CSCI 466: Networks

Lecture 2: Network Edge, Network Core

Reese Pearsall

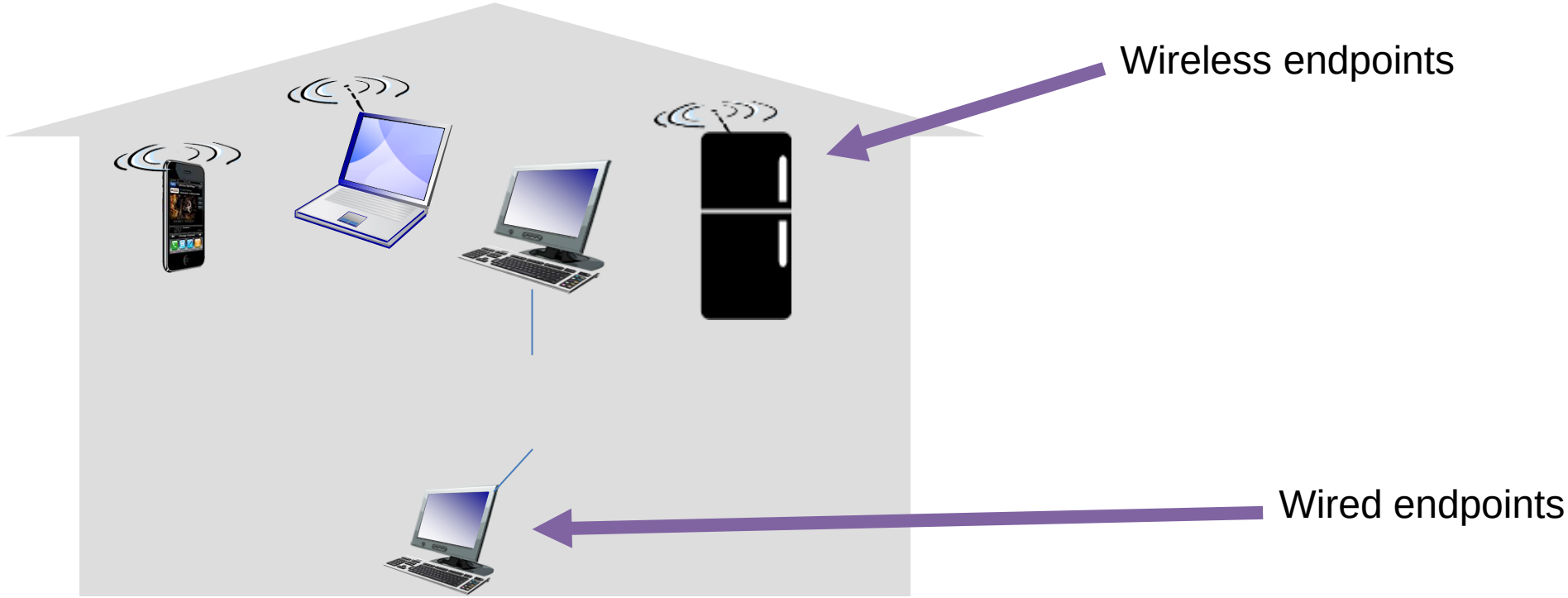
Fall 2023

Announcements

- Make sure to get the CSCI 466 role on Discord!
- Fill out the course questionnaire

End to End Communication

Devices that are connected to network are called **hosts** or **end systems**



A typical home network

How does out network get access through other networks?

End to End Communication

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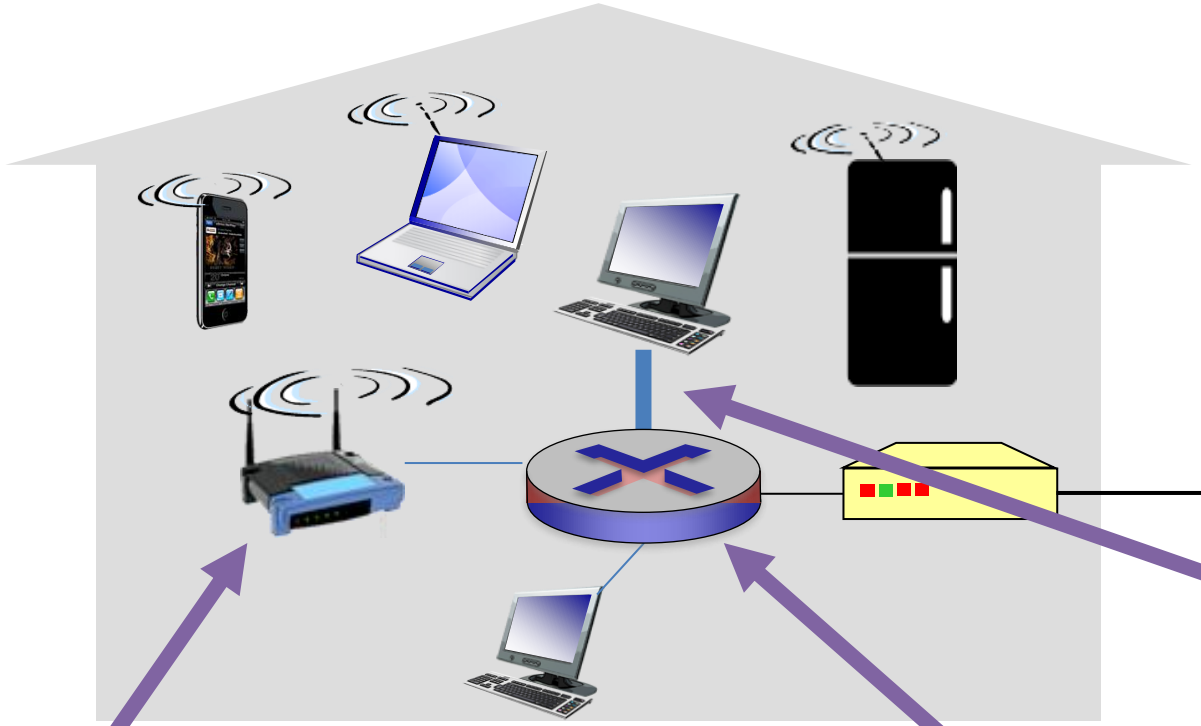

A typical home network

End systems are connected together by a network of **communication links** and **packet switches**

Communication Link

Packet Switch

wireless access point (54 Mbps)

End to End Communication

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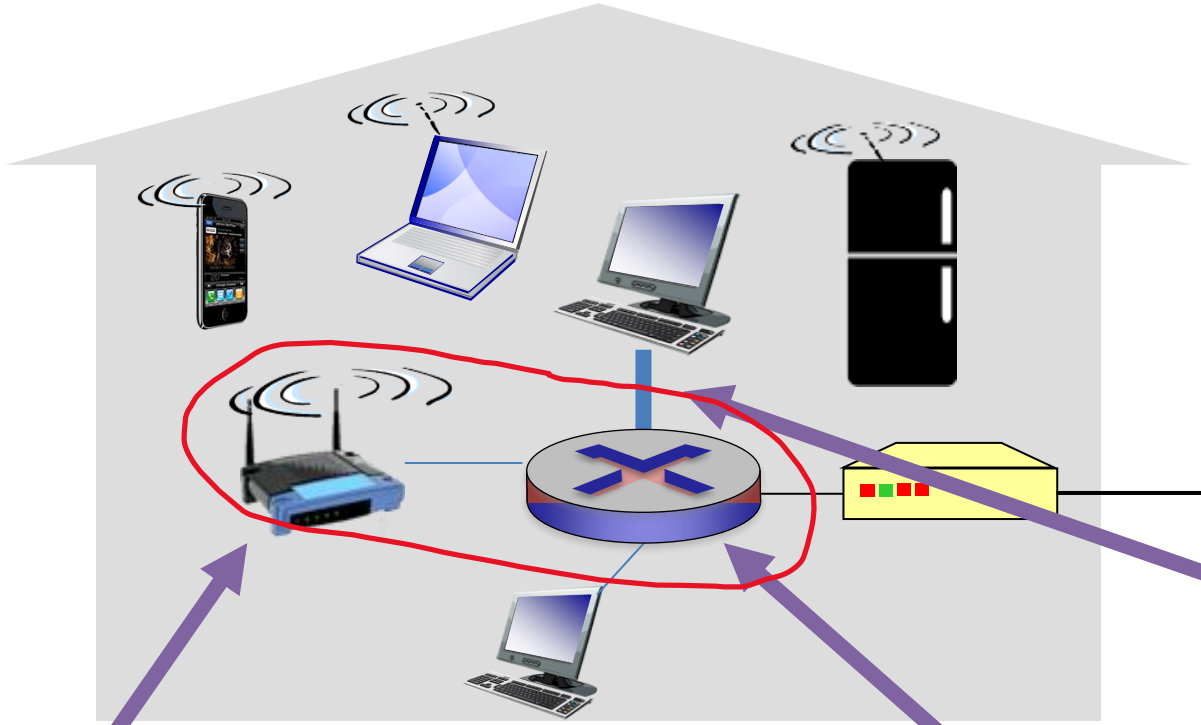

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Packet Switch

The most common packet switch we see is called a **router**

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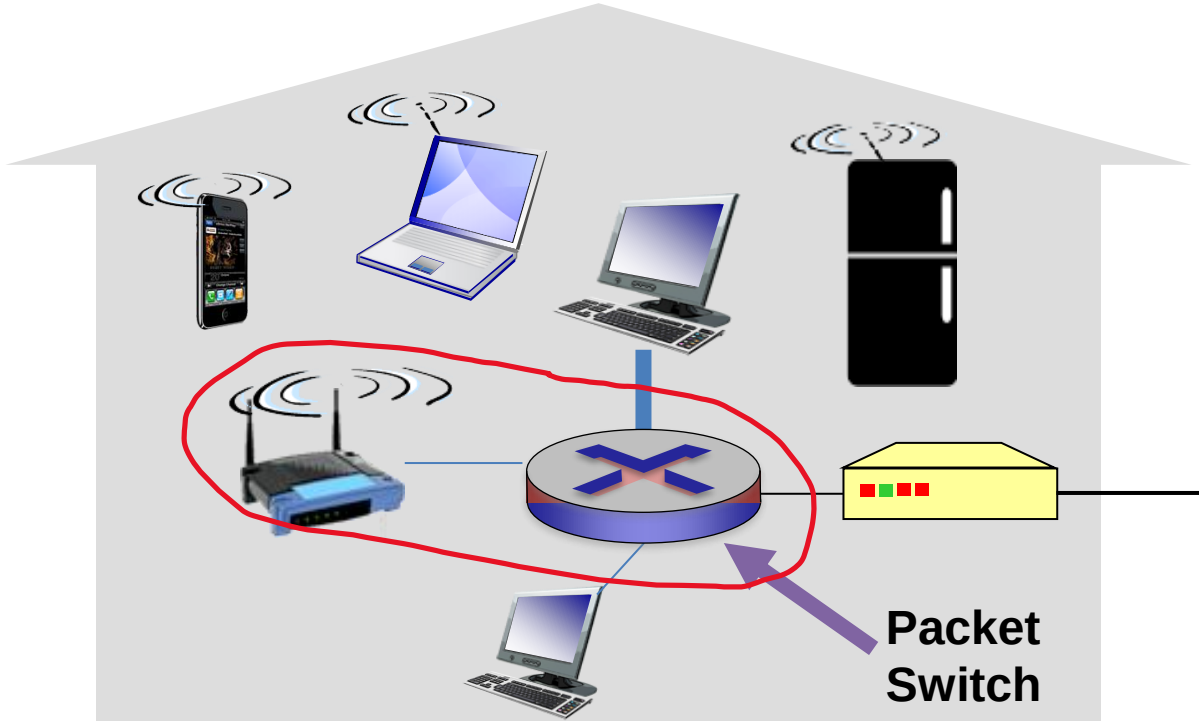

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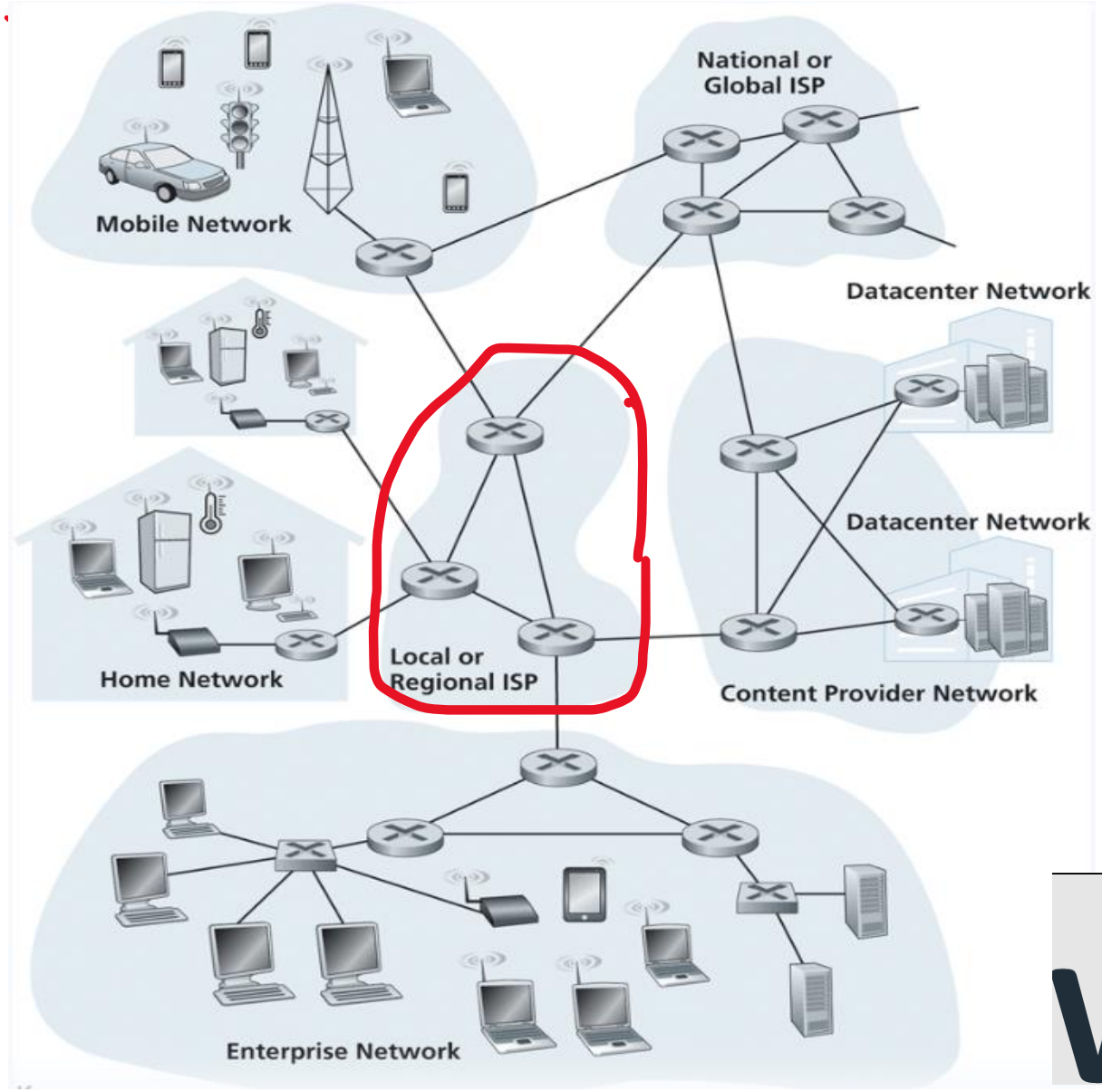
End to End Communication



End systems gain access to the internet through **Internet Service Providers (ISPs)**

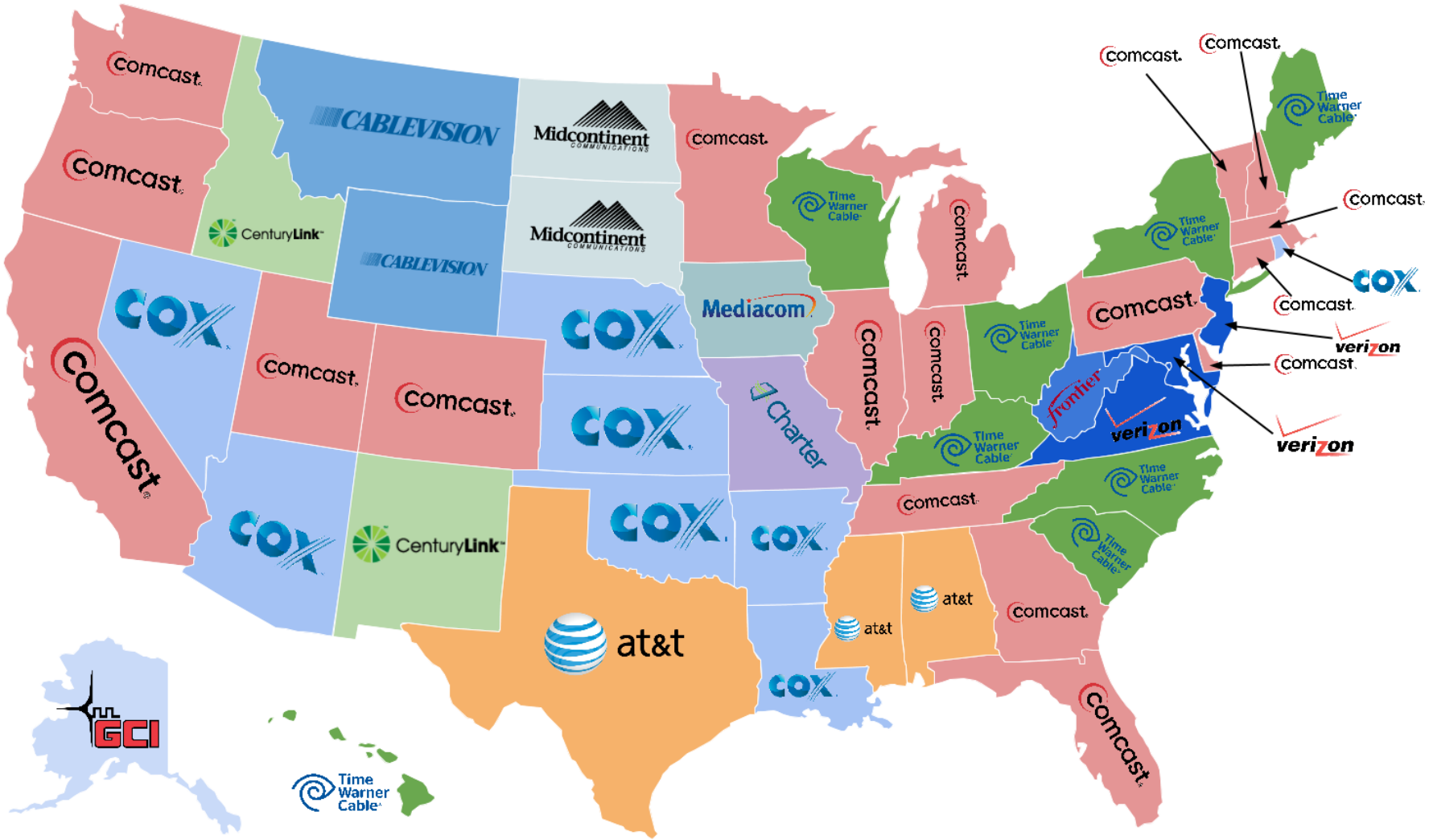
Spectrum

CenturyLink

Viasat

End to End Communication

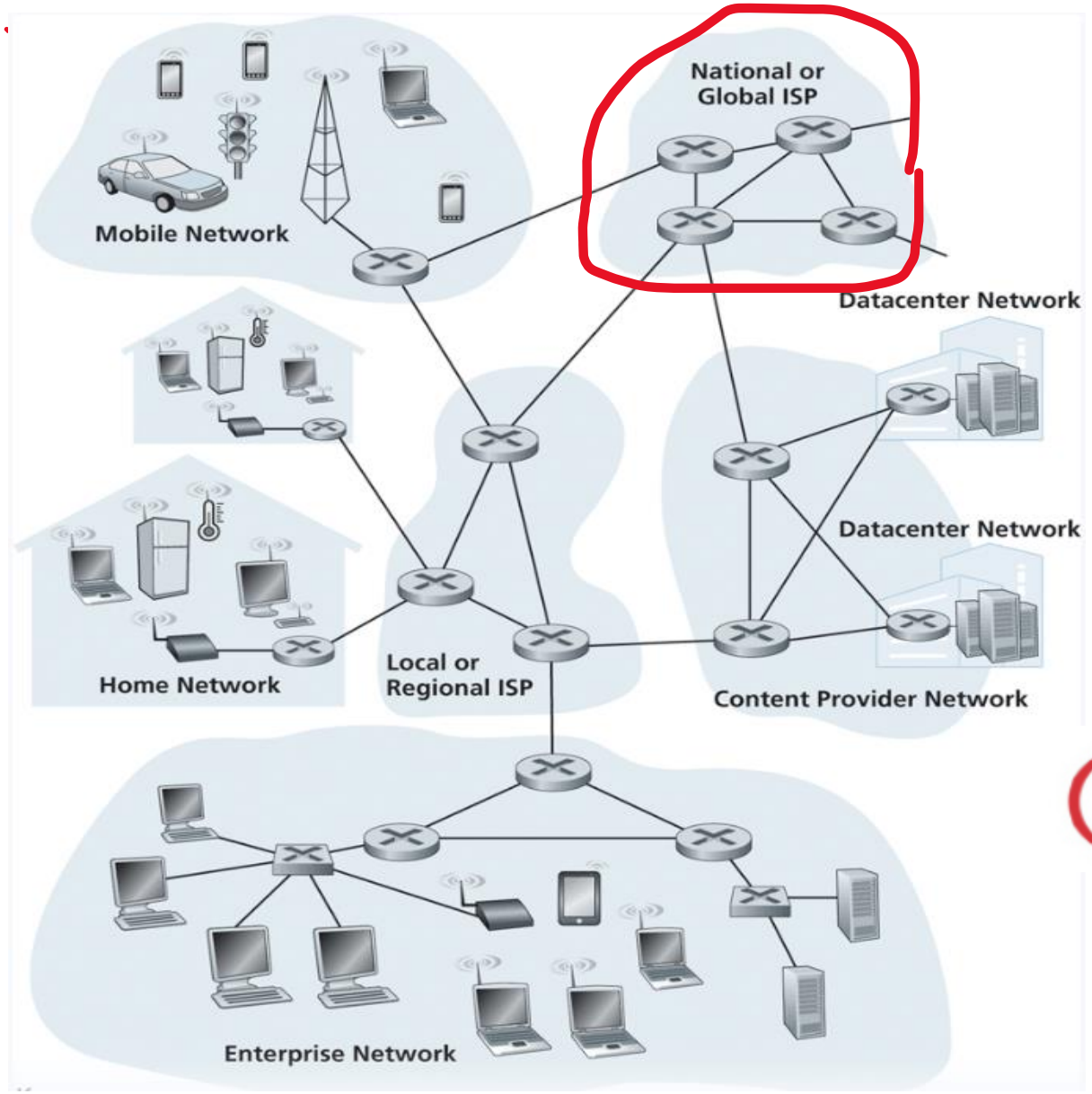
Top Internet Service Provider State-by-State



Source: 56 million web visits

WebpageFX

End to End Communication



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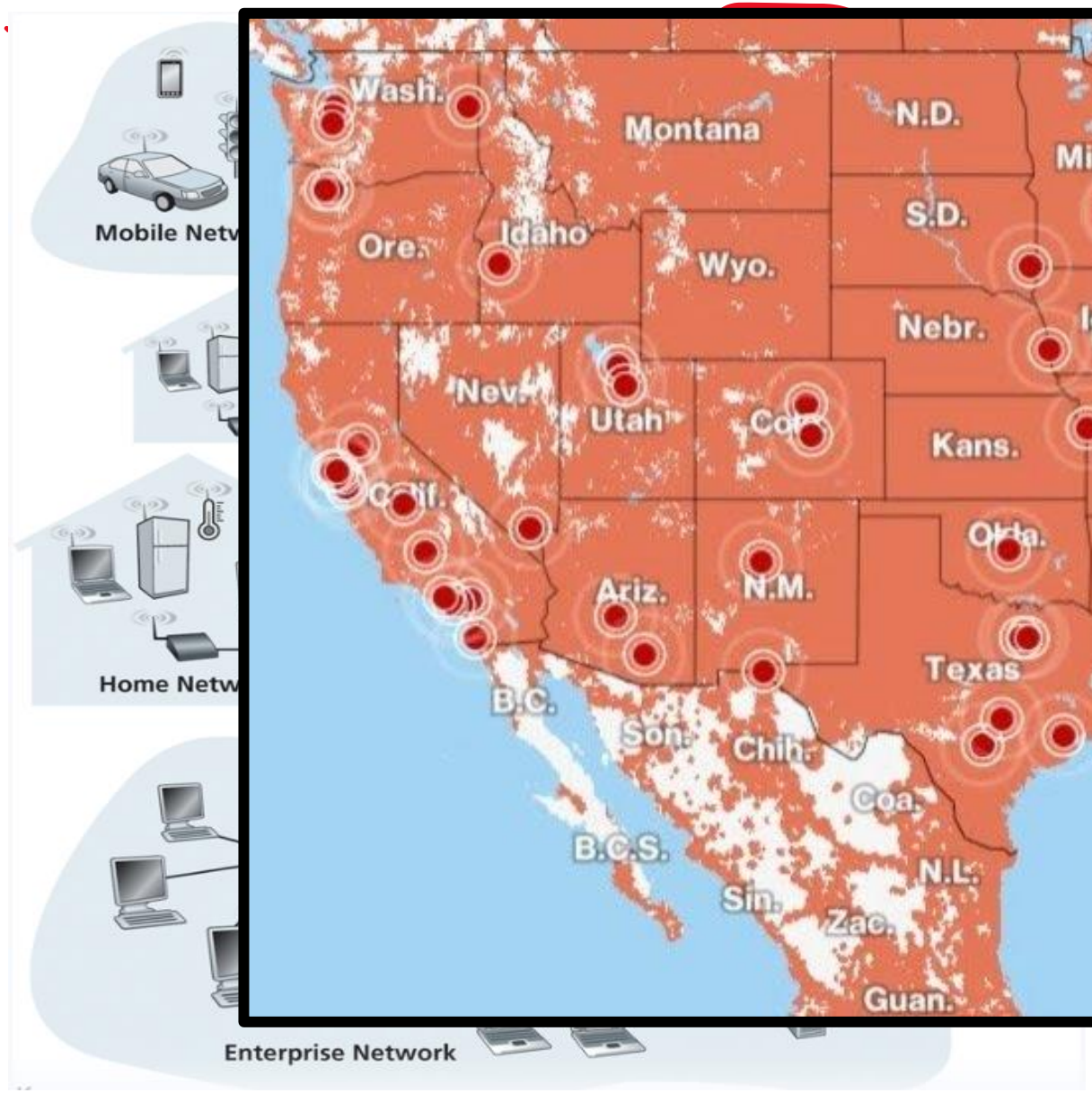

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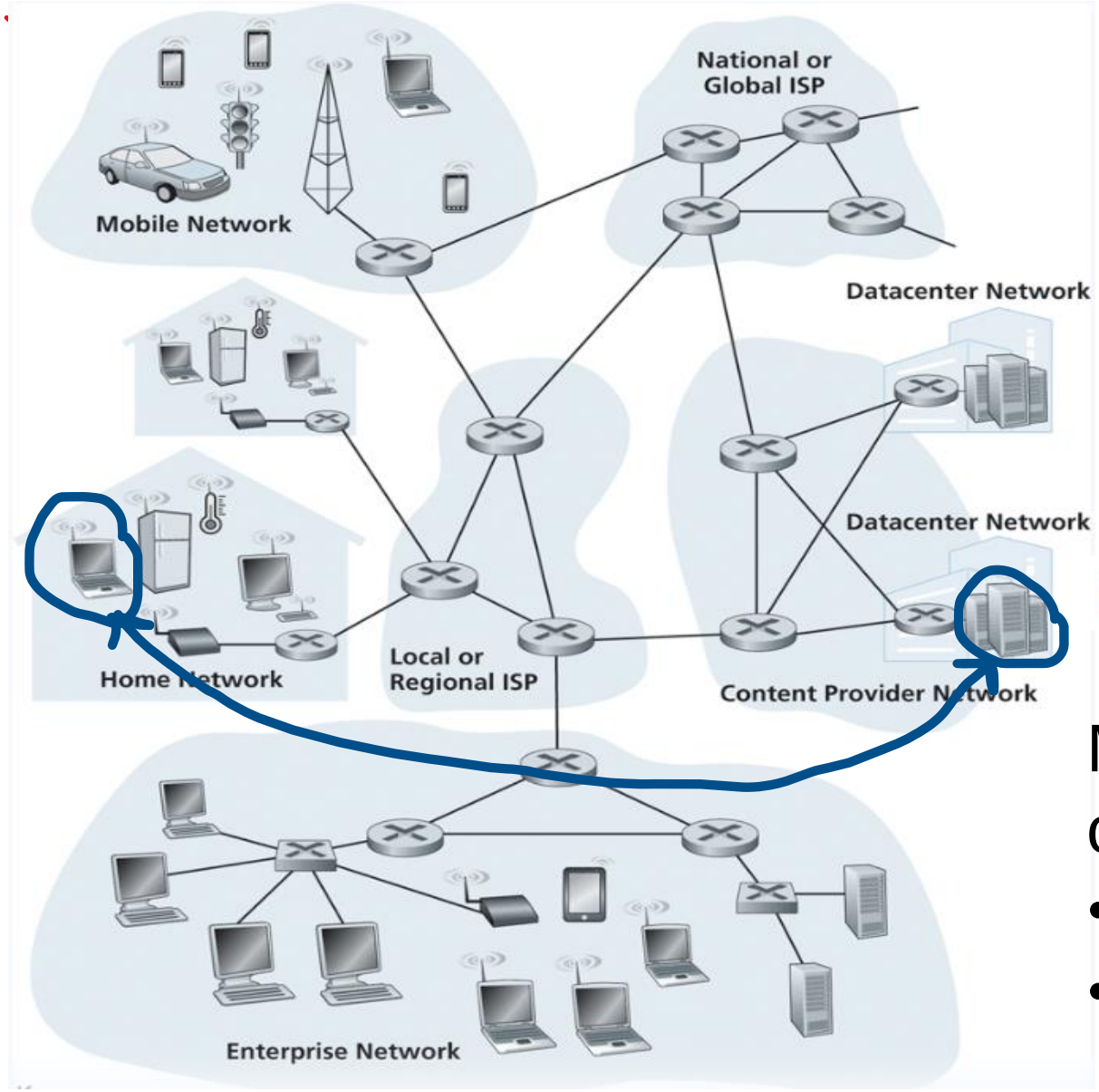


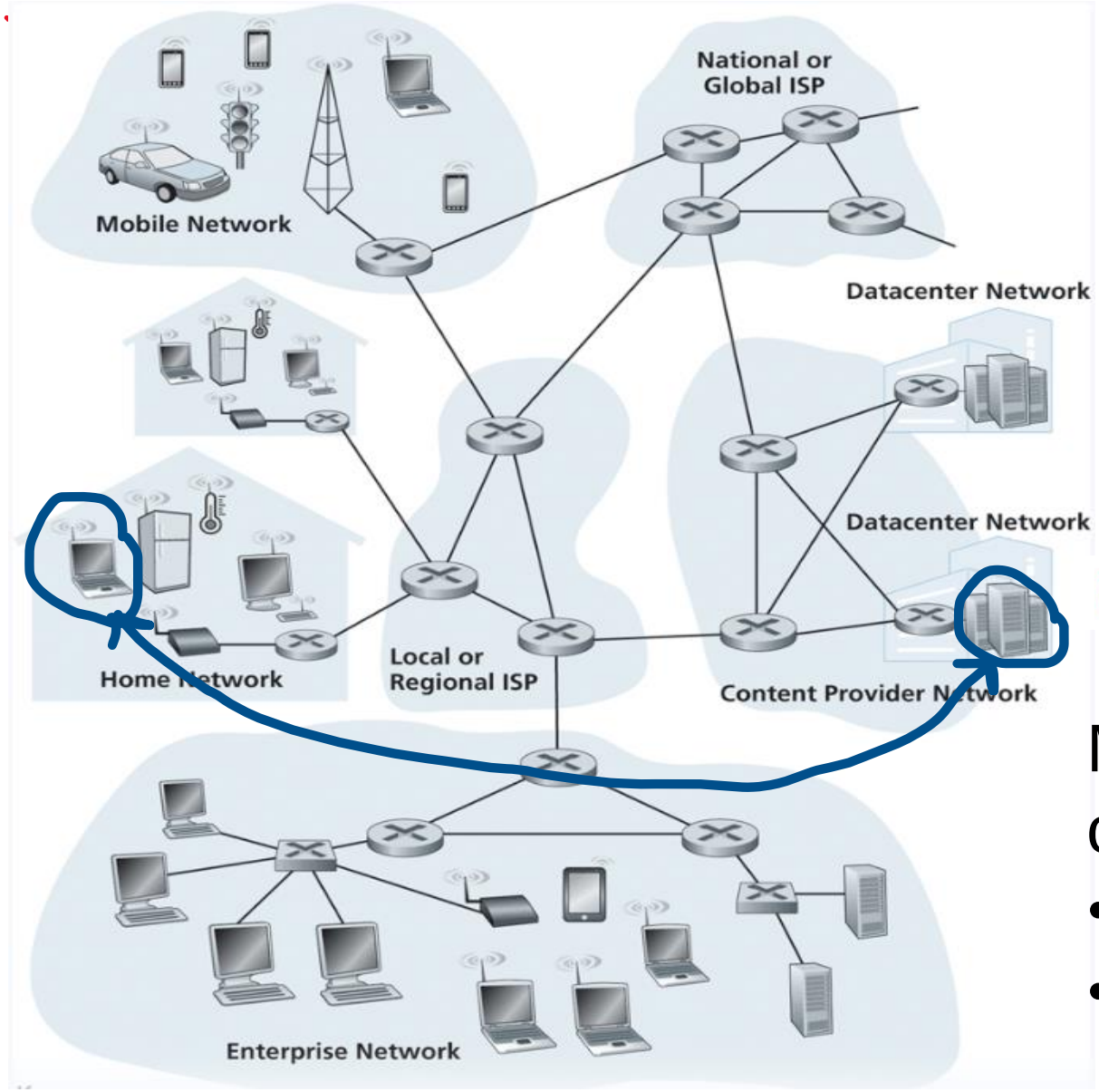
"End-to-end communication"

YouTube

Most hosts can be classified into two categories:

- Clients
- Servers

End to End Communication



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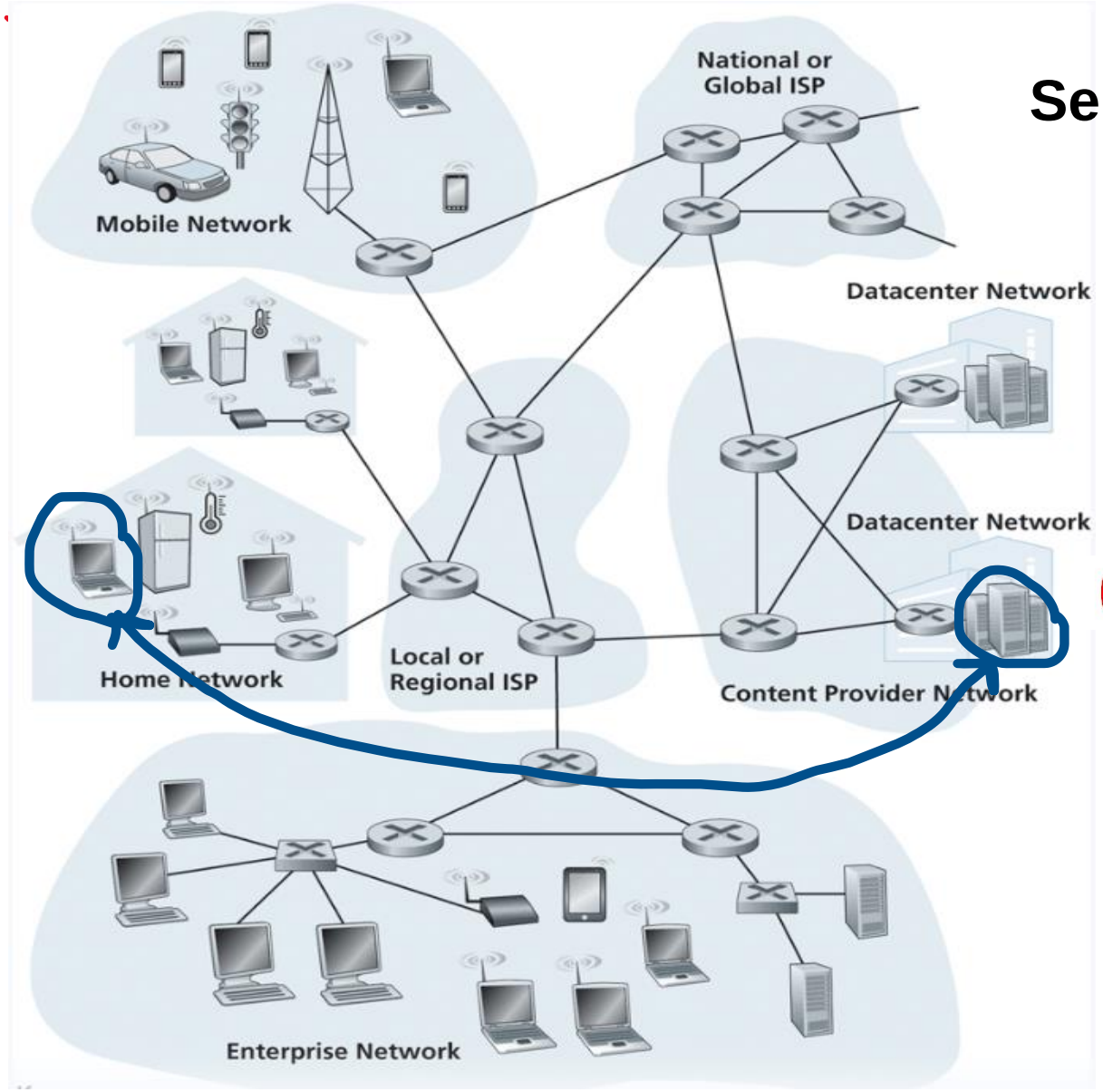
Most hosts can be classified into two categories:

- **Clients** (Desktops, Laptops, Phones)
- **Servers** (Powerful computers that store web pages, videos, emails, etc)

End to End Communication

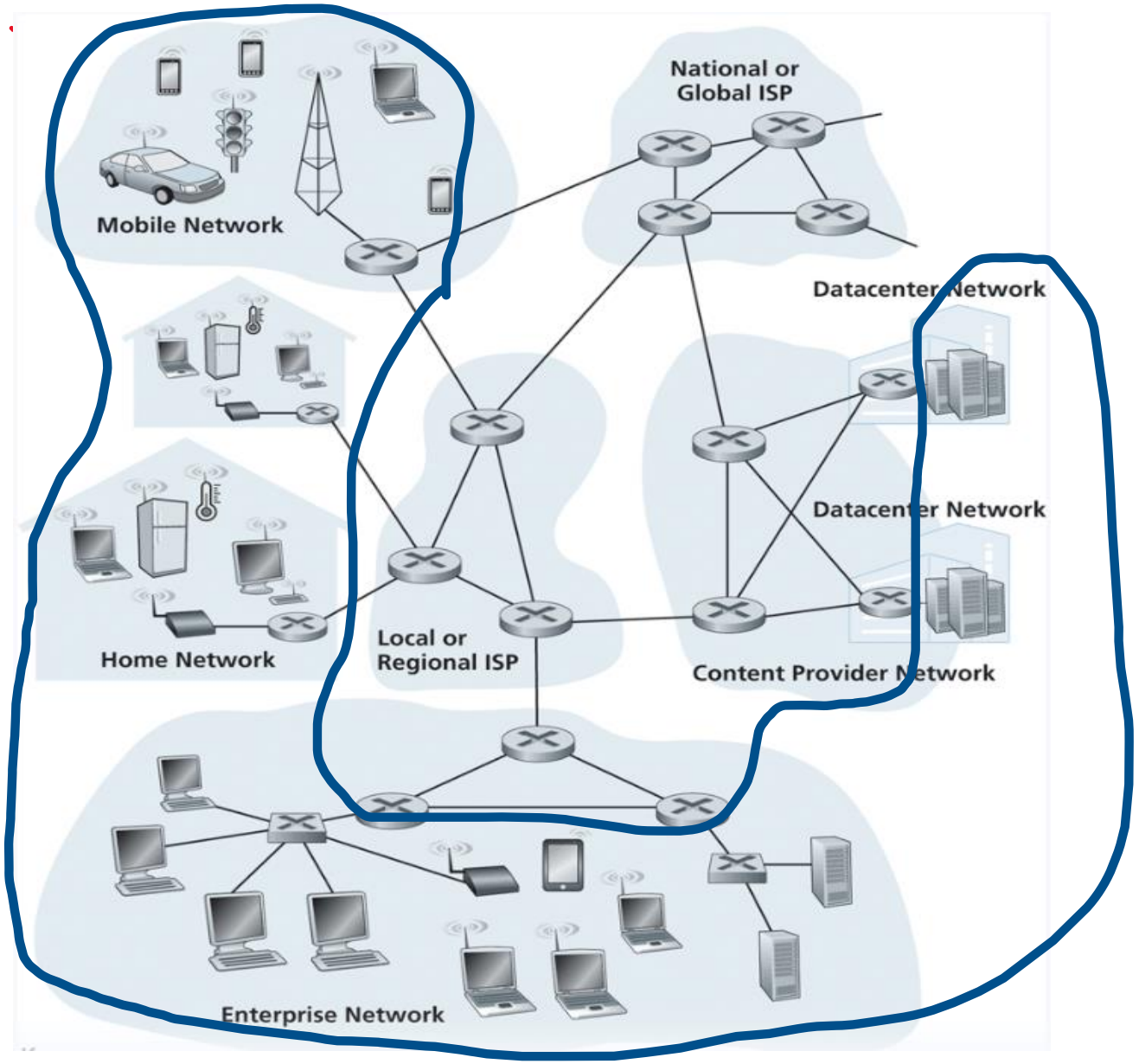


Servers typically reside in large datacenters

“End-to-end communication”

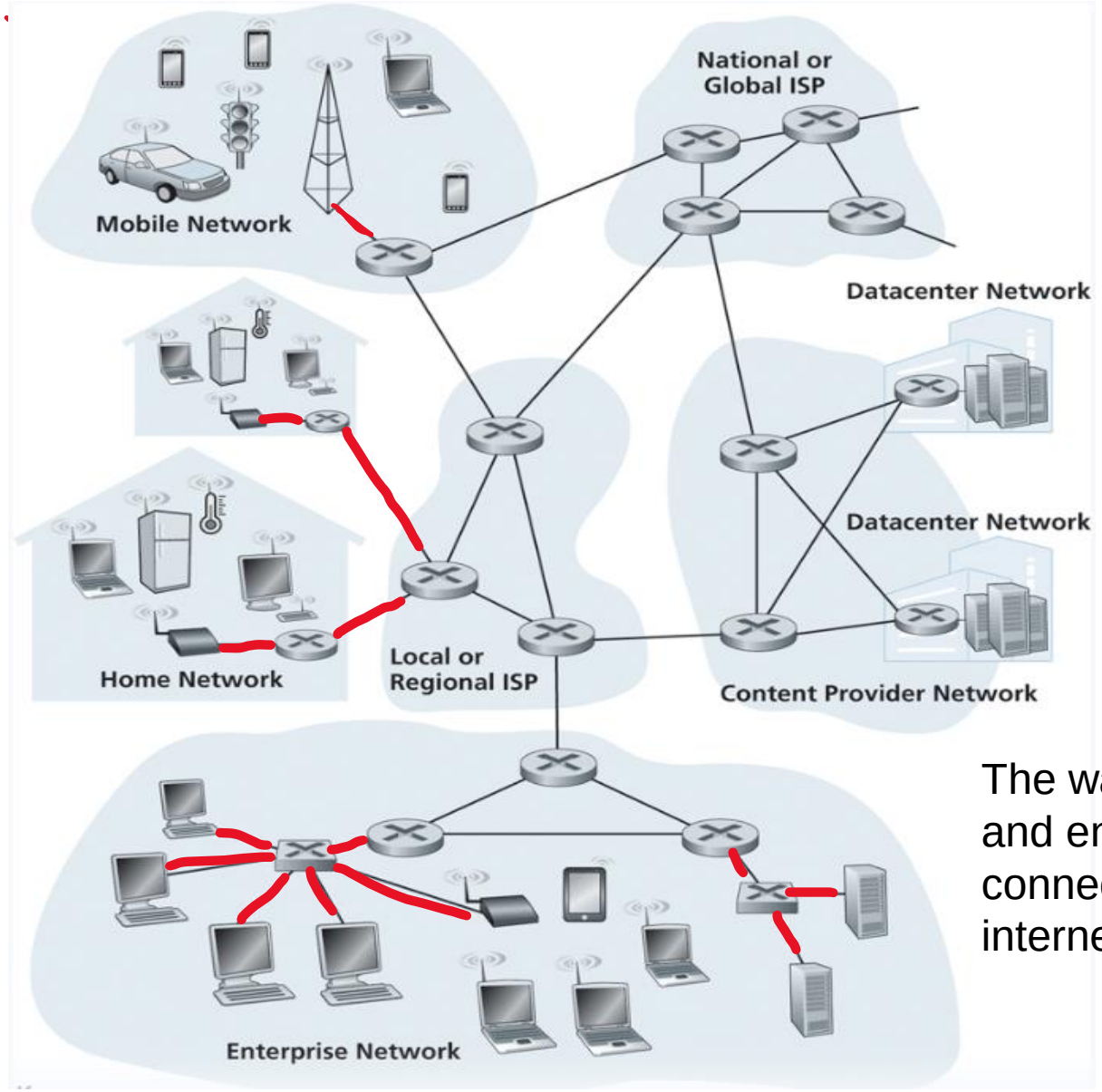
YouTube

Network Edge



The **network edge** consists of end systems

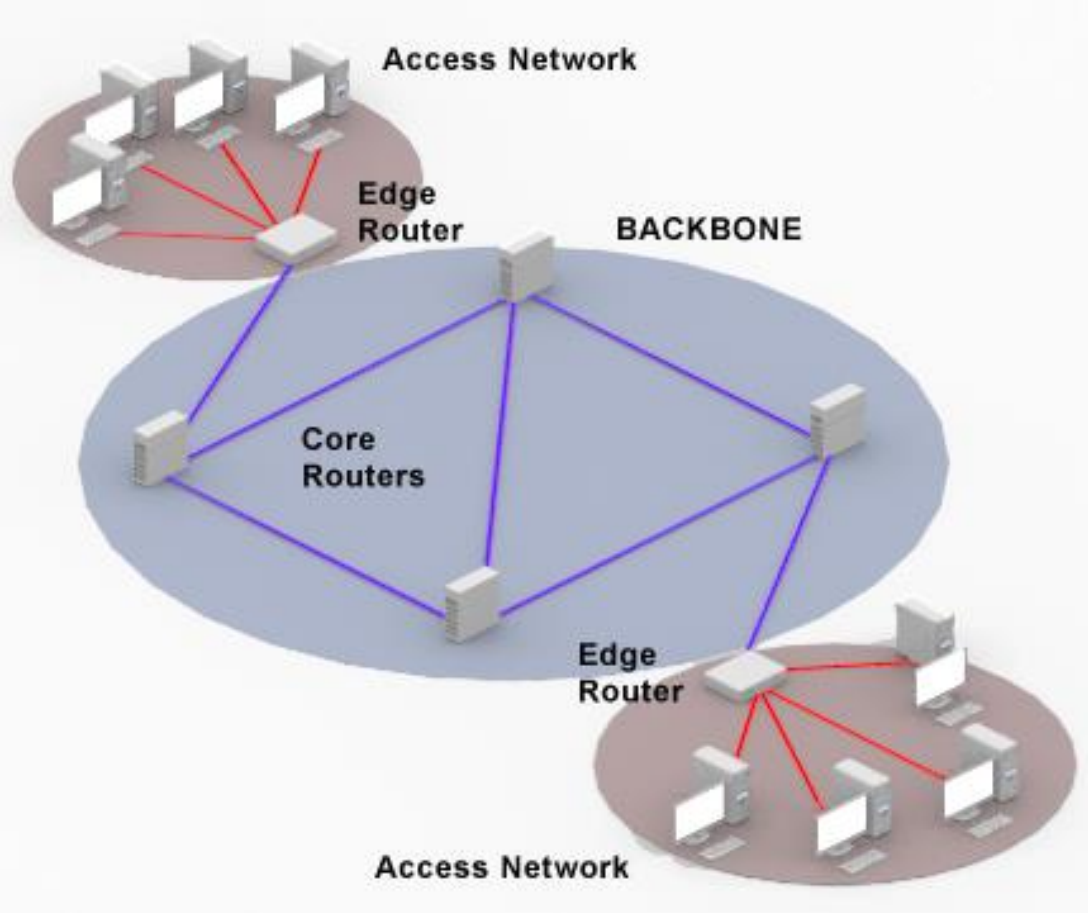
Network Edge



An **access network** is the network that physically connects an end system to the first router

The way that homes and enterprises get connected to the internet

Network Edge



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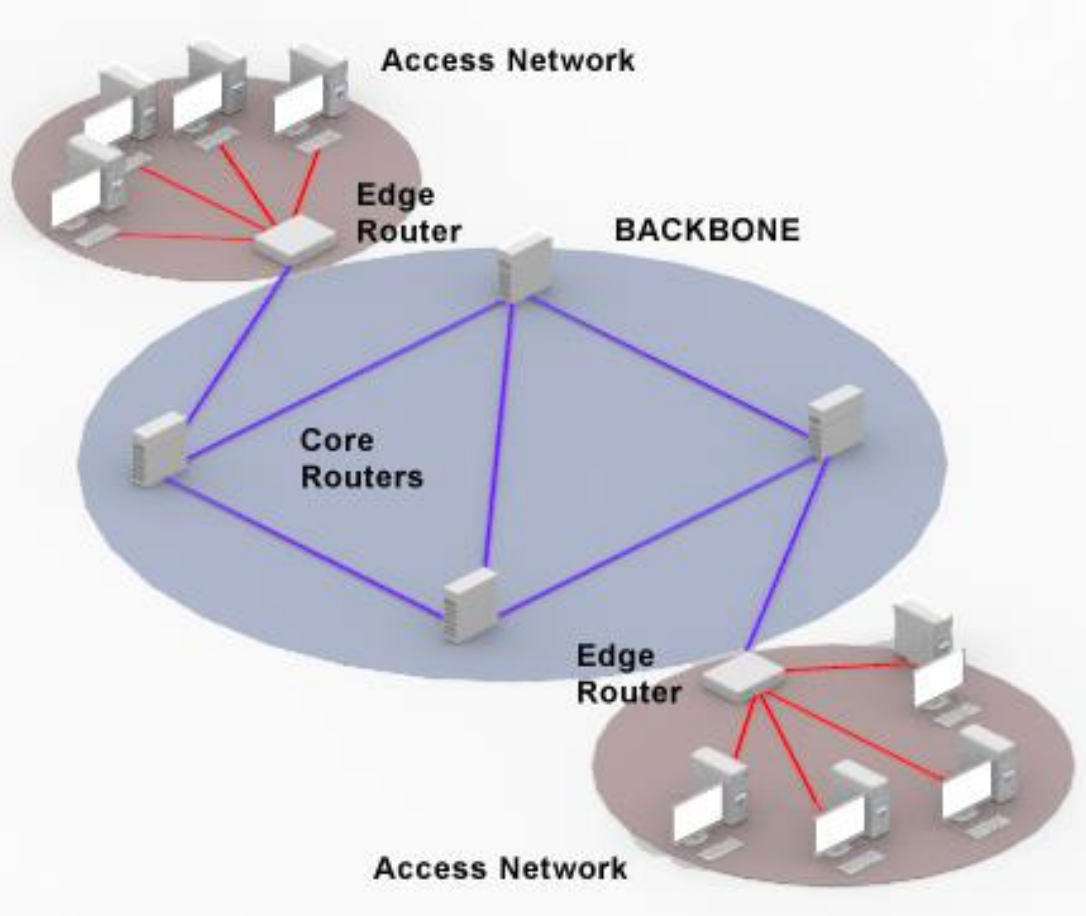
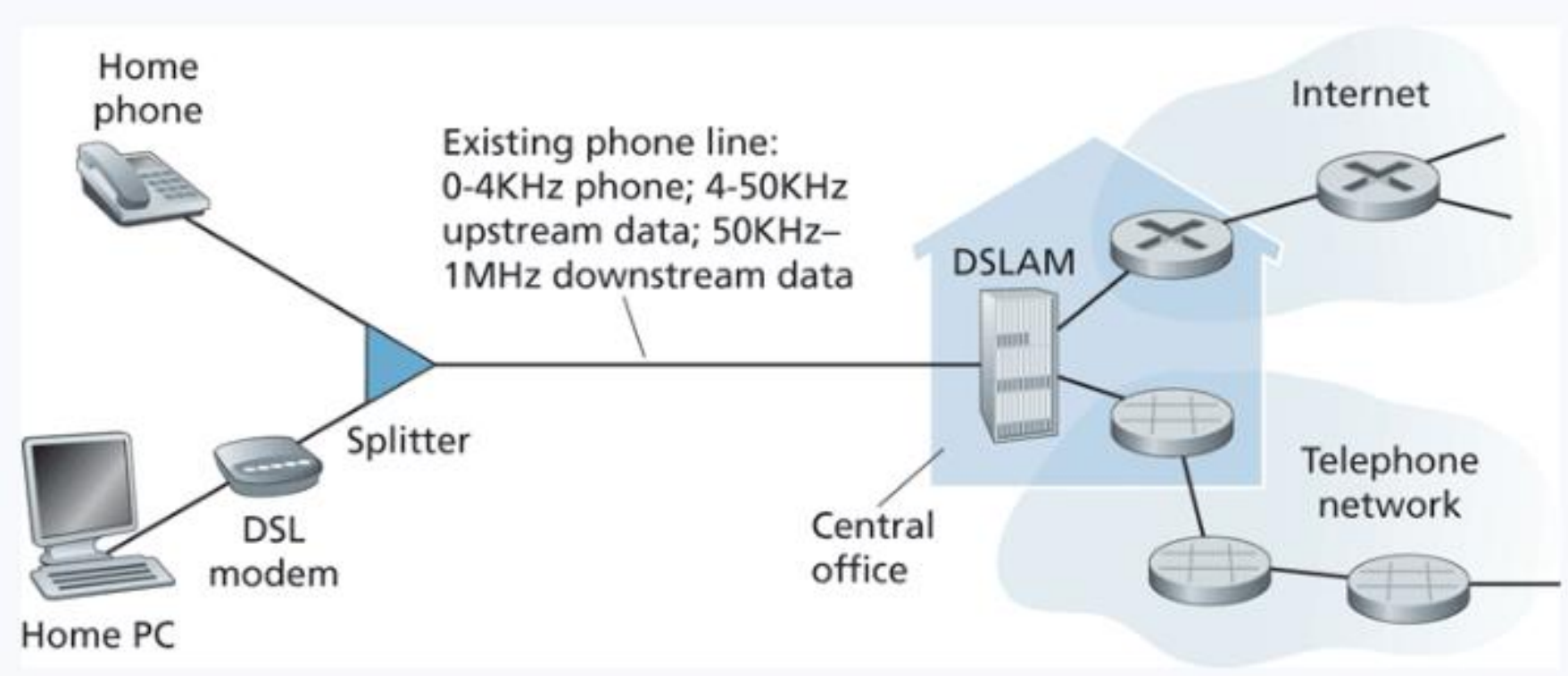


"**Edge Routers**" act as the boundary between a private network and a public network

Home Network Access

Digital Subscriber Line (DSL)



Uses existing telephone line to connect to internet and transmit data

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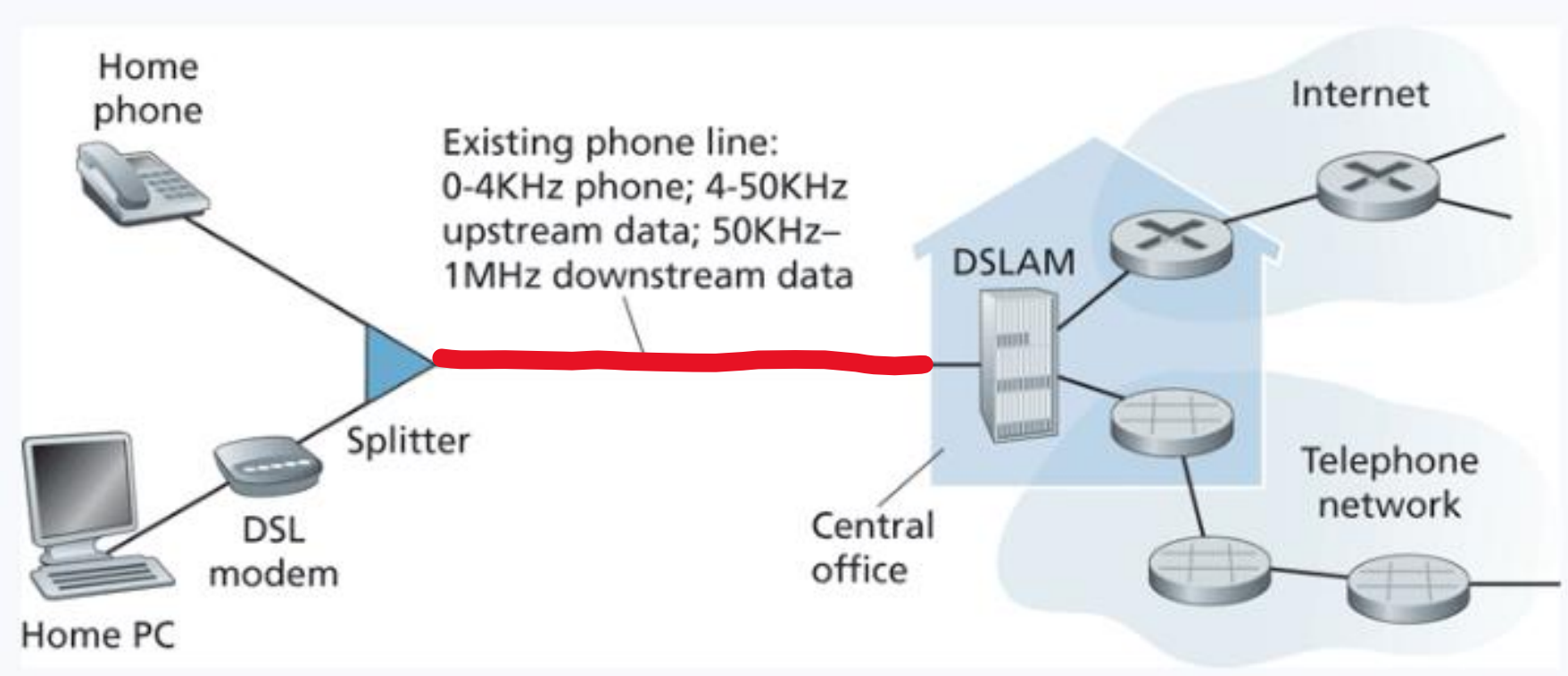


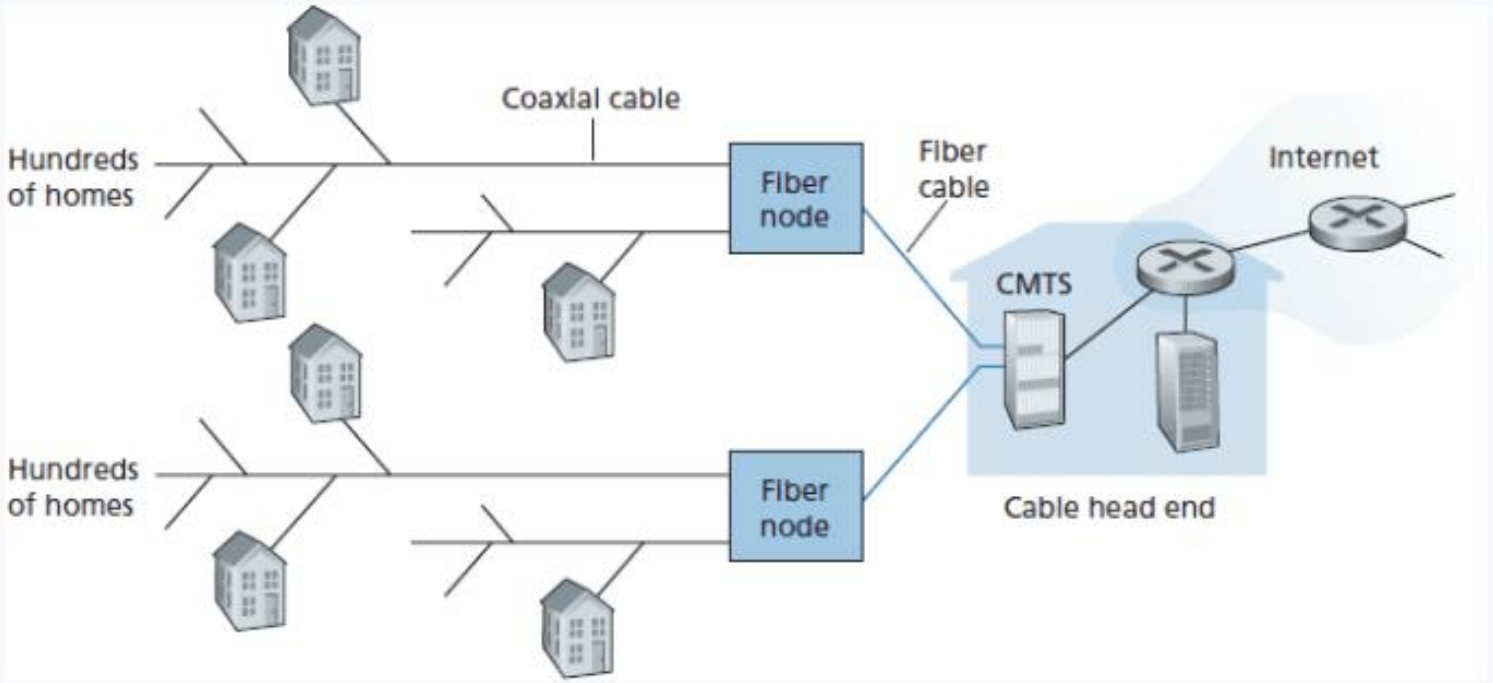
Uses existing telephone line to connect to internet and transmit data

Home Network Access

Cable Internet Access

Figure 1.6

A hybrid fiber-coaxial access network

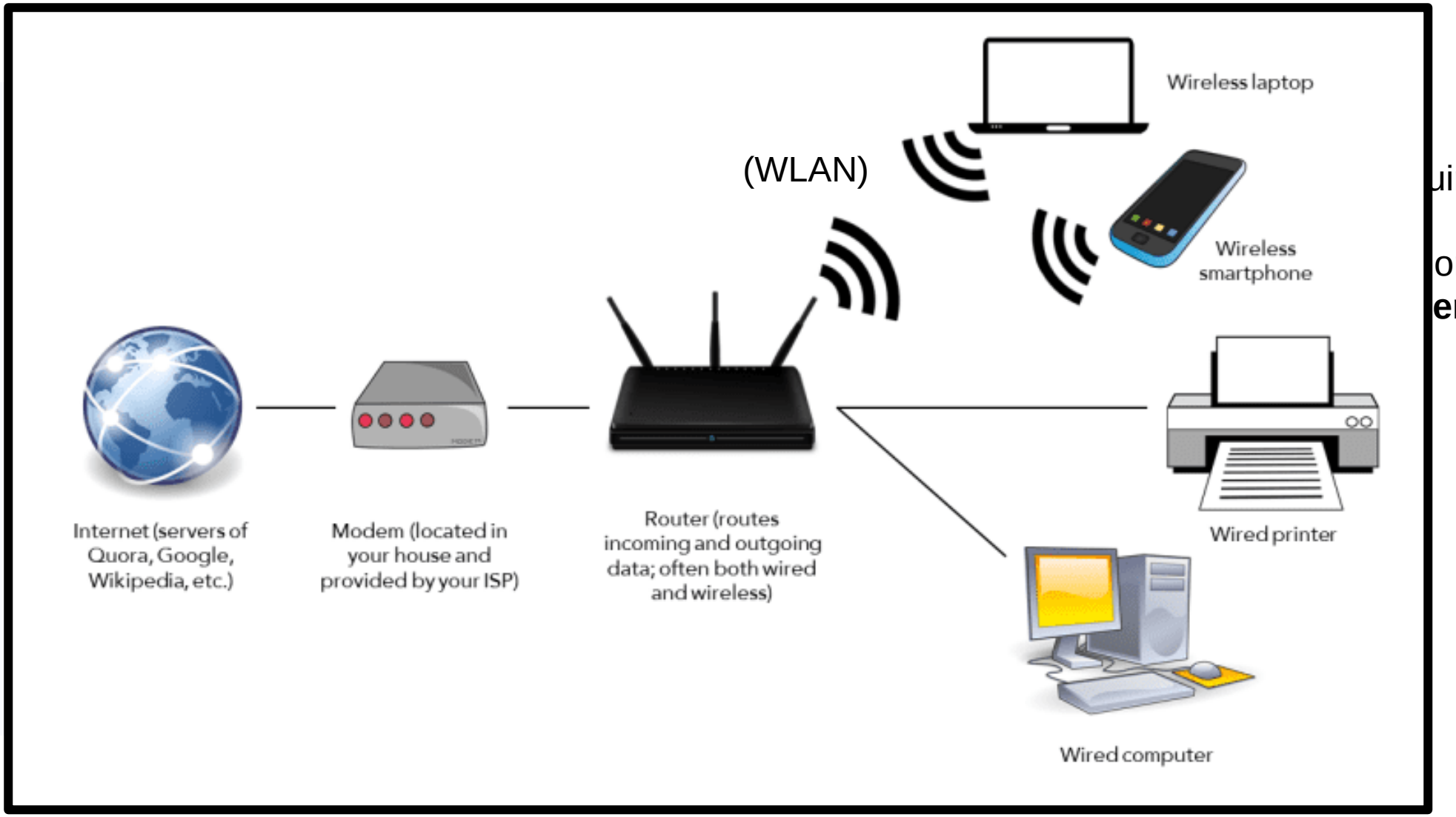


Homes will require a **modem**, which connects to a home PC with an **Ethernet** cable

Uses existing television cable lines to connect to internet and transmit data

*Shared broadcast medium

Home Network Access



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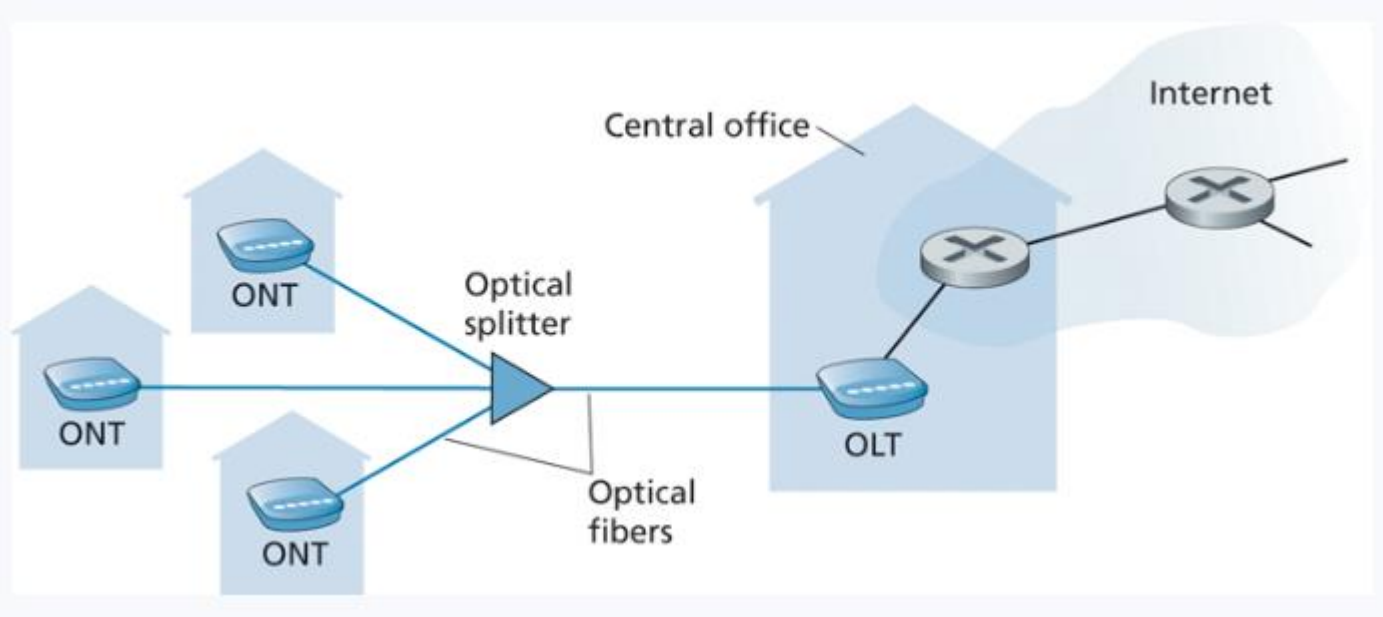
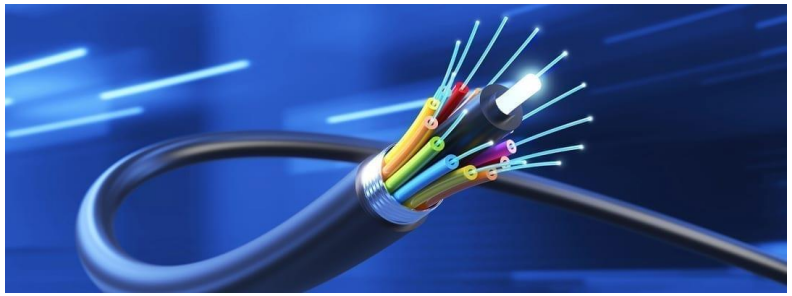
Home Network Access

Fiber Internet Access (FTTH)

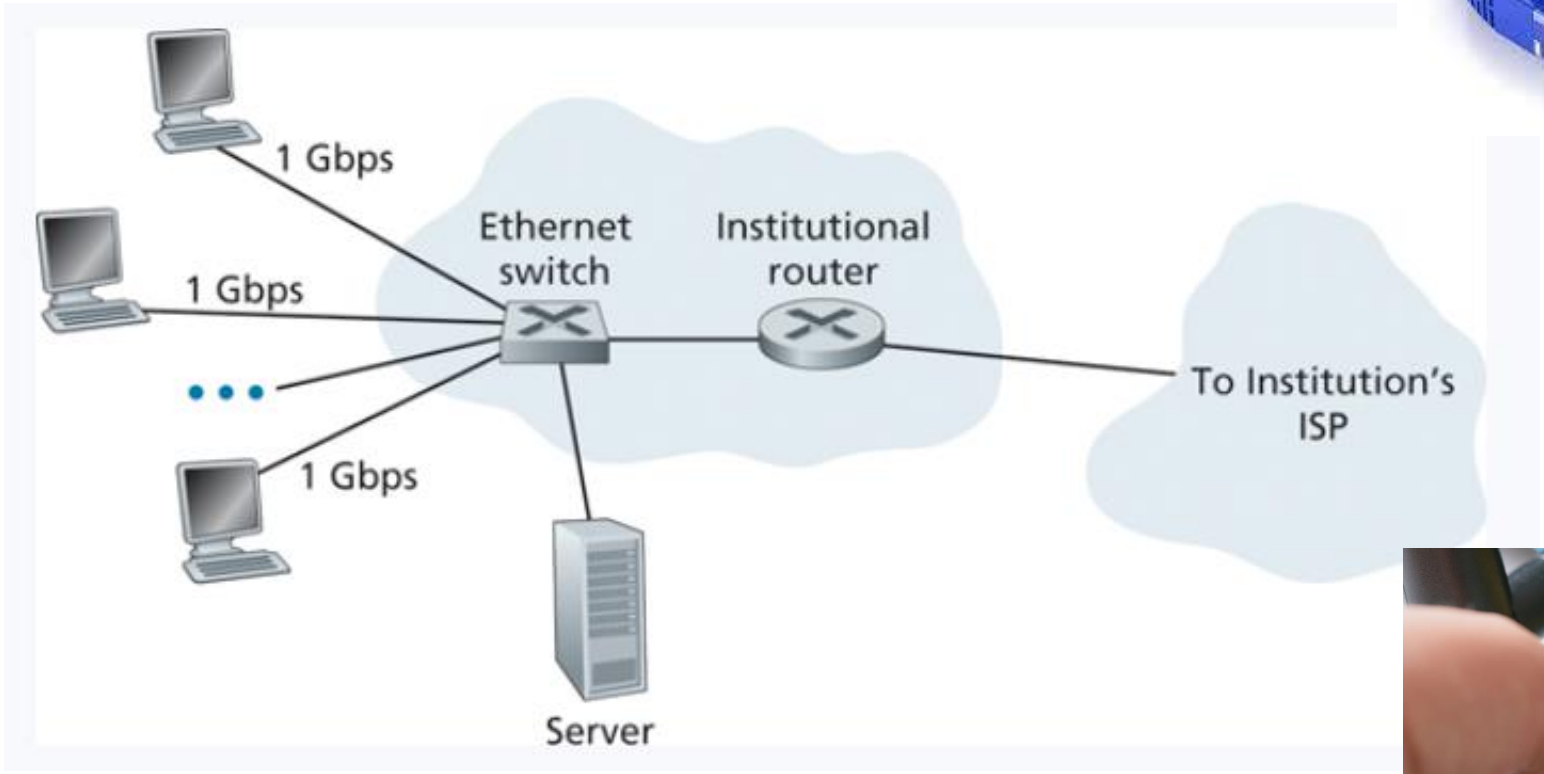


Connects homes to a shared fiber cable



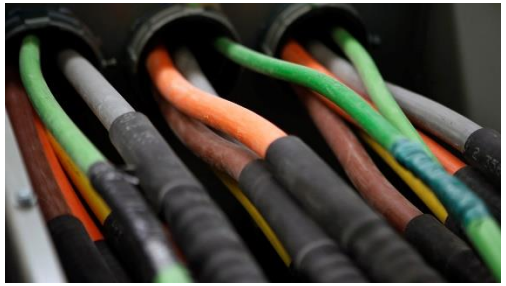
Home Network Access

Ethernet Internet Access



Ok, but like how ?

???



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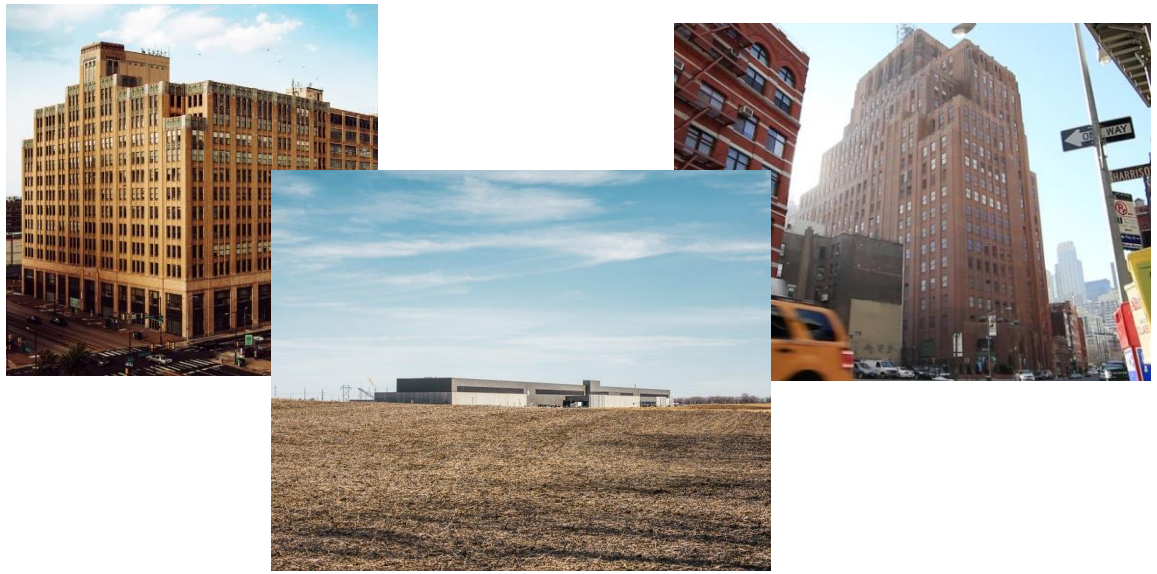
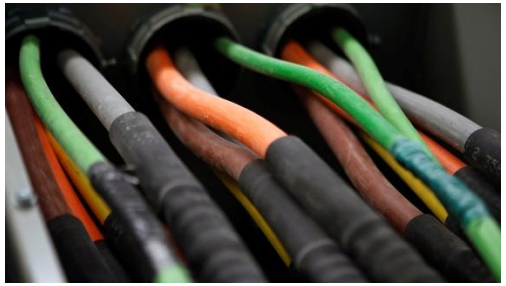
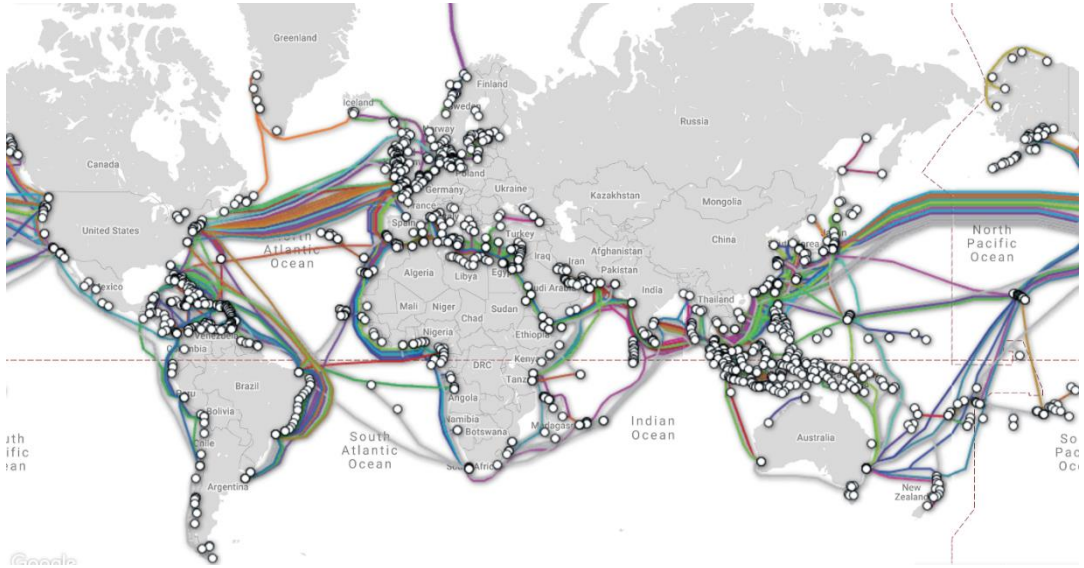
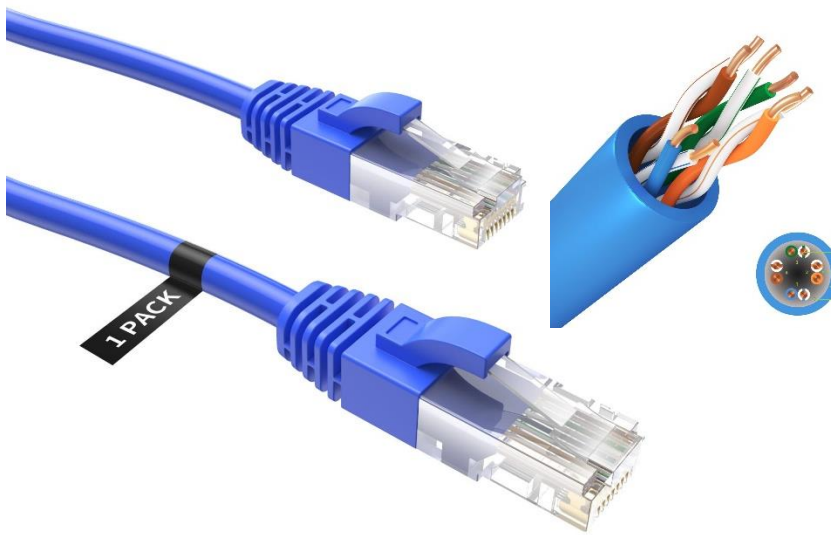




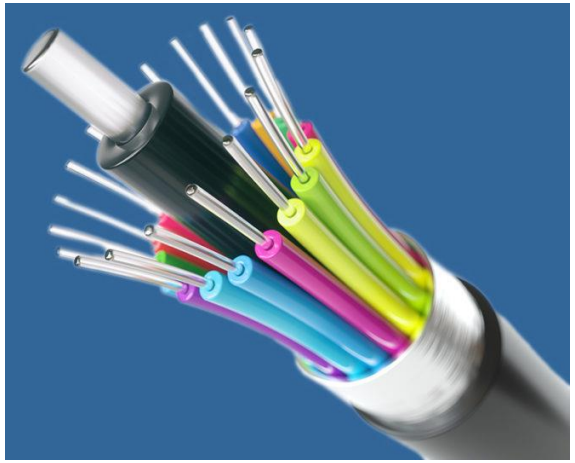


Physical Mediums



Twisted-Pair
Copper Wire

Coaxial Cable



Fiber Optic Cable

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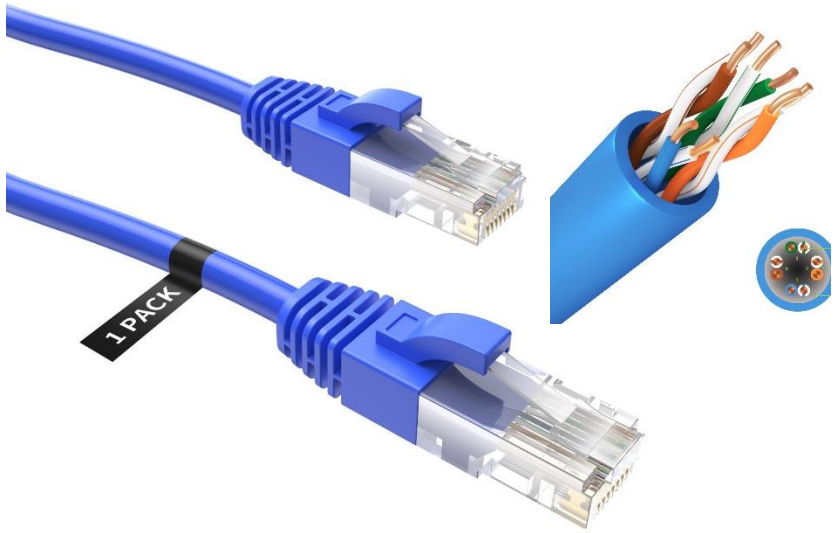
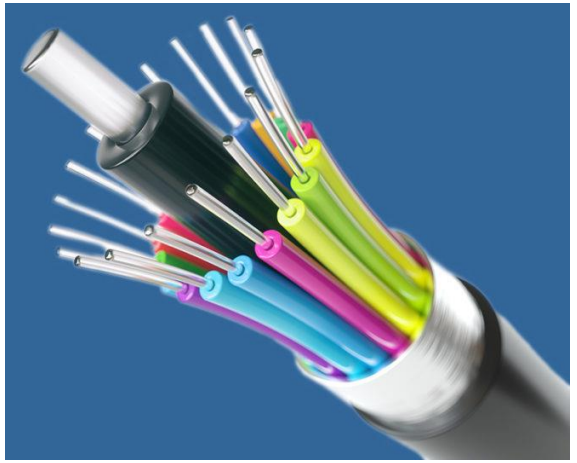


Twisted-Pair
Copper Wire

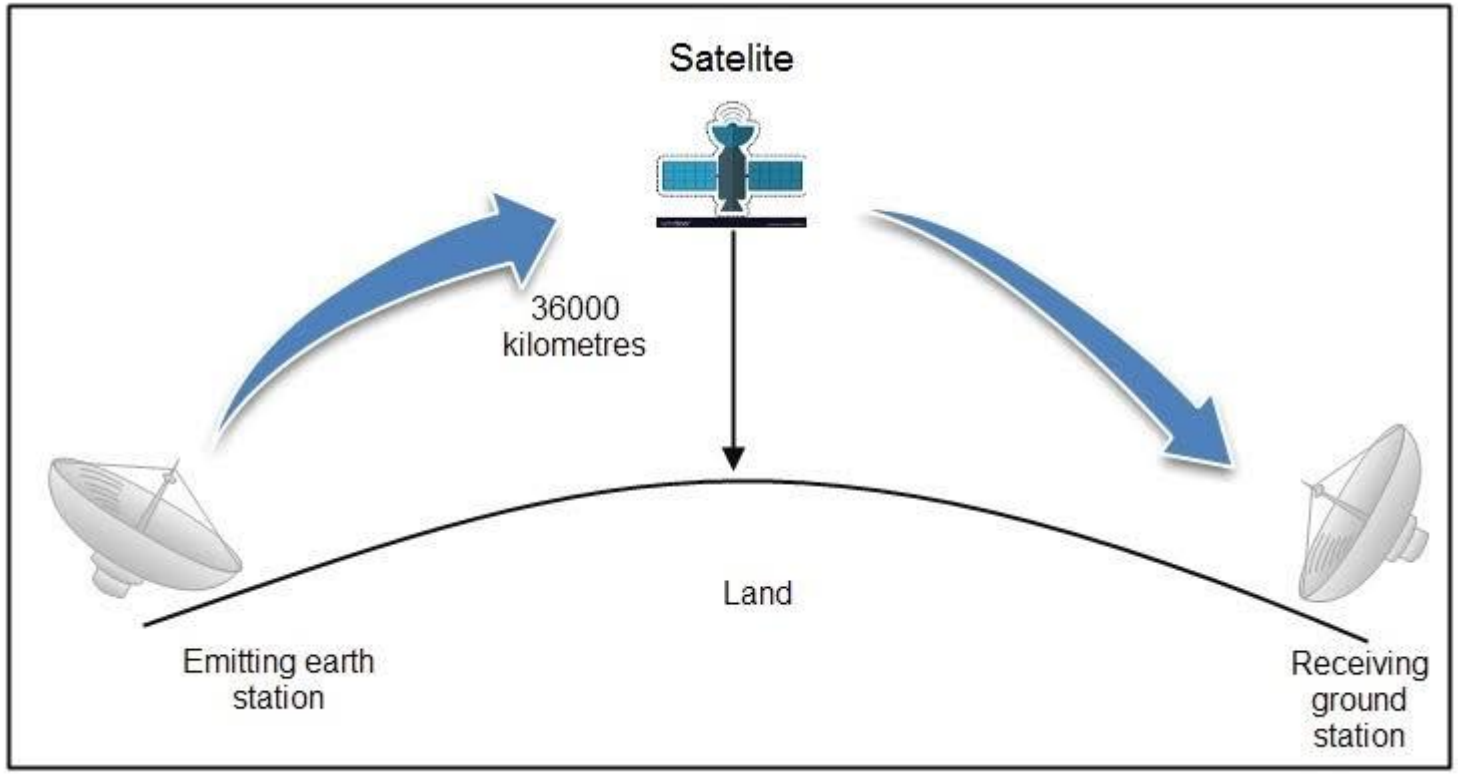
Cheap
Easy to install
can handle a variety signals



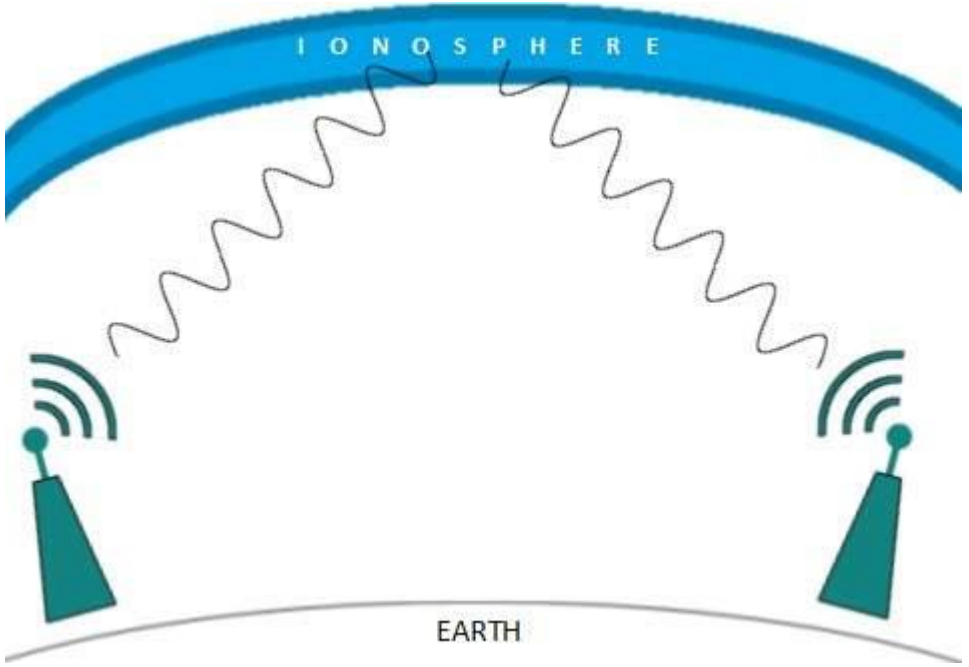
Fiber Optic Cable

Expensive
A bit more difficult to install
Much higher speeds, can transmit long distances

Ok, but like how ?



- Radio
- Microwave
- Infrared
- Satellite



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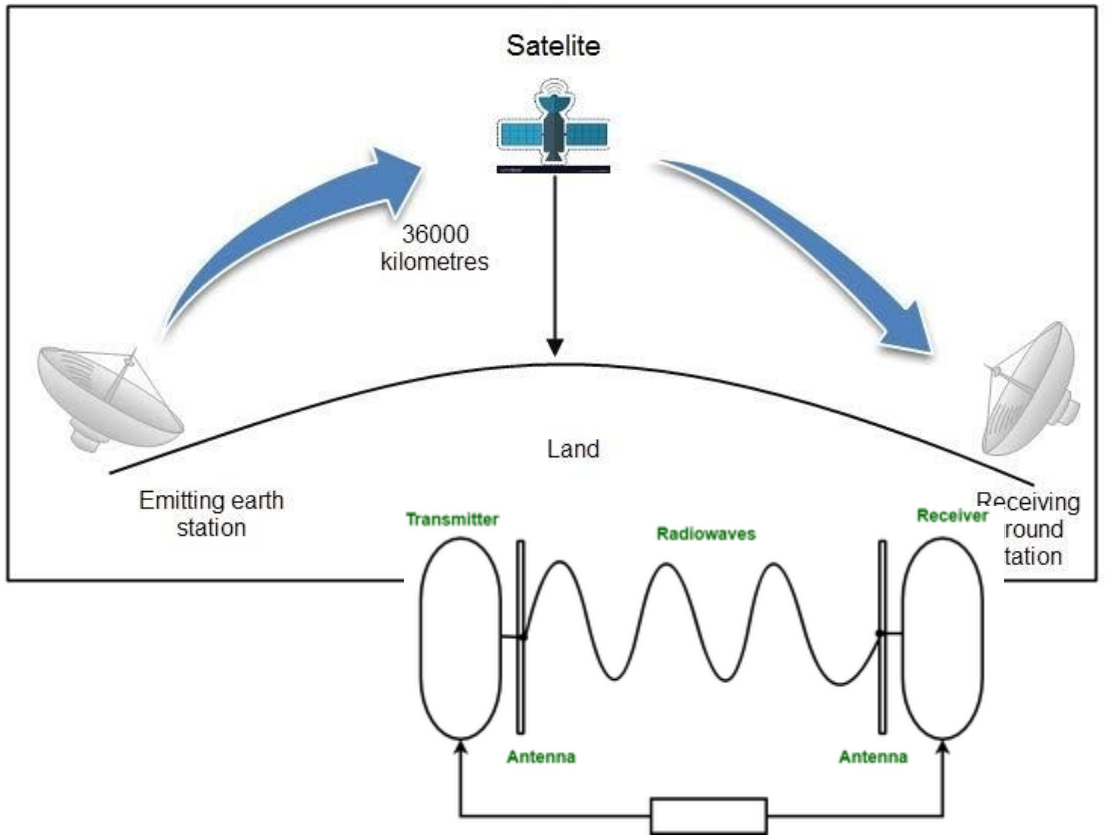
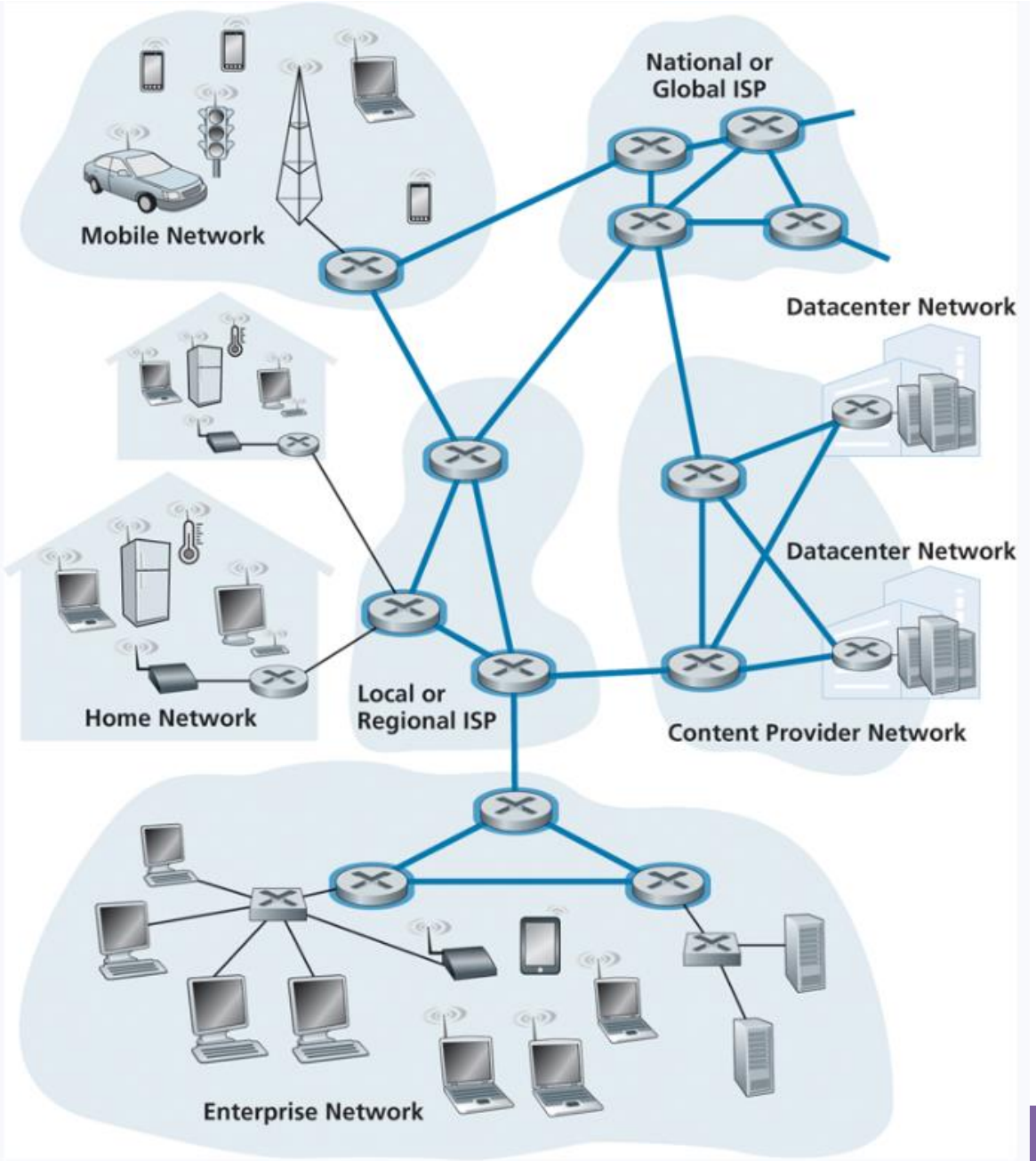
Guided Medium

Unguided Medium



The Network Core



End systems are connected together by a network of **communication links** and **packet switches**

A packet switch takes a packet arriving on one of its incoming communication links and forwards that packet on one of its outgoing communication links

Each communication link has its own **transmission rate (bits/sec)**

10 Mbps

500 kbps

100 kbps

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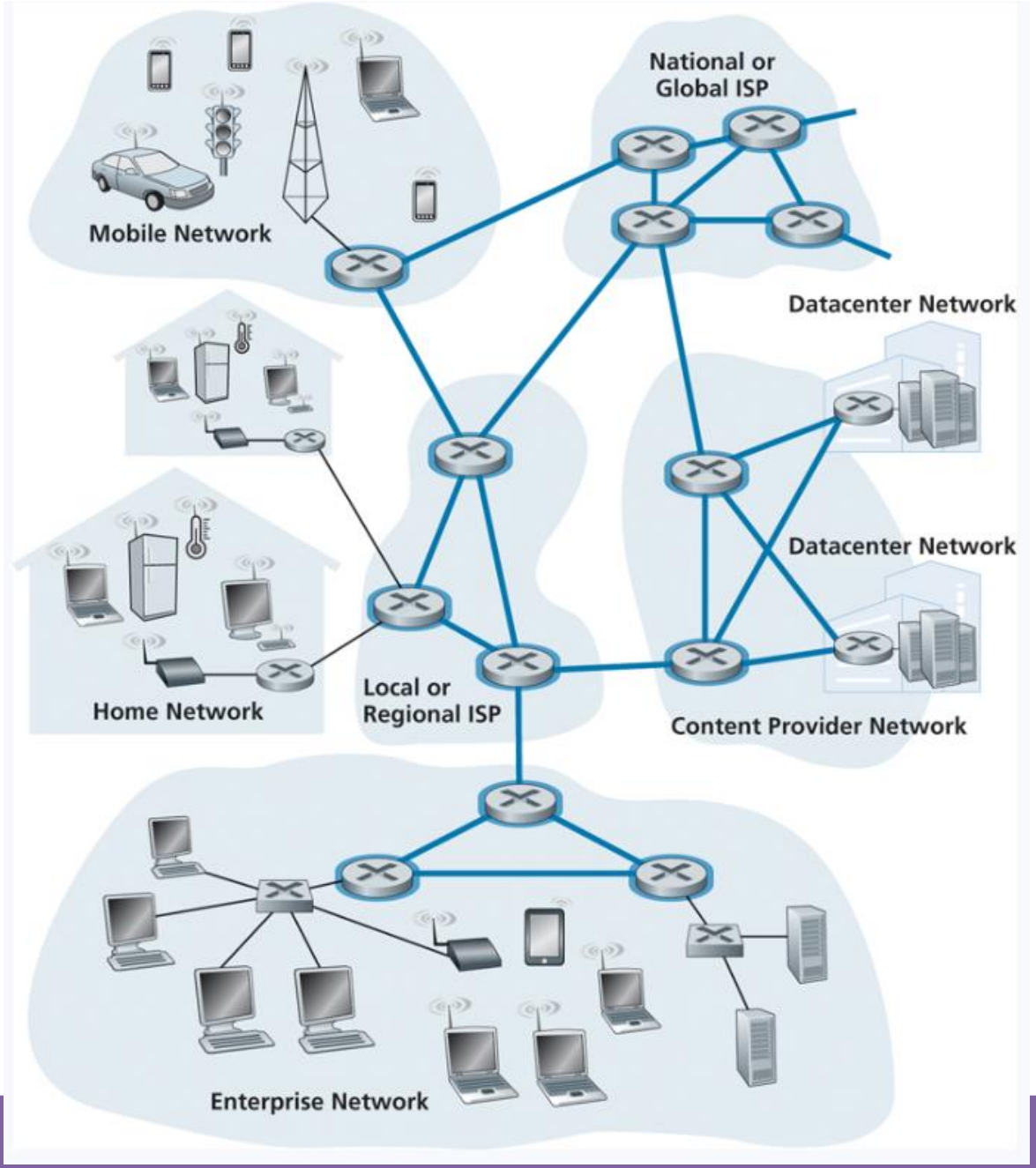

Messages going from A to B are split into **packets**

"Good morning, I hope you are having a good day!"

Generated Packet

To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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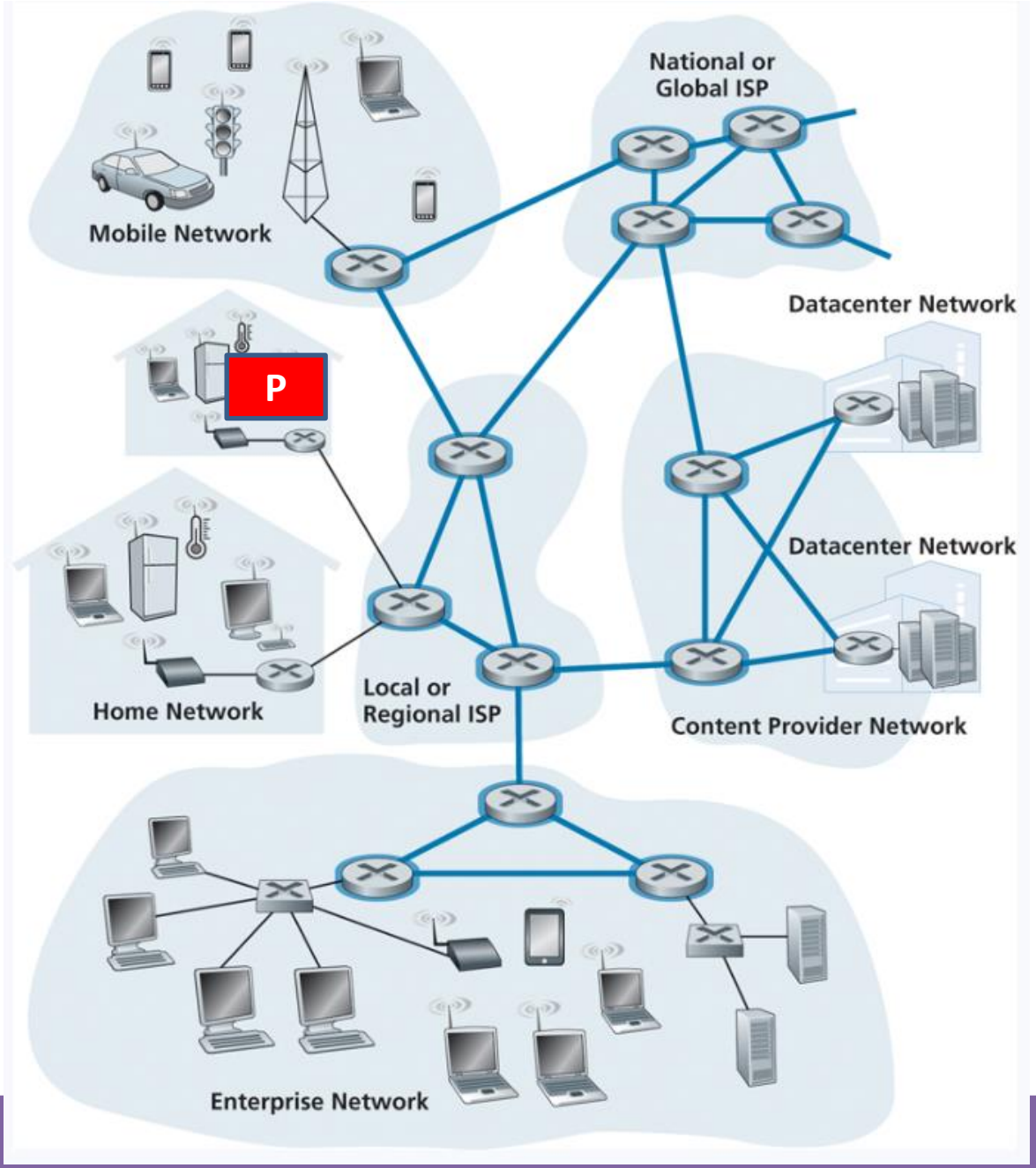
Good morning, I hope you are
having a good day!
```

1500 Bytes

The Network Core



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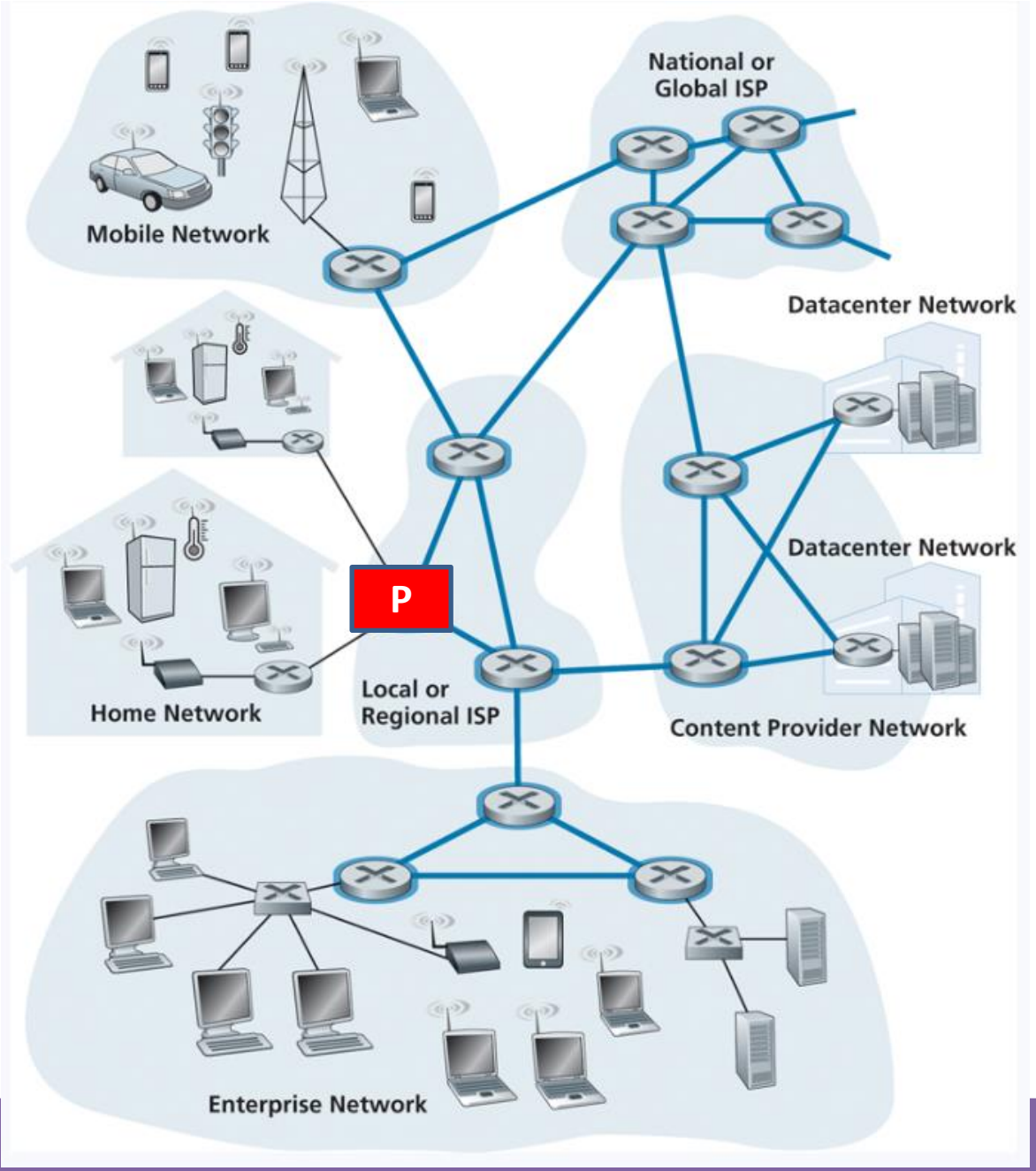

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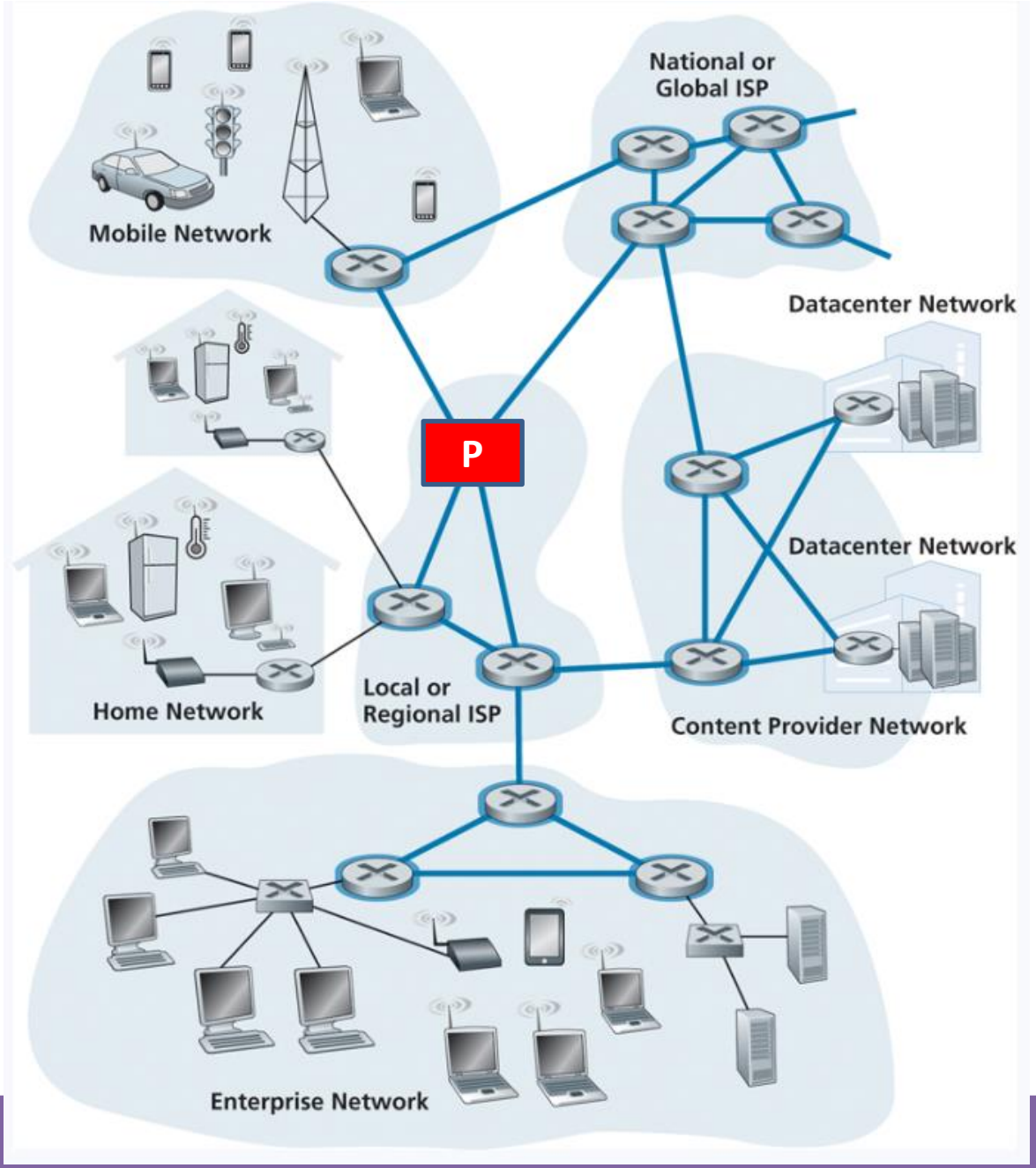

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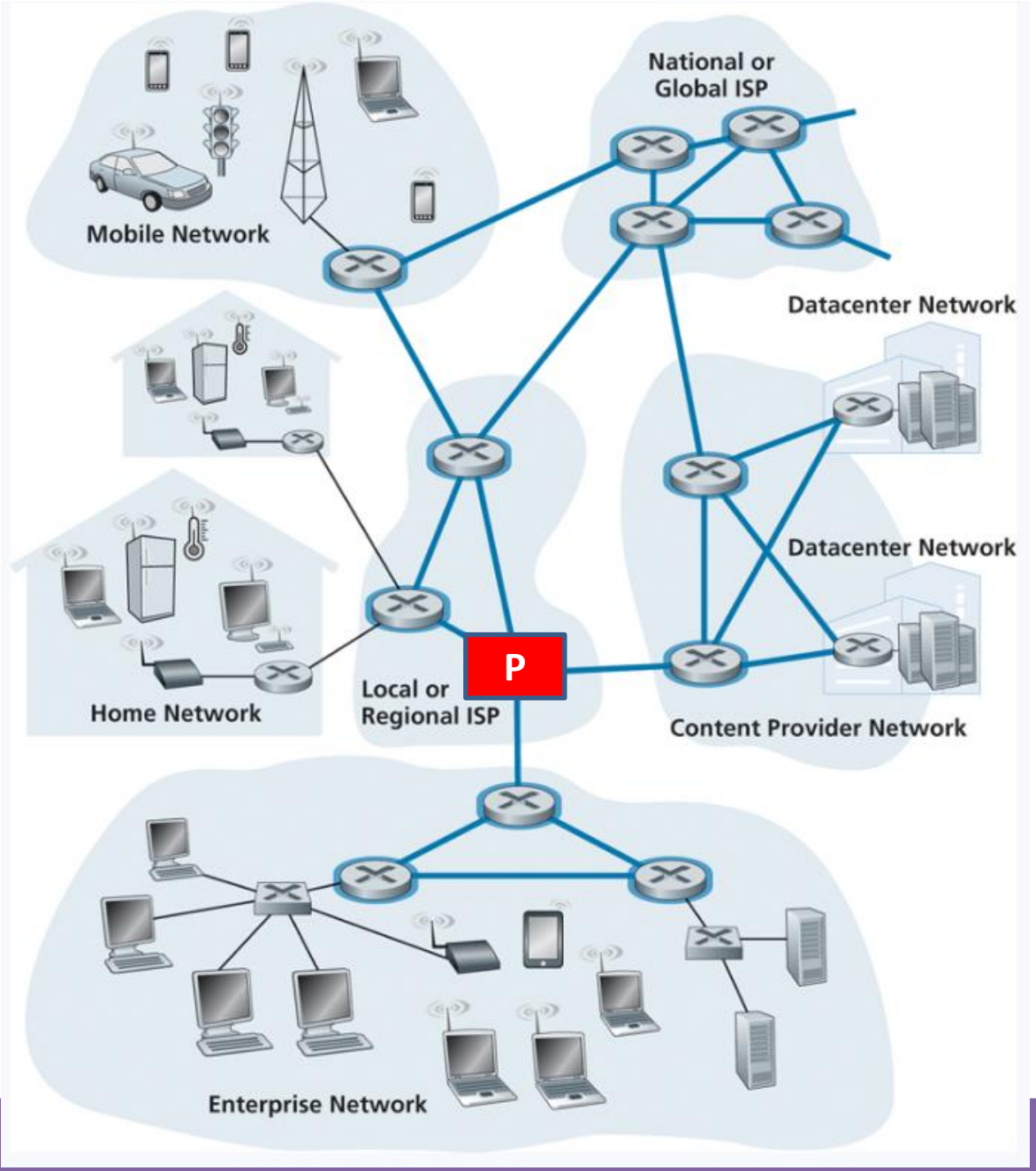

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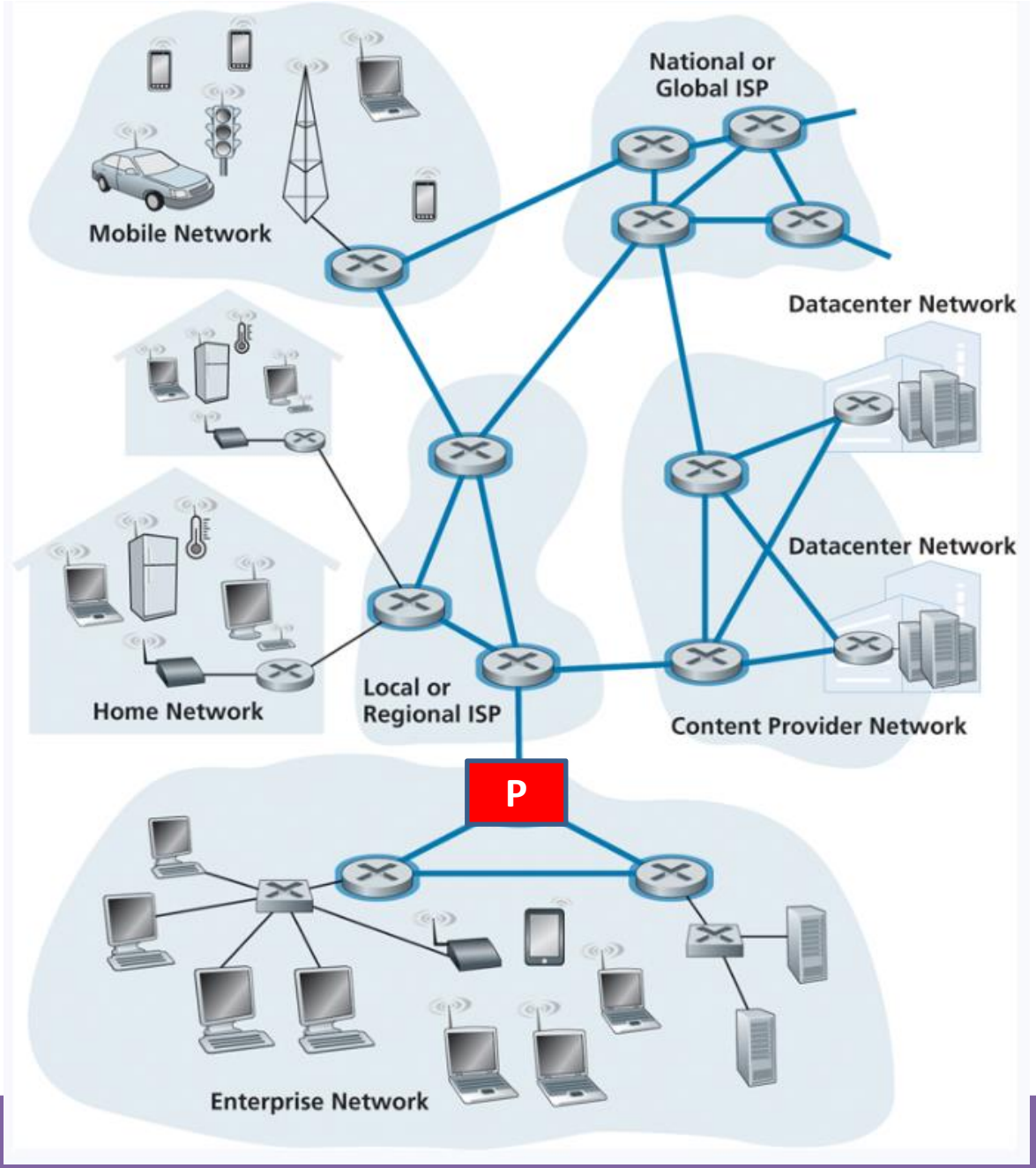

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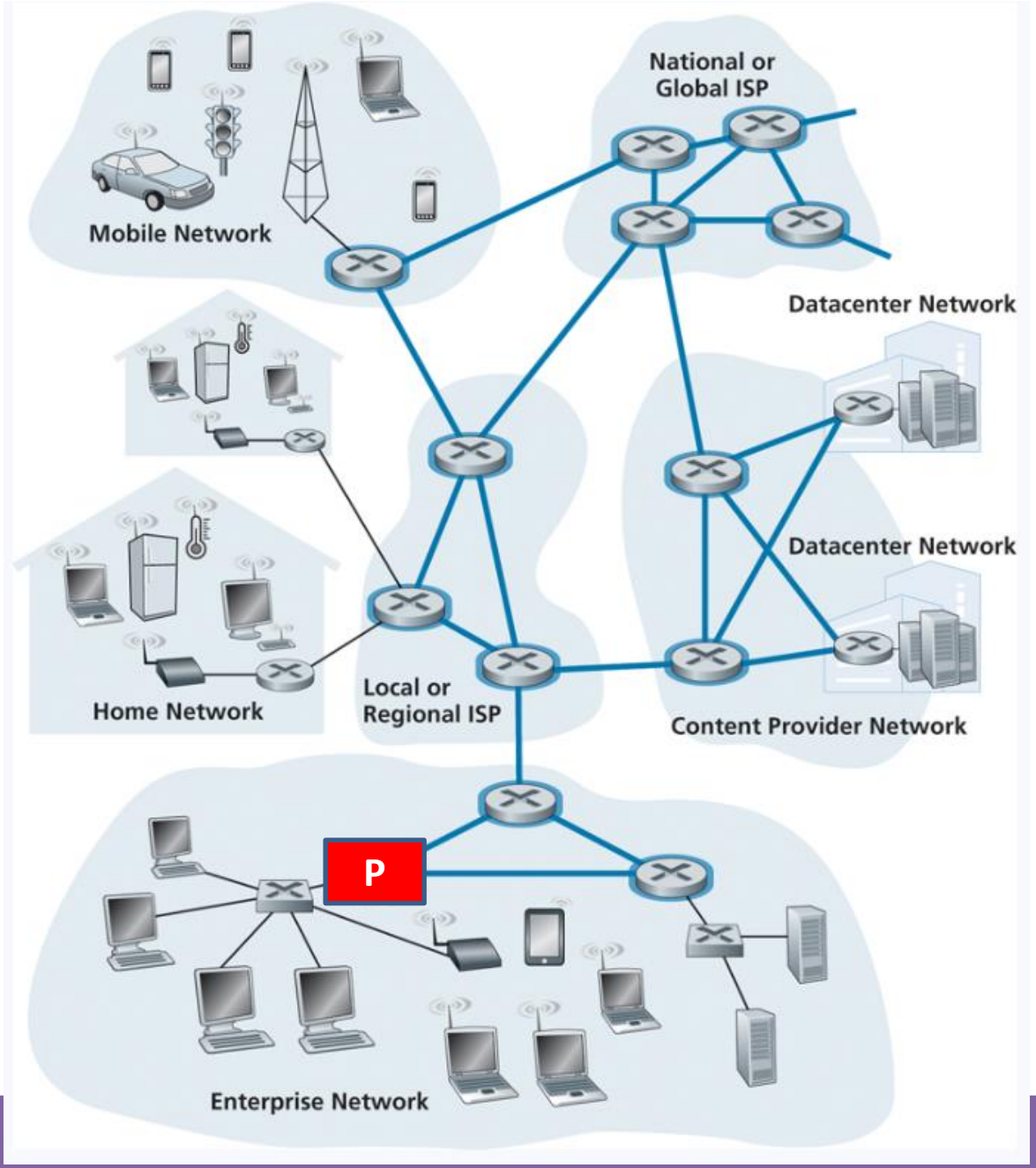

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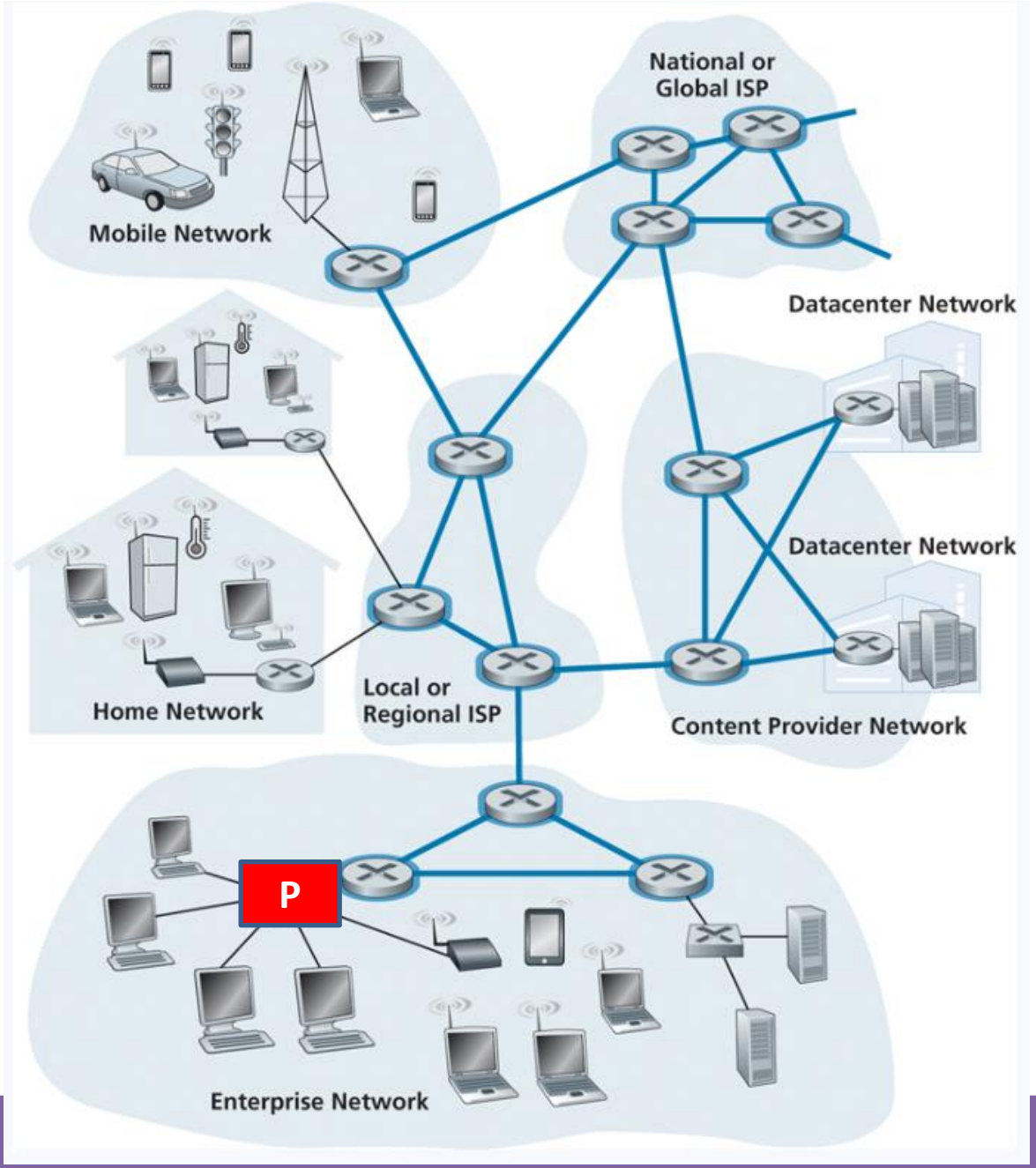

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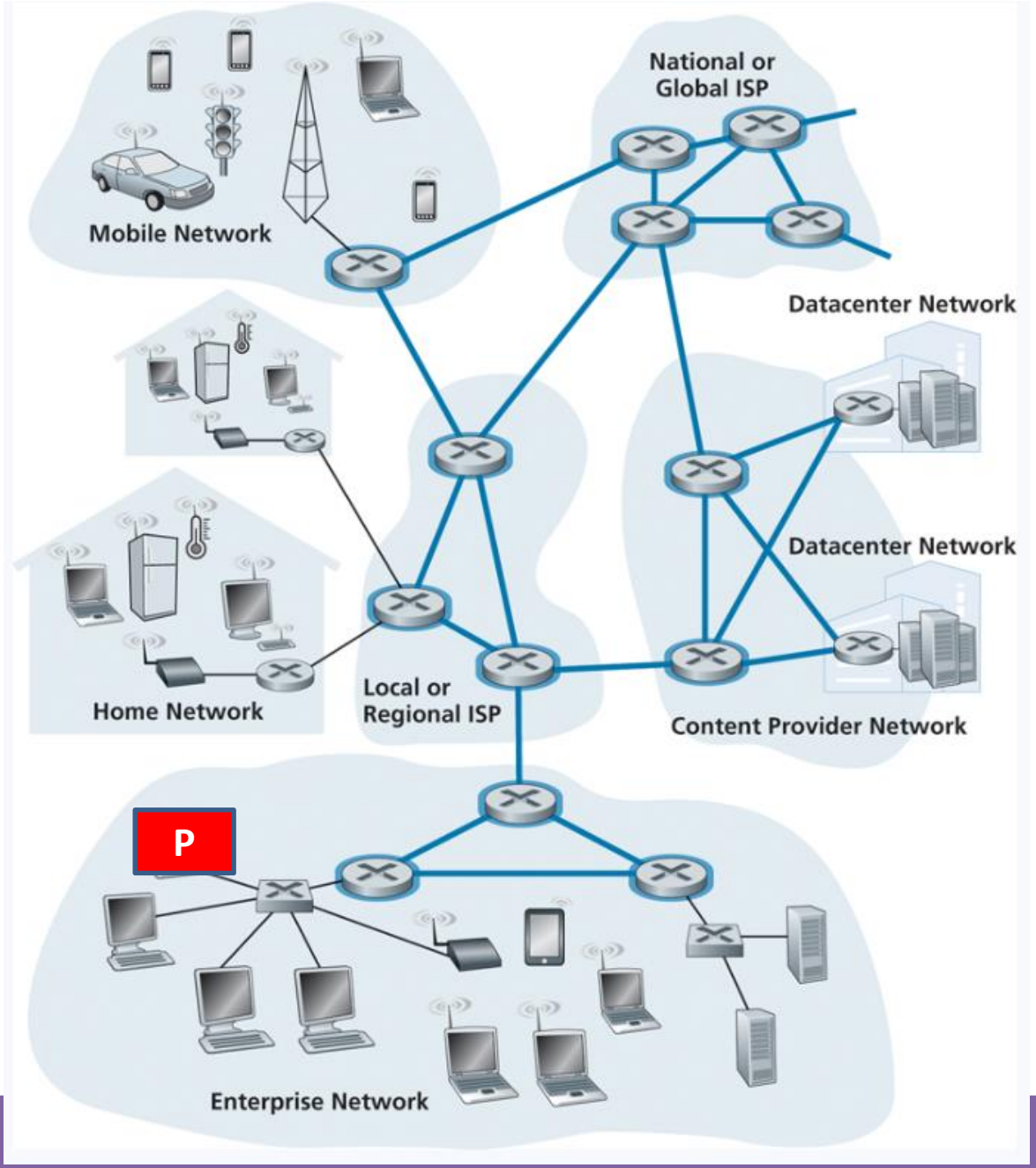

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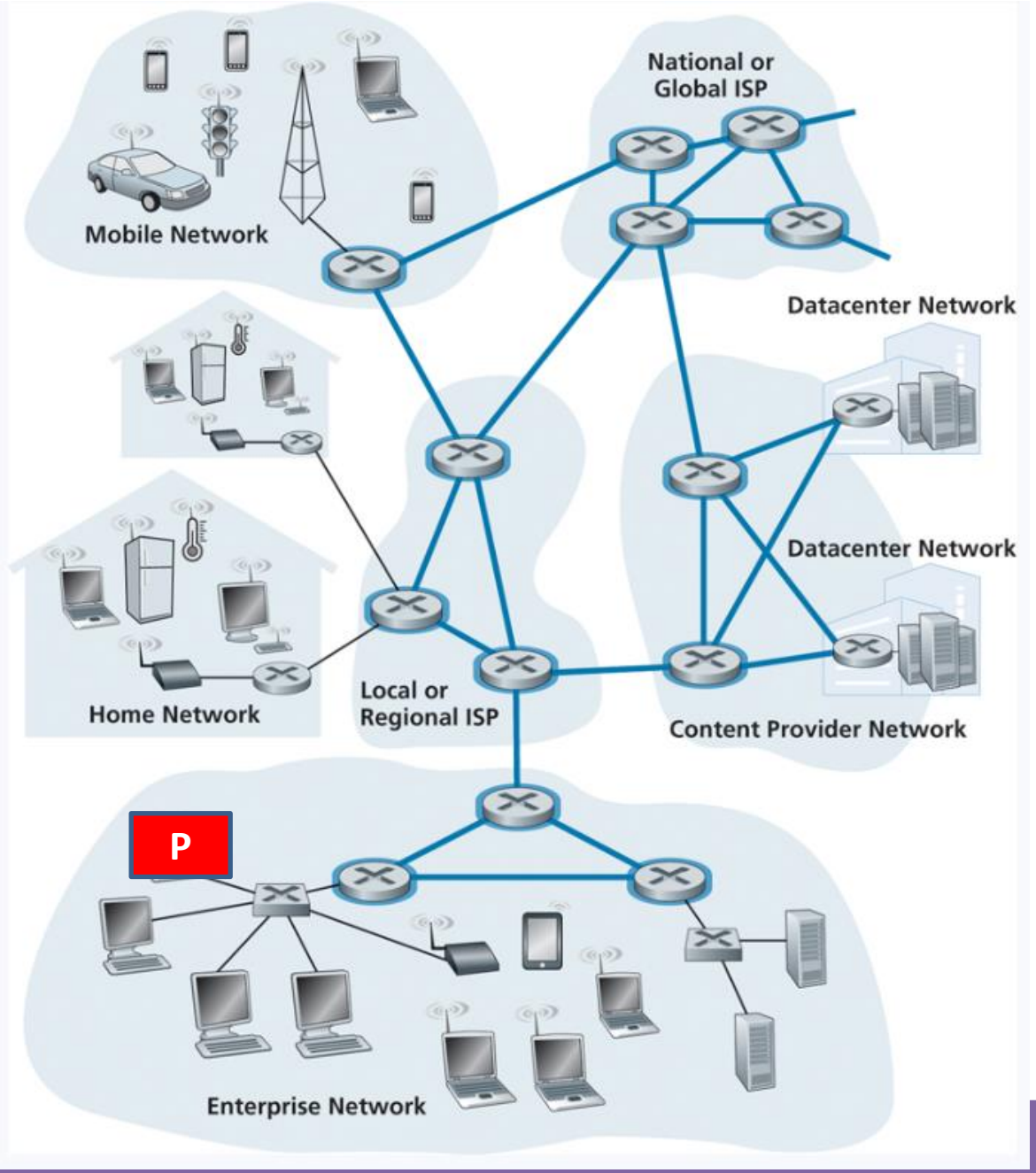

Messages going from A to B are split into **packets**

Packets are generally small, and cannot exceed a certain size

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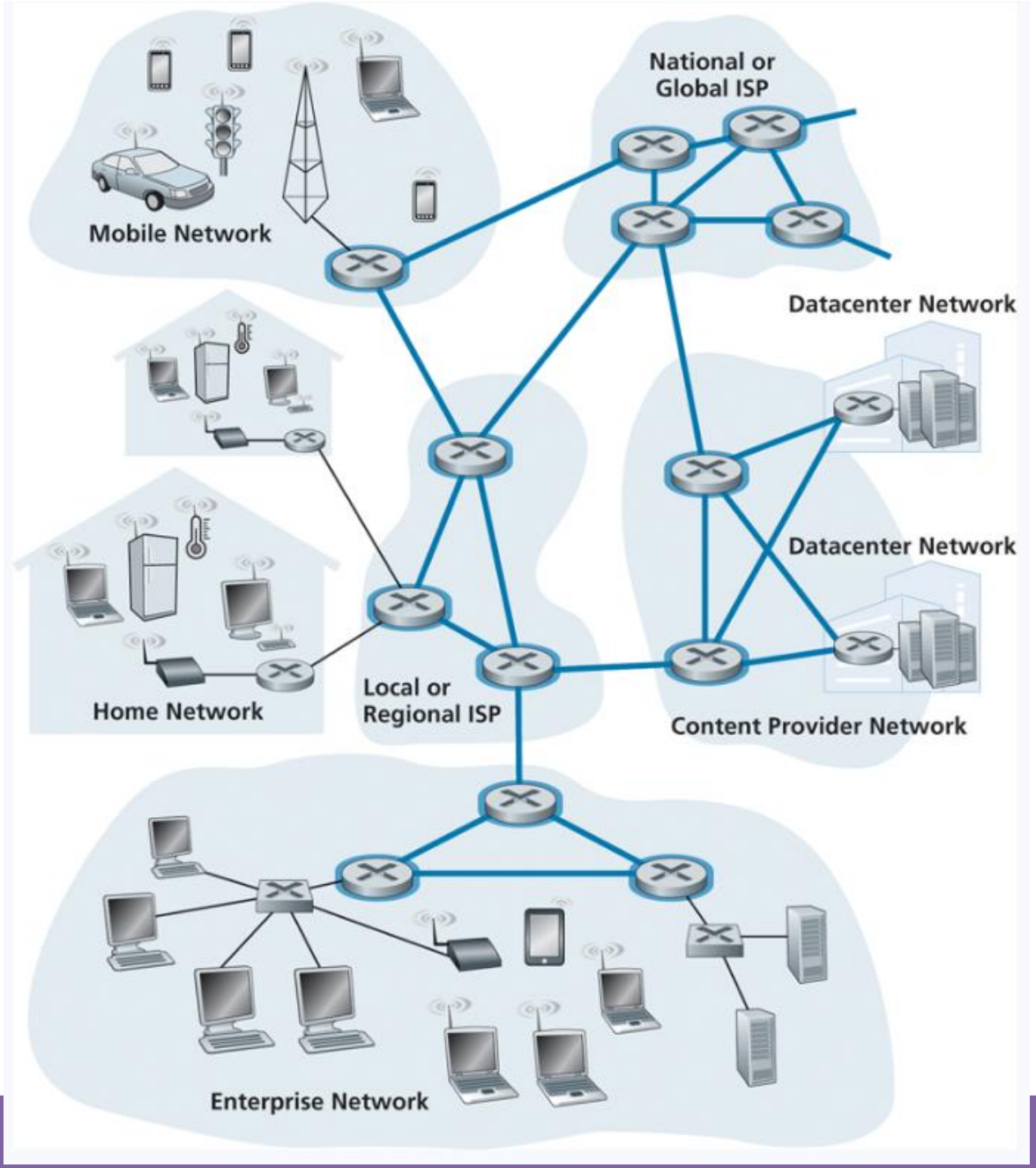

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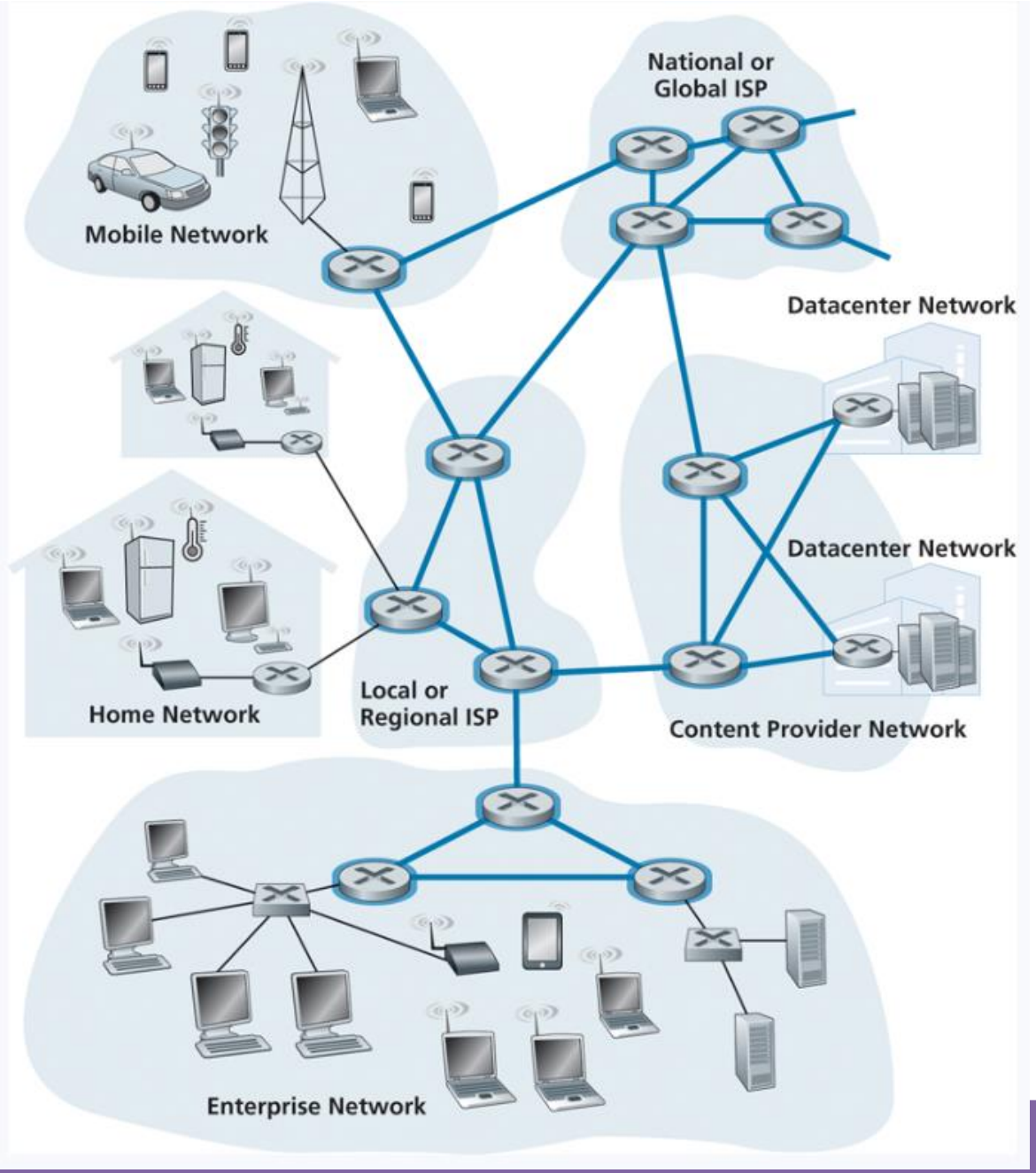
What if we are transmitting large pieces of data?

The Network Core



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What if we are transmitting large pieces of data?

We must split it up!

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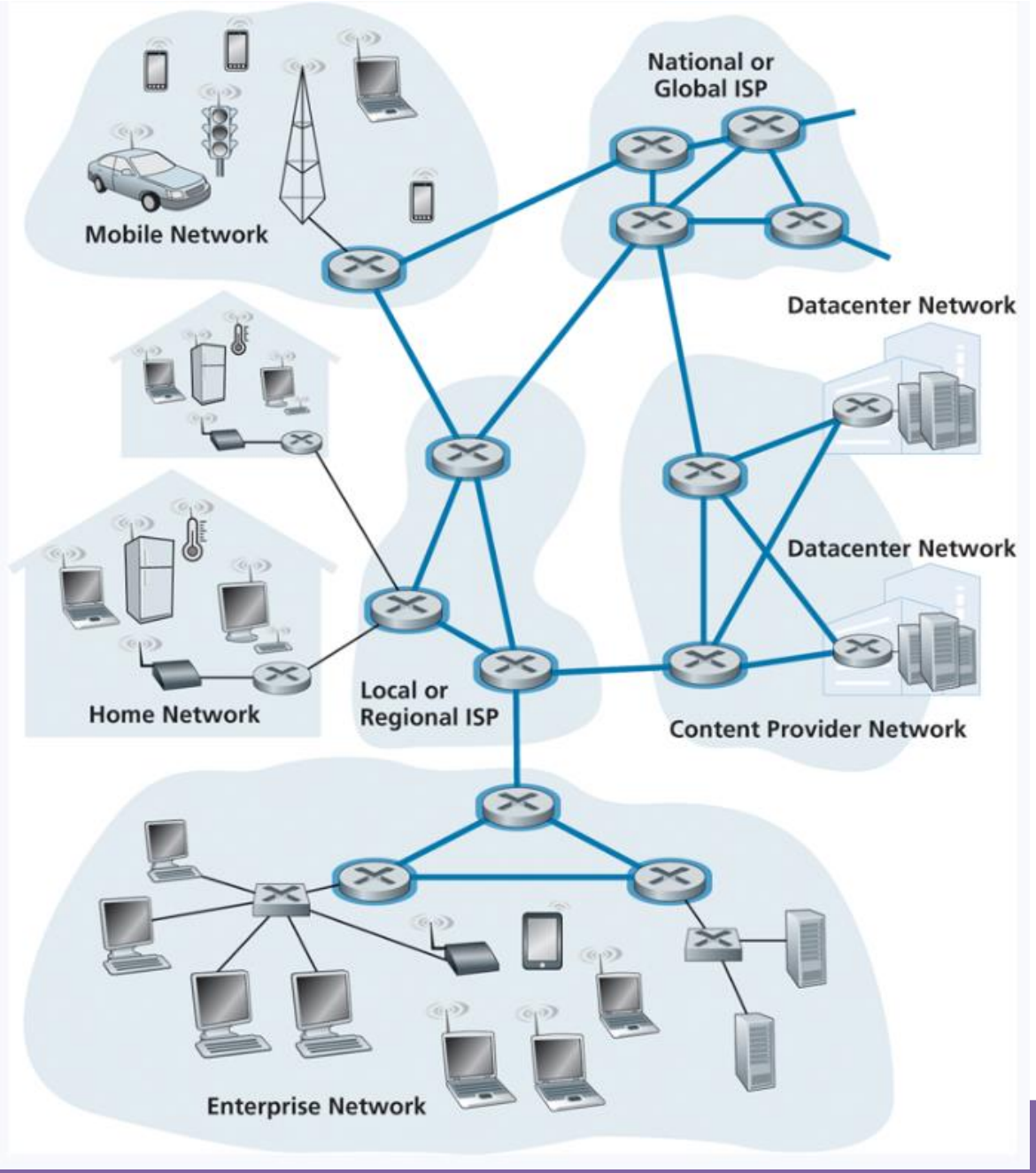

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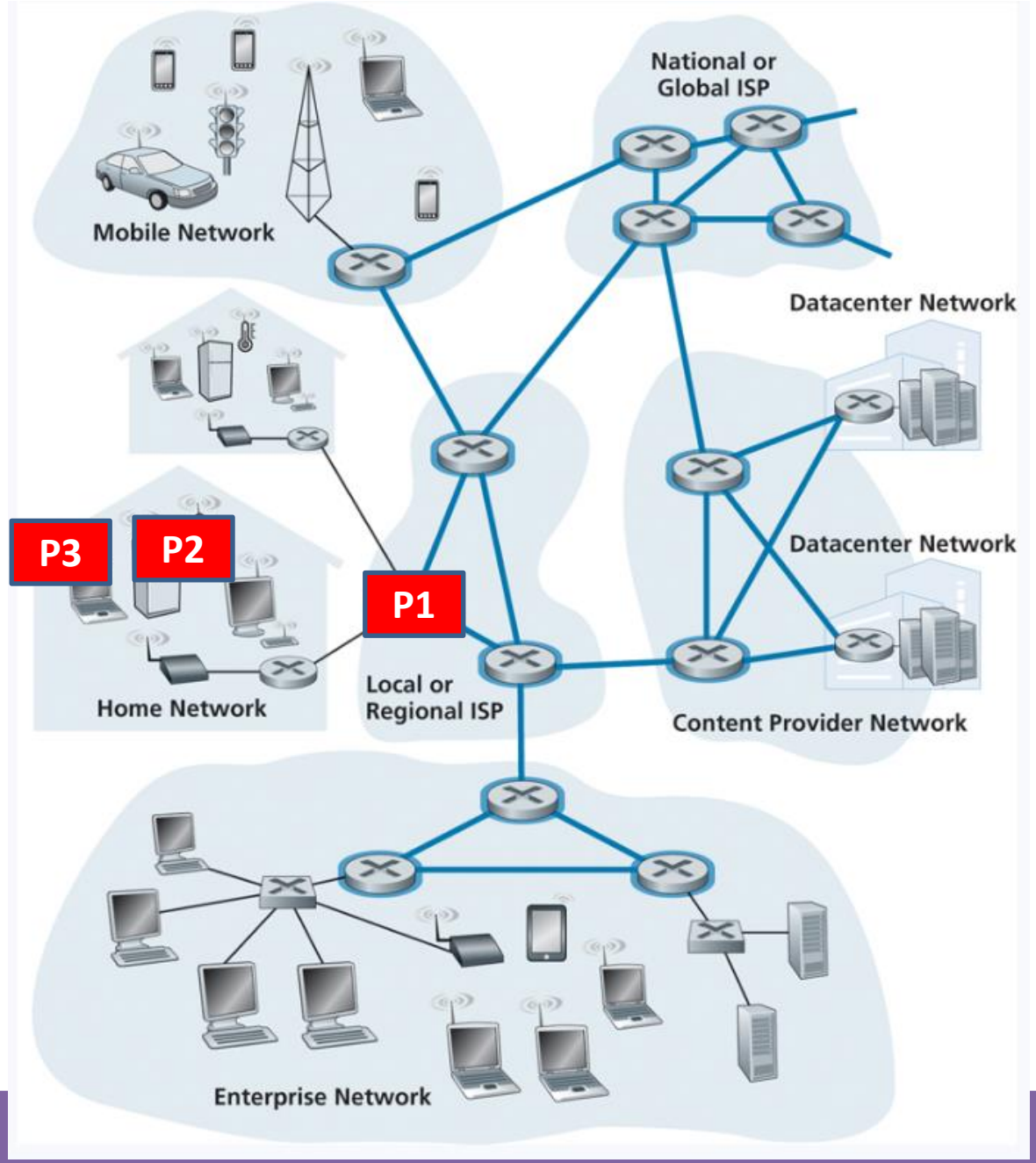

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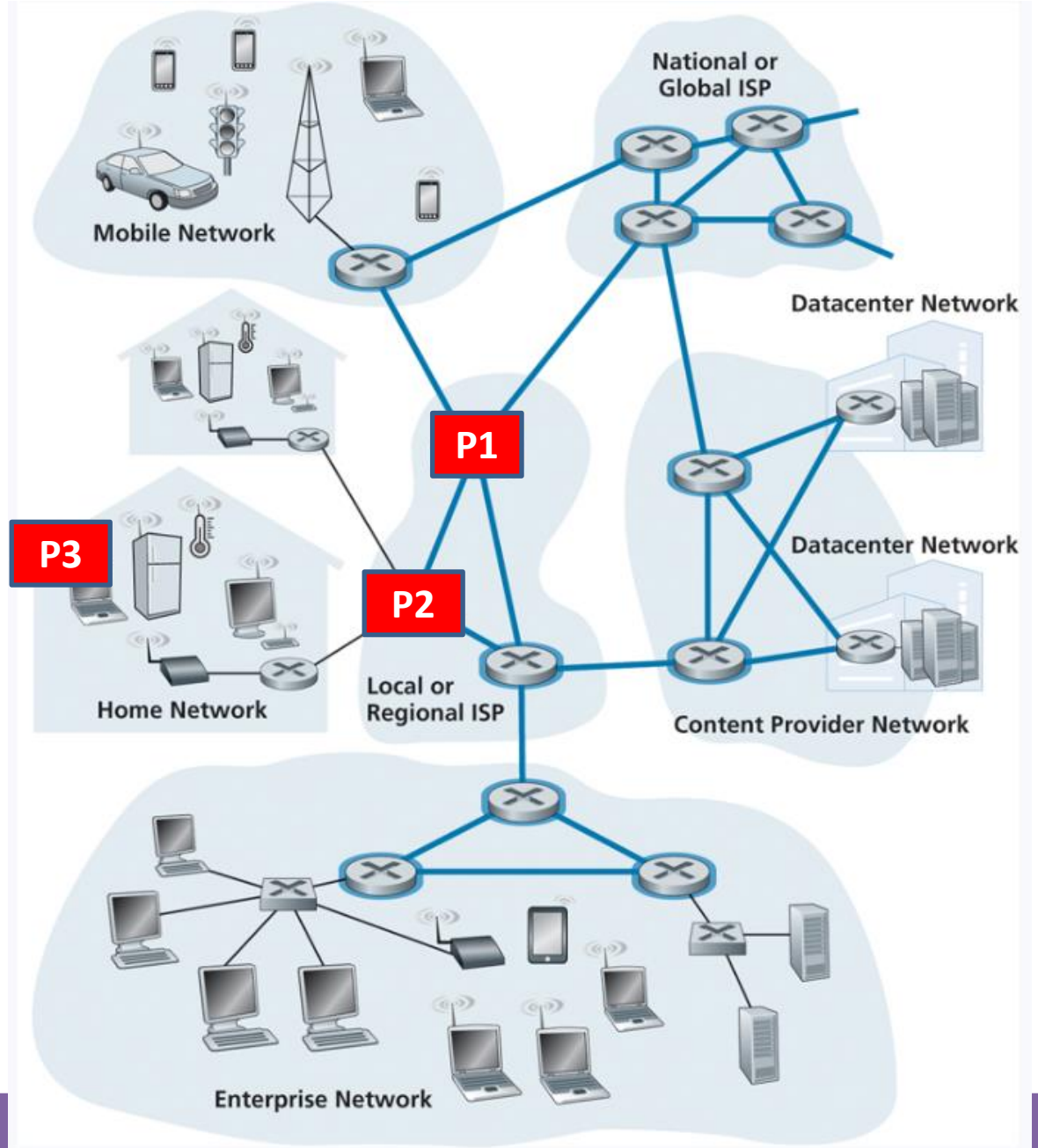

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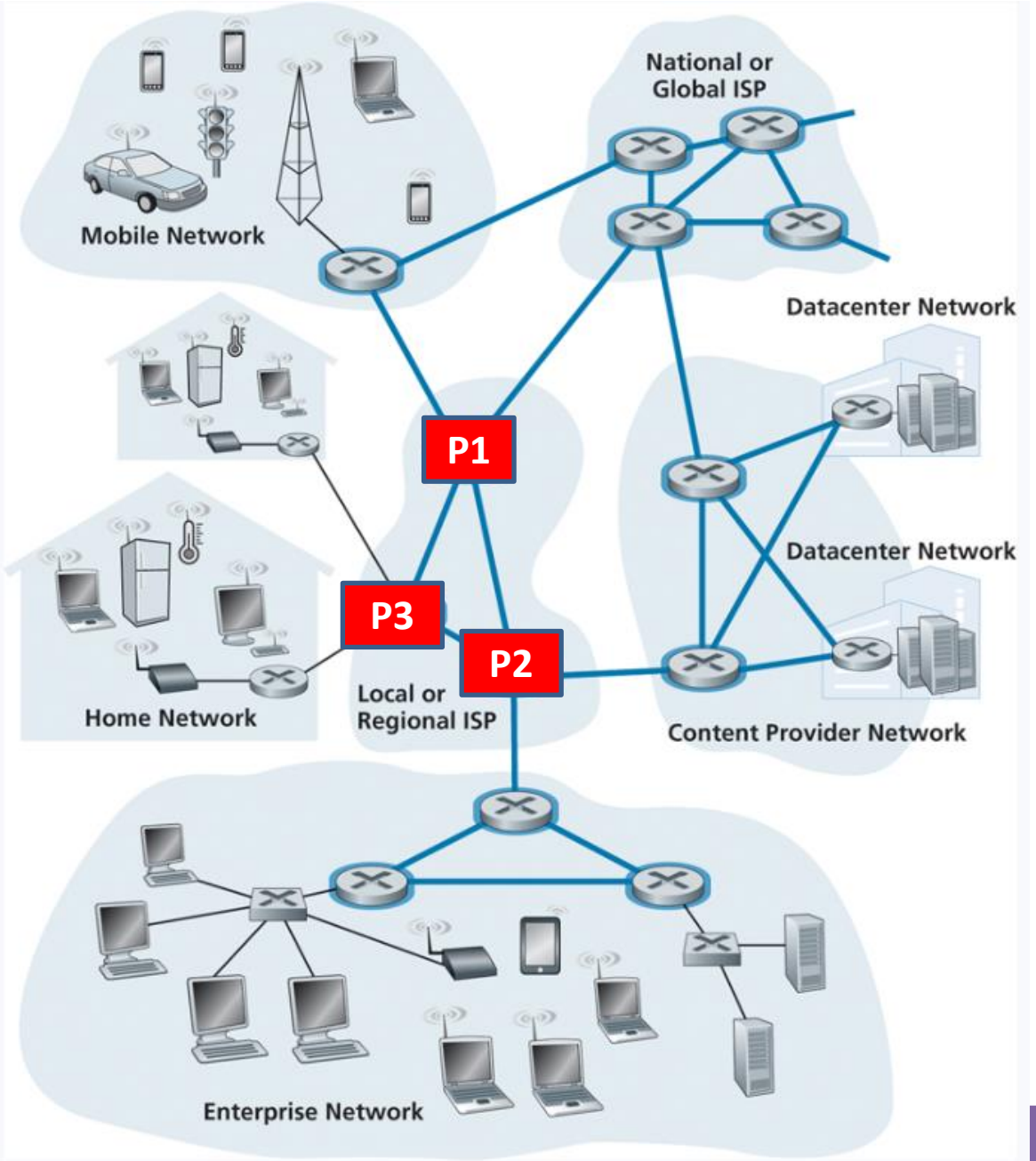

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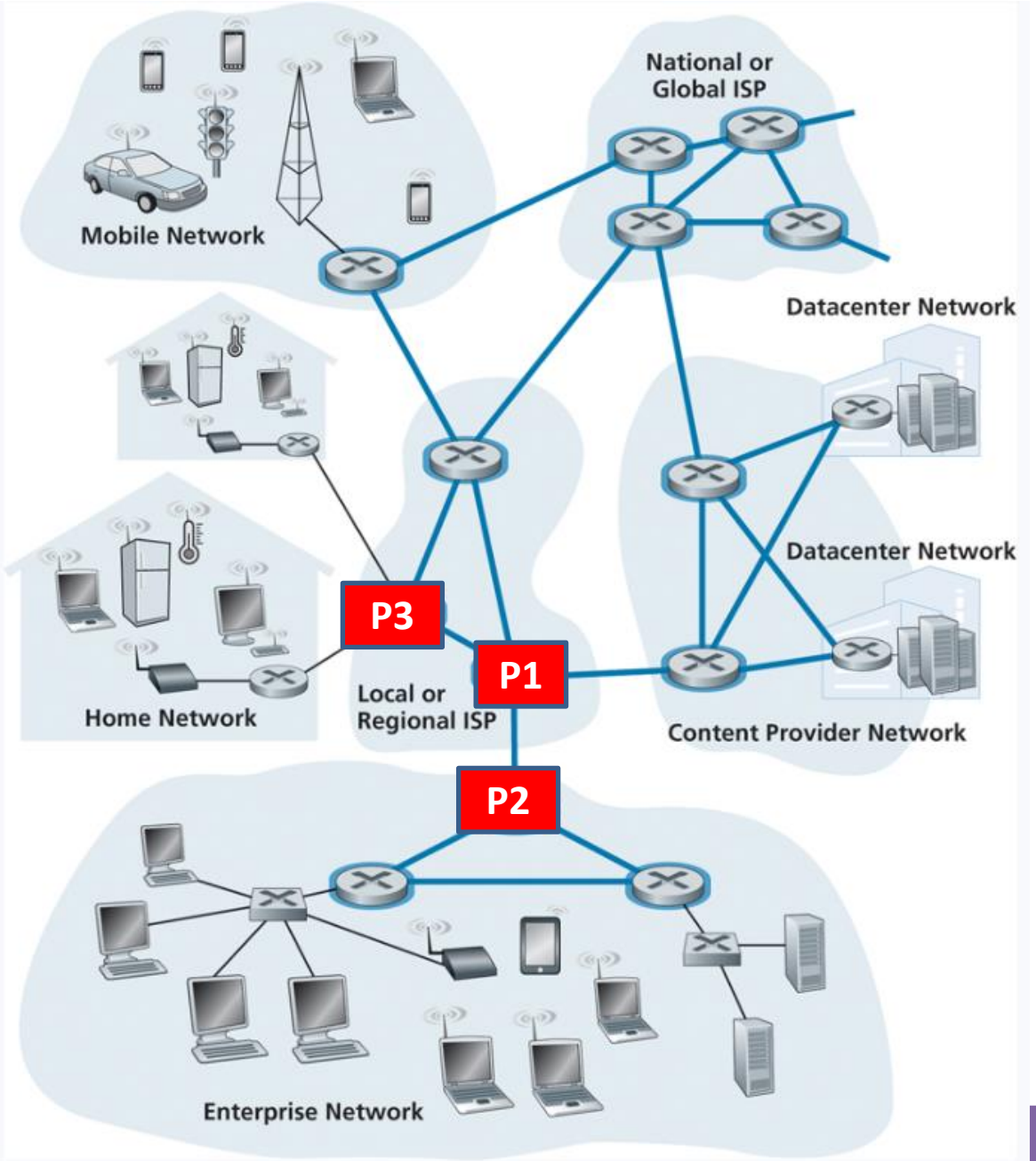

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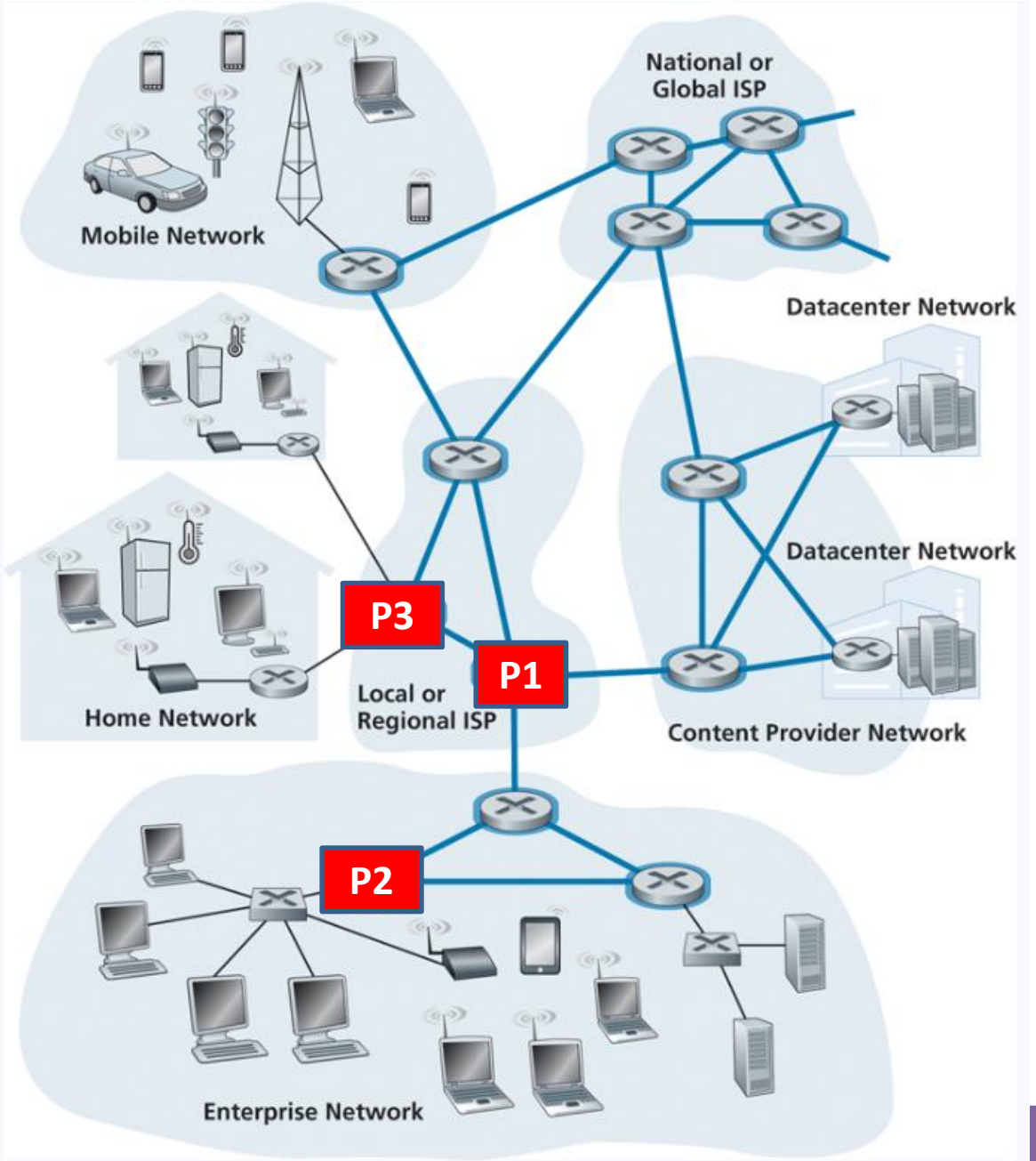

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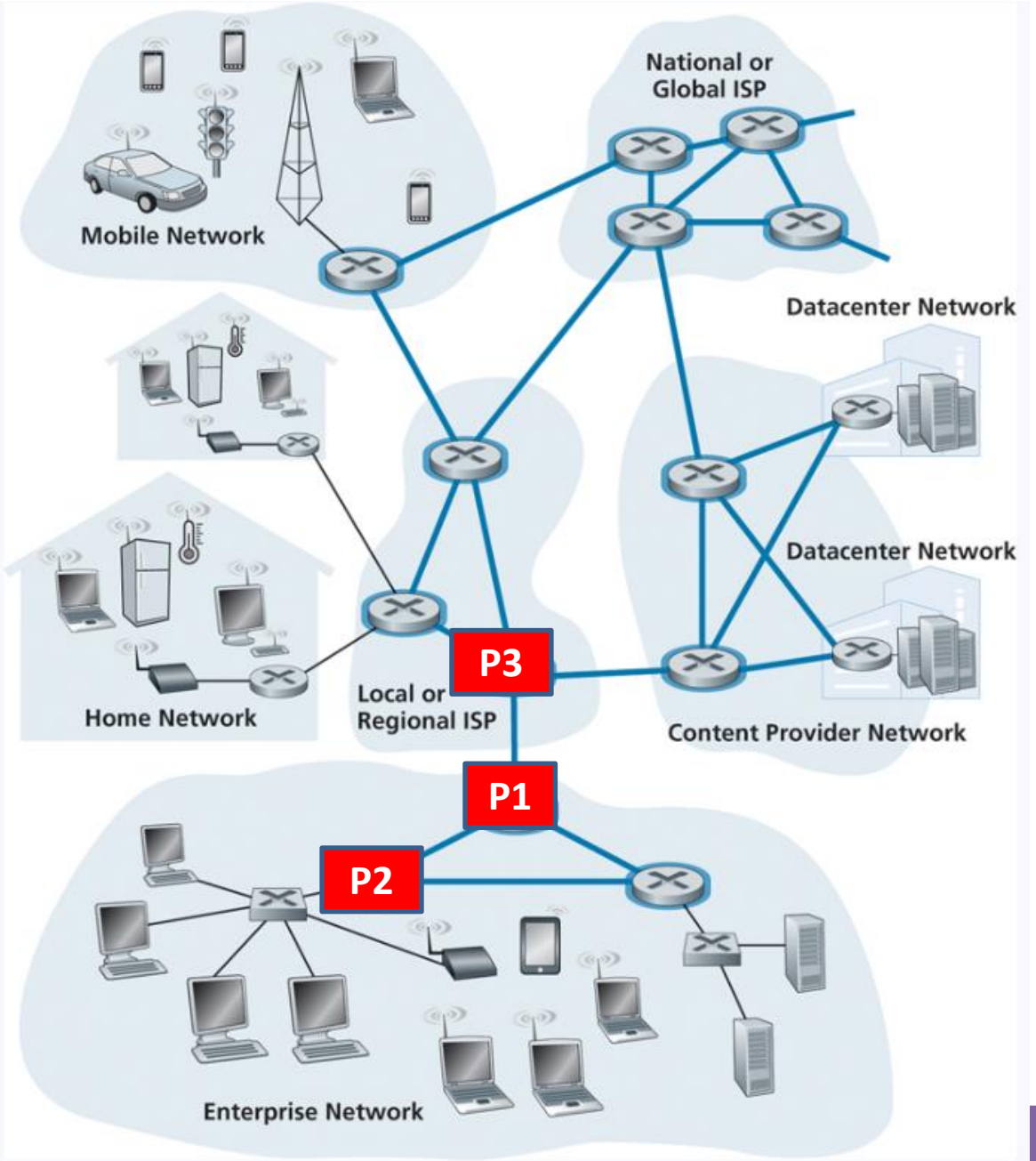

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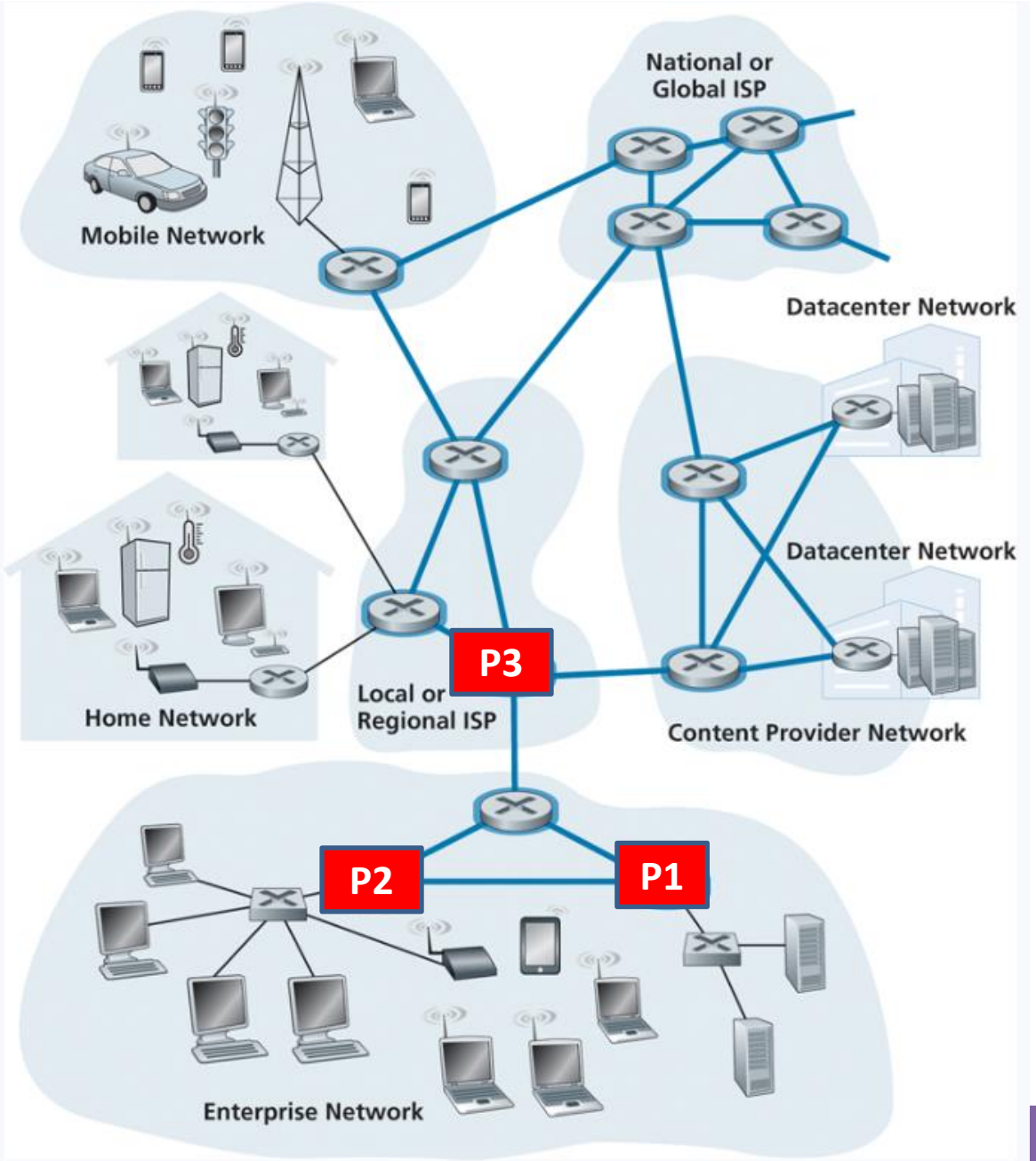

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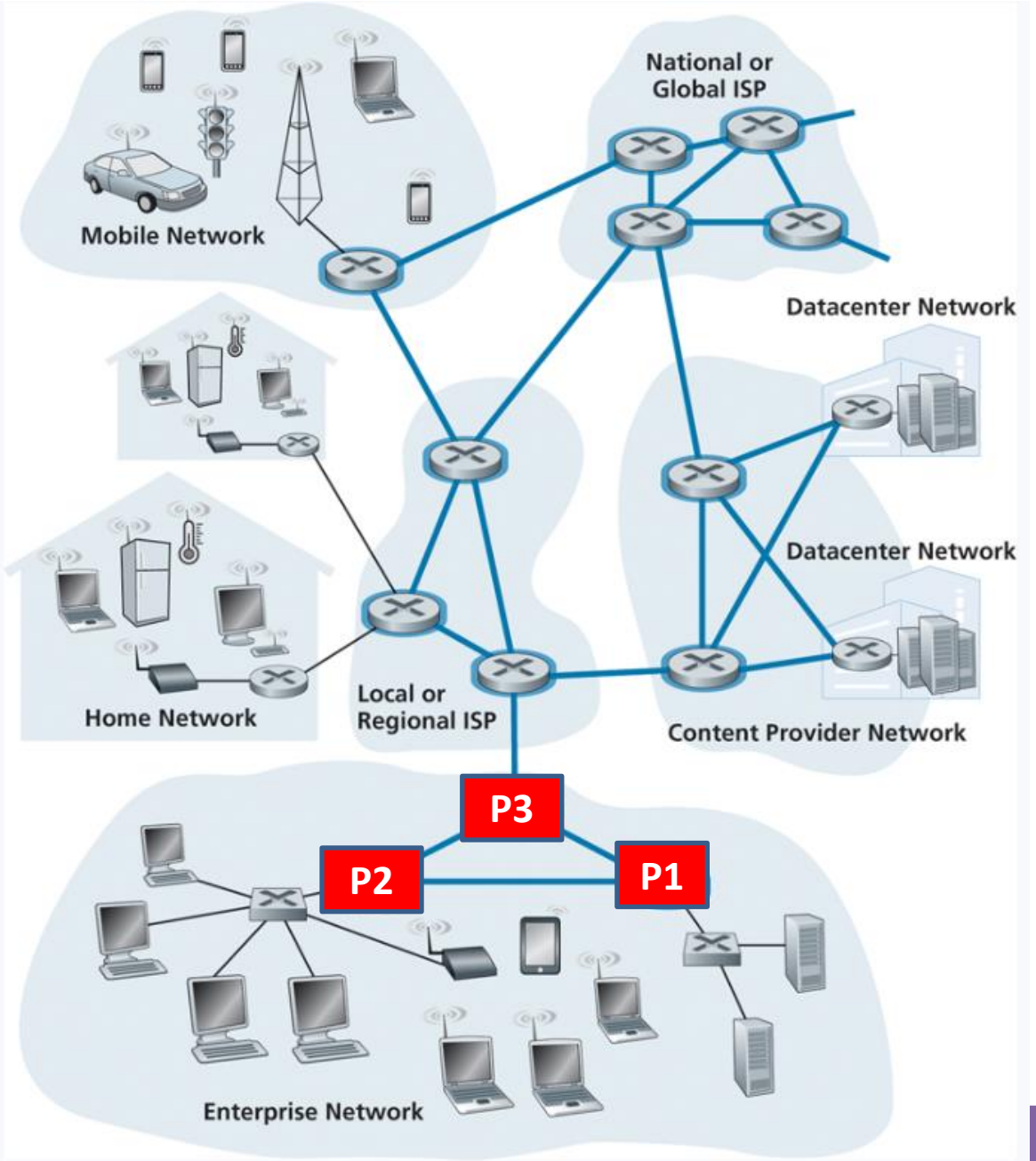

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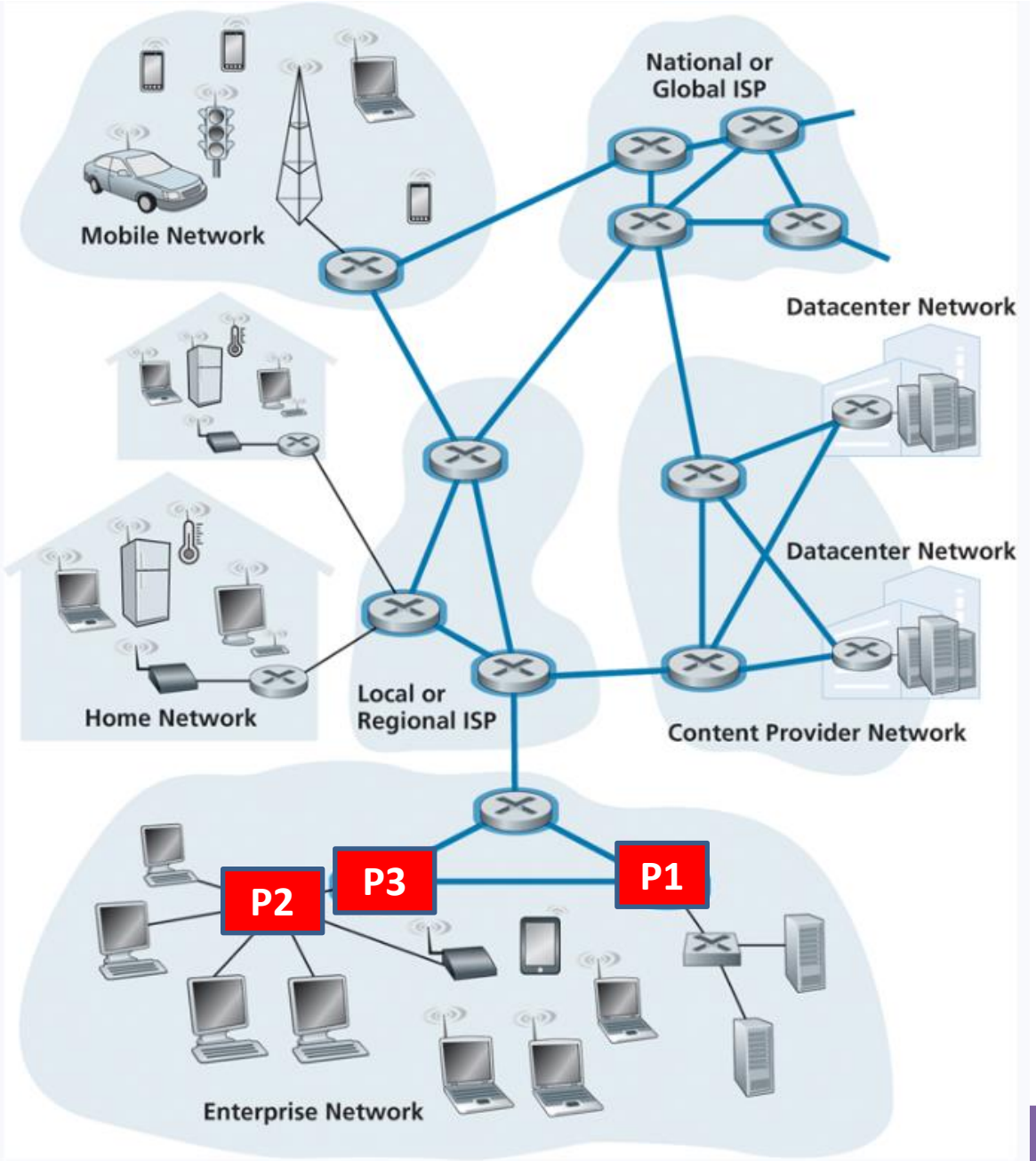

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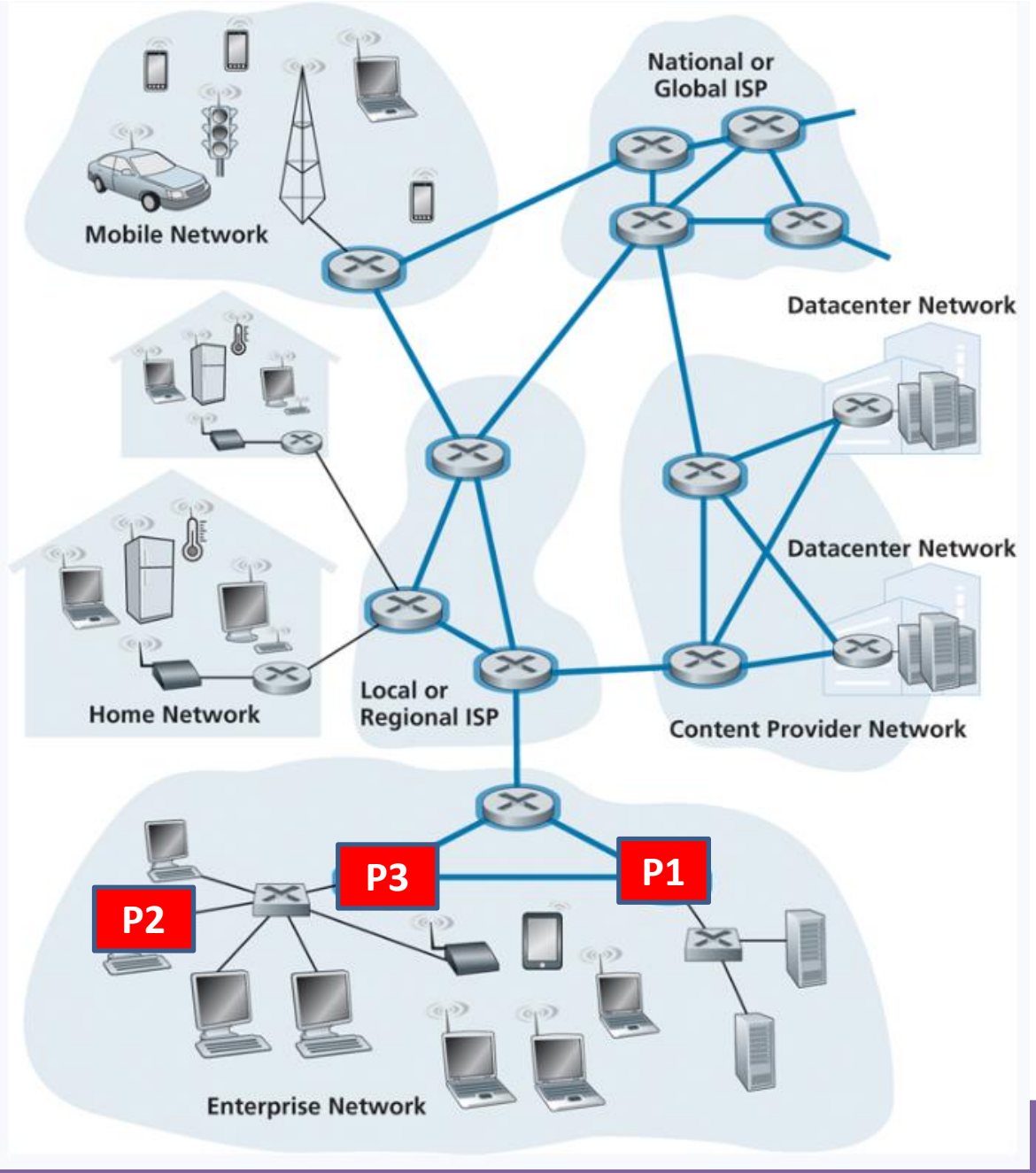

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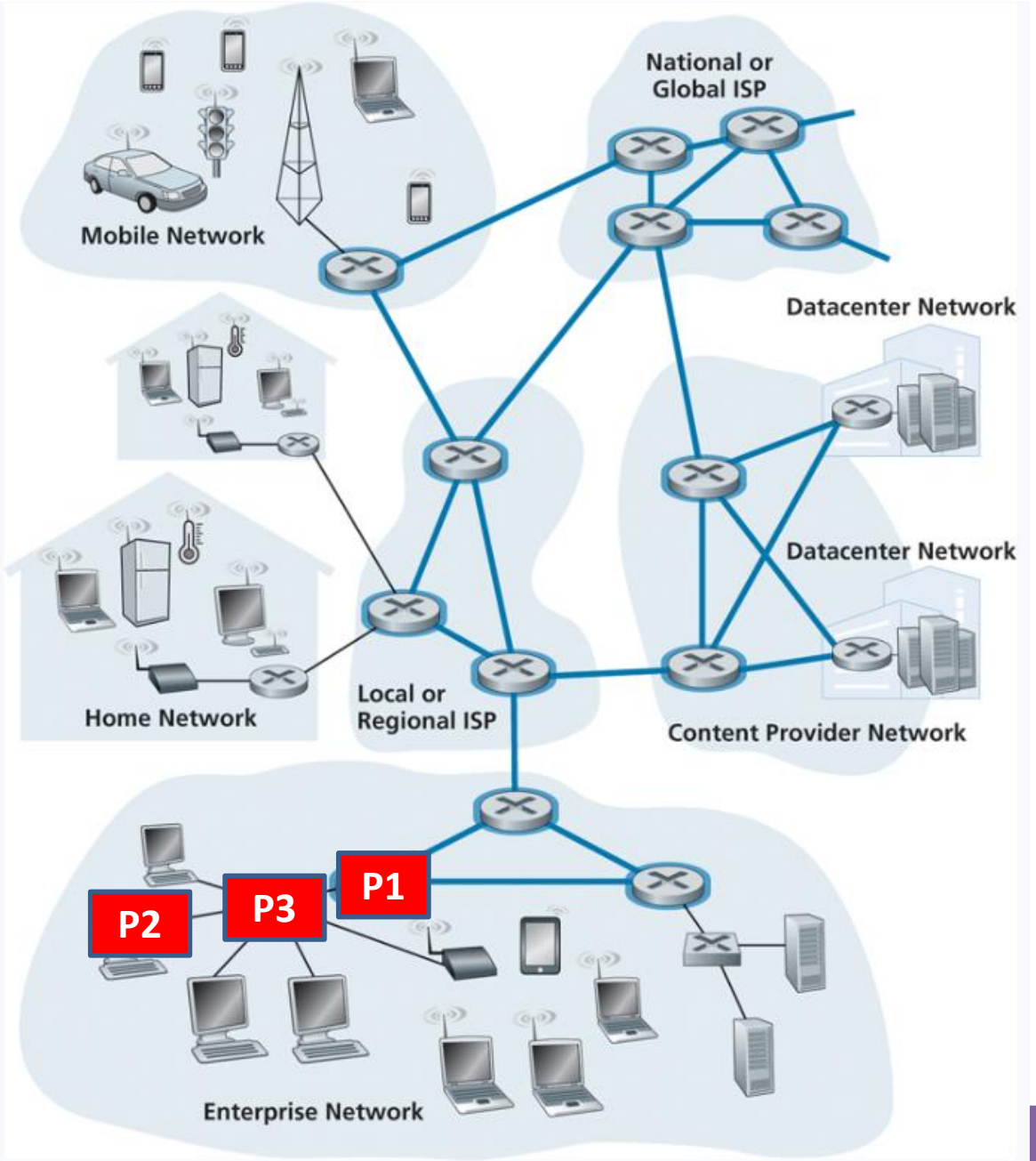

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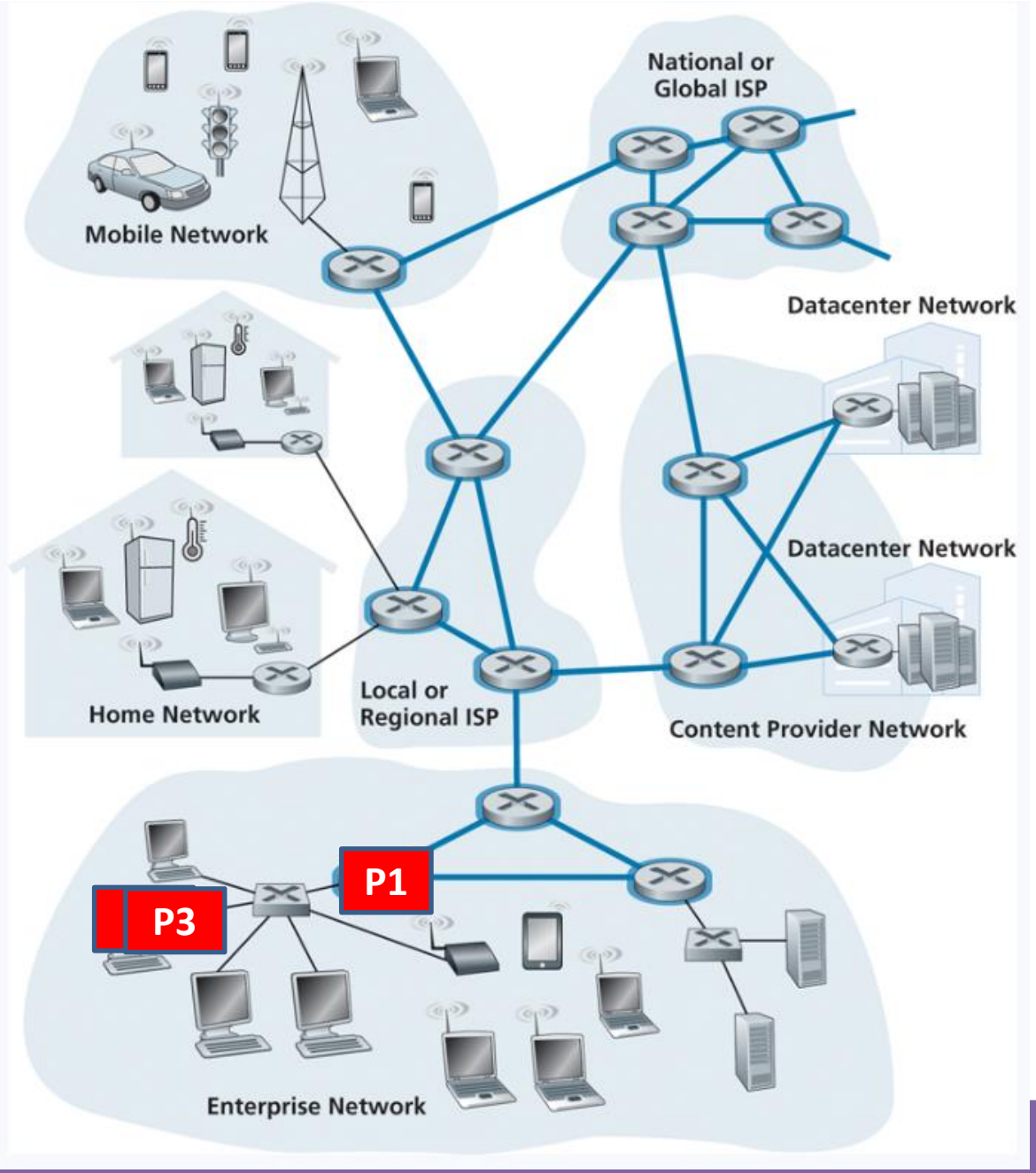

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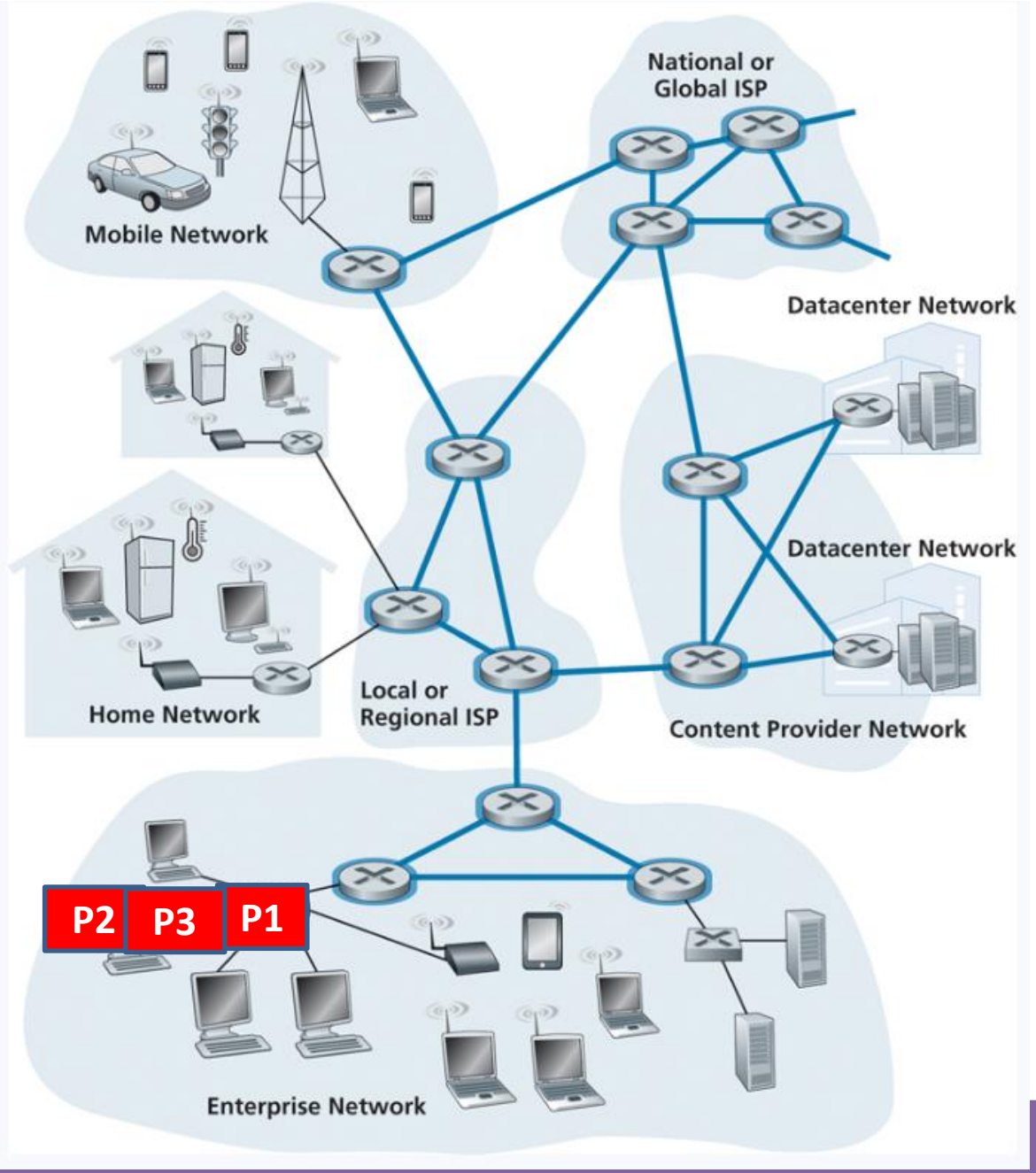

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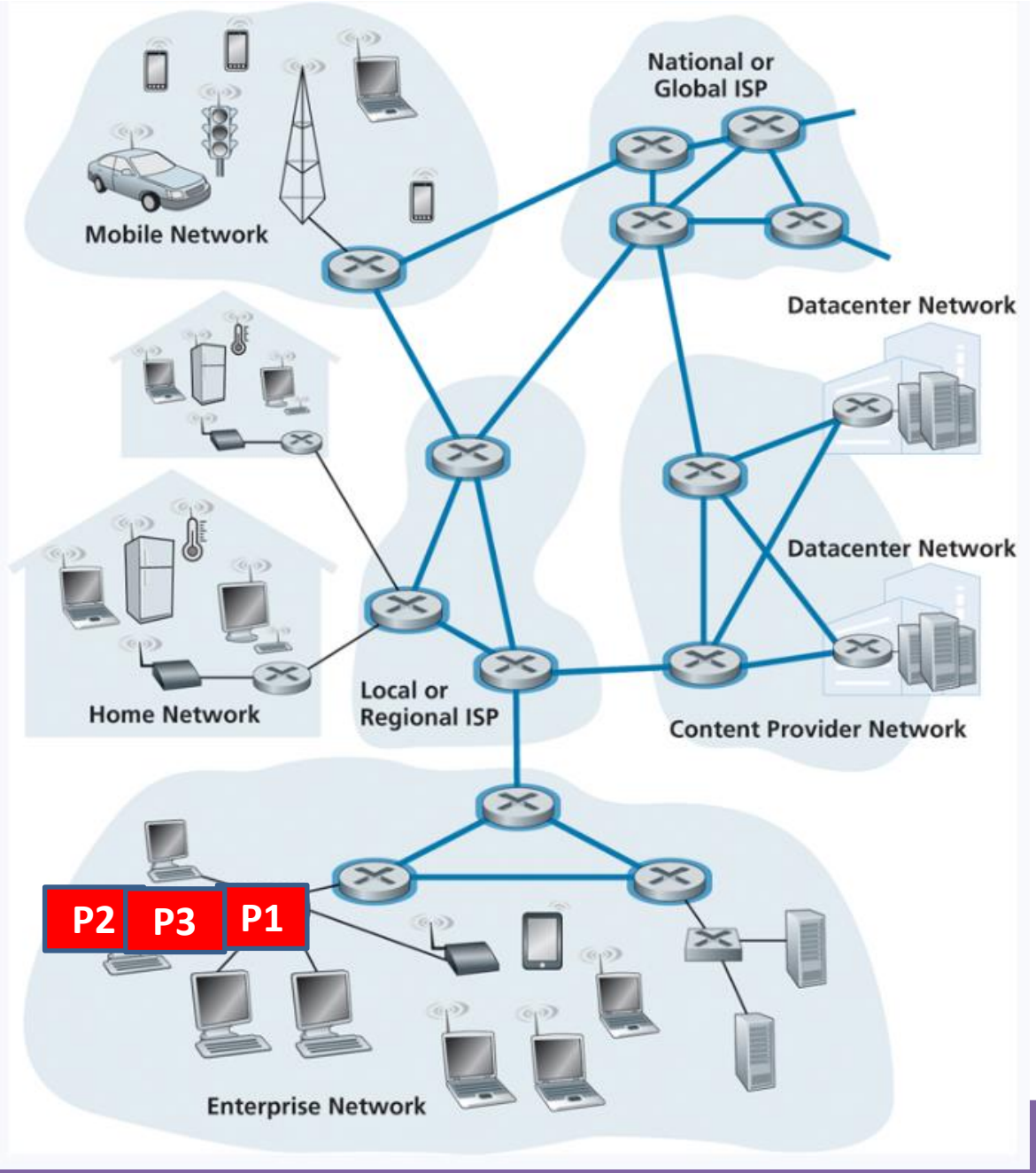

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Final Result:

P2

P3

P1

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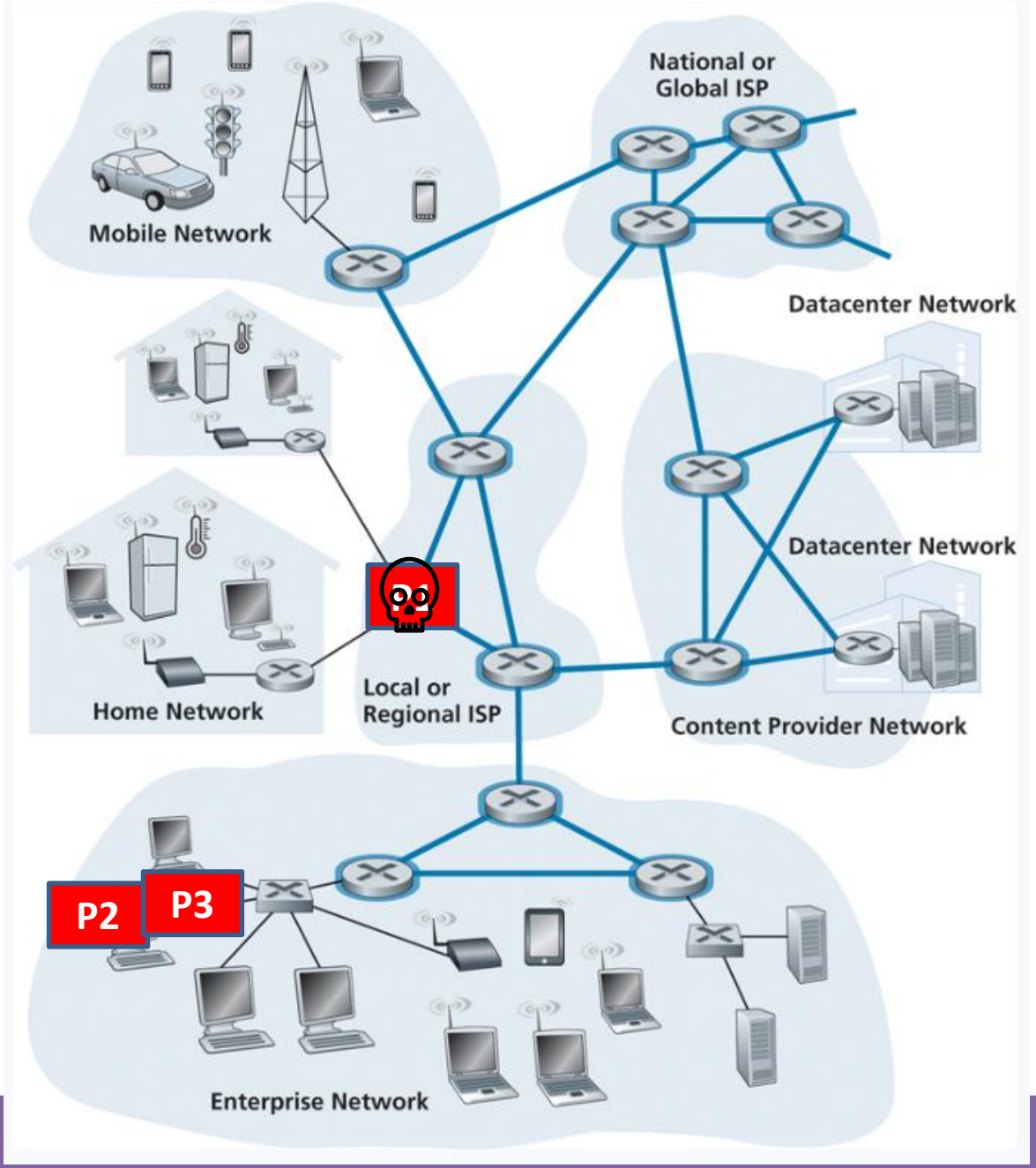

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Lost, Discarded, Corrupt **P1**

P2

P3

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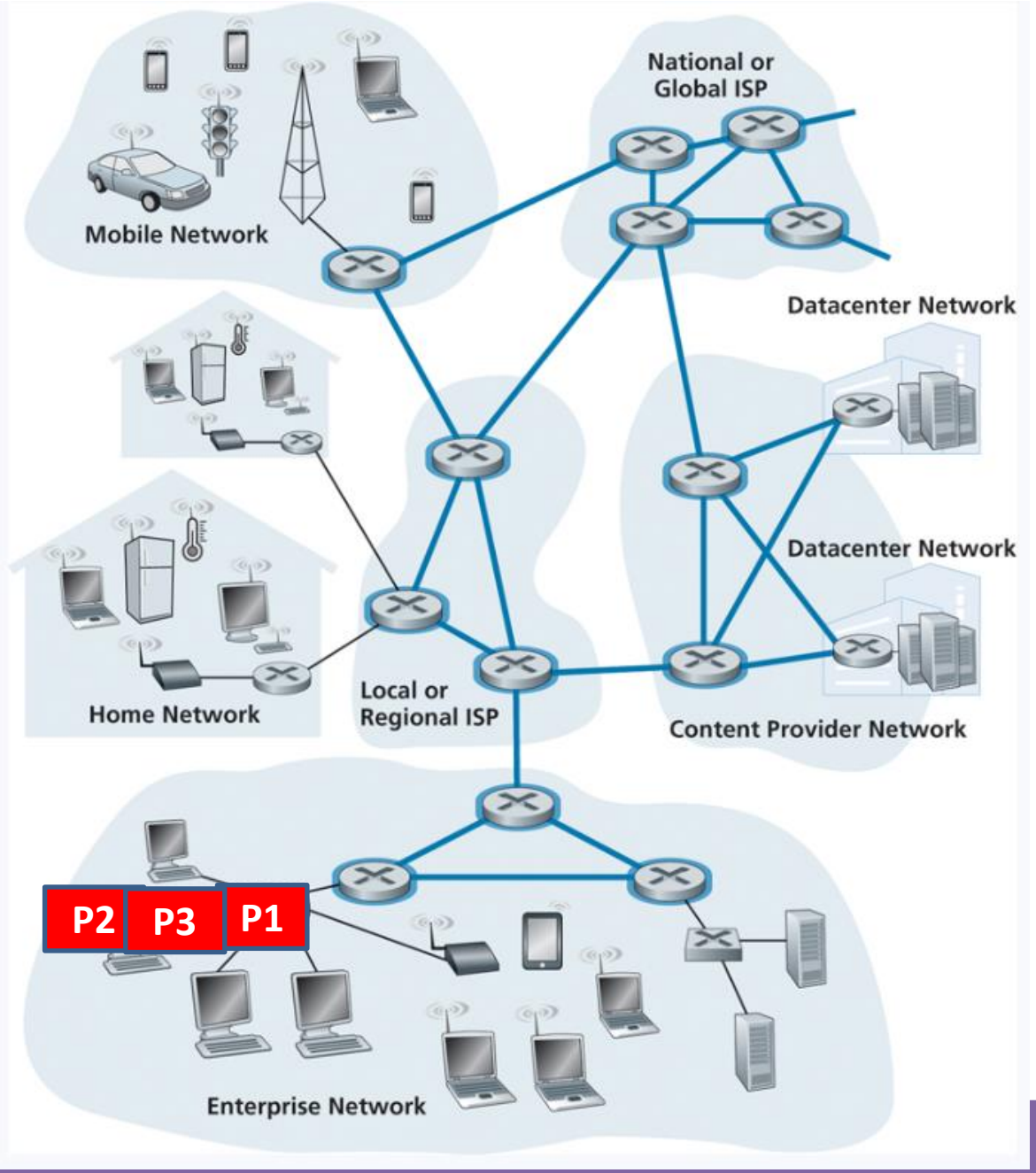

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Solution?

P3

P1

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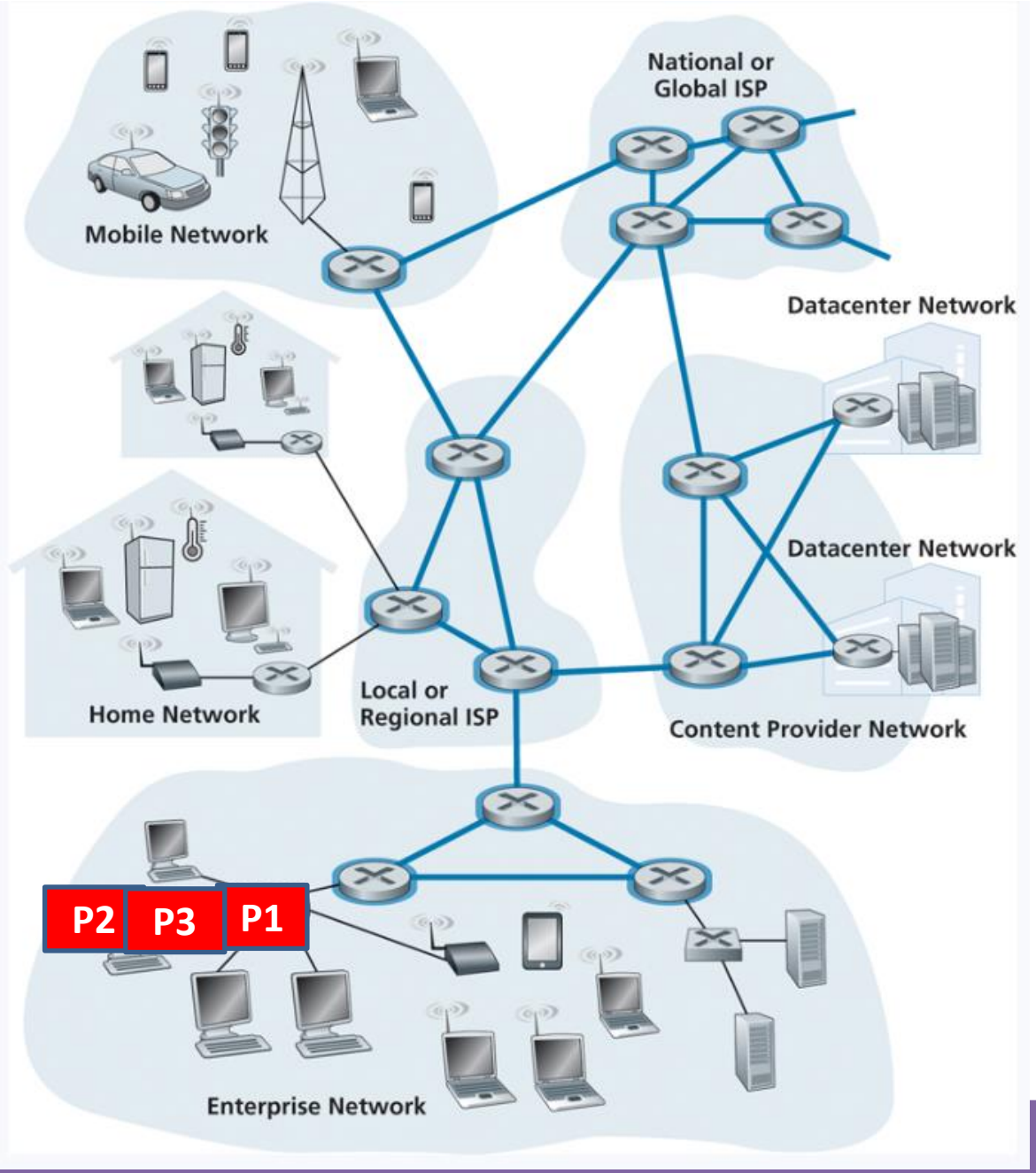

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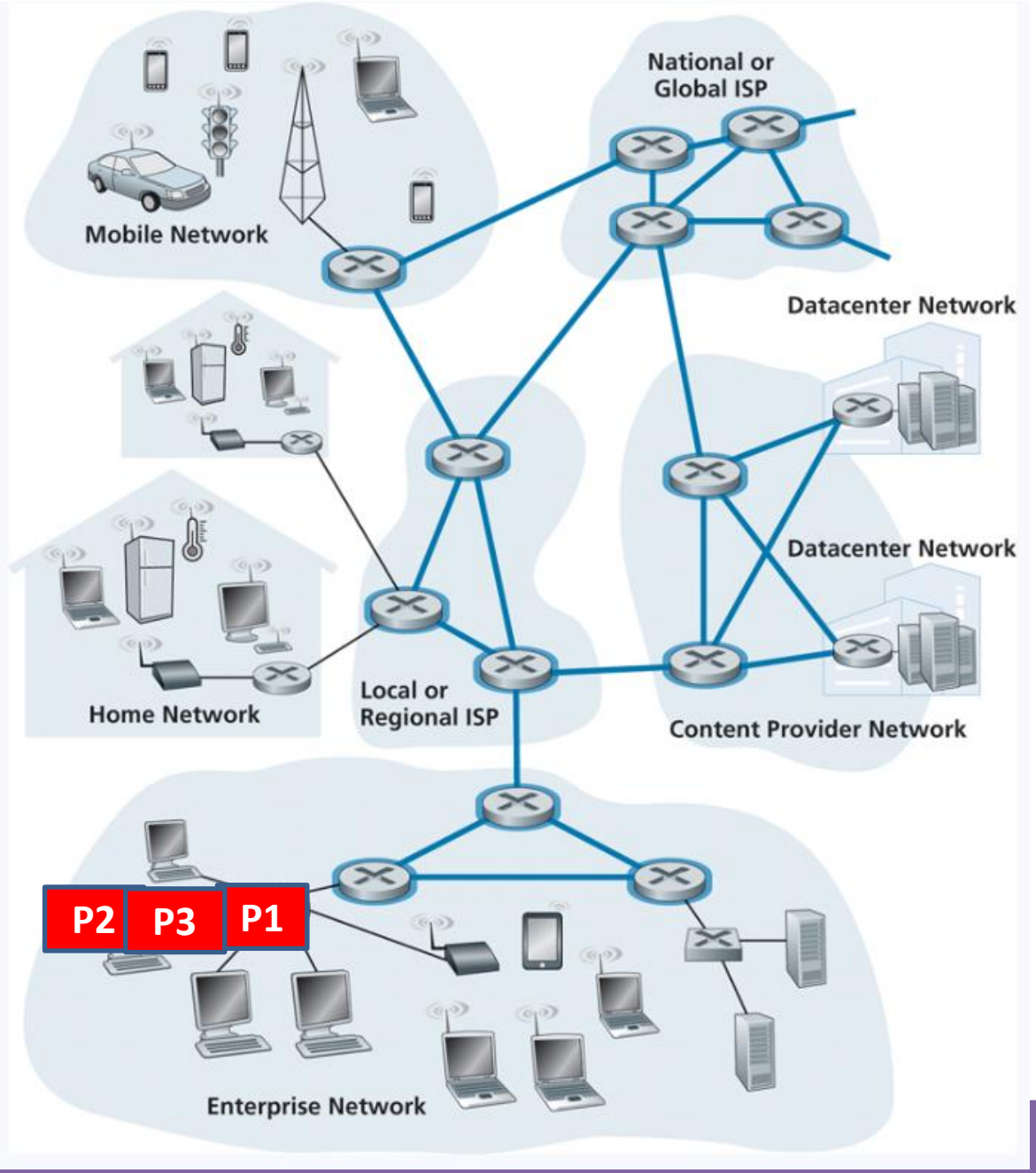

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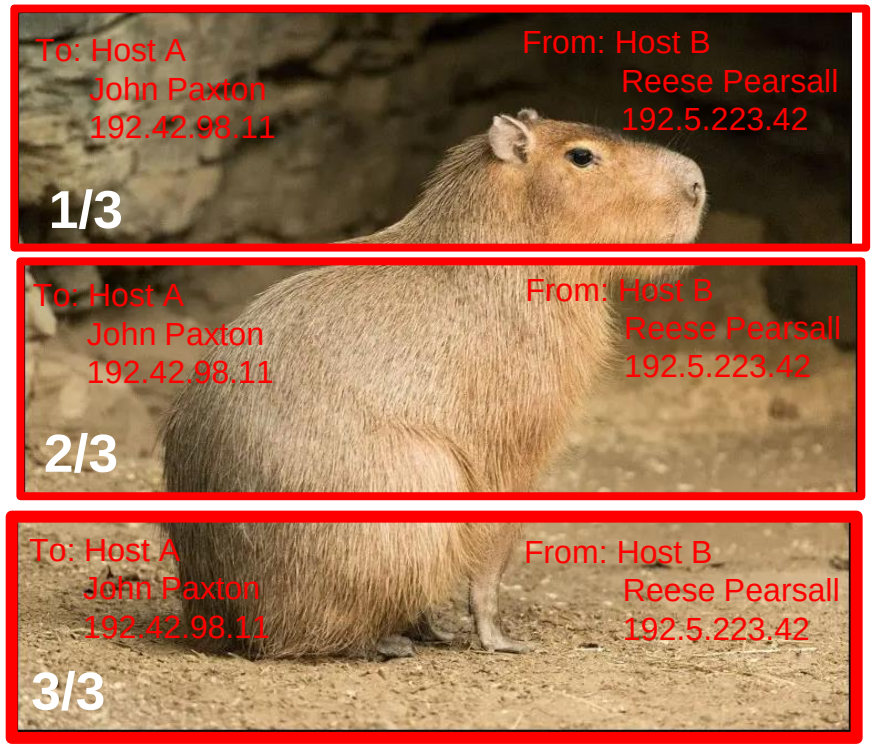

P2

P3

P1

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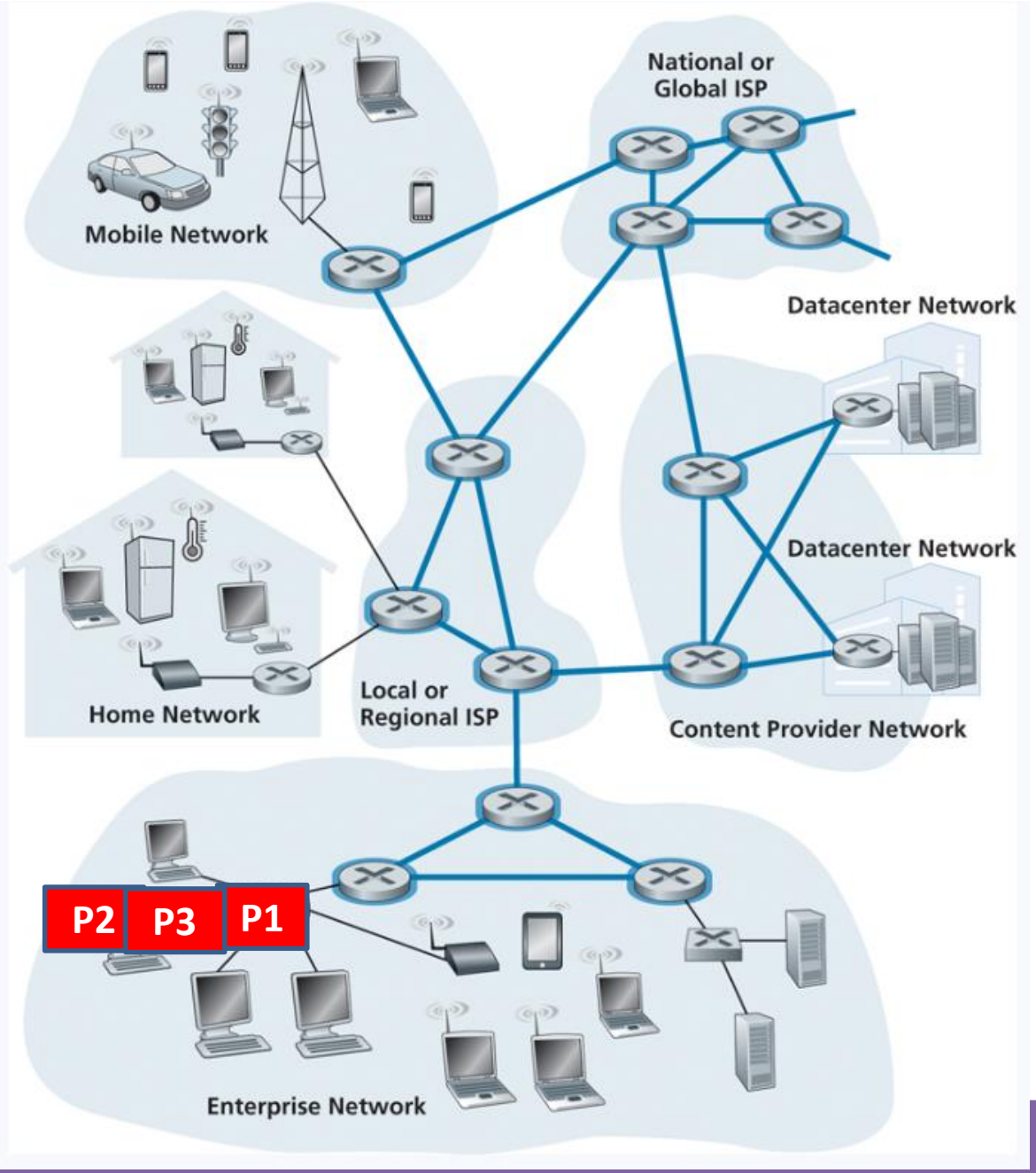

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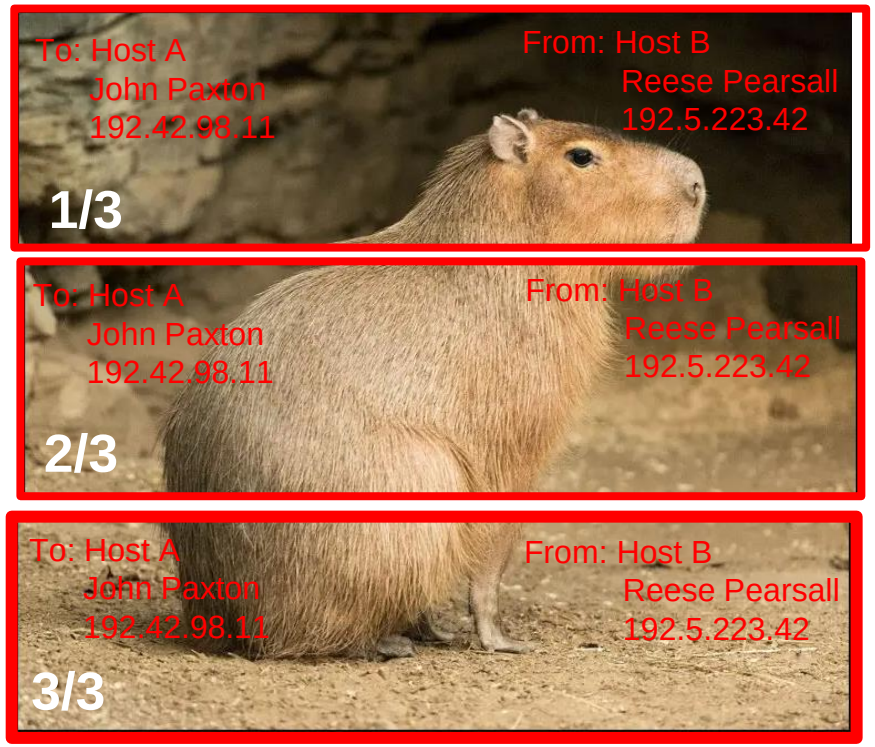


P2

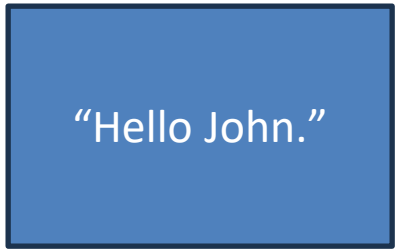
P3

P1

Solution?

Anatomy of a Packet

What a packet looks like depends on where it's at in its journey!



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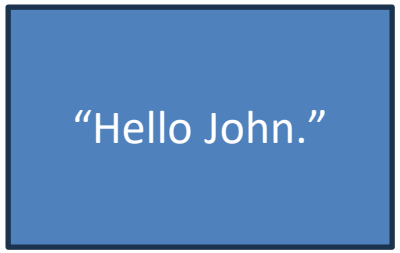
User-level message



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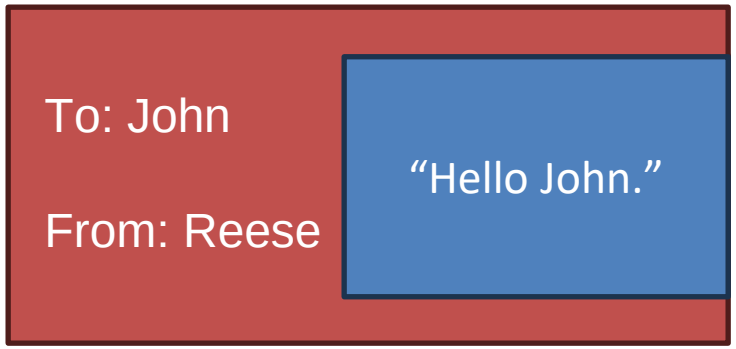
Intended receiver and sender of message



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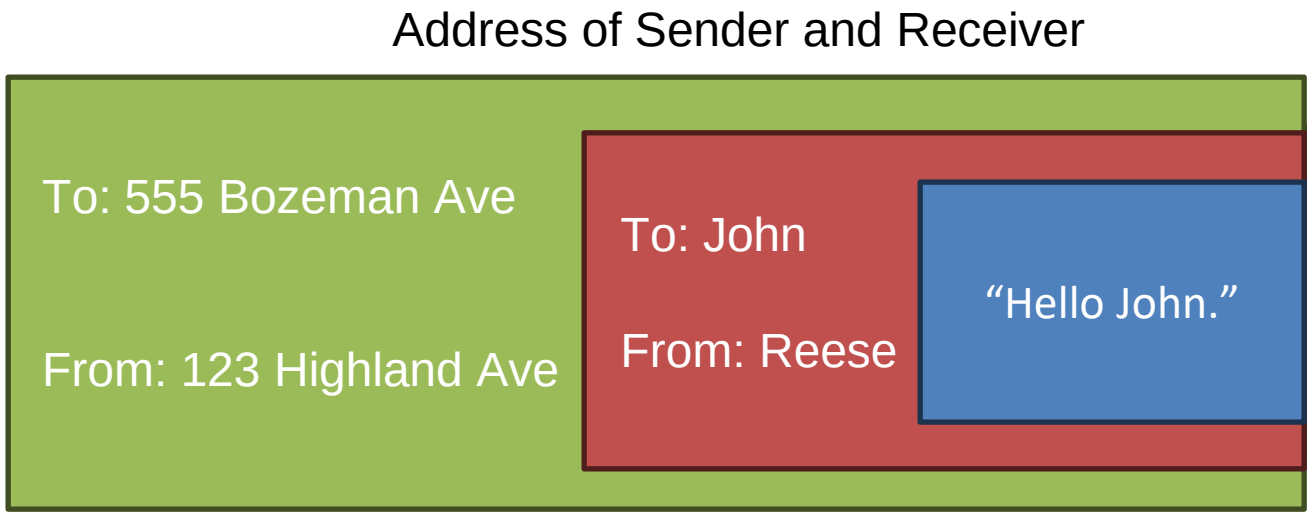

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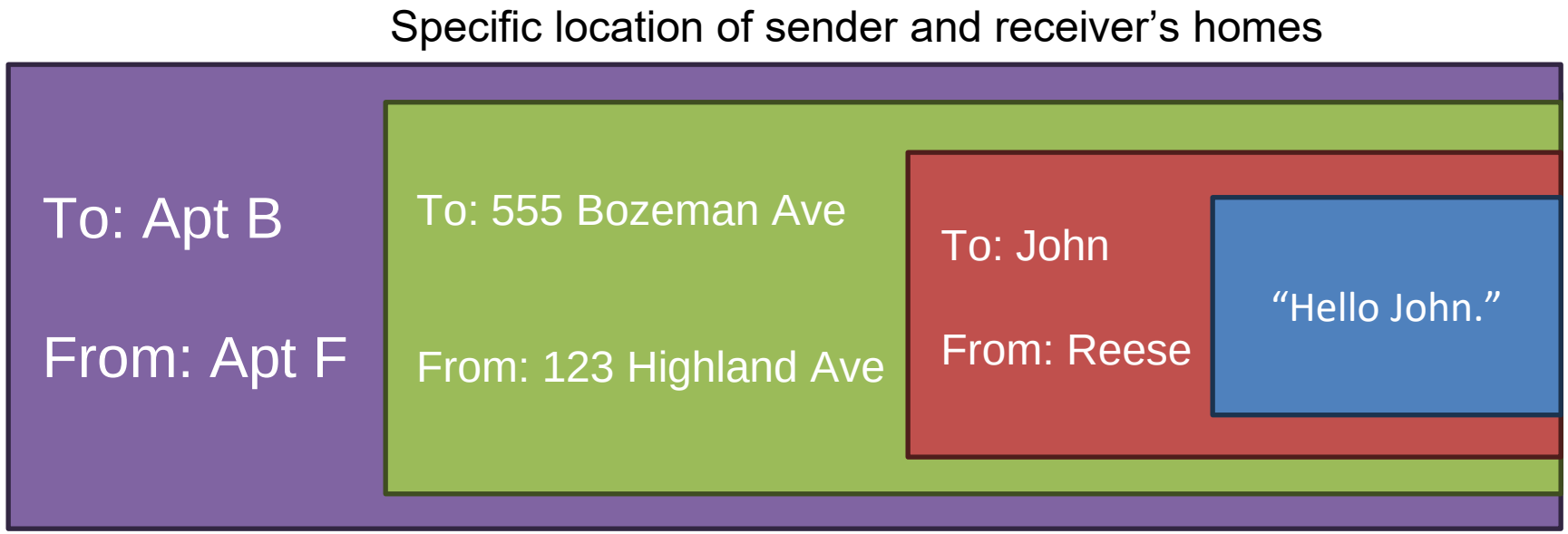

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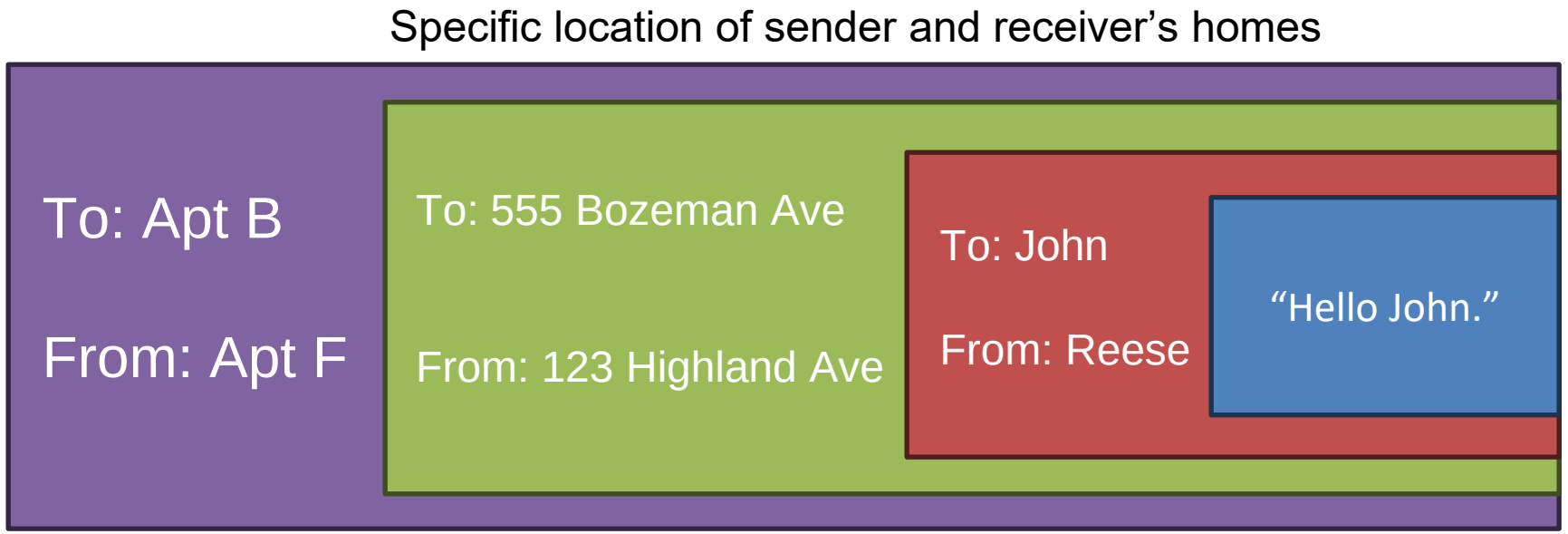

Our original message gets **encapsulated** with many pieces of information

These pieces of information help make sure our mail get sent to the correct place

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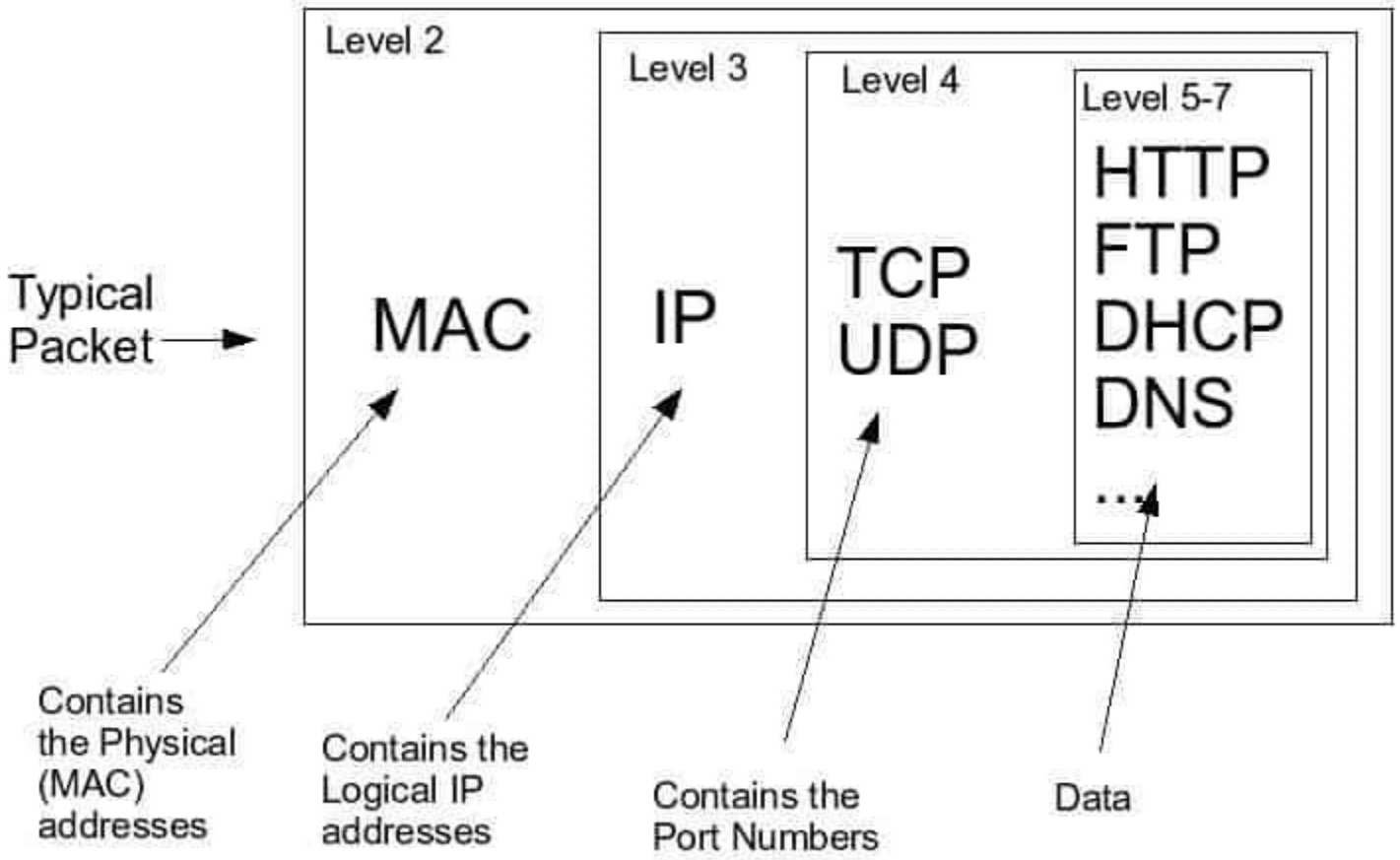
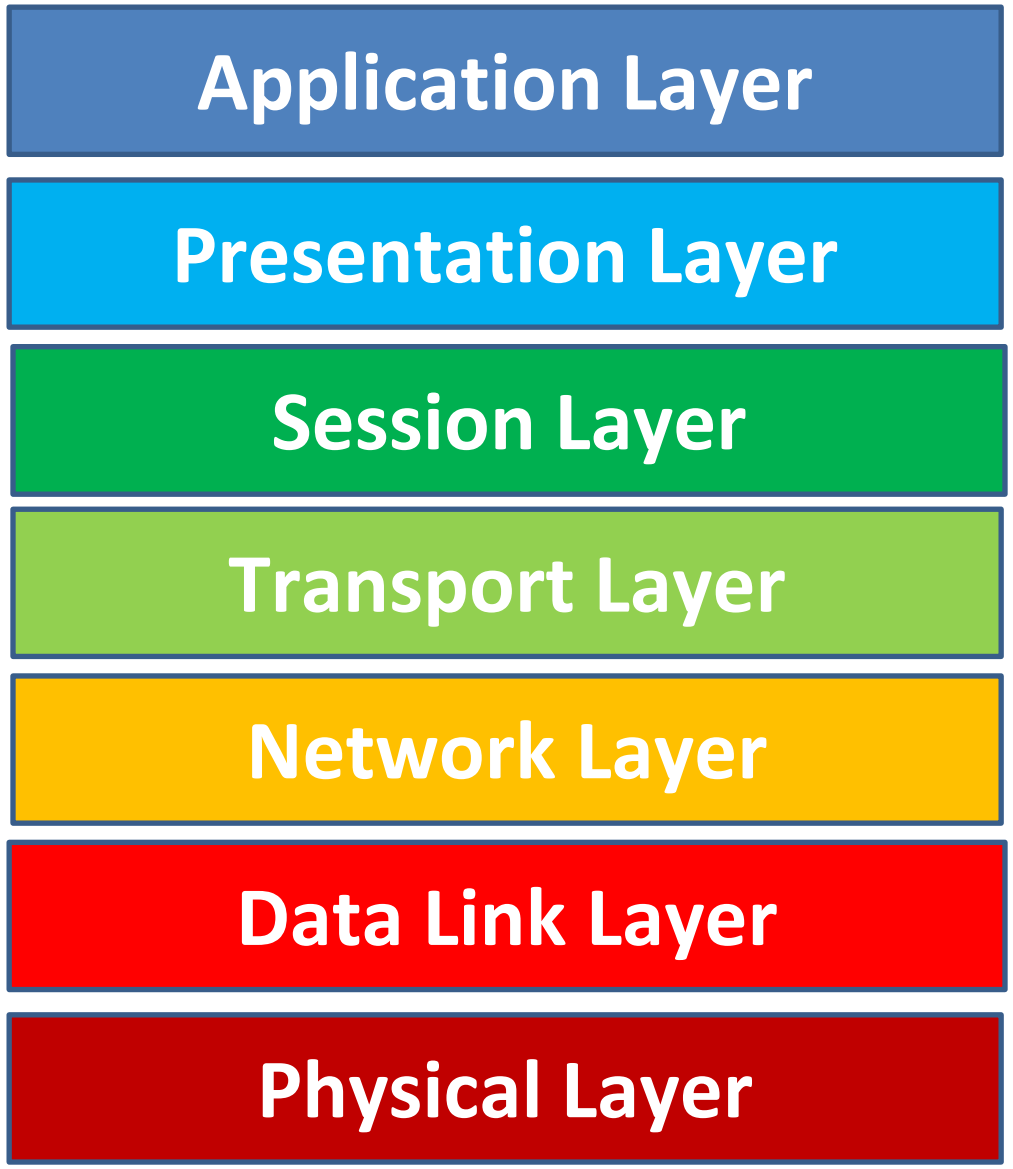


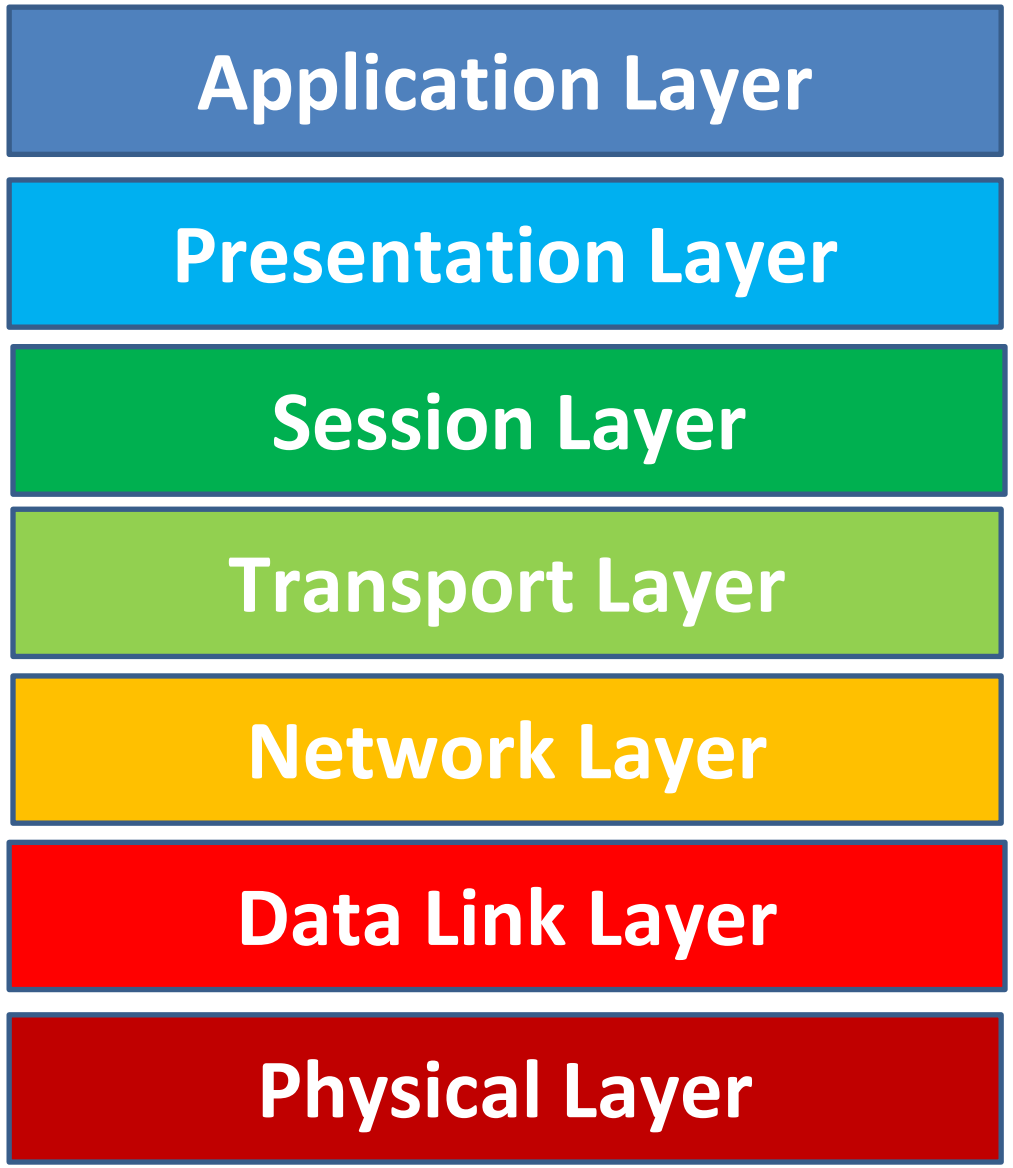
It's a complicated system!



OSI Model

Open Systems Interconnection Model

OSI Model



Application Layer

Messages from Network Applications

Physical Layer

Bits being transmitted over a copper wire


Application Layer
Presentation Layer
Session Layer
Transport Layer
Network Layer
Data link Layer
Physical Layer

Questions?