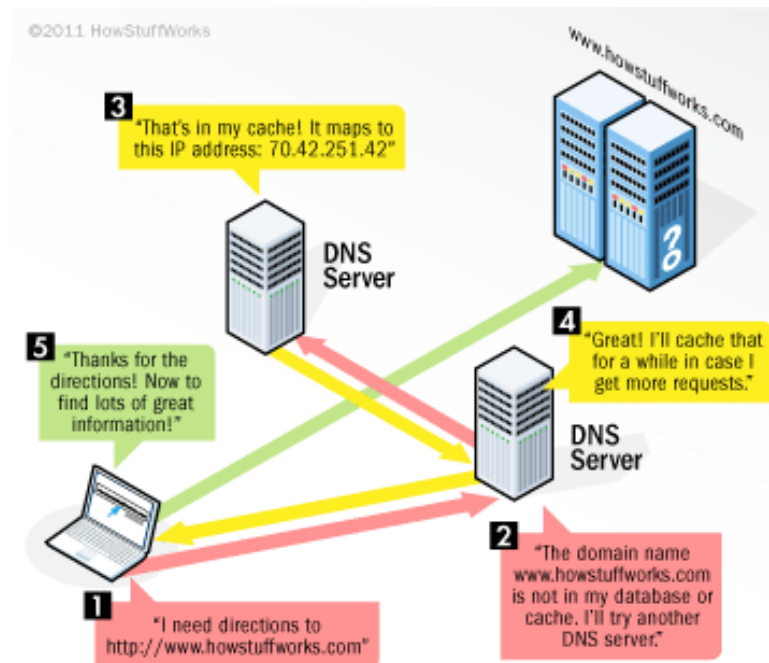


CAC 170 – Fall 2020 CS Principles

The Internet



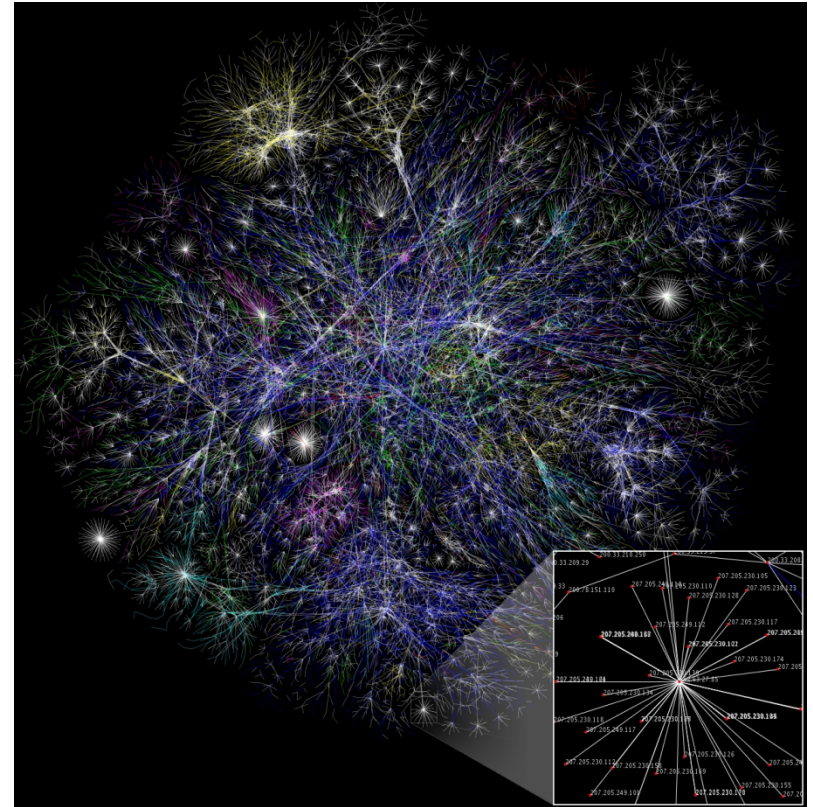
Acknowledgement

Thanks to Dr. Jeff Gray for this slide deck, and thanks to Dr. Tony Barnard (UAB CIS) for several example slides for the content of this lesson.

Computer Networks

What is a network?

- A collection of computer devices (nodes) connected by cable or wireless media (links) for the exchange of data
- Four types of networks to consider
 - ❑ Local area network (LAN)
 - ❑ Wide area network (WAN)
 - ❑ Virtual Private Network (VPN)
 - ❑ The Internet

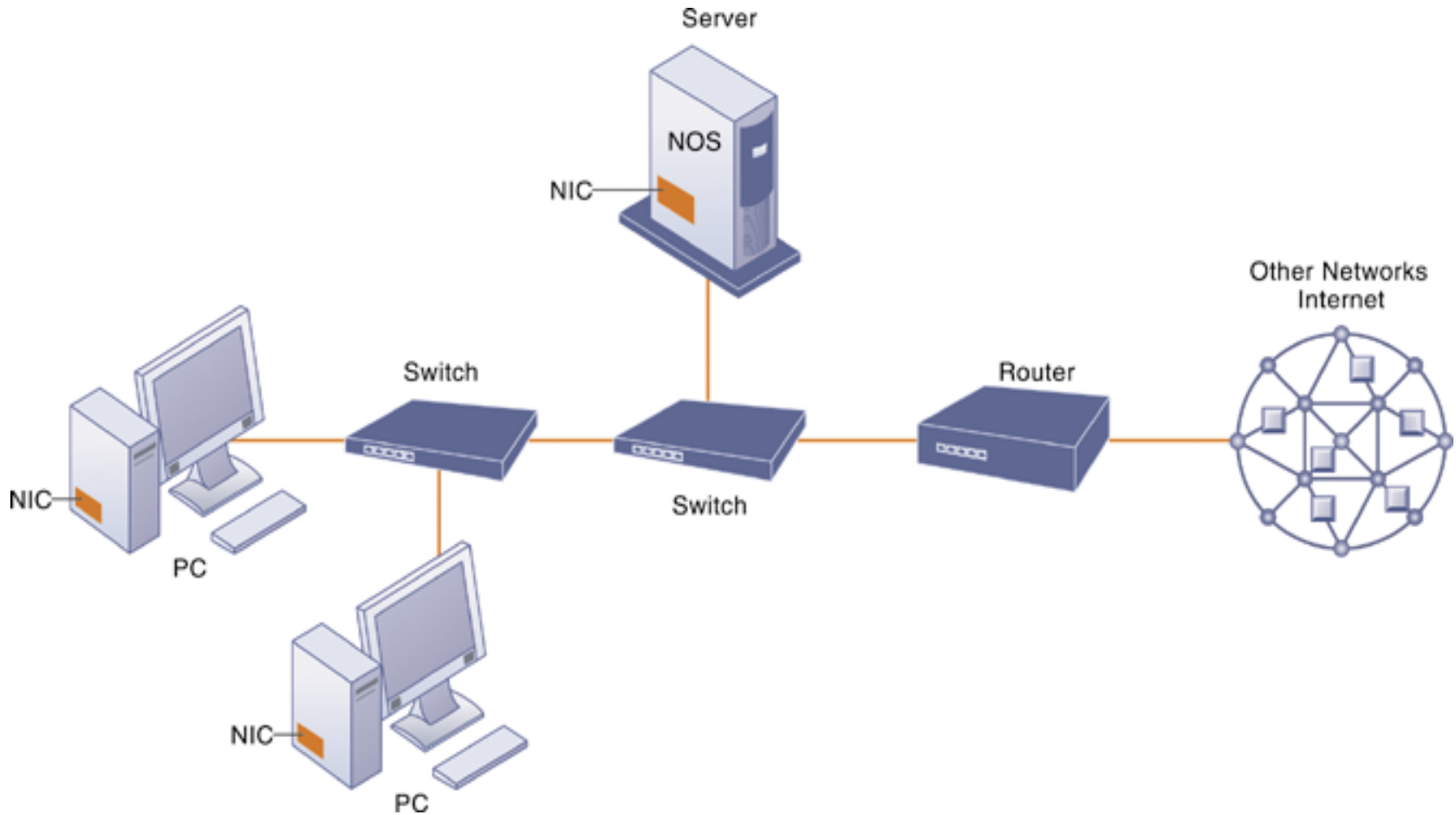


Source: http://upload.wikimedia.org/wikipedia/commons/d/d2/Internet_map_1024.jpg

Network Components

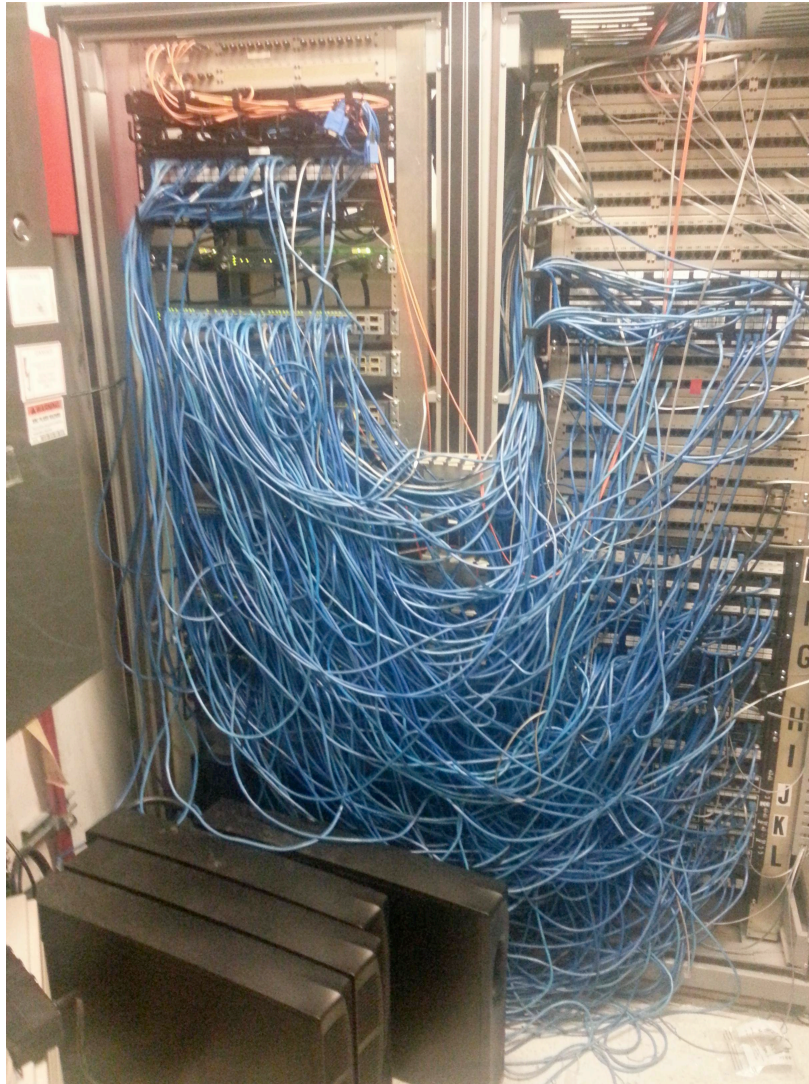
- A network consists of two or more connected computers/ devices (PCs, phones, etc.)
- Major components in a typical network
 - Client computer
 - Server computer
 - Network interface card (NIC)
 - Network operating system (NOS)
 - Connection medium
 - Hub or switch connecting multiple computers in a network
 - Routers
 - Device that forwards data “packets” between computer networks for internetwork communication

Components of a simple network



Source: <http://ocmis.blogspot.com/2013/03/telecommunications-internet-and.html>

What does a Network Closet Look Like?



I have seen network closets that look like this. I certainly would not want to be the one who has to trace one of those cables.

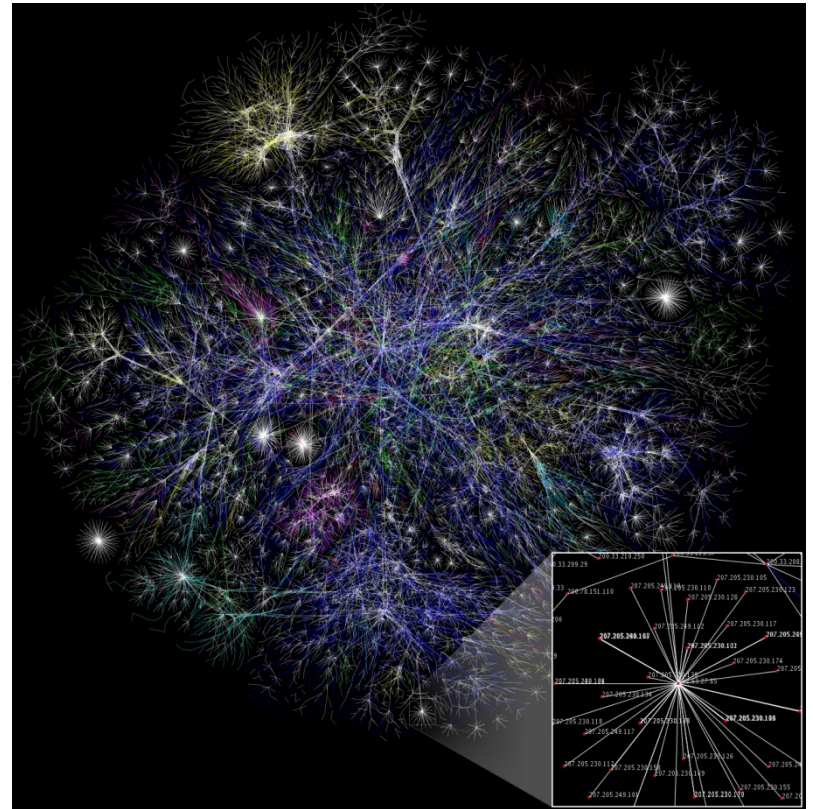
What should a Network Closet Look Like?



The Internet

What is the Internet?

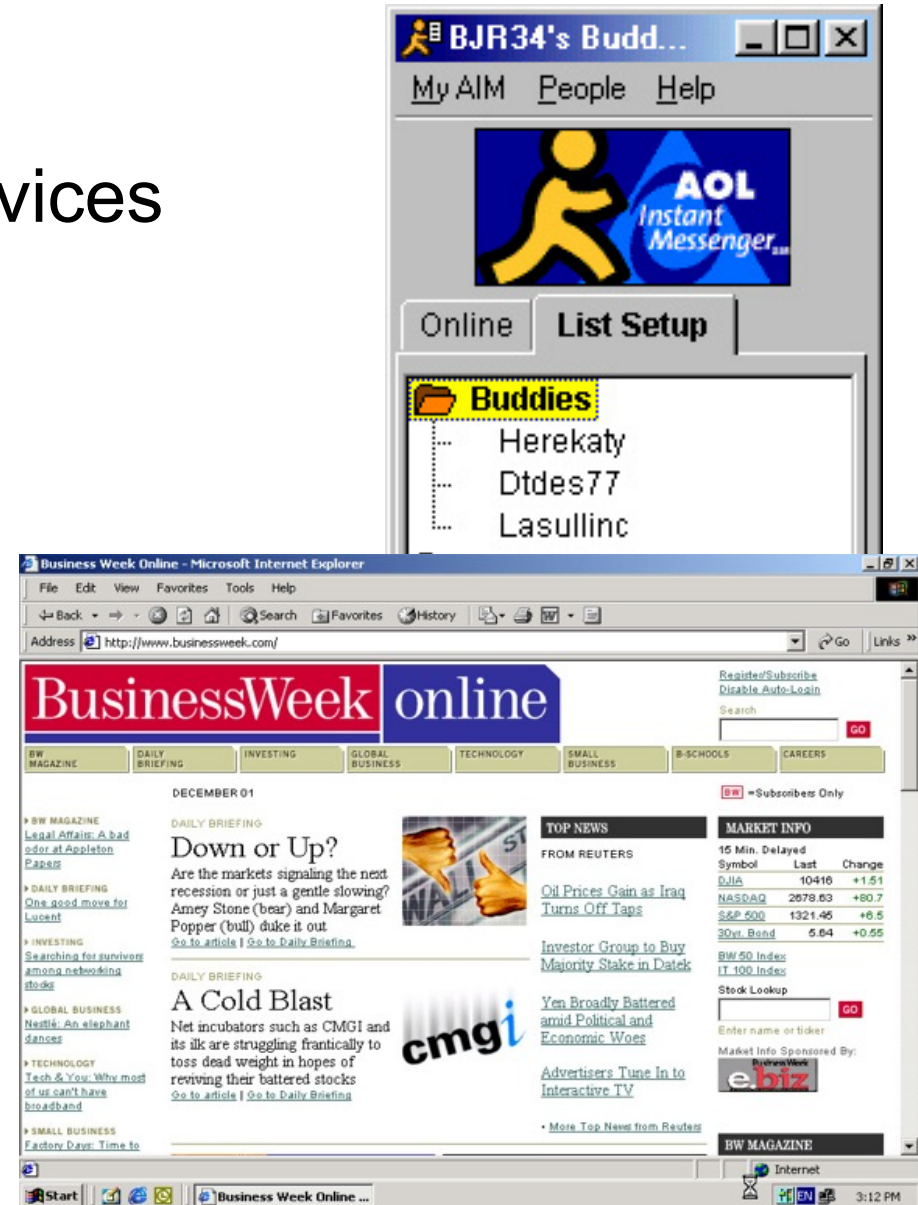
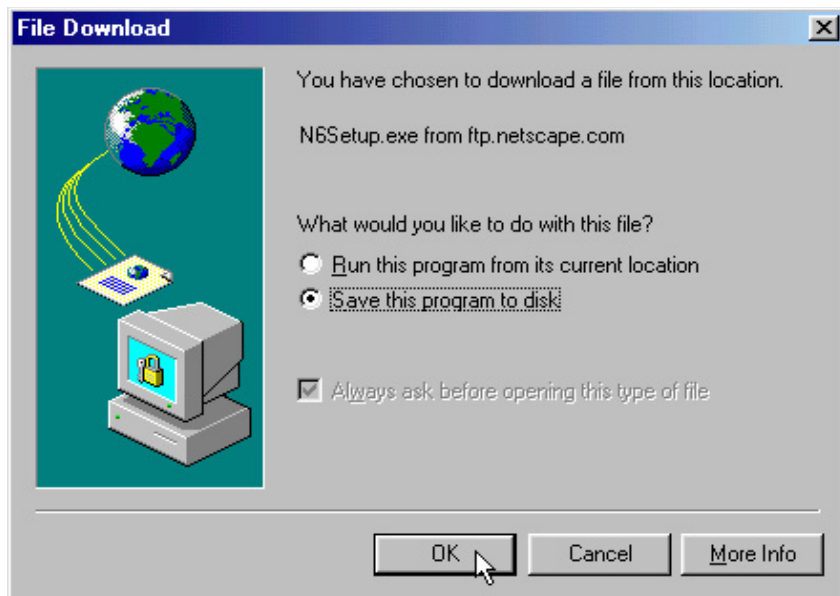
- ❑ Global system of computer networks (network of networks)
- ❑ Uses Internet protocol suite called TCP/IP (later)
- ❑ Carries various services and information resources



The Internet

What are some of the services found on the Internet?

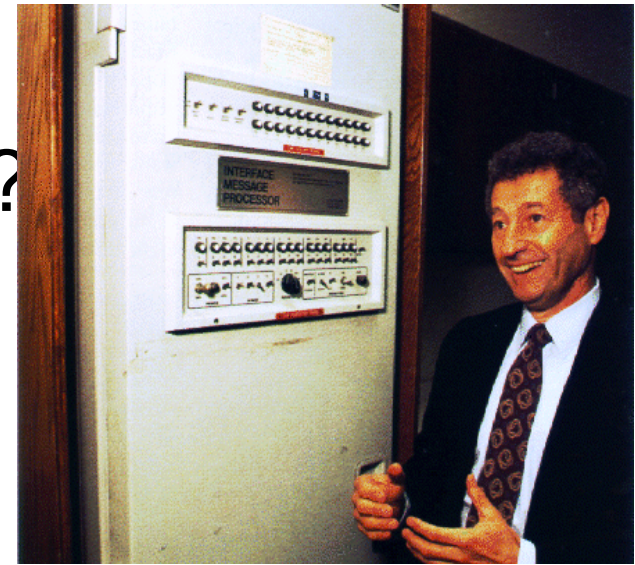
- ☒ Communication
- ☒ Data Transfer
- ☒ World Wide Web



History of the Internet

How did the Internet originate?

- ARPANET (Advanced Research Projects Agency Network)
- One of the first operational packet switching networks
- Goals:
 - function even if part of network is not operational
 - allow scientists to collaborate from different locations – wanted to easily share electronic documents
- Became functional in 1969
- Relied on TCP/IP, which is a protocol for transferring data. Just like Python has rules for how to write something, TCP/IP is the rules for how to communicate between two nodes on a network

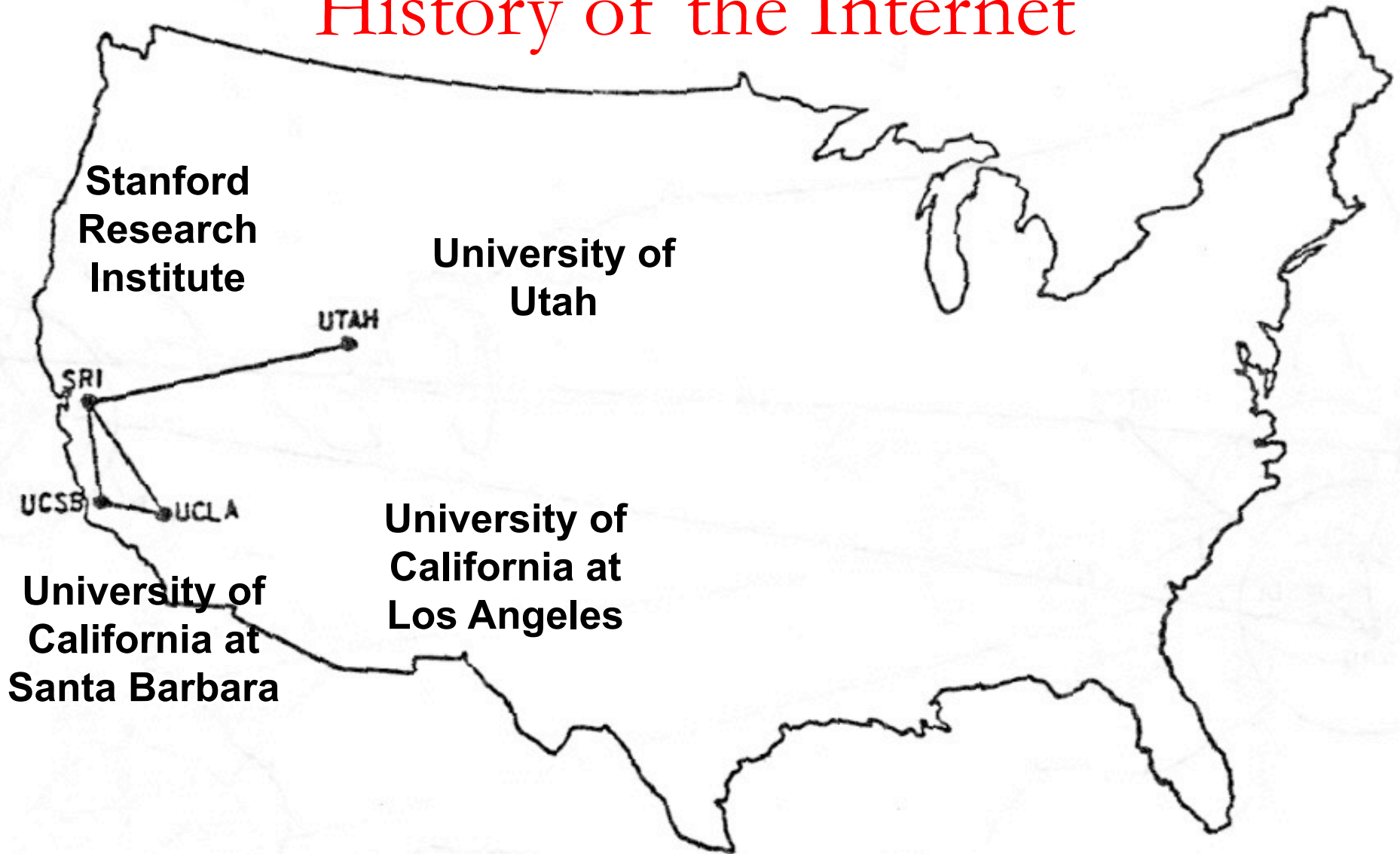


History of the Internet

What is a host node?

- Also called a host
- Any computer that directly connects to a network
- Often stores and transfers data and messages
- Provides network connections for other computers
- Four original host nodes on ARPANET

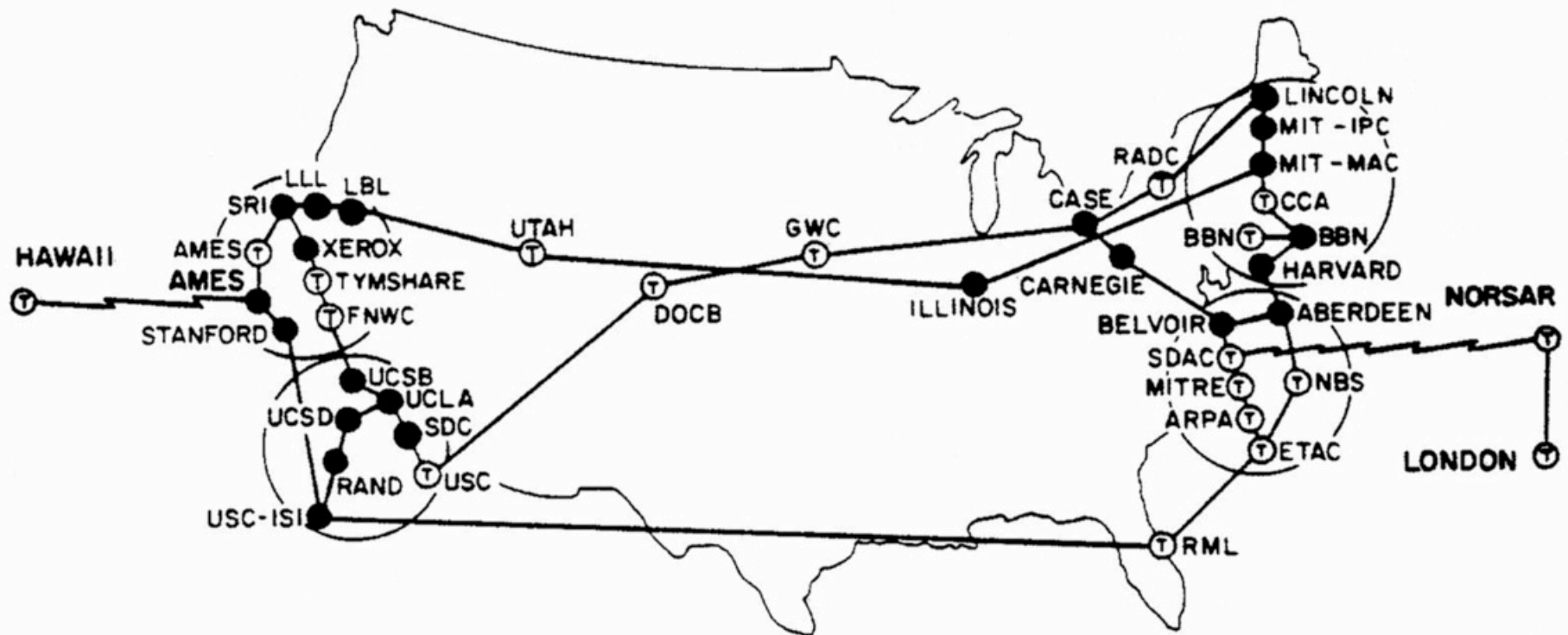
History of the Internet



The ARPANET in December 1969

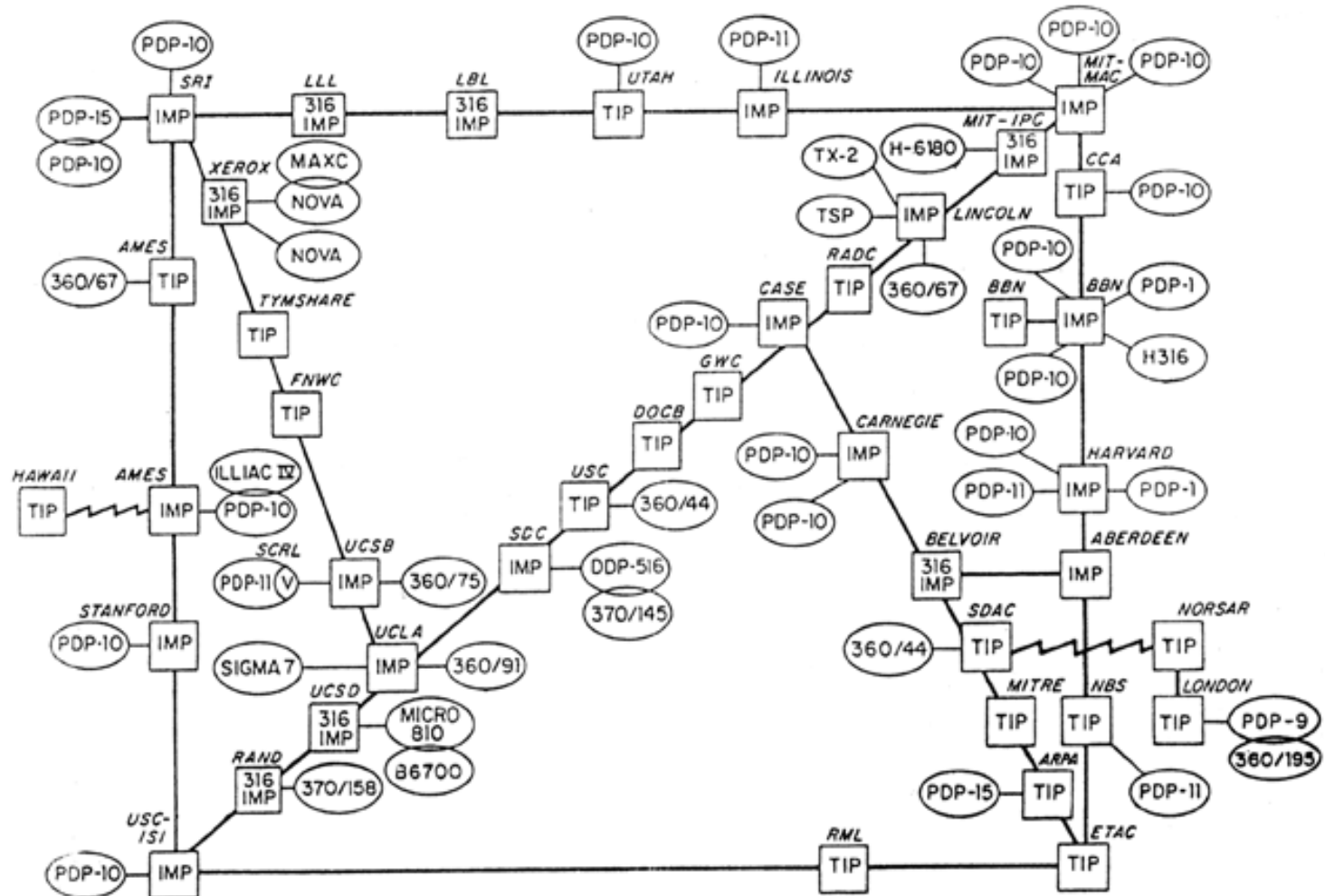
The Internet in 1973

- ARPANET goes International
reaching London



The Internet in 1973

ARPA NETWORK, LOGICAL MAP, SEPTEMBER 1973



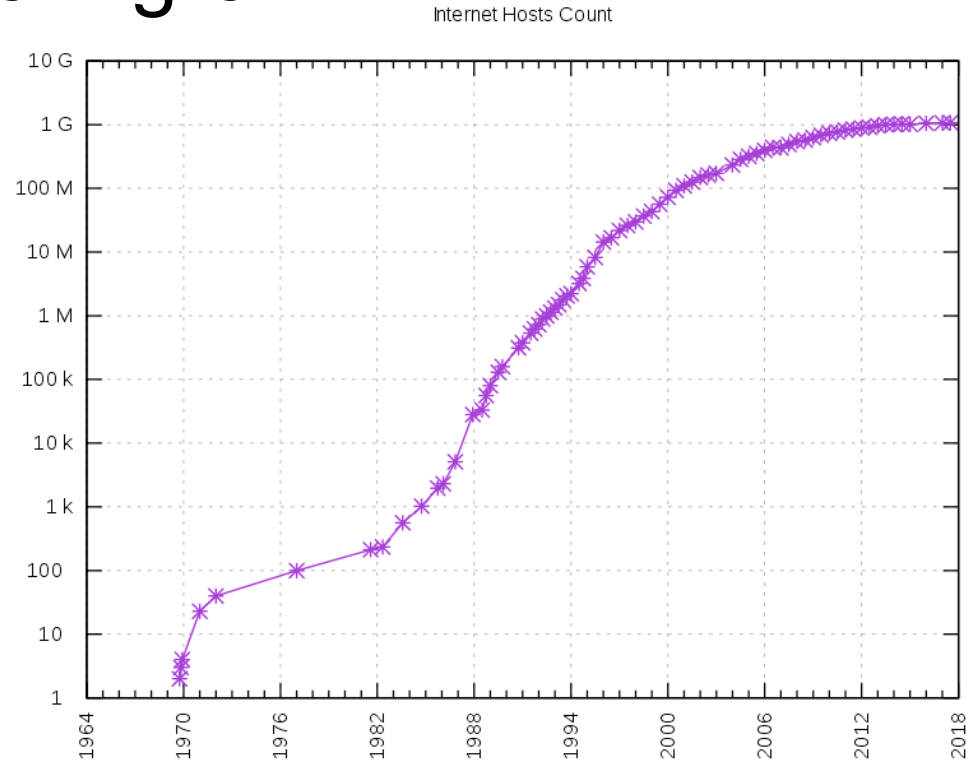
History of the Internet

How has this network grown?

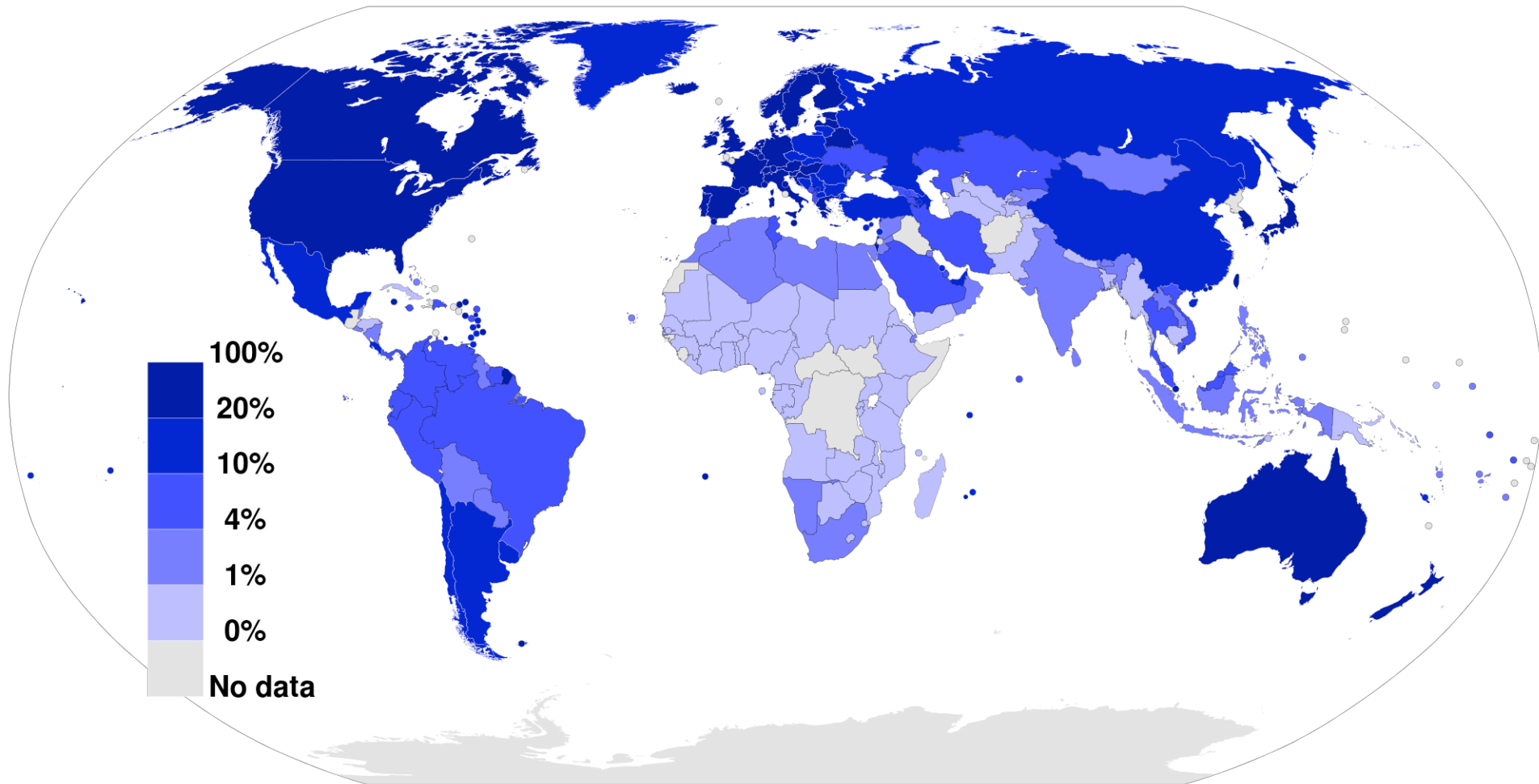
1969
Four host nodes

1984
More than 1,000 host nodes

Today
More than 900 million hosts and 7 billion users



World Map of Broadband Internet Connectivity in 2012



The World Wide Web

What is the World Wide Web (WWW)?

- Also known as the **Web**
- Created by Tim Berners-Lee
- System of connected hypertext documents (Web pages)
 - May contain text, graphics, sound, and video
- Can contain built-in connections to other documents
- The Internet is the connectivity, the web is the content
- A **Web site** is a collection of related Web pages



The World Wide Web

What is a Uniform Resource Locator (URL)?

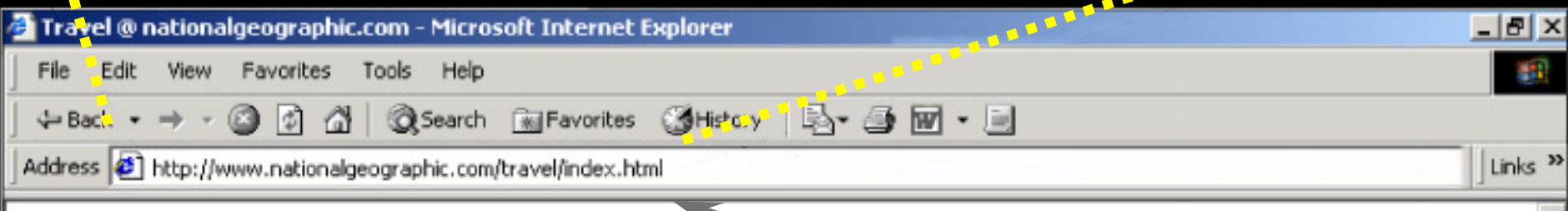
- Unique address for a Web page or other resource on net
- Browser retrieves a Web page by using the URL
- Components of URL:

protocol

domain name

path

http://www.nationalgeographic.com/travel/index.html



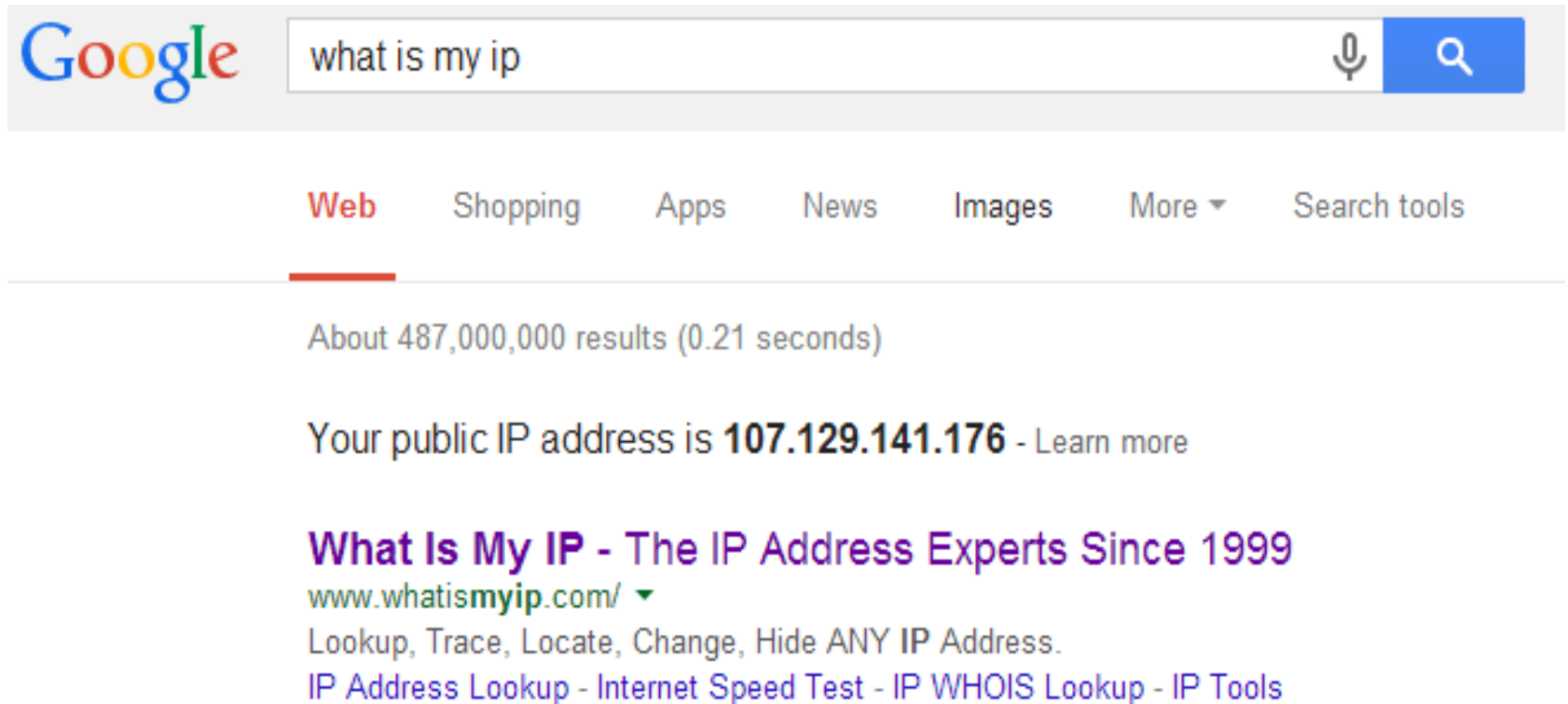
How the Internet Works

What is an Internet protocol (IP) address?

- Number that uniquely identifies each computing device connected to the Internet
- IPV4: four groups of numbers each separated by a period
- IPV6: 8 groups of hex numbers each separated by a colon
- Provides identification and 'location' address of computer
- Static addresses (web pages) vs. Dynamic (laptops)



What is my IP address?



A screenshot of a Google search interface. The search bar contains the text "what is my ip". Below the search bar, the "Web" tab is selected and underlined. The search results show "About 487,000,000 results (0.21 seconds)". The first result is "Your public IP address is **107.129.141.176** - Learn more". Below this is a link to "What Is My IP - The IP Address Experts Since 1999" with the URL "www.whatismyip.com/". The description of the link reads: "Lookup, Trace, Locate, Change, Hide ANY IP Address. IP Address Lookup - Internet Speed Test - IP WHOIS Lookup - IP Tools".

Google

what is my ip

Web Shopping Apps News Images More Search tools

About 487,000,000 results (0.21 seconds)

Your public IP address is **107.129.141.176** - Learn more


What Is My IP - The IP Address Experts Since 1999
www.whatismyip.com/
Lookup, Trace, Locate, Change, Hide ANY IP Address.
IP Address Lookup - Internet Speed Test - IP WHOIS Lookup - IP Tools

How the Internet Works

What is a domain name?

- Text version of an IP address
- Components are separated by periods
- Each domain name represents one or more IP addresses
- Domain Name System (DNS) translates domain names to the IP address

IP address  **199.95.72.10**

Domain name  **www.scsite.com**

How the Internet Works

What is a top-level domain (TLD) abbreviation?

- Domain at highest level of DNS of the Internet
- Identifies the type of organization associated with the domain

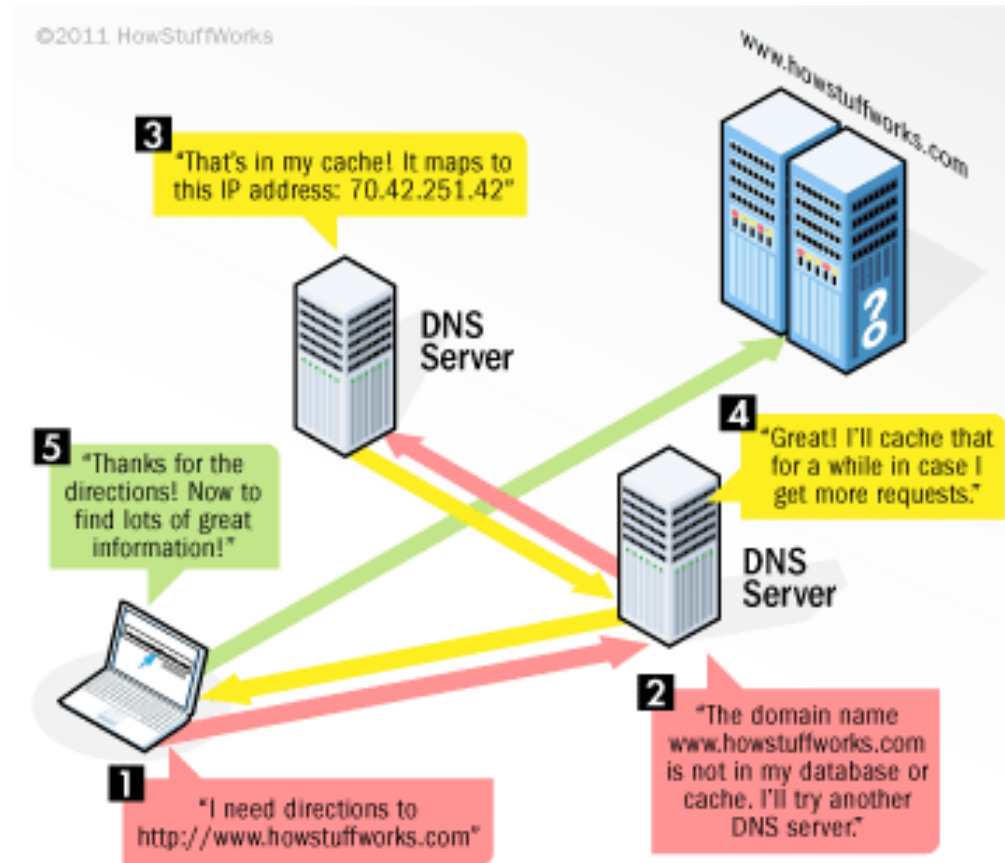
TLD Abbreviation	Type of Domain
.com	Commercial organizations (unrestricted)
.edu	Educational institutions
.gov	Government agencies
.mil	Military organizations
.net	Network provider
.org	Originally non-profit organizations

How the Internet Works

What systems control domain names?

- ☒ Internet Corporation for Assigned Names and Numbers (ICANN)
 - ☒ Assigns/maintains TLDs
- ☒ Domain Name System (DNS)
 - ☒ Stores domain names and corresponding IP addresses
 - ☒ Translates domain names to IP addresses

Abstraction and the Internet – IP Addresses



You don't have to know the literal IP address of BSC to get to the webpage. You just need to know `bsc.edu`...the details of the IP address are abstracted away from you

Internet Autonomy

Who controls the Internet?

- The Internet is a public, cooperative, and independent network
- No single entity controls or owns the Internet
- Several organizations advise and define standards

World Wide Web Consortium (W3C)

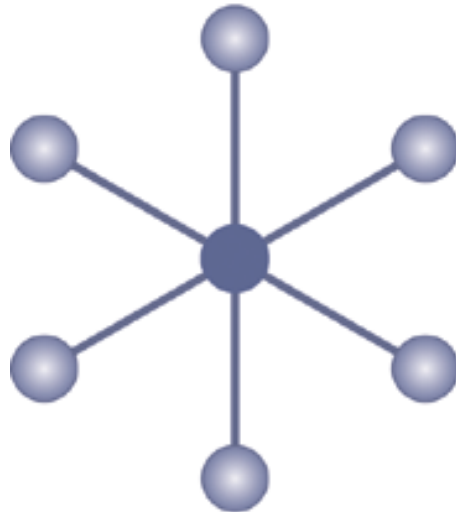
- Oversees research and sets standards and guidelines

Internet2 (I2)

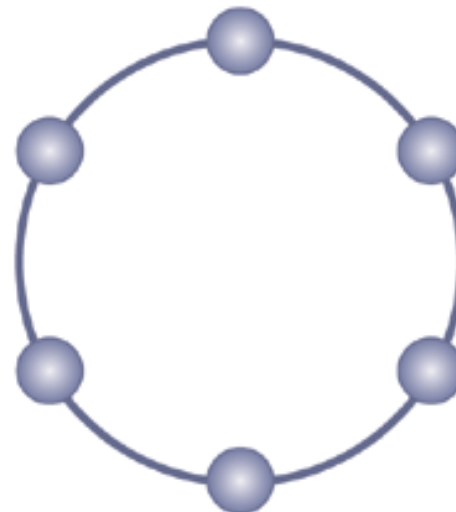
- Internet-related research and development project
- Develops and tests advanced Internet technologies

Network topologies

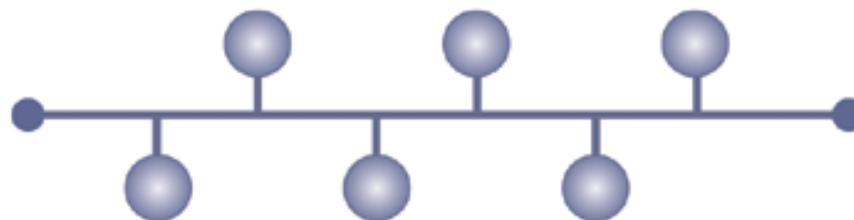
Star topology



Ring topology



Bus topology



Physical connection media

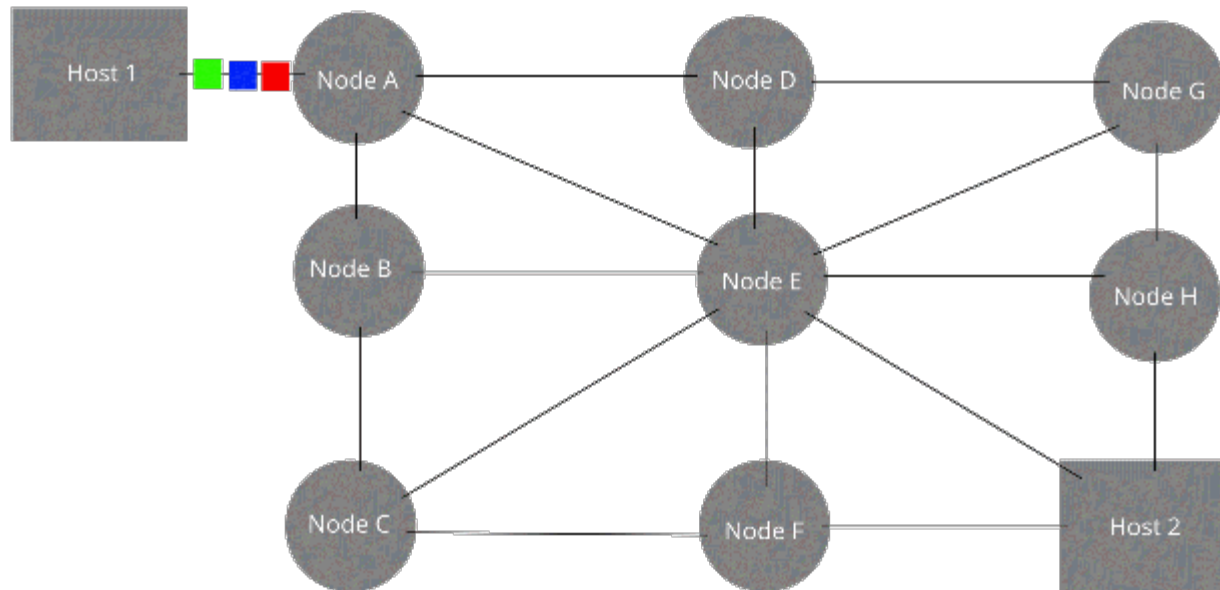
- Twisted-pair wire (modems)
 - Simplest and slowest
- Coaxial cable
 - Copper wires surrounded by thick insulation
- Fiber optics and optical networks
- Wireless transmission media and devices
 - Microwave
 - Satellites
 - Cellular telephones

Key network technology

- Packet switching
 - Method of communication that breaks a transmitted message into separate units (called packets), and allows each packet to follow any available network route that may lead to the destination
 - Upon arrival at the destination, the packets are reorganized into the original message
 - Previously circuit-switched networks required a dedicated path (circuit) through the network
 - Packet switching is dynamic and can efficiently use the network capacity and availability

Packet switched networks

The original message is Green, Blue, Red.



Source: http://en.wikipedia.org/wiki/File:Packet_Switching.gif

Packet Switching Video

- Video Overview of Packet Switching
 - <https://www.youtube.com/watch?v=L8VpthhRaEg>
 -

WireShark Demo

- Packet Sniffers

- Plaintext information floating around the internet can be captured by tools known by systems administrators, but also hackers
- The need for encrypting sensitive information becomes more understood when considering plaintext can be viewed (e.g., credit card info in websites only using http, or in plaintext email)
- May violate campus or corporate regulations
- Video demo
 - <http://www.youtube.com/watch?v=6X5TwvGXHP0&noredirect=1>

Some Controversy with Encrypted Sites (https)

- Rob Krug, Security Solutions Architect of SonicWall, wrote an article in March 2017 stating that https is actually *weakening* security (posted on Moodle)
- In the rush to encrypt websites, we have inadvertently encrypted the threats that existed within those sites
- Security programs need to do a better job of inspecting the encrypted traffic rather than relying on the fact that its encrypted so it must be secure

For Next Class

Please read

- Tim Berners Lee Article
- Read Blown to Bits Appendix

Continue working on programming assignments – new one to be posted this evening along with final project.