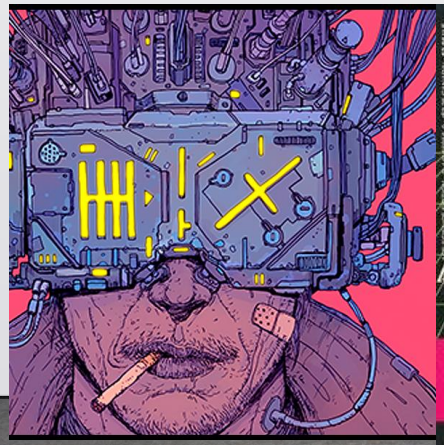
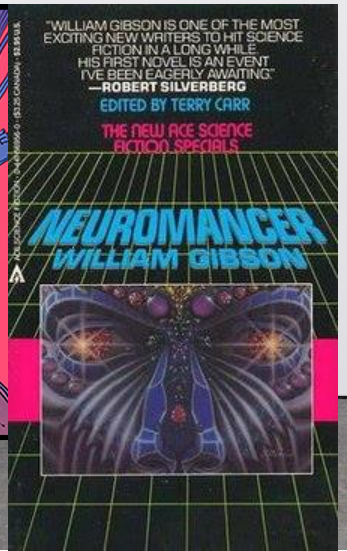
Cyberspace and the Internet

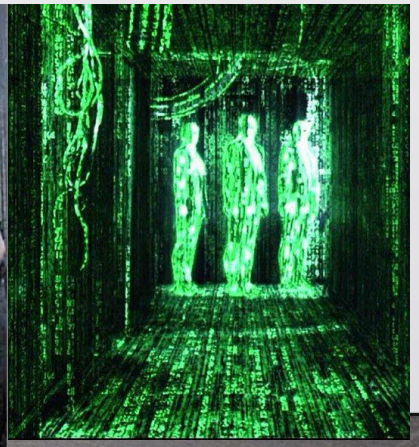
Computer Literacy

Cyberspace

- The term **cyberspace** was initially introduced by William Gibson in his 1984 science fiction novel *Neuromancer*
- "A consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts... A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding." [an excerpt of *Neuromancer*]







Definitions of Cyberspace

- "The notional **environment** in which **communication** over computer networks occurs" [Oxford Dictionaries]
- "Cyberspace is an interactive **domain** made up of digital networks that is **used to store, modify and communicate** information. It includes the internet, but also the other information systems that support our businesses, infrastructure and services." [UK Cyber Security Strategy]
- "The complex **environment** resulting from the **interaction** of people, software and services on the Internet by means of technology devices and networks connected to it, which does not exist in any physical form" [ISO/IEC Guidelines for cybersecurity]
- Are cyberspace and internet equivalent?

Internet

- Started in the 1960s
- U.S. Defense Advanced Research Projects Agency funded **ARPANET** (Advanced Research Projects Agency Network)
  - Project for secure communication for military and scientific purposes
  - Idea: globally interconnected system of computers
- **Internet**
  - Global network of networks
  - Functions via several major hubs around the world, where they connect and are able to connect to other major hubs
  - Uses internet protocol suite (TCP/IP) to link devices
  - Platform to exchange information

Intranet

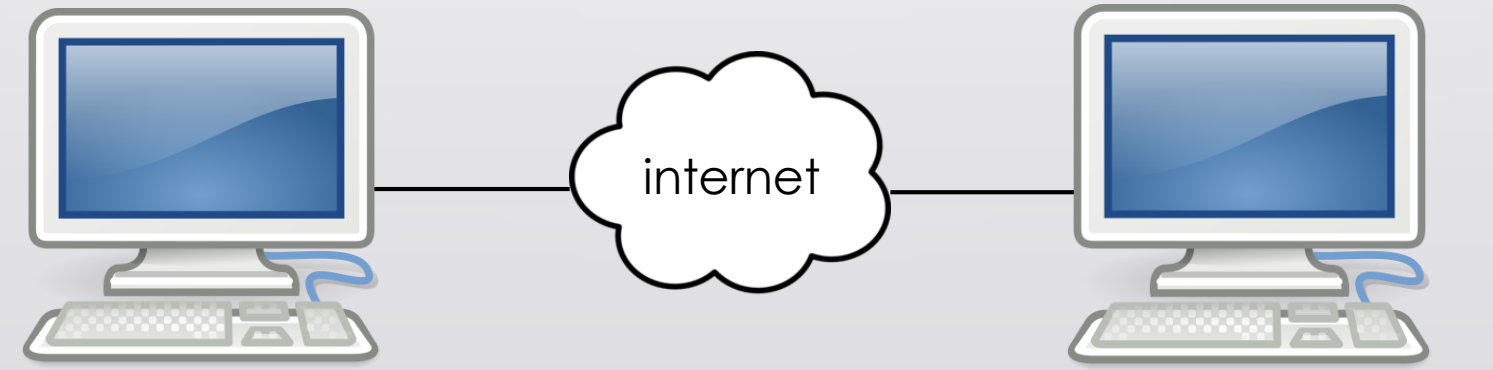
- Local or private restricted network within an organization
- Uses the same technologies and communication standards as Internet
- Typically, information can only be access by authorized persons of that organization

How does the internet work?

Internet Addresses

- Each computer connected to the internet must have a unique address
- Known as an **IP address** (IP stands for Internet Protocol)
- Assigned a temporary one through your **ISP** (internet service provider) for duration of your session
- In IPv4…
  - Address is a 32-bit number
  - Take the form: *nnn.nnn.nnn.nnn* where *nnn* is a number from 0-255.

172.16.254.1



Protocol Stacks

- Suppose you want to send a message, "Hello friend!" to computer 5.6.7.8.
- The message must be
  1. translated from alphabetic text into electronic signals
  2. transmitted over the internet
  3. then translated back into alphabetic text.
- This is accomplished through the use of a **protocol stack**
  - Every computer needs one to communicate
  - Usually built into the operating system
- The protocol stack used on the internet is referred to as the **TCP/IP protocol stack**.

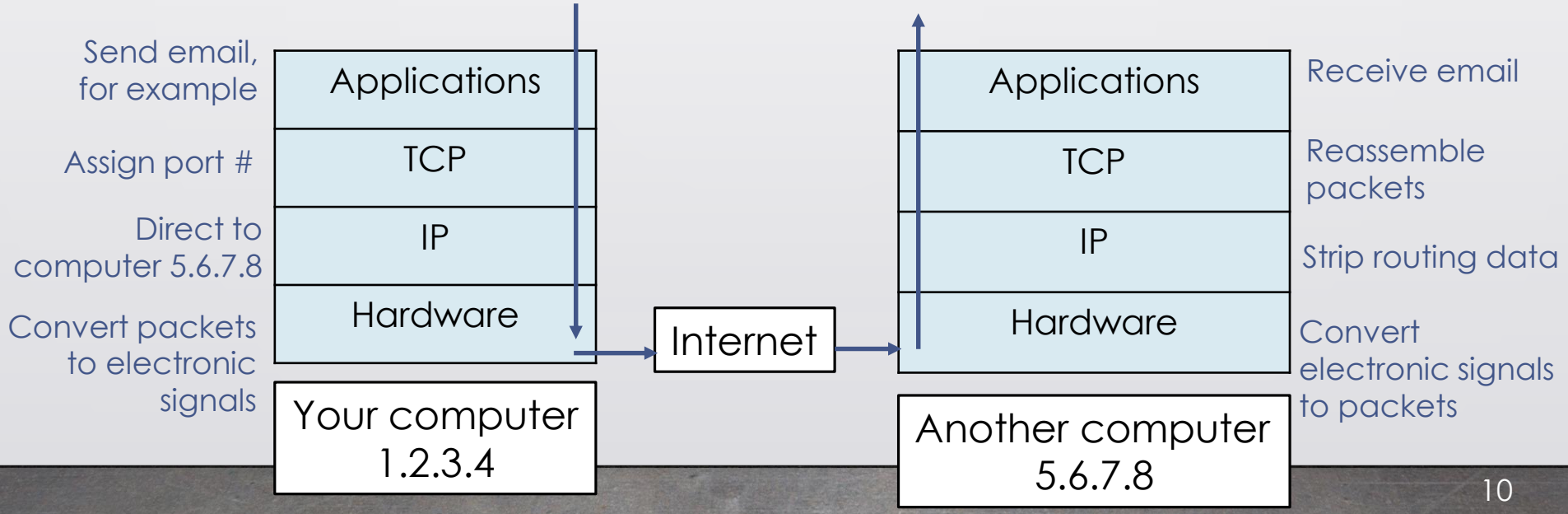
TCP/IP Protocol Stack

- The protocol stack used on the internet
- Consists of four layers of protocols
- Referred to as TCP/IP because of two major communication protocols used

Protocol Layer	Comments
Applications Protocol Layer	Protocols specific to applications (WWW, e-mail, FTP, etc)
Transmission Control Protocol Layer	Directs packets to specific application on a computer using a port number
Internet Protocol Layer	Directs packets to a specific computer
Hardware Layer	Converts binary packet data to network signals and back (network card, etc)

TCP/IP Protocol Stack: Sending a Message

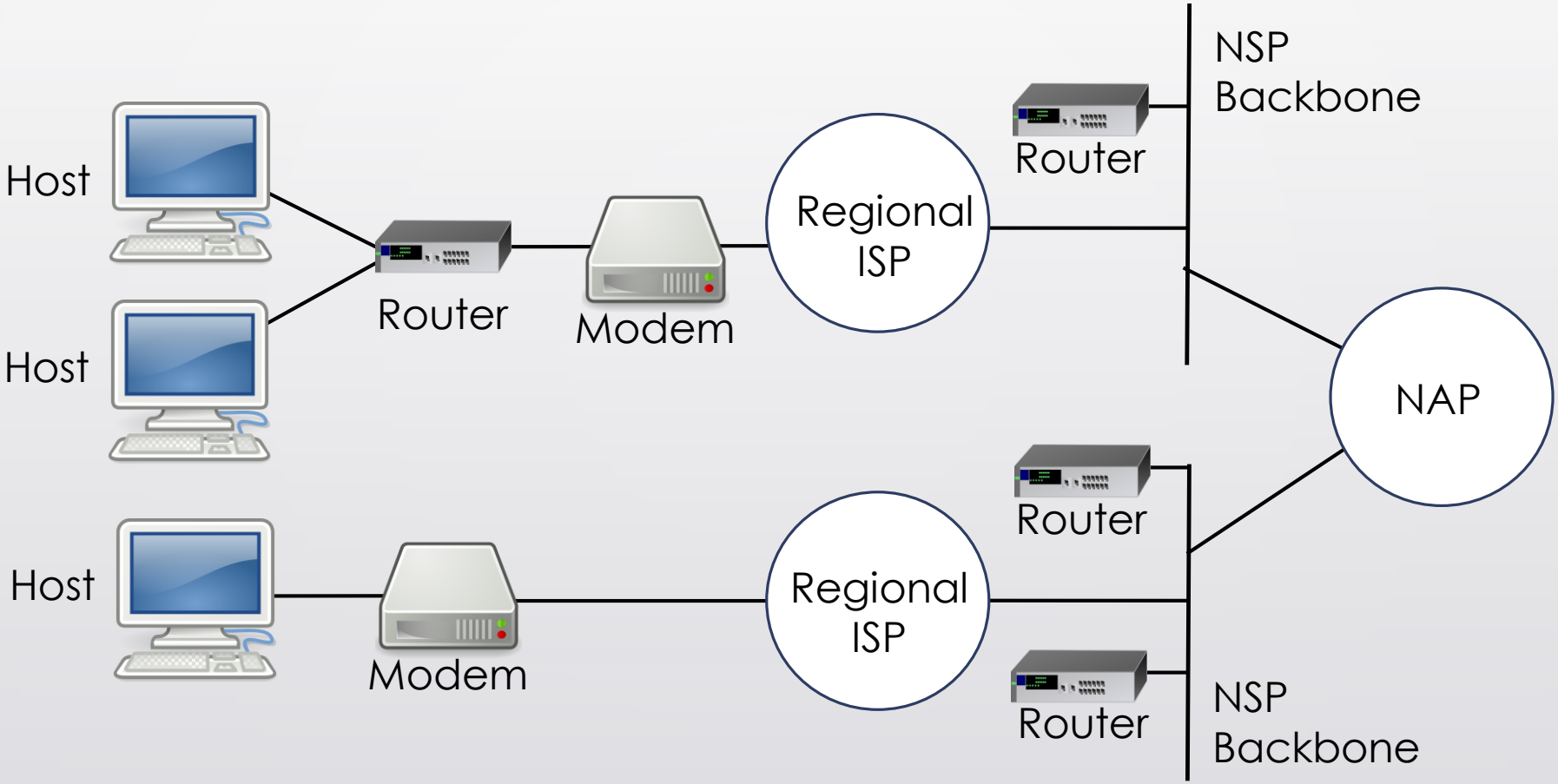
- Message starts at the top of the protocol stack on your computer and works its way downward
- Data are sent in small, manageable chunks known as **packets**.
  - If message is too long, each stack layer may break it up into smaller chunks.



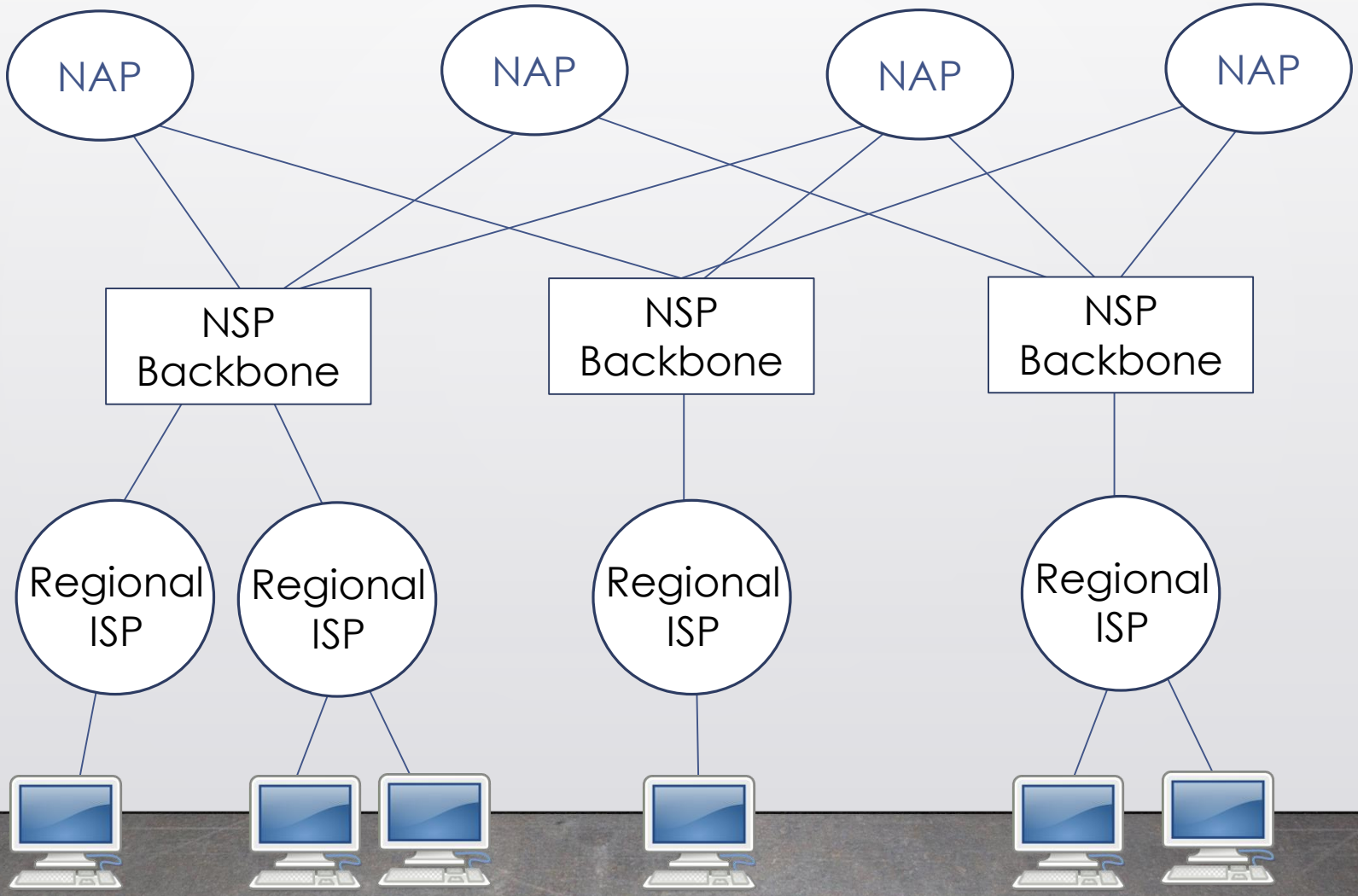
Main components of Network Infrastructure

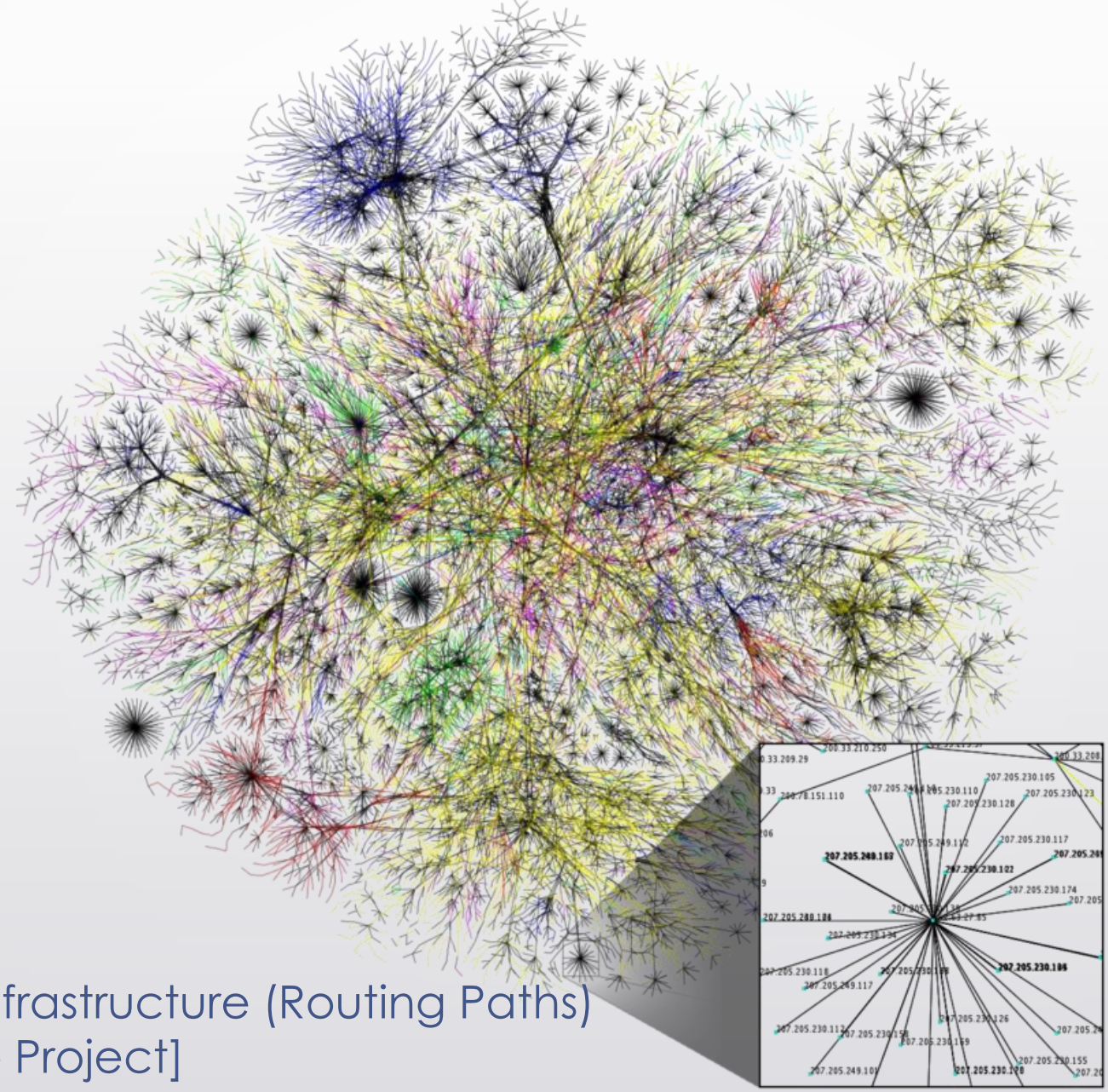
- **Host** — computer that has two-way access to other computers:
  - Receives requests
  - Replies to those requests
- **Network service providers** (NSPs)
  - Maintain the Internet backbone—the main high-speed routes
  - *Supply* ISPs with access to high-speed transmission lines
  - Provide routers at network connection points
- **Network access points** (NAPs)
  - How NSPs are linked
  - Allow data to start on one network then cross to another
- **Routers**
  - Specialized devices that connect networks, locate the best path of transmission, and ensure that data reaches its destination

Abstract Network Infrastructure



Simplified Internet Infrastructure





Internet Infrastructure (Routing Paths)
[The Opte Project]

Accessing the Internet

Internet Service Providers

- **Internet service providers** (ISPs)
  - Supply and sustain user connections to the Internet
  - Maintain the hardware and software
  - Protect their sites and networks from outside threats
- Hot spots
  - Public location that provides Internet access for wireless devices

- Important terminology
  - **Bandwidth**: quantity of data that can be transmitted through a medium in a given amount of time
    - **Downstream speed**: speed of data towards end user
    - **Upstream speed**: speed of data from user to internet

Common Types of Internet Access

- **Dial-up access:** very slow; uses the phone line
- **Digital subscriber line (DSL):** high-speed connection through telephone network; doesn't interrupt telephone
- **Cable access:** high-speed connection using a cable modem on coaxial wiring originally developed for TV; not phone line
- **Satellite:** high-speed connection using satellite modem and dish
- **Fiber-optic service:** very high-speed connection; fiber-optic lines direct to the home

Domain Names and Address Resolution

- You want to access cs.kent.edu, but don't know the IP address.
- **Domain Name Service (DNS)**, is a distributed database which keeps track of computer's names and their corresponding IP addresses on the internet
- When you go to a web address in your browser..
  - it first connects to a DNS server to perform **address resolution**
  - May be redirected to another DNS if that domain name was not found

Internet Domains

- **hostname** is the name of the host computer and is followed by one or more **domains** separated by periods
- Example: host.subdomain.subdomain.domain
  - cs.kent.edu
  - en.wikipedia.org
- Some of the many, many top-level domains
  - .biz—Businesses
  - .com—commercial organizations
  - .info—Information services
  - .gov—government entities