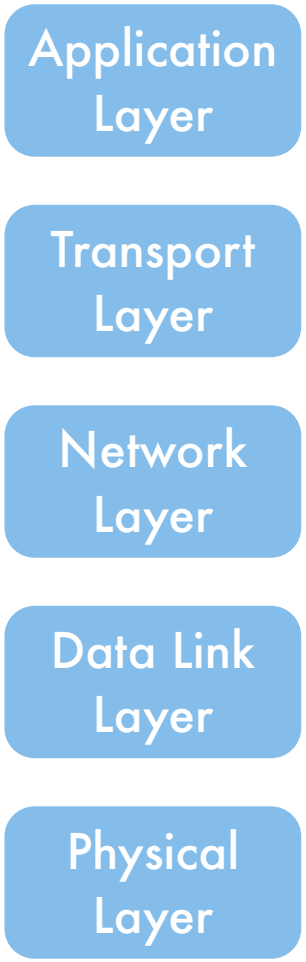
Introduction to Programming for Scientists

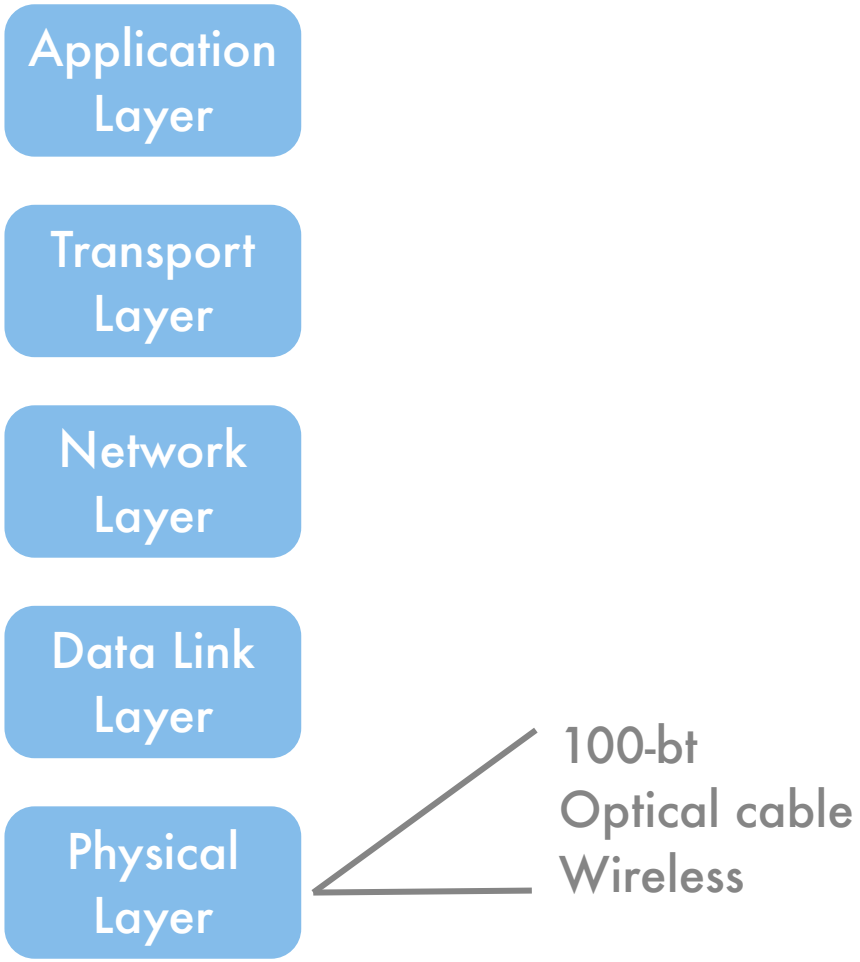
Lecture 9

Homework Review

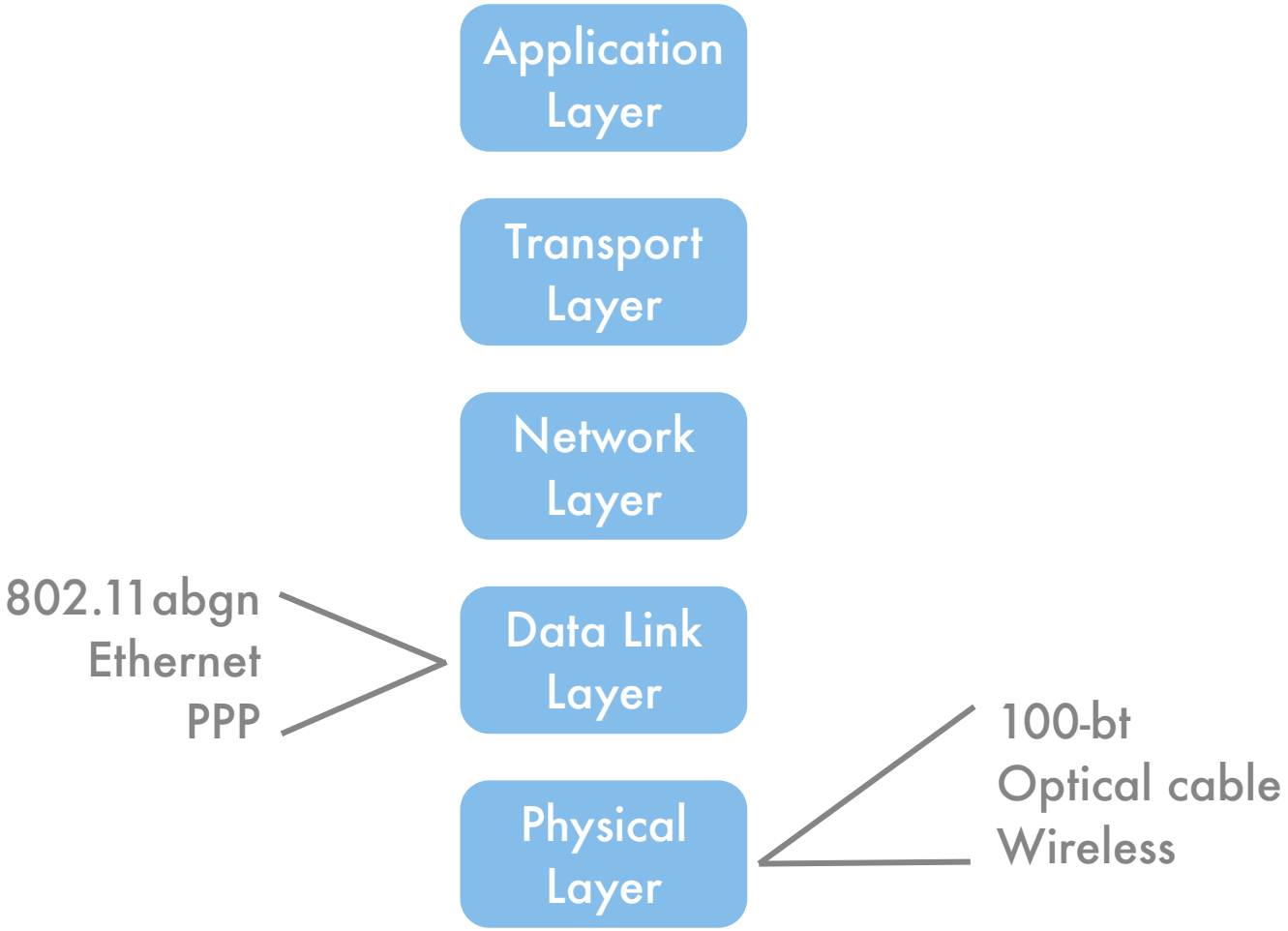
Networking


Application Layer
Transport Layer
Network Layer
Data Link Layer
Physical Layer

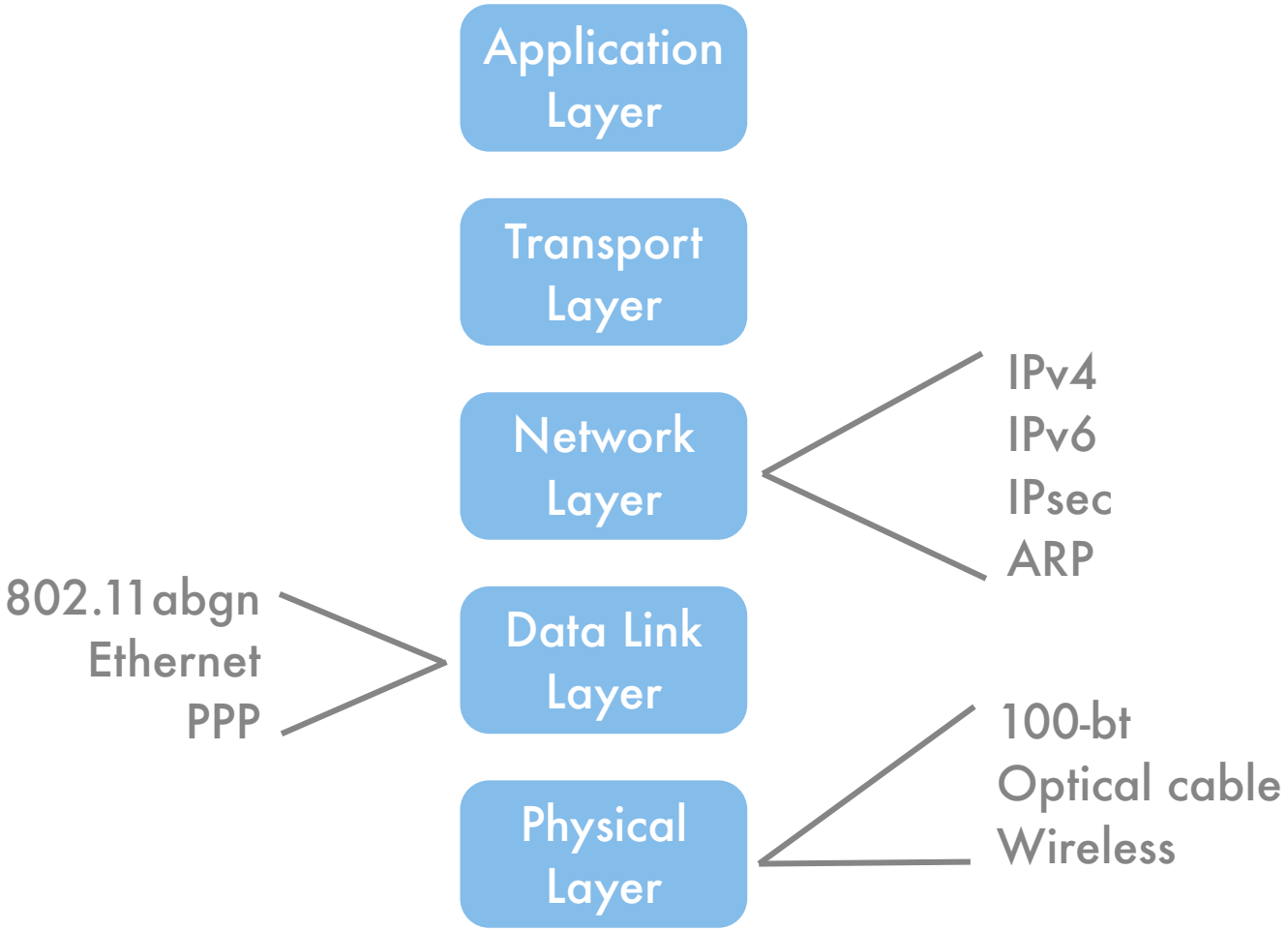
Networking


Application Layer
Transport Layer
Network Layer
Data Link Layer
Physical Layer
100-bt
Optical cable
Wireless

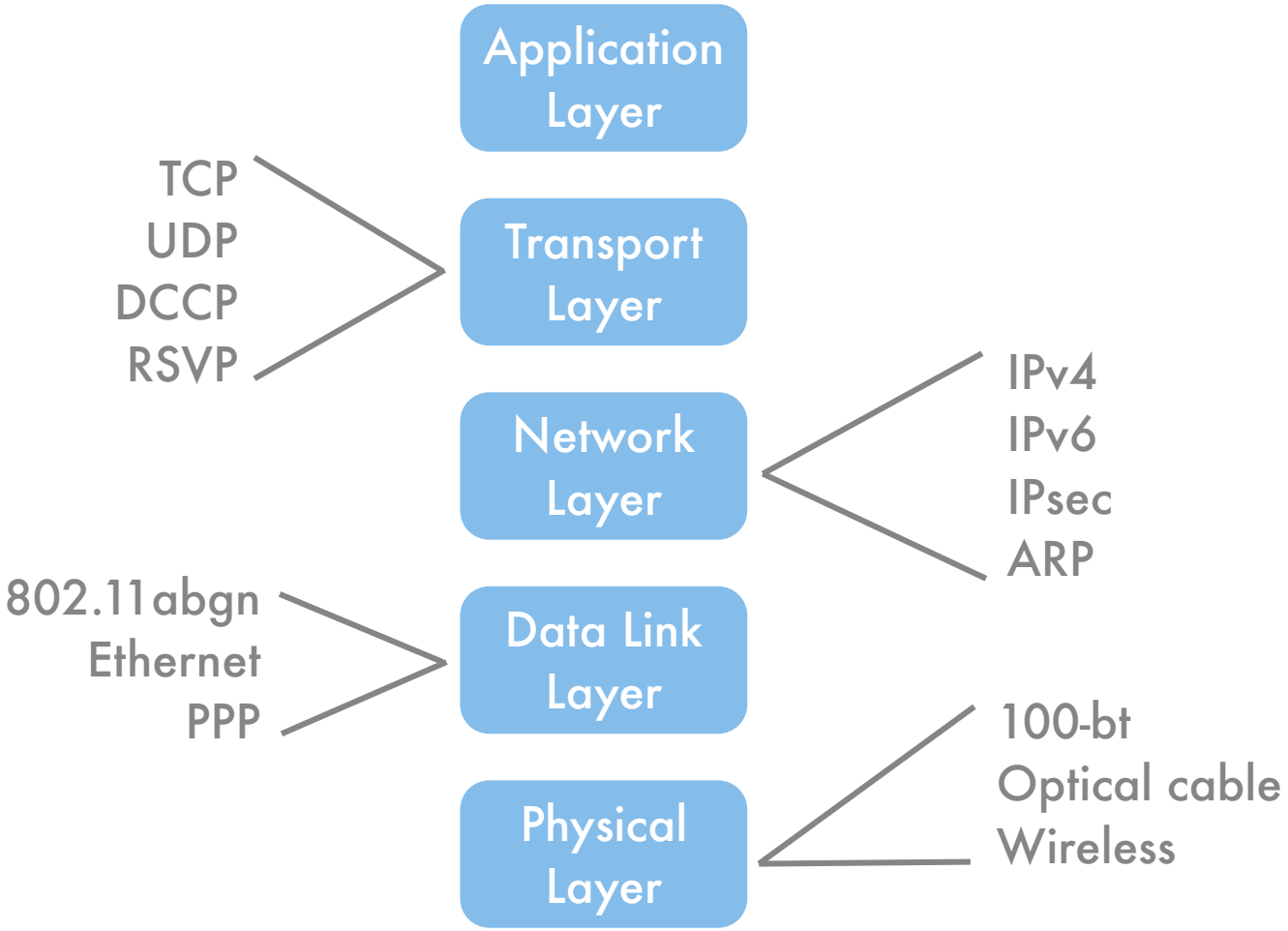
Networking


Application Layer
Transport Layer
Network Layer
802.11abgn
Ethernet
PPP
Data Link Layer
Physical Layer
100-bt
Optical cable
Wireless

Networking


Application Layer
Transport Layer
Network Layer
Data Link Layer
Physical Layer
IPv4
IPv6
IPsec
ARP
802.11abgn
Ethernet
PPP
100-bt
Optical cable
Wireless

Networking


Application Layer
TCP
UDP
DCCP
RSVP
Transport Layer
Network Layer
IPv4
IPv6
IPsec
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802.11abgn
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Data Link Layer
Physical Layer
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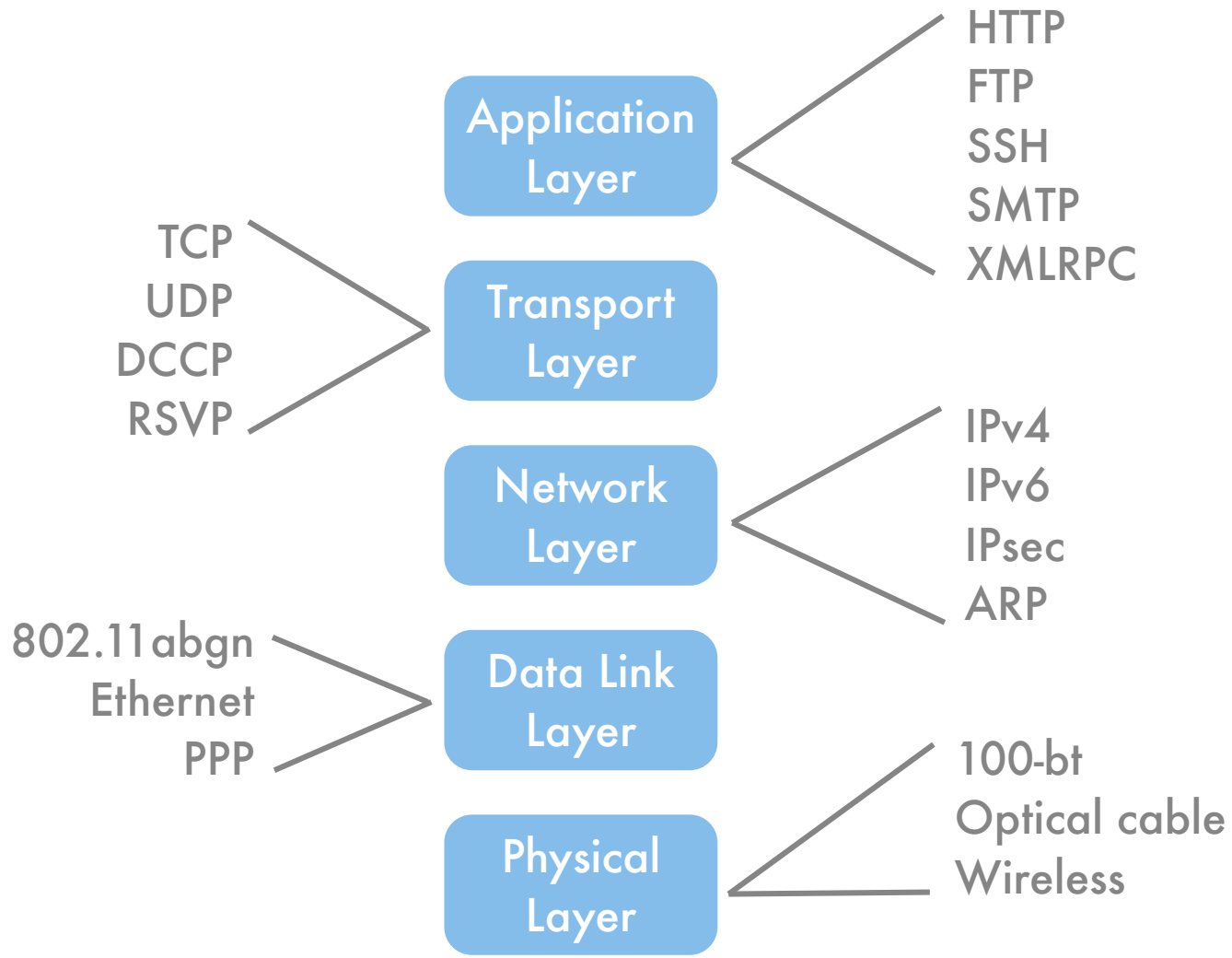
Optical cable
Wireless

Networking


Application Layer
HTTP
FTP
SSH
SMTP
XMLRPC
Transport Layer
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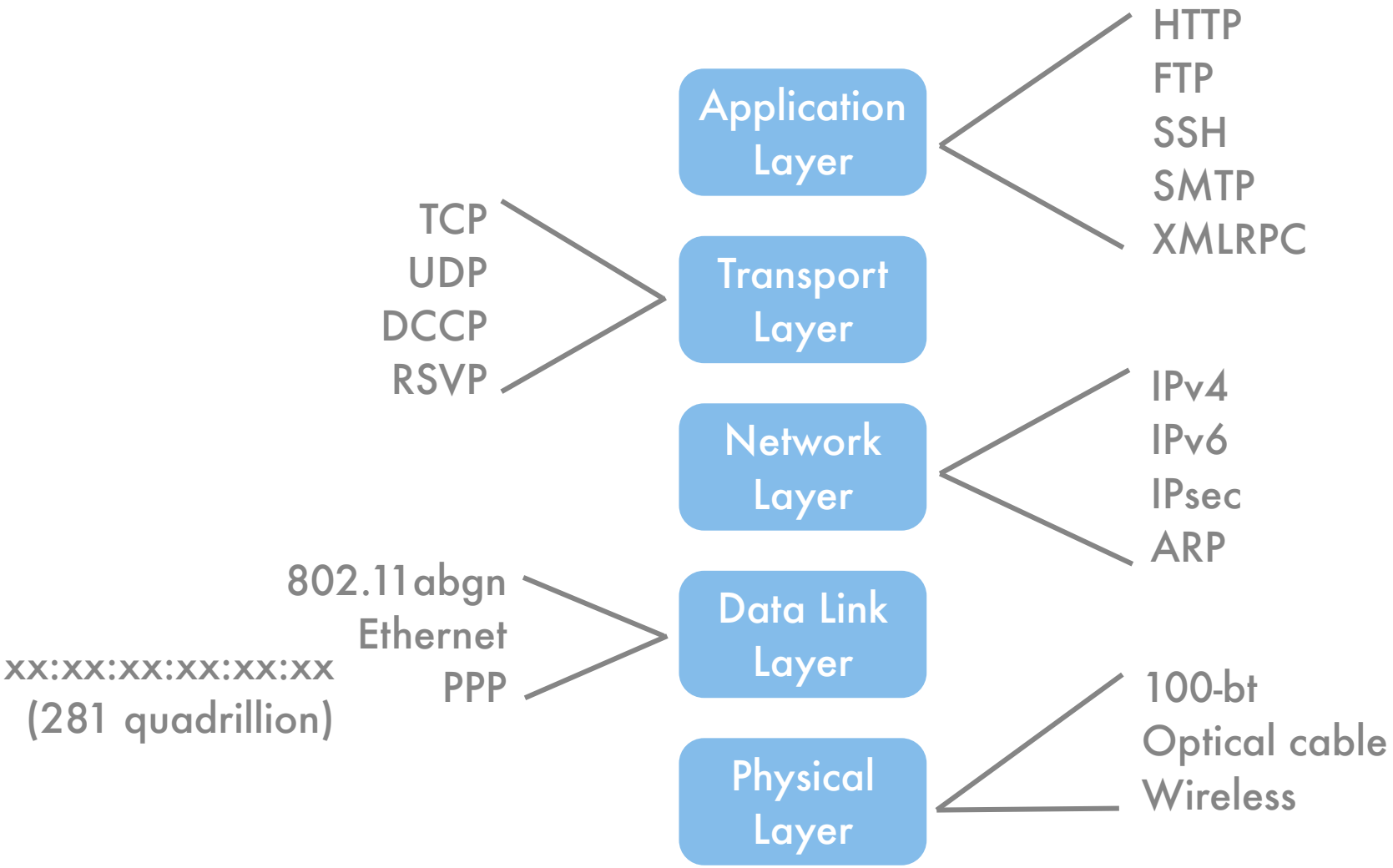
Networking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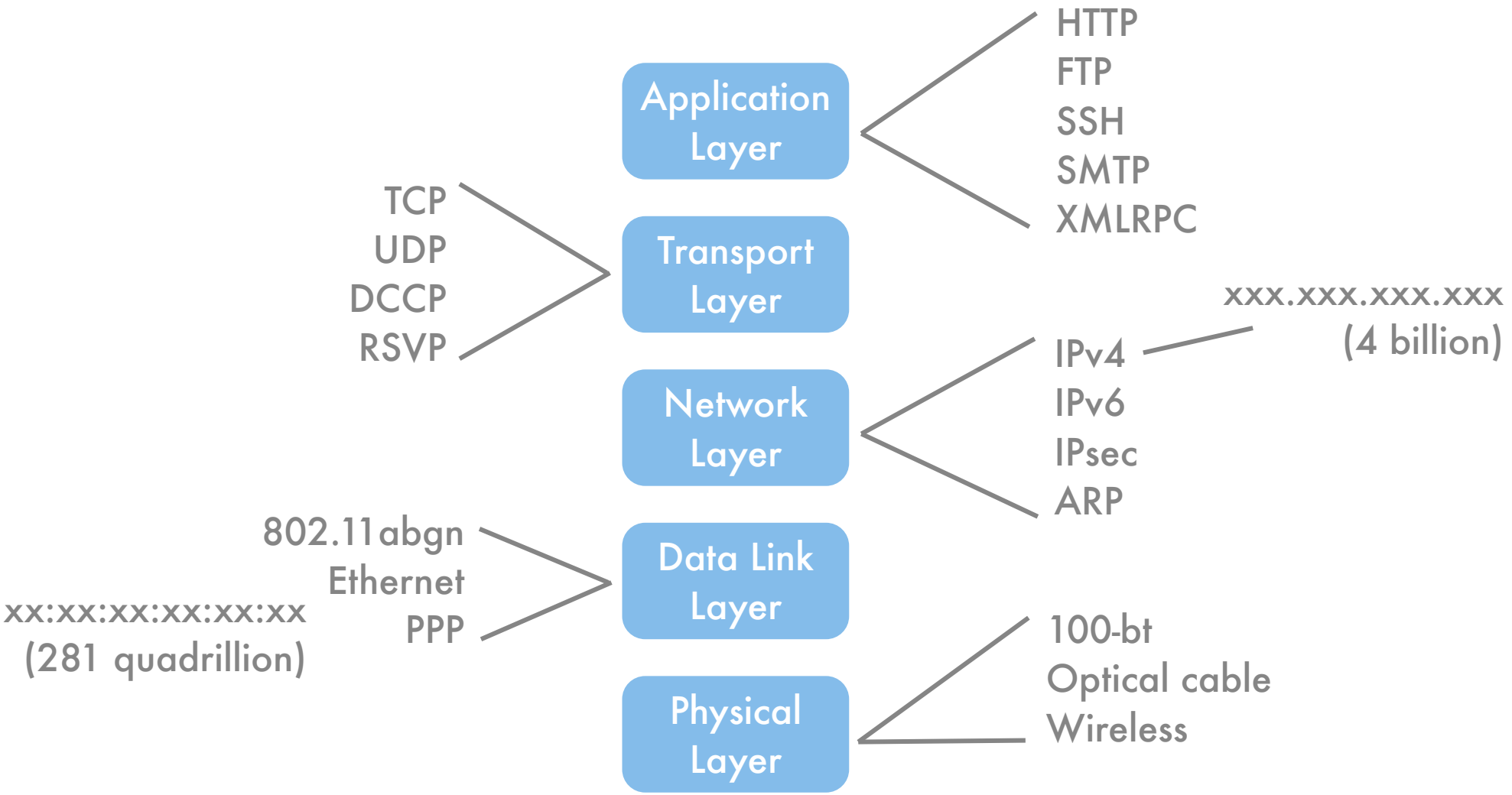
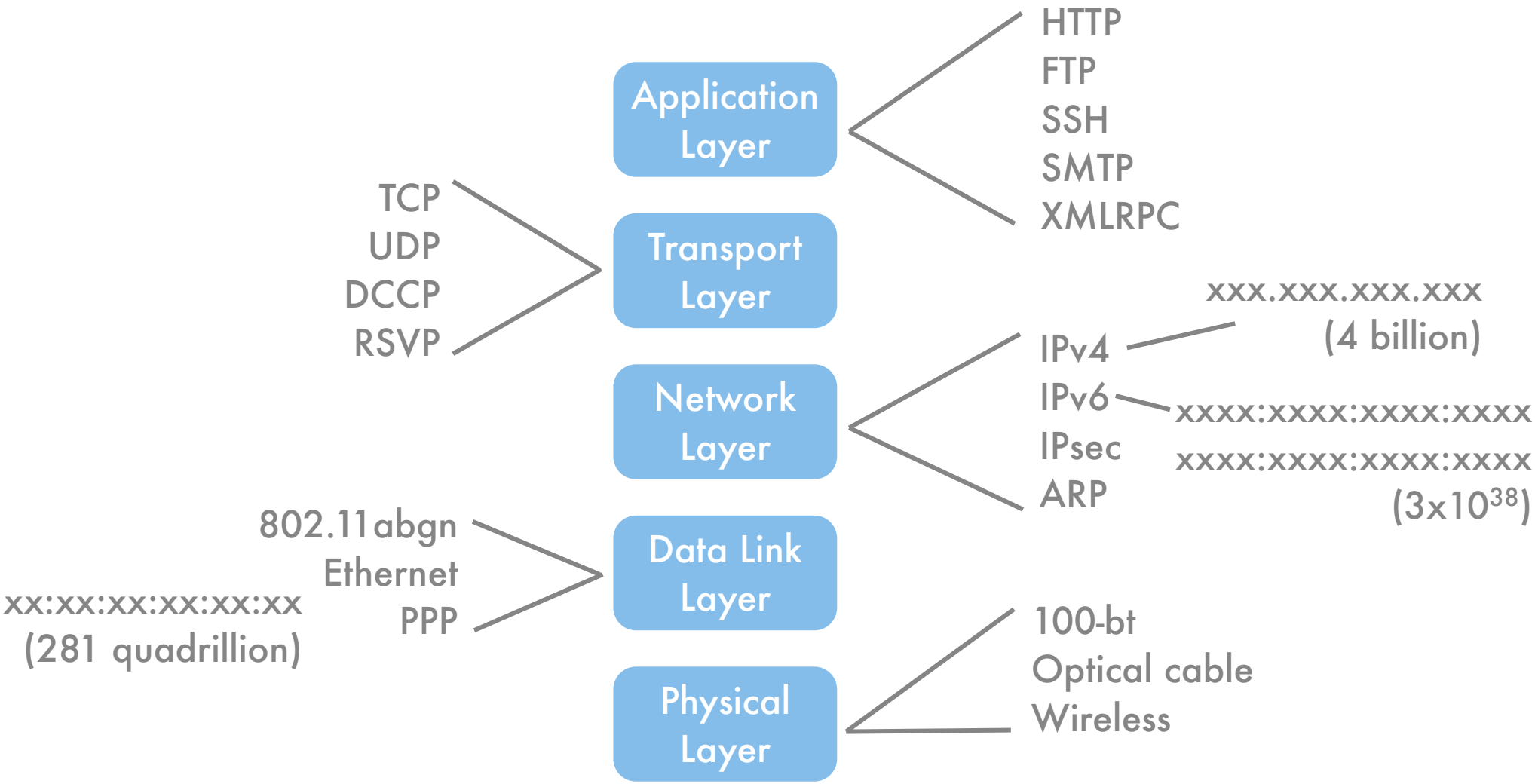
IPv6
IPsec
ARP
Data Link Layer
802.11abgn
Ethernet
PPP
xx:xx:xx:xx:xx:xx
(281 quadrillion)
Physical Layer
100-bt
Optical cable
Wireless

Networking


Application Layer
HTTP
FTP
SSH
SMTP
XMLRPC
Transport Layer
TCP
UDP
DCCP
RSVP
Network Layer
IPv4
xxx.xxx.xxx.xxx
(4 billion)
IPv6
IPsec
ARP
Data Link Layer
802.11abgn
Ethernet
PPP
xx:xx:xx:xx:xx:xx
(281 quadrillion)
Physical Layer
100-bt
Optical cable
Wireless

Networking


Application Layer
HTTP
FTP
SSH
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Transport Layer
TCP
UDP
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RSVP
Network Layer
IPv4
xxx.xxx.xxx.xxx
(4 billion)
IPv6
xxxx:xxxx:xxxx:xxxx
xxxx:xxxx:xxxx:xxxx
(3x10^38)
IPsec
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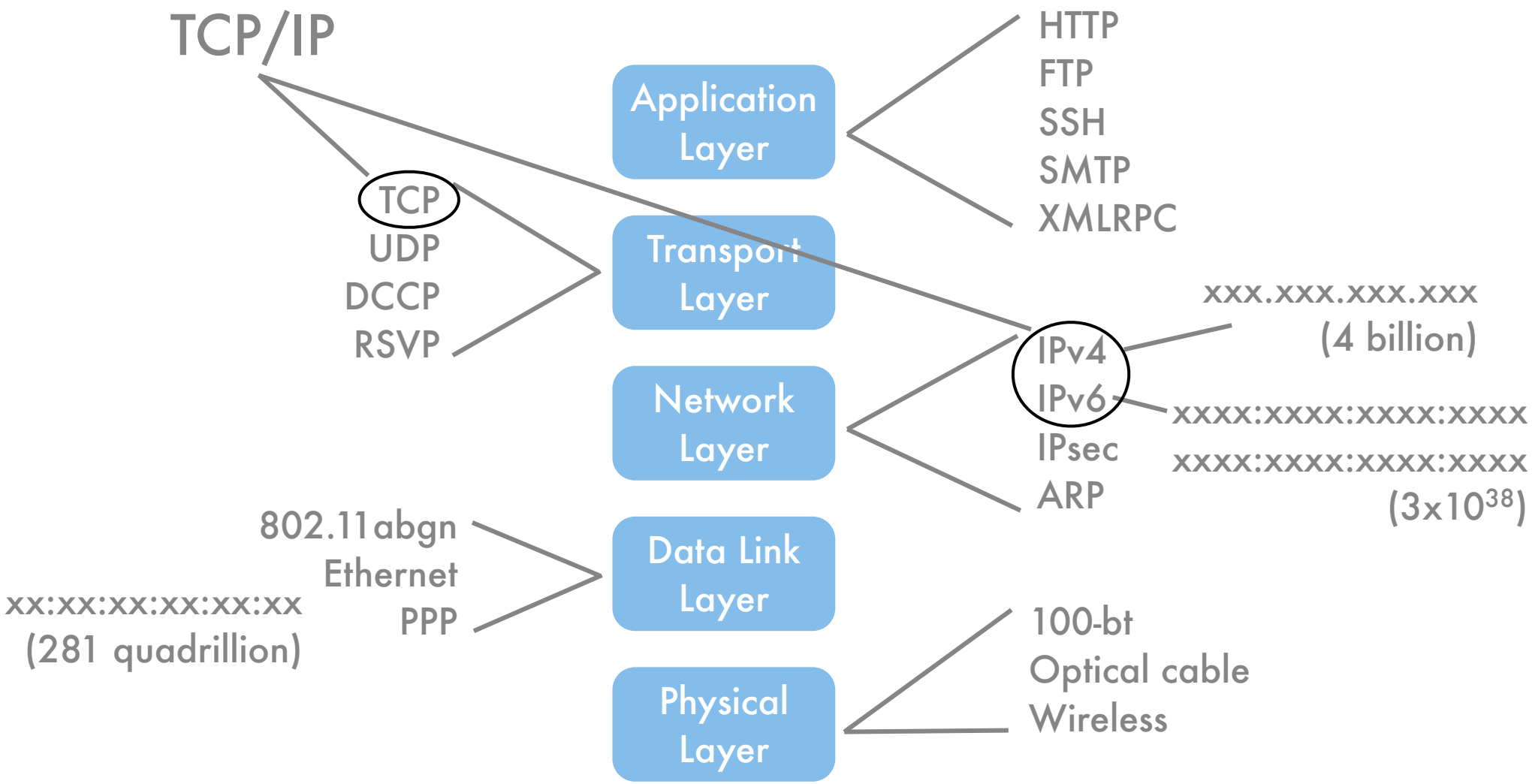
TCP/IP
Application Layer
HTTP
FTP
SSH
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XMLRPC
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Transport Layer
IPv4
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IPsec
ARP
xxx.xxx.xxx.xxx
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IPv4 Network Parameters

- IP Address - Computer's unique* address (x.x.x.x)
- Netmask - defines local 'subnet', machines the computer can speak to 'directly'
- Router - Address used to contact machines outside subnet
- DNS Server - Address where names can be mapped to addresses
- Port - For a specific connection 0-65535, 0-1023 reserved for system services

* - Some addresses are for 'private networks'. These are 10.*.*.*, 172.16.*.*-172.31.*.*, and 192.168.*.*

Common Services

port	service
21	ftp
22	ssh
23	telnet
25	smtp (mail)
79	finger
80	http (web)
110	pop3 (email retrieval)
123	ntp (time)
137-139	Windows file sharing
143	imap (email retrieval)
443	https (secure http)

Sockets (TCP/UDP)

UDP

192.168.10.10 4000

4000 192.168.10.11

TCP

192.168.10.10

4000 192.168.10.11

Sockets (TCP/UDP)

UDP

192.168.10.10 4000

4000 192.168.10.11

TCP

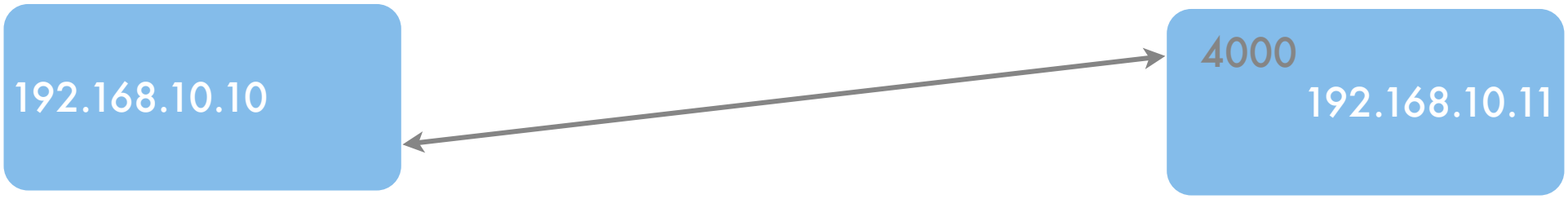
192.168.10.10

4000 192.168.10.11

Sockets (TCP/UDP)

UDP

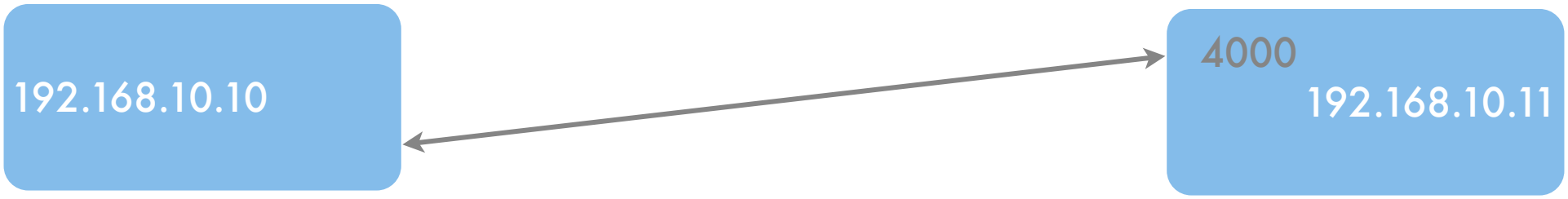
TCP



Sockets (TCP/UDP)

UDP

TCP



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NAT

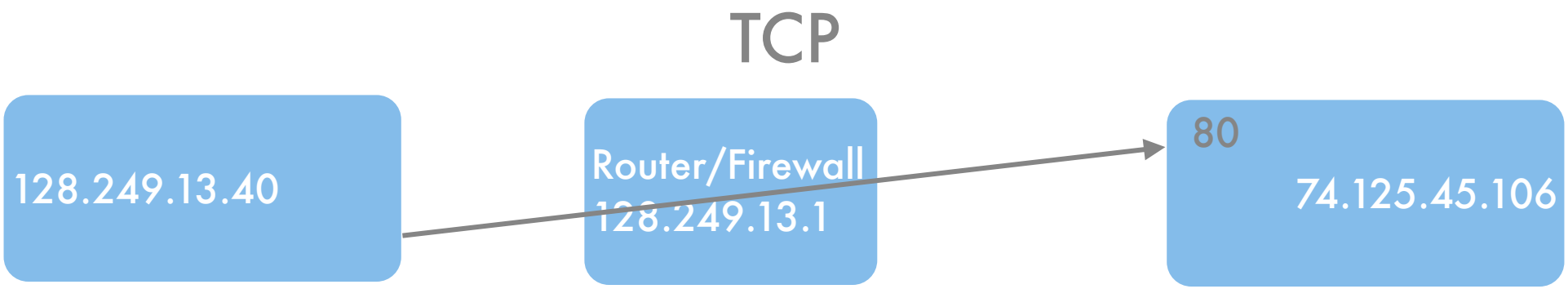
TCP

128.249.13.40

Router/Firewall
128.249.13.1

74.125.45.106

NAT



NAT

TCP

128.249.13.40

Router/Firewall
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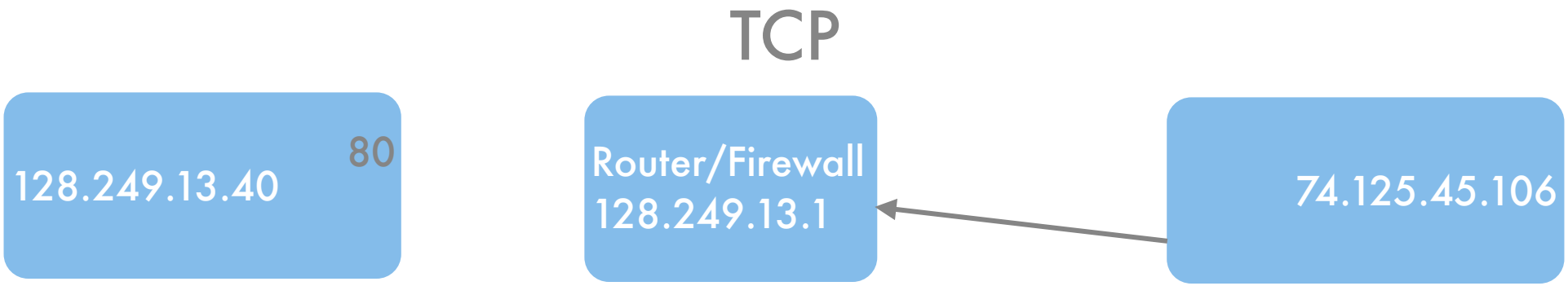

NAT

TCP

NAT

TCP


Intranet
10.10.10.25
Router/Firewall
128.249.13.1
Internet
80
74.125.45.106

NAT

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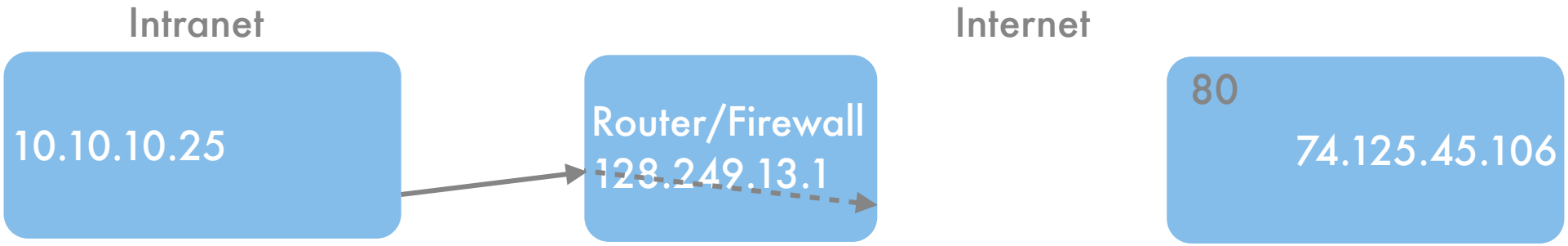
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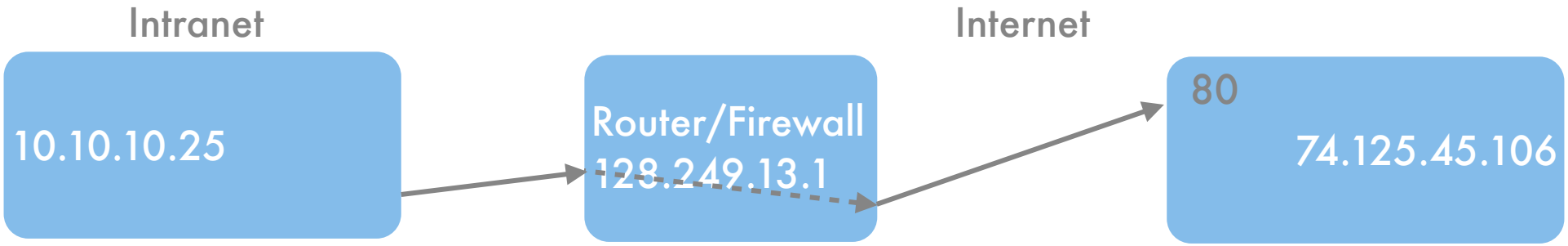
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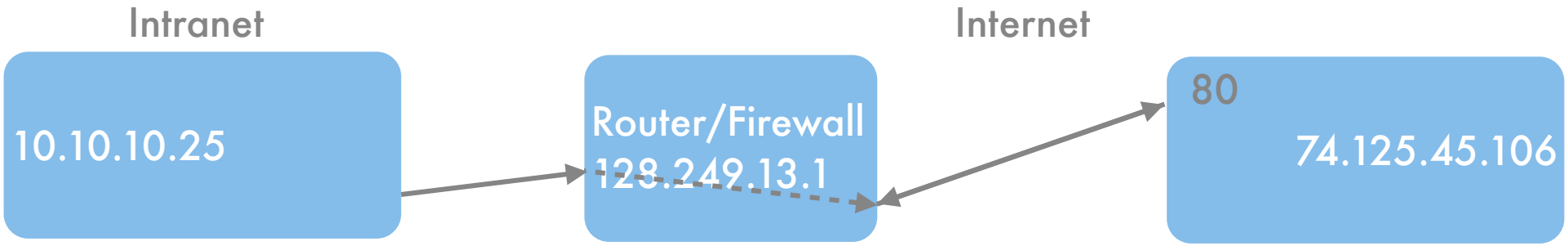
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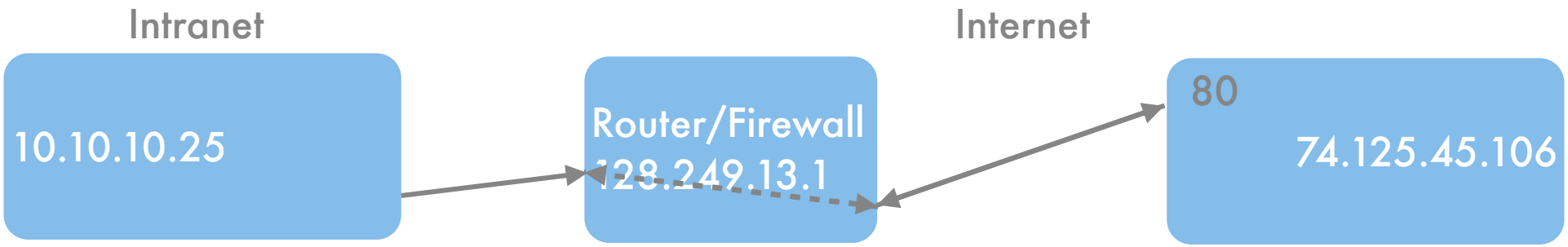
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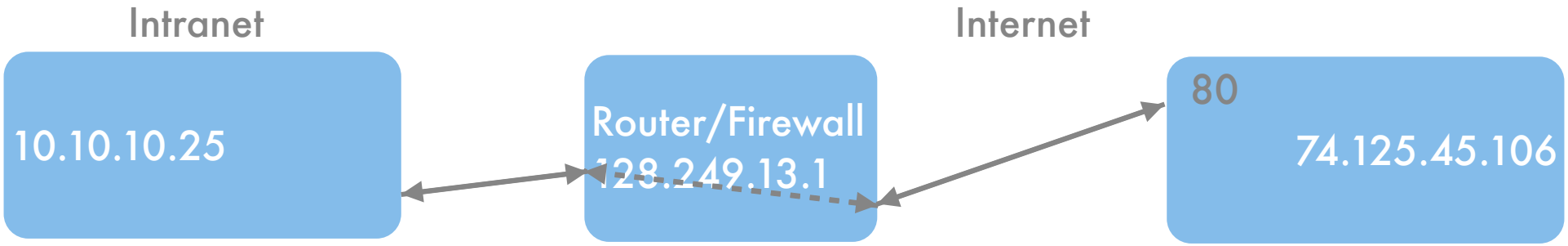
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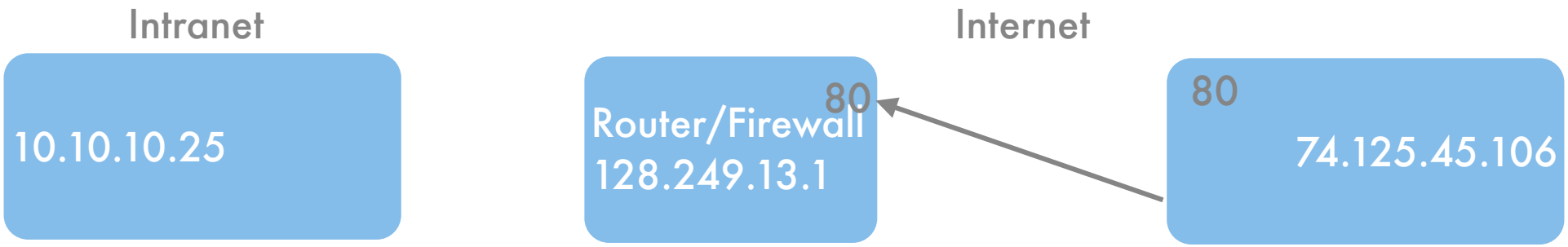
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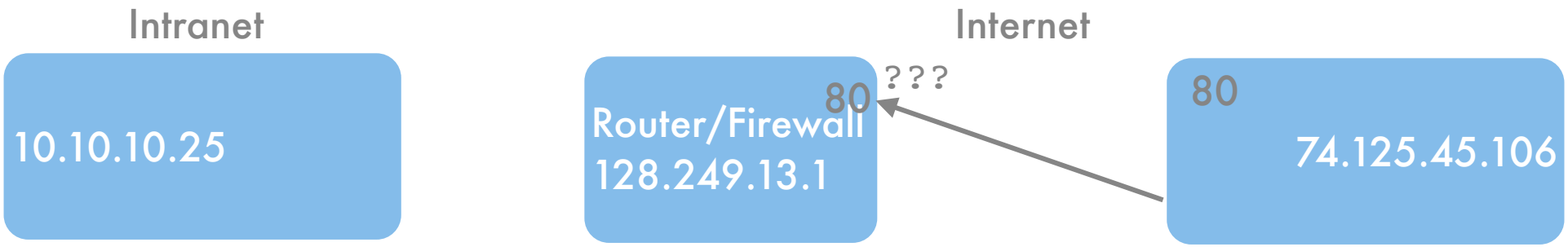
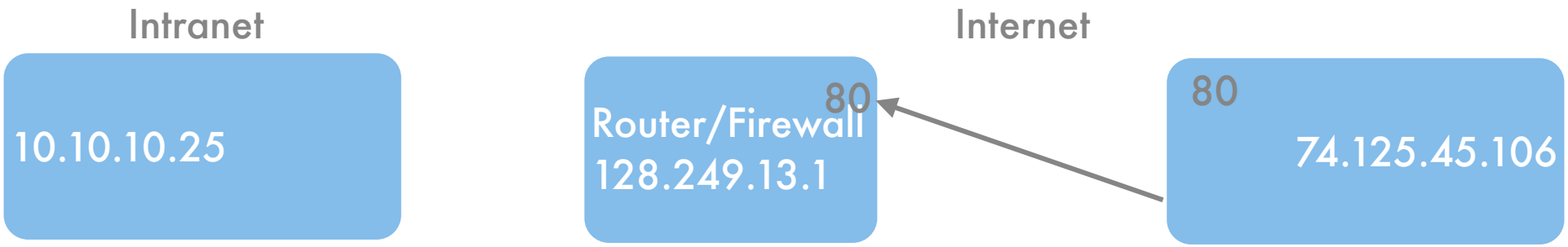
TCP


Intranet
10.10.10.25
Internet
???
80
Router/Firewall
128.249.13.1
80
74.125.45.106

NAT

TCP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80
Internet
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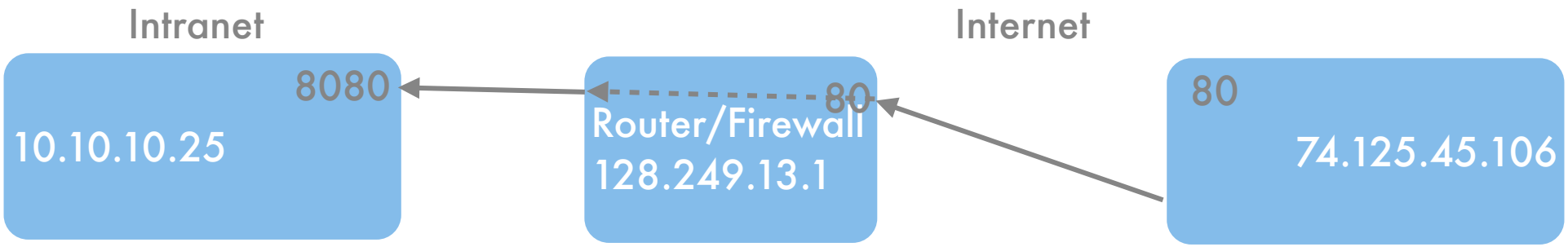
TCP


Intranet
8080
10.10.10.25
Router/Firewall
128.249.13.1
80
Internet
80
74.125.45.106

Socket Module

- gethostname() - name of the current machine
- gethostbyname() - given a name, returns an IP address
- gethostbyaddr() - given an address, returns names and other info
- socket() - create a new socket
  - listen(n) - waits for incoming connections on a socket n>1
  - accept() - accepts an incoming connection, returns tuple with socket
  - connect((host,port)) - connects to a remote socket
  - send(), recv() - send and receive data
- bind() - bind a socket to an address
- select() - from select module, lets you wait for activity on set of sockets

UDP

```
#receiver
import socket
s=socket.socket(socket.AF_INET,socket.SOCK_DGRAM)
s.bind(("",40000))
while (1): print s.recv(256)              # or s.recvfrom(256)

#sender
s=socket.socket(socket.AF_INET,socket.SOCK_DGRAM)
s.bind((“”,40000))
s.setsockopt(socket.SOL_SOCKET, socket.SO_BROADCAST, 1)
s.sendto(“Hello there”,(“<broadcast>”,40000))
```

Making Connections

```
# Receiver/server
import socket
sock=socket.socket()        # default is to make a normal internet socket
sock.bind((“”,40000))
sock.listen(1)
sock2=sock.accept()
print sock2[0].recv(256)

# Sender
import socket
sock=socket.socket()
sock.connect((target,40000))
sock.send(“Hello there”)
```

Threads

How to do more than one thing at a time (sort of)

```
from threading import Thread
def func():
        for i in range(30):
            time.sleep(1)
            print i
thread=Thread(target=func,args=(1,2,3...))        # create a new thread
thread.start()
```

Client/Server Demo