

# Lecture 01-2: What is Internet anyway

CS 326E Elements of Networking

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The title of the slide is inspired by the following video



So...

What is **Internet** anyway?

**Goal:**

**After this lecture you will be able to answer!**

# Outline

1. Goals

 2. What is Internet: Components and Architecture

3. Internet communication: Protocols and Layers

# What makes up the Internet?

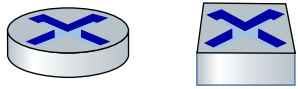
How you would explain it to 5-year olds...

# The Internet: a “nuts and bolts” view



Billions of connected computing **devices**:

- **hosts** = end systems
- runs **apps** at Internet’s “edge”



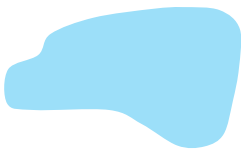
**Routers and switches**:

- forwards packets



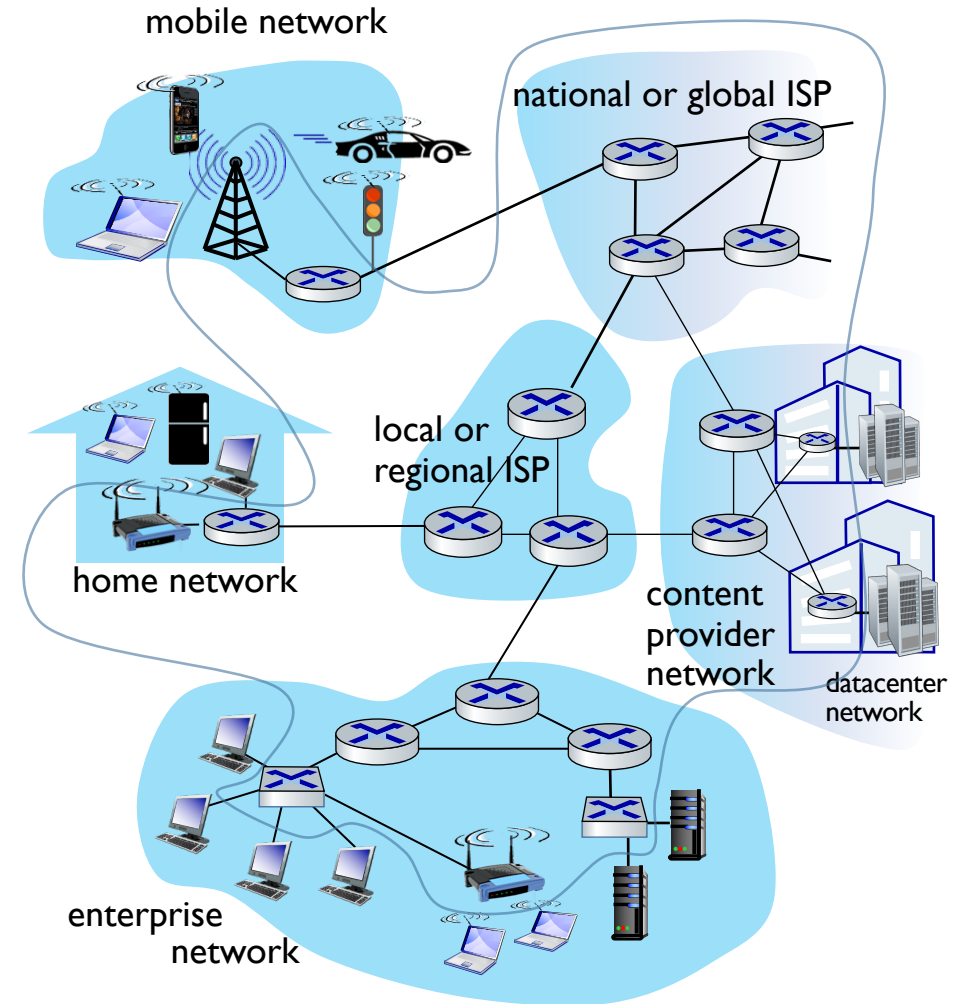
**Communication links**

- fiber, copper, radio, satellite
- transmission rate: bandwidth



**Networks**

- collection of devices, routers, links: managed by an organization

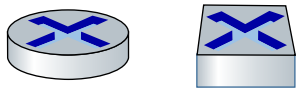


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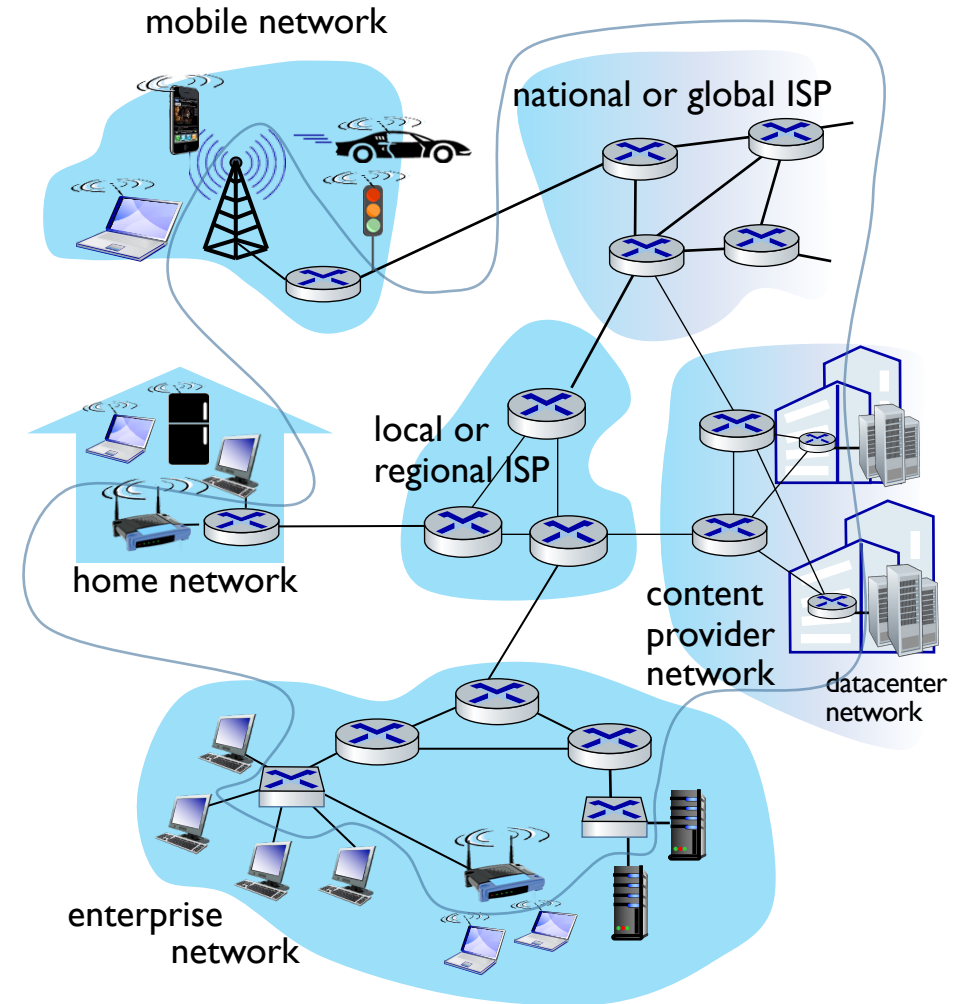
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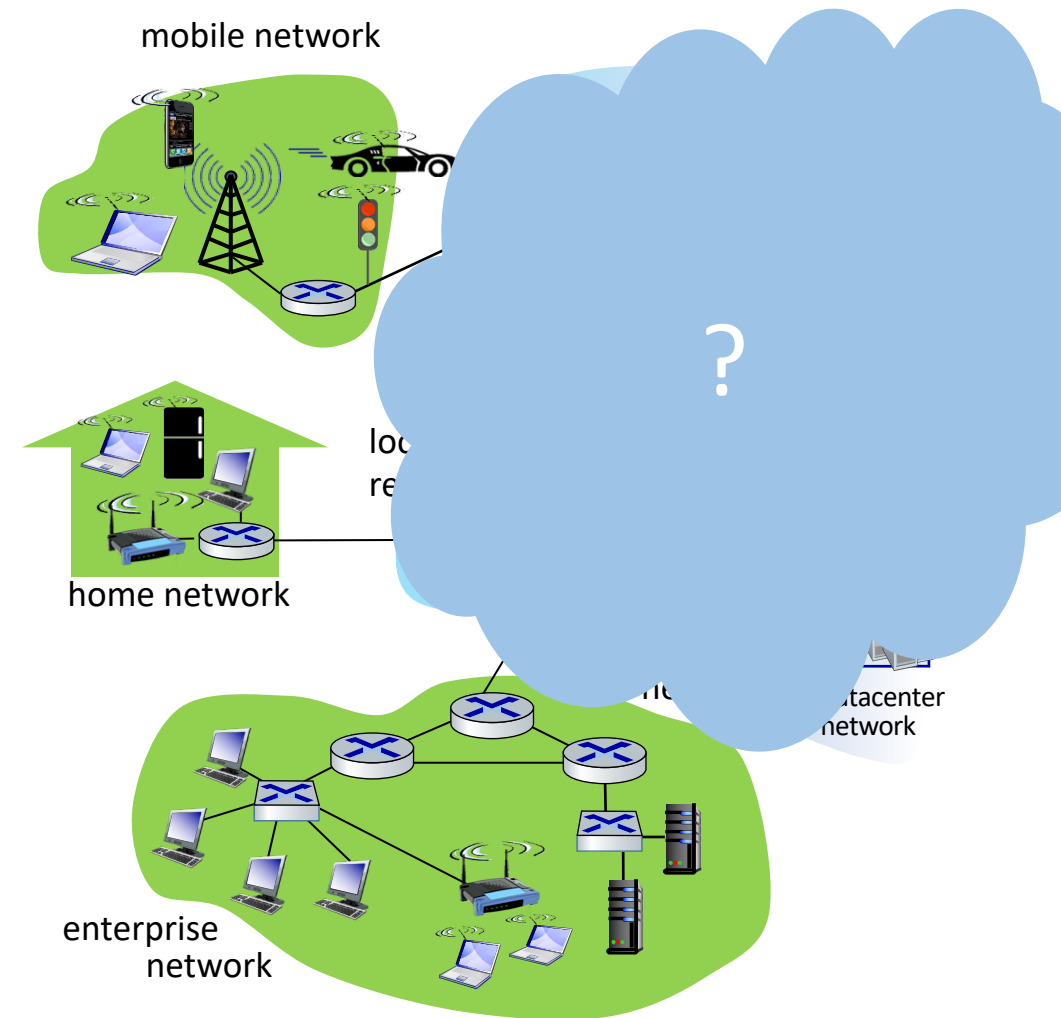
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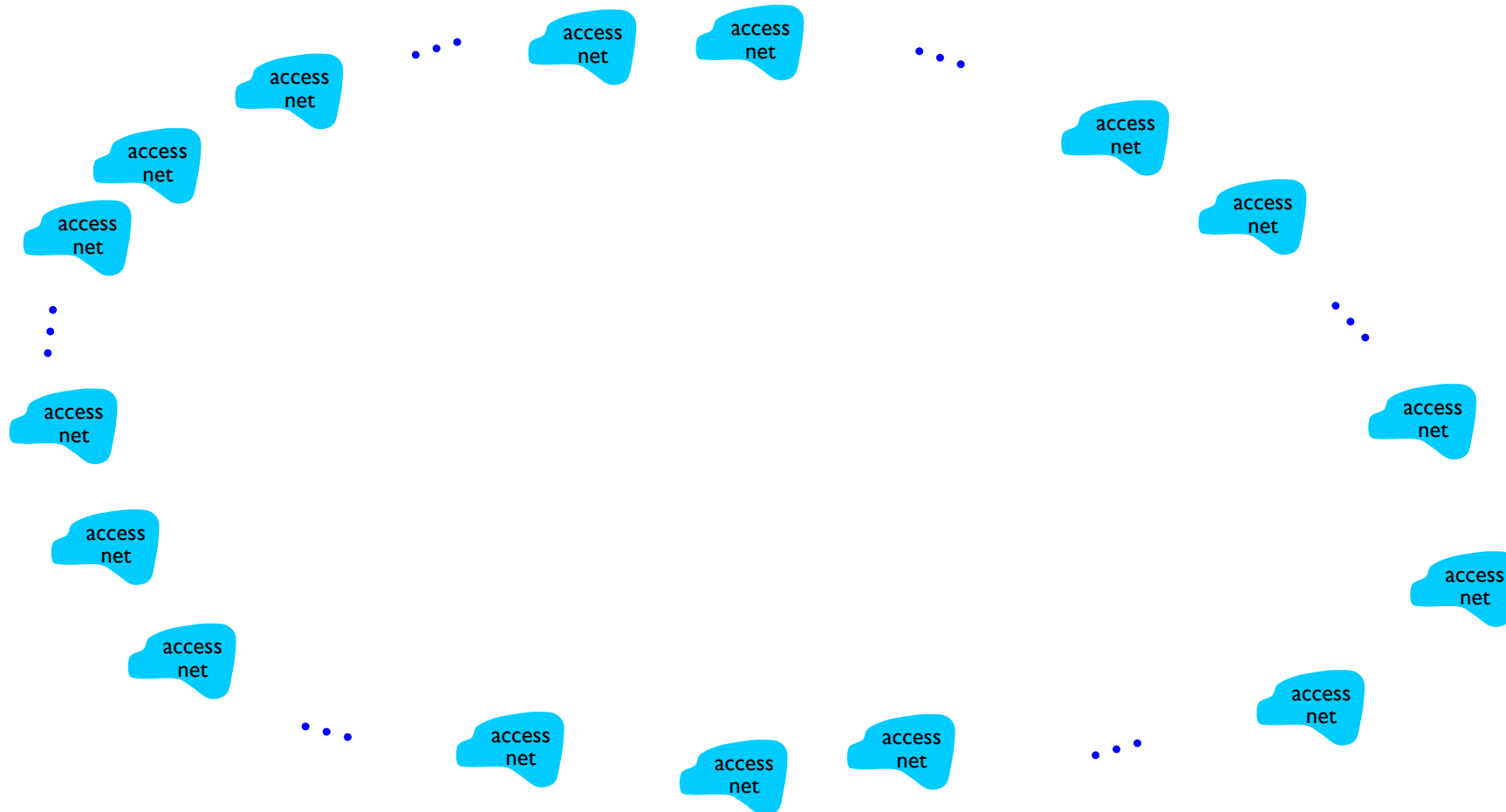
# Let's start with an **access network**

- **Access network** – the network that physically connects an end host to its **first router**
  - Types: home, enterprise, mobile network
- Hosts connect to Internet via **access Internet Service Providers (ISPs)**

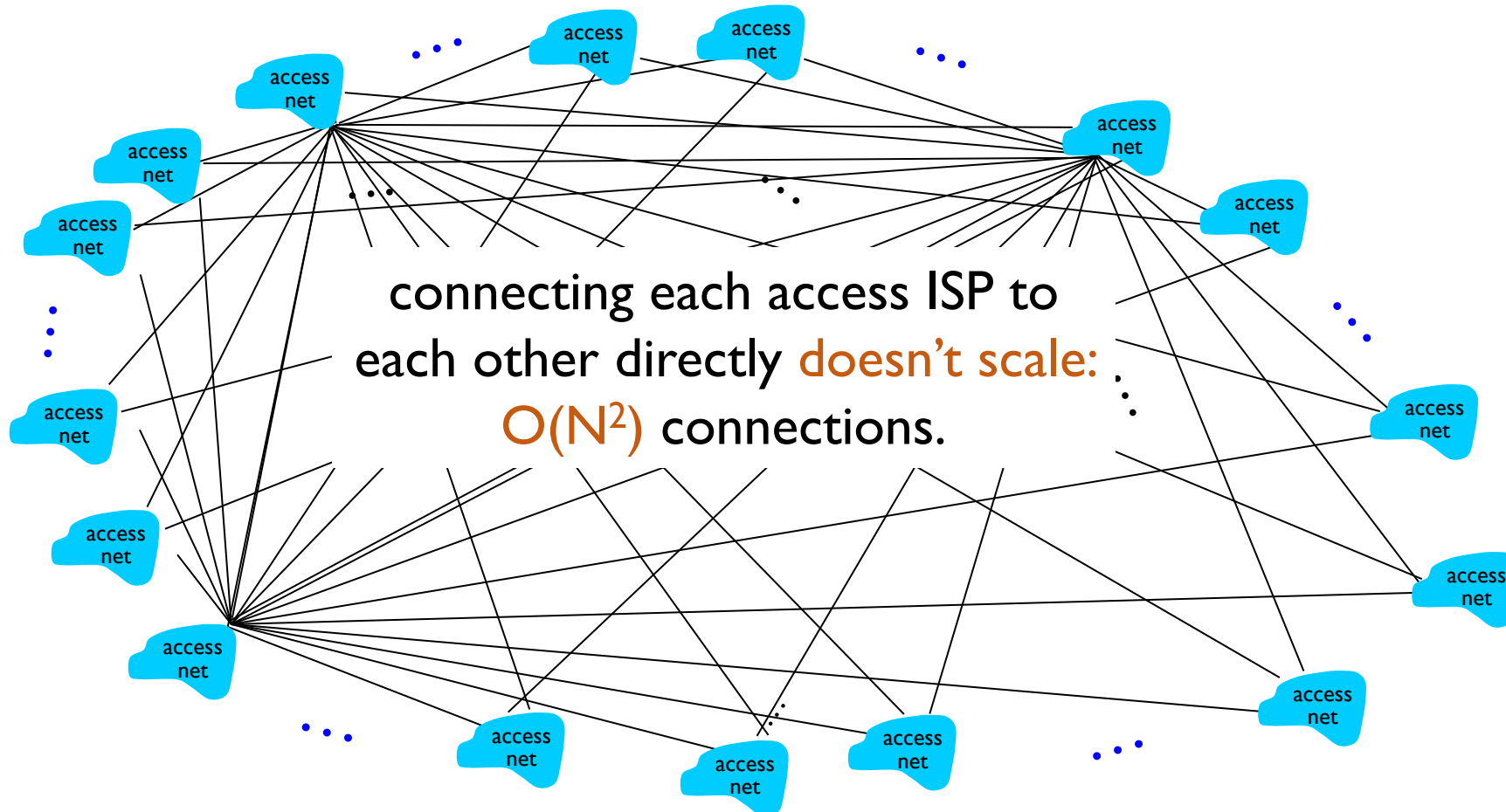


How to connect these access networks?

# Given millions of access ISPs how to connect them together?

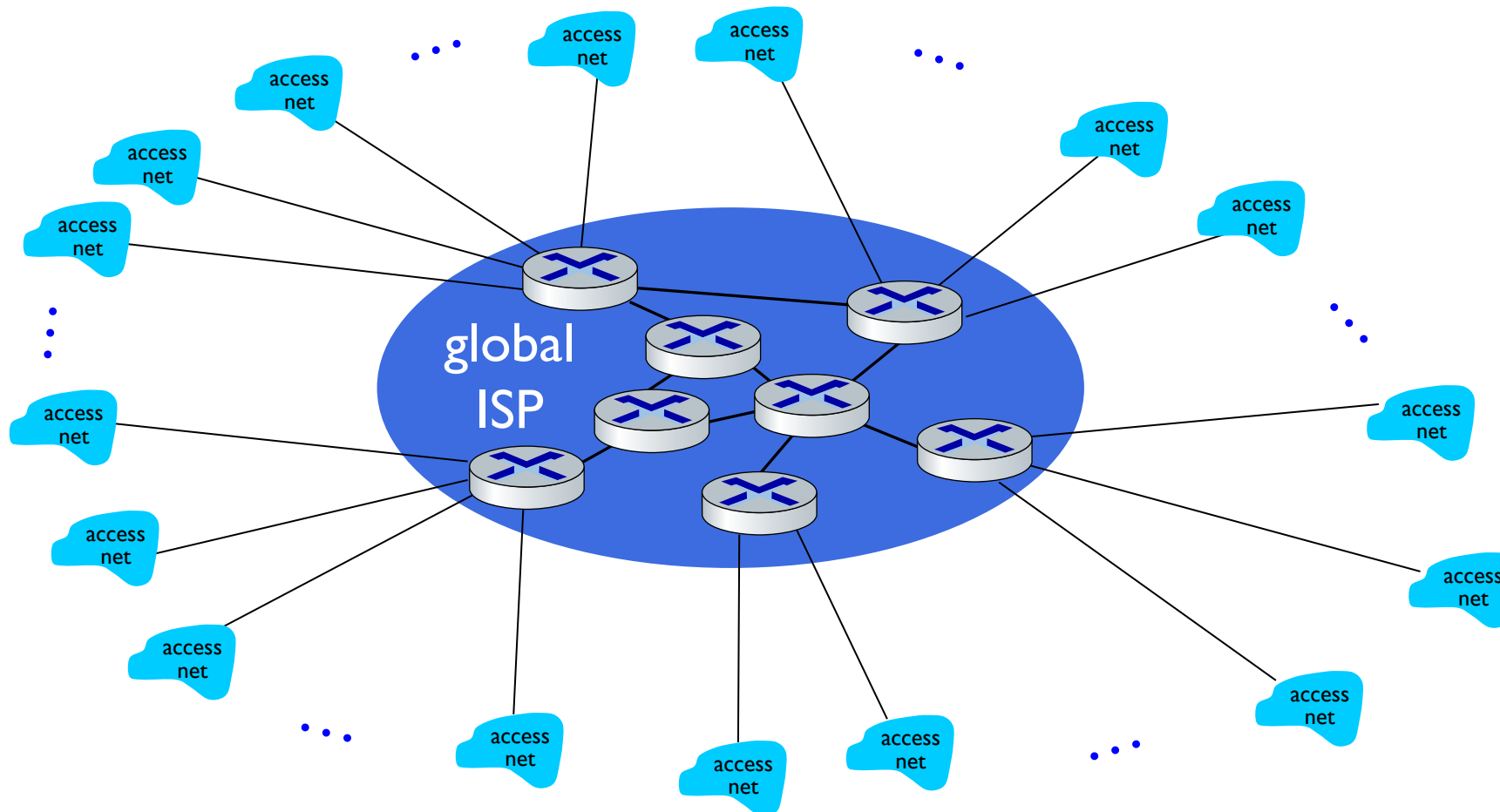


# Given millions of access ISPs how to connect them together?

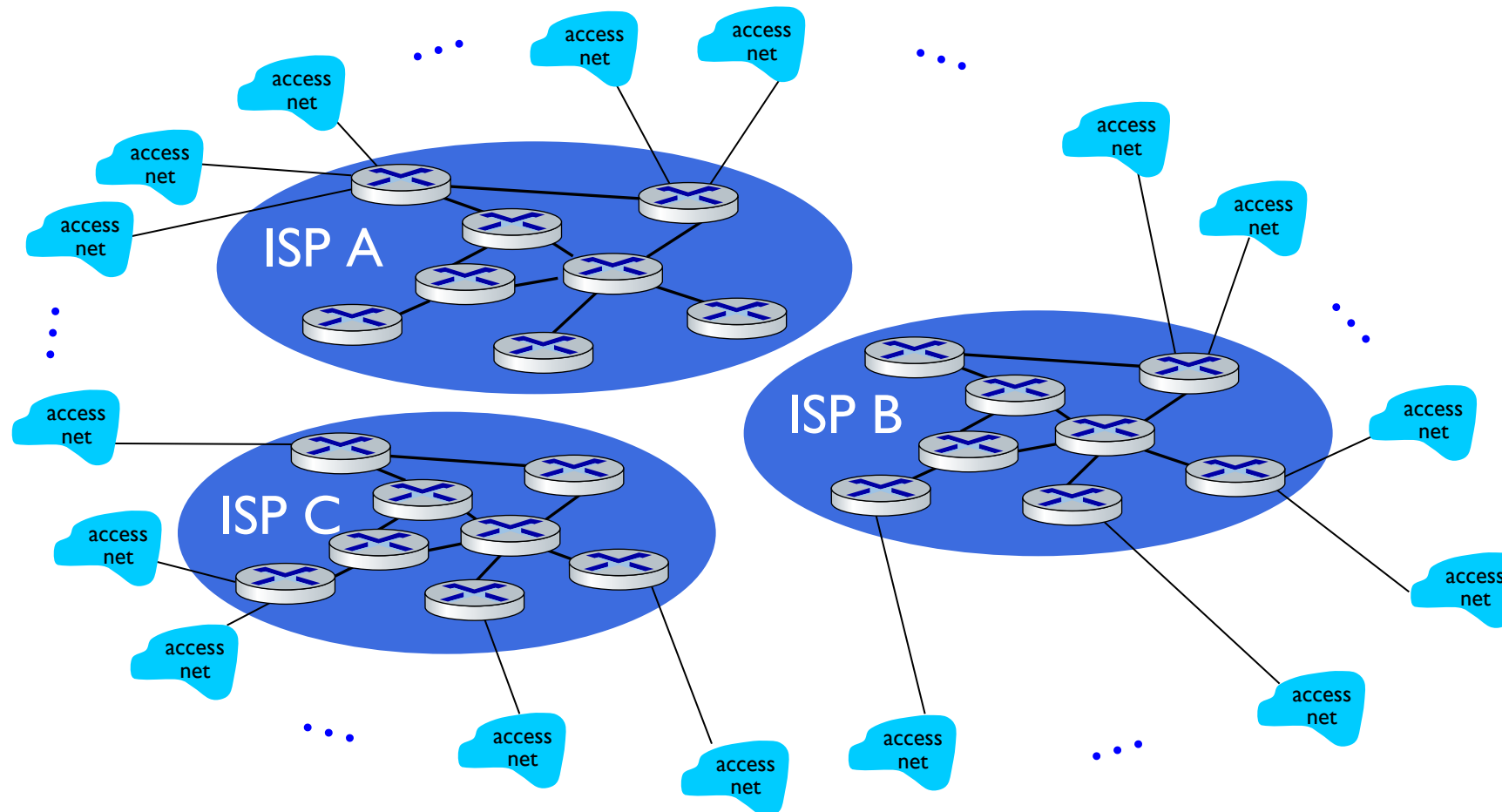


# Option: Connect each access ISP to one global transit ISP

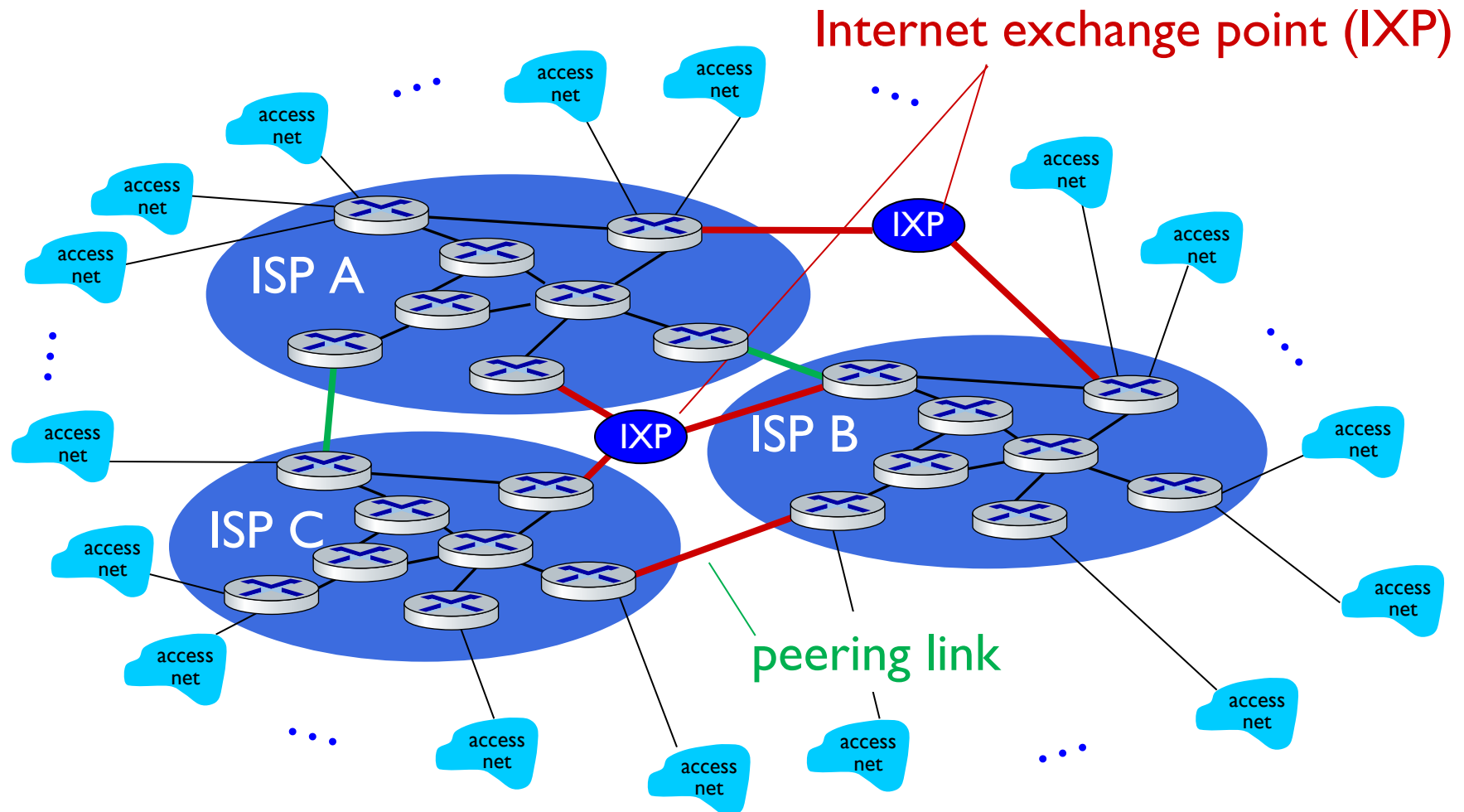
Customer and provider ISPs have economic agreement.



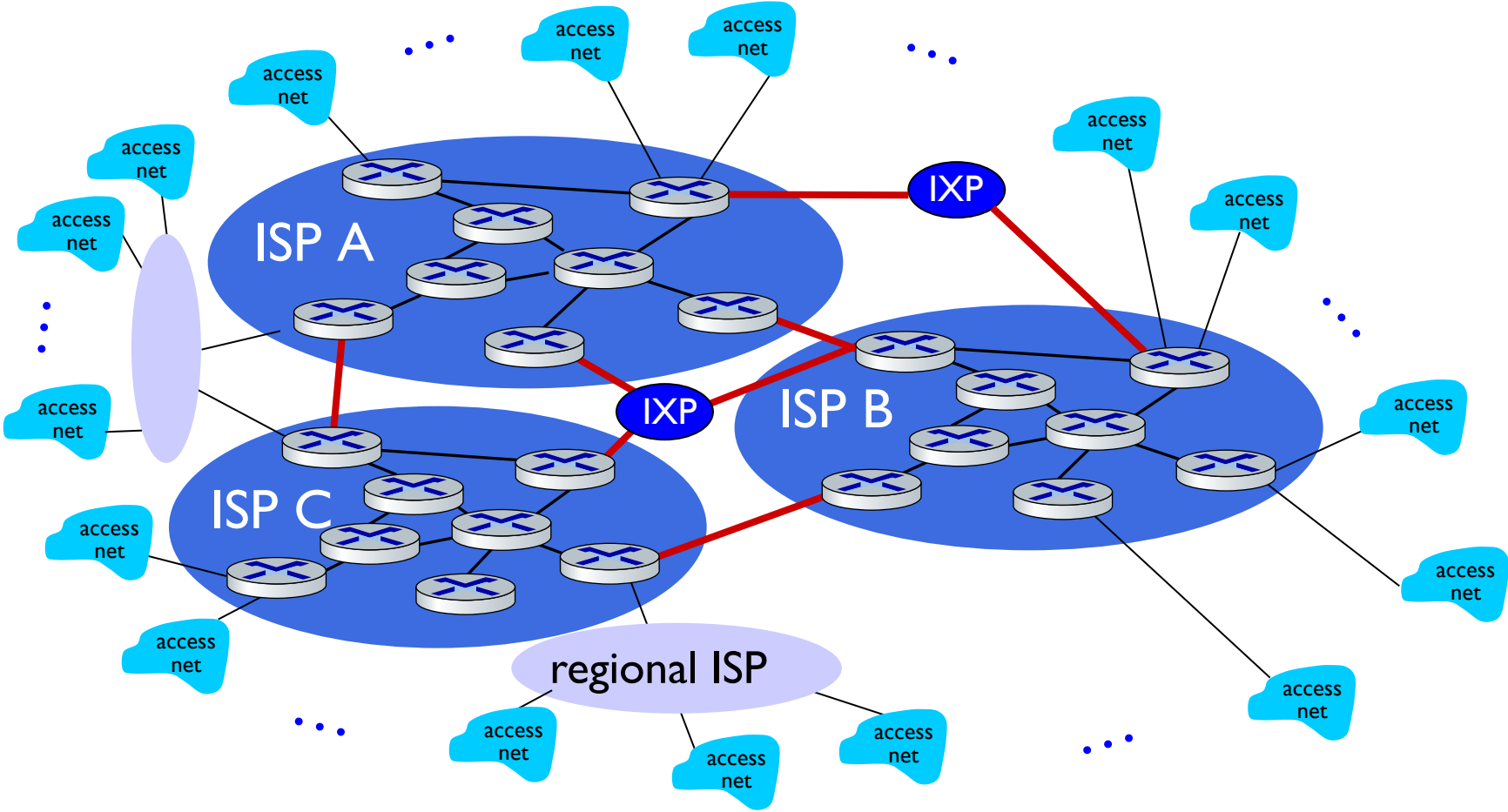
But if one global ISP is viable business, **competitors** will rise



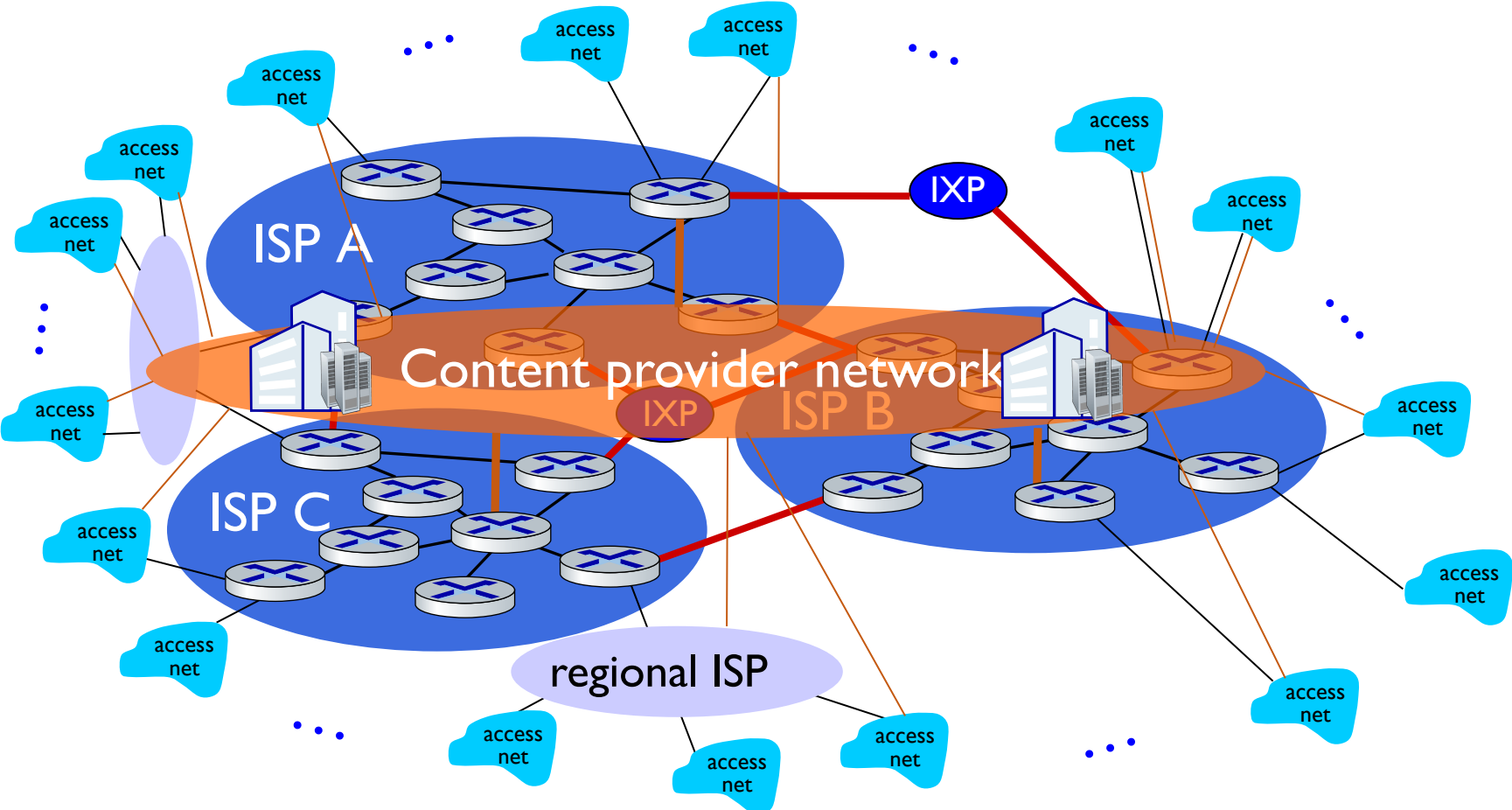
**IXP** is the physical infrastructure through which ISPs exchange Internet traffic



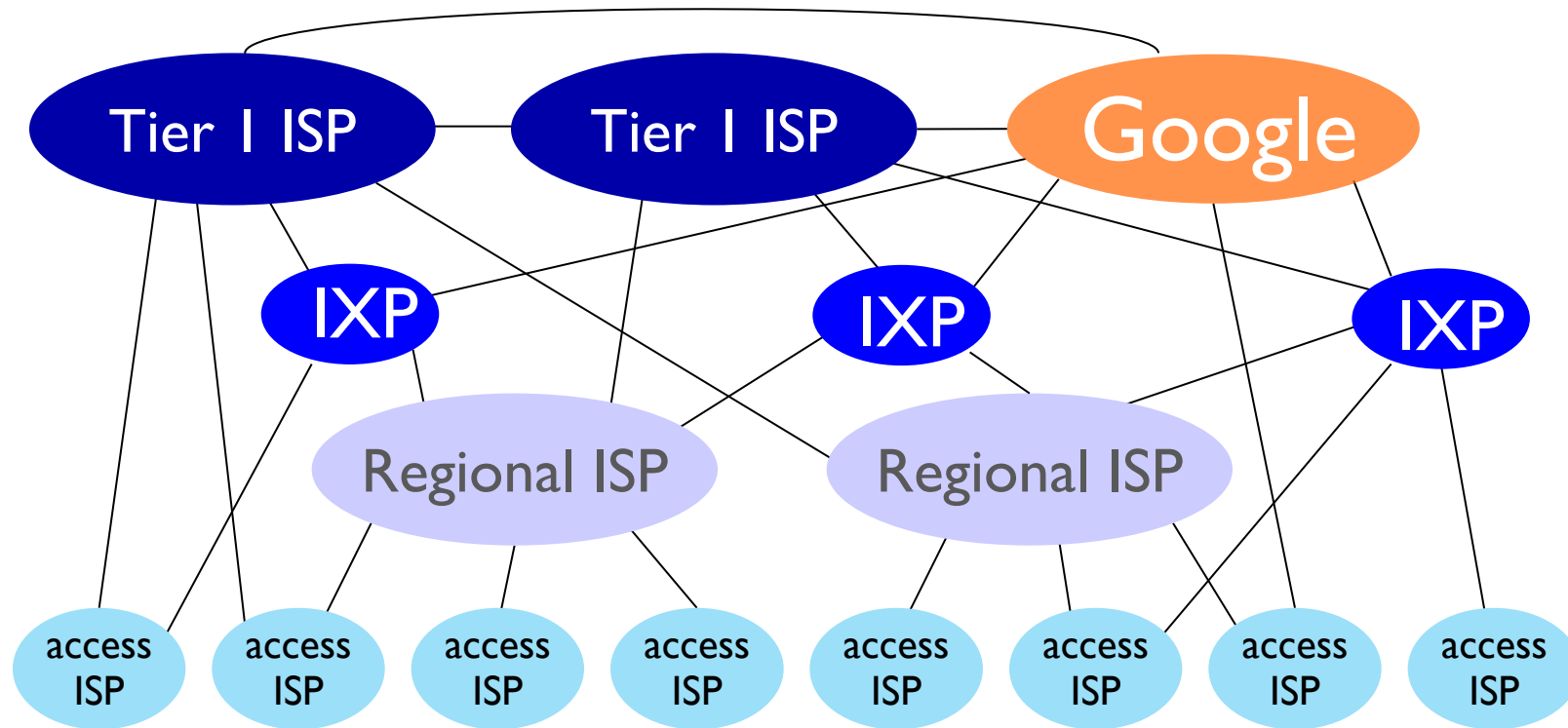
And **regional networks** may arise to connect access networks to ISPs



Also, content providers may run their own network to bring services and content close to end users



# Internet structure: a “network of networks”



At “center”: small # of well-connected large networks

- **“tier-1” commercial ISPs** (e.g., Level 3, Sprint, AT&T, NTT): national & international coverage
- **content provider networks** (e.g., Google, Facebook): private network that connects its data centers to Internet, often bypassing tier-1, regional ISPs

Now that we are connected,  
how can we communicate over these networks?

# Outline

1. Goals
2. What is Internet: the Components and the Architecture
-  3. Two basic building blocks of Internet communication

Now two entities are connected via physical medium  
What should happen next?

What would be the **basic building blocks** in network communication?

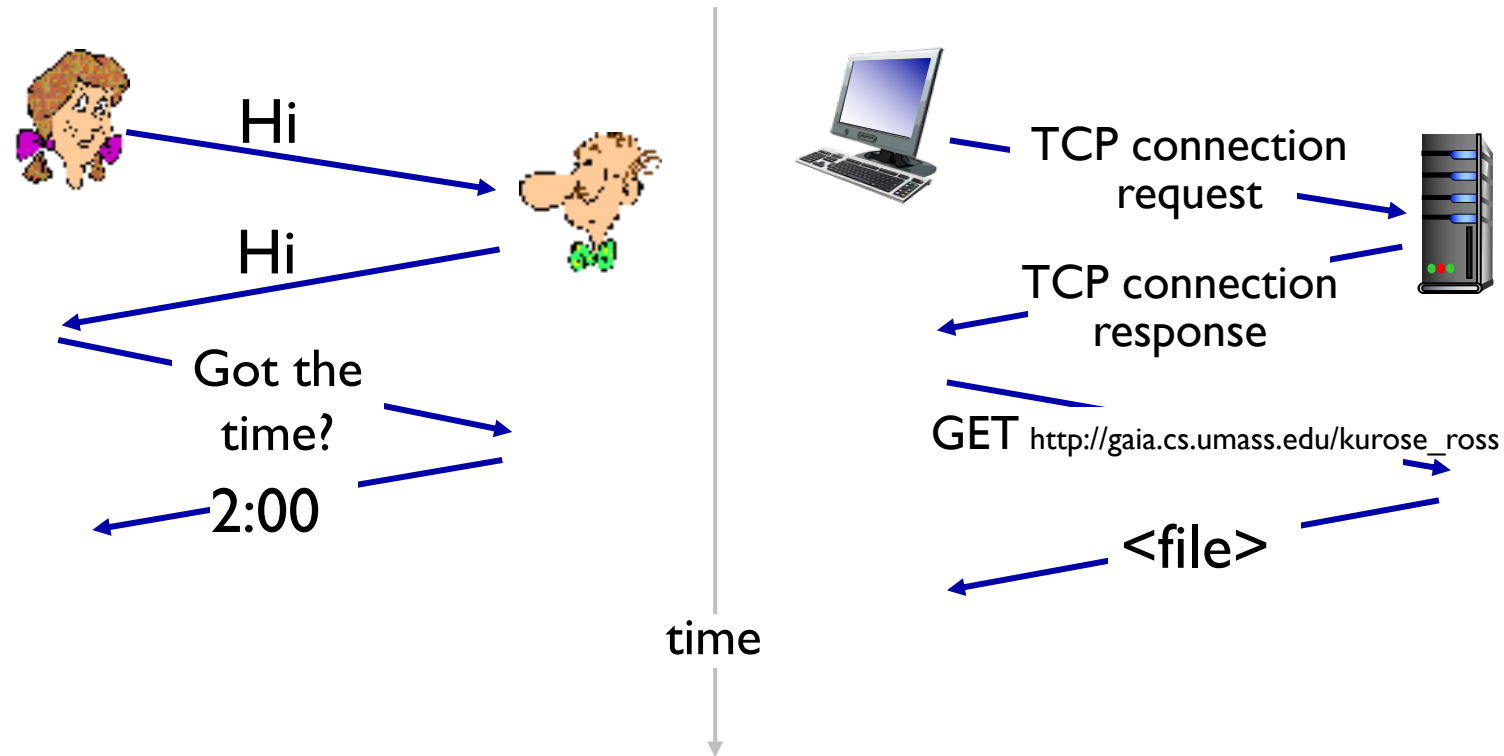
**Protocols** and **layering** are the basic building blocks in network communication

So...

What is **protocol** anyway?

# Why protocol?

Need to agree on who/when/how/what we will communicate

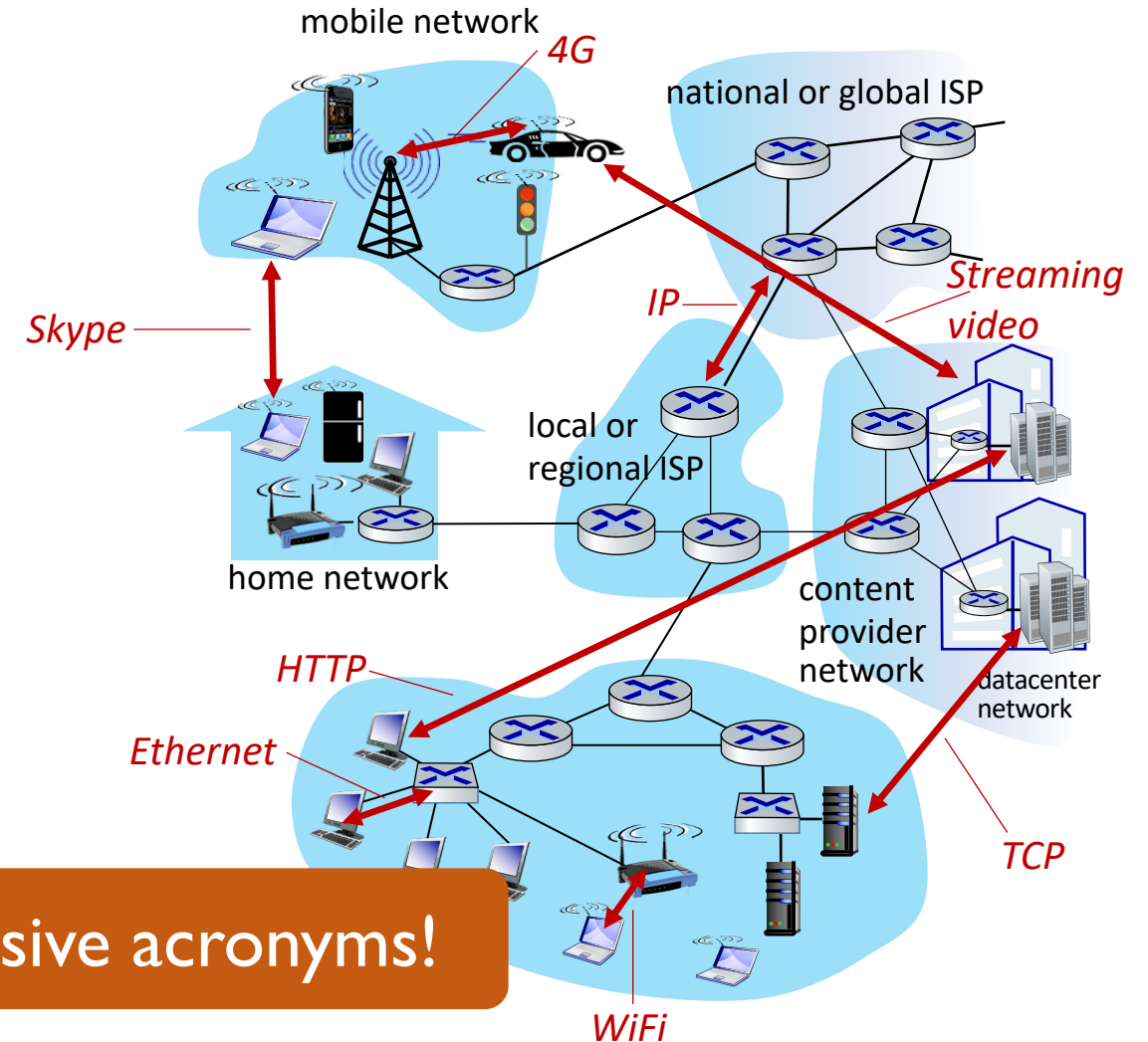


A human protocol vs computer network protocol

# Protocols specifies how messages should be sent and received among network entities

HTTP, TCP, IP, ARP, DHCP, DNS, FTP, ICMP, IGMP, IMAP, LDAP, POP3, NTP, MAC, BGP, IRP, PTP, SNMP, SSH, TLS, SIP, RTSP, XMPP, etc..

Protocols follow **Internet standards** maintained by **Internet Engineering Task Force (IETF)**



Welcome to the world of excessive acronyms!

# Why layering?

# What are the layers?

# Layers in Internet Protocol Stack

HTTP, SMTP, Skype

Application

TCP, UDP

Transport

IP

Network

Ethernet, WiFi

Link

802.3 PHY

Physical

Example Protocols

Layers

Responsible for

FTP, HTTP, SMTP

Application

application specific needs

TCP, UDP

Transport

process to process data transfer

IP

Network

host to host data transfer across different network

Ethernet, WiFi

Link

data transfer between physically adjacent nodes

802.3 PHY

Physical

bit-by-bit or symbol-by-symbol delivery

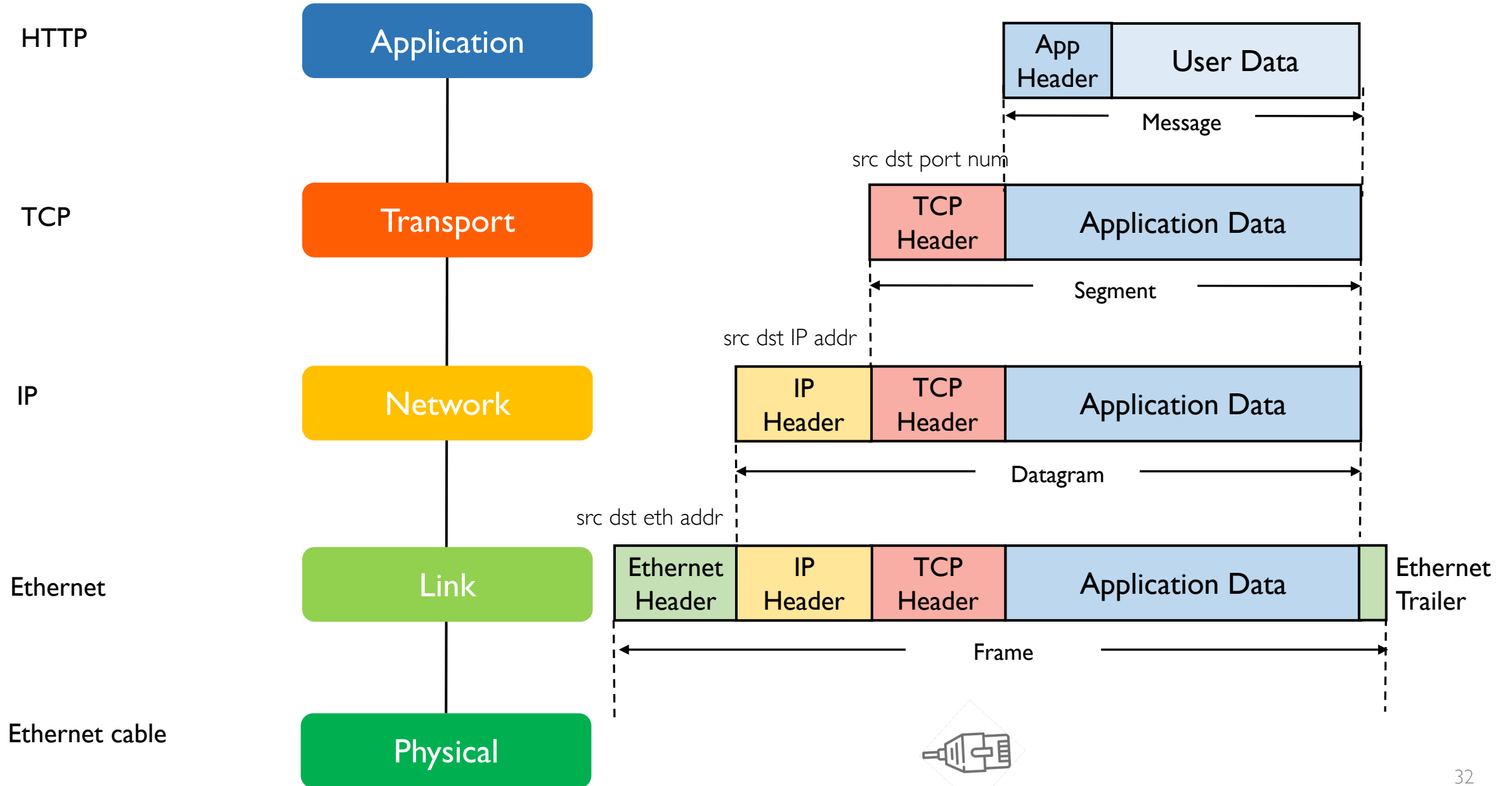


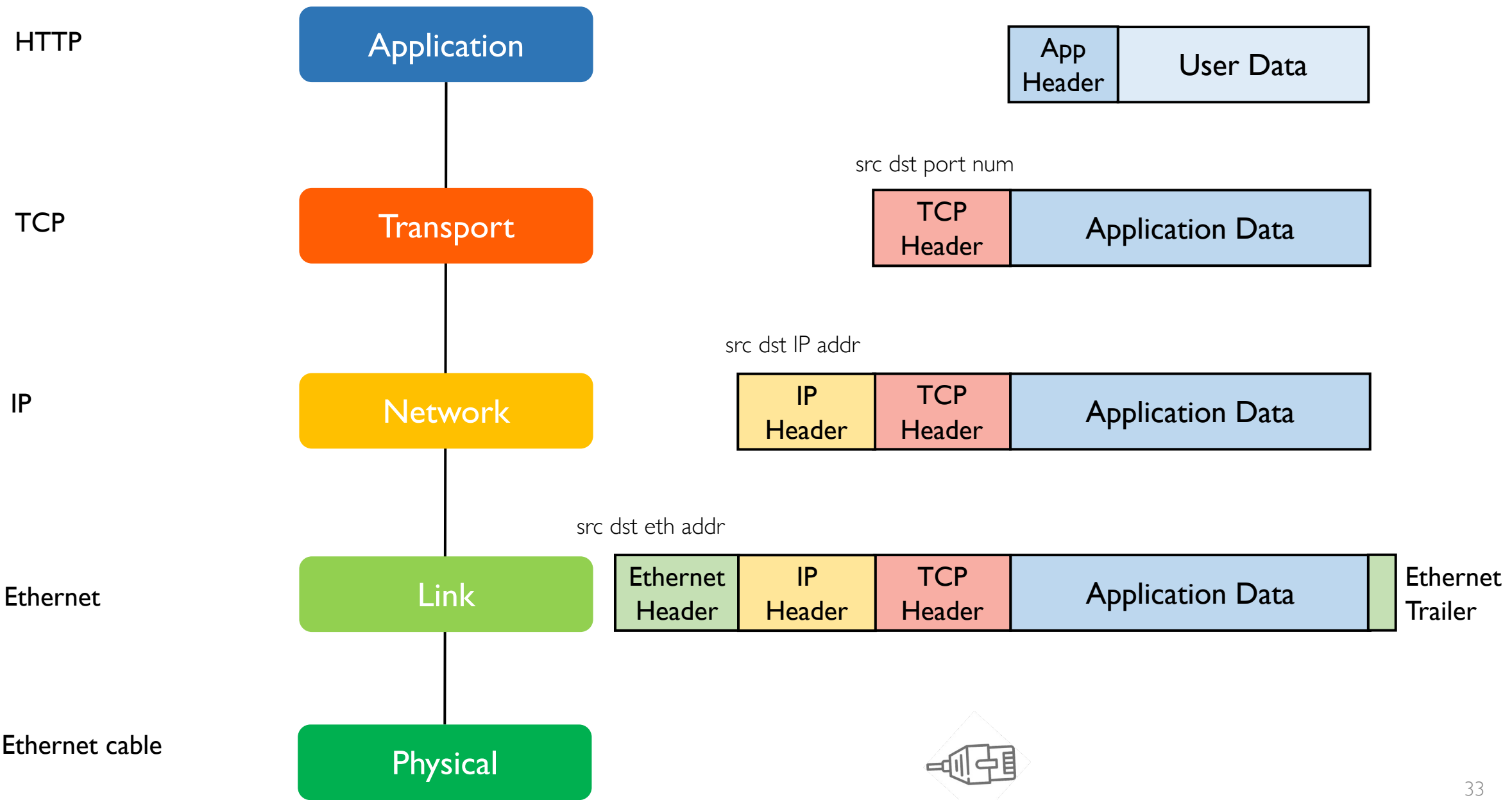
# Need to solve various interesting problems



- How to share the same link between multiple users?
- How to do node discovery?
- How to determine the number of hops and routes to take?
- How to ensure the data is indeed received
- How to ensure multiple packets would be delivered in order?
- What if the other party is sending too fast?
- How to ensure the communication is safe?
- How to ensure “Bob” is really “Bob”?
- ...

Assign each problem to an appropriate layer(s)!





# Pros and cons of layering



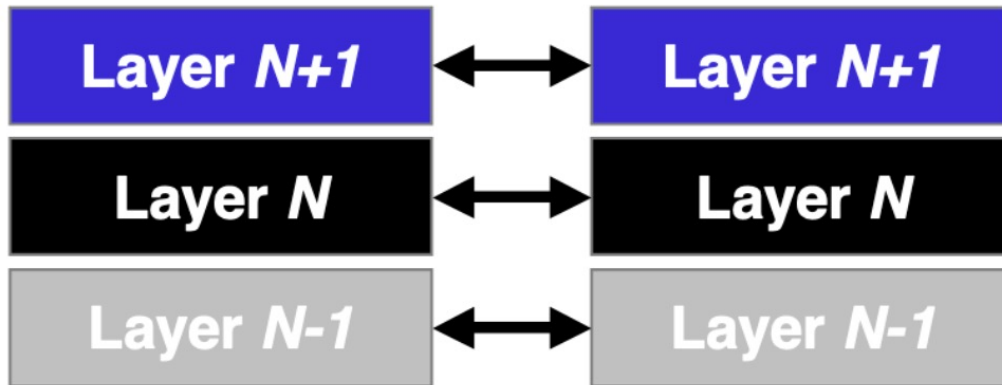
# True/False

- A protocol always involve two communicating parties
- The two communicating parties can be from different layers

Note:

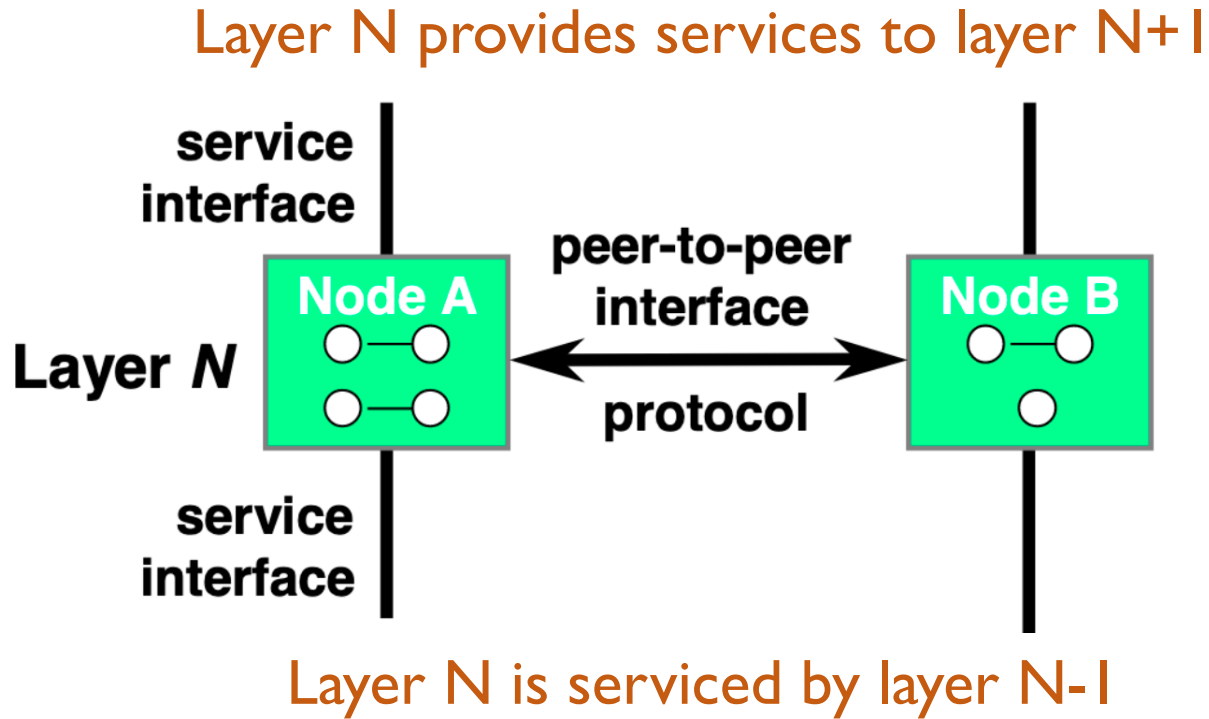
**Protocols** are horizontal and **layers** are vertical

**Protocols** provides ways  
for peers to communicate **horizontally**



Layer N ONLY interact with peers  
in the same layer N via protocol

Each **layer** provides service to their upper layer



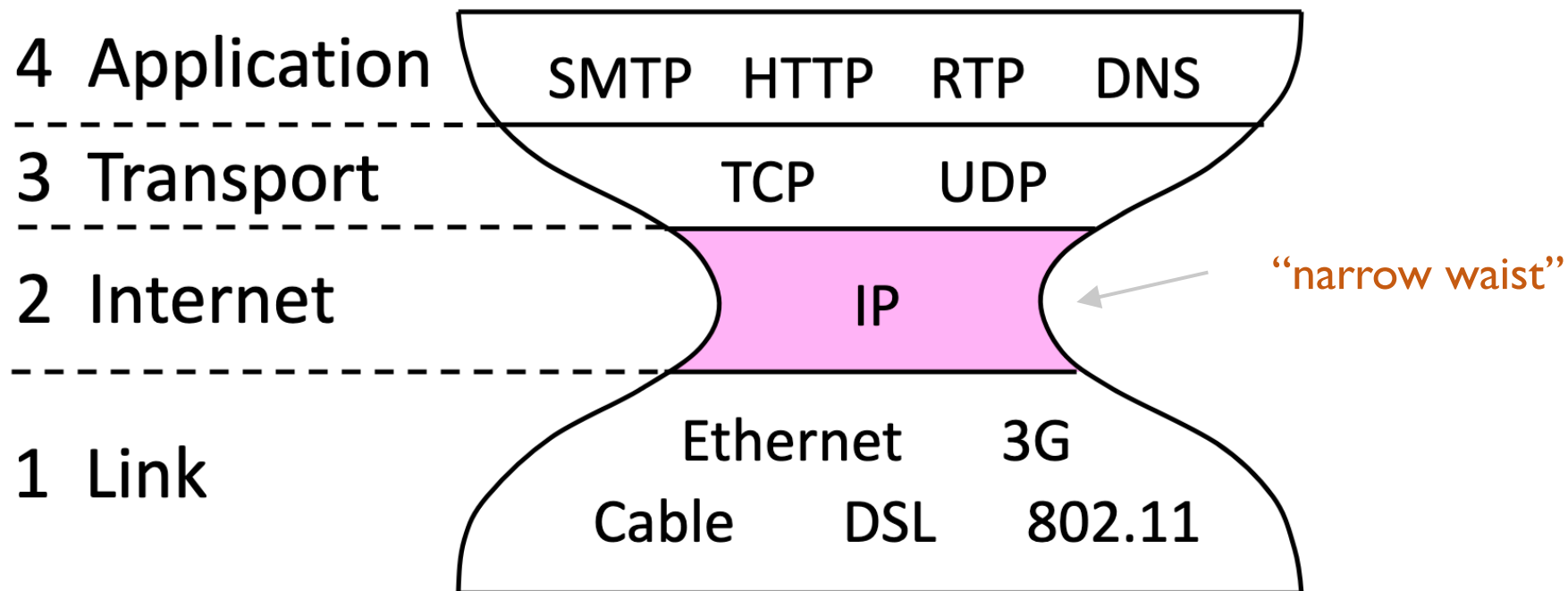
In summary,  
What is **Internet** anyway?

# Backup Slides

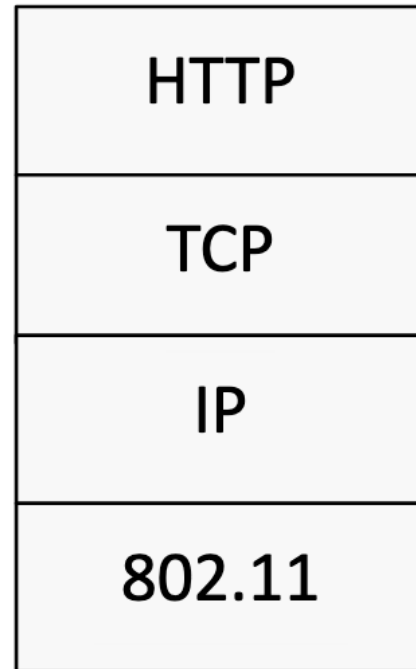
Some more concepts and terms..

# Hourglass: IP is the “narrow waist” of the Internet

- Supports many different apps above and links below

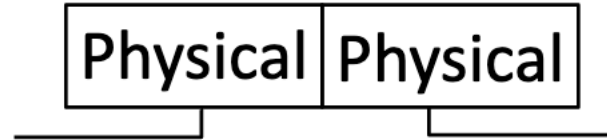


“Protocol stack” refers to a set of protocols in use

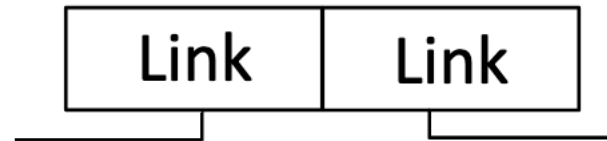


# Repeater vs switch vs router vs proxy

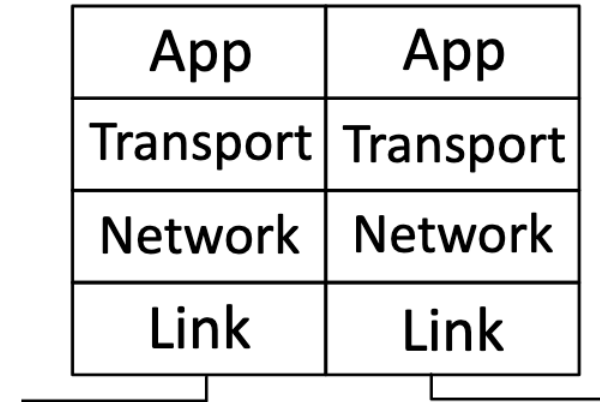
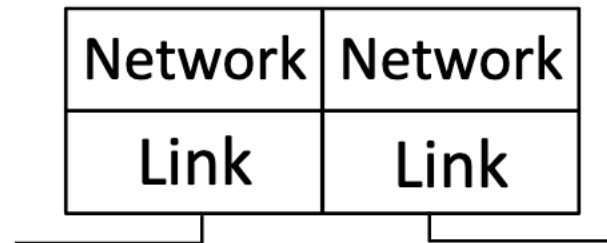
Repeater (hub)



Switch (bridge)



Router



Proxy

But they all look like this! 😊



# Acknowledgements

Slides are made based on

- James Kurose's slides