

Introduction to Internet #1

Introduction to Internet and Web



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01. WHAT IS THE INTERNET?

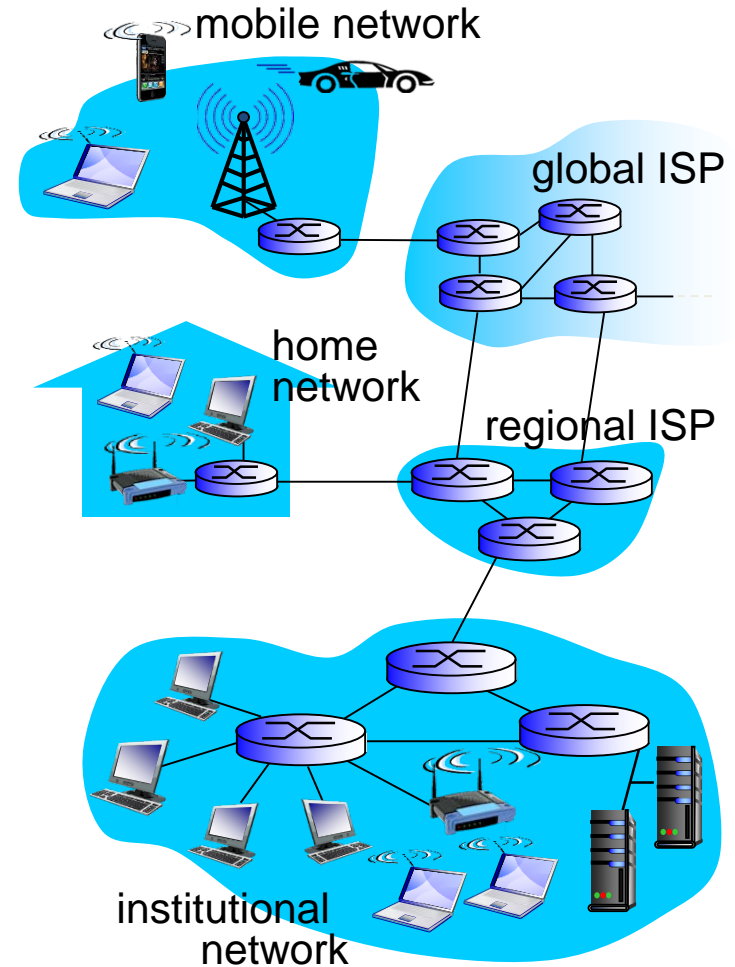
What is the Internet?

❖ **Internet** = Inter- + net (work)

▪ “network of networks”

❖ Various types of networks

▪ Internet Service Provider (ISP)



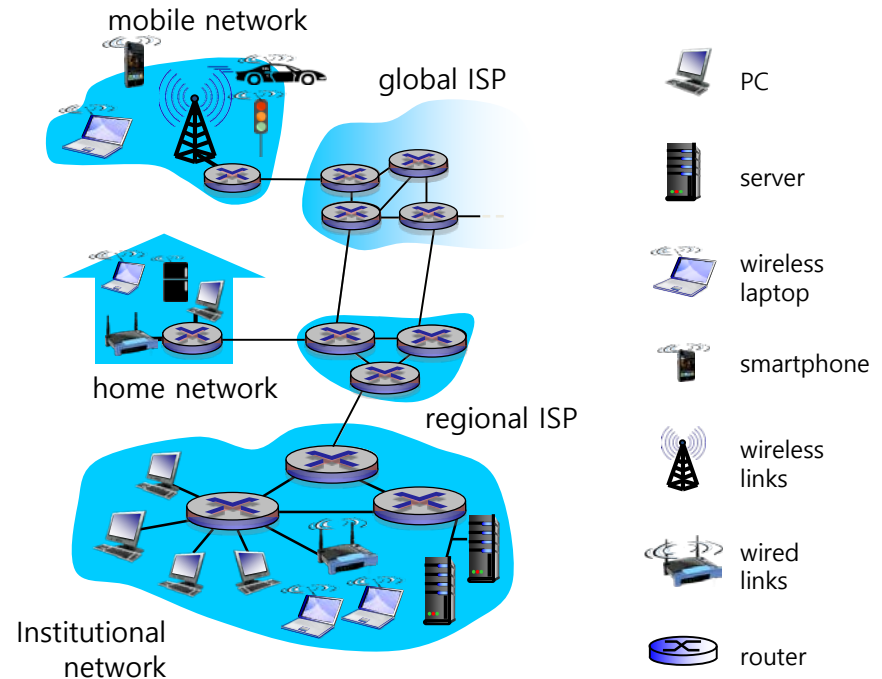
What Compose the Internet?

❖ HW components

- hosts (=end systems)
 - Packets (chunks of data)
- interconnection devices
 - Routers and switches
- links
 - copper, fiber, radio, satellite

❖ SW components

- operating software
- application programs
- protocols



Communication Protocol

❖ Definition

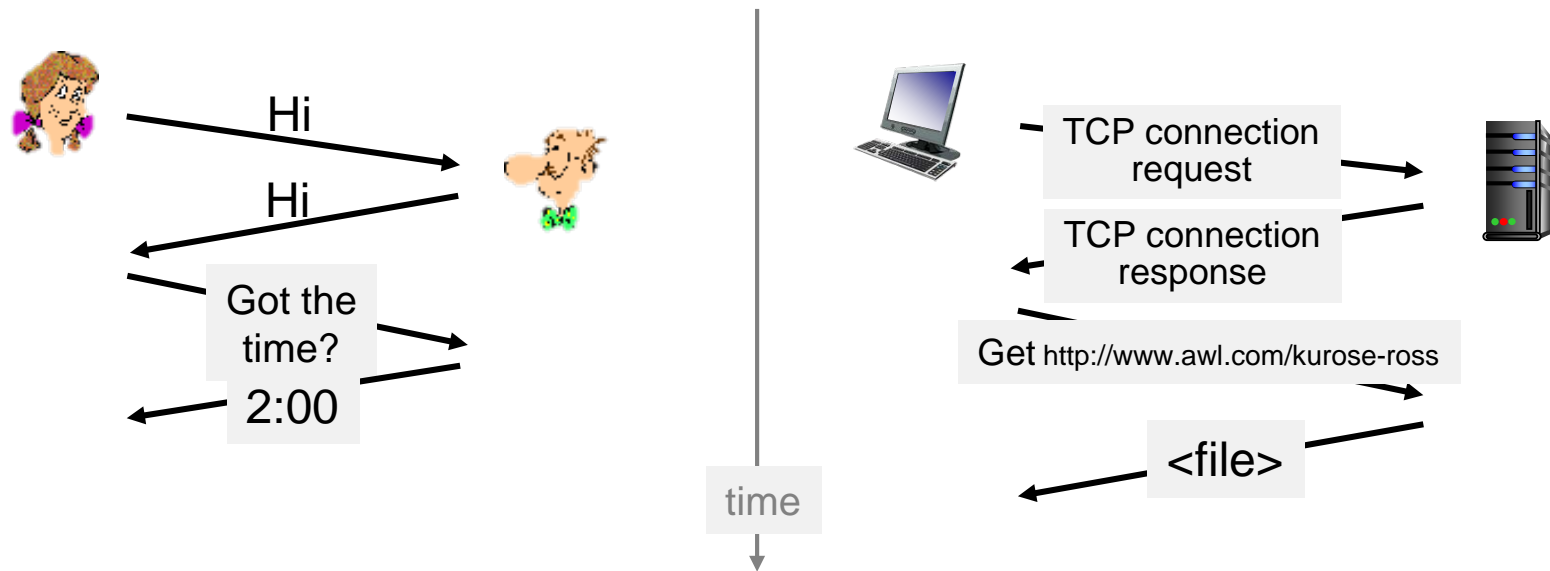
- a defined set of rules and regulations that determine how data is transmitted in telecommunications and computer networking (from Wikipedia)



출처 - <http://rtrfm.com.au/story/talk-the-talk-why-its-hard-to-learn-a-language/>

Communication Protocol

❖ Human protocol vs. Comm. protocol



Communication Protocol

❖ All communication activity in Internet governed by protocols

❖ Protocols define

- message format
- order of messages sent and received among network entities
- actions taken on message transmission, receipt

02. NETWORK STRUCTURE

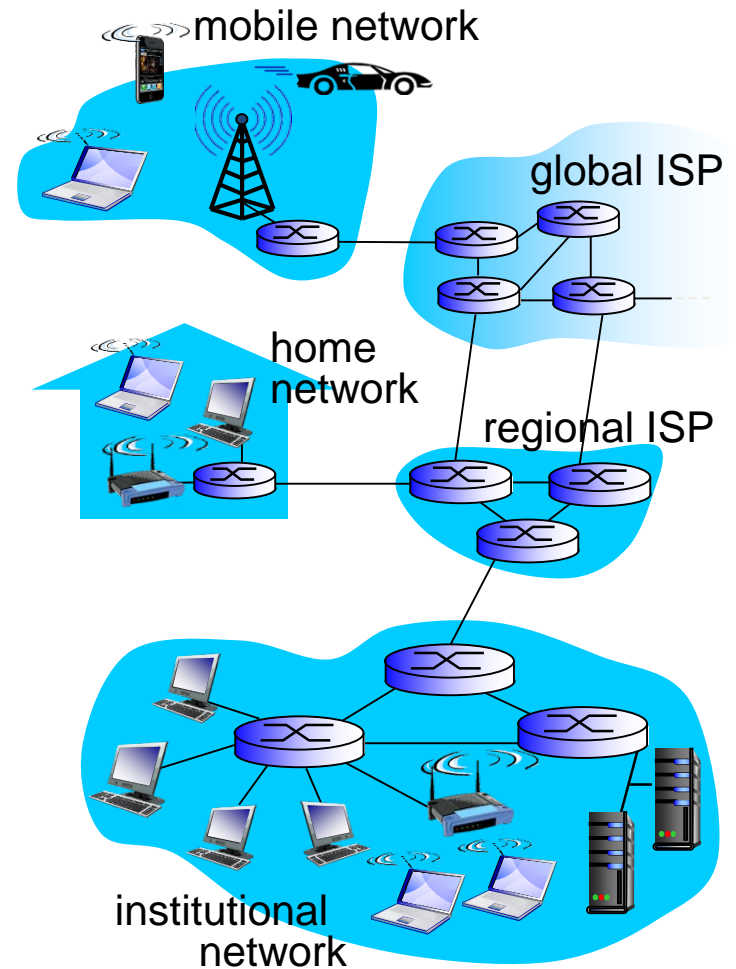
Network Structure

❖ Network edge

- hosts: clients and servers
- servers often in data center

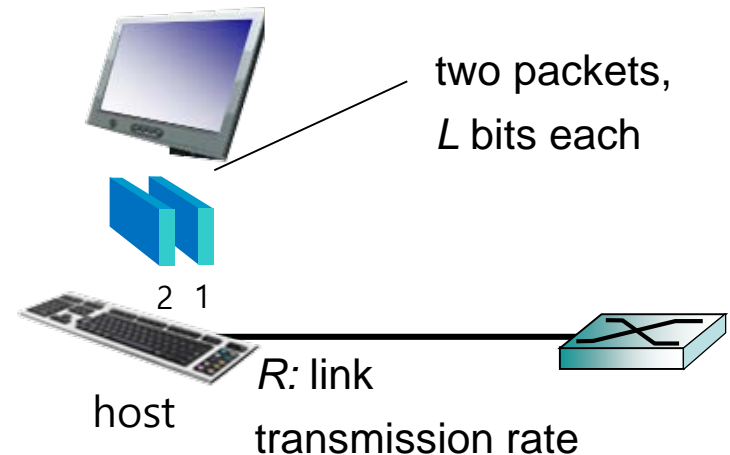
❖ Network core

- Interconnected routers or switches



Network Edge

- ❖ Takes an application message
- ❖ Breaks it into smaller chunks, known as **packets**, of length less than MTU
 - Maximum Transmission Unit (MTU)
- ❖ Transmits packet into access network
 - link transmission rate, a.k.a. link capacity or link bandwidth



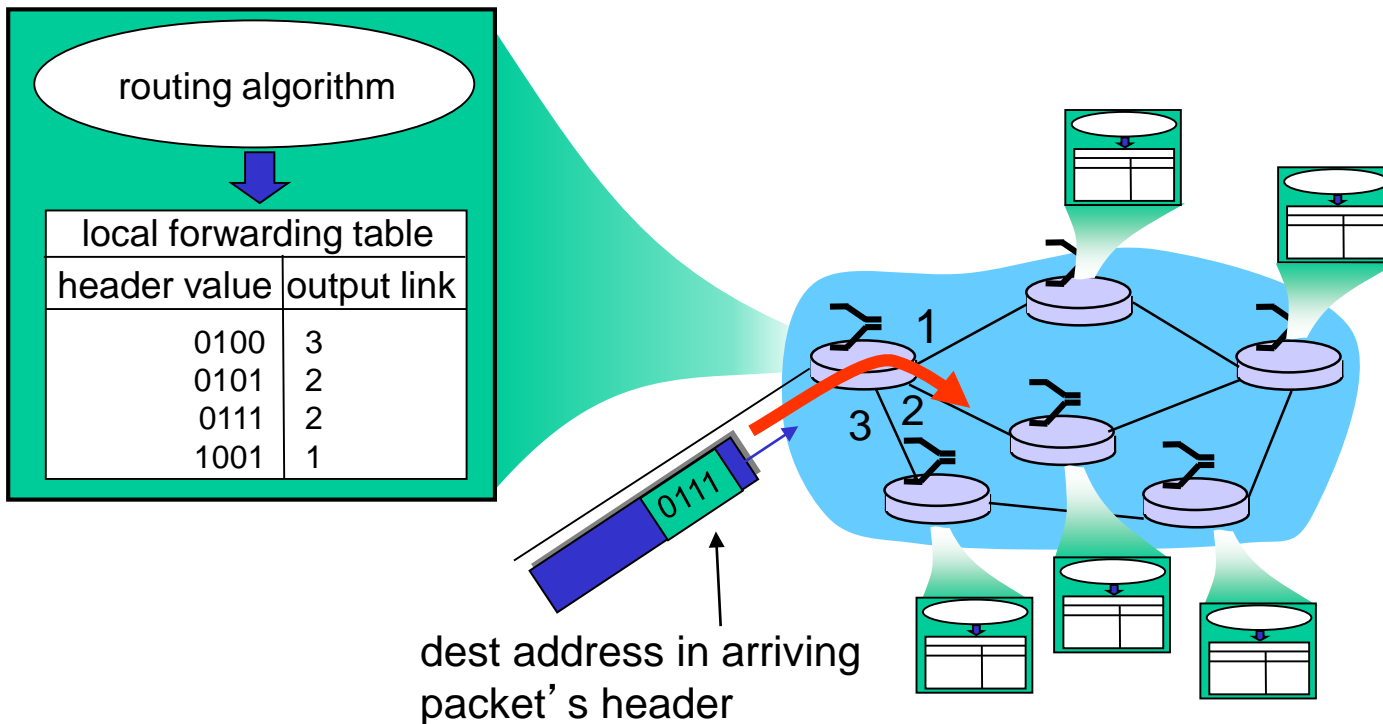
$$\text{packet transmission delay} = \text{time needed to transmit } L\text{-bit packet into link} = \frac{L \text{ (bits)}}{R \text{ (bits/sec)}}$$

Network Core

❖ Mesh of interconnected routers

❖ Function

- packet forwarding from one router (or switch) to the next along the path from source to dest.



03. INTERNET STRUCTURE

Internet Structure

❖ Who's in charge of the Internet?

Nobody! Or Everybody!

- Youtube link: <https://youtu.be/Dxcc6ycZ73M?t=90>
- independently operated networks

❖ End systems connect to Internet via **access ISPs** (Internet Service Providers)

- residential, company, and university ISPs

❖ Access ISPs in turn must be interconnected

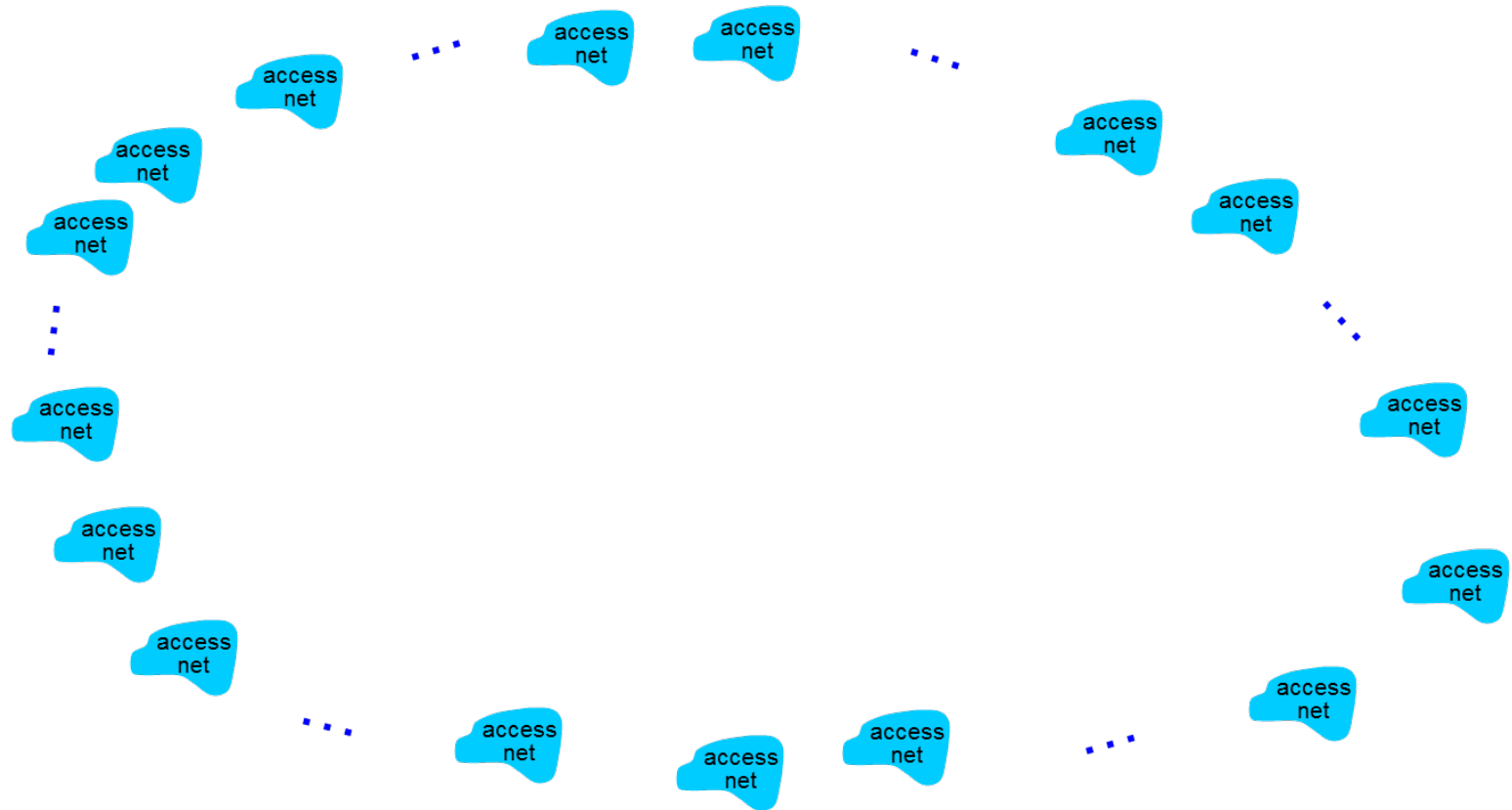
- so that any two hosts can be communicated

❖ Resulting network of networks is very complex

- evolution driven by economics and national policy

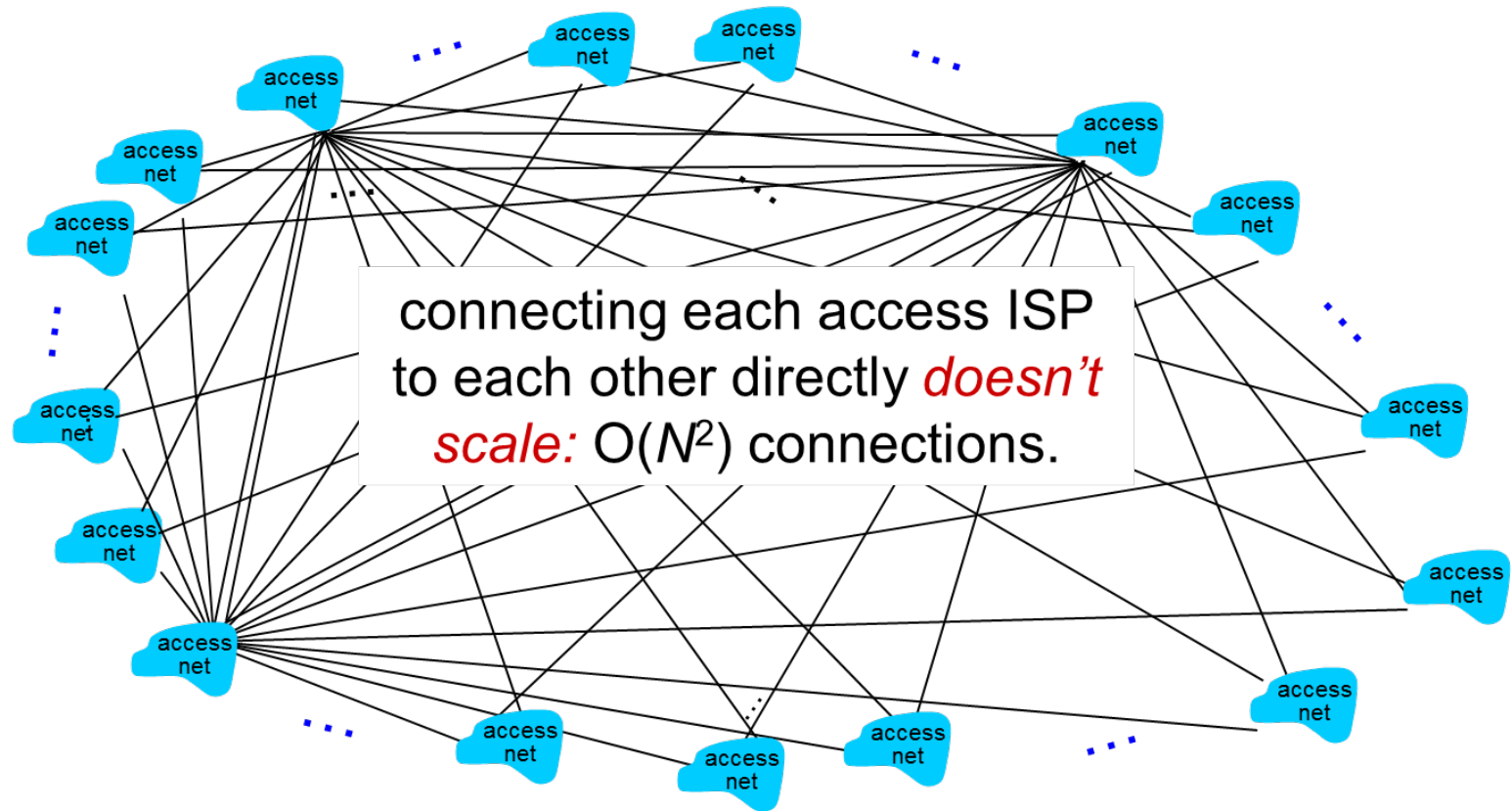
Internet Structure

❖ Question: given millions of access ISPs, how to connect them together?



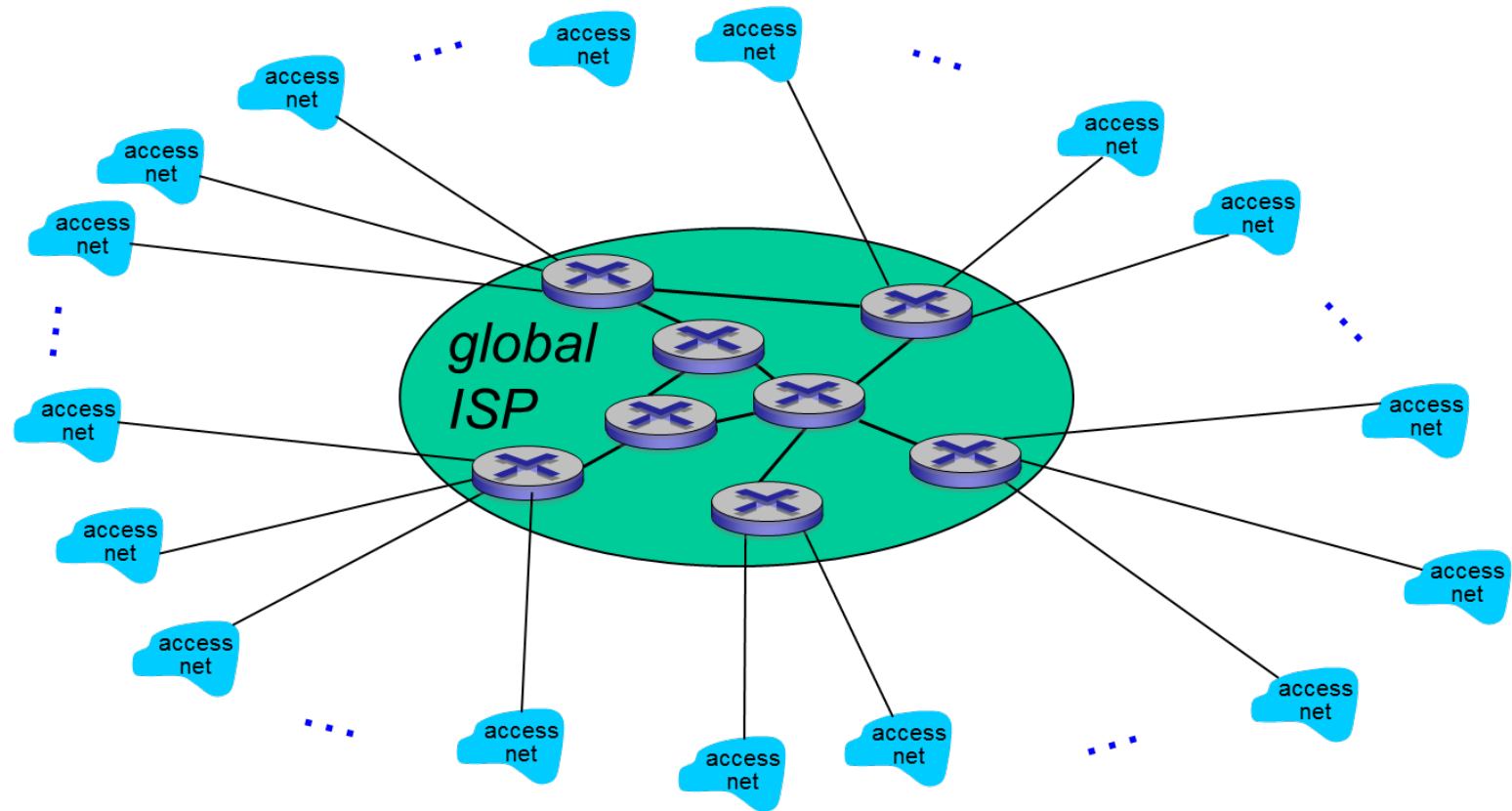
Internet Structure

❖ Naïve method: connect each access ISP to every other access ISP



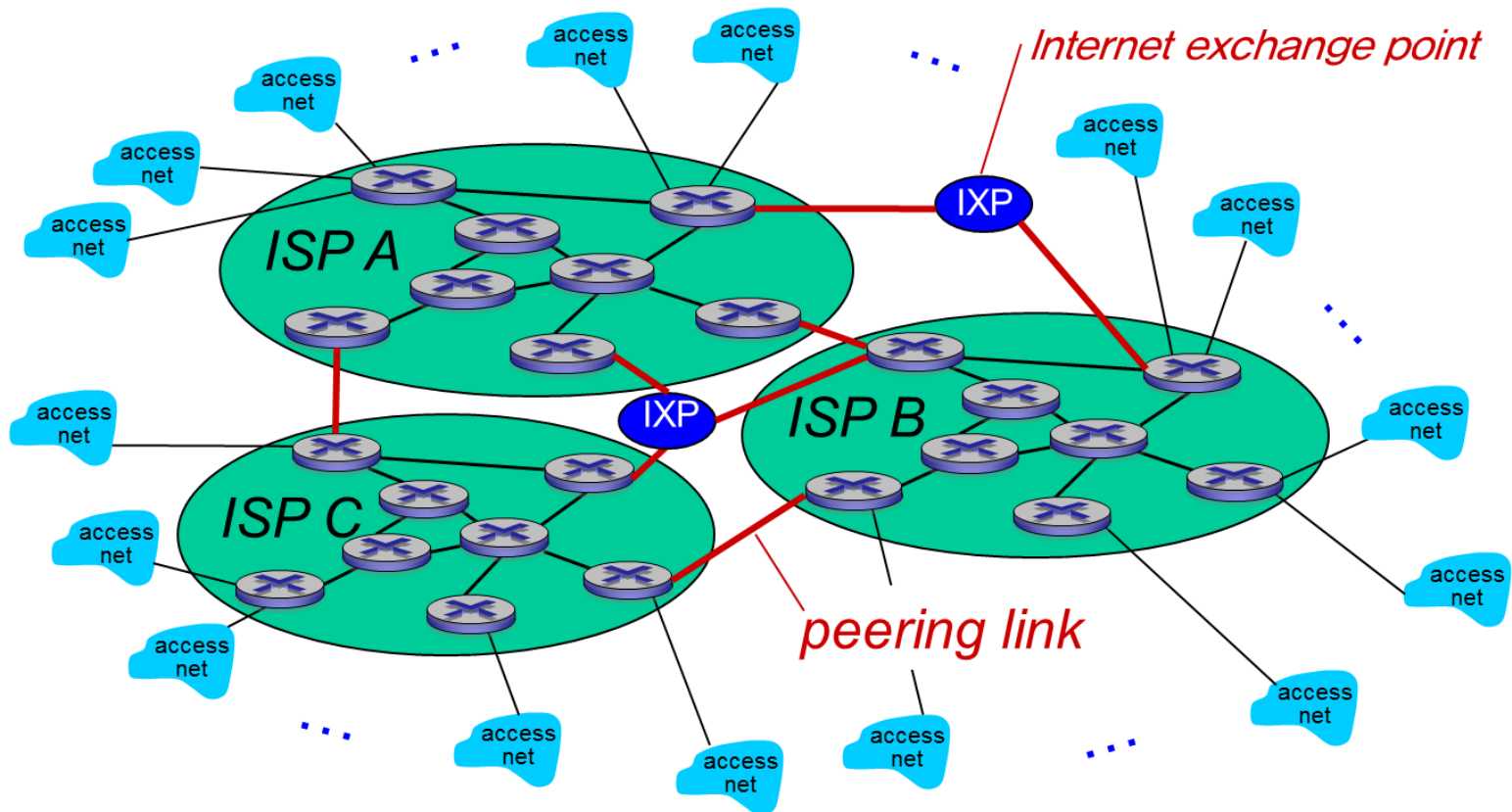
Internet Structure

❖ Scalable method: connect each access ISP to one global transit ISP



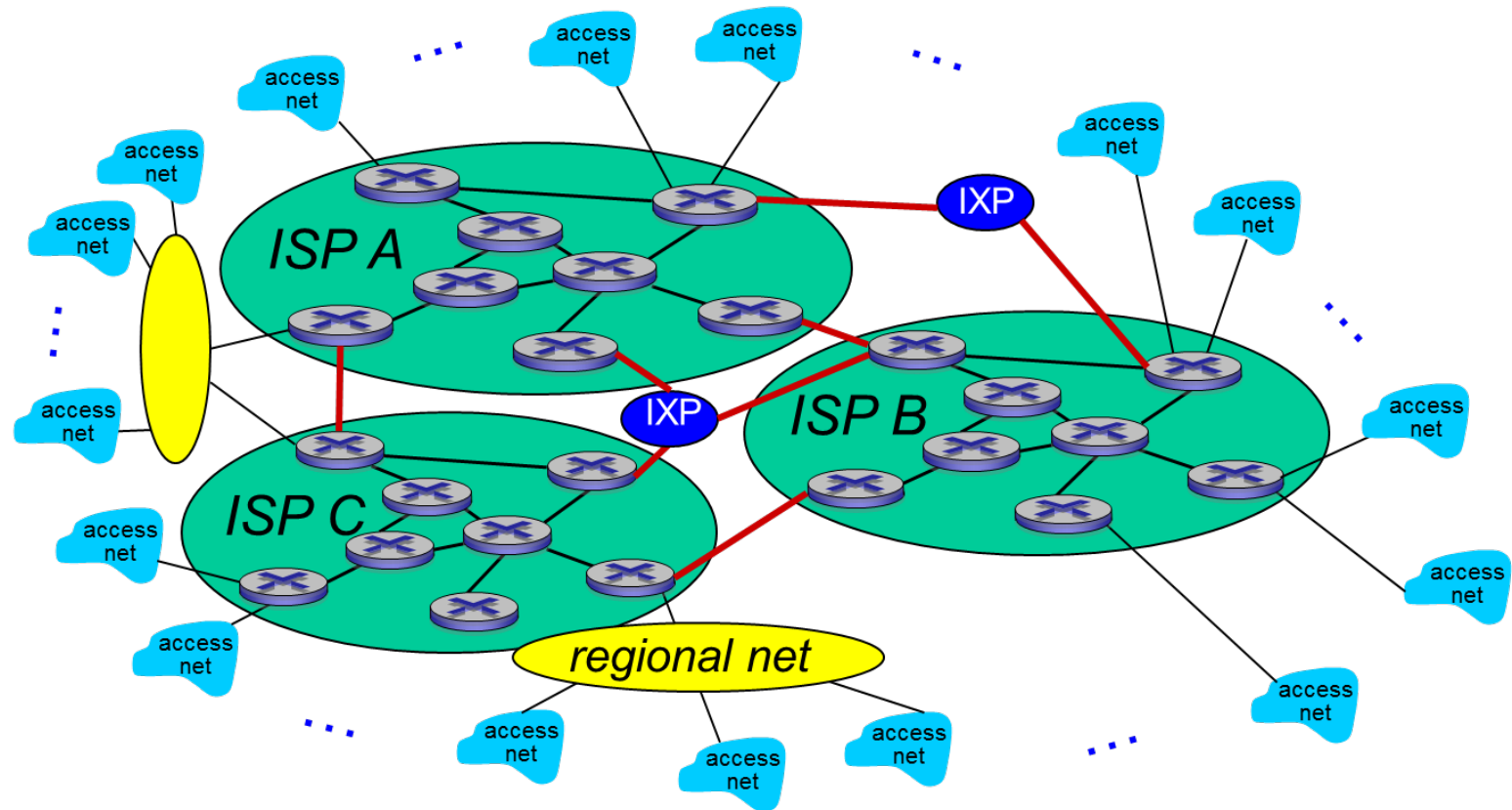
Internet Structure

❖ Competing ISPs appear... which must be interconnected



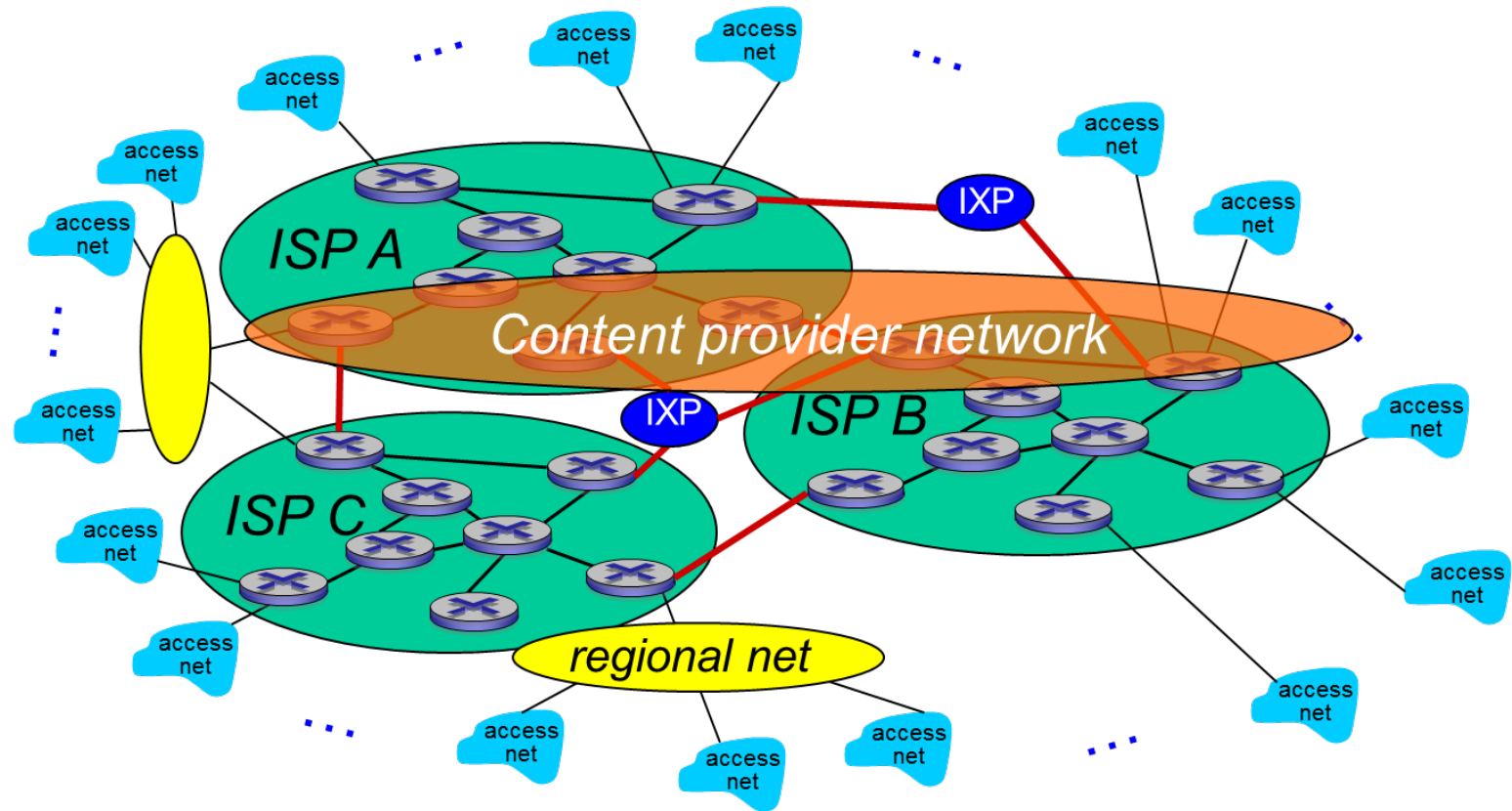
Internet Structure

❖ Regional networks arise to connect access networks to ISPs



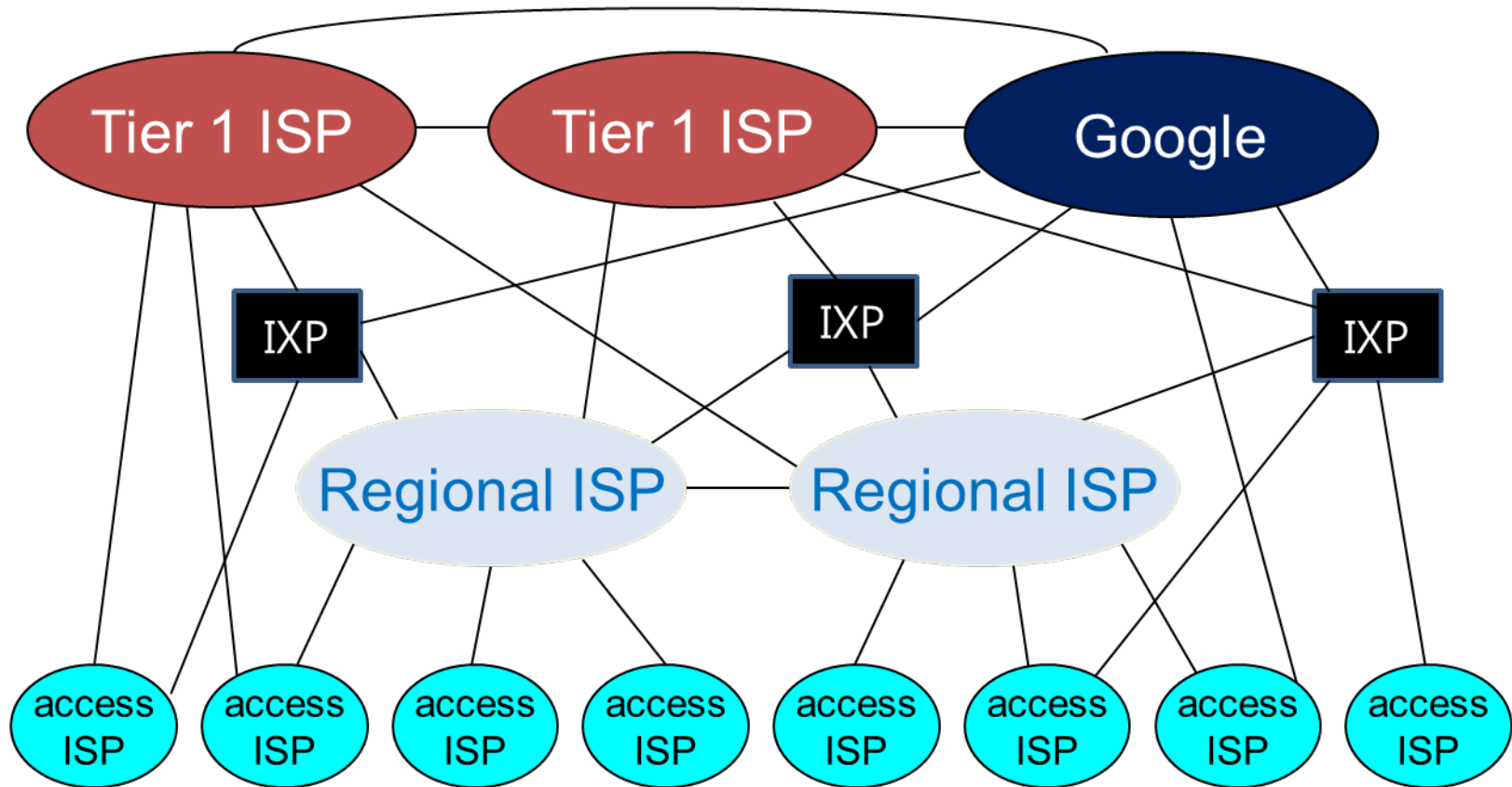
Internet Structure

- ❖ Content provider (e.g., Google, Microsoft, Akamai) run their own network to bring services and content close to end users



Internet Structure

❖ Seen vertically as:

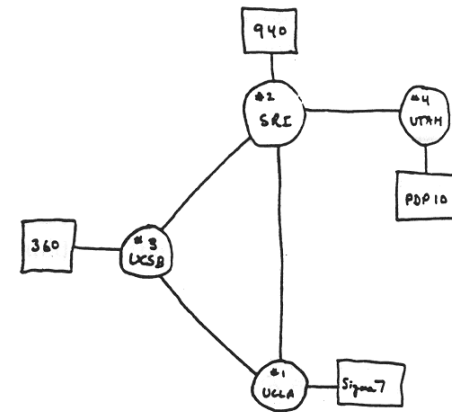


04. HISTORY OF THE INTERNET

Internet History (1961~1972)

❖ Early packet-switching principles

- 1961: Kleinrock - queueing theory shows effectiveness of packet-switching
- 1967: ARPAnet conceived by Advanced Research Projects Agency
- 1969: first ARPAnet node operational
- 1972
 - ARPAnet public demo
 - NCP (Network Control Protocol) first host-host protocol
 - first e-mail program
 - ARPAnet has 15 nodes



THE ARPA NETWORK

Internet History (1972~1980)

❖ Internetworking, new and proprietary nets

- 1974: Cerf and Kahn - architecture for interconnecting network
- 1976: Ethernet at Xerox PARC
- 1979: ARPAnet has 200 nodes



출처 - <http://www.amongtech.com/unsung-heroes-internet-pioneers-youve-never-heard/>

Cerf and Kahn's internetworking principles:

- minimalism, autonomy - no internal changes required to interconnect networks
- best effort service model
- stateless routers
- decentralized control

define today's Internet architecture

Internet History (1980~1990)

❖ New protocols, a proliferation of networks

- 1983: deployment of TCP/IP
- 1982: smtp e-mail protocol defined
- 1983: DNS defined for name-to-IP-address translation
- 1985: ftp protocol defined
- 1988: TCP congestion control
- new national networks: Csnet, BITnet, NSFnet, Minitel
- 100,000 hosts connected to confederation of networks



Internet History (1990~2000)

❖ Commercialization, the Web, new apps

- 1991: NSF lifts restrictions on commercial use of NSFnet (decommissioned, 1995)
- Early 1990's: Web
 - HTML, HTTP: Tim Berners-Lee
 - 1994: Mosaic, later Netscape
 - Commercialization of the Web
- Late 1990's-2000's
 - more killer apps: instant messaging, P2P file sharing
 - network security to forefront
 - est. 50 million host, 100 million+ users



Internet History (Present)

❖ Present

- 5B devices attached to Internet (2016)
 - smartphones and tablets
- Aggressive deployment of broadband access
- Increasing ubiquity of high-speed wireless access
- Emergence of online social networks:
 - Facebook: ~ one billion users
- Service providers (Google, Microsoft) create their own networks
 - bypass Internet, providing “instantaneous” access to search, video content, email, etc.
- e-commerce, universities, enterprises running their services in “cloud” (e.g., Amazon EC2)

➤ Internet

- Network of networks
- Hots, interconnection devices, links

➤ Network structure

- Network edge and network core

➤ Internet structure

- Several tiers of internet service providers

➤ Internet history