Review of Important Networking Concepts TCP/IP

1. TCP/IP Protocol Suite
2. Addressing TCP/IP
3. Layers in the Example
4. Encapsulation and Decapsulation
5. Different Layers Views of Networking

1. TCP/IP Protocol Suite

Summary of OSI Layers

OSI/RM - Open Systems Interconnection/Reference Model

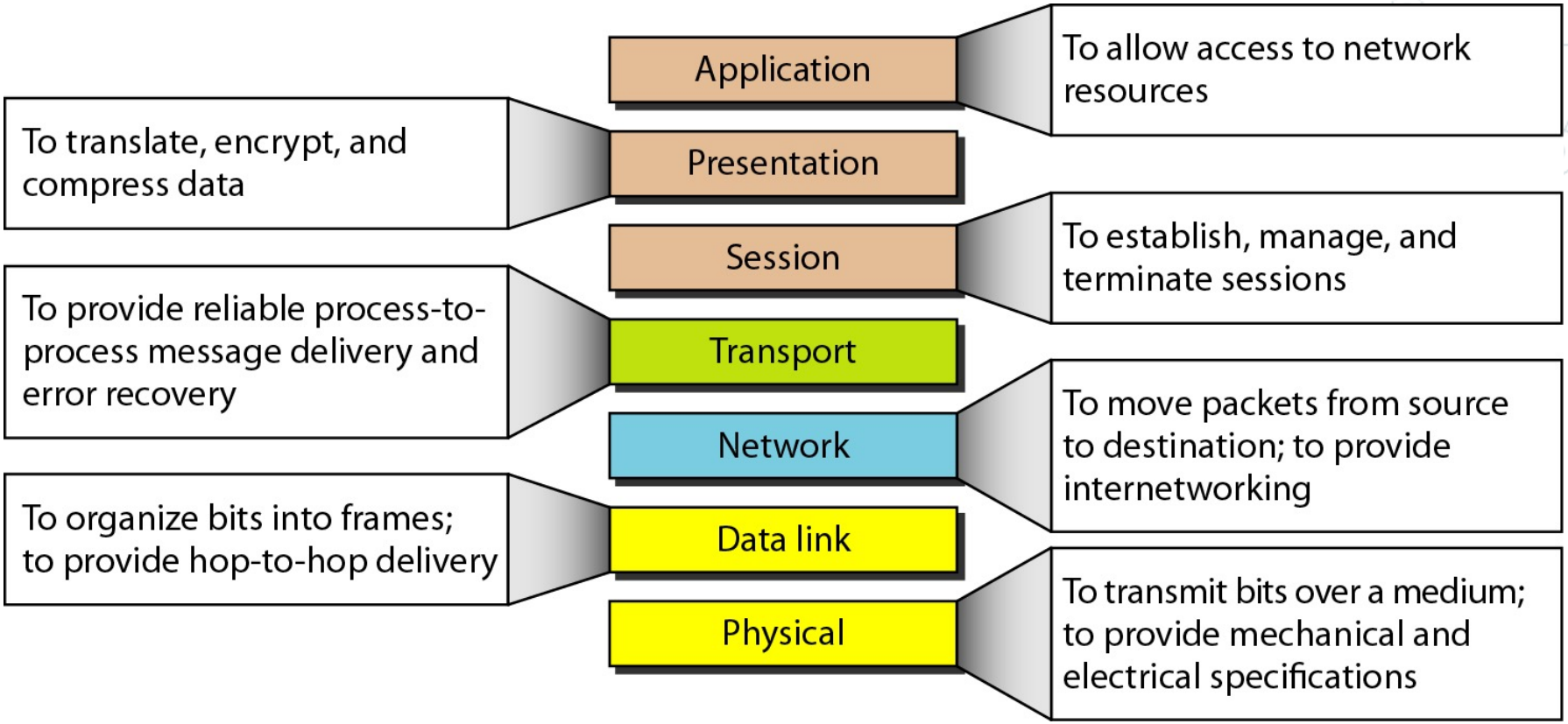
Physical: how to transmit bits
Data link: how to transmit frames
Network: how to route packets
Transport: how to send packets end2end
Session: how to tie flows together
Presentation: byte ordering, security
Application: everything else

In terms of ***encapsulation*** a common mnemonic to remember it by:

All	**A**pplication Layer
People	**P**resentation Layer
Seem	**S**ession Layer
To	**T**ransport Layer
Need	**N**etwork Layer
Data	**D**ata Link Layer
Processing	**P**hysical Layer

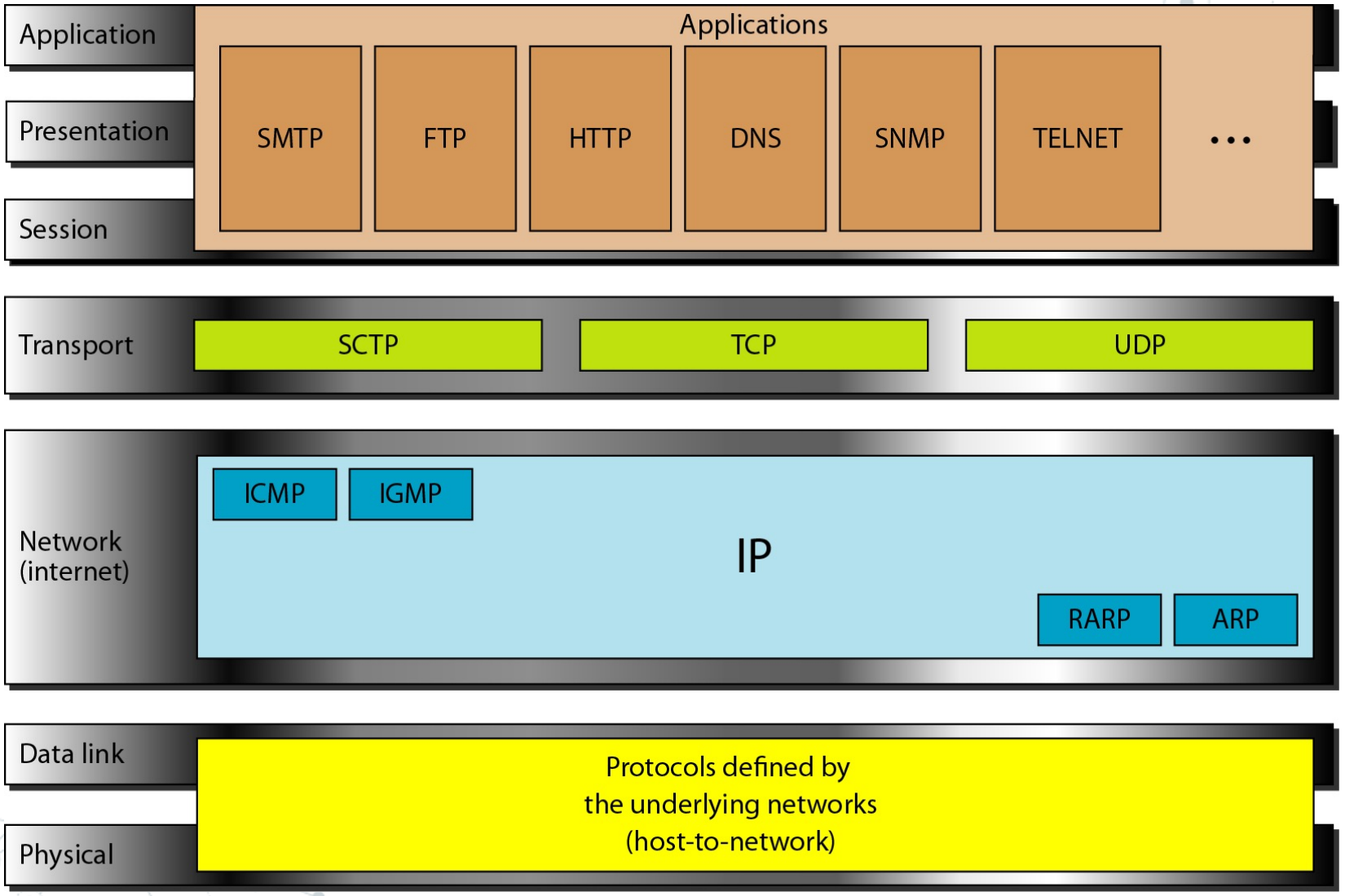
TCP/IP Protocol Suite

Summary of OSI layers



TCP/IP Protocol Suite

TCP/IP and OSI model



TCP/IP Protocol Suite

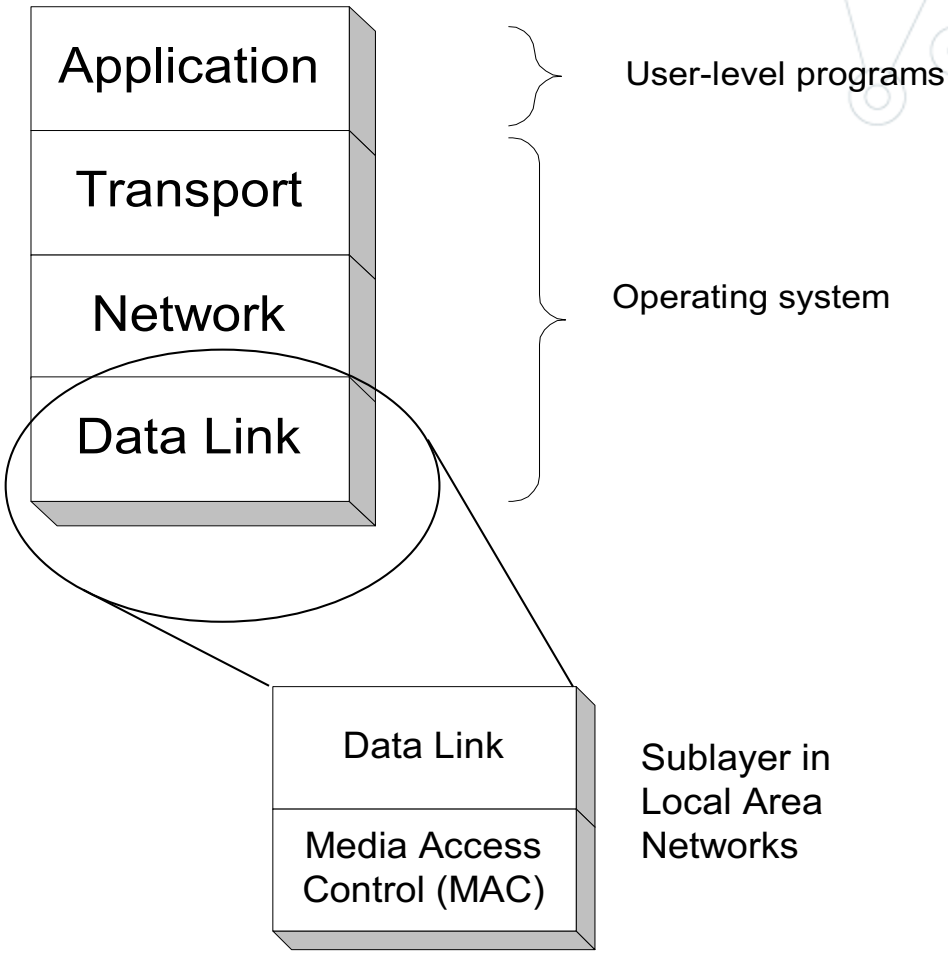
Summary of TCP/IP layers

The layers in the TCP/IP protocol suite do not exactly match those in the OSI model.

The original TCP/IP protocol suite was defined as having four layers: **host-to-network, internet, transport, and application**.

However, when TCP/IP is compared to OSI, we can say that the TCP/IP protocol suite is made of five layers: **partial physical, data link, network, transport, and application**.

The TCP/IP protocol suite is the protocol architecture of the **Internet.** The TCP/IP protocol stack does not define the lower layers of a complete protocol stack.



TCP/IP Protocol Suite

Services & Functions of the TCP/IP Layers

Each layer relies on services from layer below and exports services to layer above
Interface defines interaction.
Hides implementation - layers can change without disturbing other layers (black box).

Data Link Layer:

Service:	Reliable transfer of frames over a link Media Access Control on a LAN
Functions:	Framing, media access control, error checking

Network Layer:

Service:	Move packets from source host to destination host
Functions:	Routing, addressing

Transport Layer:

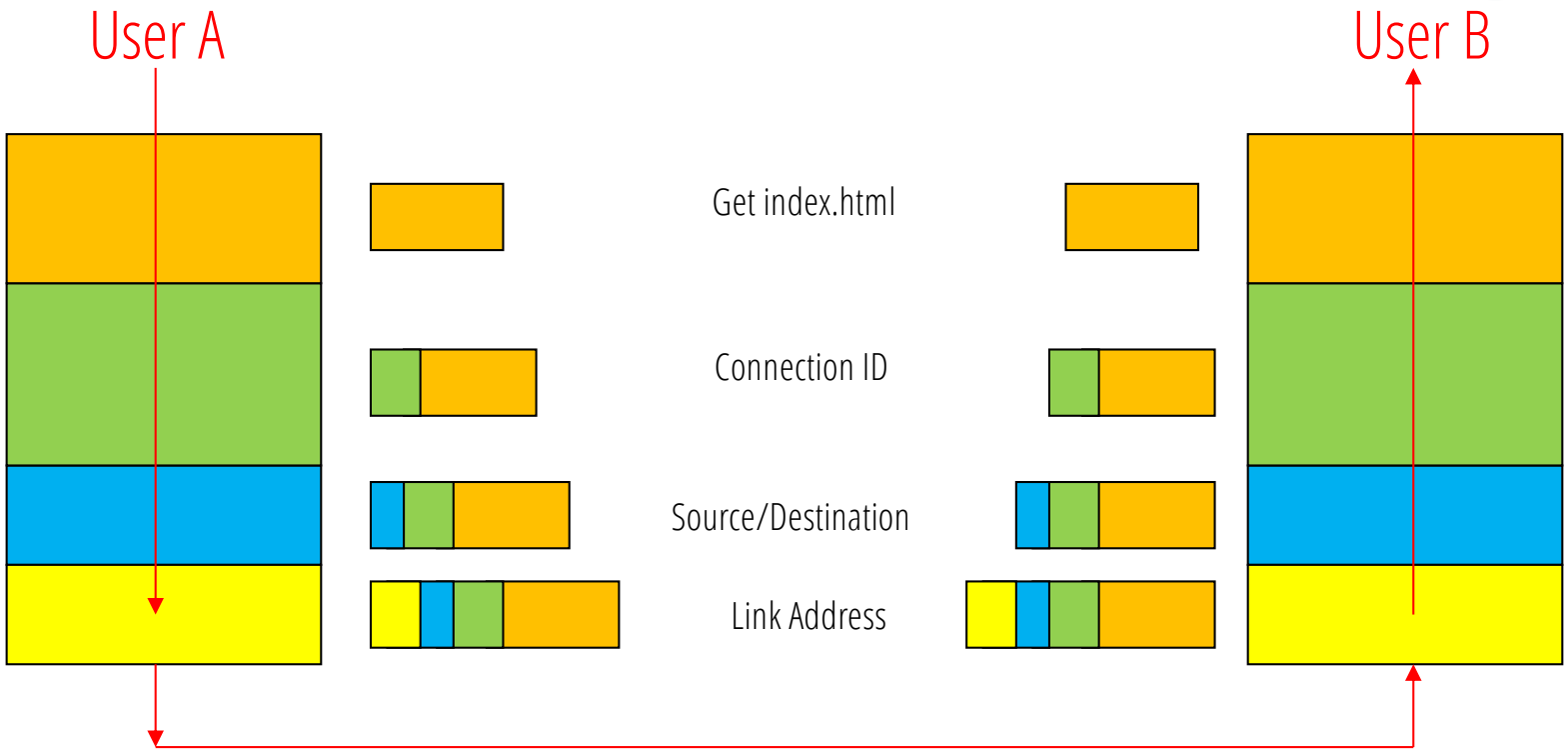
Service:	Delivery of data between hosts
Functions:	Connection establishment/termination, error control, flow control

Application Layer:

Service:	Application specific (delivery of email, retrieval of HTML documents, reliable transfer of file)
Functions:	Application specific

TCP/IP Protocol Suite

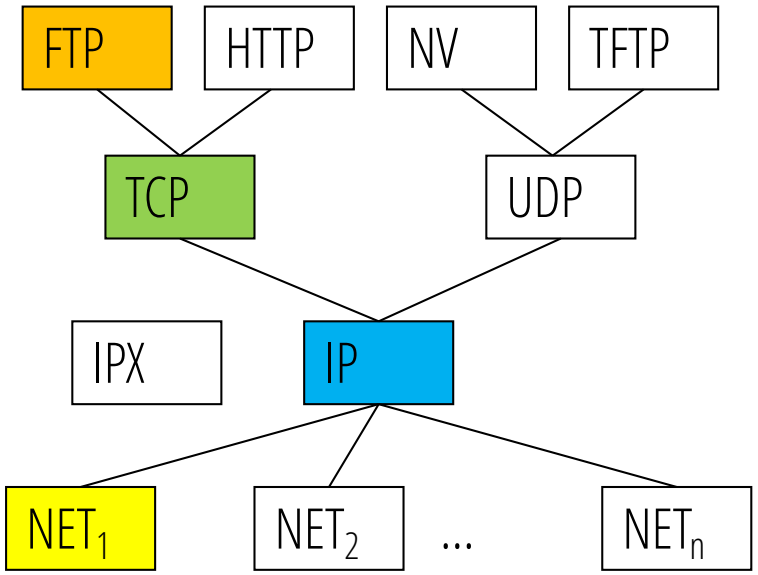
Layer Encapsulation, Protocol Multiplexing & Demultiplexing

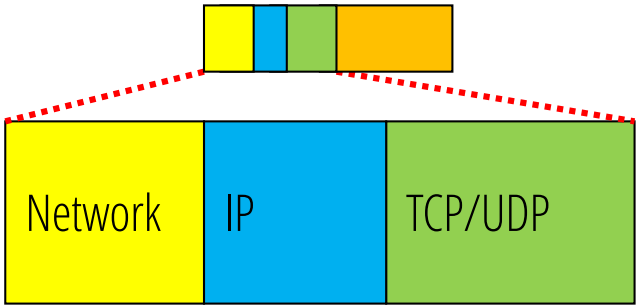


TCP/IP Protocol Suite

Layer Encapsulation, Protocol Multiplexing & Demultiplexing

Multiple choices at each layer





Type Field Protocol Field Port Number

TCP/IP Protocol Suite

Layers and Services

Service provided by TCP to HTTP:

reliable transmission of data over a logical connection

Service provided by IP to TCP:

unreliable transmission of IP datagrams across an IP network

Service provided by Ethernet to IP:

transmission of a frame across an Ethernet segment

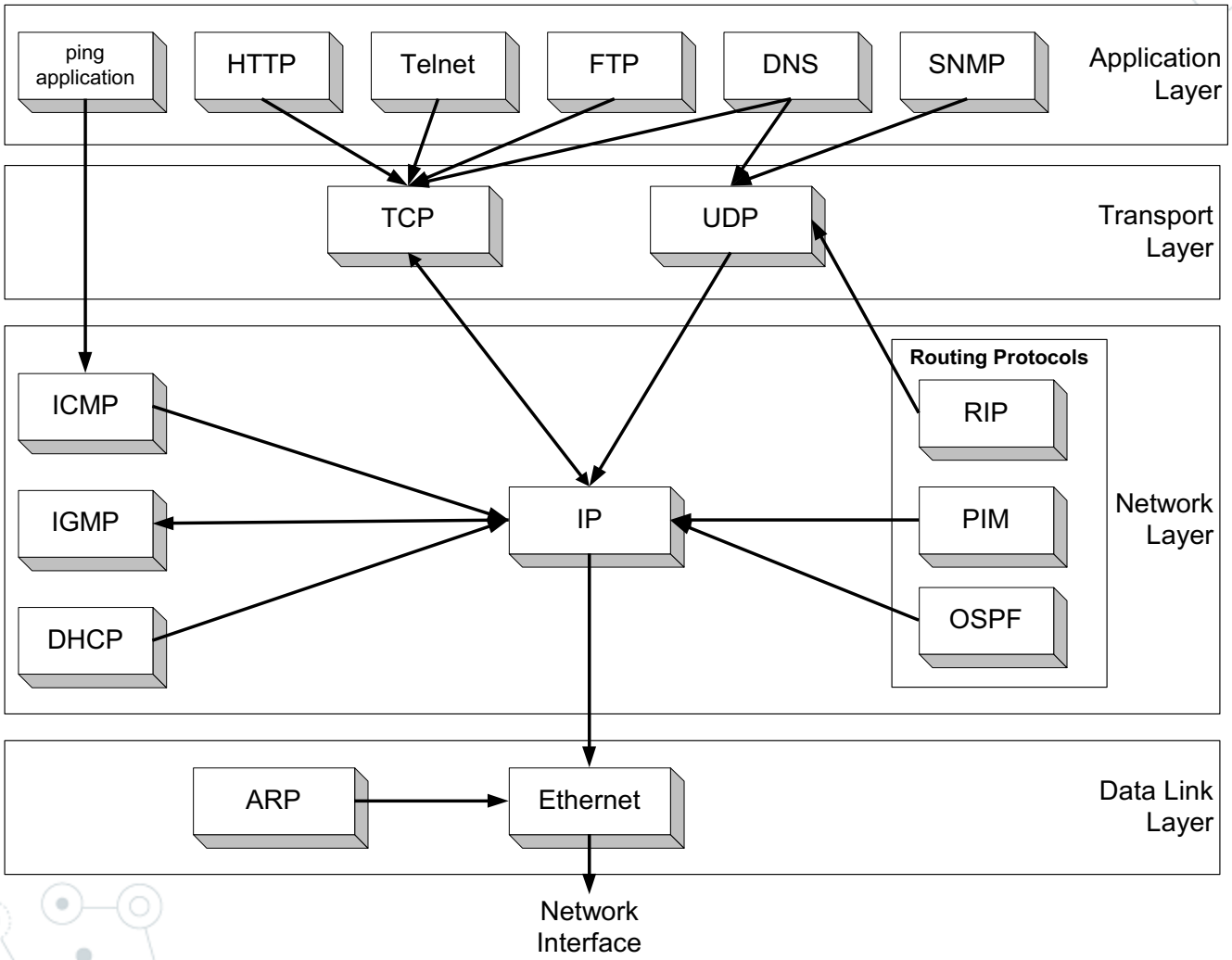
Other services:

DNS: translation between domain names and IP addresses

ARP: translation between IP addresses and MAC addresses

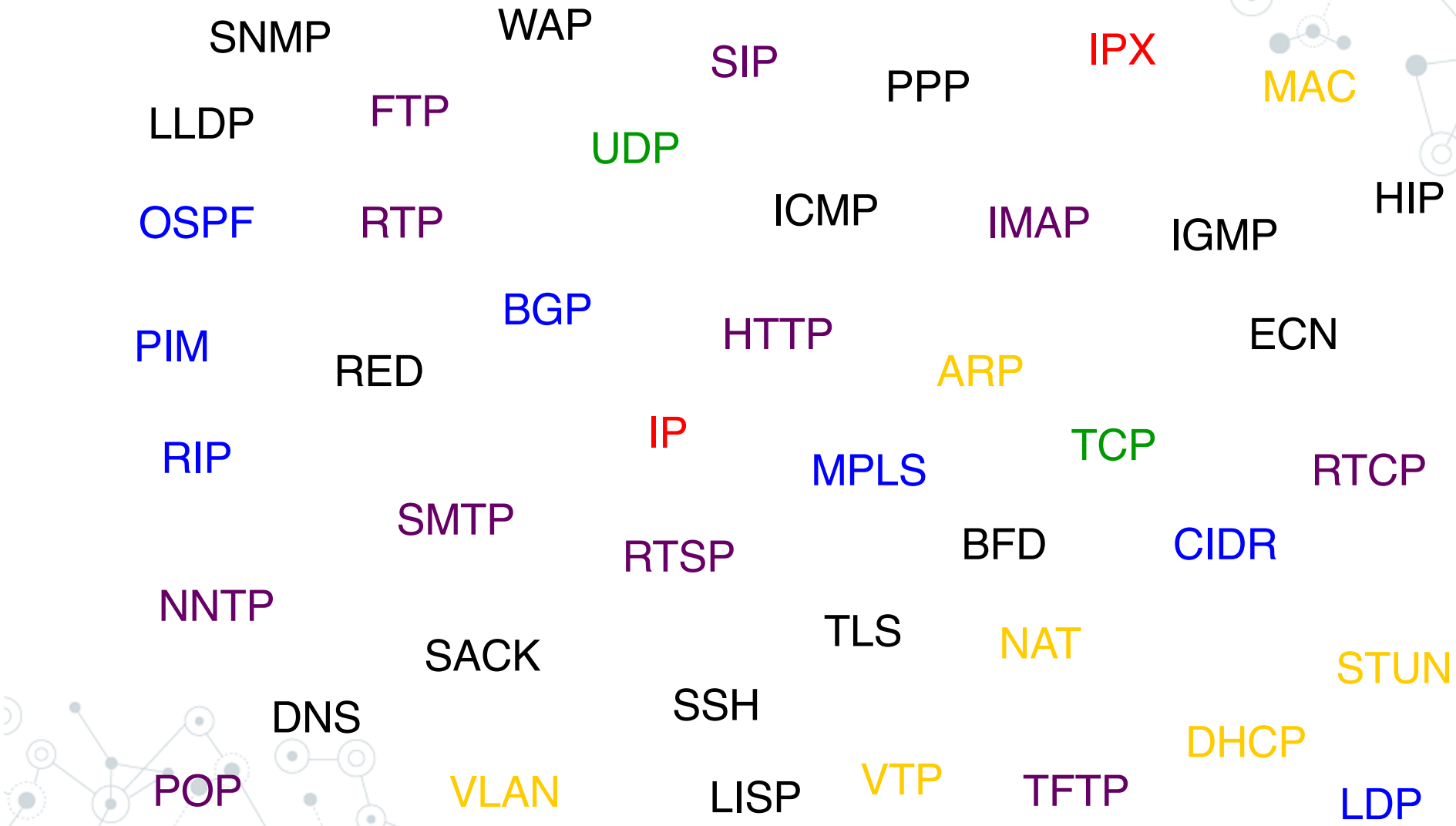
TCP/IP Protocol Suite

Assignment of Protocols to Layers



TCP/IP Protocol Suite

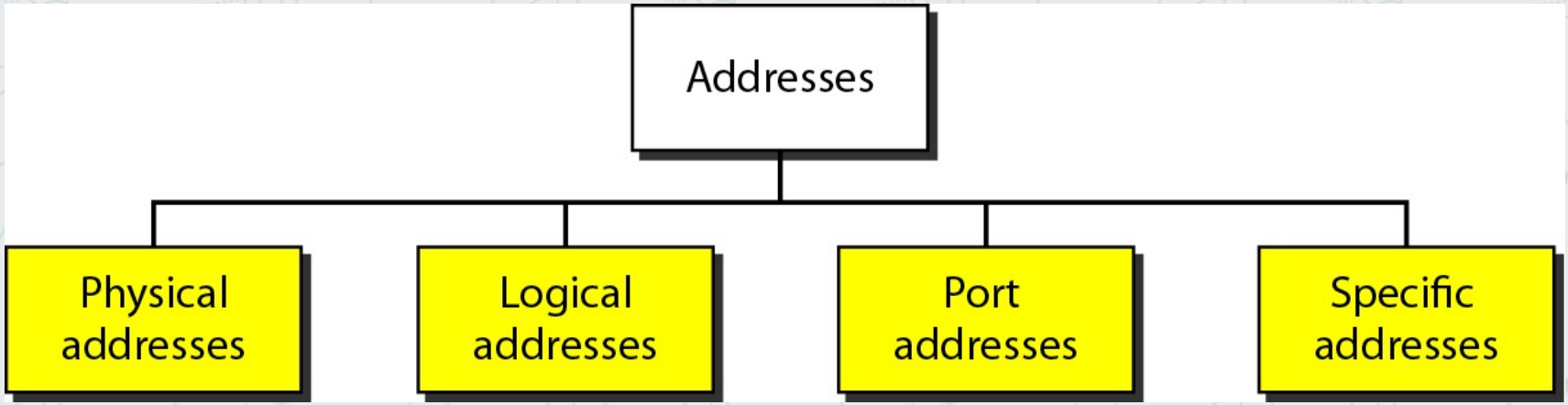
Protocols Acronyms



2. Addressing TCP/IP

Addressing Levels

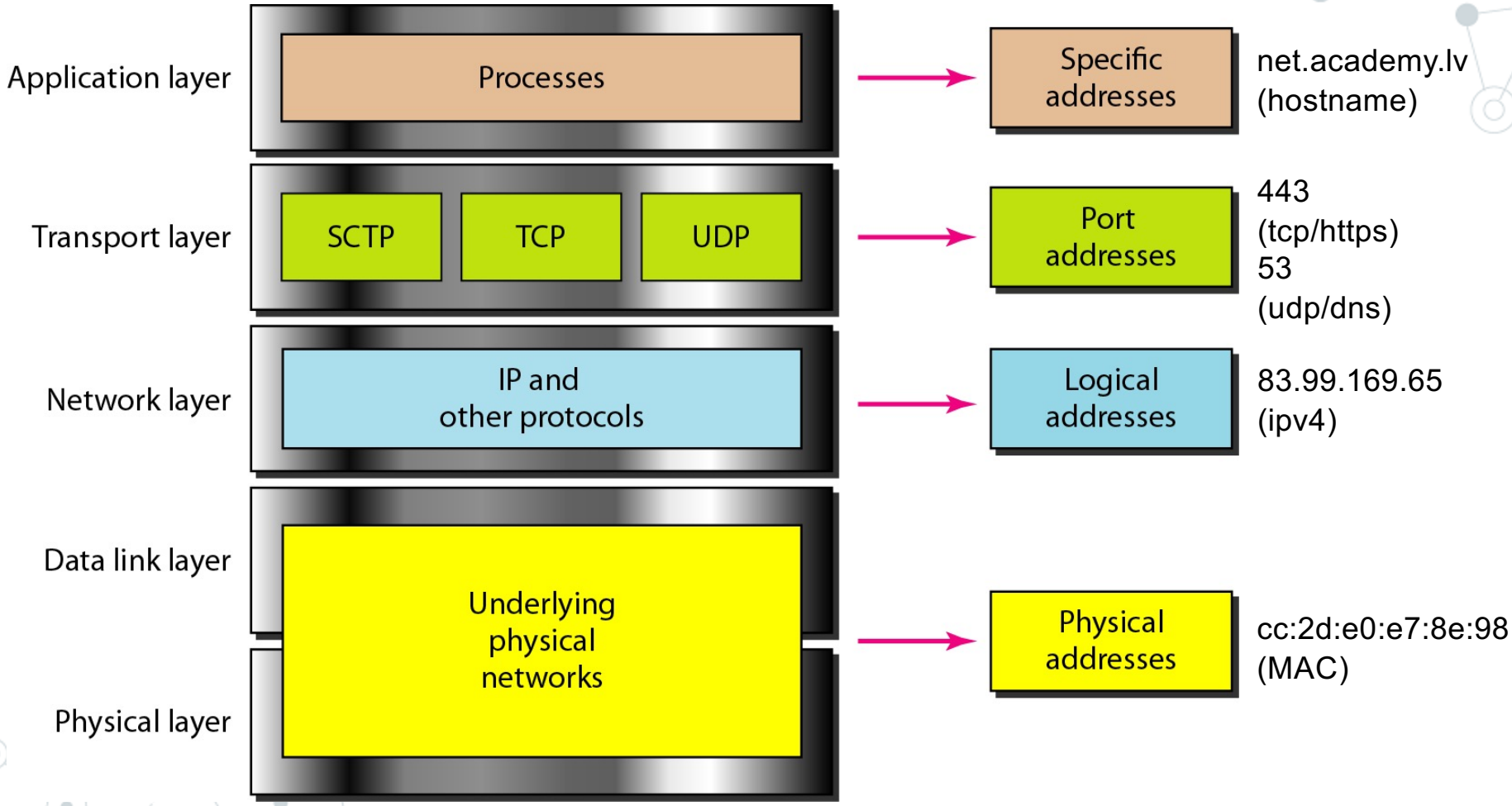
Four levels of addresses are used in an internet employing the TCP/IP protocols: **physical, logical, port, and specific (symbolic or human or domain)**.



cc:2d:e0:e7:8e:98 83.99.169.65 443 net.academy.lv

Addressing TCP/IP

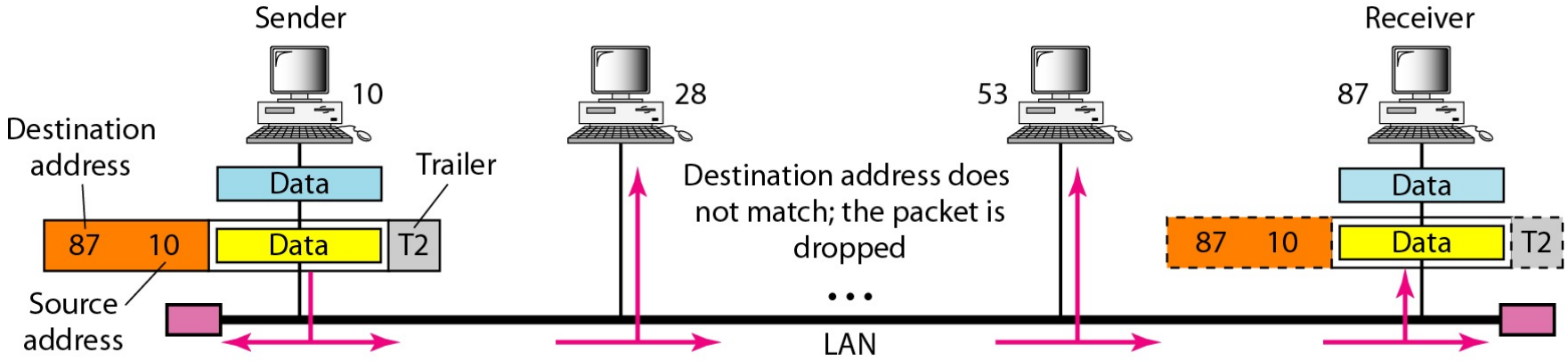
Relationship of layers and addresses in TCP/IP



Addressing TCP/IP

Example of Physical (MAC) addresses

The two nodes are connected by a link (bus topology LAN). As the figure shows, the computer with **physical address 10** (is the sender) sends a frame to the computer with **physical address 87** (is the receiver).

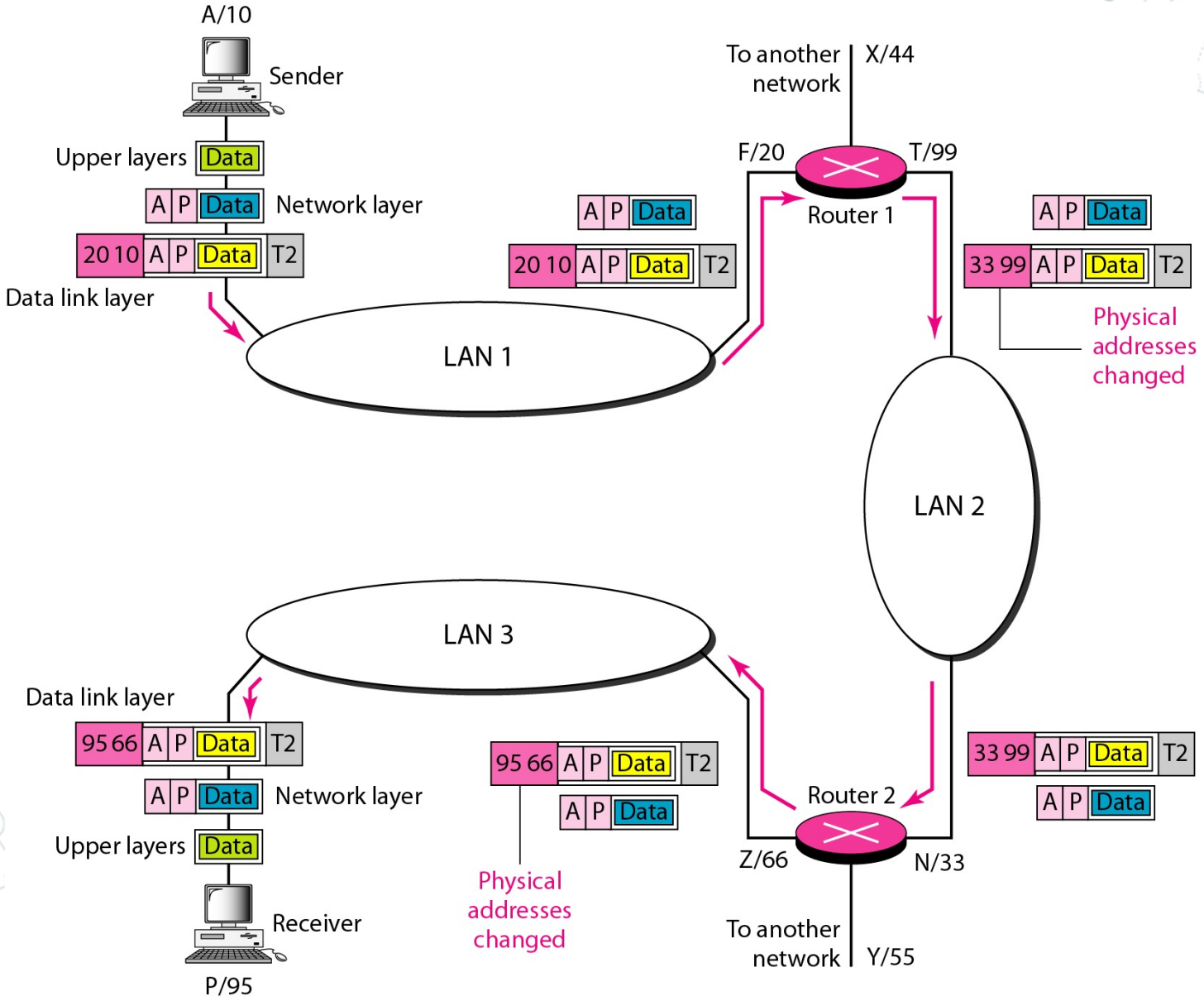


Most local-area networks use a **48-bit (6-byte) physical (MAC) address** written as 12 hexadecimal digits; every byte (2 hexadecimal digits) is separated by a colon, as shown below:

07:01:02:01:2C:4B
A 6-byte (12 hexadecimal digits) physical address.

Addressing TCP/IP

Example of Logical (IP) addresses



Addressing TCP/IP

Example of Logical (IP) addresses

Figure above shows a part of an internet with two routers connecting three LANs.

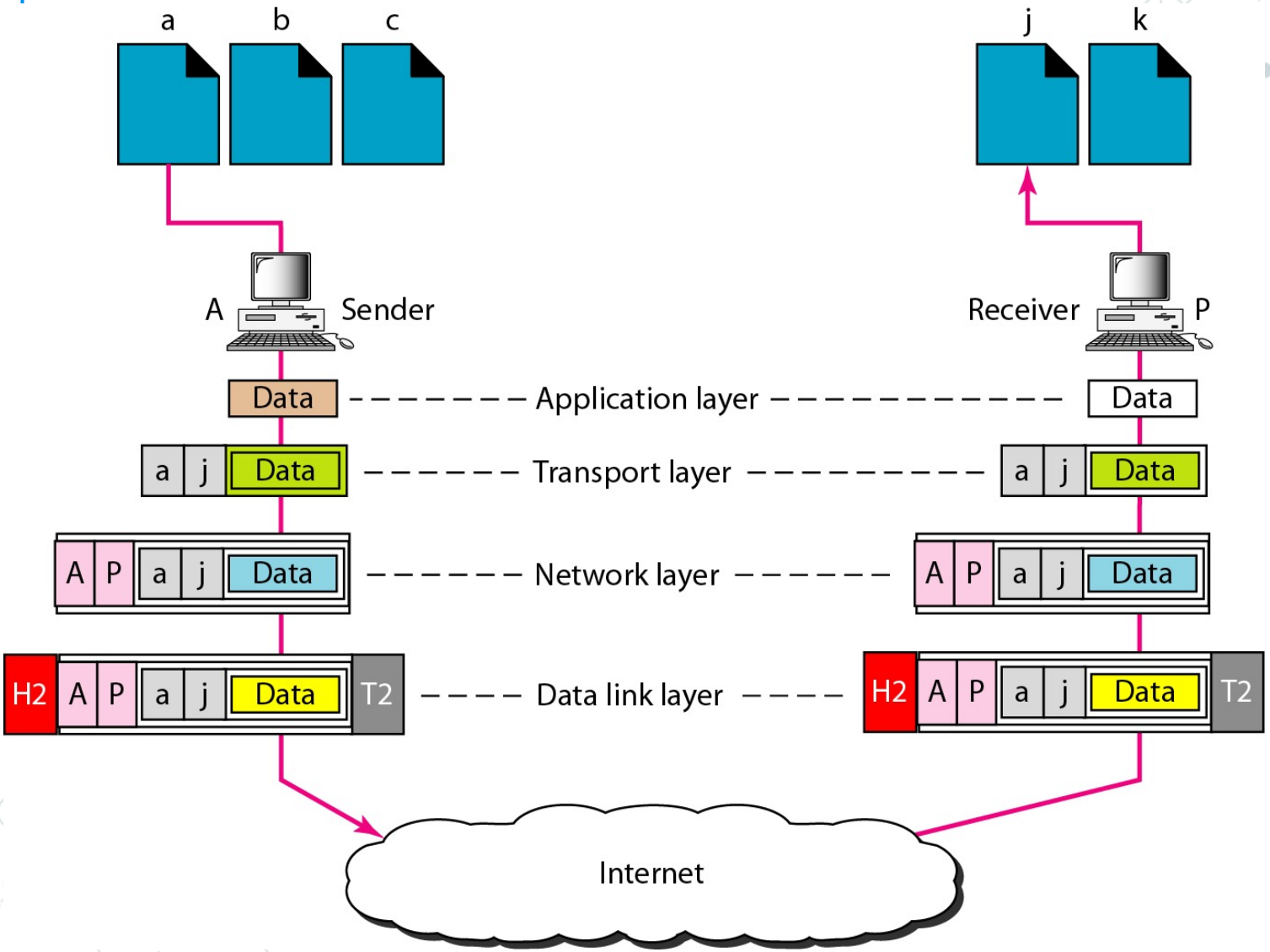
- Each device (computer or router) has a pair of addresses: logical A,P,X,T,.. and physical 20,10,33,99, for each connection.
- In this case, each computer is connected to only one link and therefore has only one pair of addresses.
- Each router, however, is connected to three networks (only two are shown in the figure). So each router has three pairs of addresses, one for each connection.

Note.
The physical addresses will change from hop to hop,
but the logical addresses usually remain the same
(Remark: but fake logical address change on NAT system).

83.99.169.65
A 4-byte (4 decimal digits) logical address.

Addressing TCP/IP

Example of Port addresses



Addressing TCP/IP

Example of Port addresses

Figure above shows two computers communicating via the Internet.

- The sending computer is running three processes at this time with port addresses “a”, “b”, and “c”.
- The receiving computer is running two processes at this time with port addresses “j” and “k”.
- Process ”a” in the sending computer needs to communicate with process “j” in the receiving computer.

Note.
The physical addresses change from hop to hop,
logical and port addresses (sockets) do not change from source to destination.

53
A 16-bit TCP or UDP port address, represented as numbers from different pools,
TCP from pool 0-65535, and UDP from pool 0-65535.

Addressing TCP/IP

Practice. Net Tools for different address types finding

1. WhoIs Domain Lookup
https://who.is
Task1. Find domains:
academy.lv
bank.lv
isma.lv
abracadabra.lv

2. DNS LookUp
https://ping.eu/nslookup/
Task2. Find IP address:
academy.lv, military.lv, teacher.lv
microsoft.com
linux.org
isma.lv.

3. Country by IP
https://ping.eu/country-by-ip/
Task3. Find Countrys:
13.77.161.179
40.113.200.201
104.215.148.63
microsoft.com.

4. TCP/UDP Port Scaner
https://www.ipfingerprints.com/portscan.php
Task4. Find open ports in interval 20-1000:
83.99.169.65;
85.254.233.14;
193.203.196.144;
if15.nano.lv.

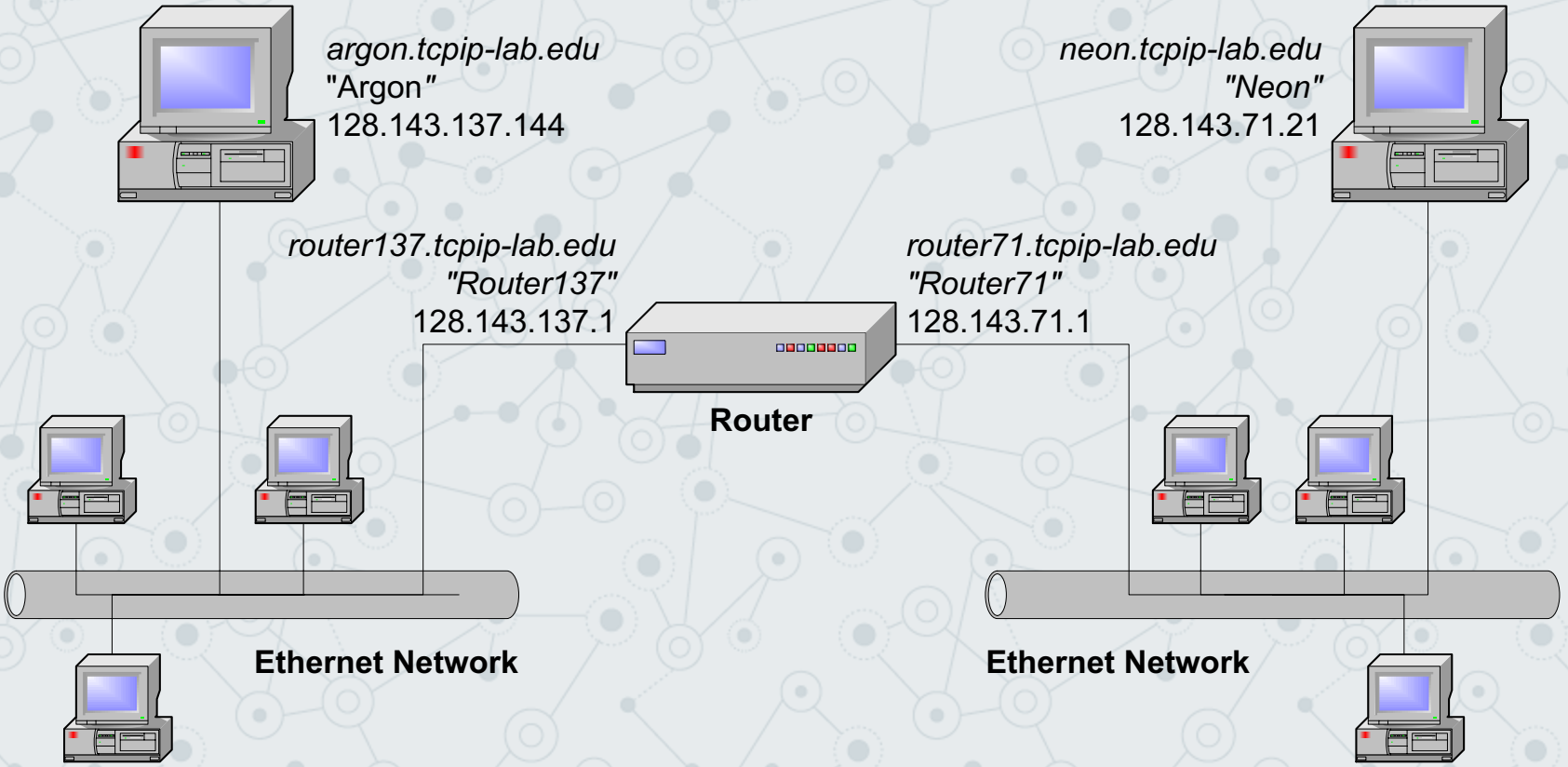
5. TCP/UDP Port Description Finder
https://www.adminsub.net/tcp-udp-port-finder
Task5. Find ports descriptions:
80/tcp;
53/tcp,udp;
443/tcp,udp;
22/tcp.

6. MAC Address Finder
https://www.adminsub.net/mac-address-finder
Task6. Find MAC address Vendors:
00:24:a5:f5:2e:ed;
cc:2d:e0:e7:8e:98;
9c:04:eb:da:70:f2;
00:0c:29:60:88:99

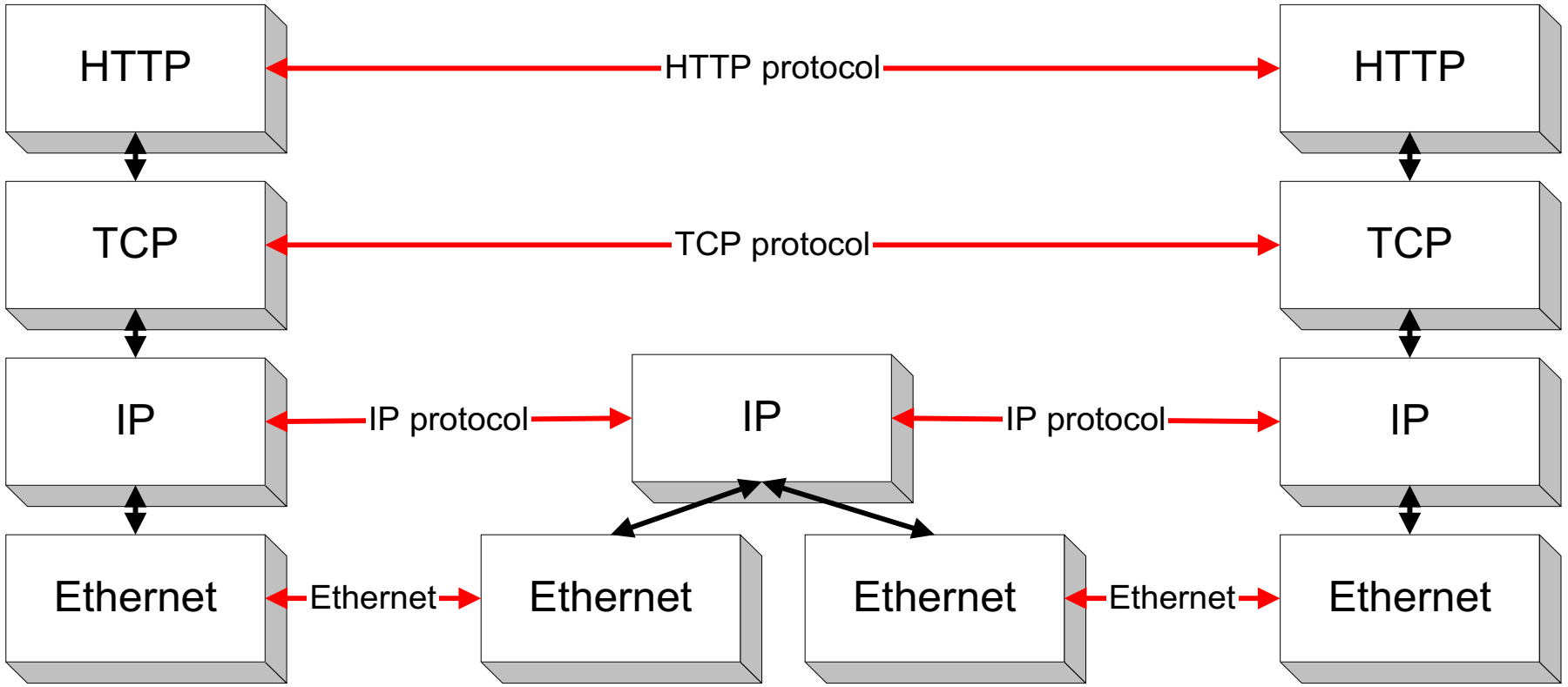
3. Layers in the Example

Please see the presentation in the PPSX file!

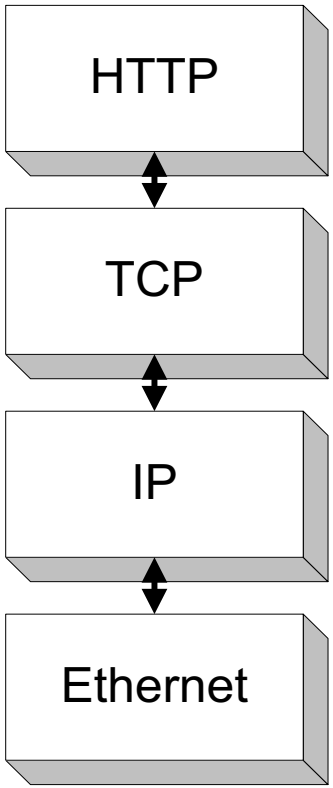
http://net.academy.lv/lection/net_LS-02ENa_tcpip-concept-example.ppsx



Layers in the Example



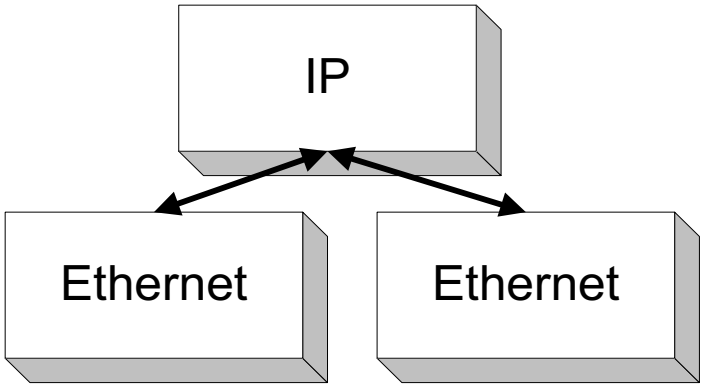
Layers in the Example



argon.tcpip-lab.edu
128.143.137.144

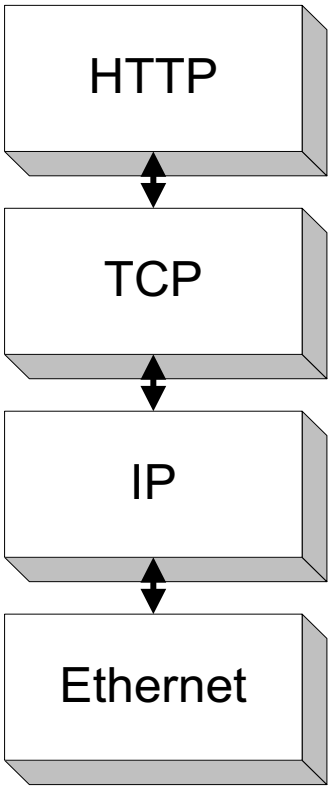
Please see the presentation in the PPSX file!

http://net.academy.lv/lection/net_LS-02ENa_tcpip-concept-example.ppsx



router71.tcpip-lab.edu
128.143.137.1
00:e0:f9:23:a8:20

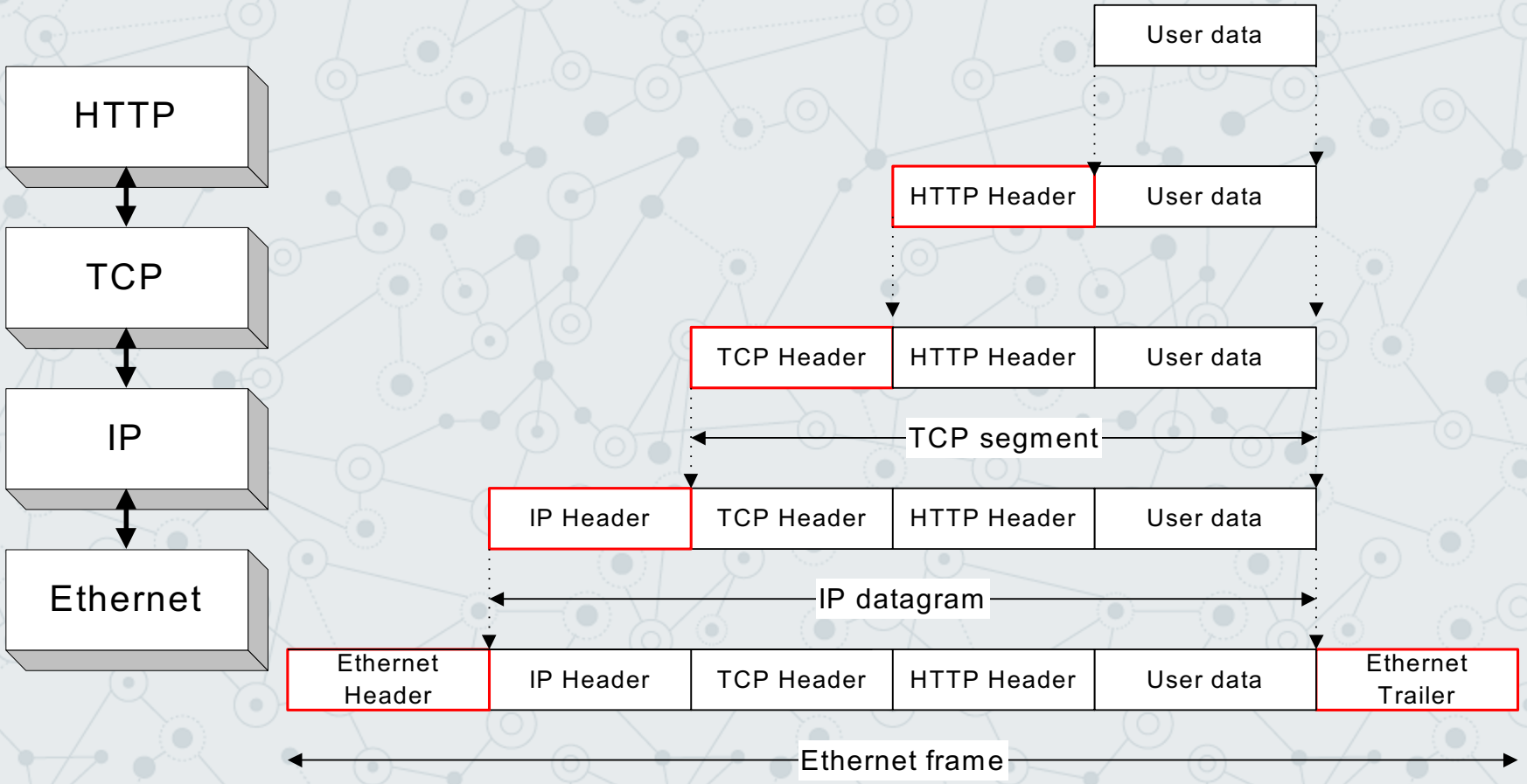
router137.tcpip-lab.edu
128.143.71.1



neon.tcpip-lab.edu
128.143.71.21

4. Encapsulation And Decapsulation

As data is moving down the protocol stack, each protocol is adding layer-specific control information



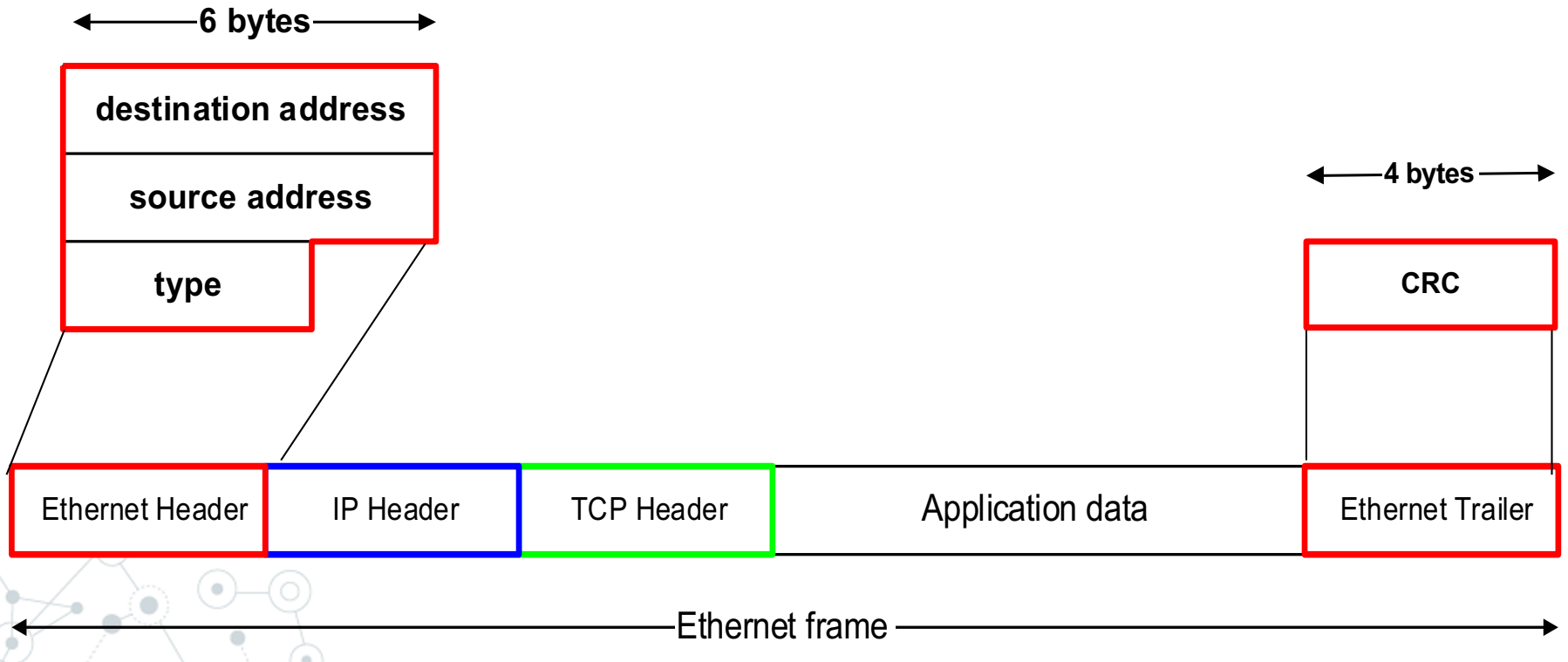
Encapsulation and Decapsulation in our Example

Let us look in detail at the Ethernet frame between Argon and the Router, which contains the TCP connection request to Neon.

This is the frame in hexadecimal notation.

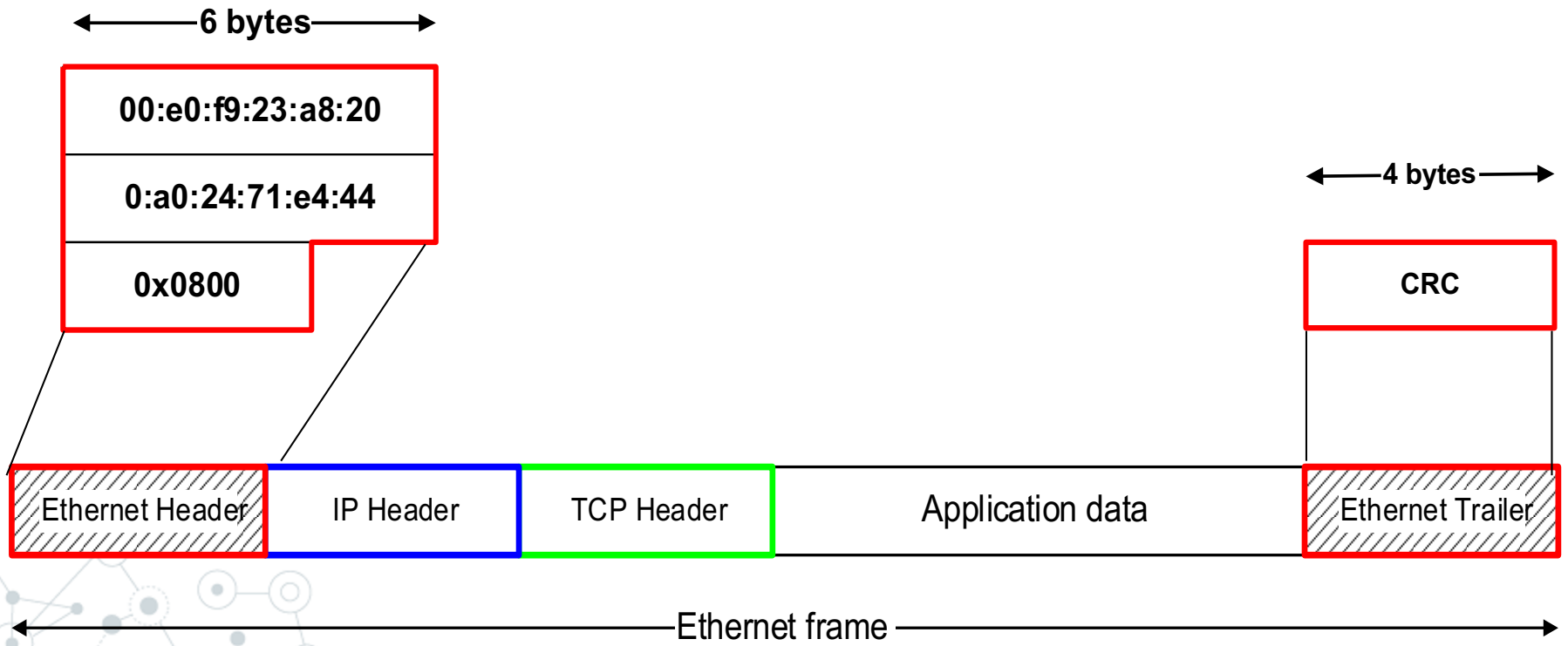
```
00e0 f923 a820 00a0 2471 e444 0800 4500 002c
9d08 4000 8006 8bff 808f 8990 808f 4715 065b
0050 0009 465b 0000 0000 6002 2000 598e 0000
0204 05b4 f430 0351
```

Encapsulation and Decapsulation: Ethernet Header Fields

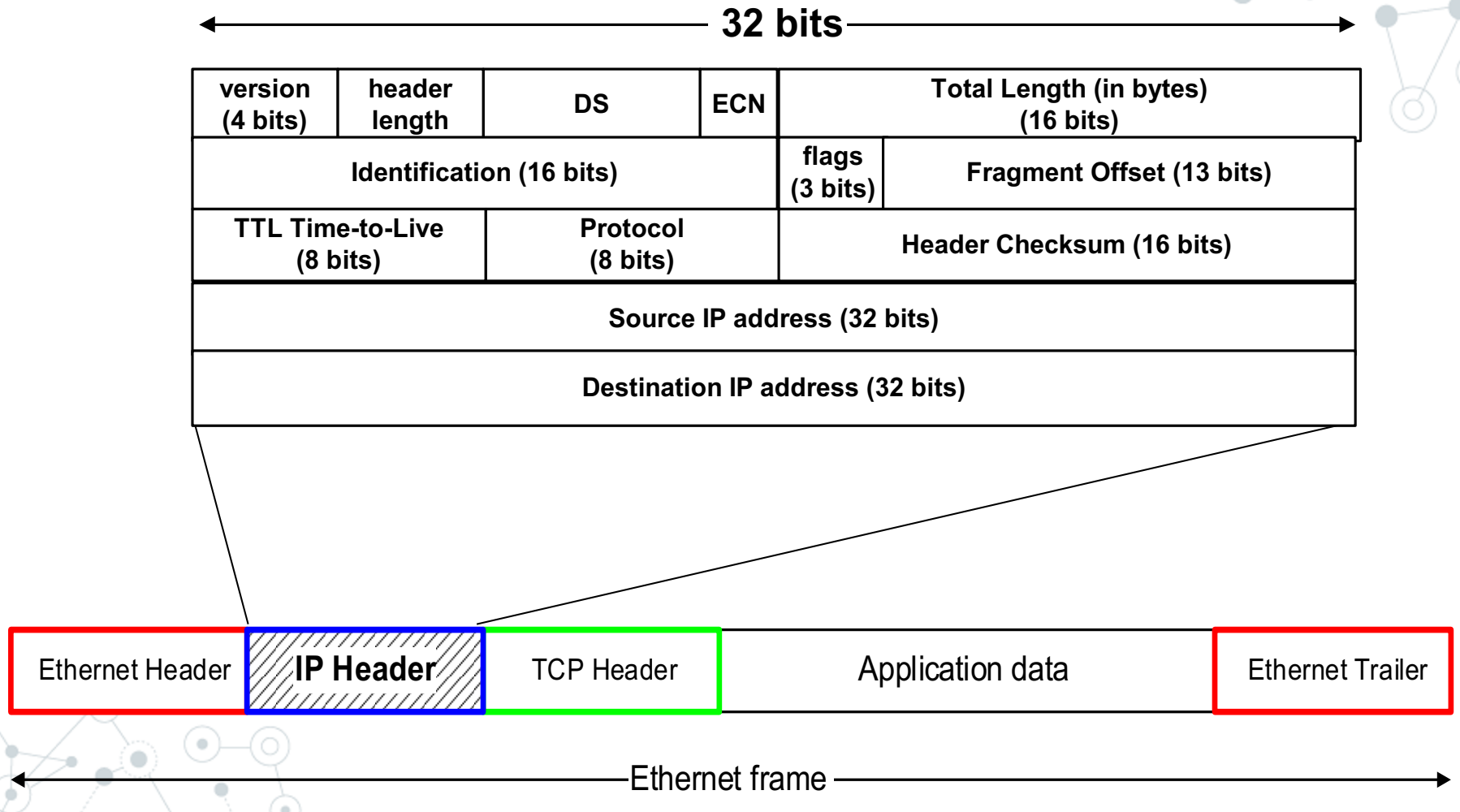


Encapsulation and Decapsulation: Ethernet Header Value

```
00e0 f923 a820 00a0 2471 e444 0800 4500 002c
9d08 4000 8006 8bff 808f 8990 808f 4715 065b
0050 0009 465b 0000 0000 6002 2000 598e 0000
0204 05b4 f430 0351
```



Encapsulation and Demultiplexing: IP Header Fields



Encapsulation and Decapsulation: IP Header Values

```
00e0 f923 a820 00a0 2471 e444 0800 4500 002c
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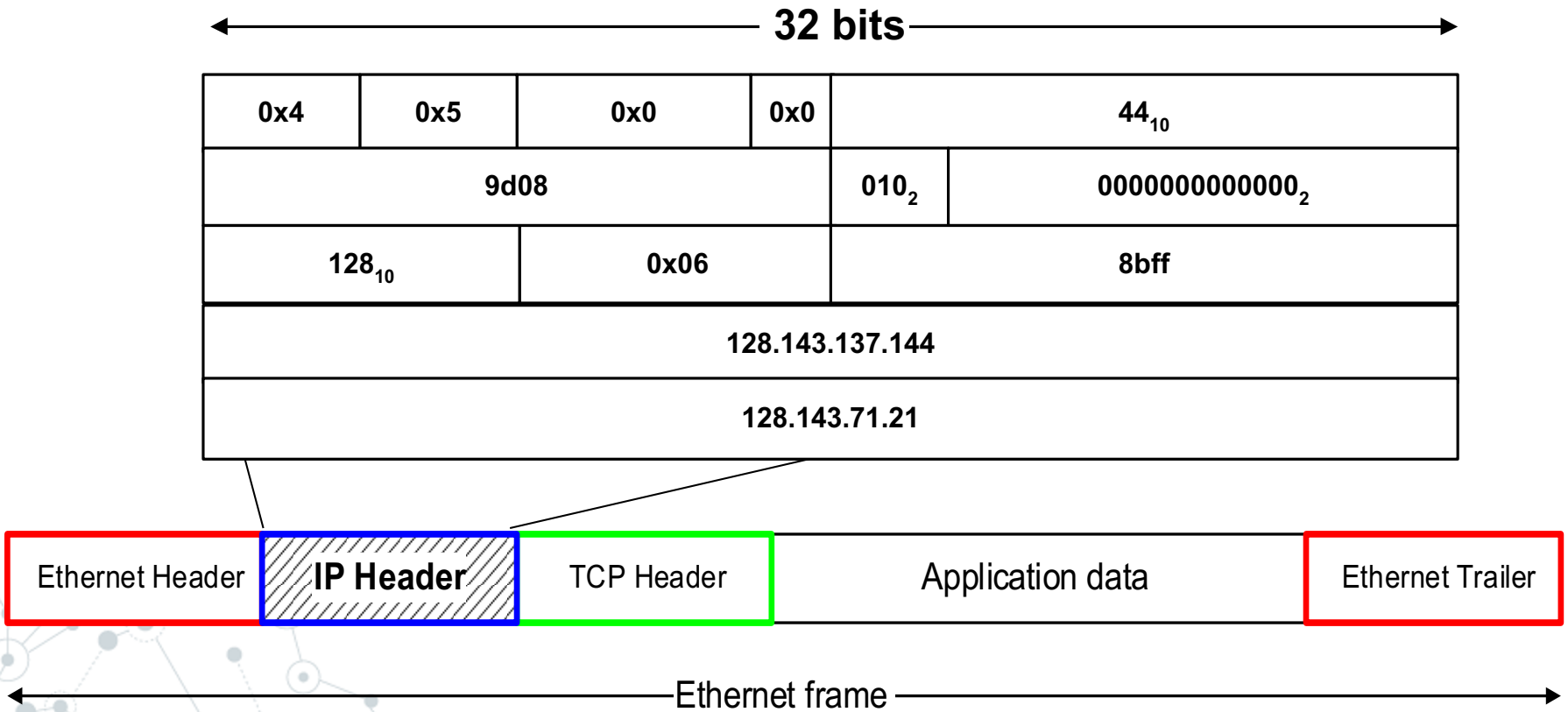
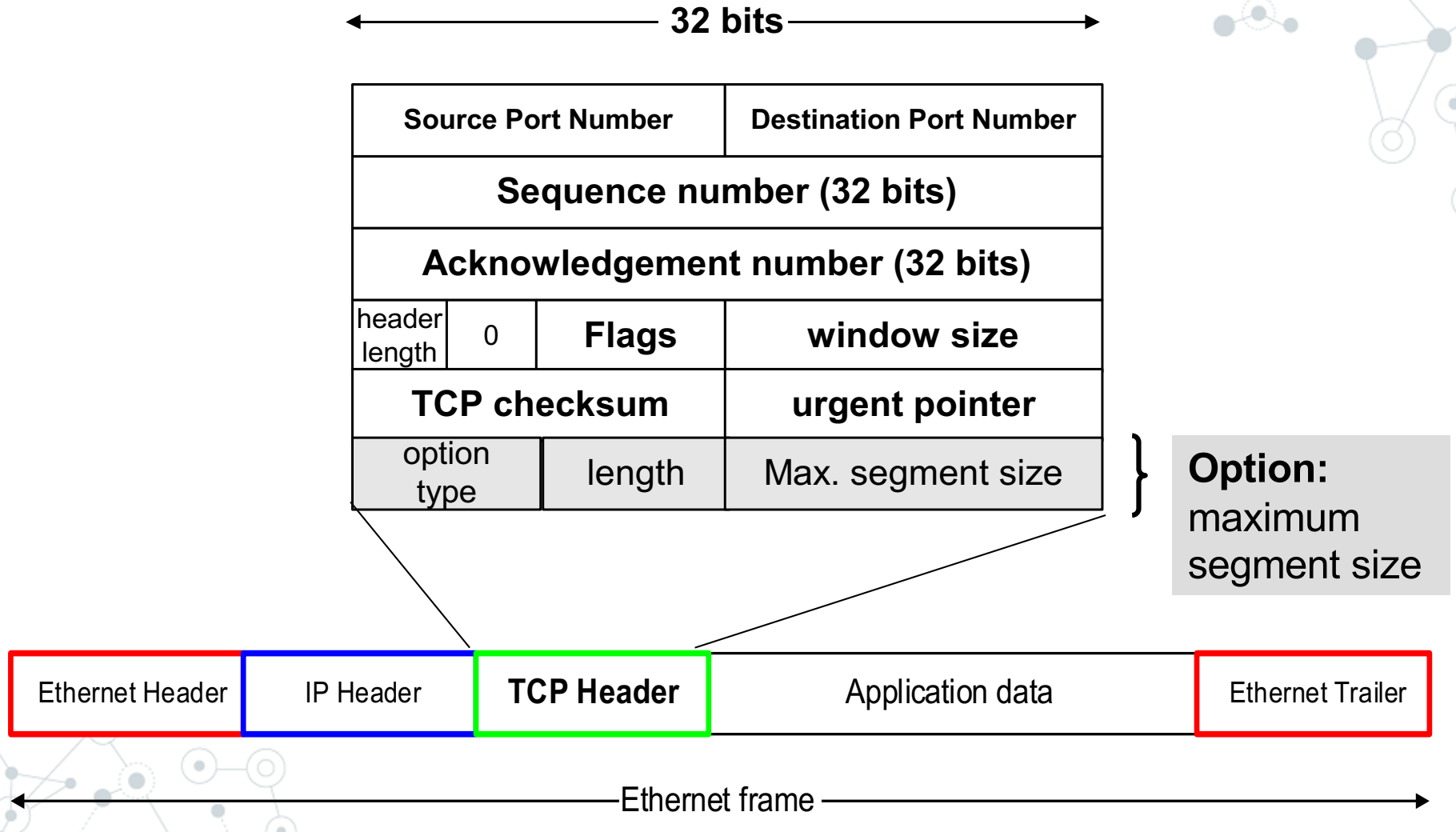
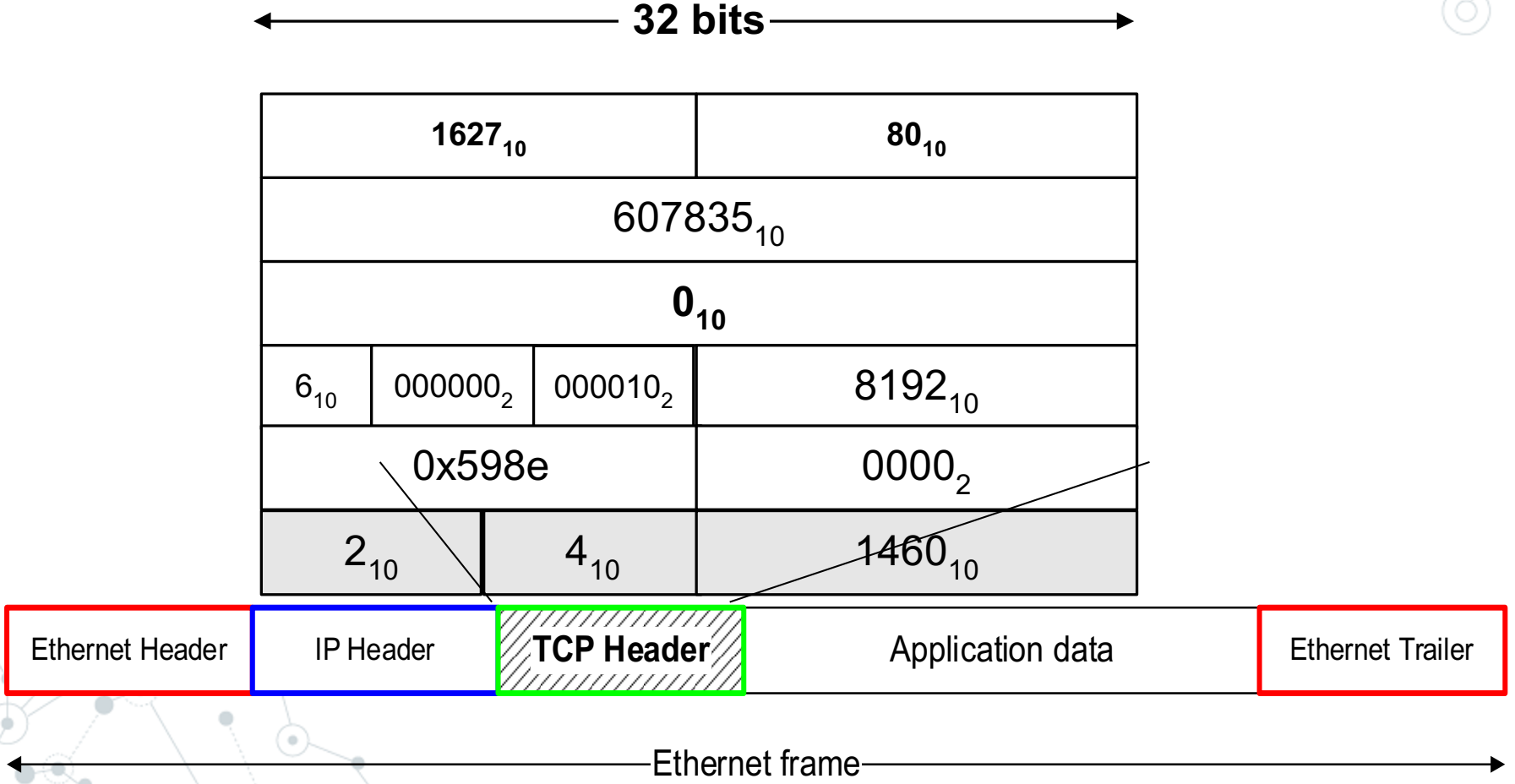


Encapsulation and Decapsulation: TCP Header Fields



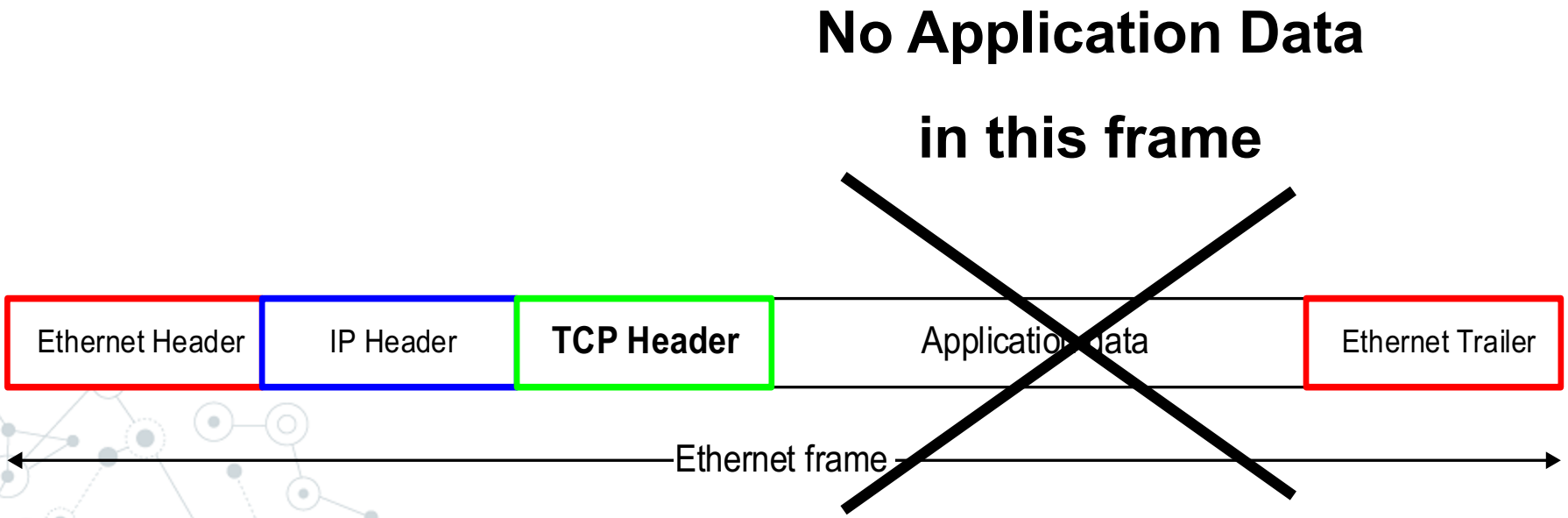
Encapsulation and Decapsulation: TCP Header Value

```
00e0 f923 a820 00a0 2471 e444 0800 4500 002c
9d08 4000 8006 8bff 808f 8990 808f 4715 065b
0050 0009 465b 0000 0000 6002 2000 598e 0000
0204 05b4 f430 0351
```



Encapsulation and Decapsulation: Application data

```
00e0 f923 a820 00a0 2471 e444 0800 4500 002c
9d08 4000 8006 8bff 808f 8990 808f 4715 065b
0050 0009 465b 0000 0000 6002 2000 598e 0000
0204 05b4 f430 0351
```

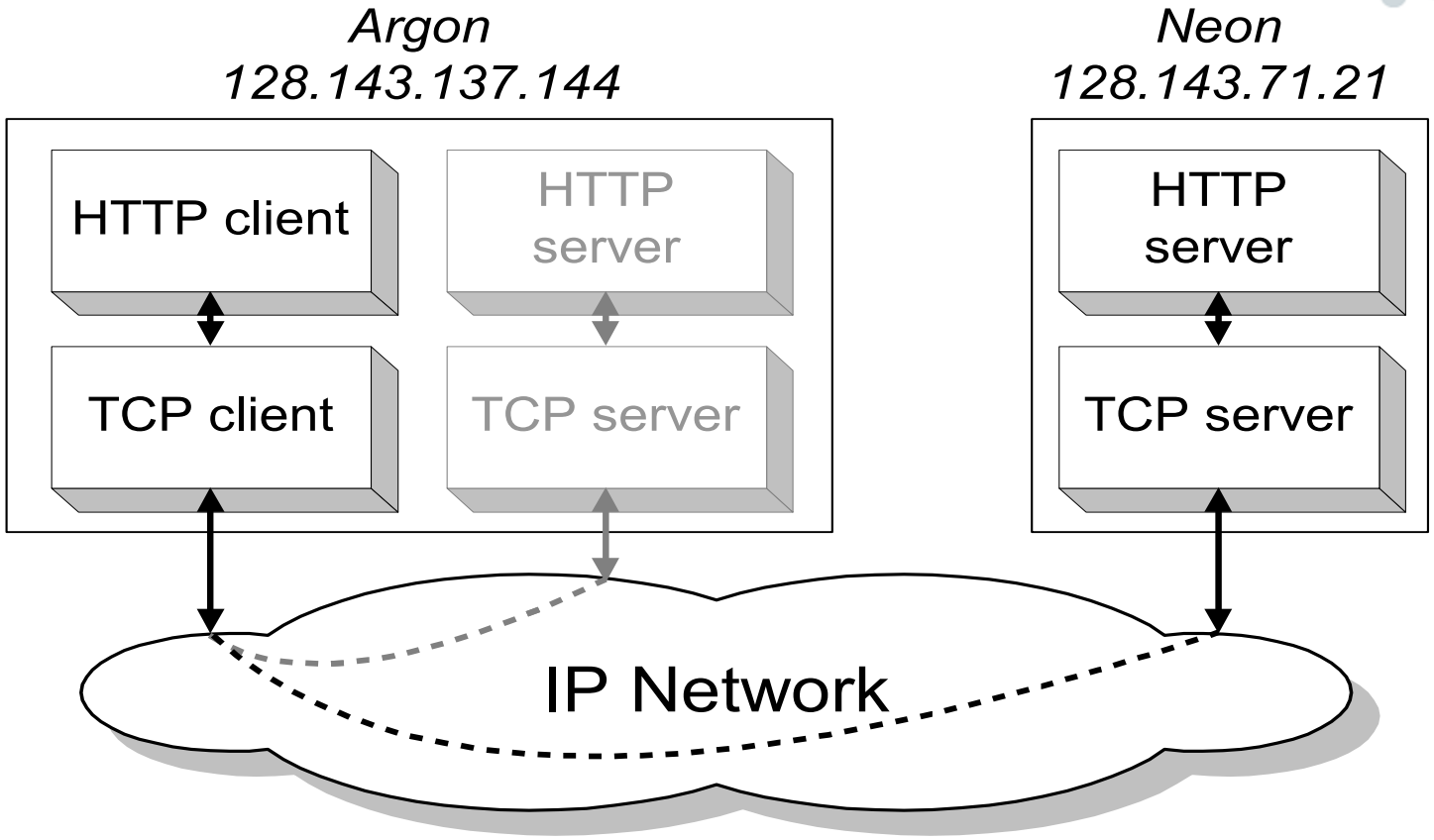


5. Different Layers View Of Networking

Different Layers of the protocol stack have a different view of the network.

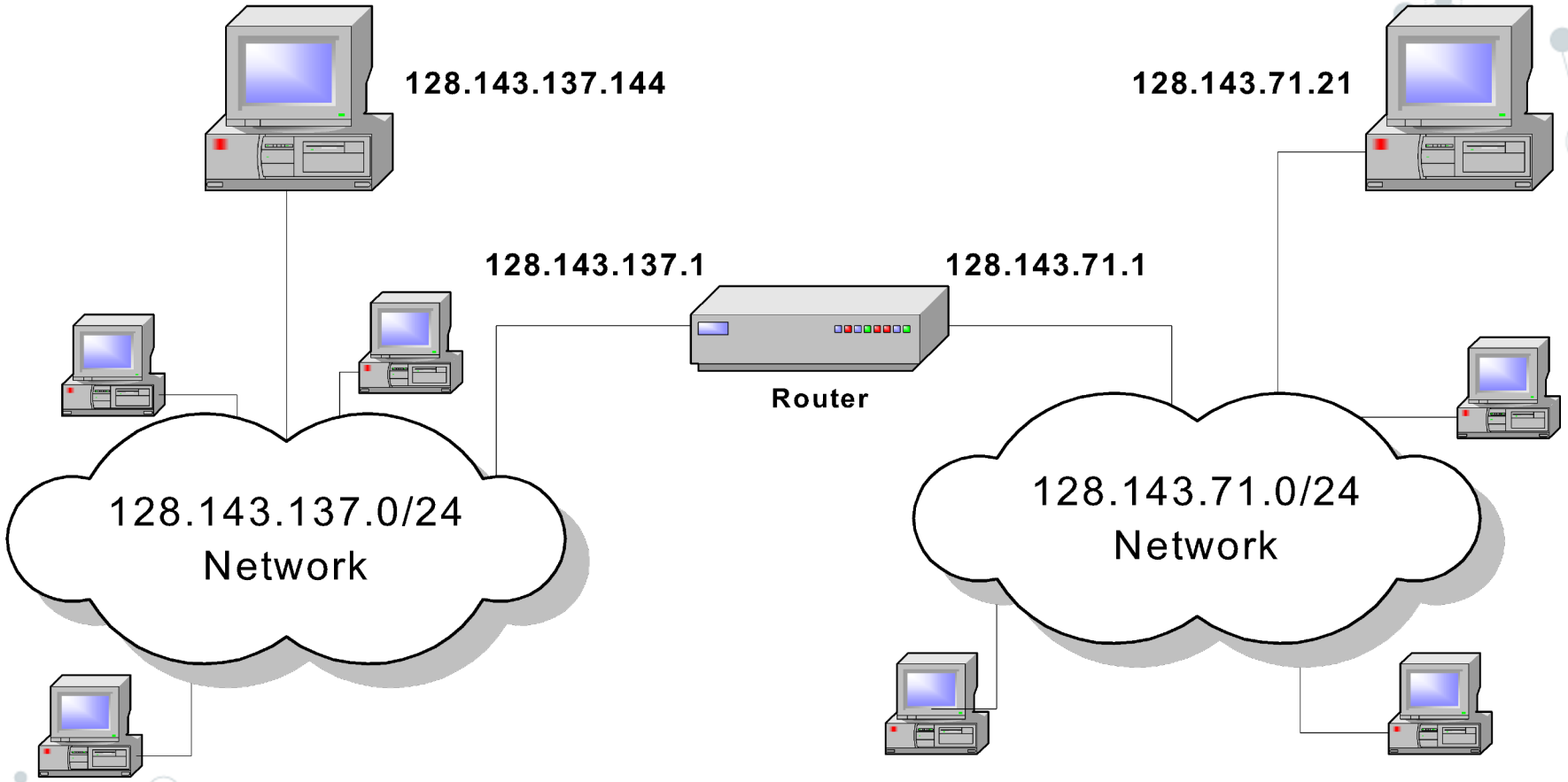
Different Layers View Of Networking

Network View of HTTP's and TCP's



Different Layers View Of Networking

Network View of IP Protocol



Different Layers View Of Networking

Network View of Ethernet