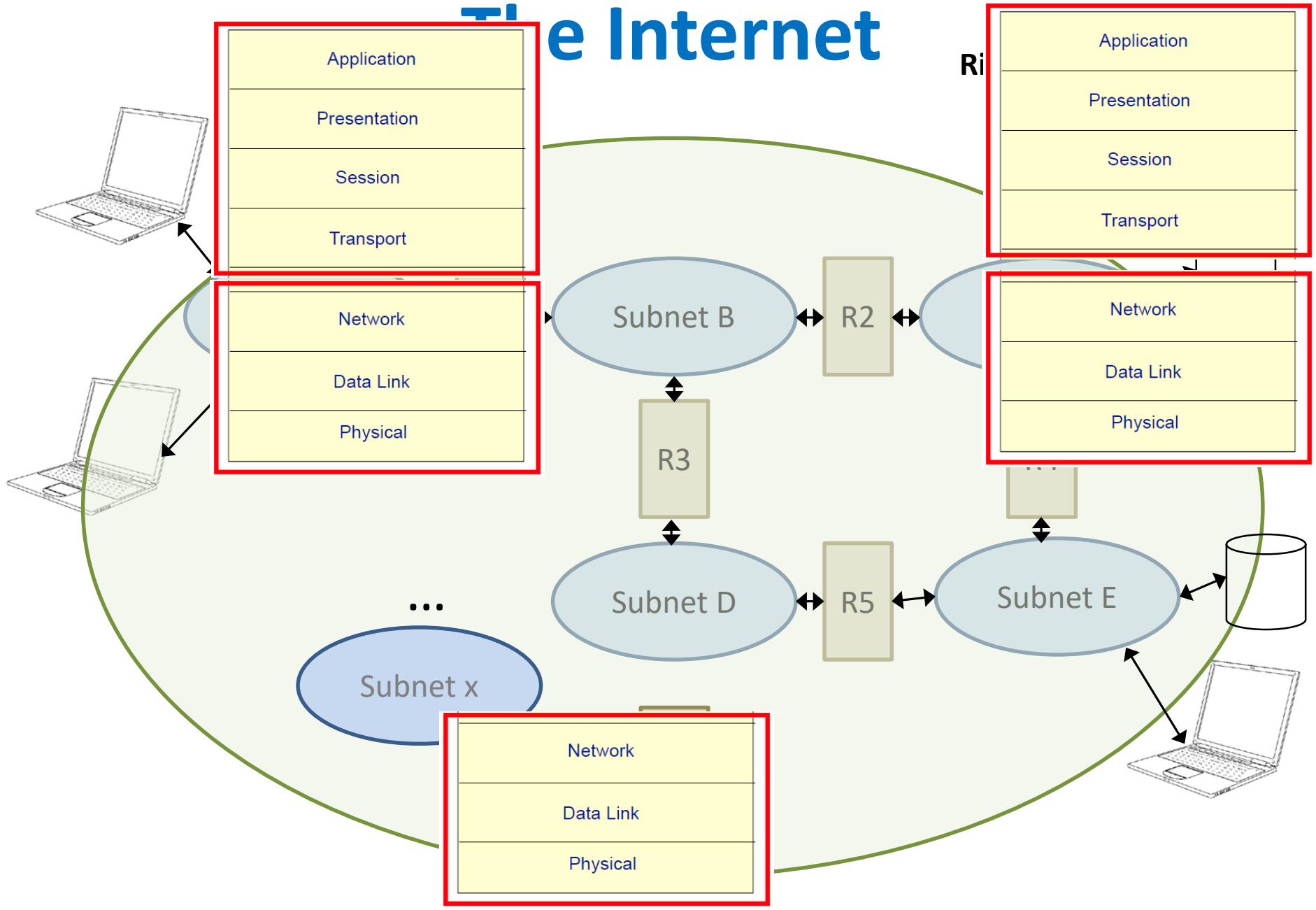

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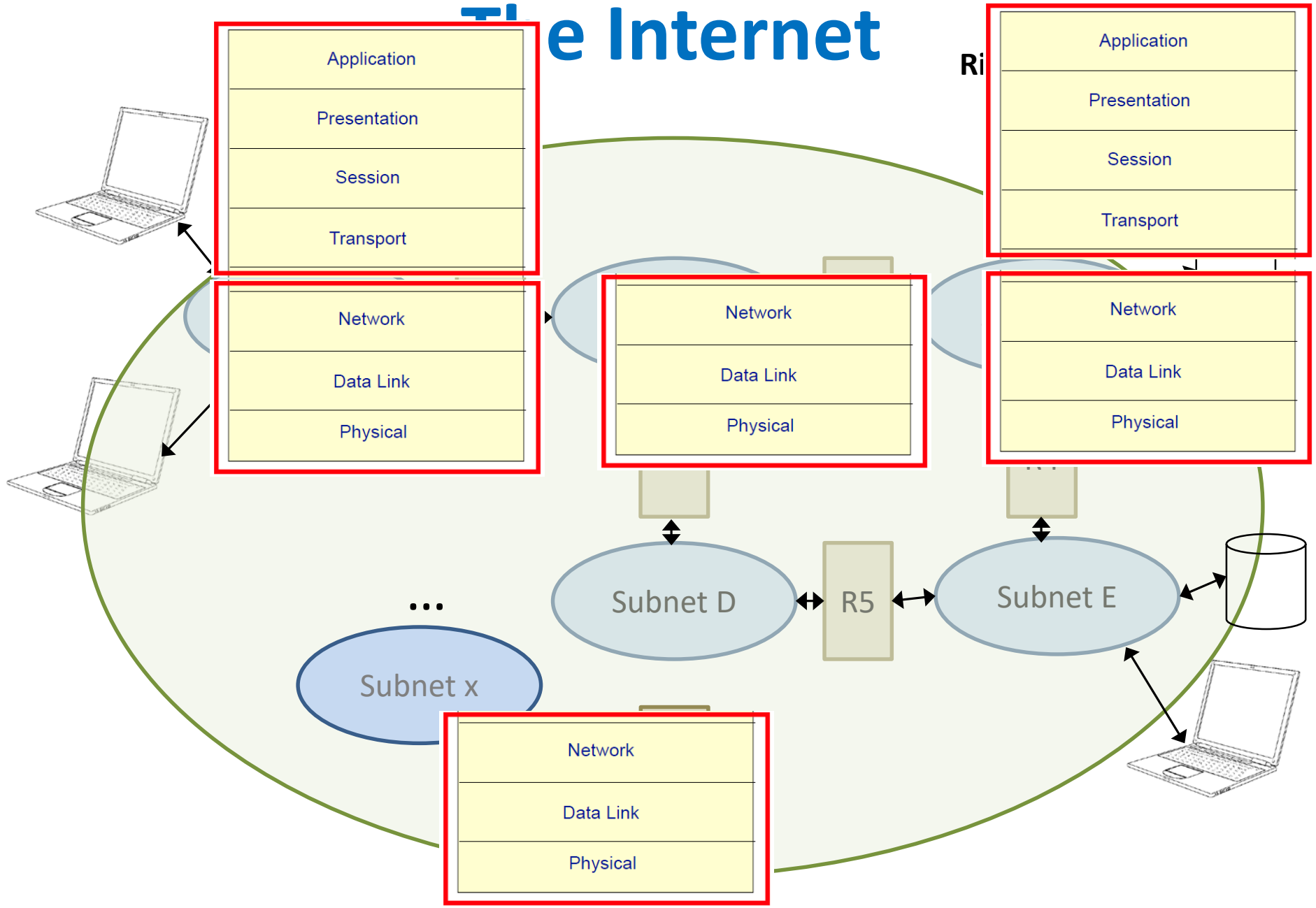

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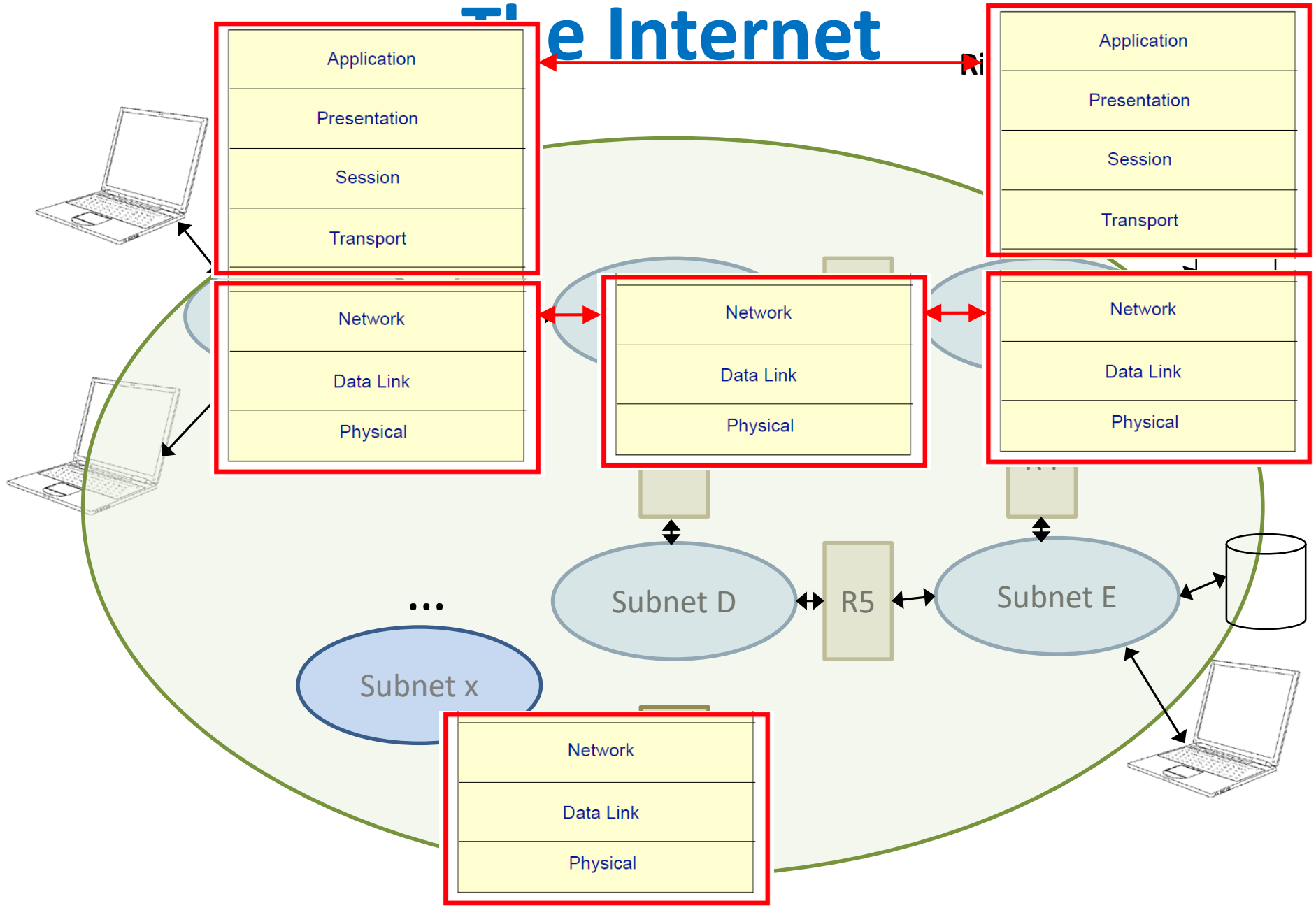
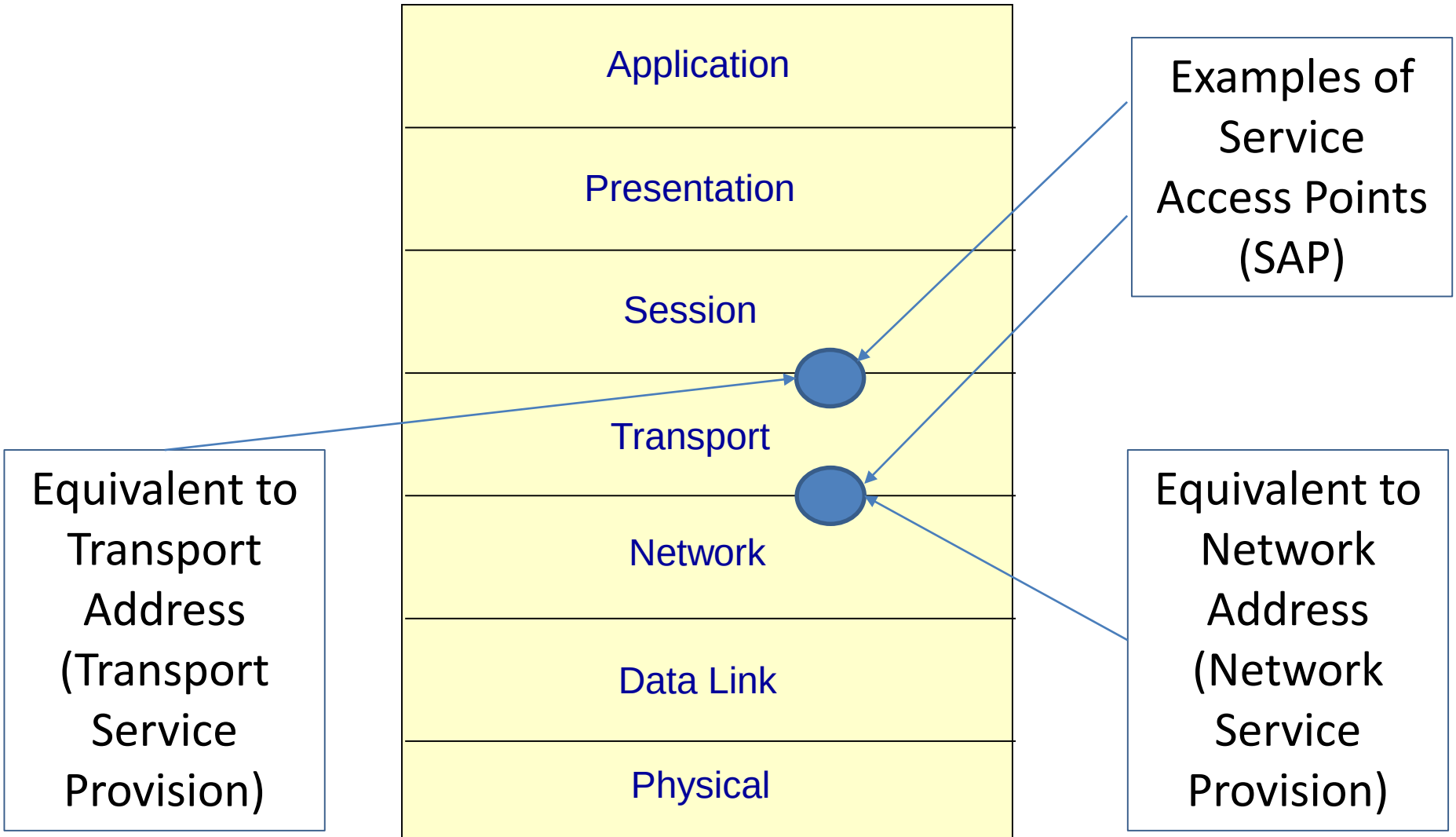


OSI model: details



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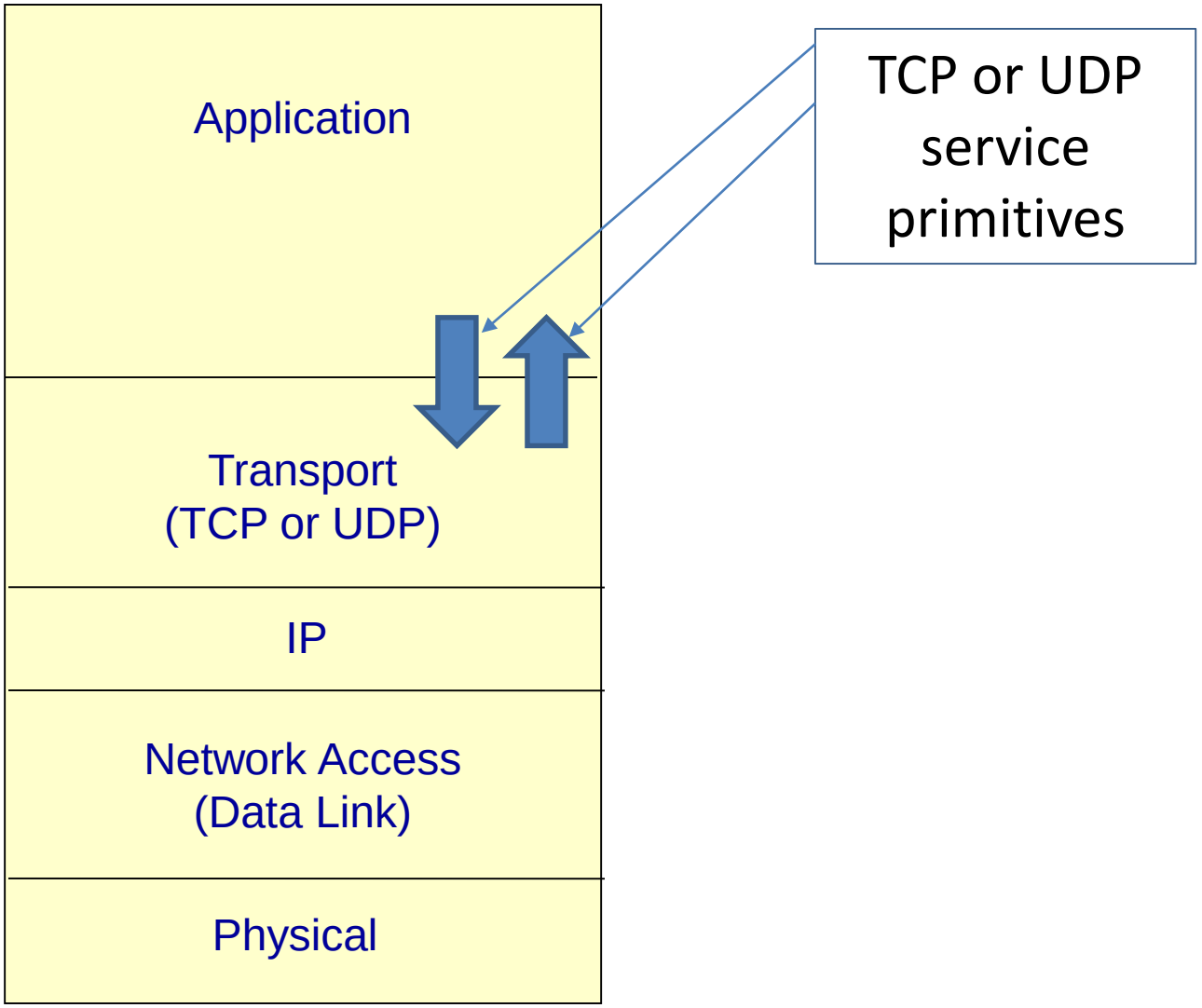

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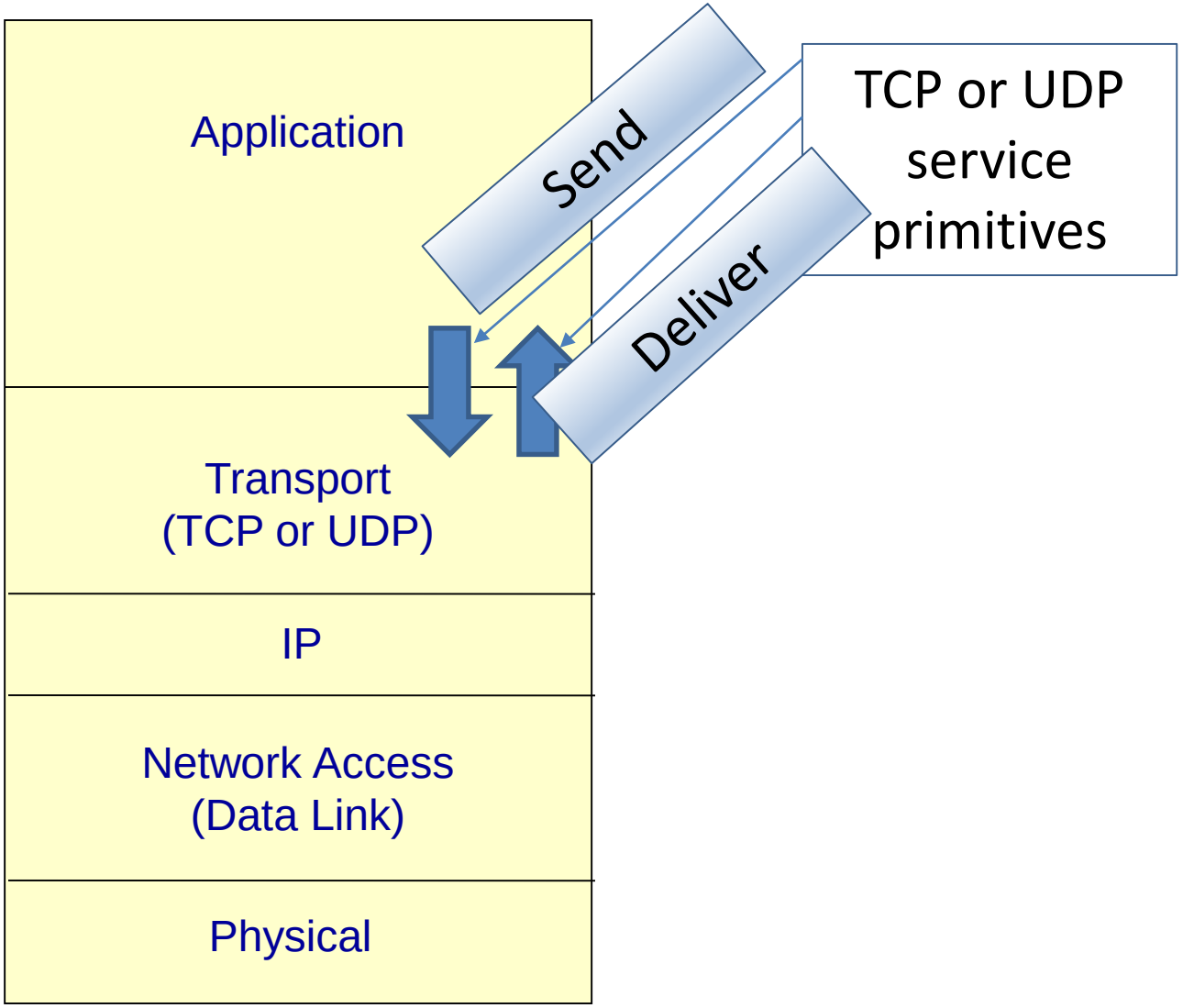
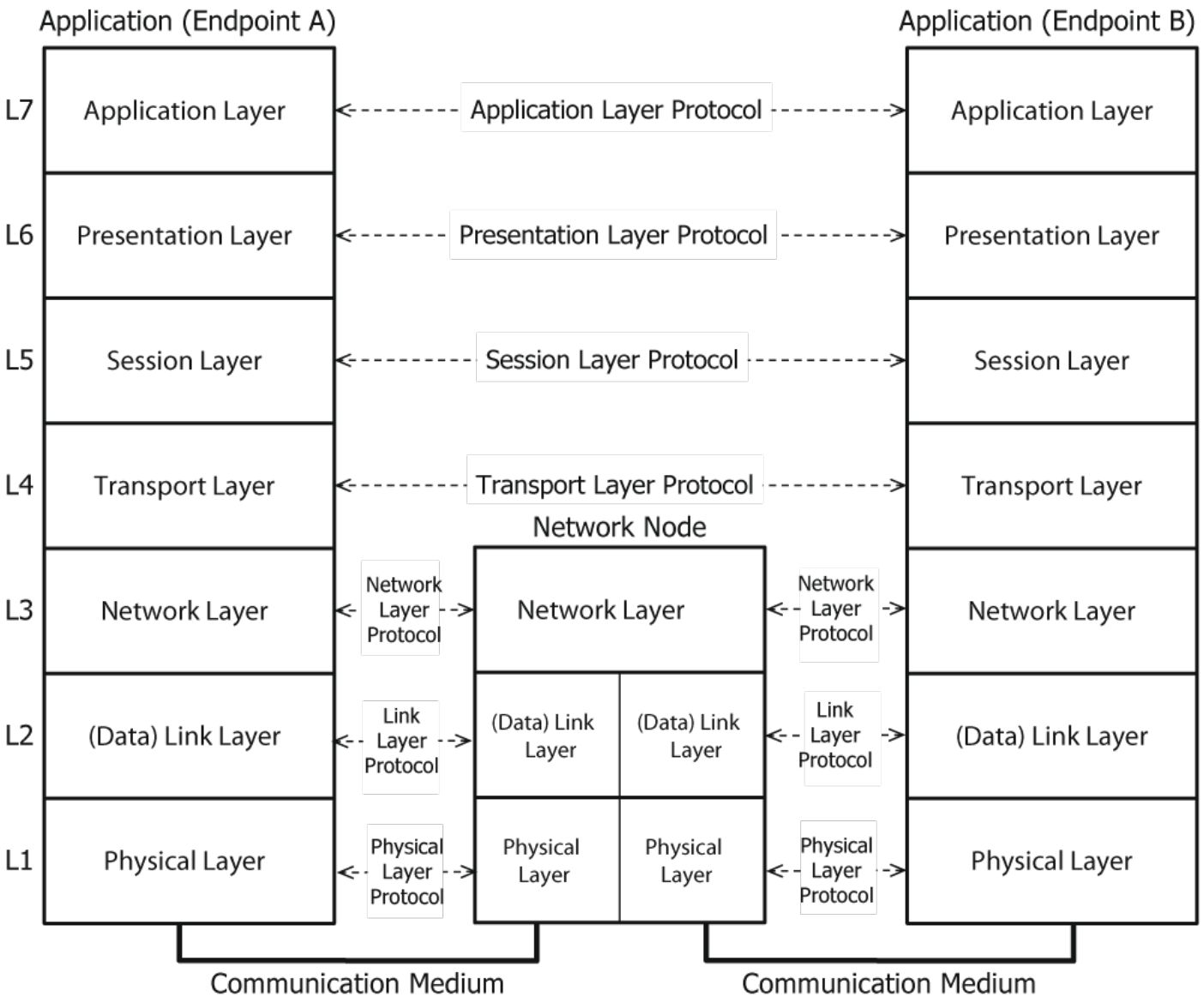


Communication



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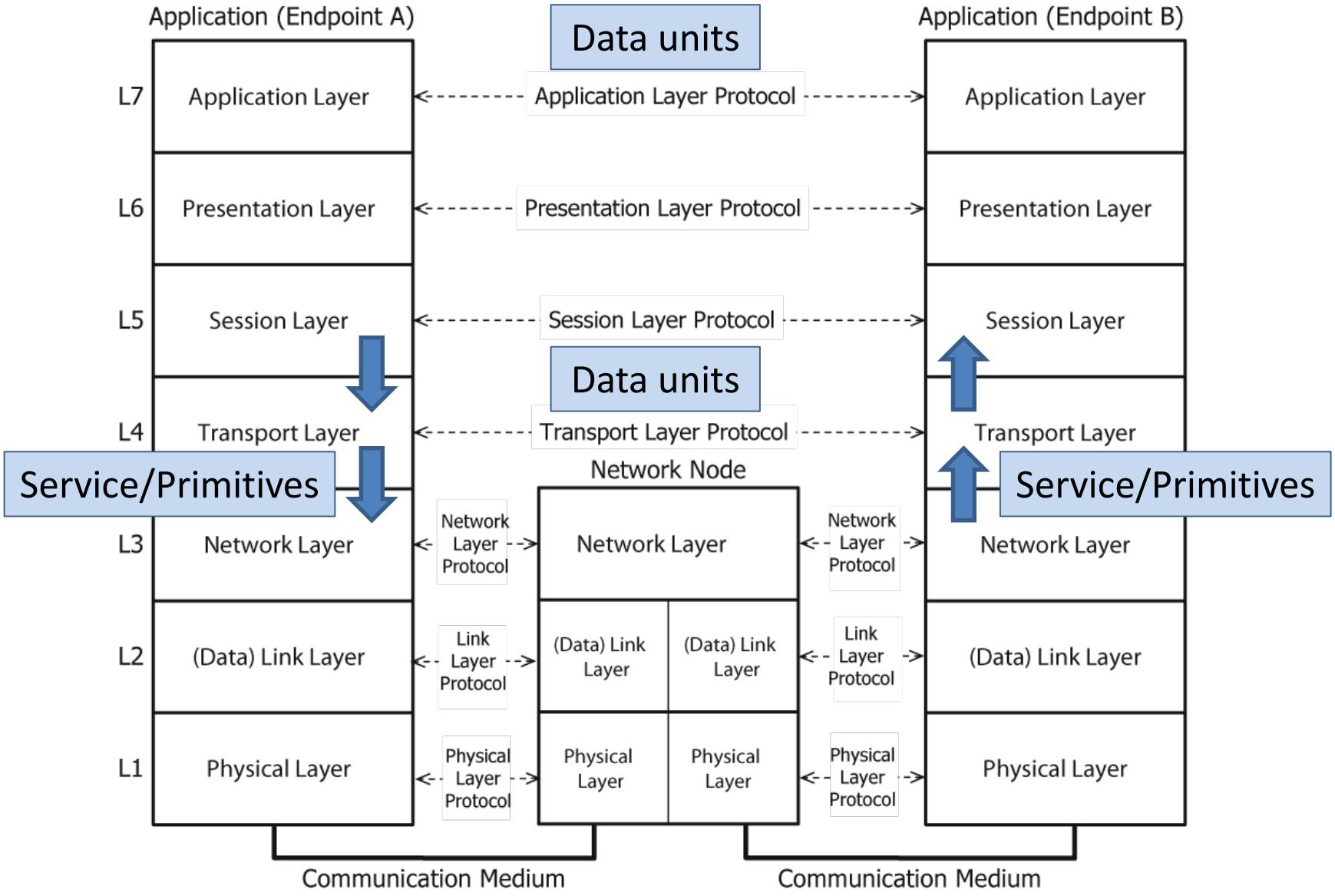

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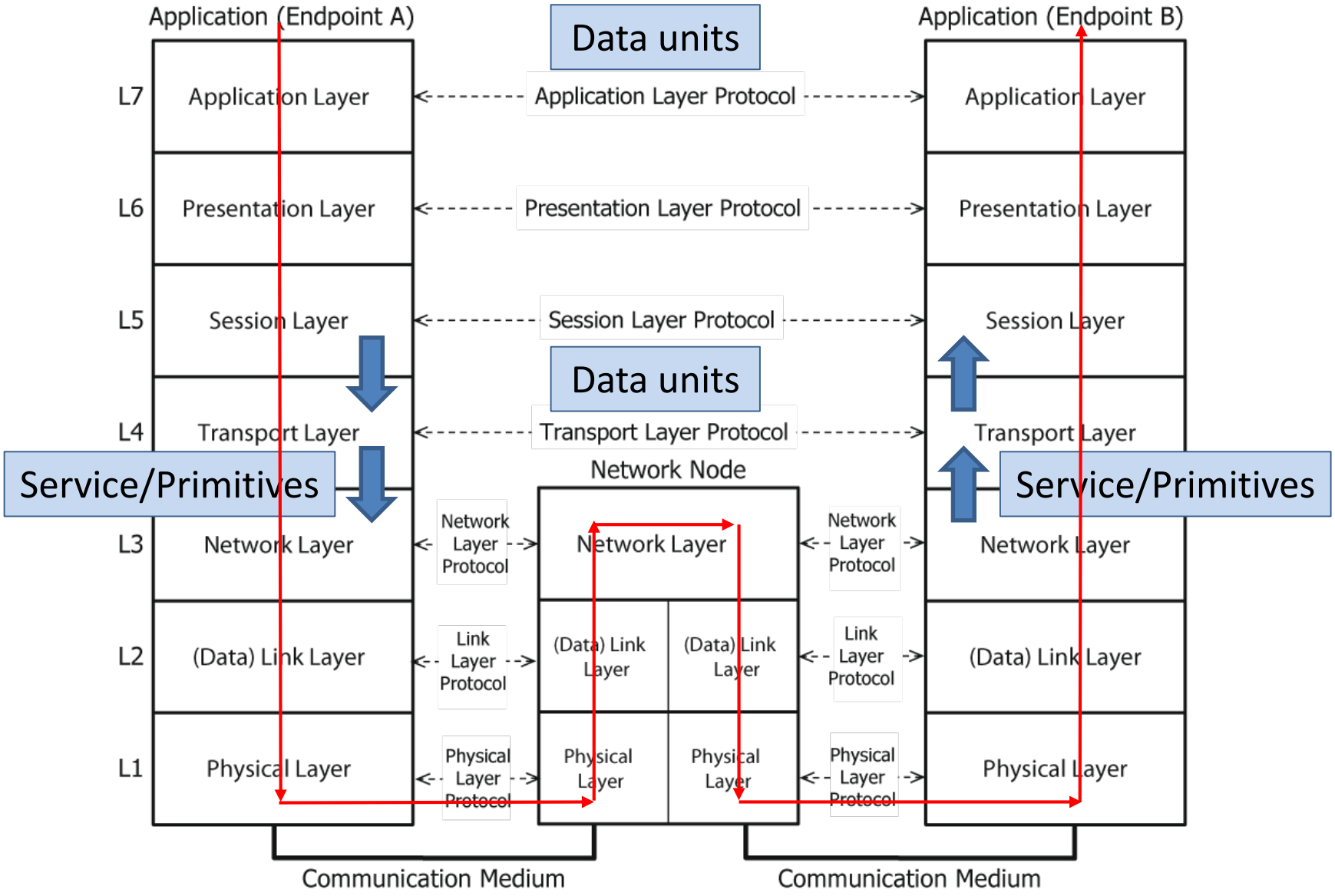
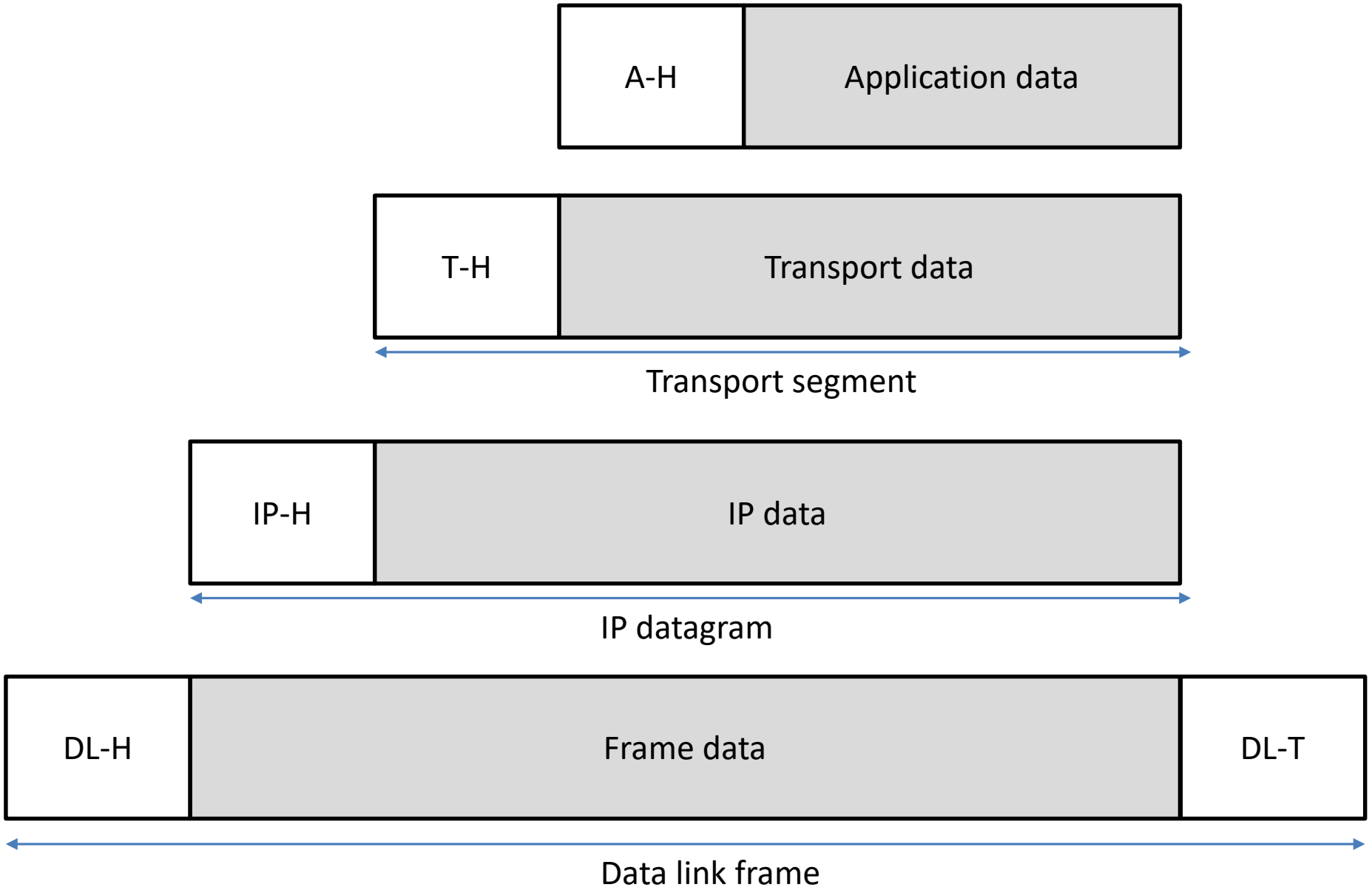


Protocol data units



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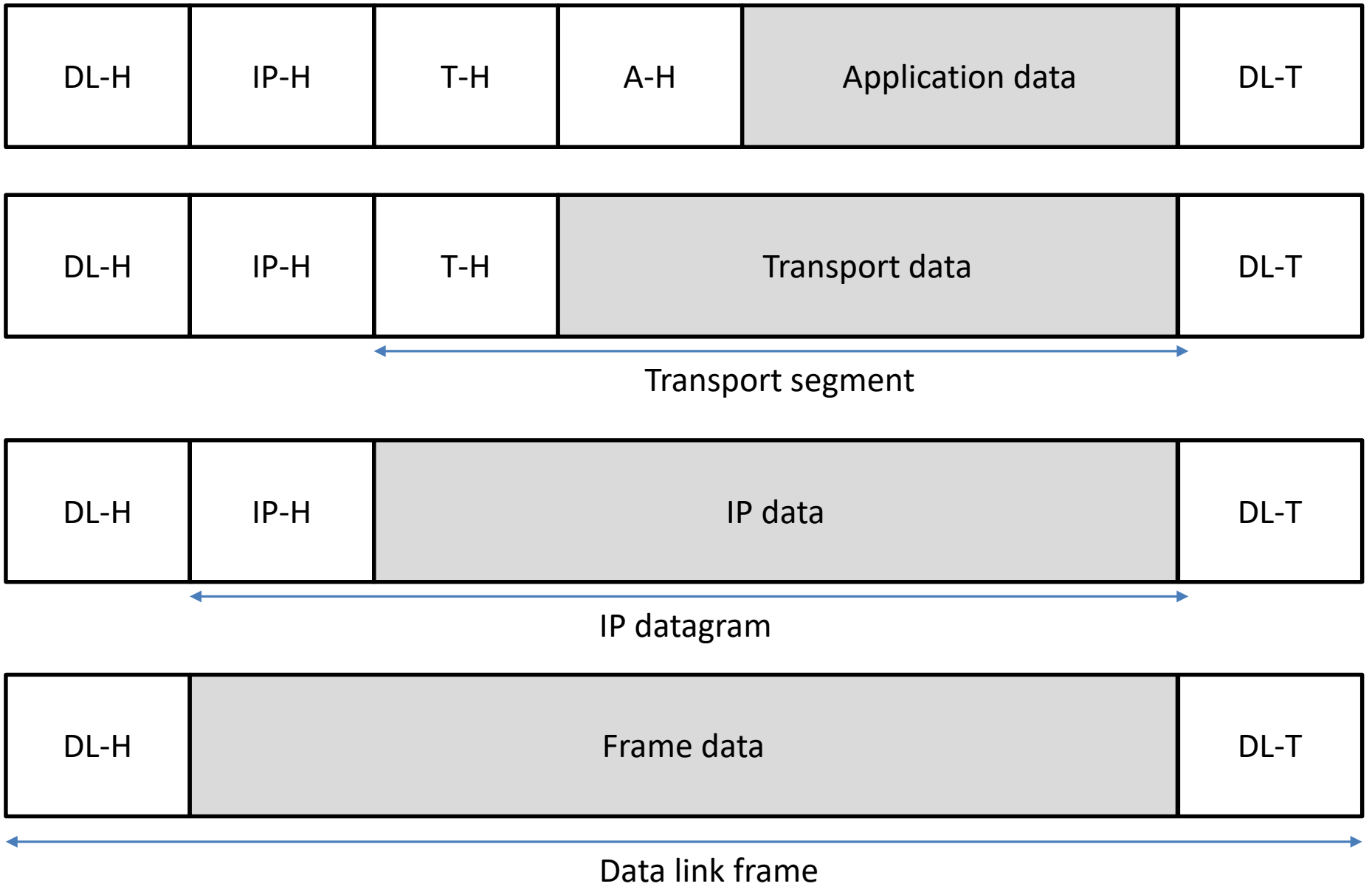

More basic concepts

- Service (Operations, Primitives)
- Protocol (“Dialogue”, Interaction)
- Information (“Message”)
- Format (Data Units: header and “user” data)
- Specific data units:
  - Transport (TCP): Segment.
  - Transport (UDP): Datagram.
  - IP: Datagram.
  - Data link: Frame.
- **Protocol vs. Format**

More basic concepts

Internet model:

- Based on the IP (Internet Protocol)
- Data unit → Datagram
- IP is connection-less!
- TCP is connection-oriented!!
- Connection-less: No pre-defined path.
- Connection-oriented:
  3 phases (connection, data transfer, release)
- “Best effort” vs. Reliable.

Standardization

- Common specifications for interoperability
- Open vs. Closed development
- Forum-like: industry, users, service providers, regulators, administration, …
- “Formal” standardization organizations:
  - *(States-based)*
    ISO, IEC, ISO/IEC, ITU, ITU-T, CEN, …
  - *(Organizations/Individuals-based)*
    IEEE, IETF, W3C, …
- SDO: **Standards Development Organization**