# CSCI 466: Networks

Lecture 2: Network Edge, Network Core, OSI Model

Reese Pearsall

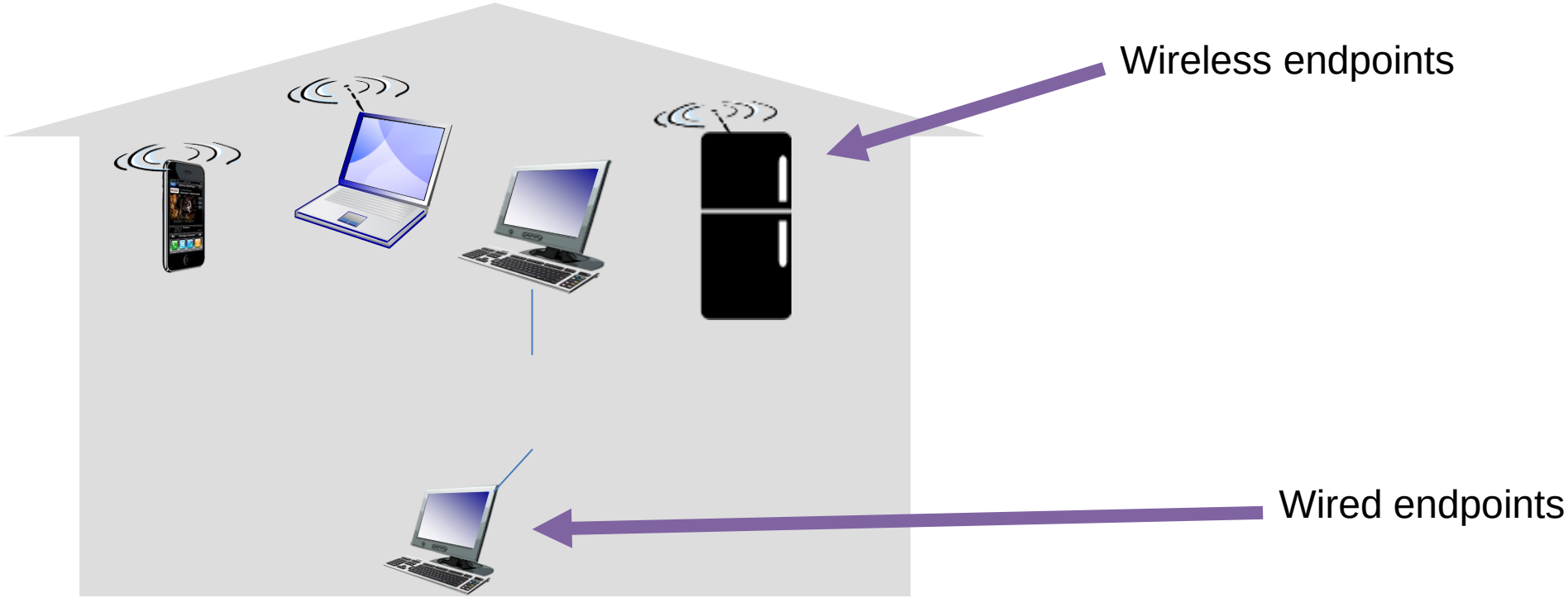
Fall 2022

# Announcements

- D2L Only used for submitting assignments and for posting grades
- You can always email me to arrange a time to meet (in person or virtually)
- Lectures will be recorded (but I am currently figuring out new recording software)

# End to End Communication

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

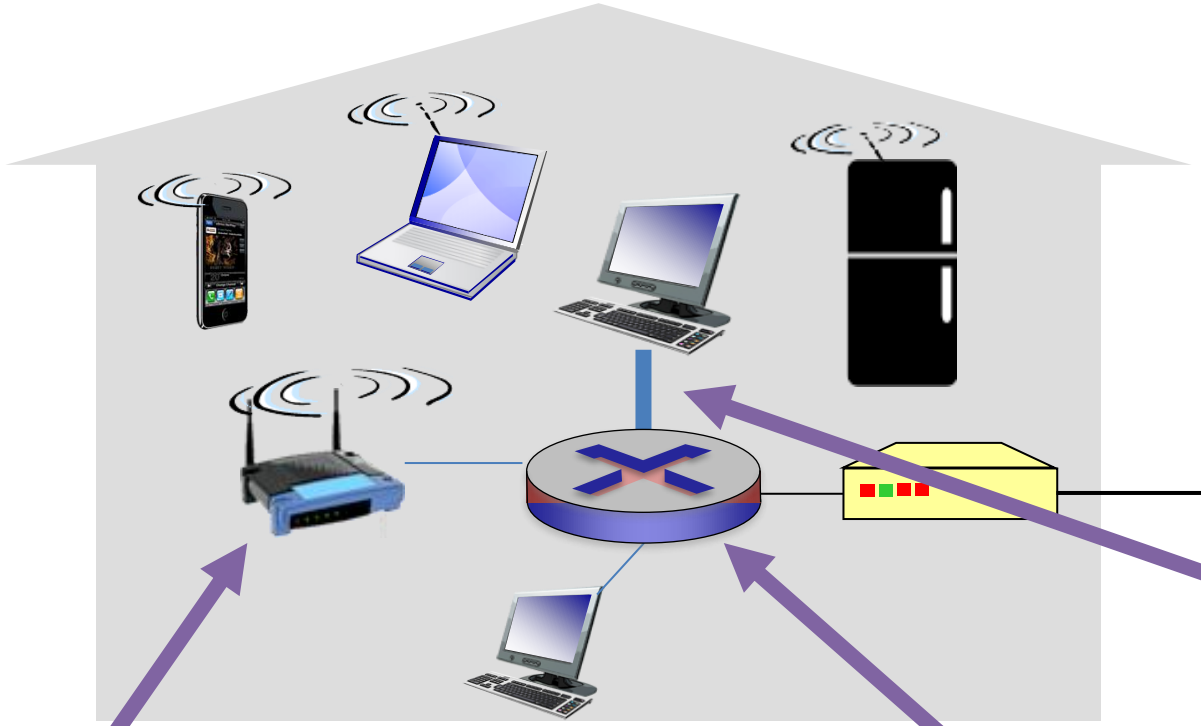



A typical home network

**How does out network get access through other networks?**

# End to End Communication

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



A typical home network

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

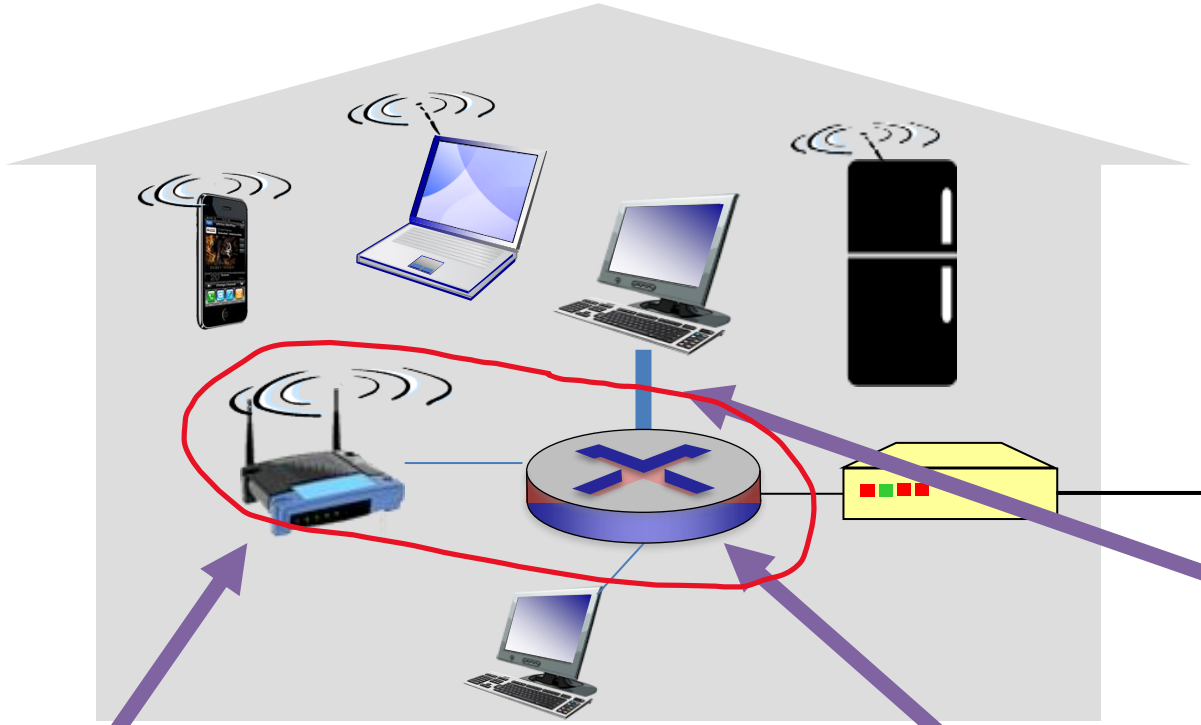
**Communication Link**

**Packet Switch**

**wireless access point (54 Mbps)**

# End to End Communication

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



A typical home network

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

**Communication Link**

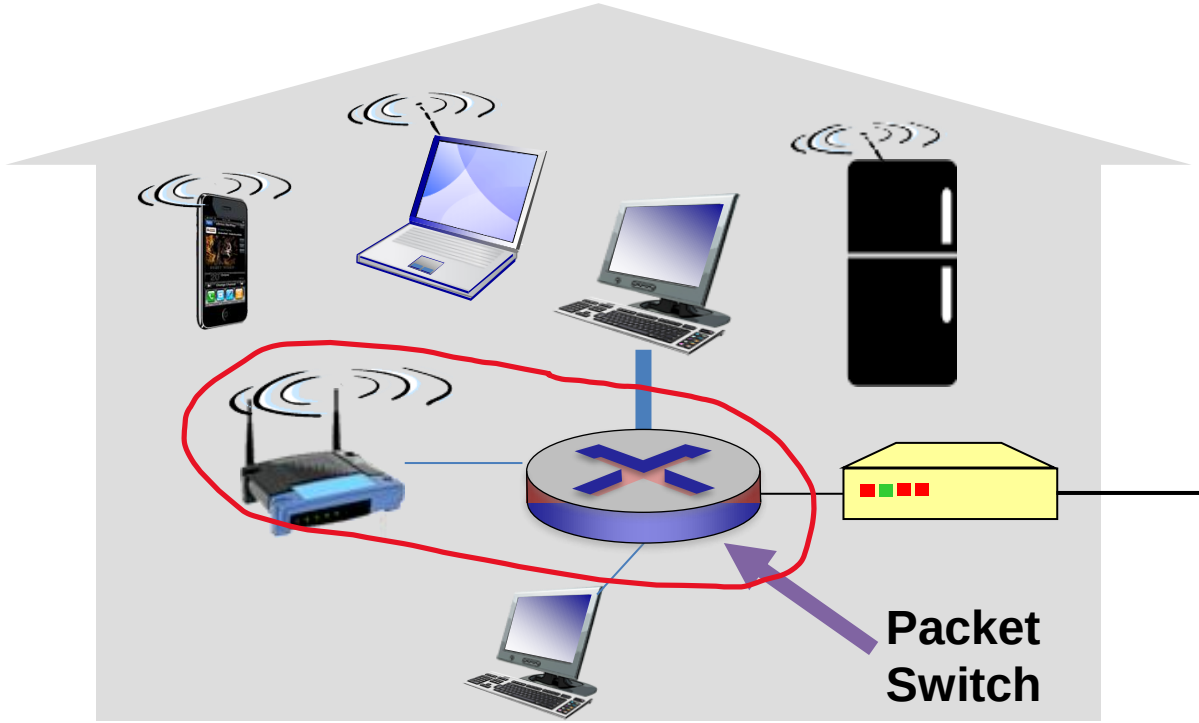
**wireless access point (54 Mbps)**

**Packet Switch**

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

# End to End Communication

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



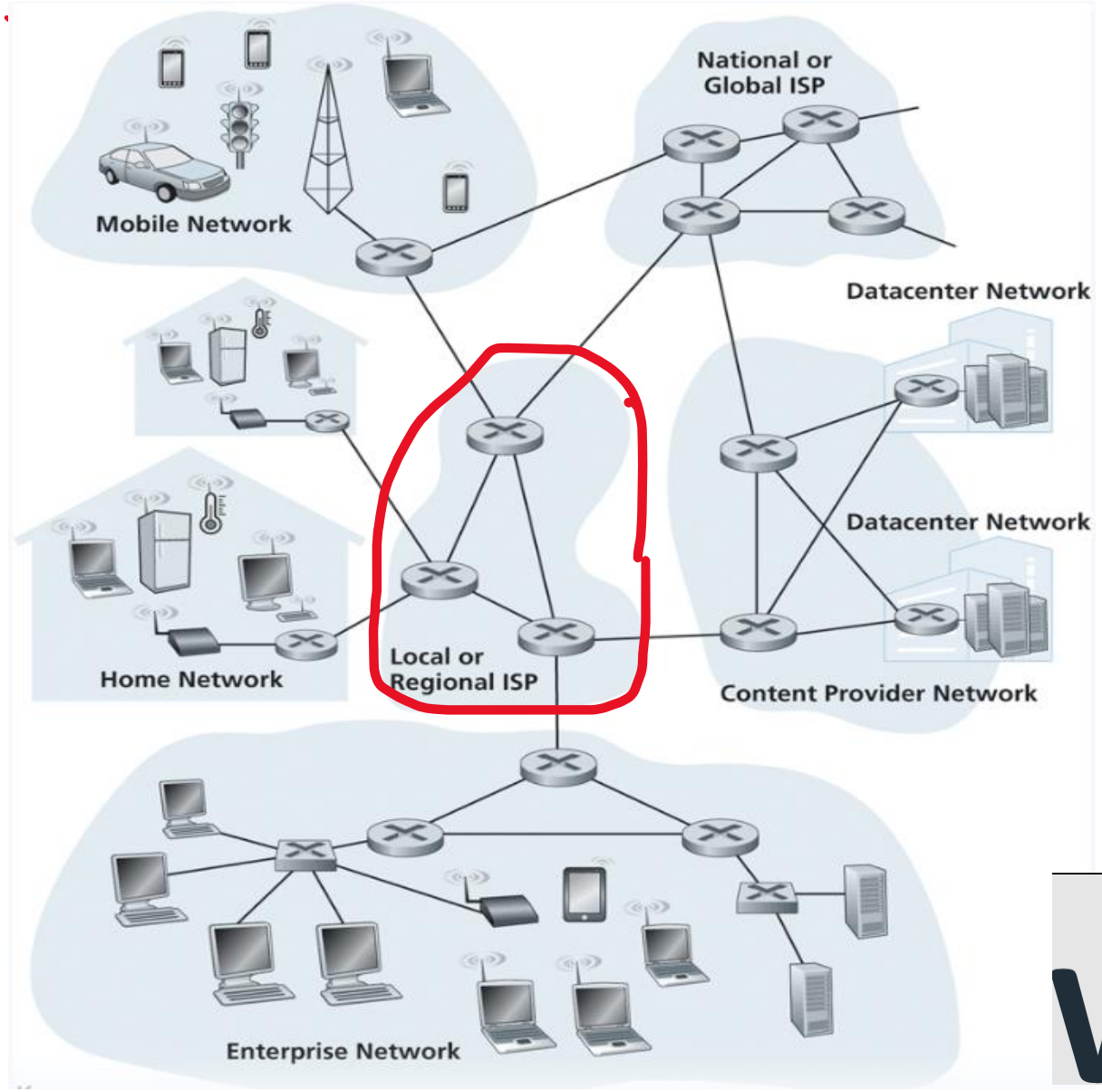

A typical home network

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

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

# End to End Communication




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

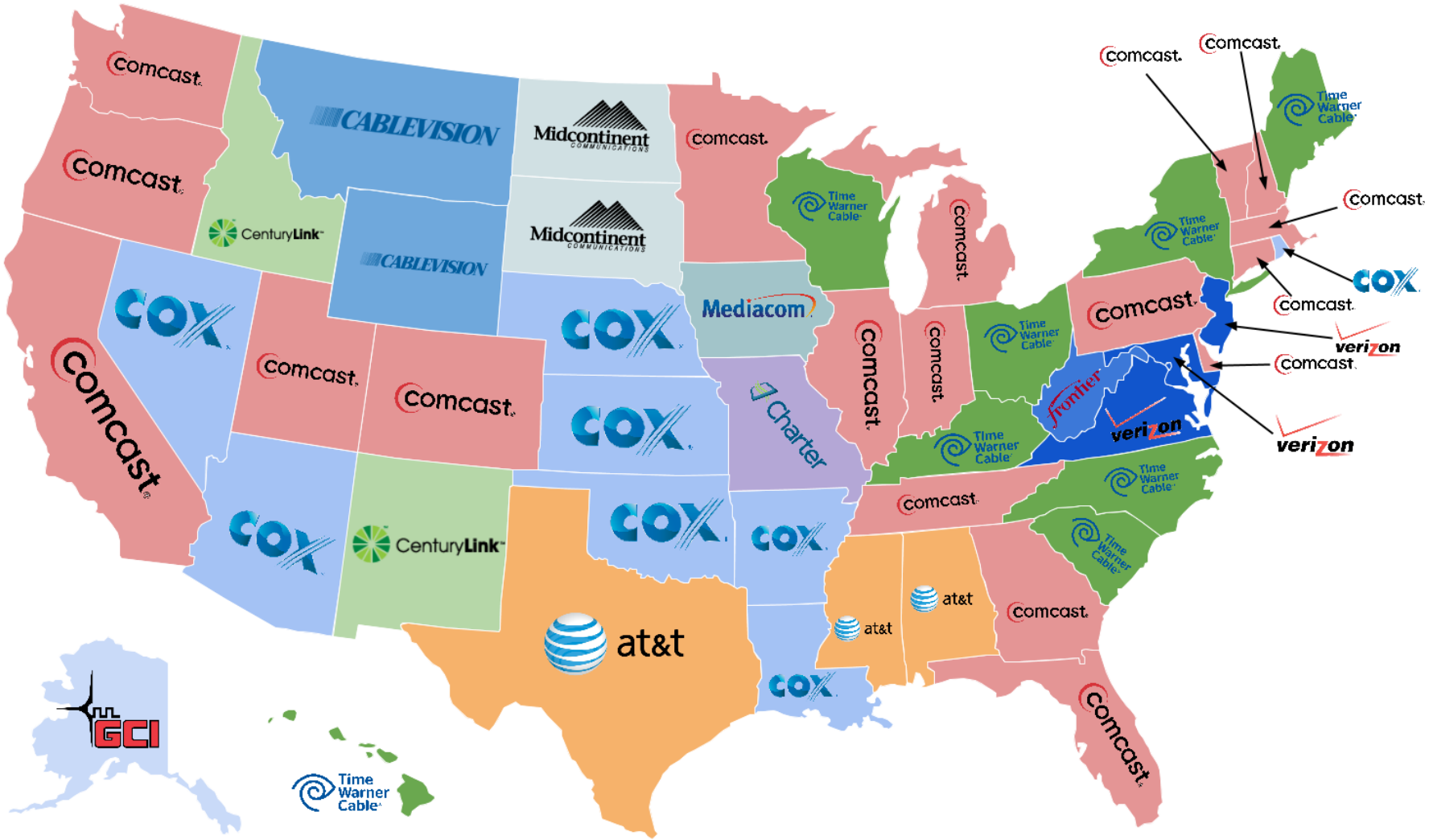
Spectrum

CenturyLink

Viasat

# End to End Communication

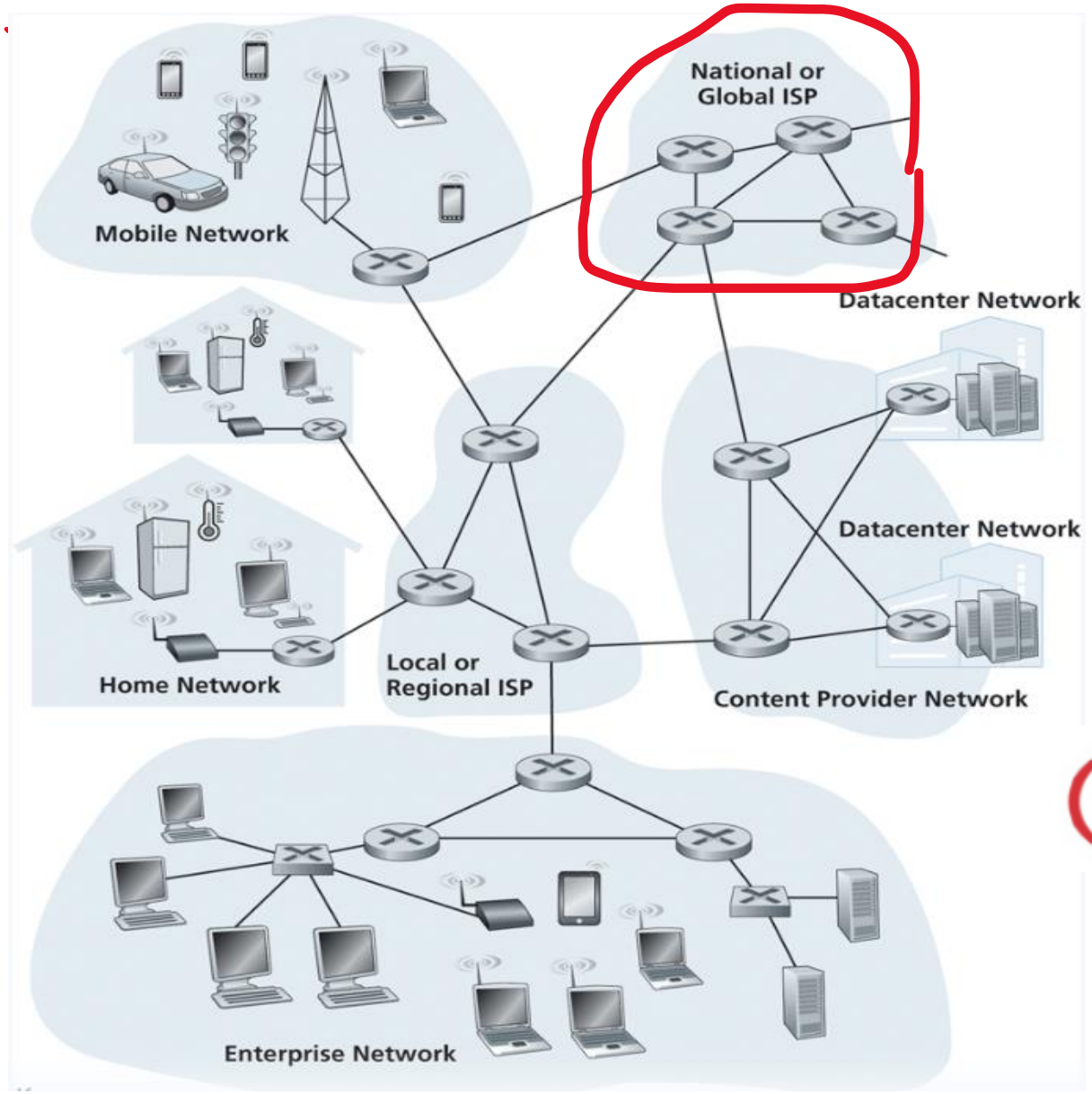

## Top Internet Service Provider State-by-State




Source: 56 million web visits

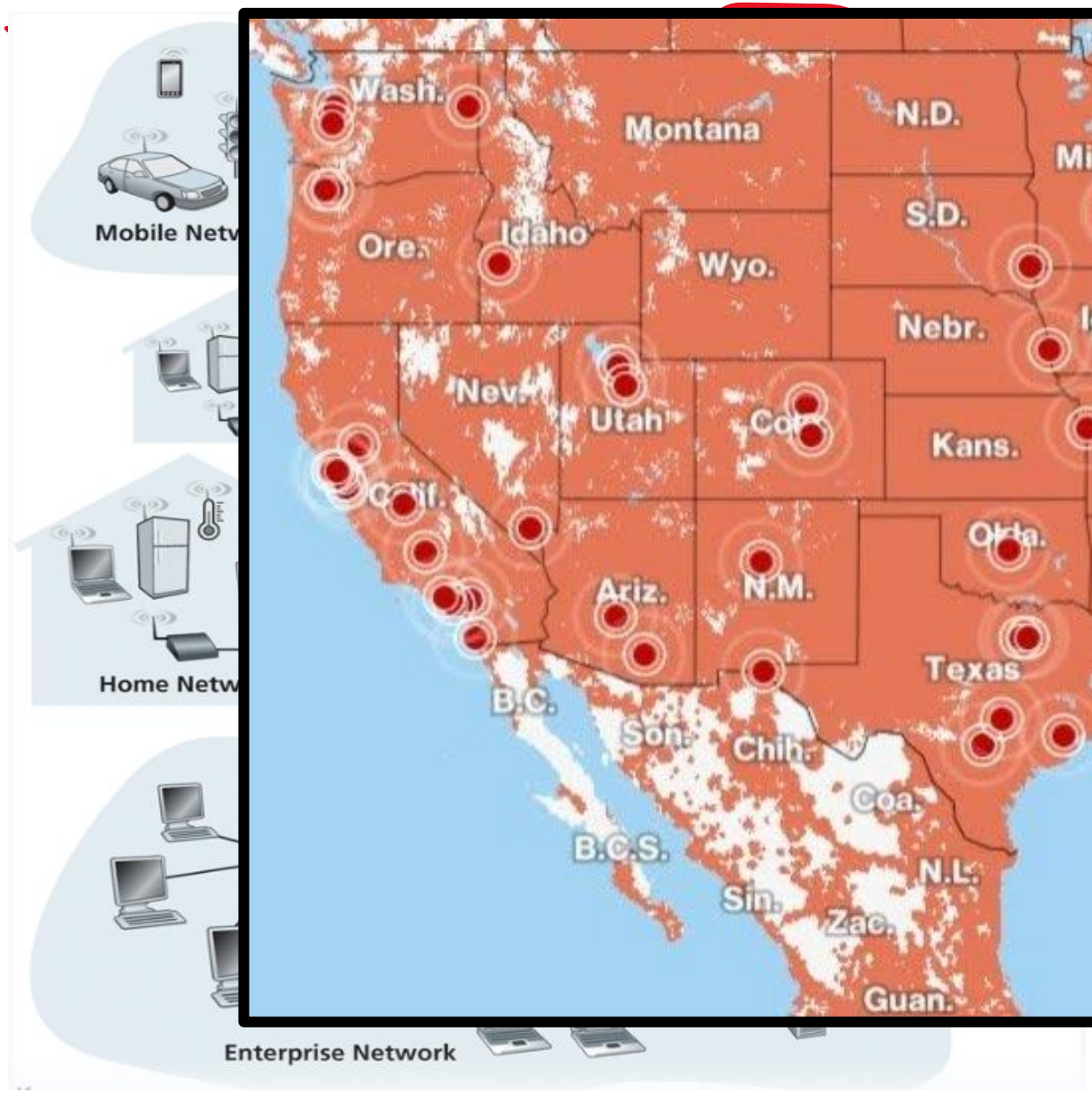
WebpageFX

# End to End Communication

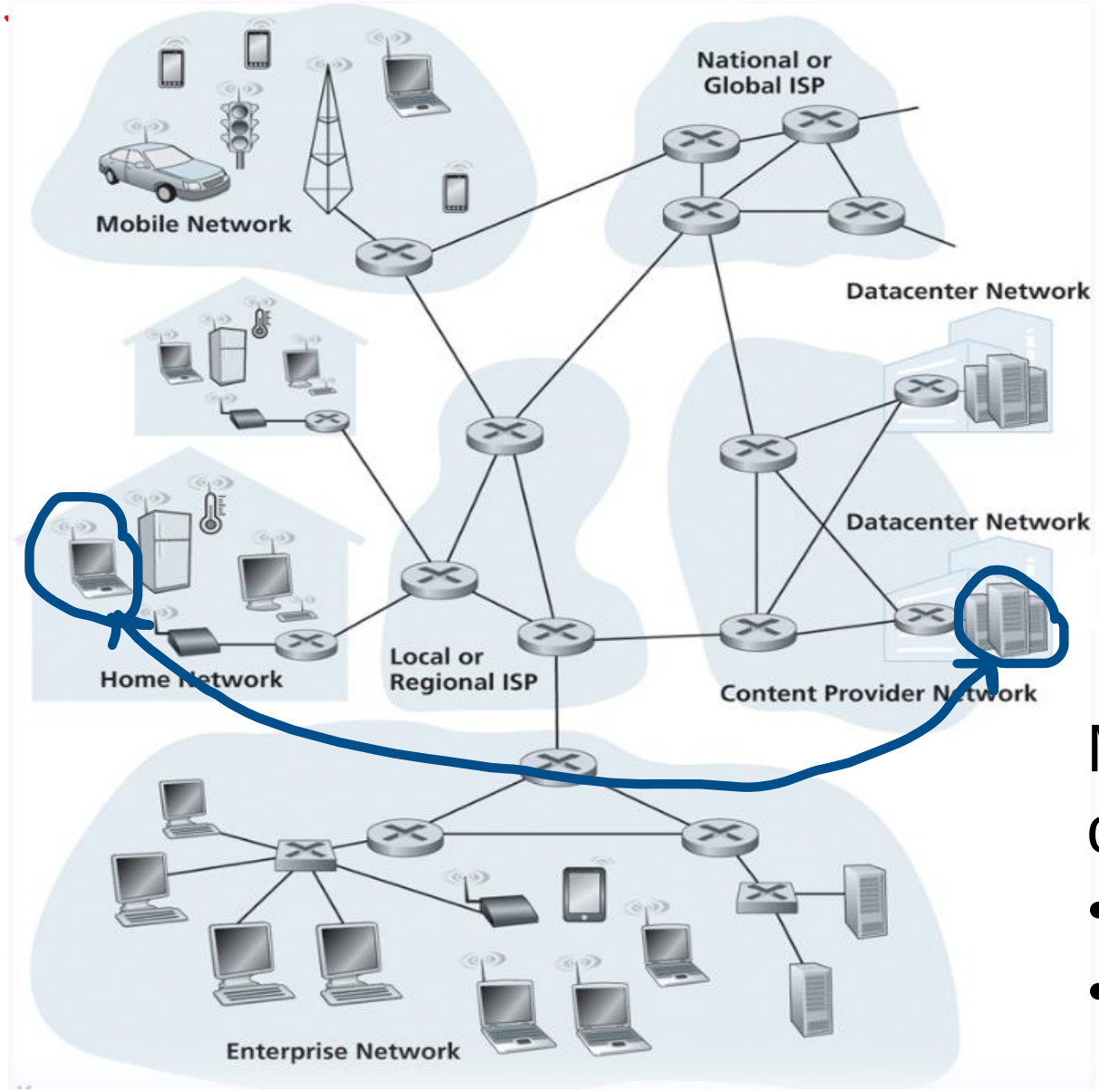



End systems gain access to the internet through **Internet Service Providers (ISPs)**

# End to End Communication



# End to End Communication



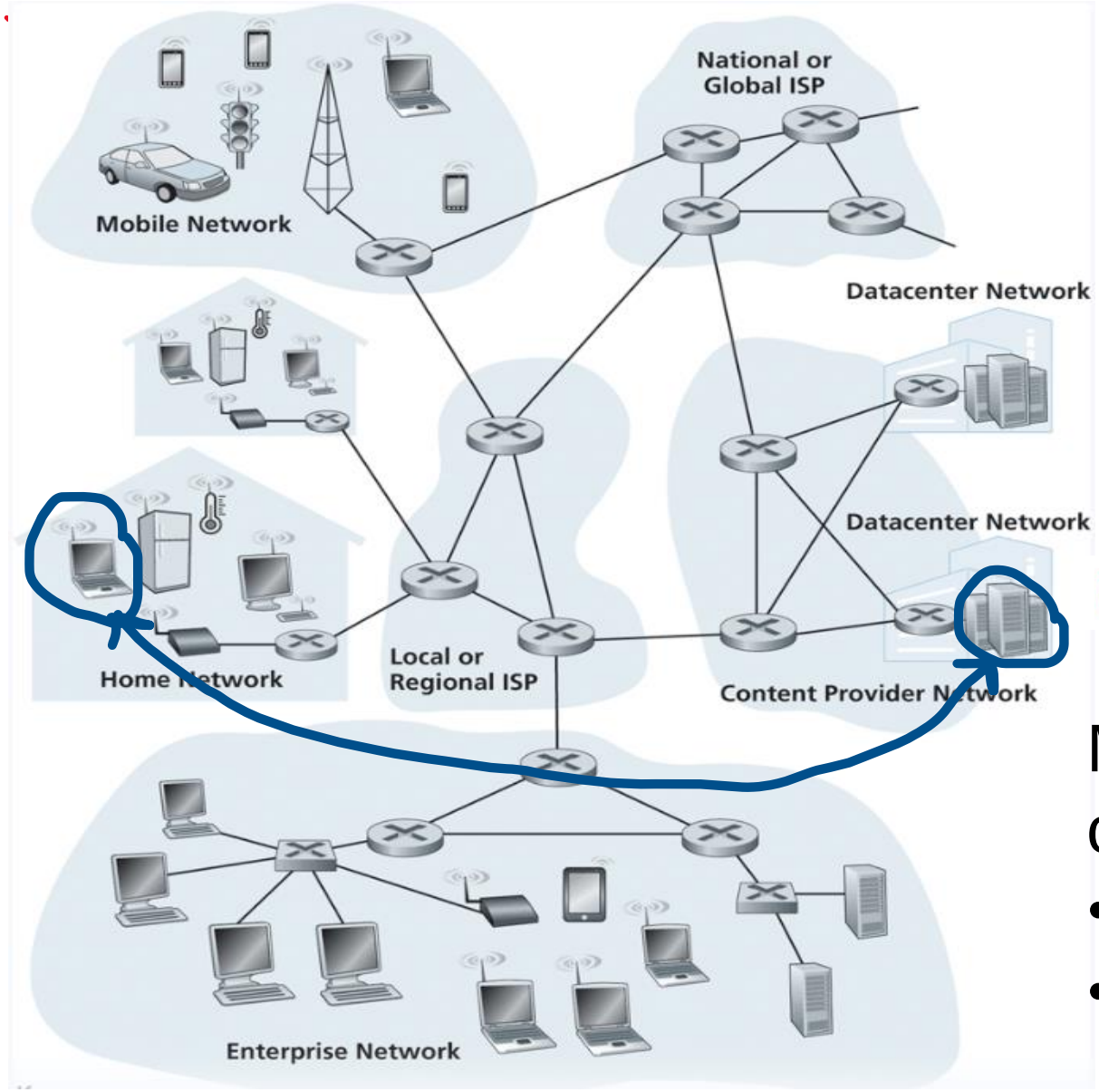

"End-to-end communication"

YouTube

Most hosts can be classified into two categories:

- Clients
- Servers

# End to End Communication



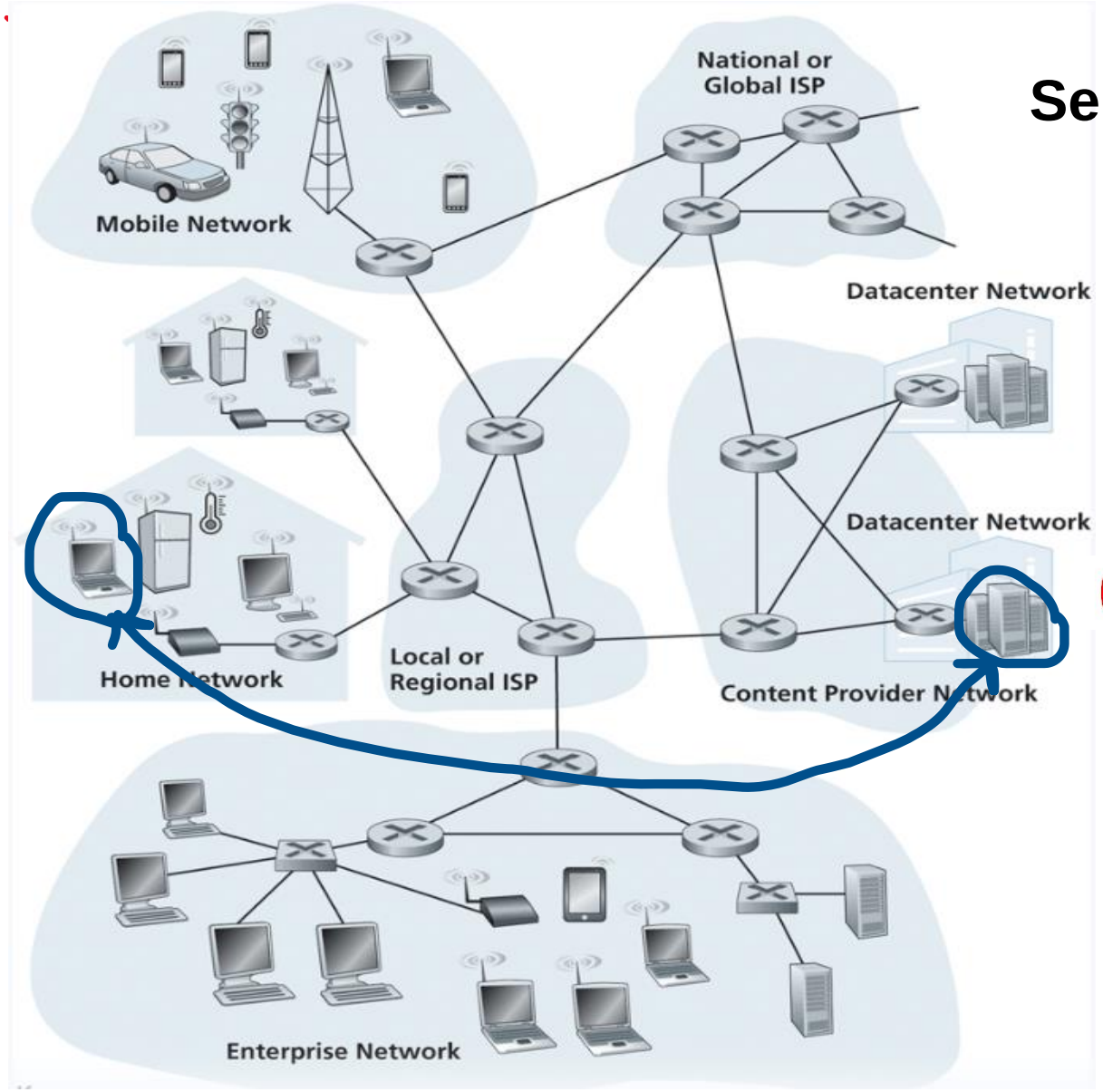

"End-to-end communication"

YouTube

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

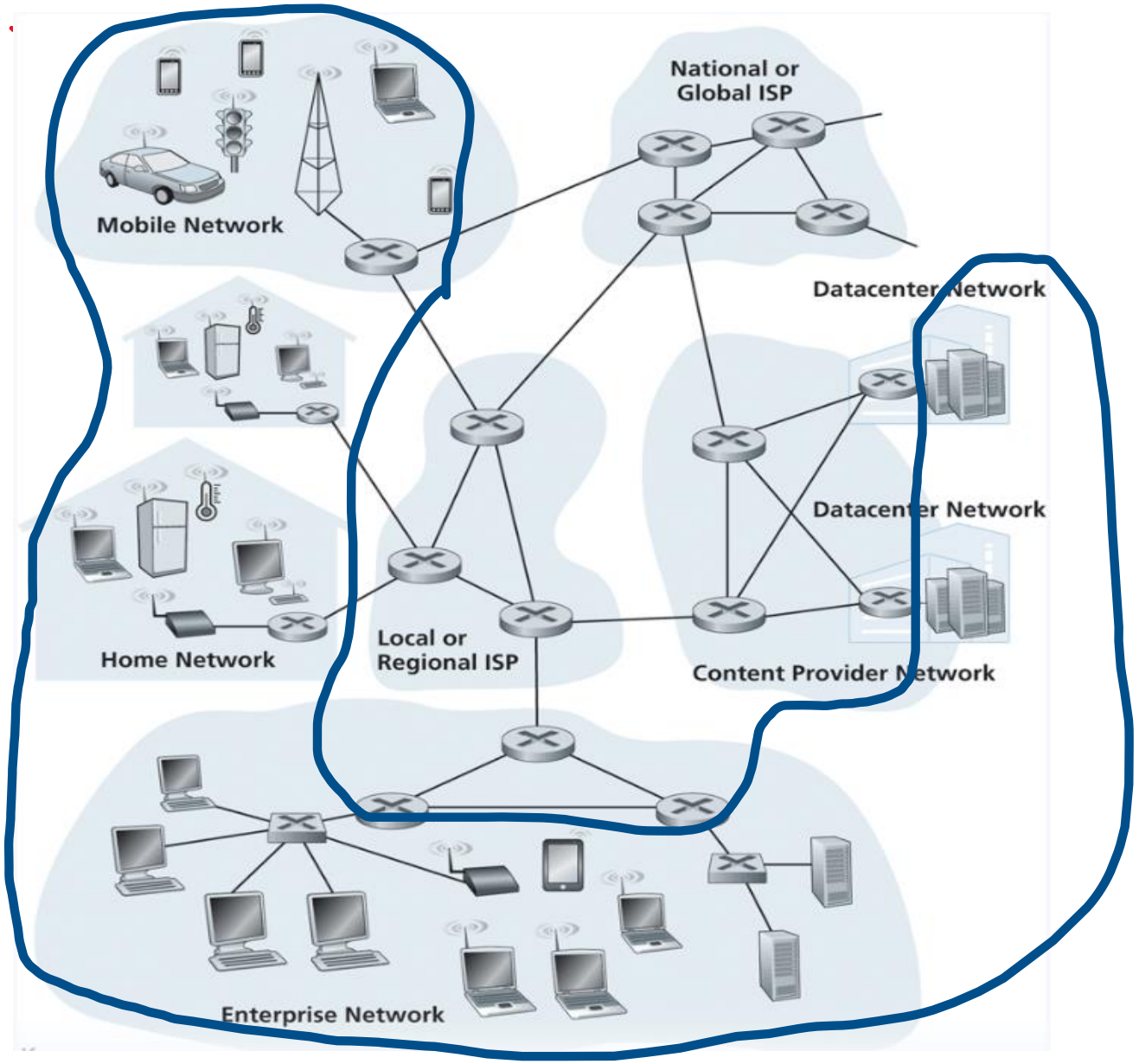



**Servers** typically reside in large datacenters

“End-to-end communication”

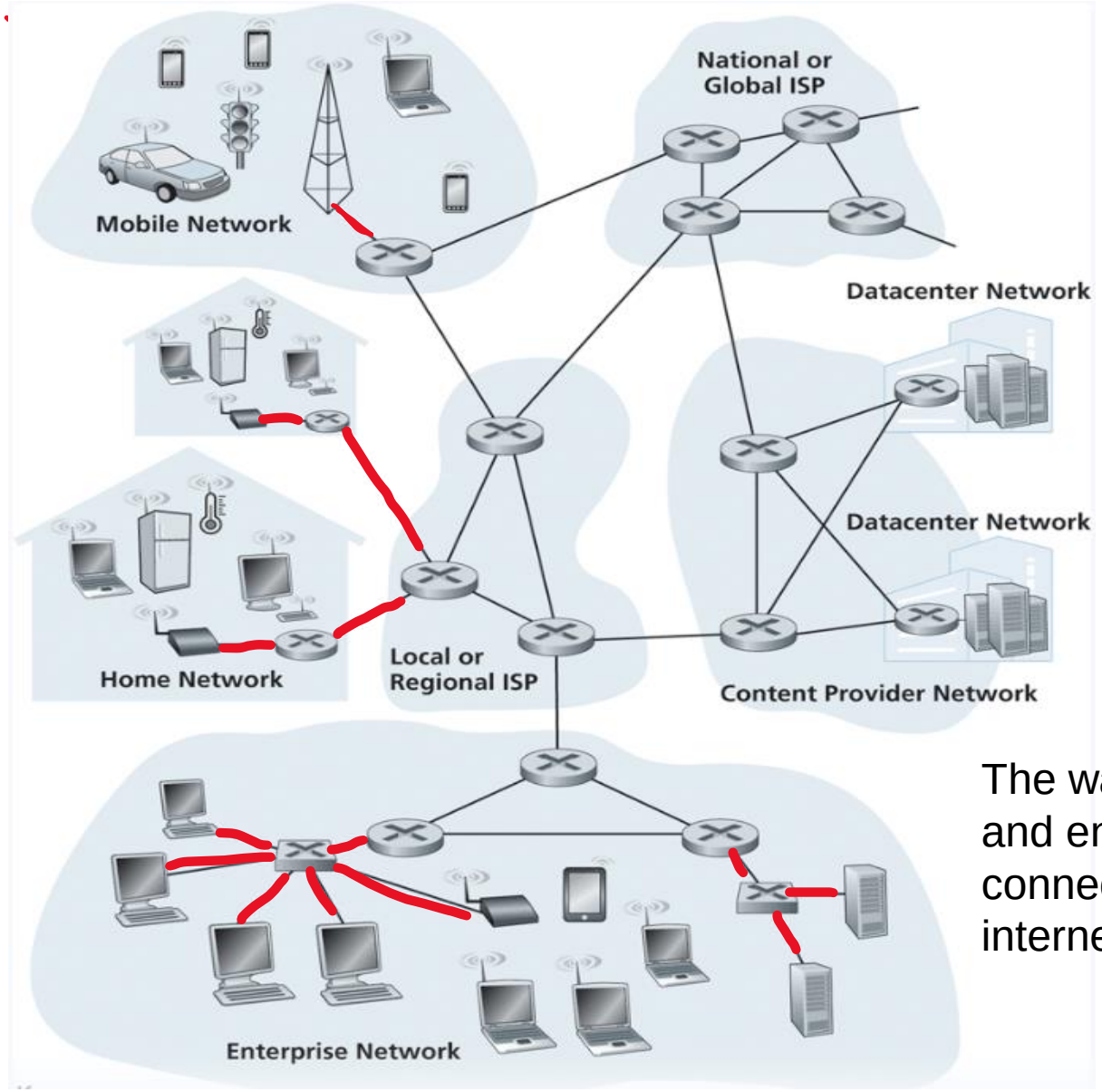
YouTube

# Network Edge




The **network edge** consists of end systems

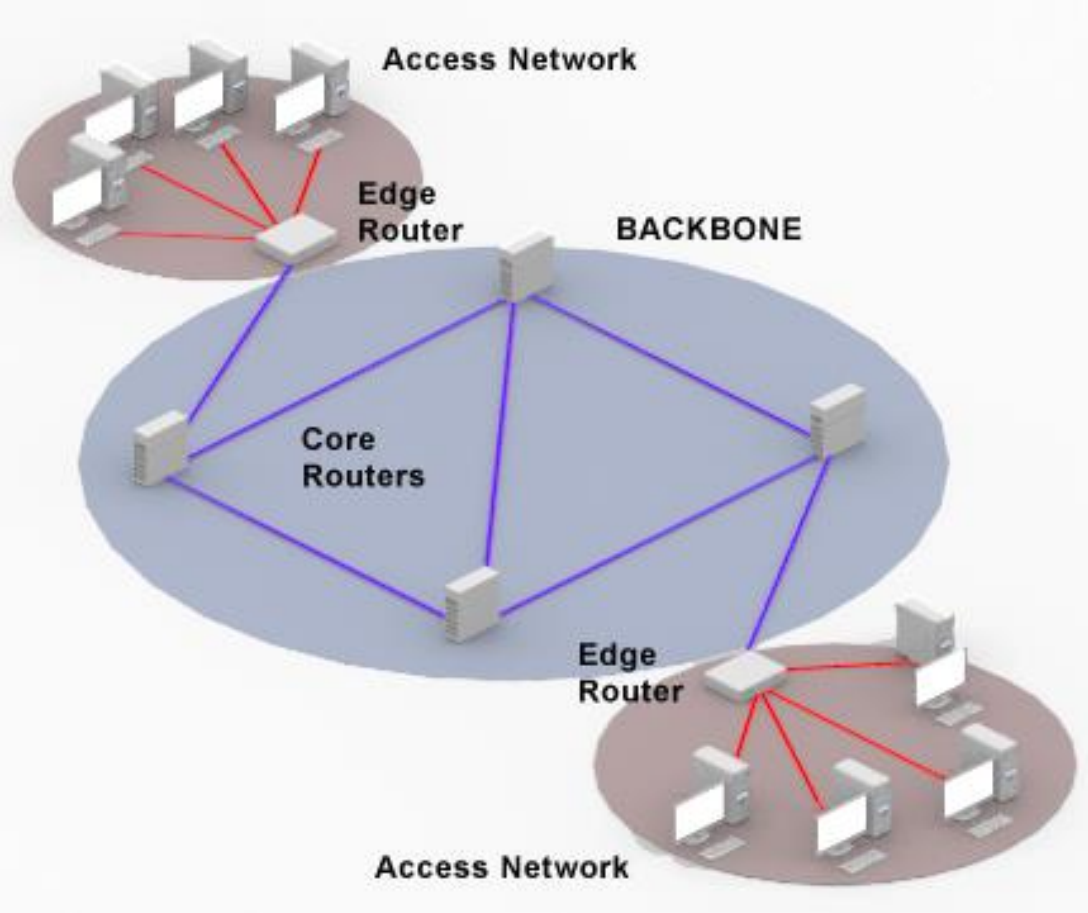
# Network Edge




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

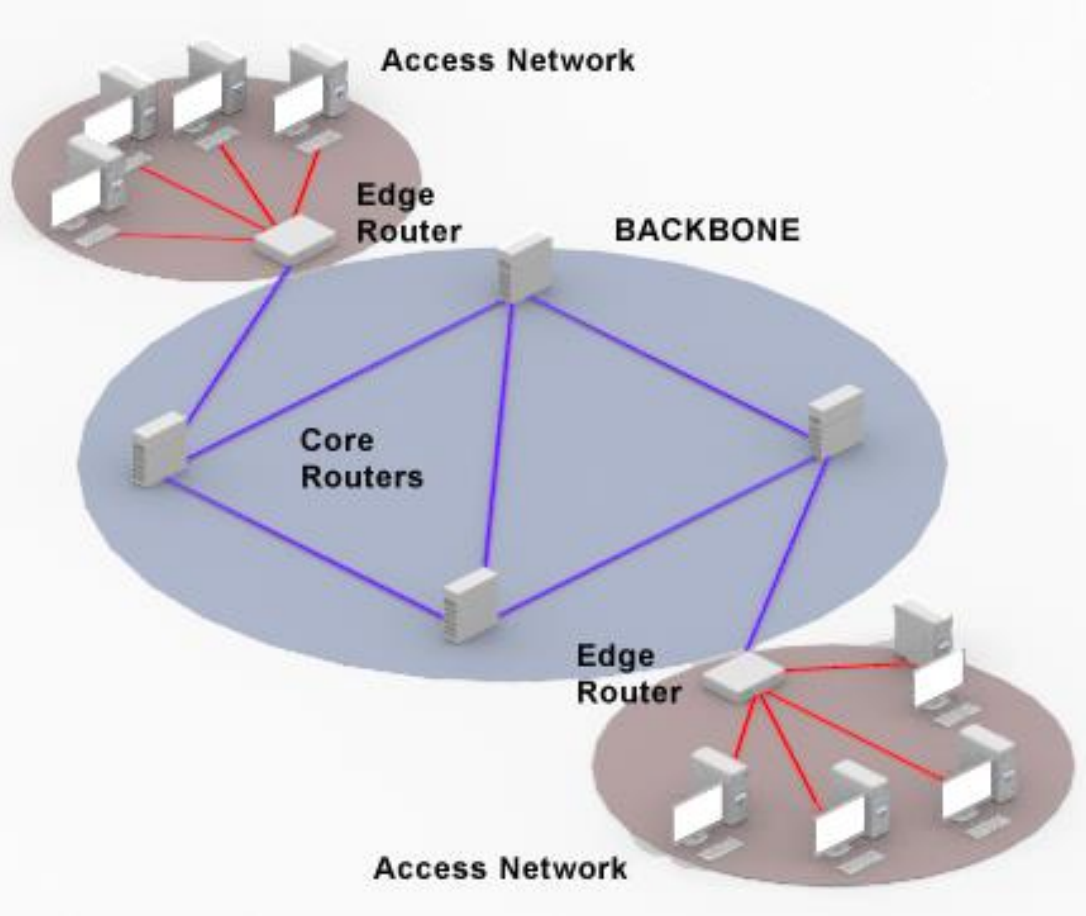
# Network Edge




The way that homes and enterprises get connected to the internet

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

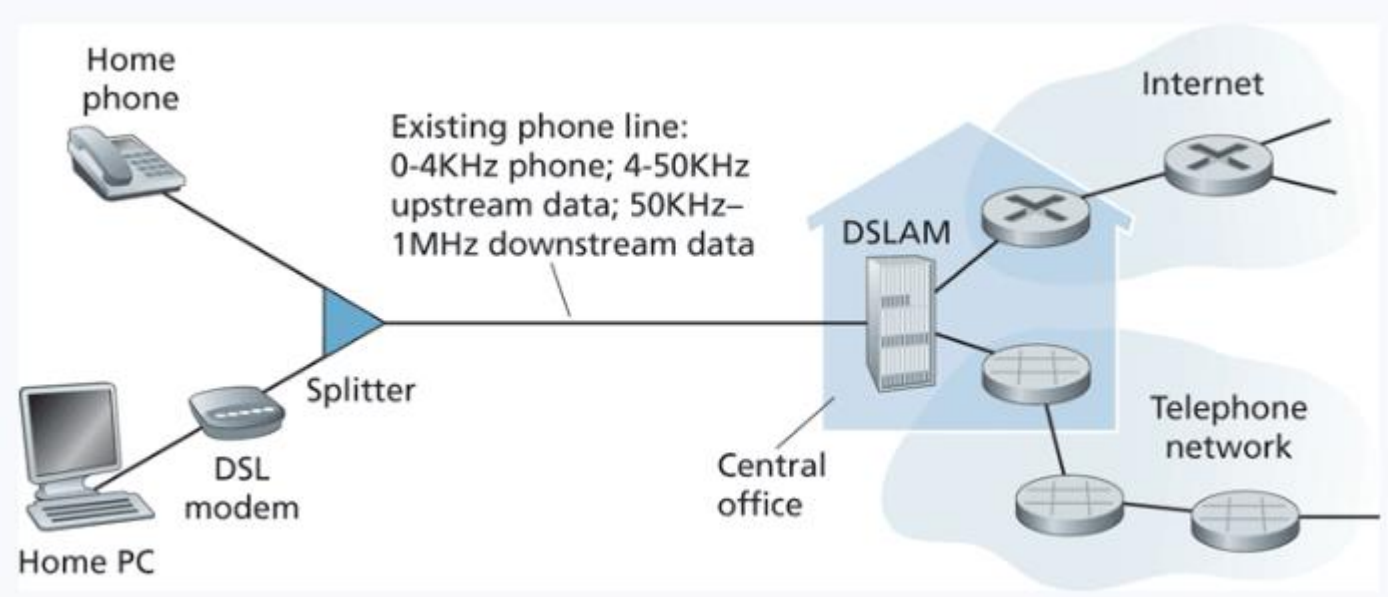
# End to End Communication




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

# Home Network Access

**Digital Subscriber Line (DSL)**



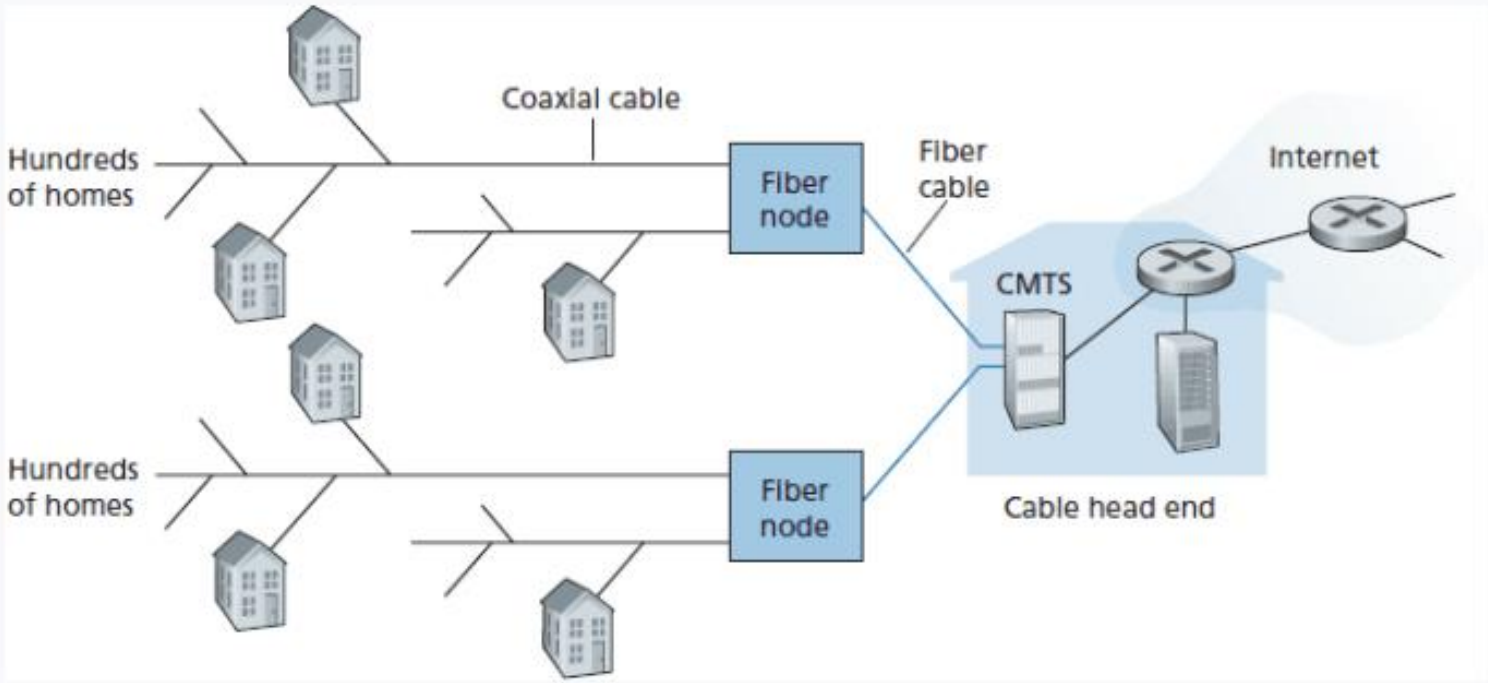

Uses existing telephone line to connect to internet and transmit data

# Home Network Access

## Cable Internet Access

**Figure 1.6**

A hybrid fiber-coaxial access network

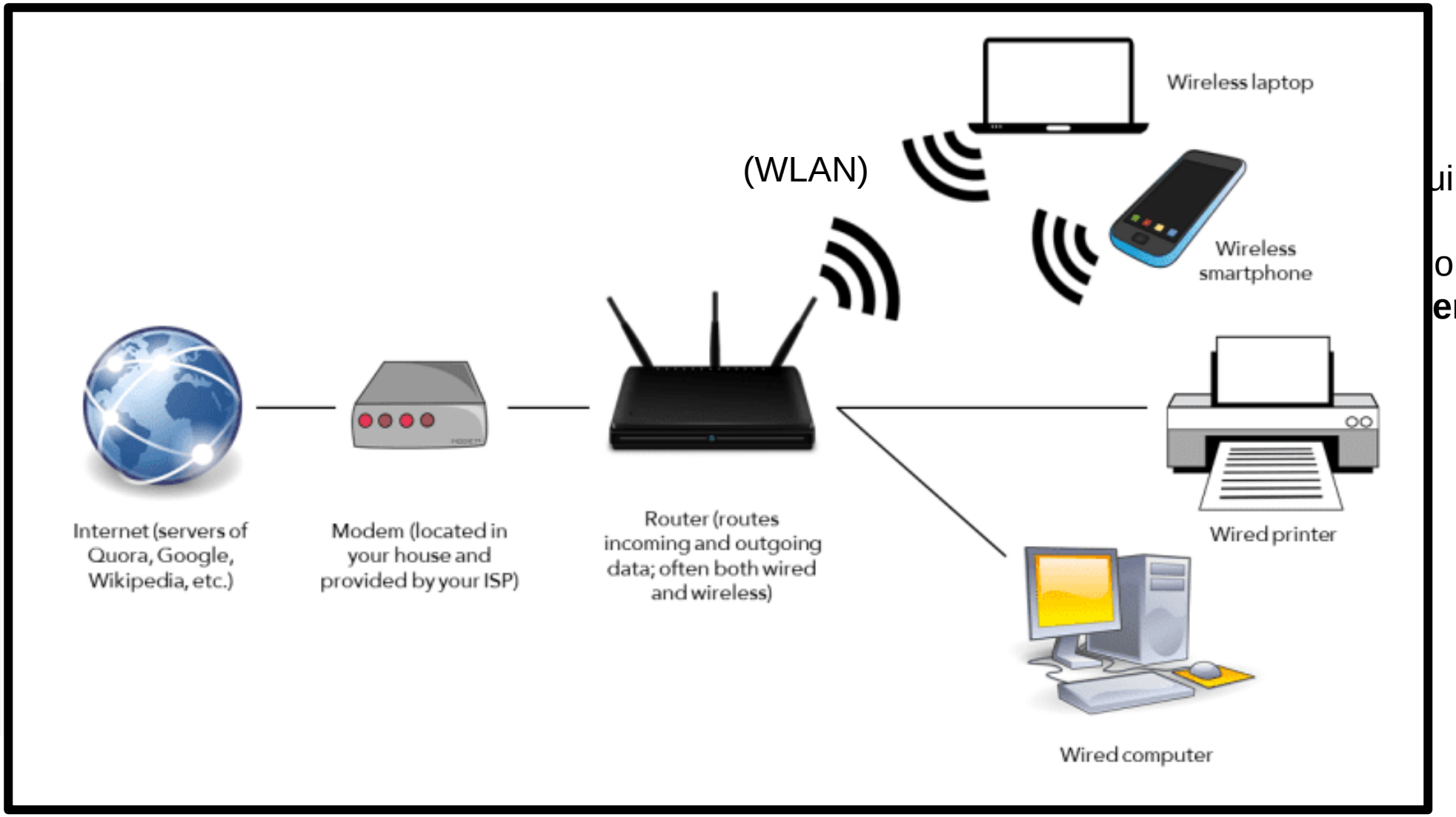



Homes will require a **modem**, which connects to a home PC with an **Ethernet** cable


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

*Shared broadcast medium

# Home Network Access

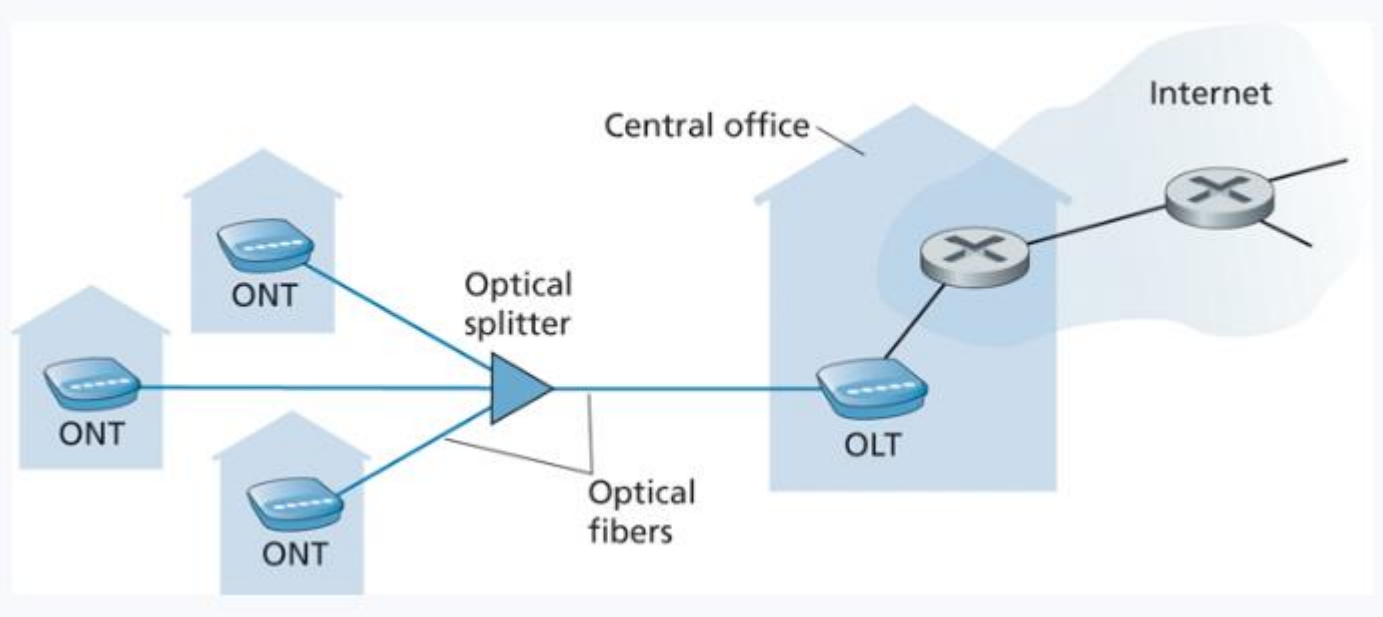



uire a

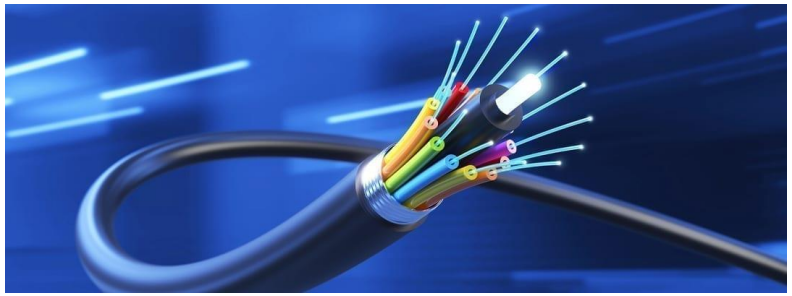
ome
**ernet**

# Home Network Access

**Fiber Internet Access (FTTH)**

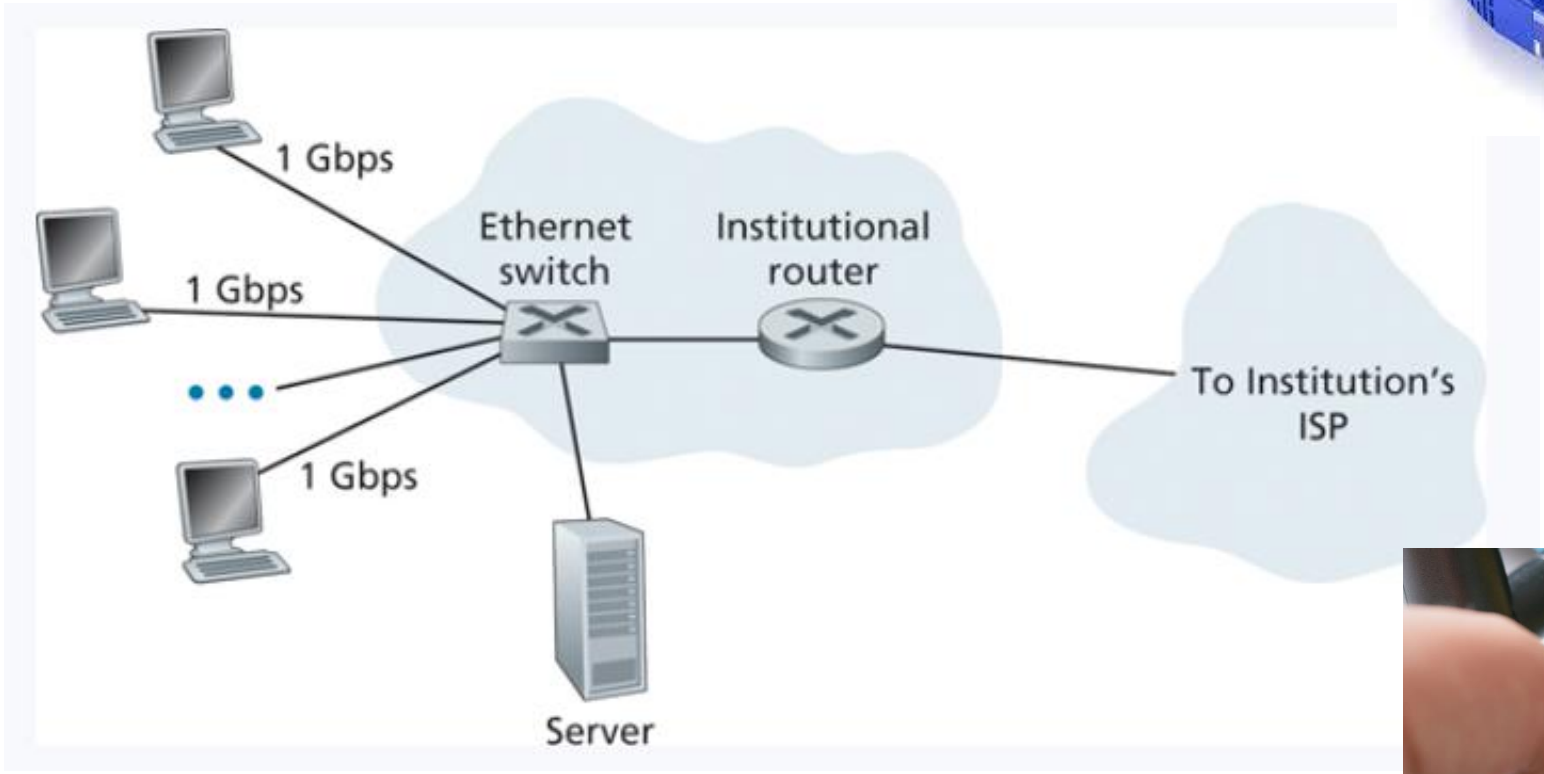



Connects homes to a shared fiber cable

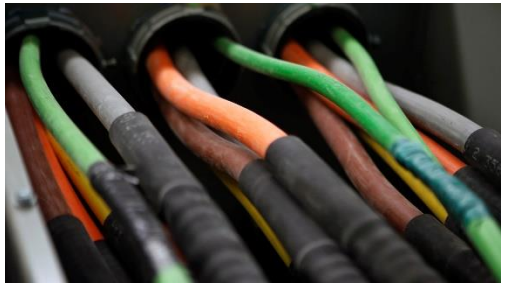


# Home Network Access

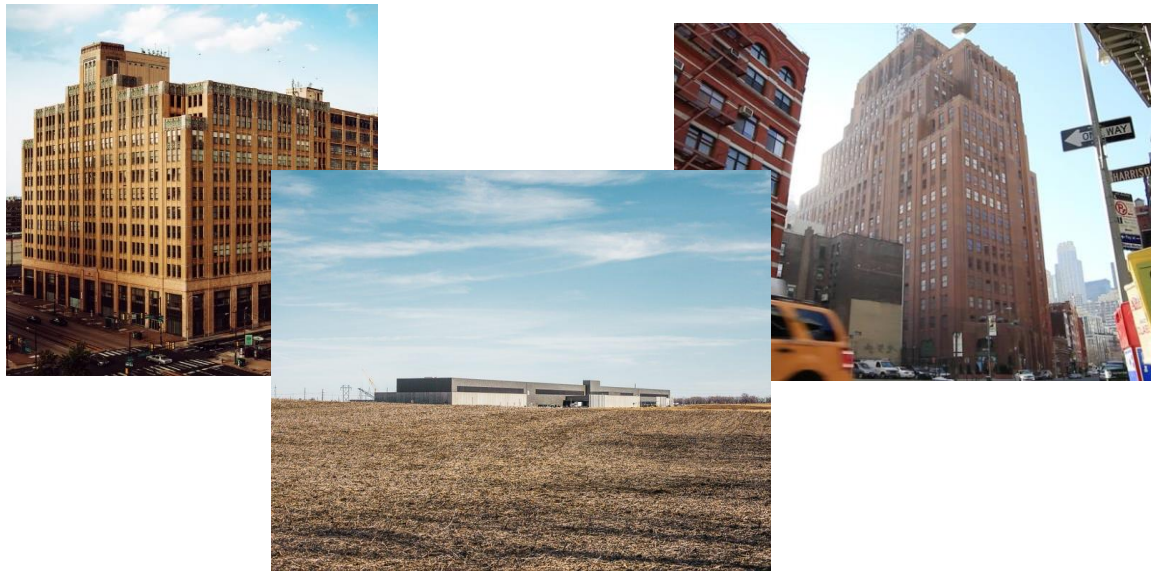
Ethernet Internet Access

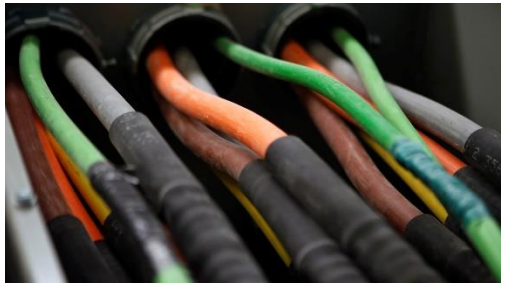


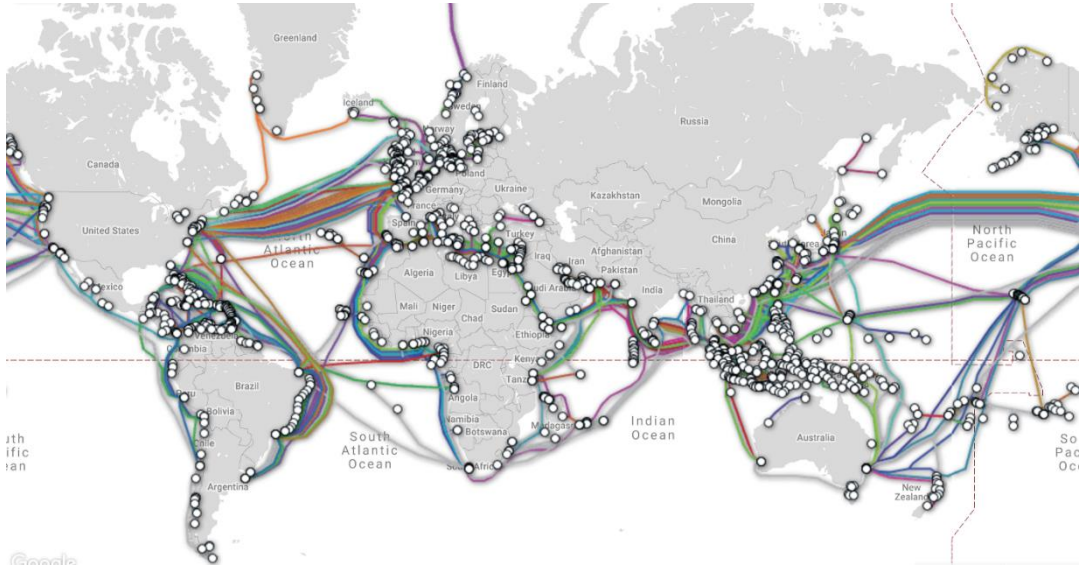

# Ok, but like how ?



# Ok, but like how ?

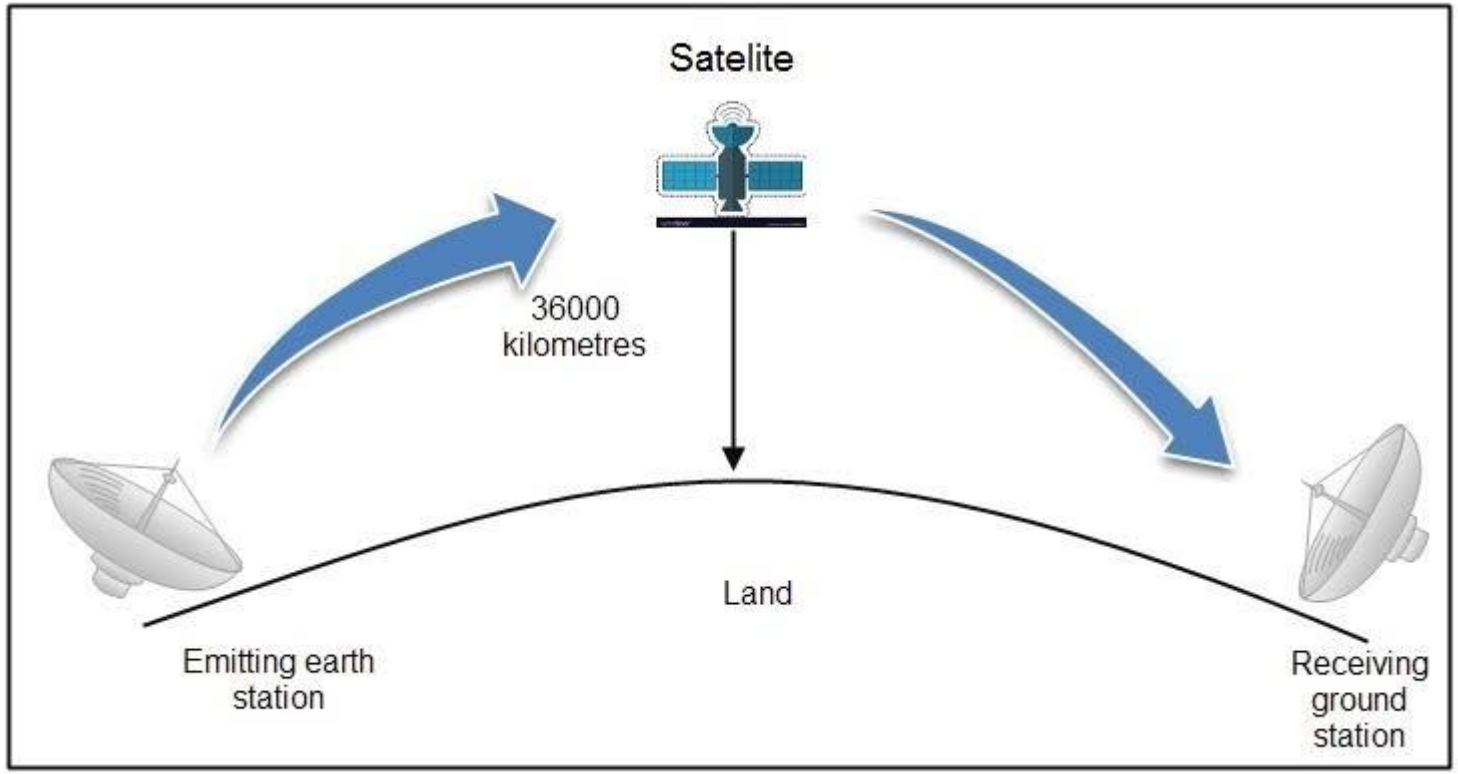




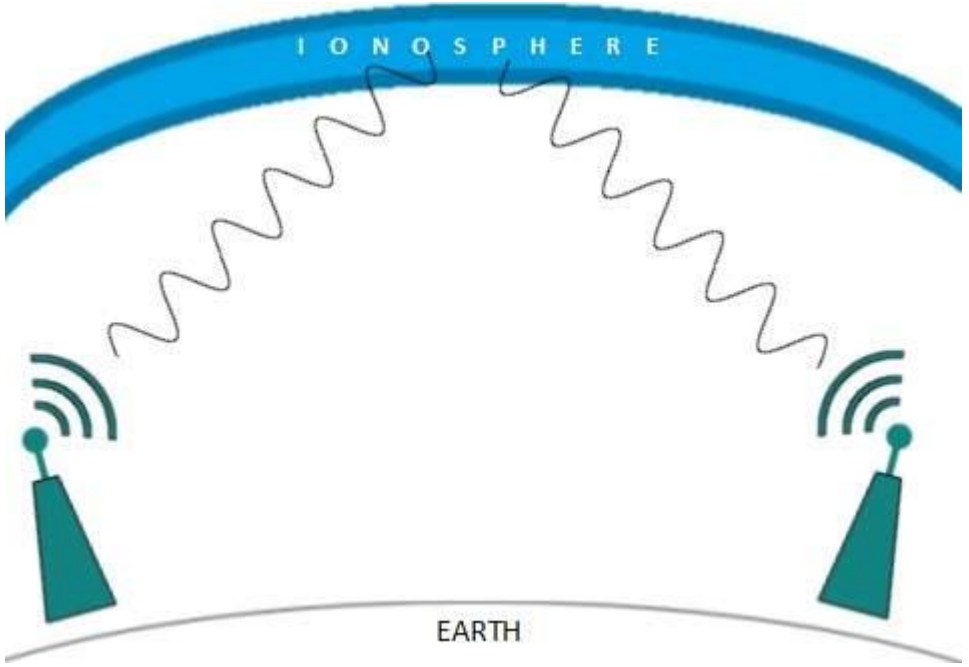



Twisted-Pair Copper Wire, Coaxial Cable, Fiber Optics

# Ok, but like how ?



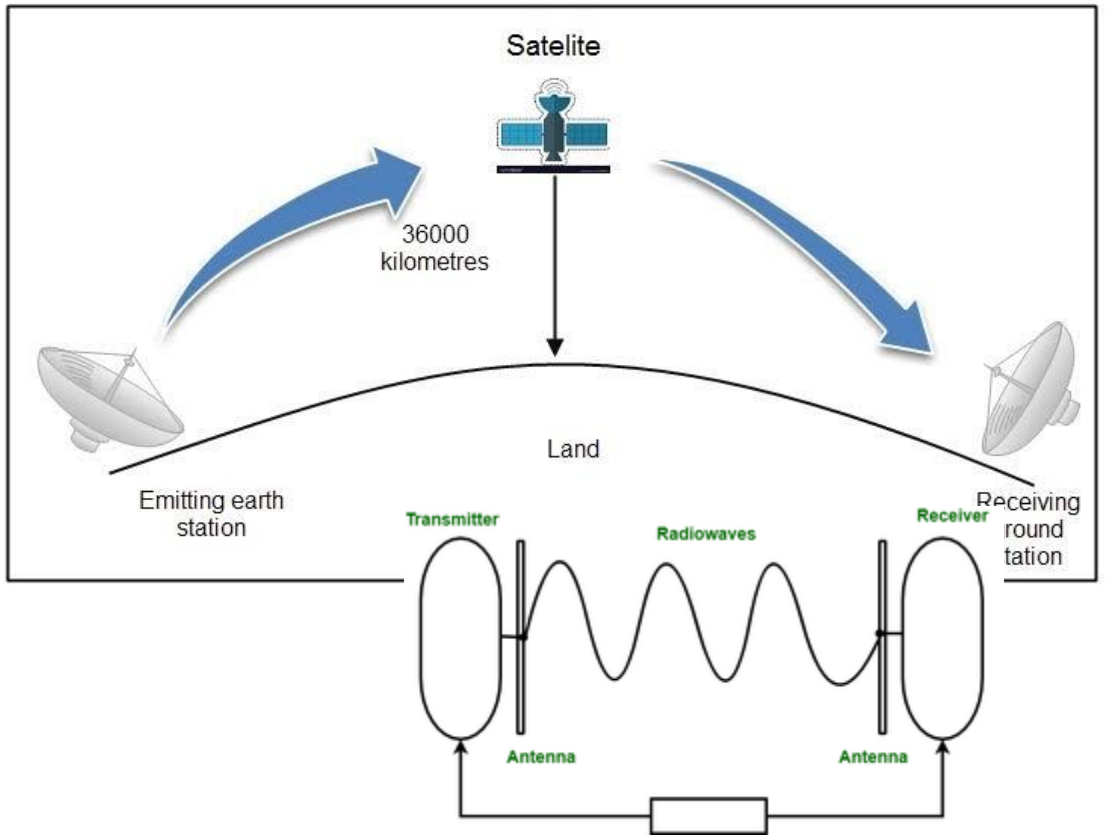

- Radio
- Microwave
- Infrared
- Satellite



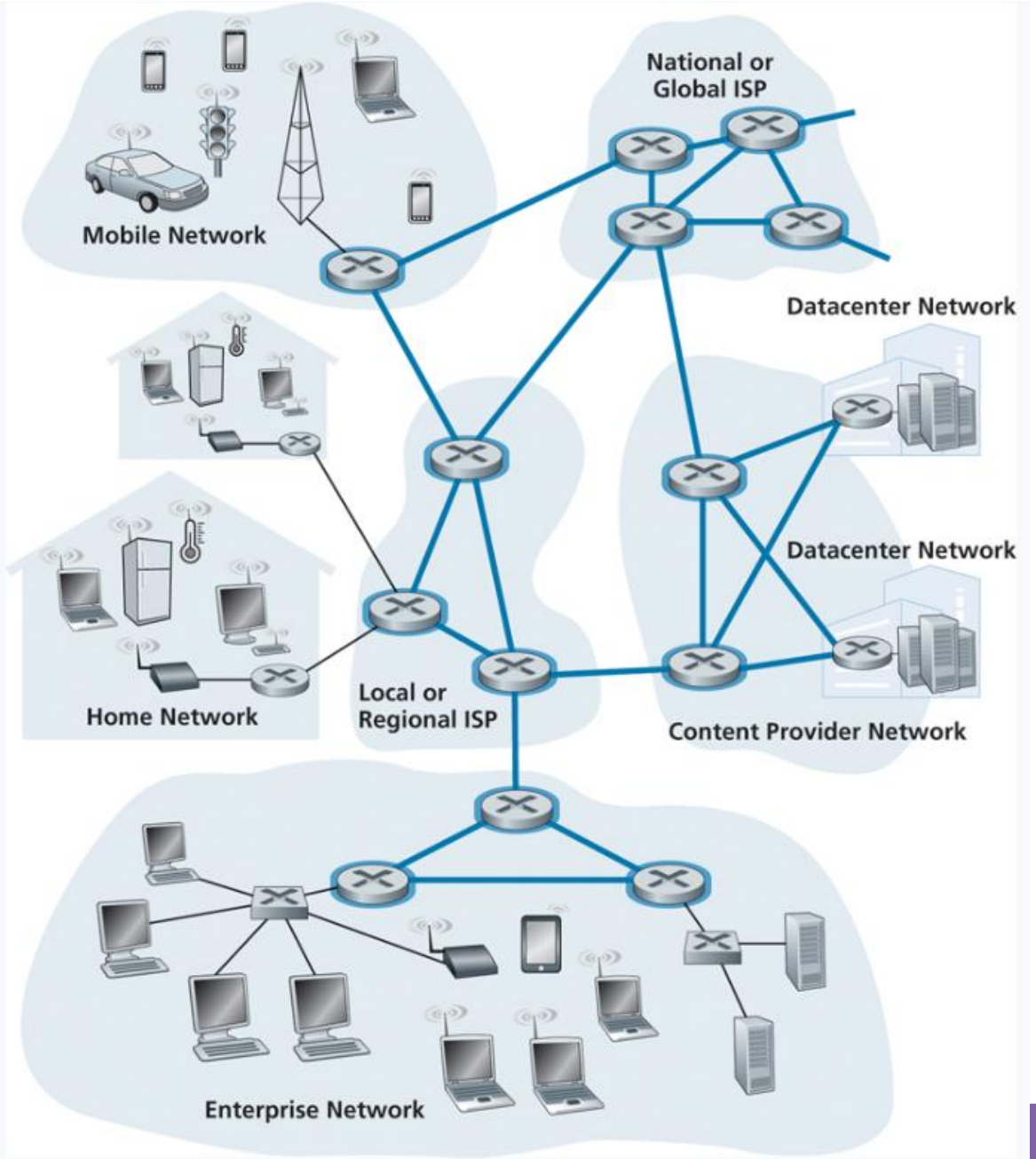
# Ok, but like how ?

## 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

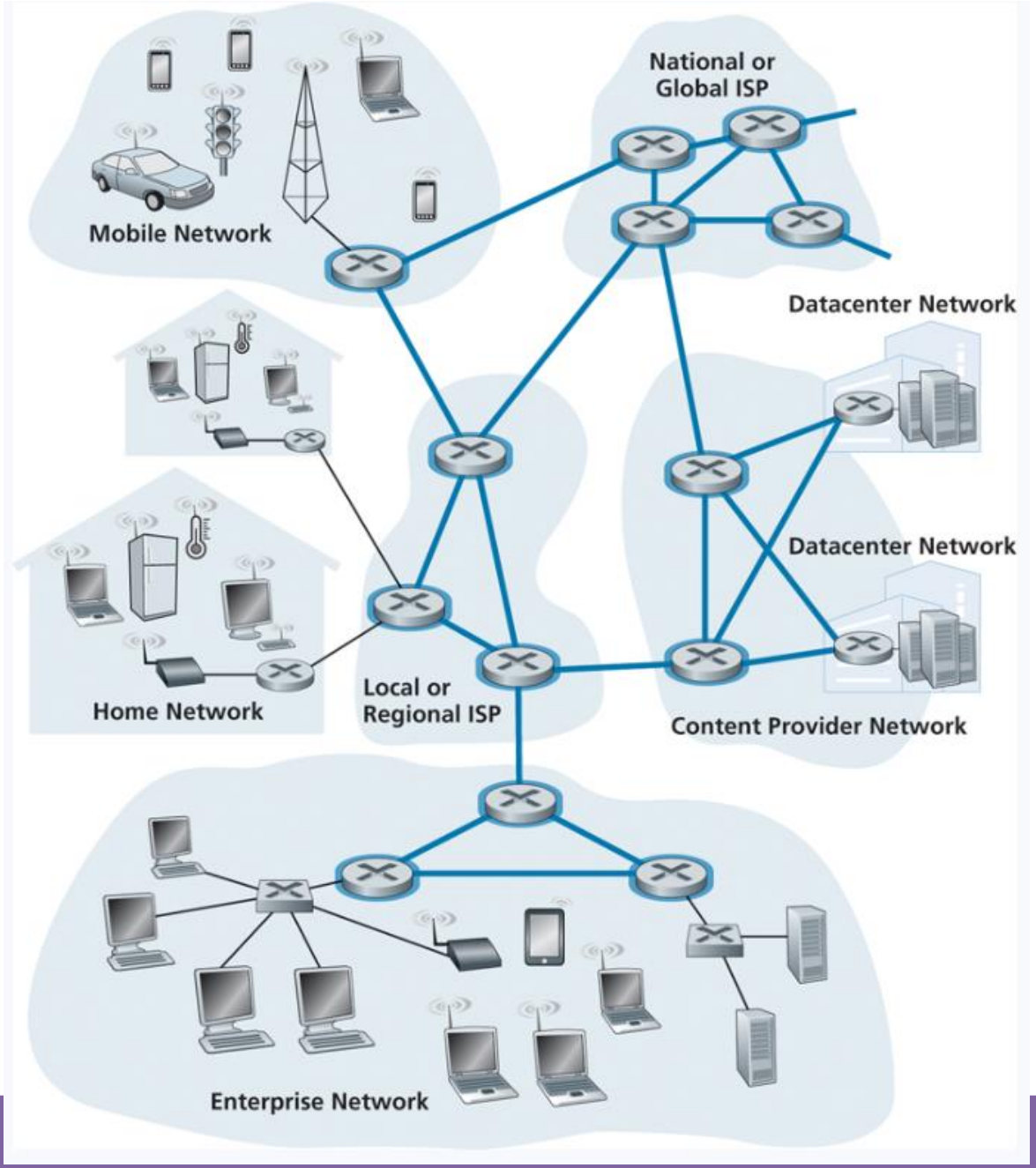
Each communication link has its own **transmission rate (bits/sec)**

10 Mbps

500 kbps

100 kbps

# The Network Core




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

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

Generated Packet

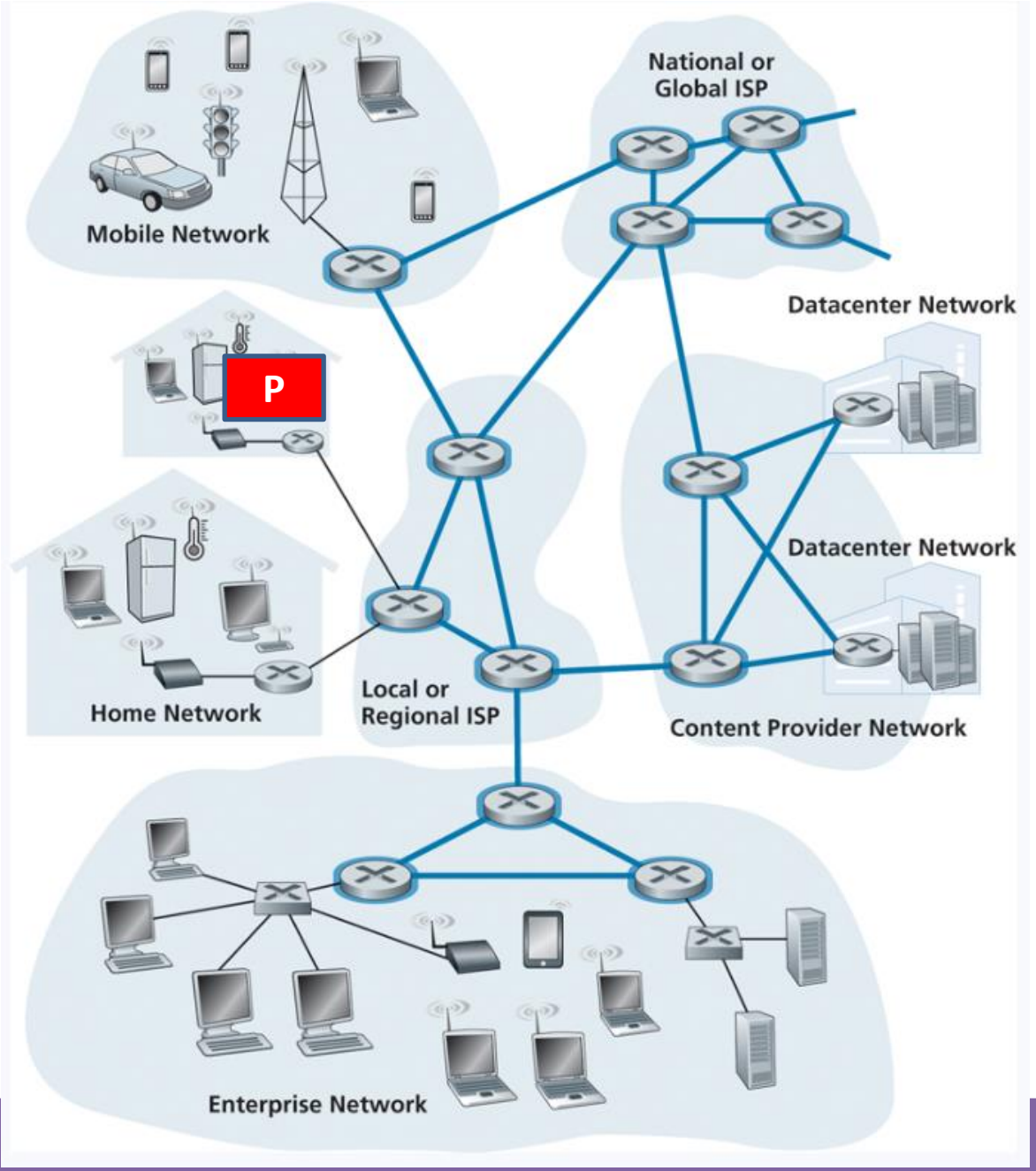
To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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

1500 Bytes

# The Network Core




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

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

Generated Packet

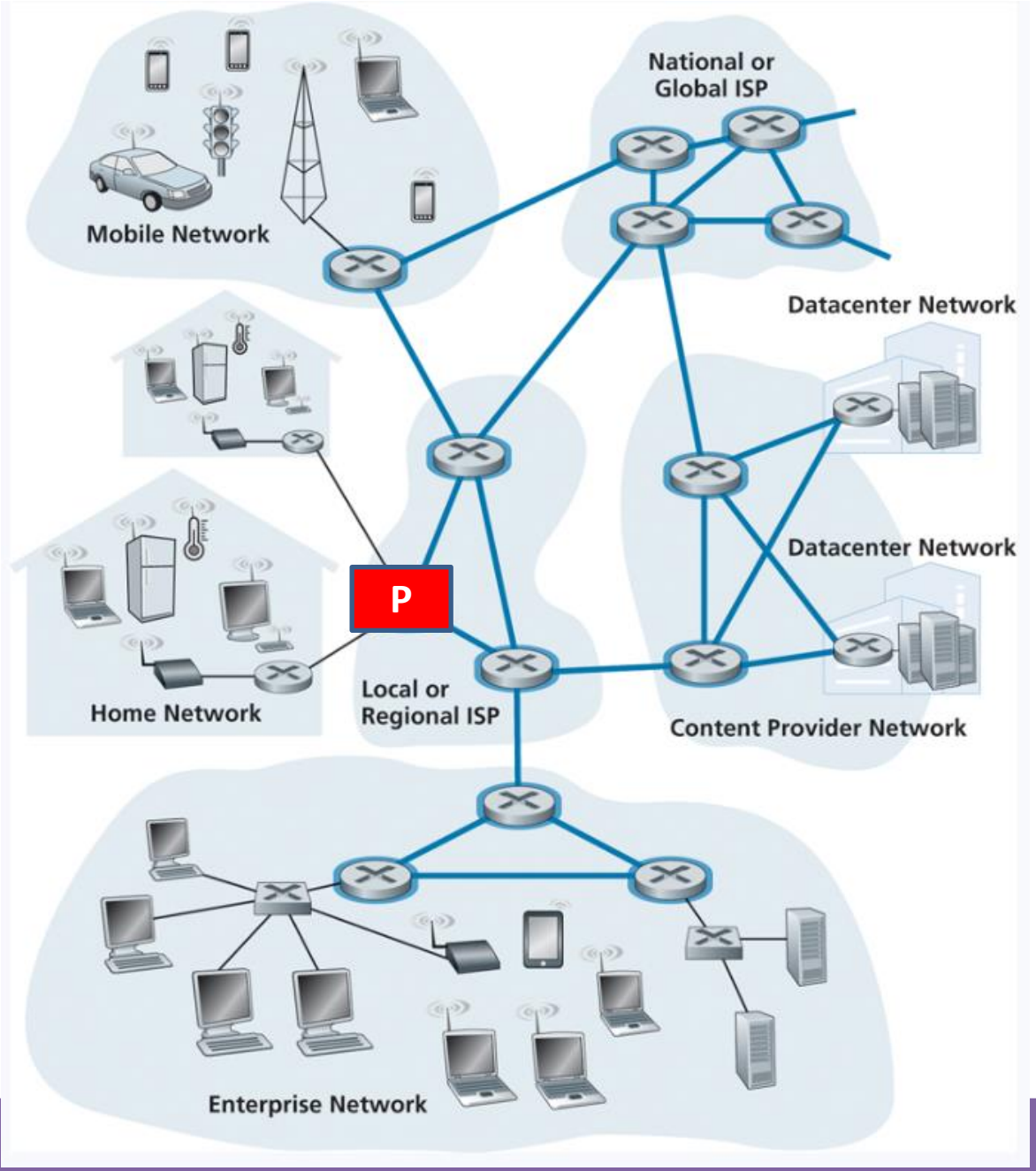
To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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

1500 Bytes

# The Network Core




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

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

Generated Packet

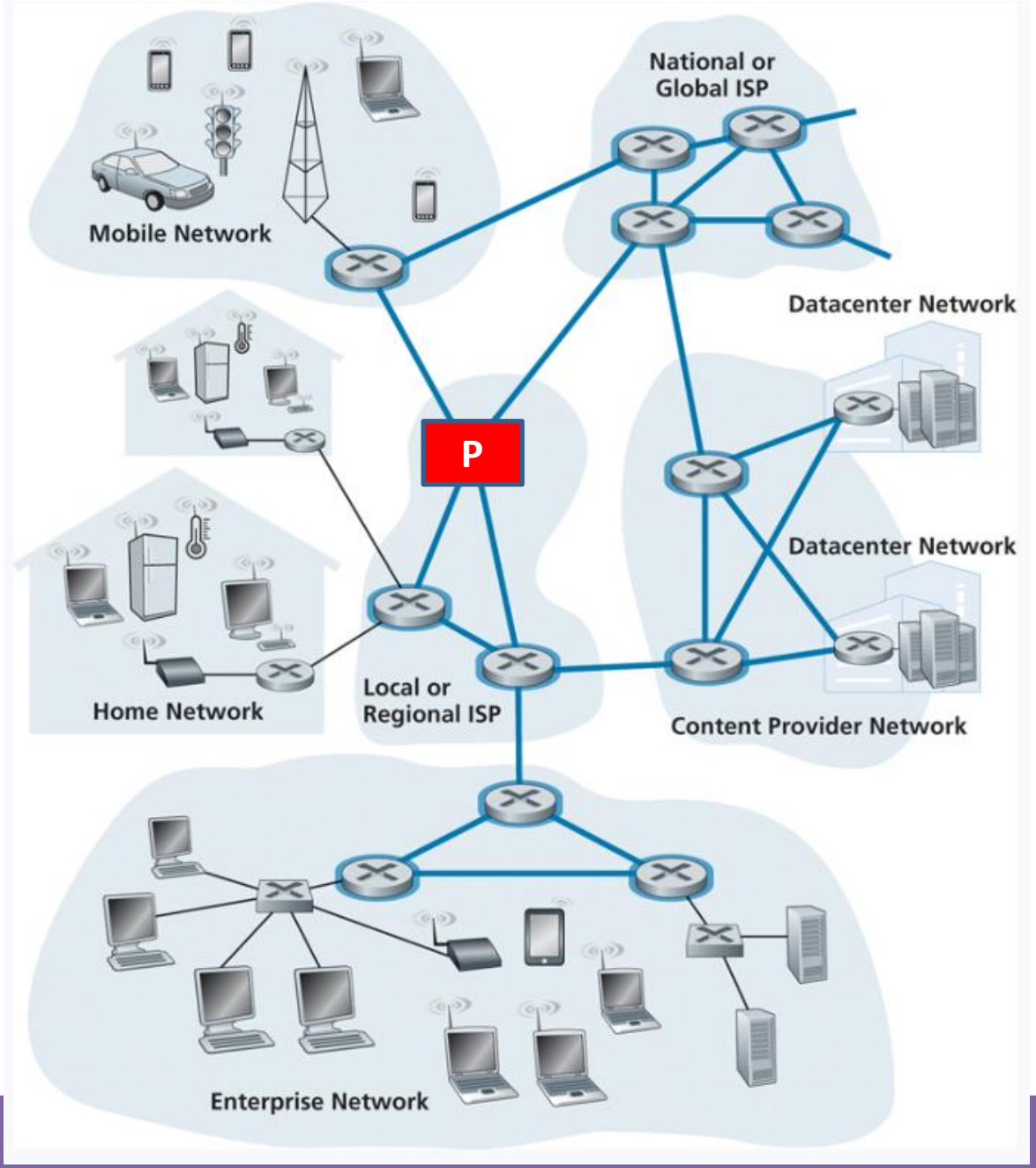
To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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

1500 Bytes

# The Network Core




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

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

Generated Packet

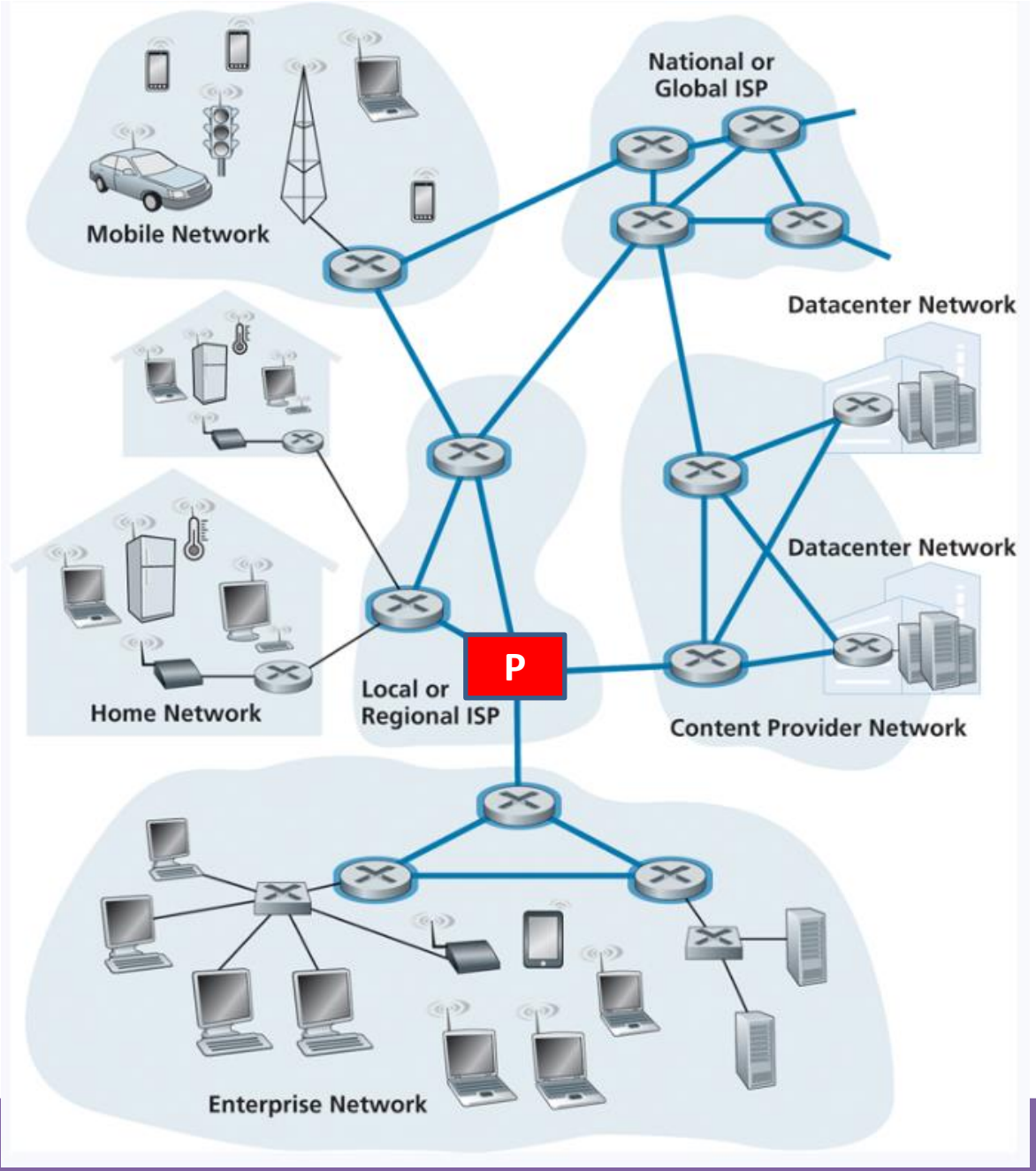
To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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

1500 Bytes

# The Network Core




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

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

Generated Packet

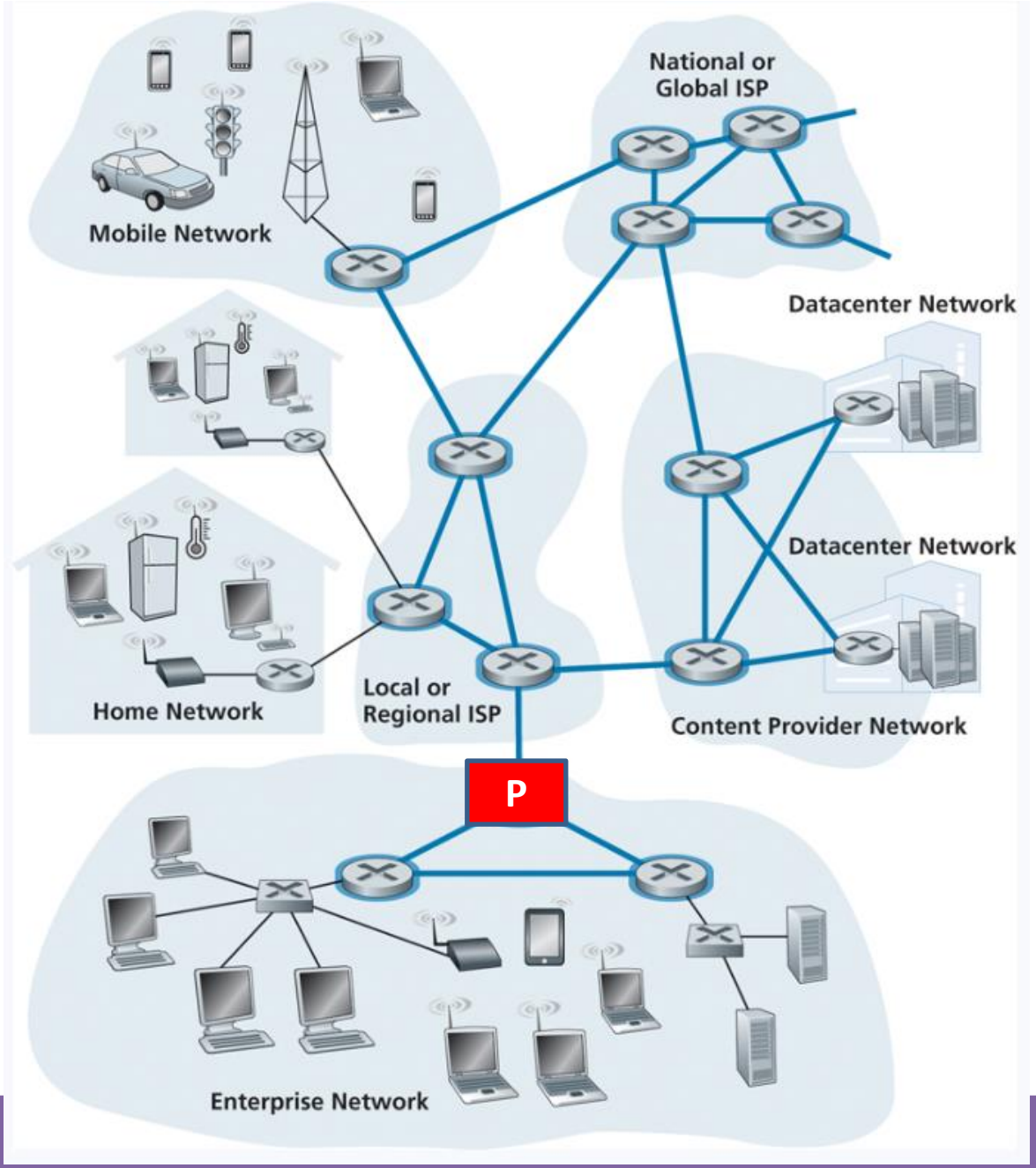
To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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

1500 Bytes

# The Network Core




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

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

Generated Packet

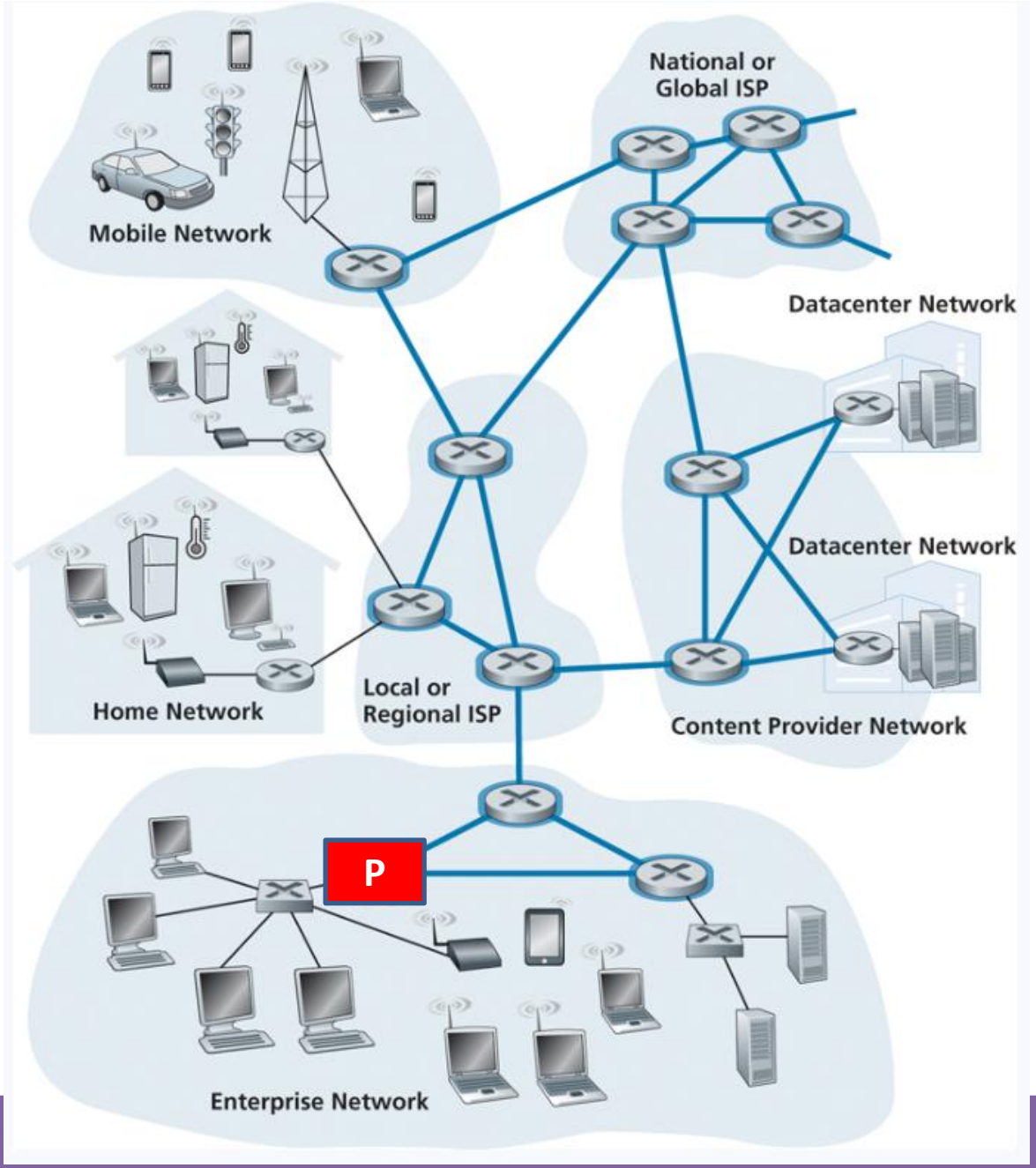
To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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

1500 Bytes

# The Network Core




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

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

Generated Packet

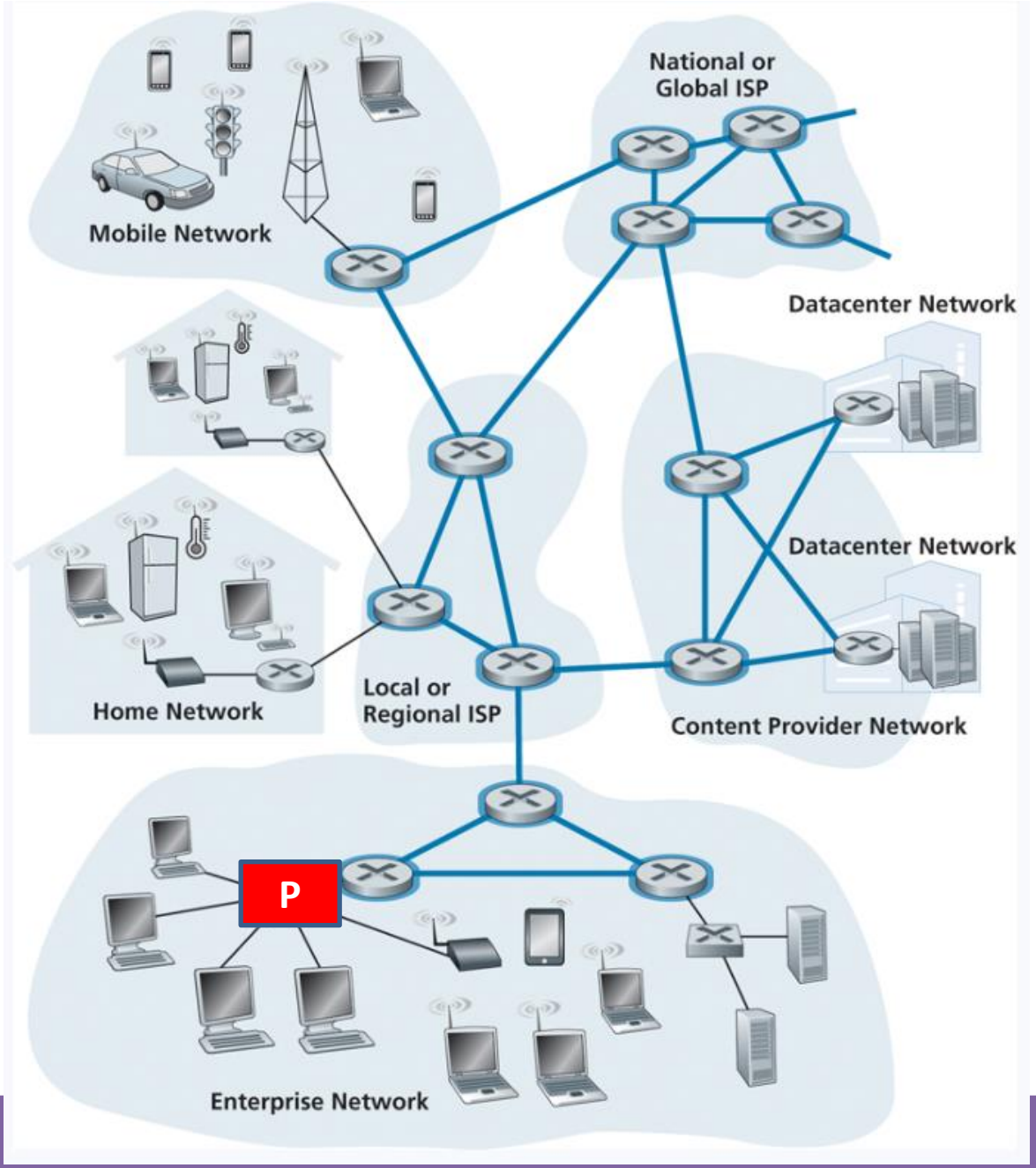
To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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

1500 Bytes

# The Network Core




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

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

Generated Packet

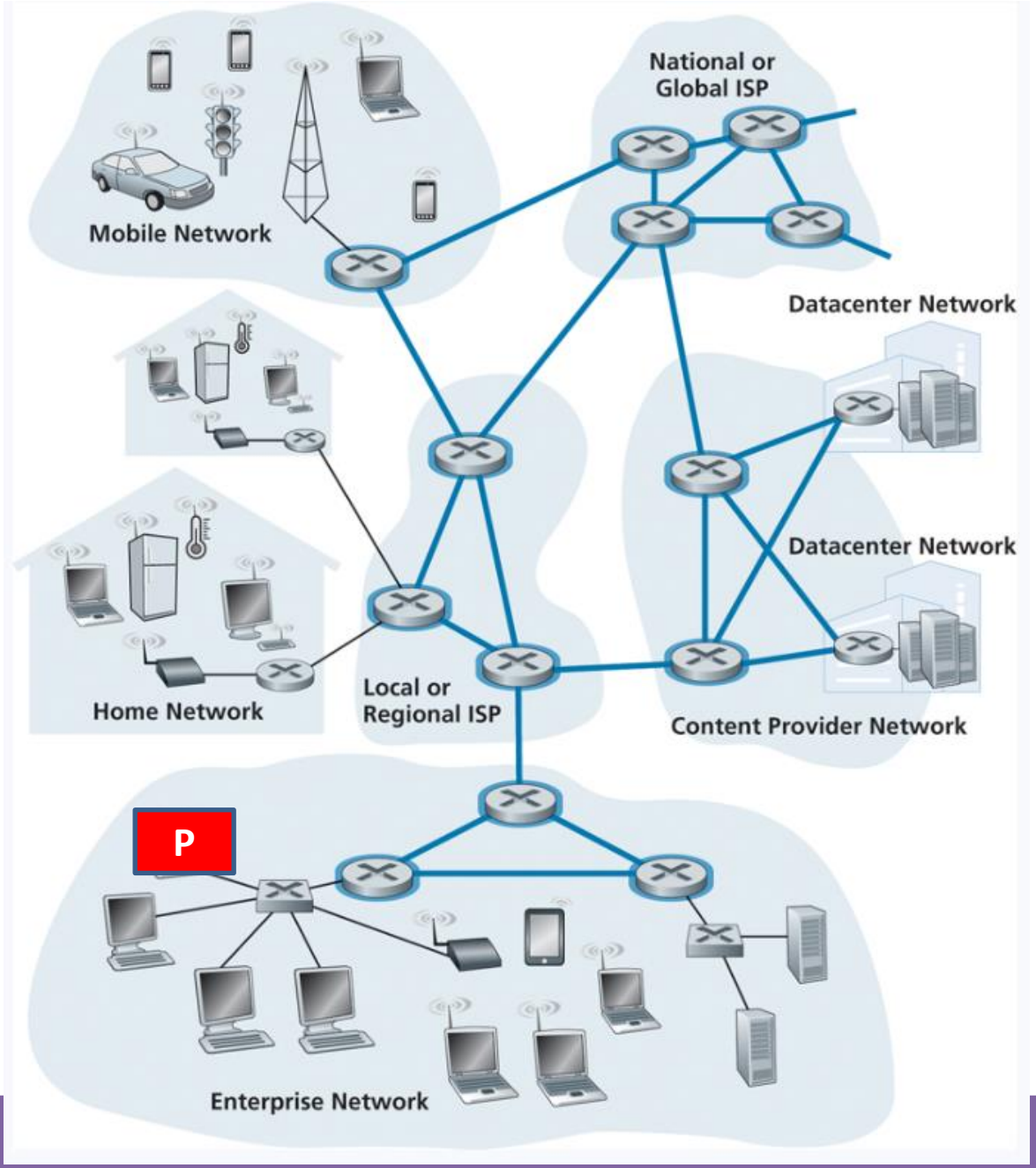
To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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

1500 Bytes

# The Network Core




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

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

Generated Packet

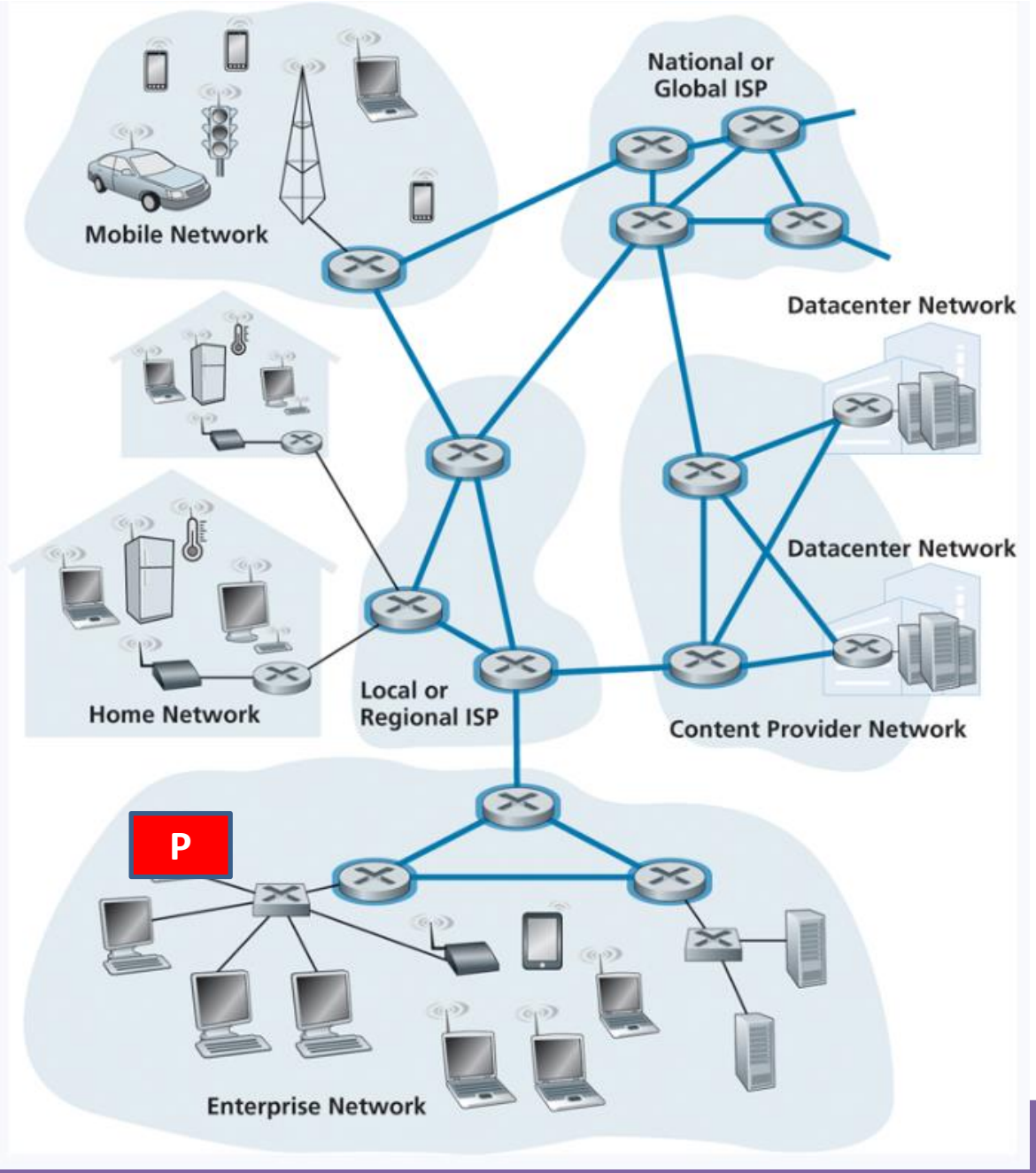
To: Host A
John Paxton
192.42.98.11

From: Host B
Reese Pearsall
192.5.223.42

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

1500 Bytes

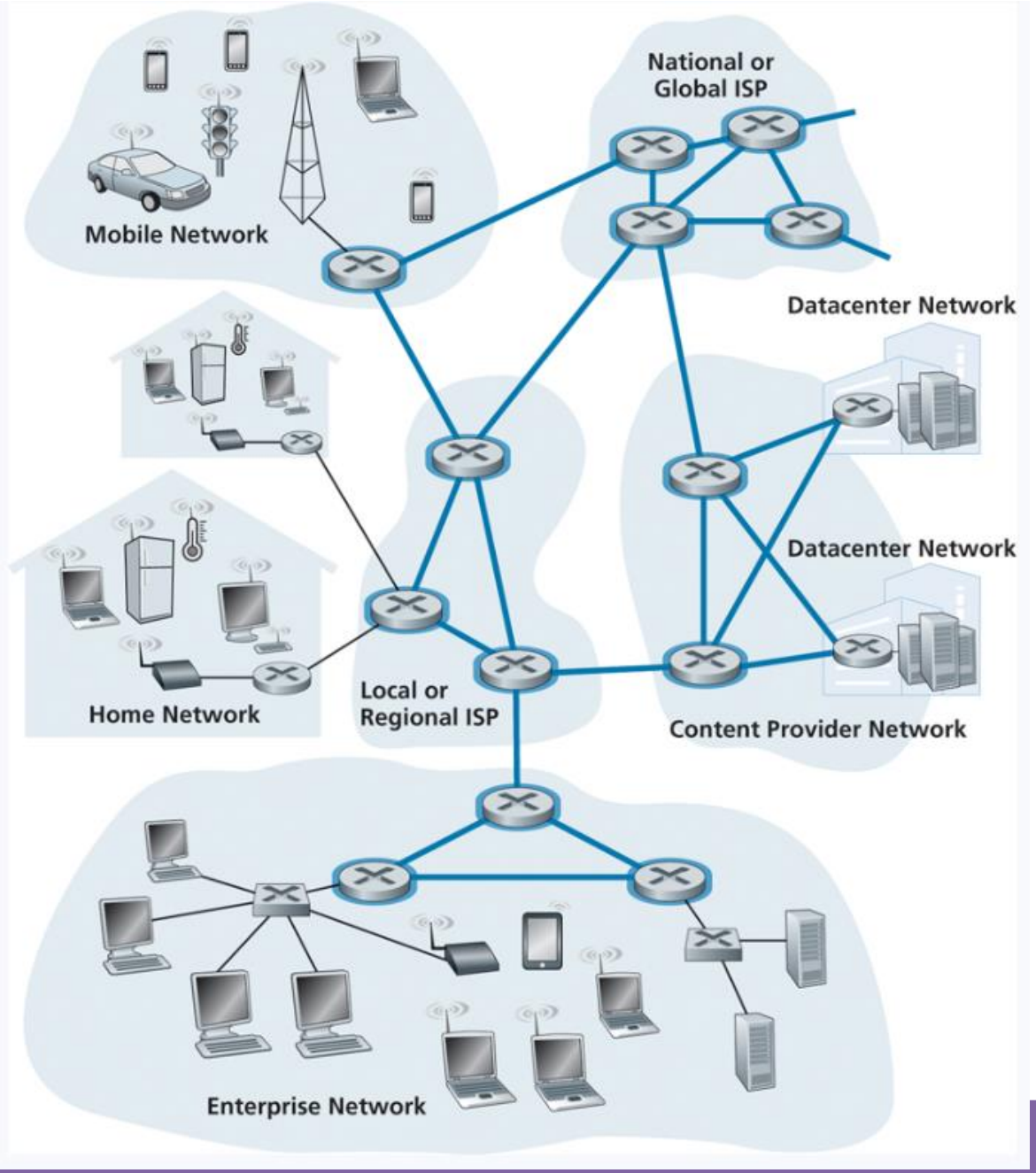
# The Network Core




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

Packets are generally small, and cannot exceed a certain size

# The Network Core

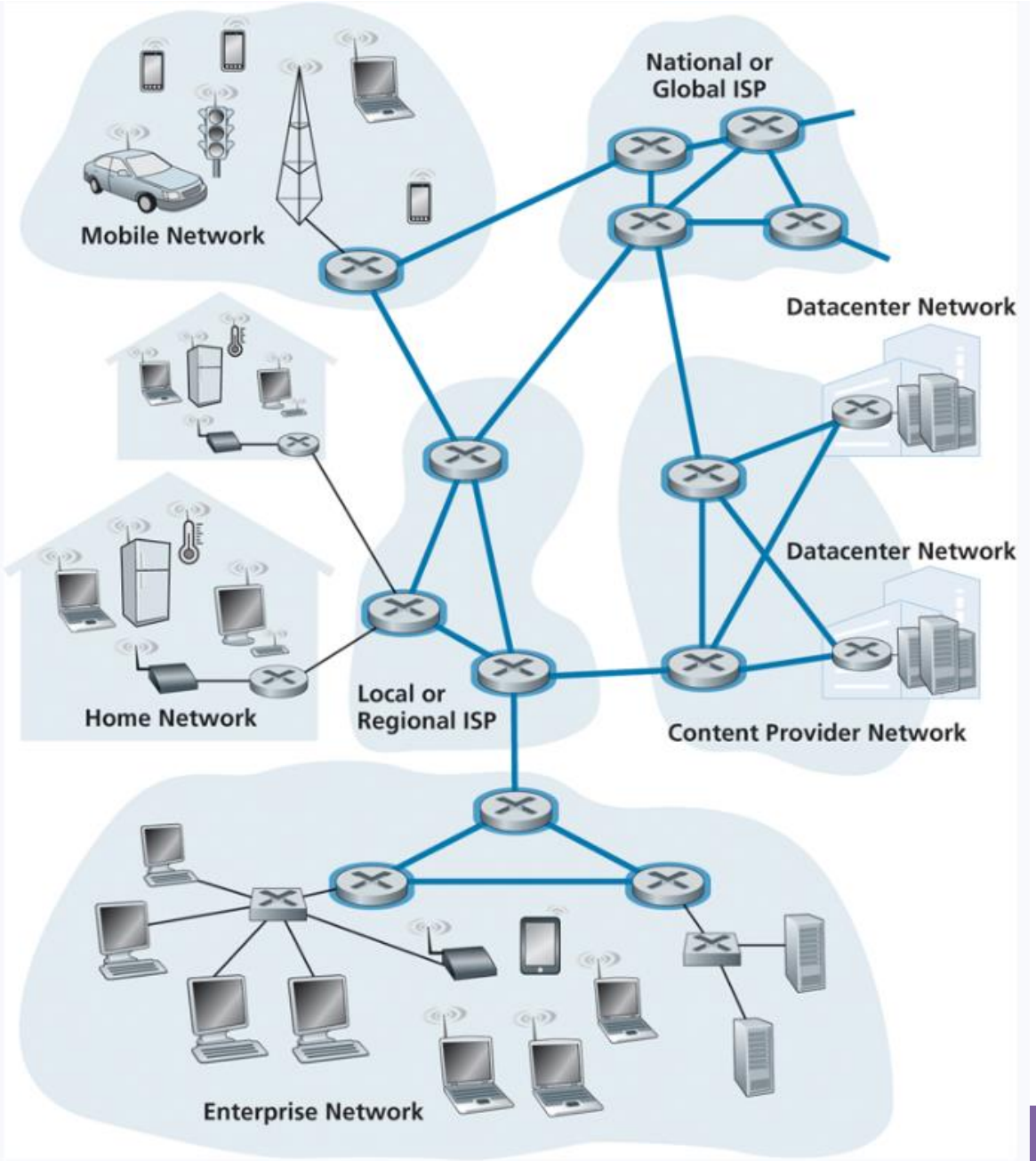



## Messages going from A to B are split into **packets**

Packets are generally small, and cannot exceed a certain size

What if we are transmitting large pieces of data?

# The Network Core



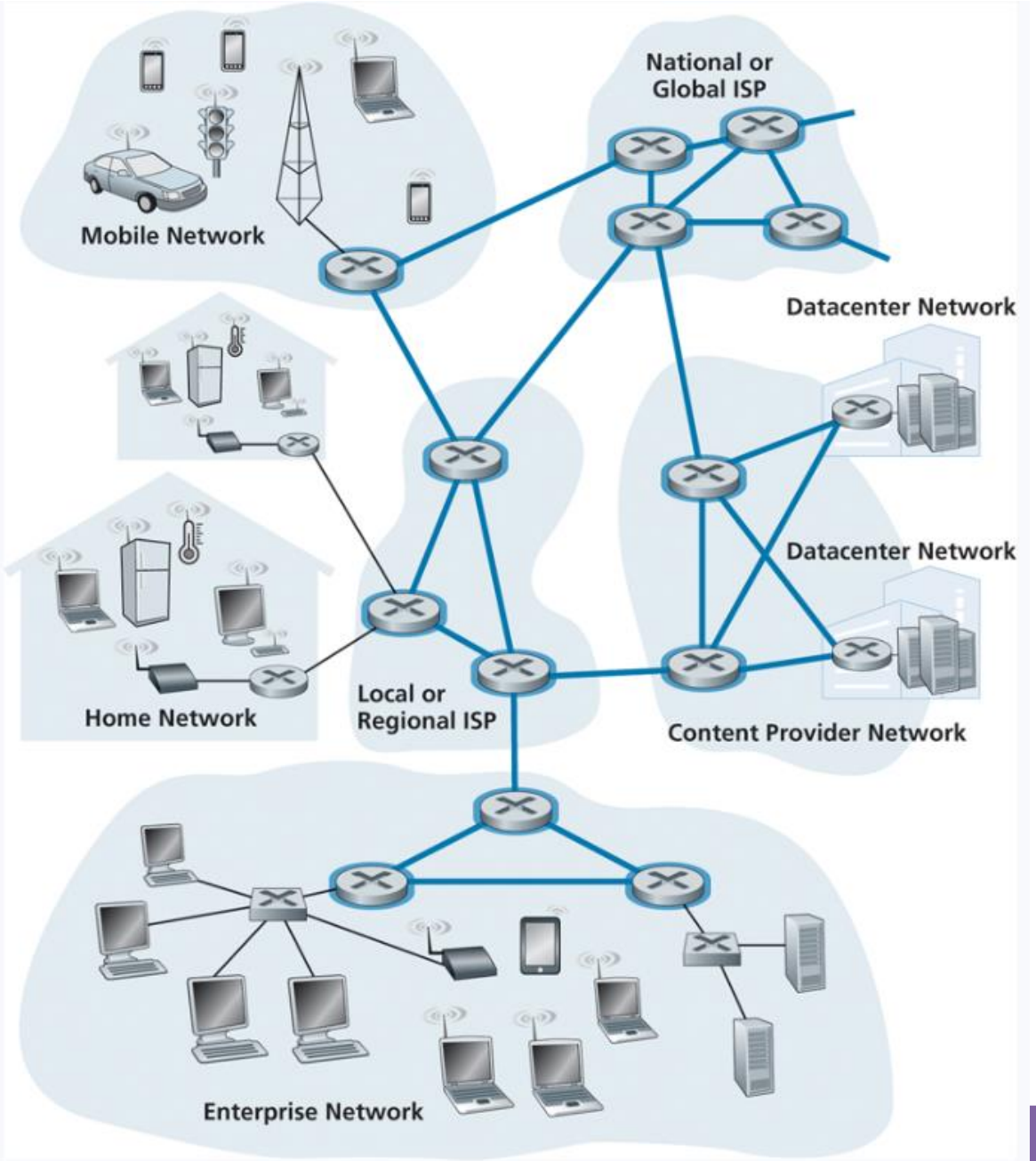

## Messages going from A to B are split into **packets**

Packets are generally small, and cannot exceed a certain size

What if we are transmitting large pieces of data?

We must split it up!

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

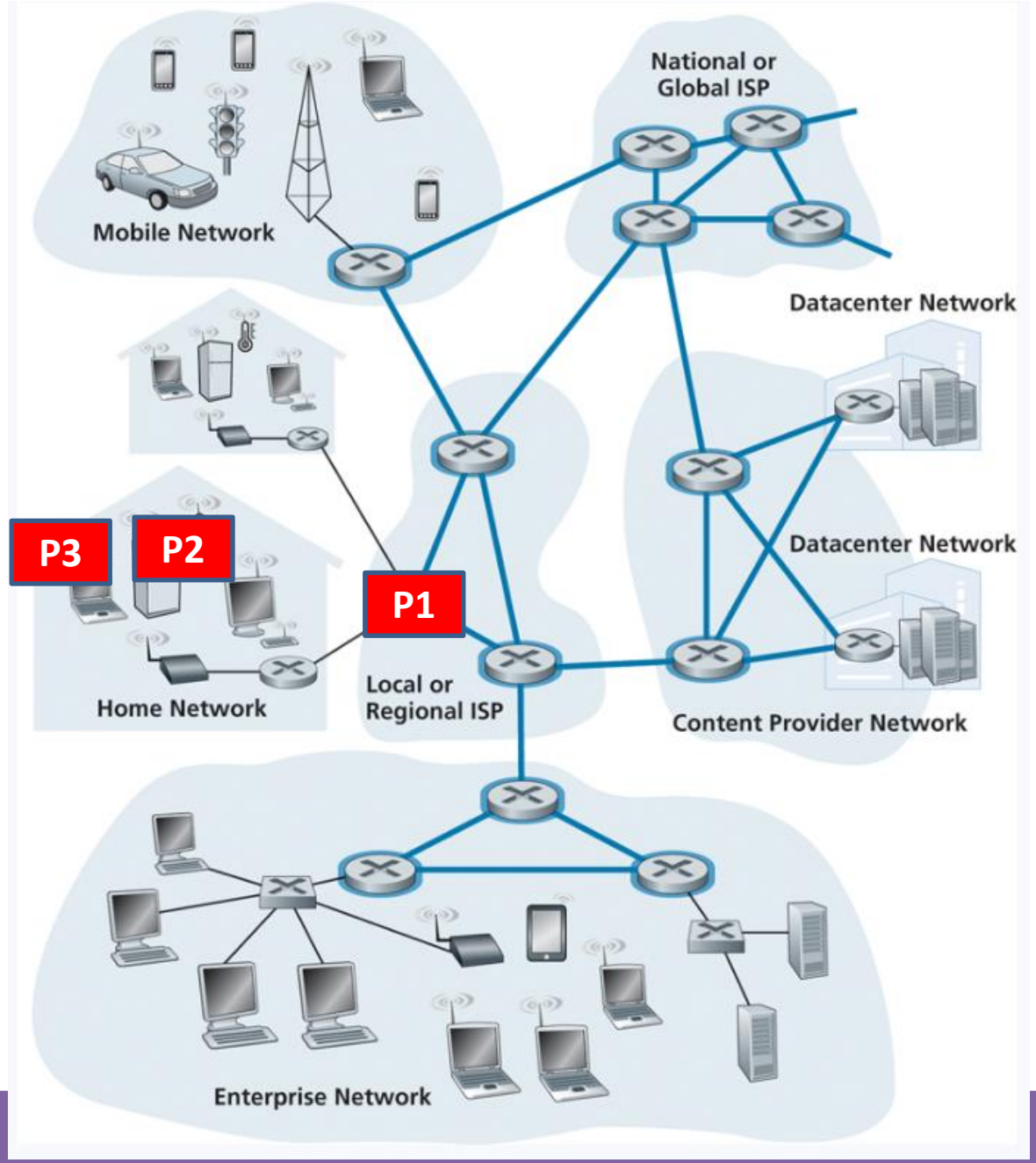
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

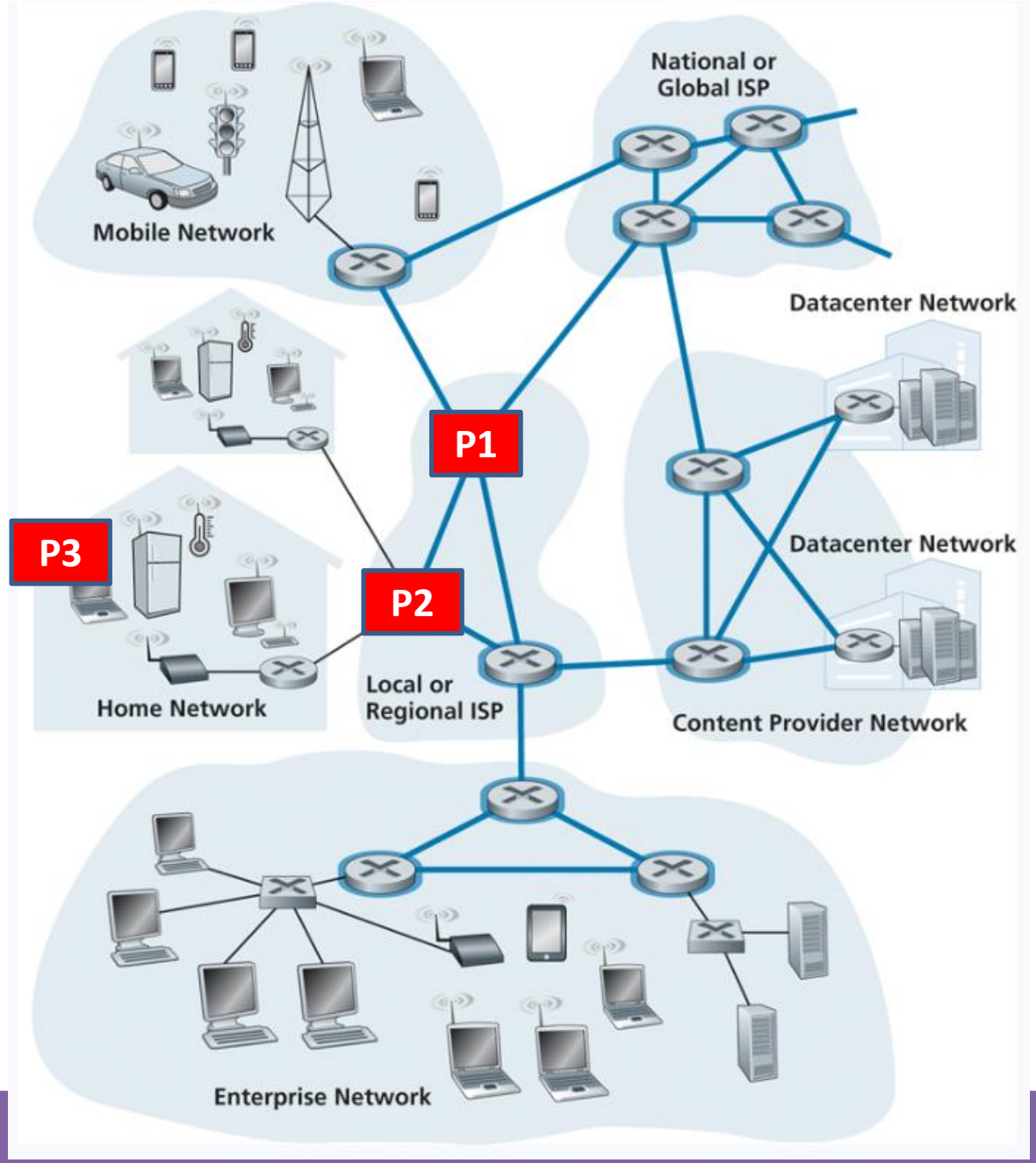
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

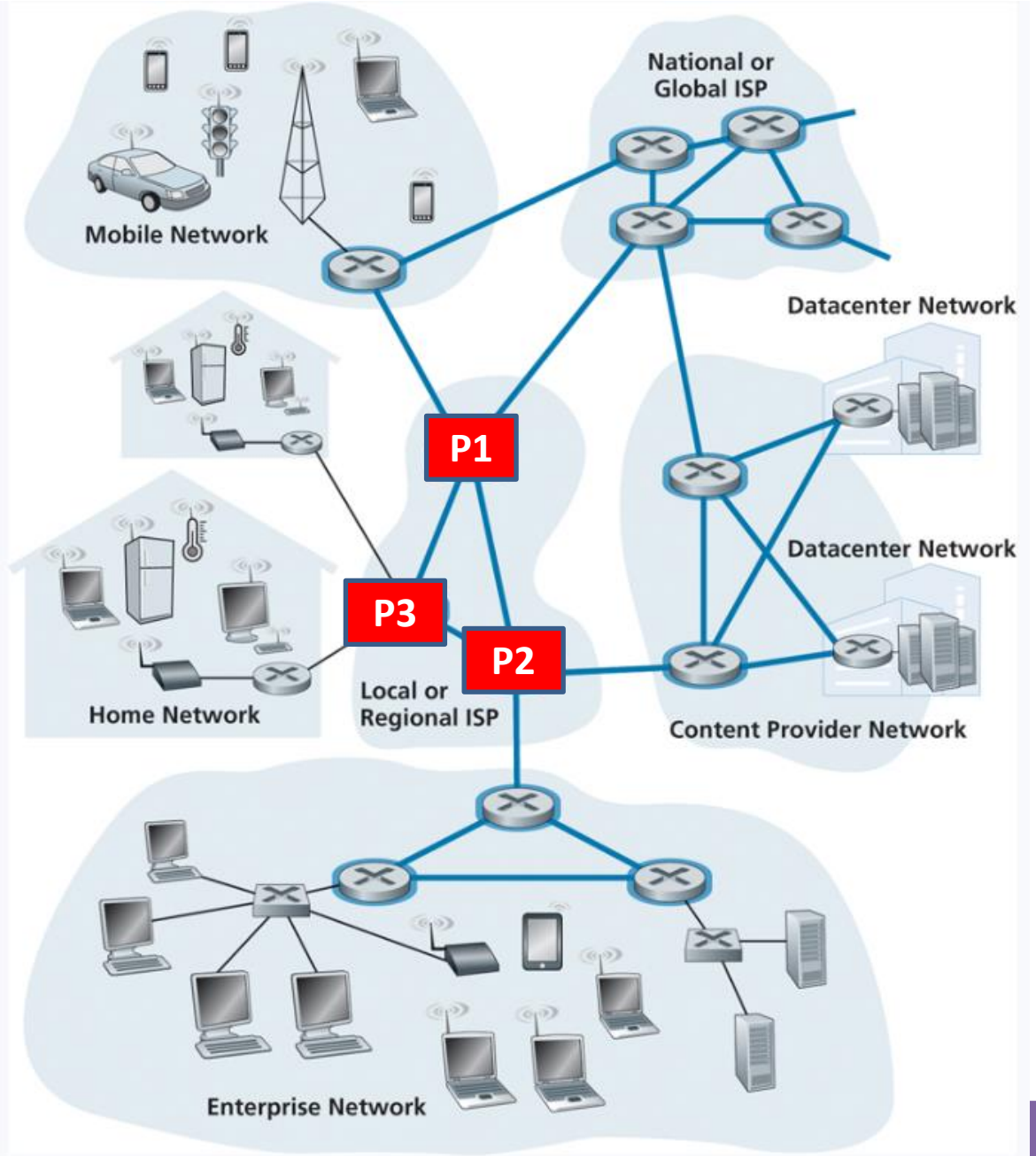
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

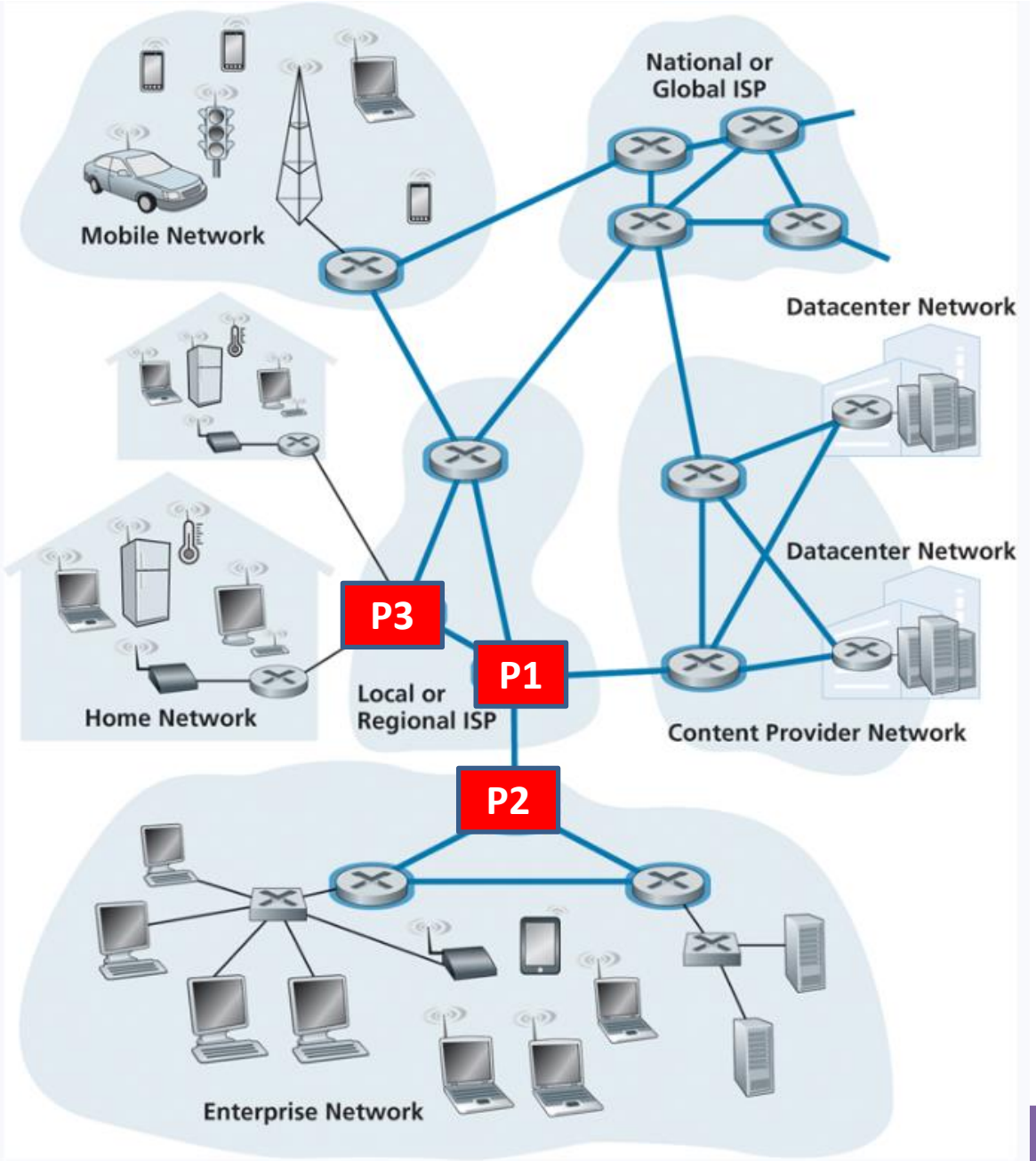
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

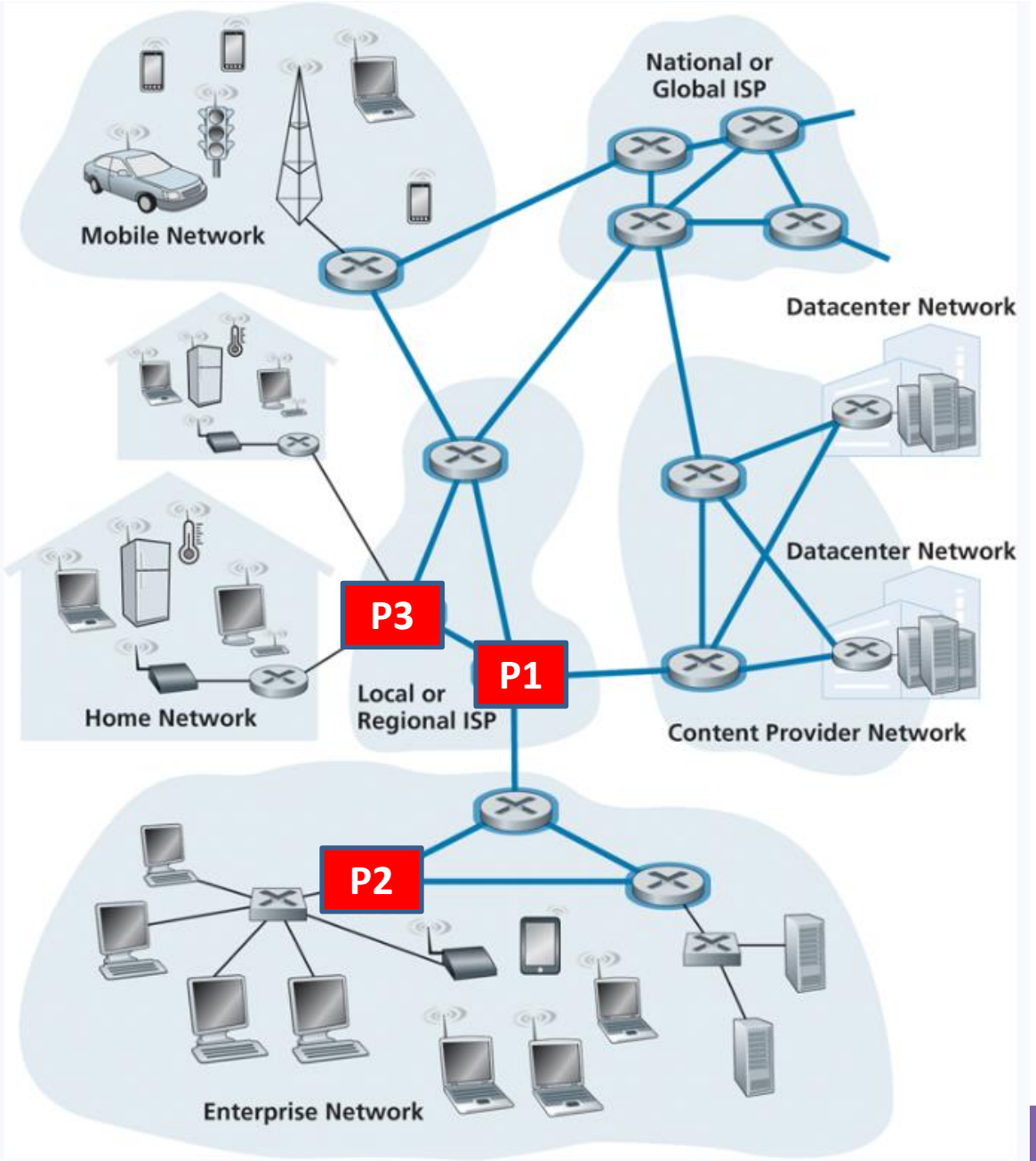
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

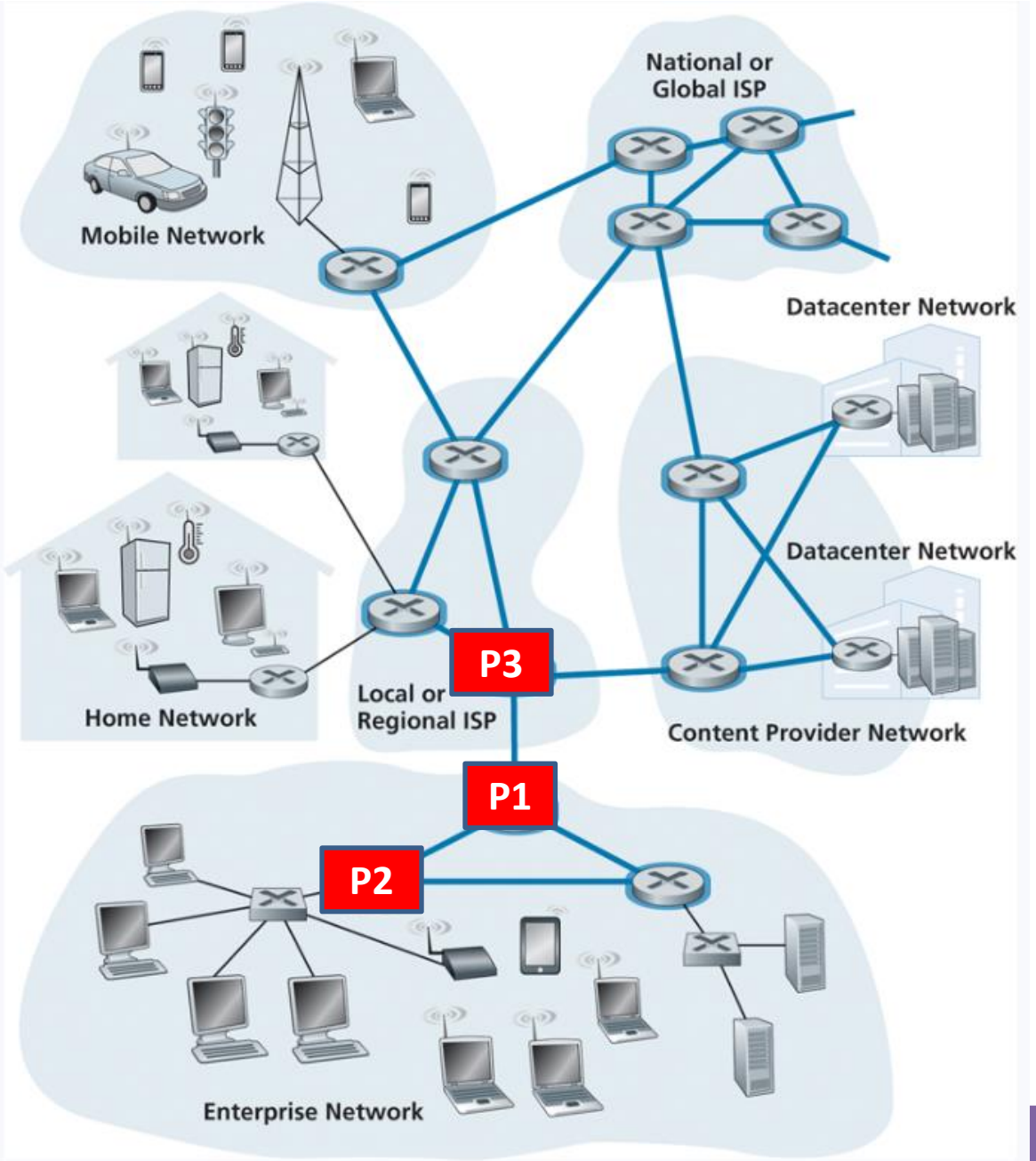
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

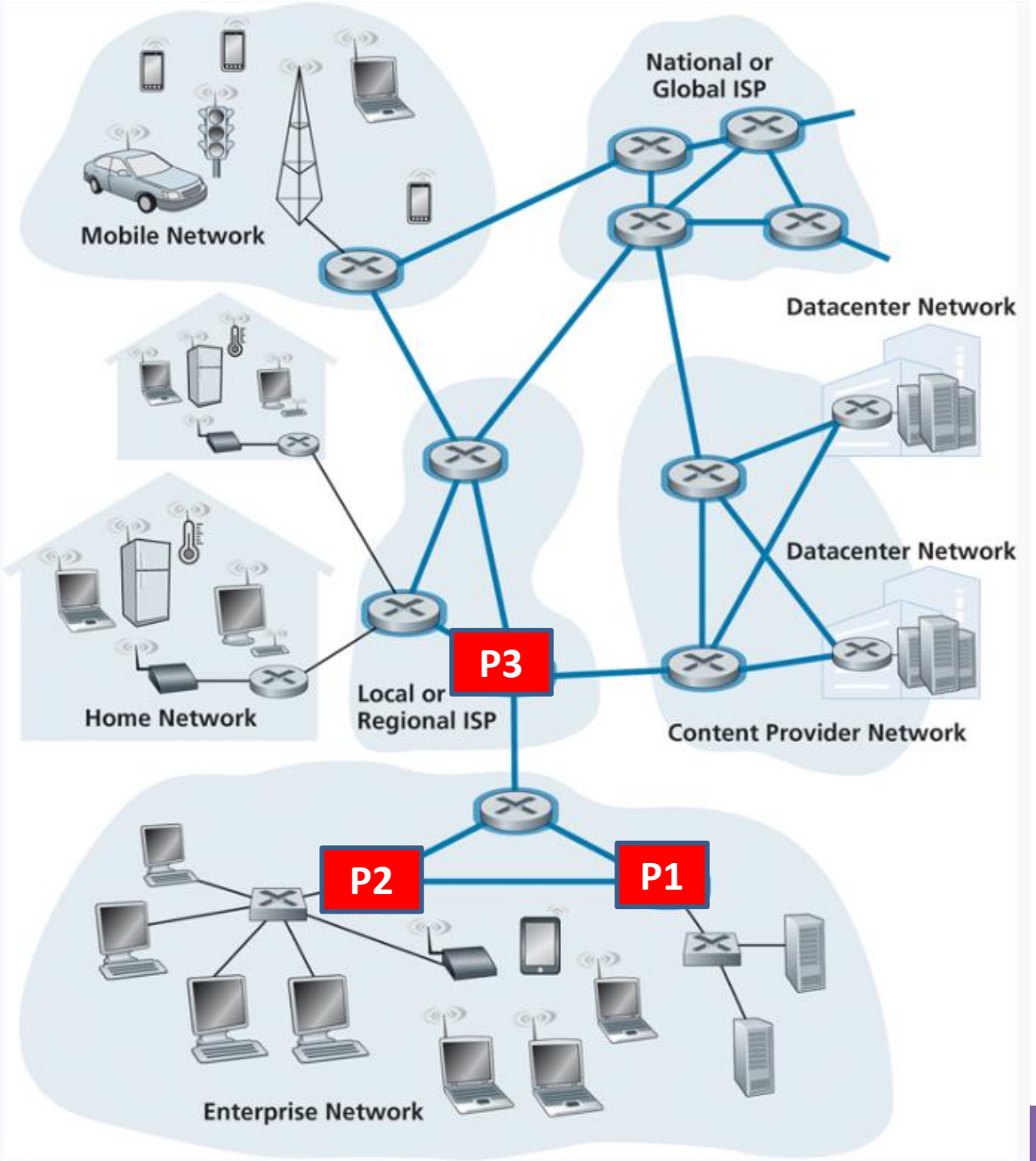
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

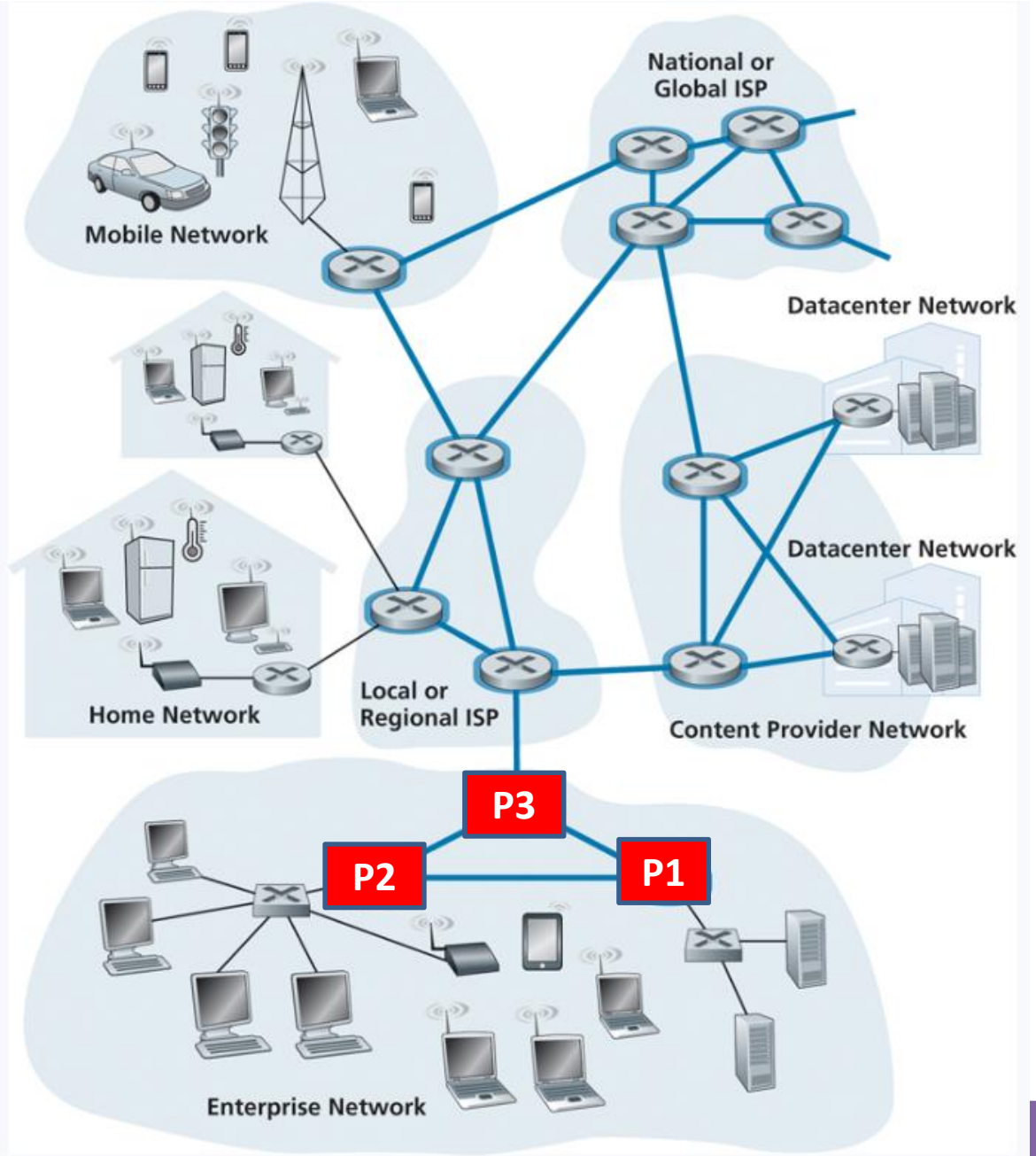
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

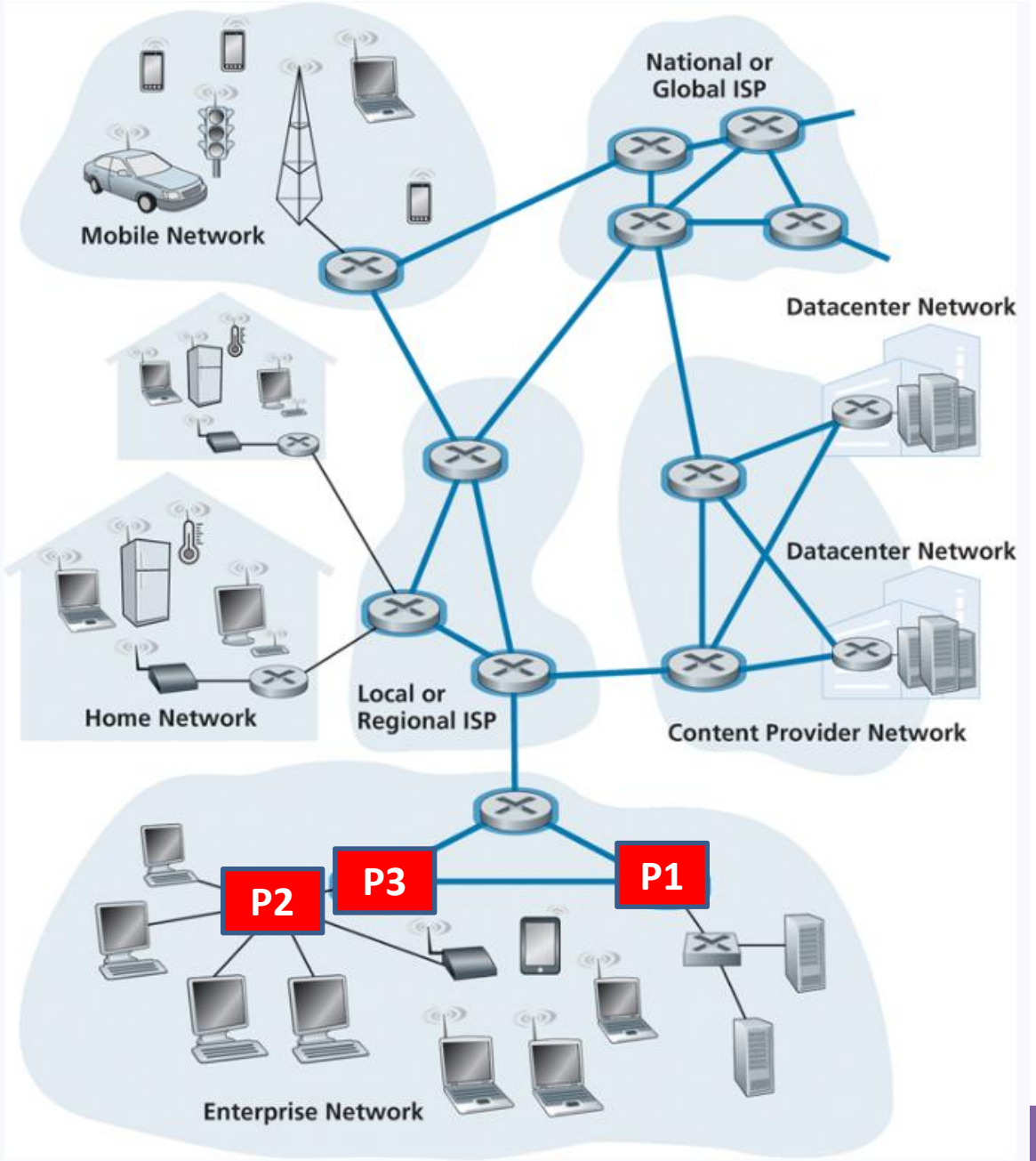
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

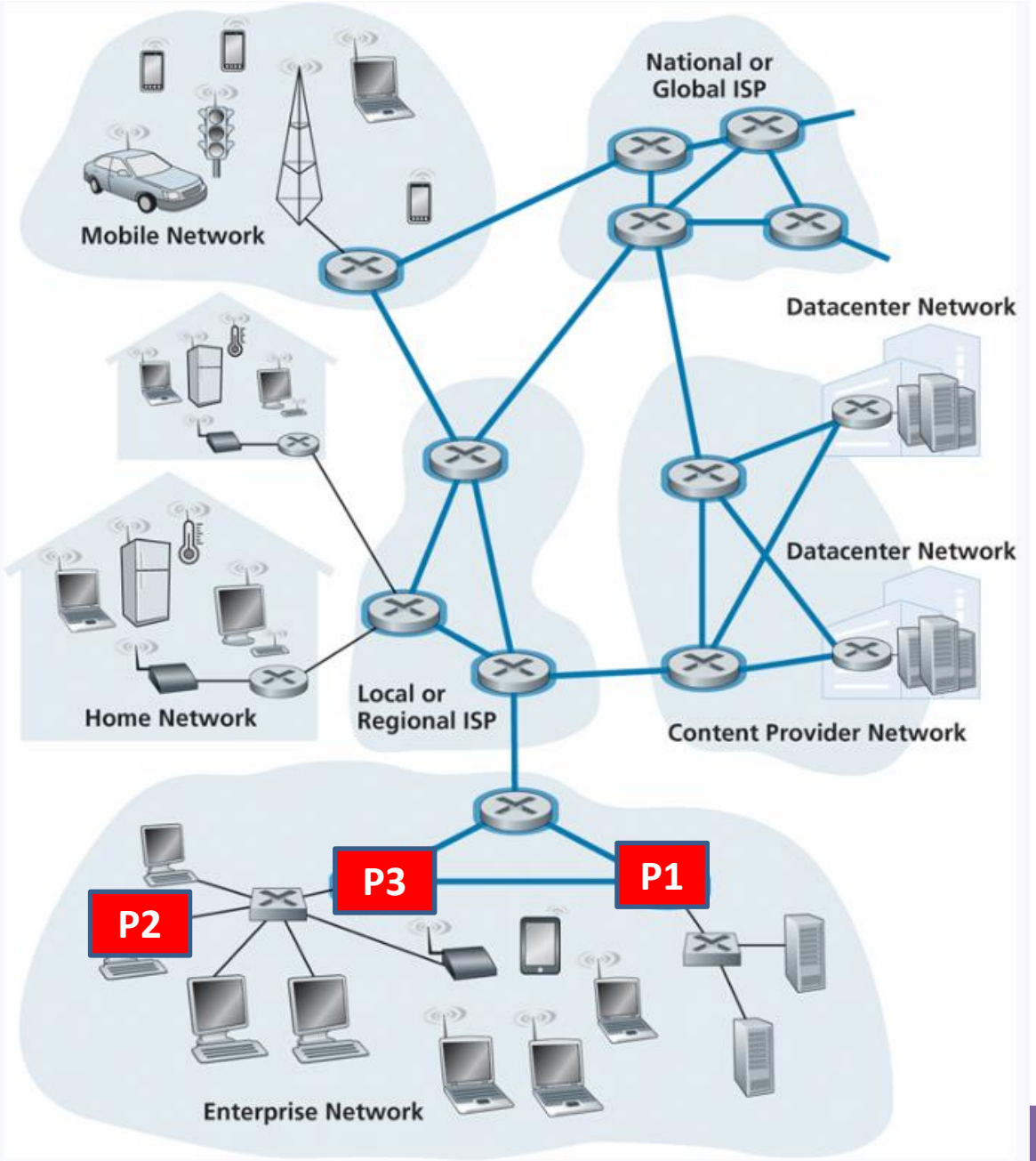
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

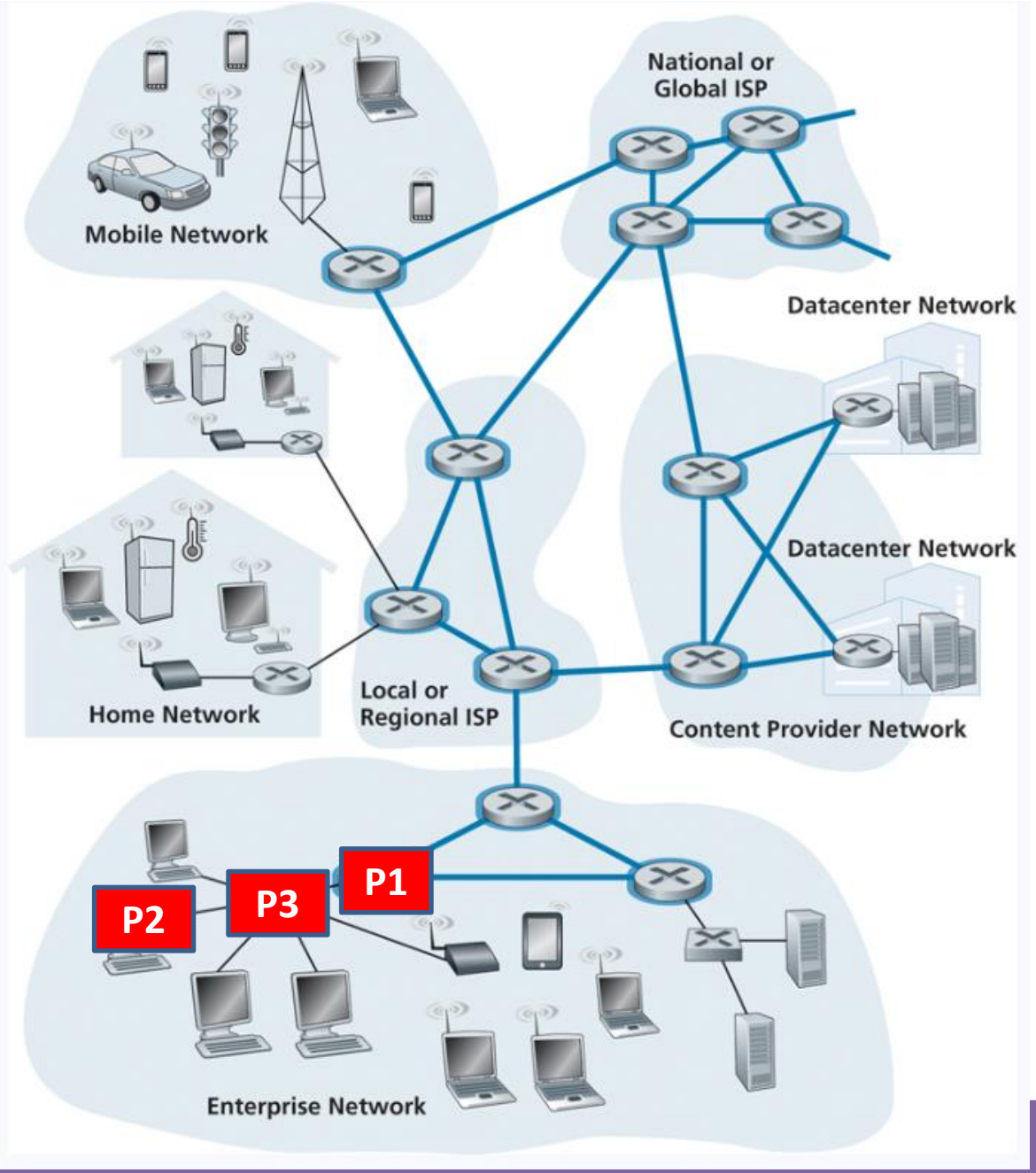
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

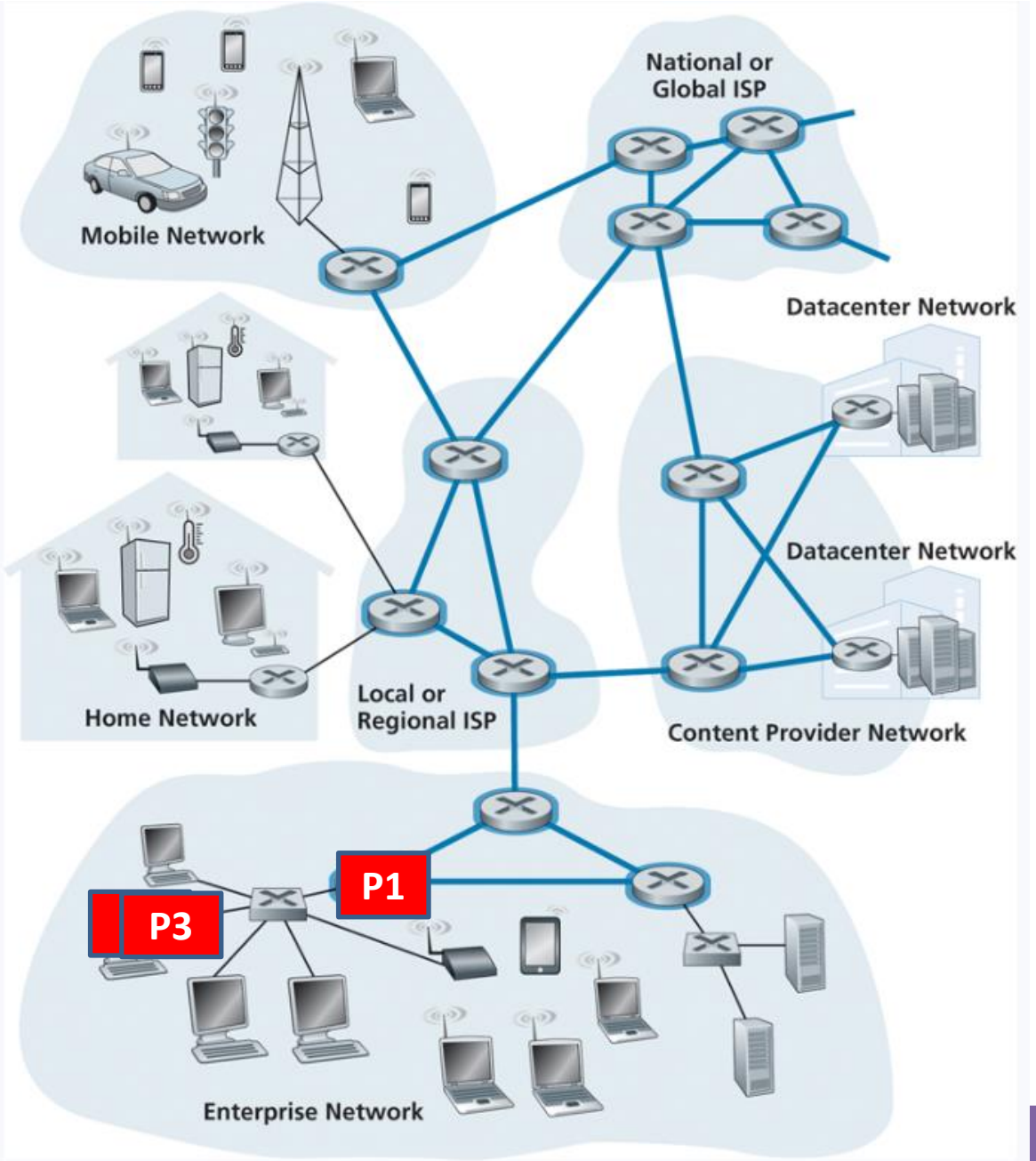
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

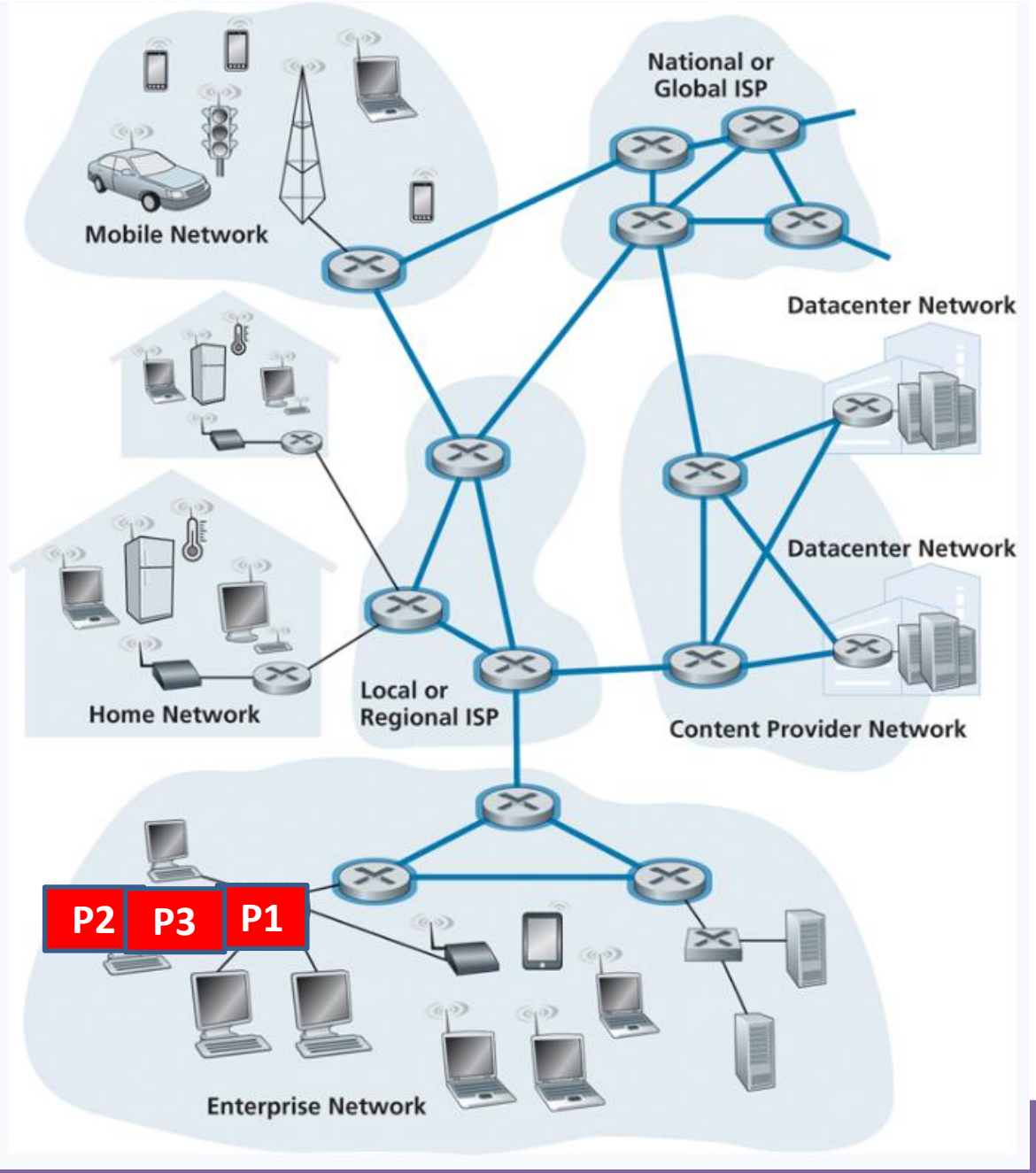
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size


**P1**

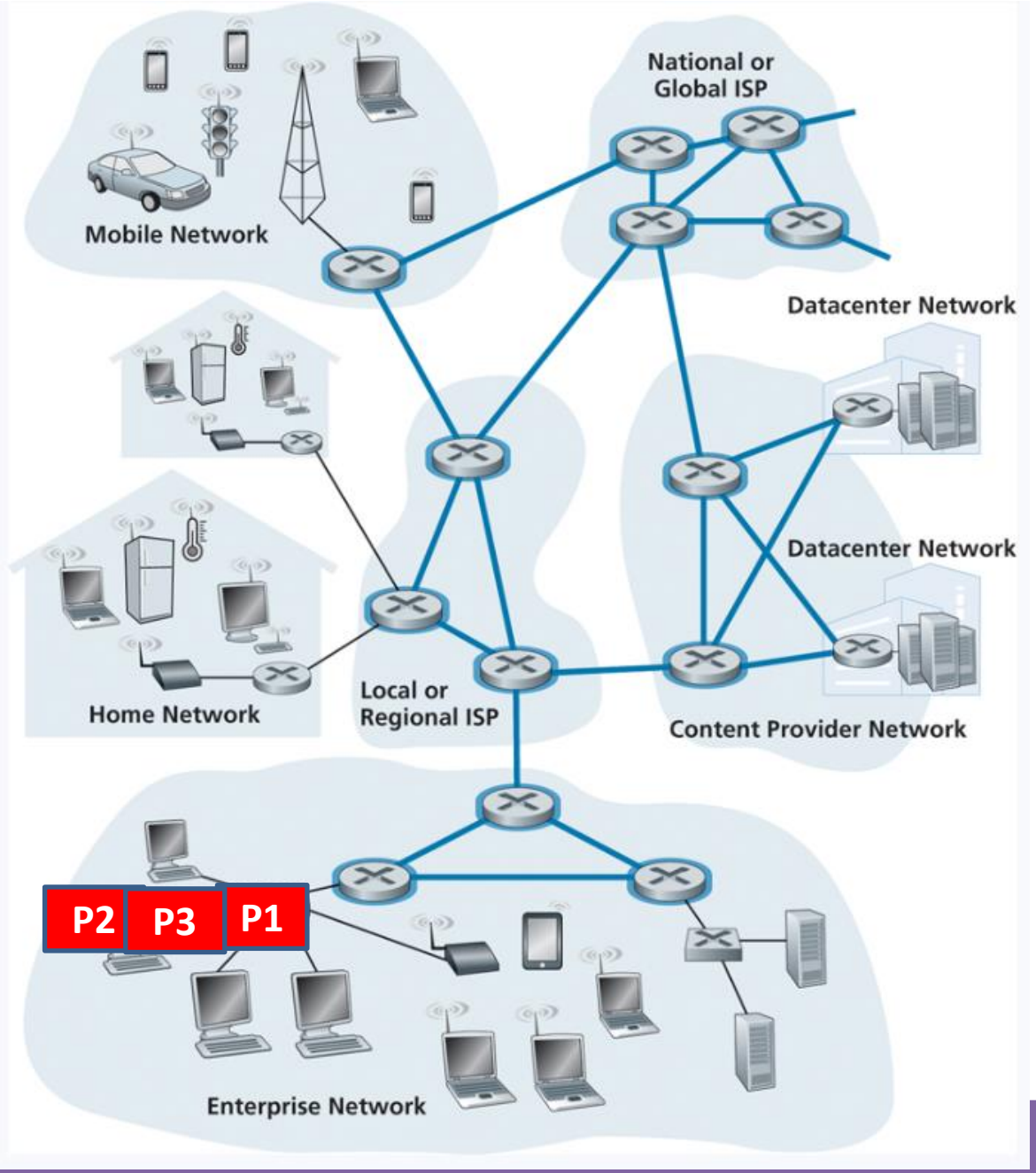
What if we are transmitting large pieces of data?


**P2**

We must split it up!


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size

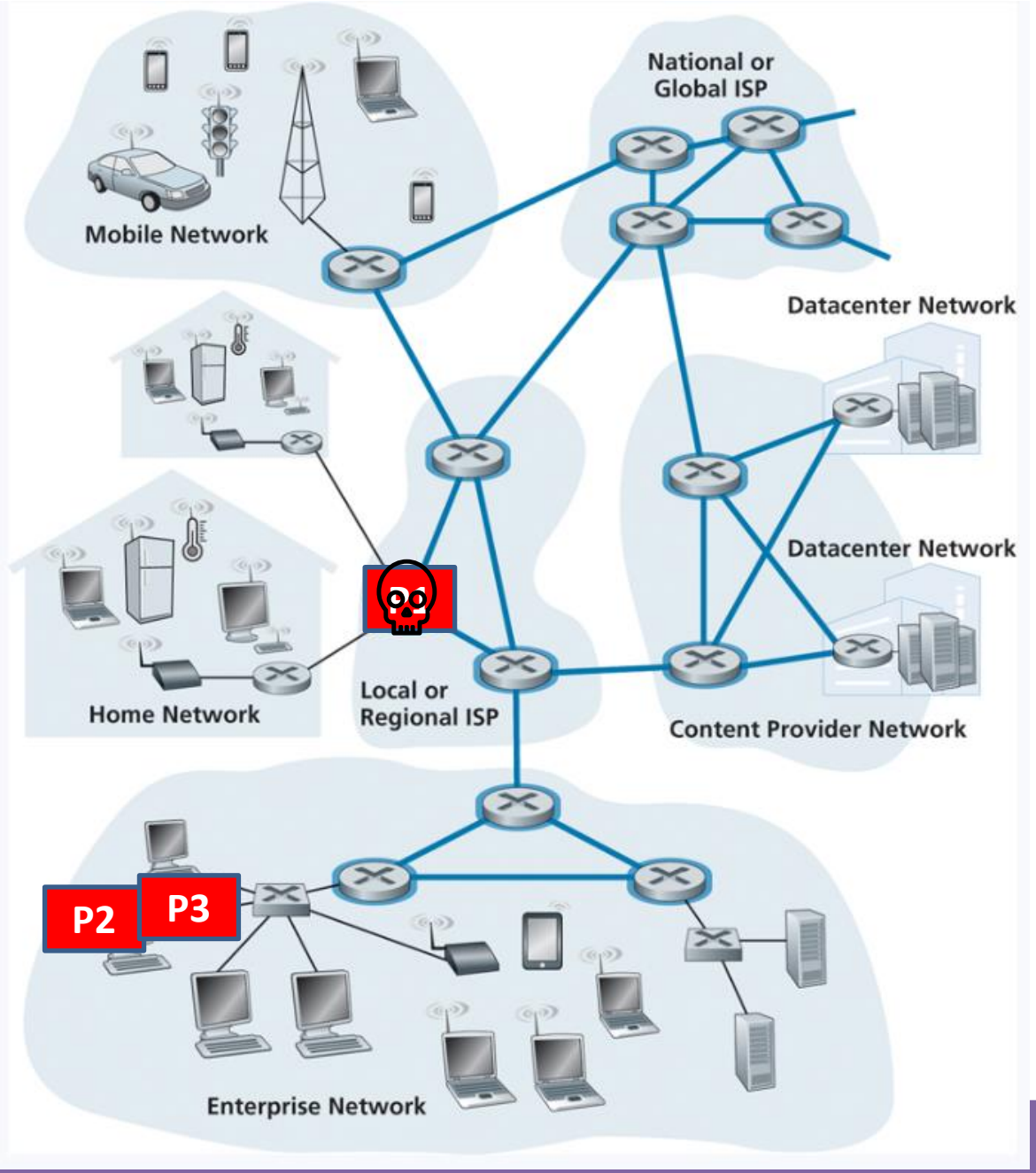
**Final Result:**


**P2**


**P3**


**P1**

# The Network Core




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

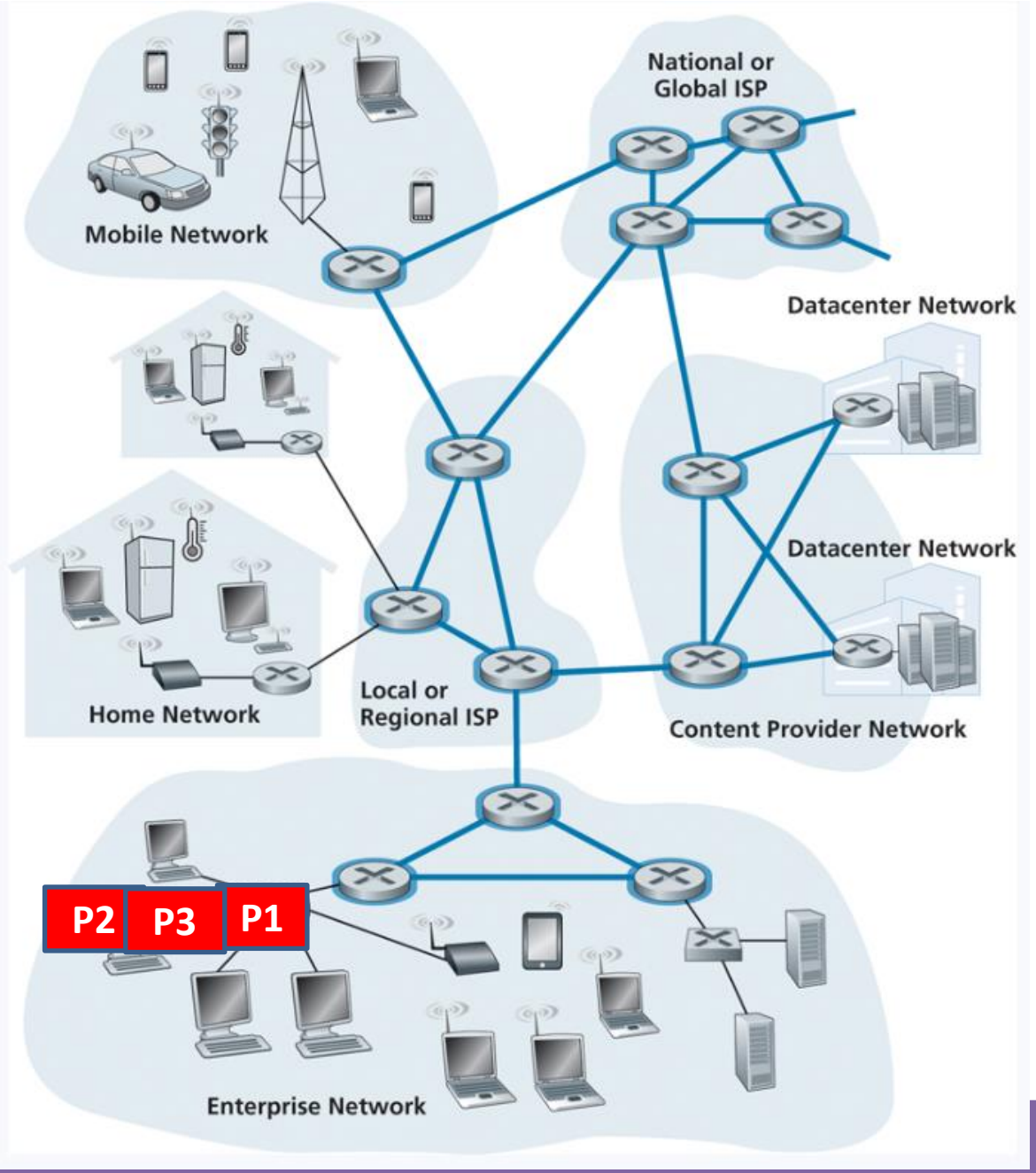
Packets are generally small, and cannot exceed a certain size

Lost, Discarded, Corrupt **P1**


**P2**


**P3**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size

**Final Result:**

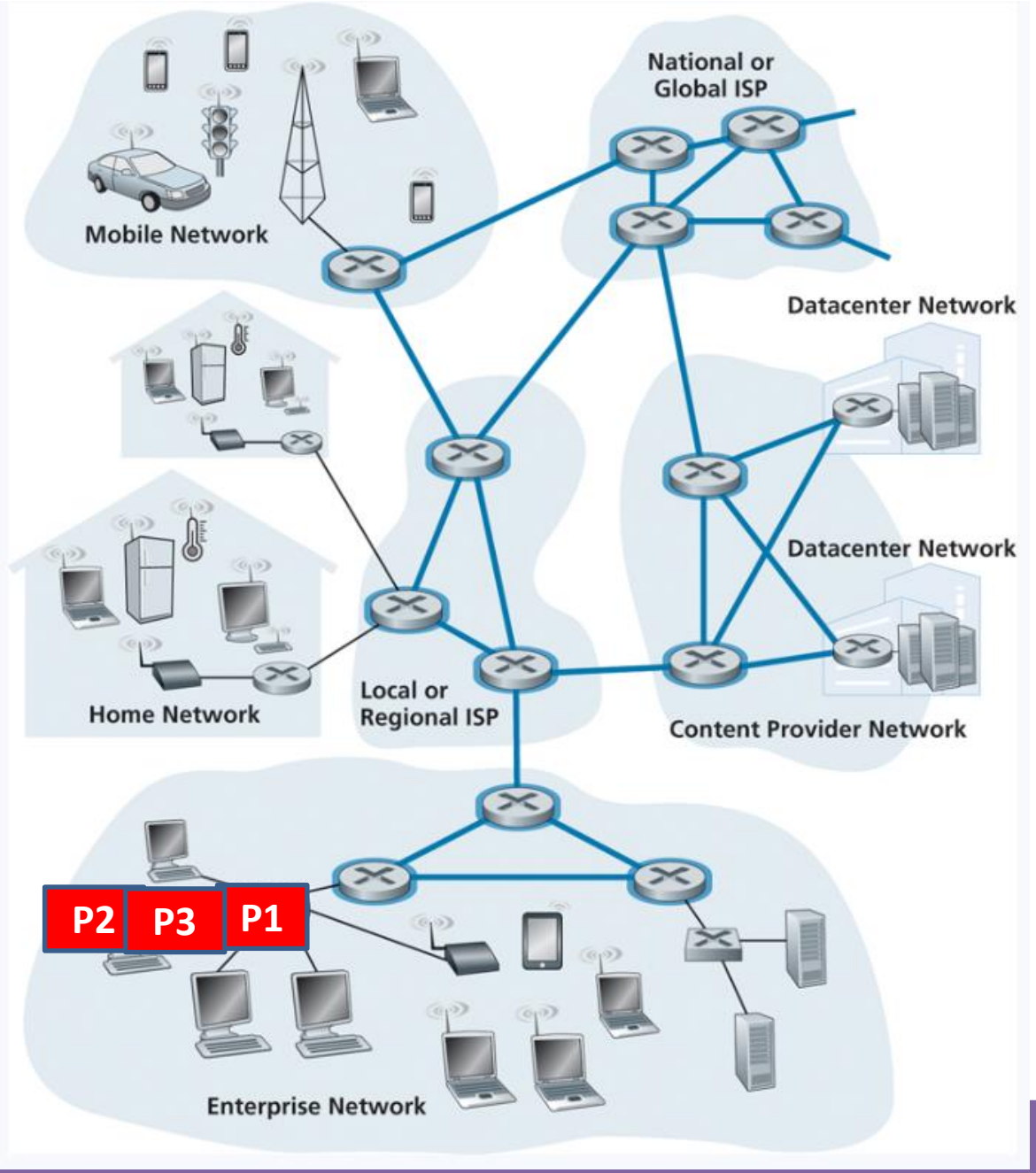

**P2**

**Solution?**


**P3**


**P1**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size

**Final Result:**

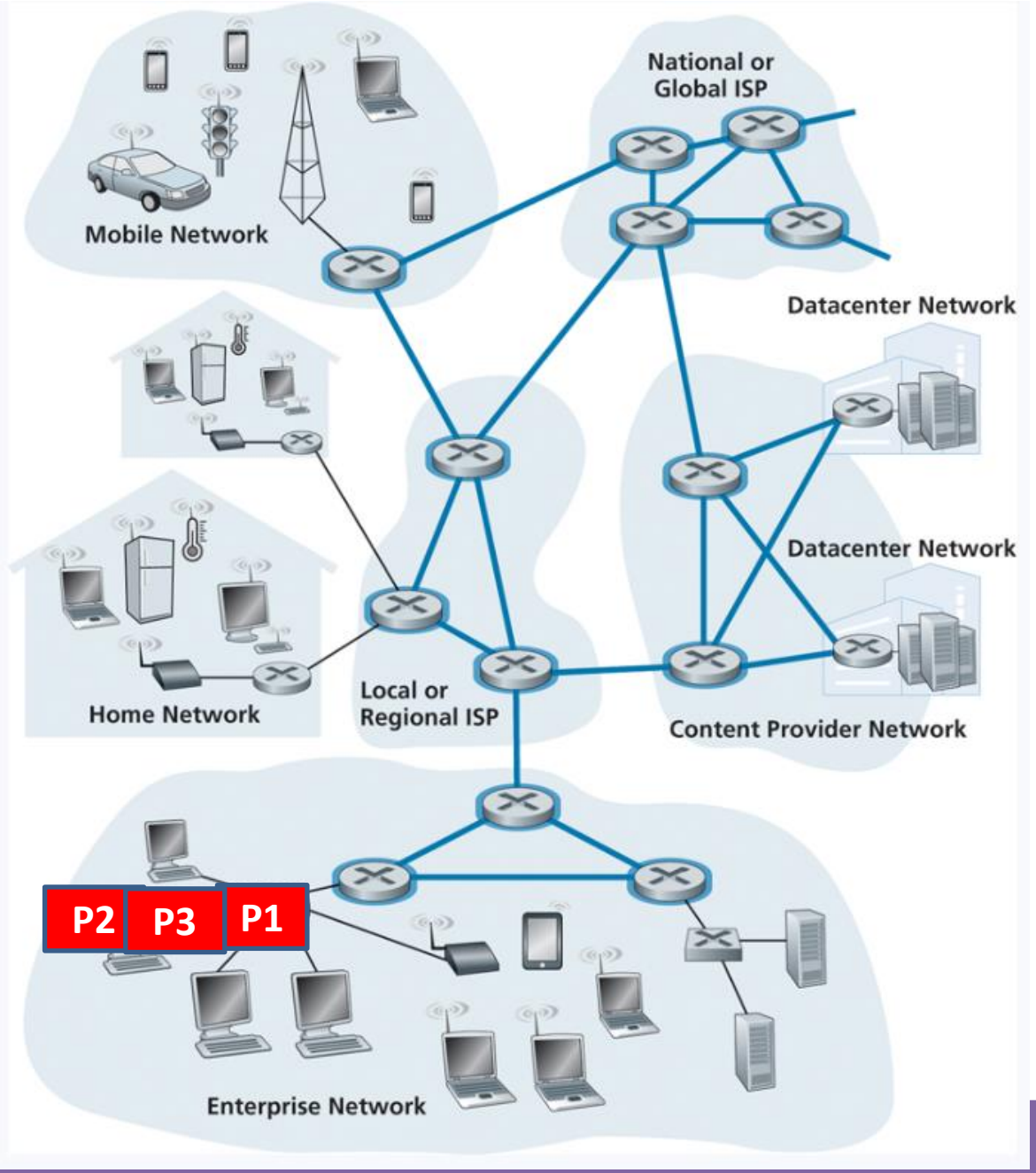

**P2**

**Solution?**


**P3**


**P1**

# The Network Core




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

Packets are generally small, and cannot exceed a certain size

**Final Result:**

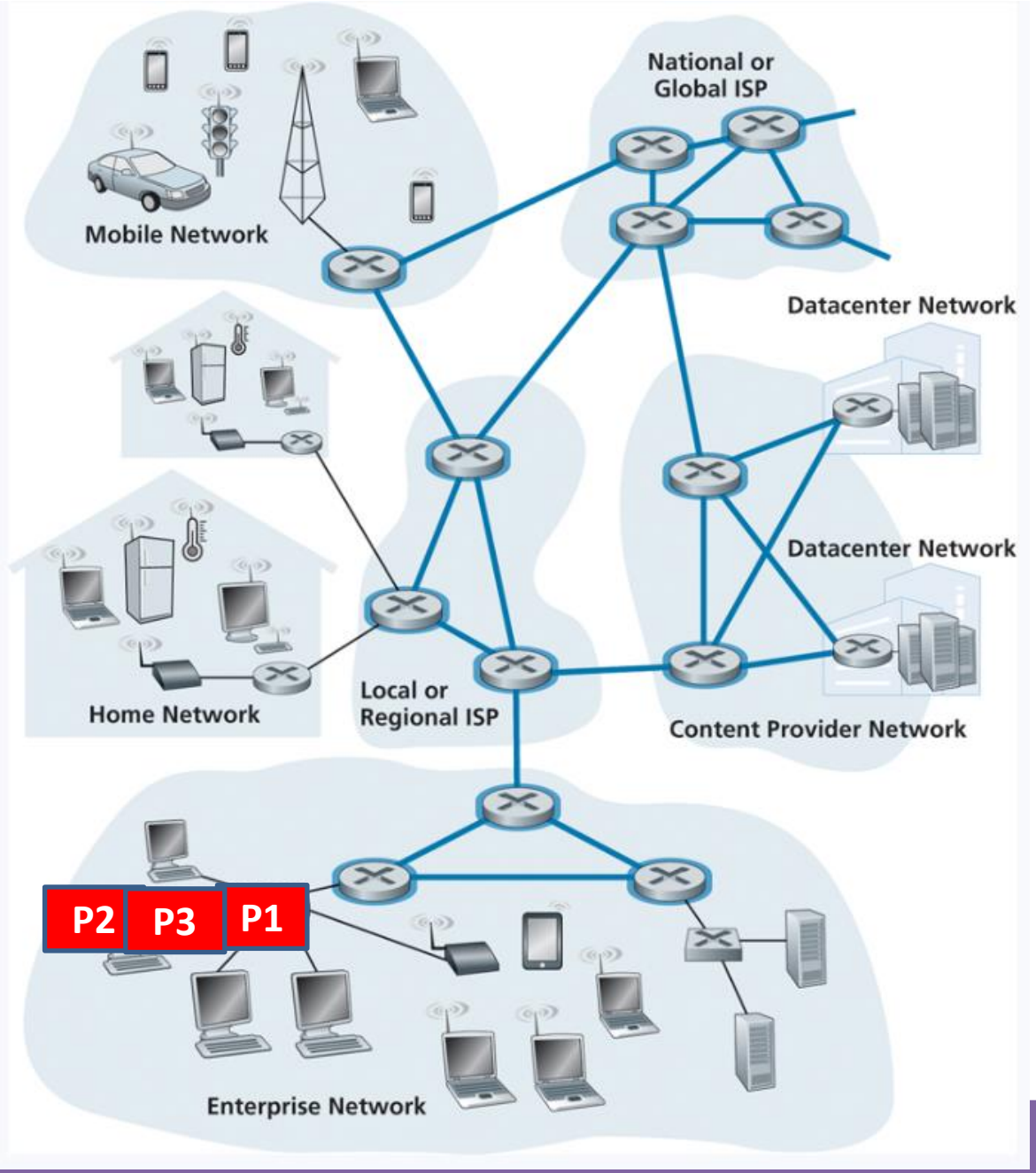
**P2**


**Solution?**

**P3**


**P1**

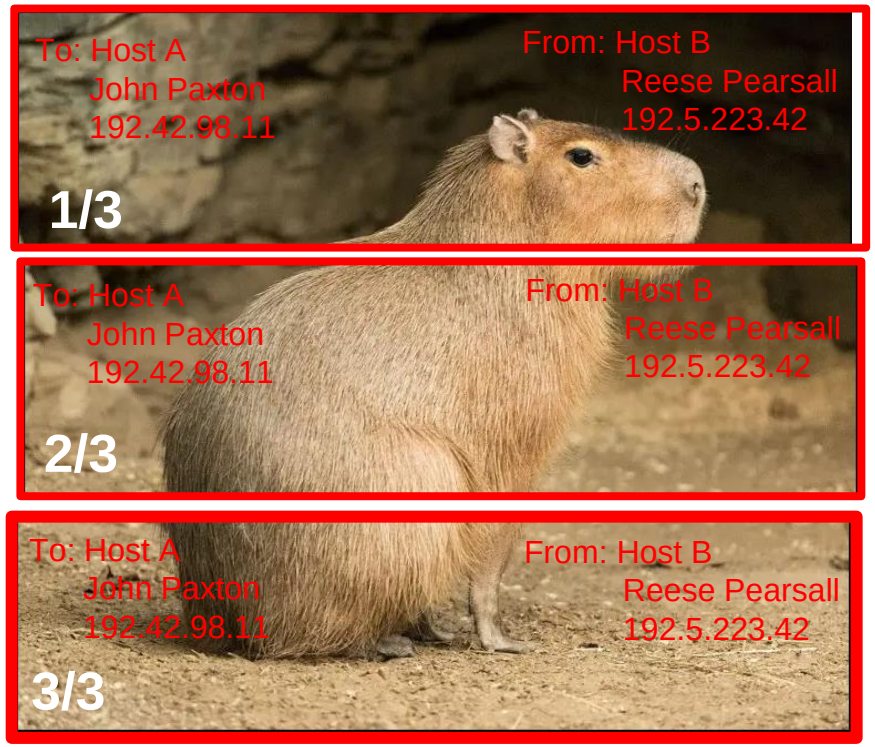
# The Network Core




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

Packets are generally small, and cannot exceed a certain size

**Final Result:**



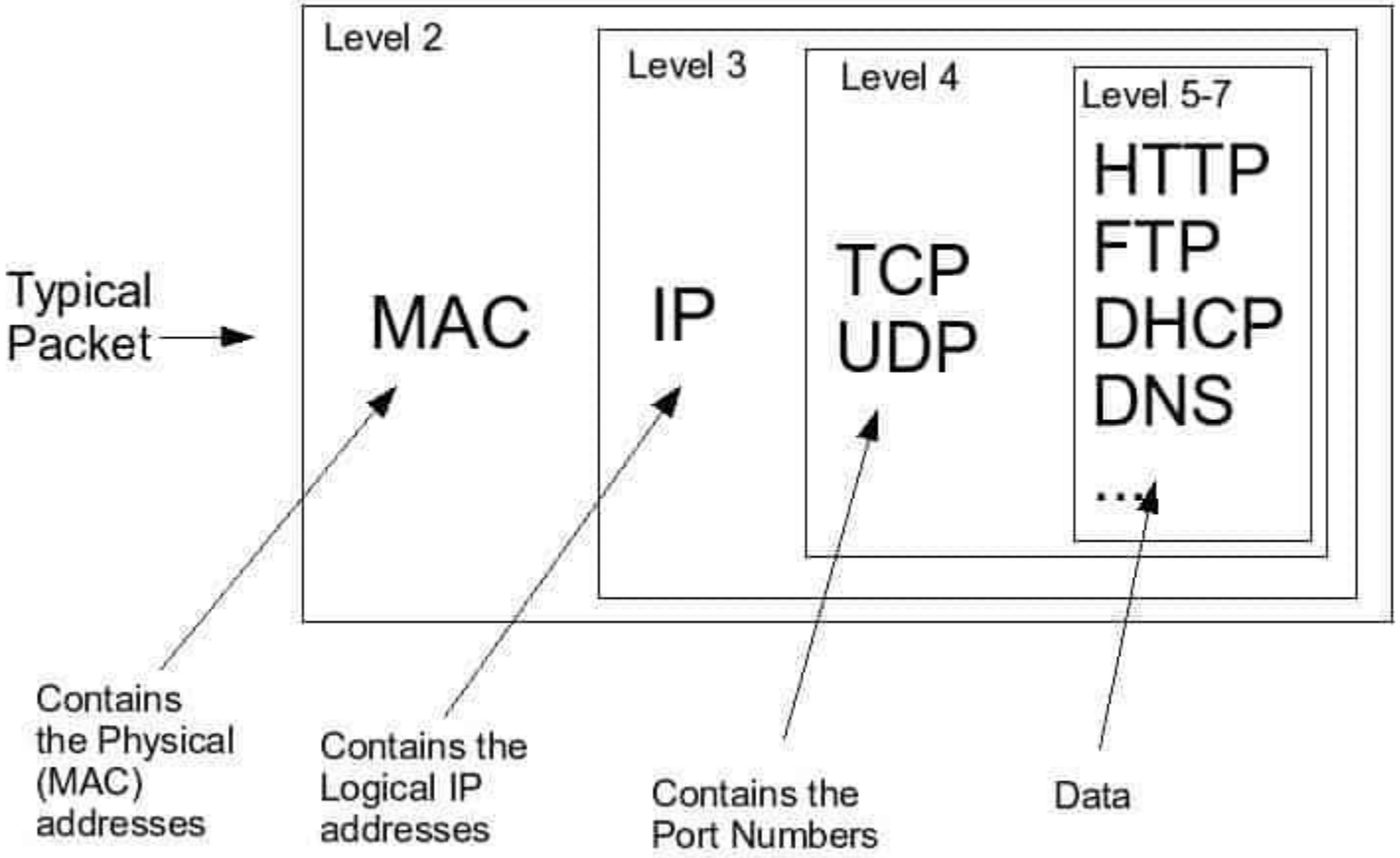

**P2**

**P3**

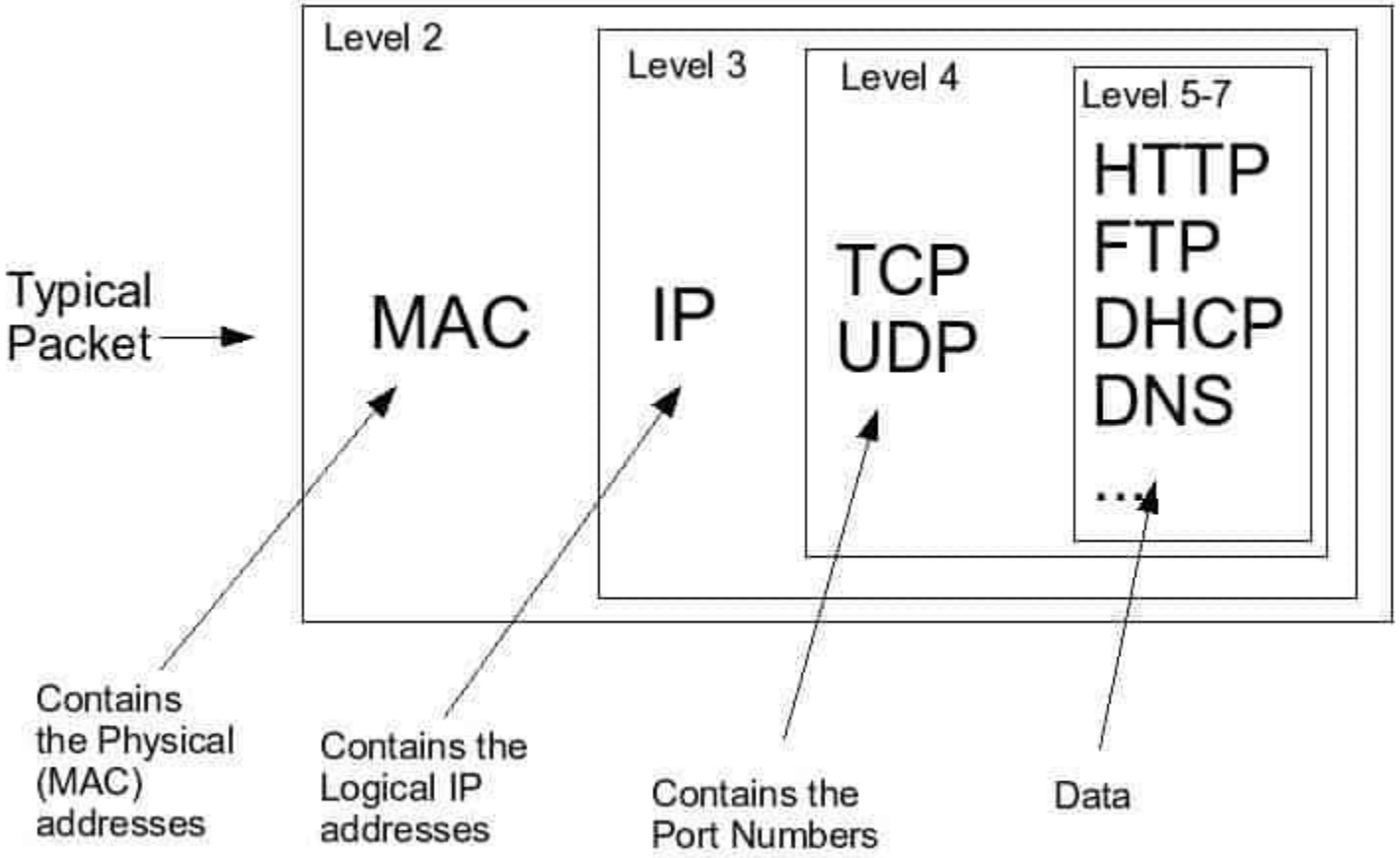
**P1**

**Solution?**

# Anatomy of a Packet

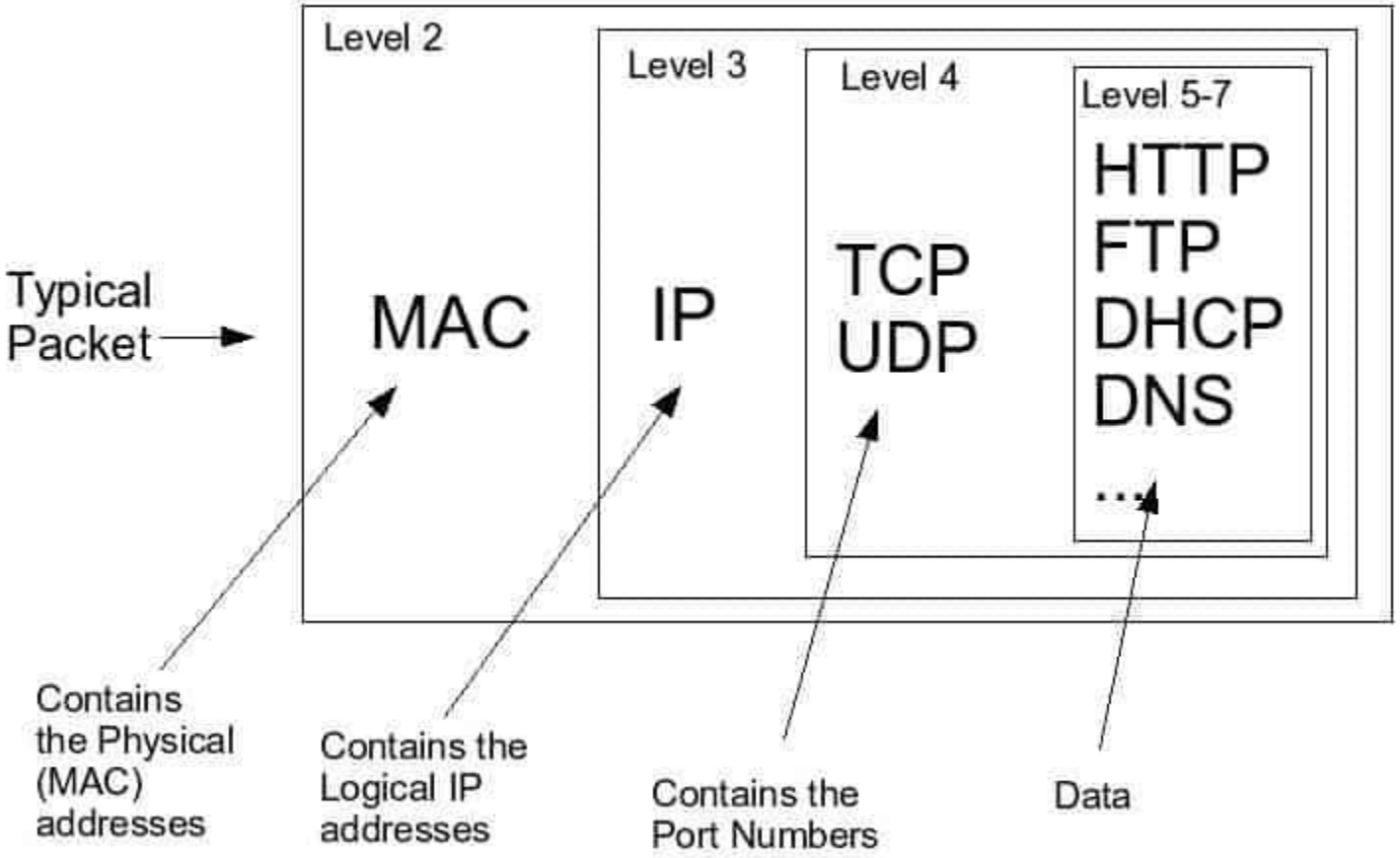


# Anatomy of a Packet



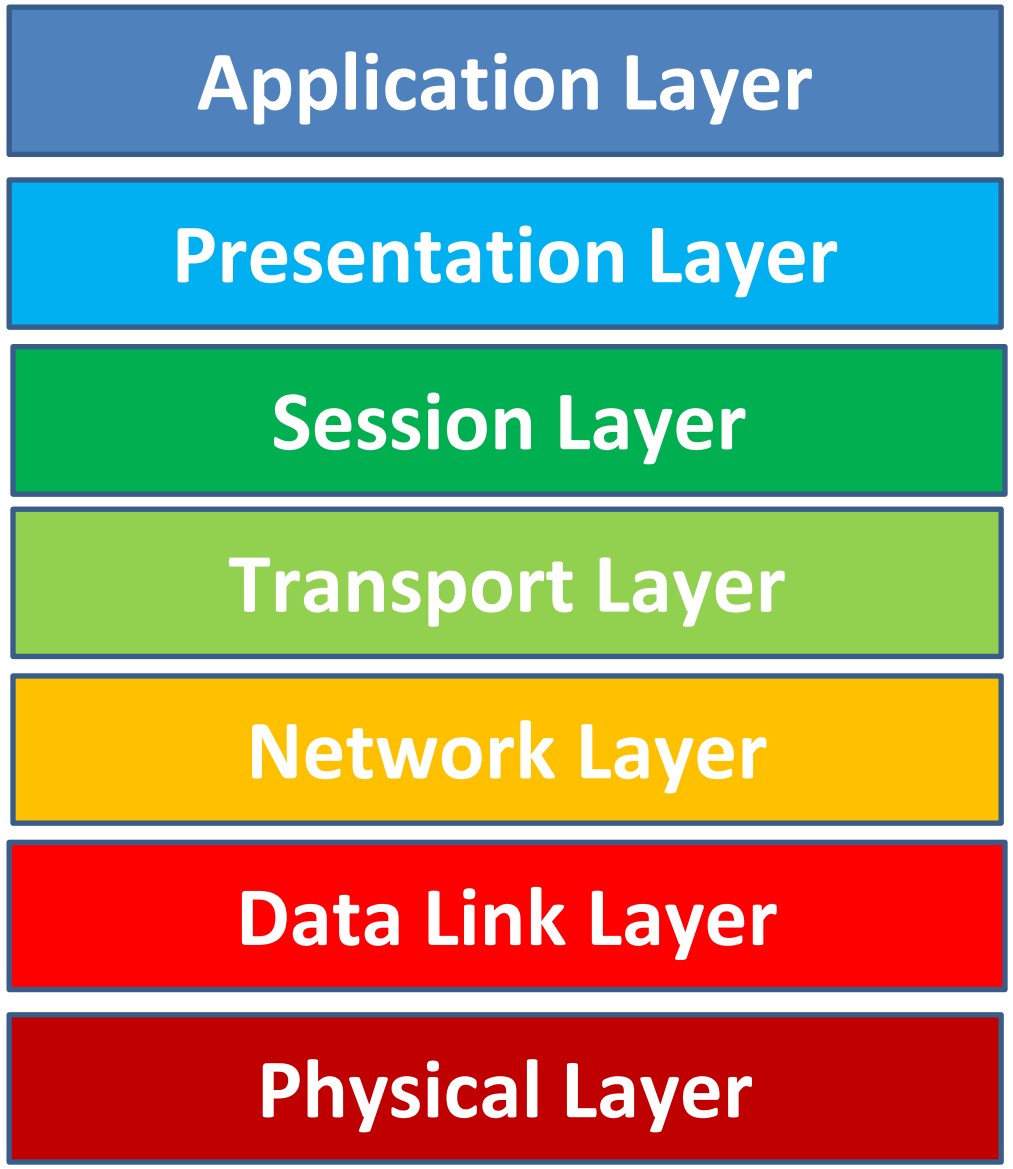

**Along the way, more information is appended to the packet!**

# Anatomy of a Packet




**Along the way, more information is appended to the packet!**

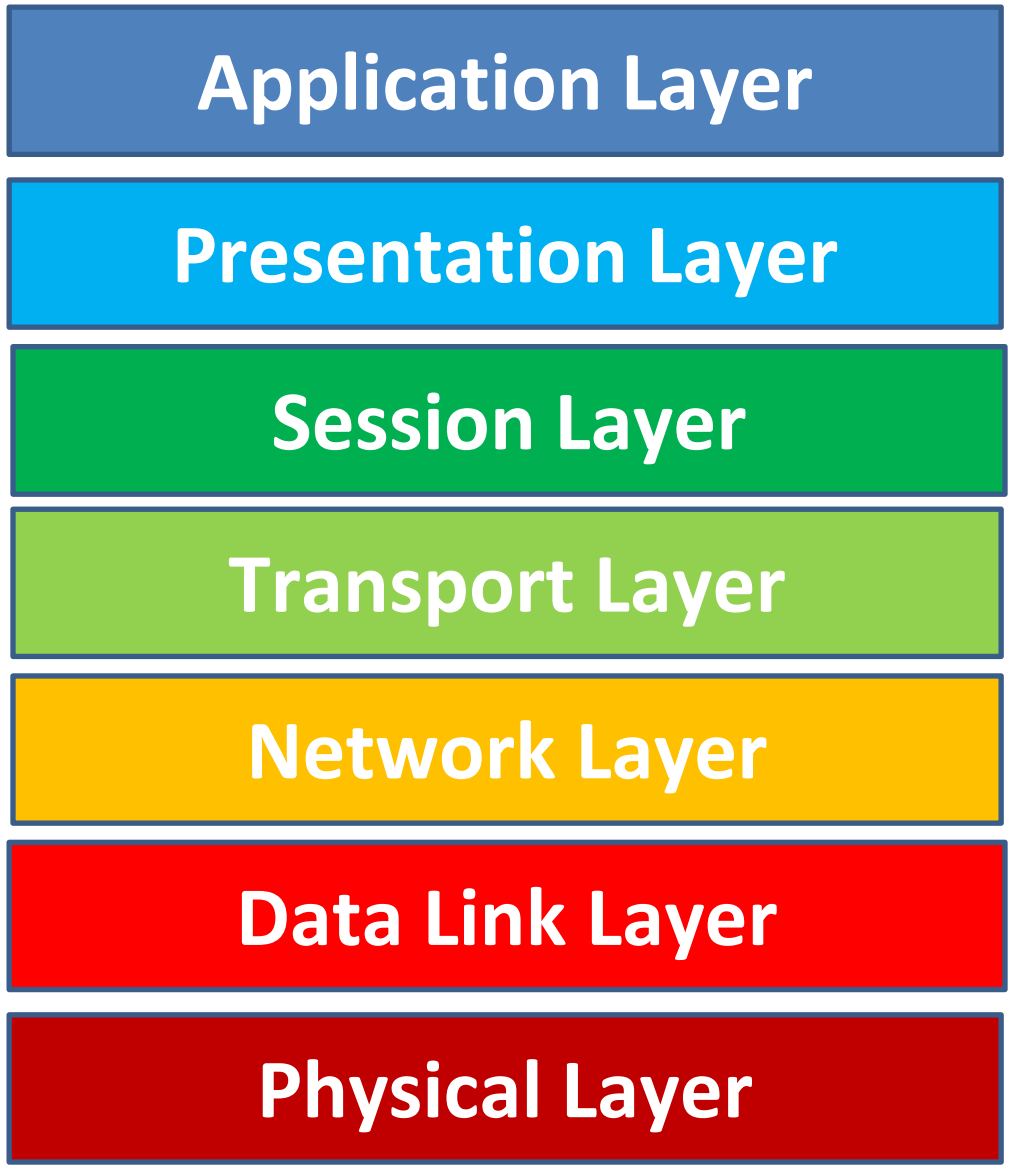
**It's a complicated system!**




# 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?