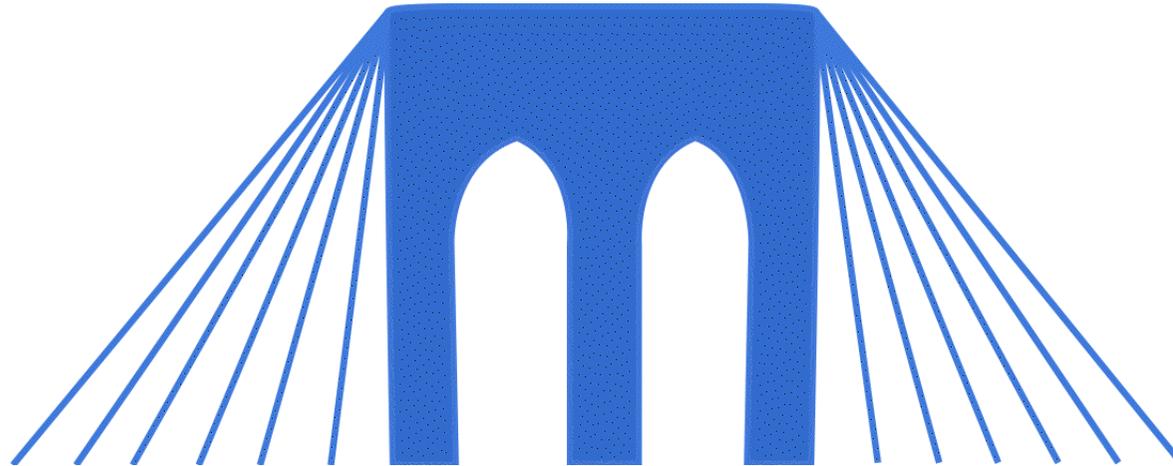# BRIDGES TO COMPUTING

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The Internet & World Wide Web

"The Internet.
All the piracy
and none of the scurvy."
-- Anonymous

M. Meyer
Bridges To Computing
2010

Content

- Topics:
  - Internet and WWW Overview
    - History
    - Technologies
    - Connecting to the Internet
    - Internet Software Tools
    - The World Wide Web

- Resources:
  - Meyers, CompTia A+ Certification

Networks

◦ When computers talk to each other, this is called a network.
- The network can have different kinds of computers and peripherals attached to it.
- Networks in which computers are physically connected to each other in the close geographical proximity are called local area networks (LANs)
- Other networks are called wide area networks (WANs)

◦ The Internet is a wide area network.

◦ The Internet is an open system = "a system whose architecture is not a secret"

What is the Internet?

- The internet is a WAN.
- History
  - Motivated by military desire for secure, reliable, efficient communications in the result of nuclear war.
  - ARPAnet (circa 1971): used "NCP"
  - TCP (1974): hardware independent.
  - Open internet was standardized in September 1981
- Fundamental ideas:
  - Uses "data packets" to move information (packet switching).
  - Relies (mostly) on insulated cables.
  - Allows communication without a "dedicated connection".

Internet Providers

- The Internet is divided into groups called tiers.
- Tier 1, consists of 9 companies (AT&T) providing high-speed fiber-optic networks (backbones) to the major cities of the earth.
- Tier 1 backbones interconnect at special network access points (NAPs). Tier 1 providers do not charge each other.
- Tier 2 providers (Time Warner) own smaller, regional networks and pay the Tier 1 providers.
- Tier 3 providers are even more regional and connect to Tier 2 providers.
- Backbone routers connect to more than one other backbone router, creating a big, interwoven framework for communication
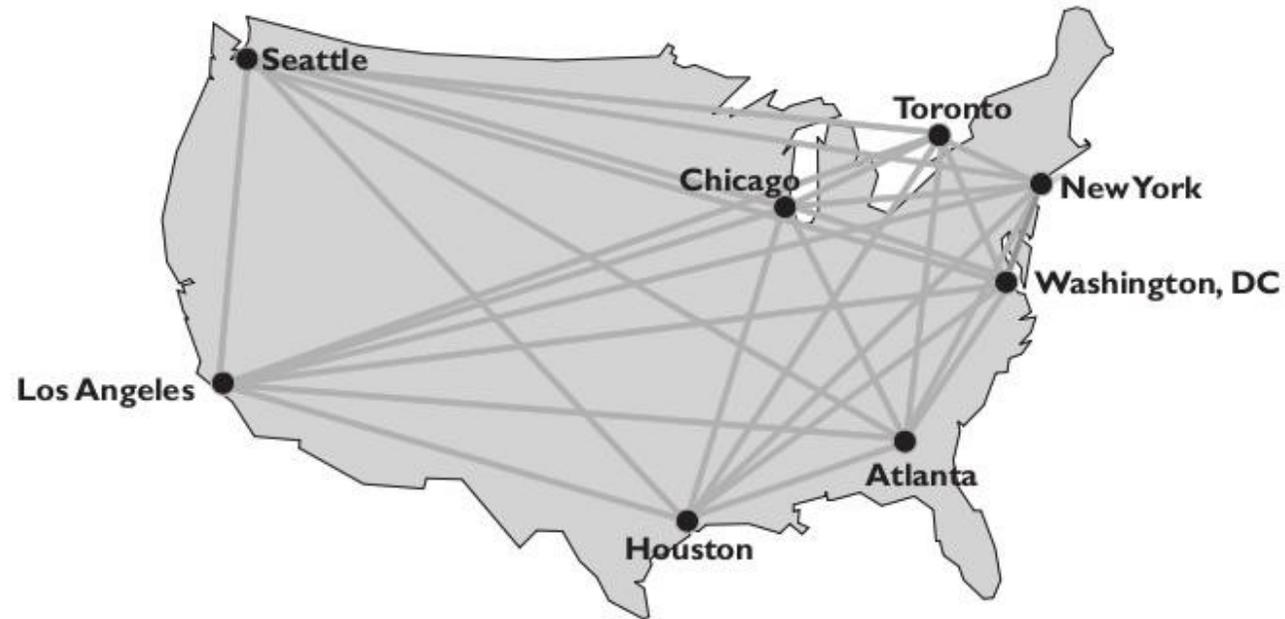
Tier 1 (level) U.S. cities.

Figure 25-1 Internet Tier 1 connections

- A total of nine companies provide Tier 1 Internet connectivity to the U.S. and the World.
- If any one cable is cut/damaged communication between cities is still possible.

Tier 1 International Cables

The internet's undersea world

The vast majority of the world's communications are not carried by satellites but an altogether older technology: cables under the earth's oceans. As a ship accidentally wipes out Asia's net access, this map shows how we rely on collections of wires of less than 10cm diameter to link us all together
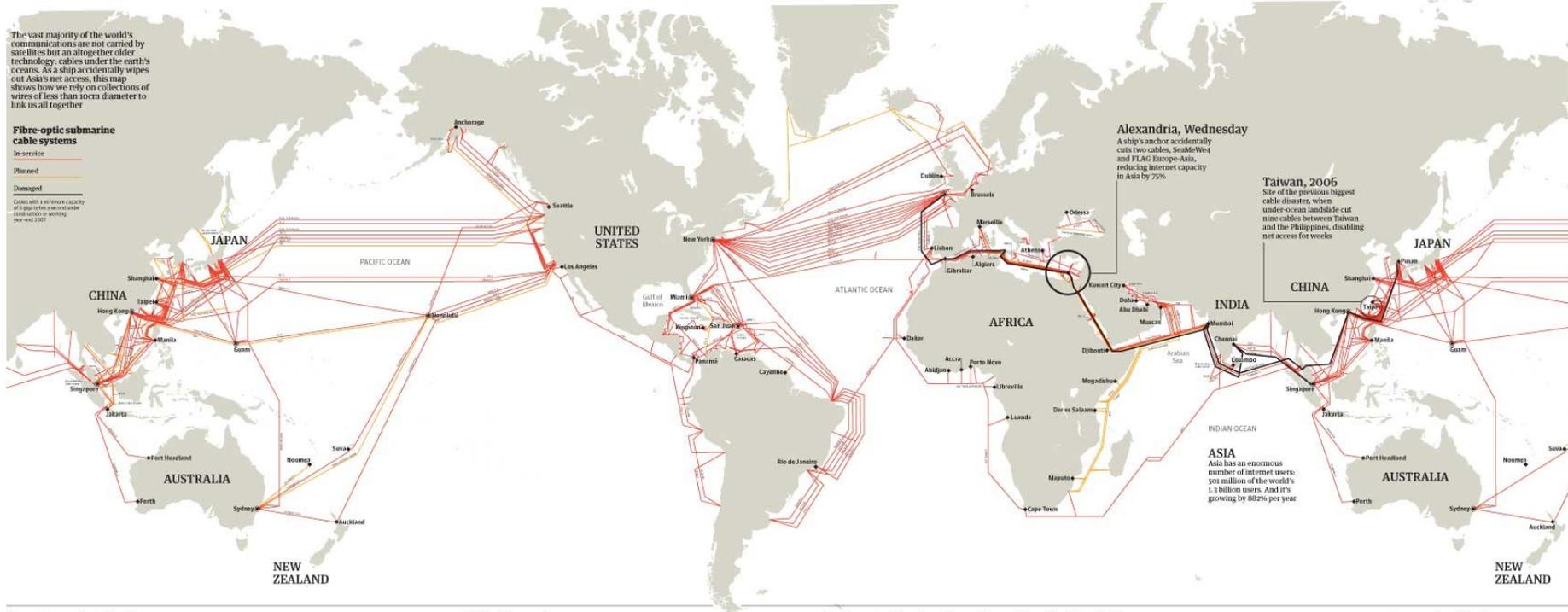
Fibre-optic submarine cable systems
In-service
Planned
Damaged
Cables with a minimum capacity of 5 gigabytes a second under construction or working year-end 2007

Alexandria, Wednesday
A ship's anchor accidentally cuts two cables, SeaMeWe4 and FLAG Europe-Asia, reducing internet capacity in Asia by 75%

Taiwan, 2006
Site of the previous biggest cable disaster, when under-ocean landslide cut nine cables between Taiwan and the Philippines, disabling net access for weeks

ASIA
Asia has an enormous number of internet users: 501 million of the world's 1.3 billion users. And it's growing at 882% per year

Internet users affected by the Alexandria accident
The main countries affected in Wednesday's event

60m India
12m Pakistan
6m Egypt
4.7m Saudi Arabia
1.7m UAE
0.8m Kuwait
0.3m Qatar
0.2m Bahrain
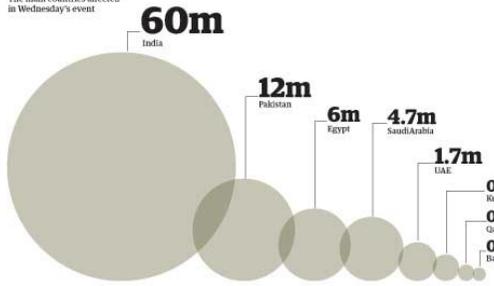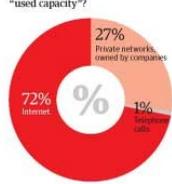
World cable capacity
Submarine cable operators light (turn on) capacity on their systems to sell bandwidth to other carriers. Carriers buy extra capacity, mainly to hold in reserve. On the trans-Atlantic route 80% of the bandwidth is purchased, but only 29% is used

Capacity in terabytes a second
Total capacity 7.1 tbps
Purchased capacity 5.7 tbps
Used capacity 2.1 tbps
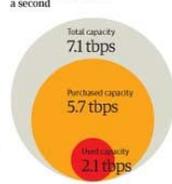
What makes up "used capacity"?
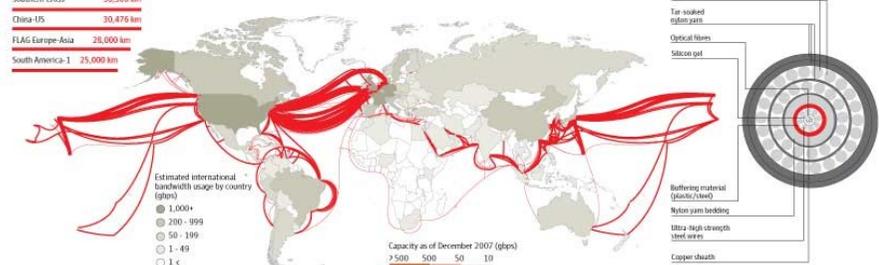27% Private networks, owned by companies
72% Internet
1% Telephone calls

The longest submarine cables
The SeaMeWe-3 system from Norden in Germany to Keoje, South Korea connects 32 different countries with 39 landing points

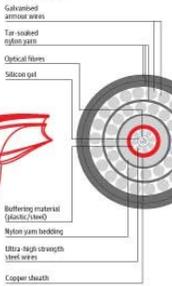| Cable	Length
SeaMeWe-3	39,000 km
Southern Cross	30,500 km
China-US	30,476 km
FLAG Europe-Asia	28,000 km
South America-1	25,000 km

The world's cables in bandwidth
The first intercontinental telephony submarine cable system, TAT-1, connected North America to Europe in 1958 and had an initial capacity of 640,000 bytes per second. Since then, total trans-Atlantic cable capacity has soared to over 7 trillion bps

Estimated international bandwidth usage by country (gbps)
1,000+
200 - 999
50 - 199
1 - 49
1 ‹

Capacity as of December 2007 (gbps)
500   500   50   10
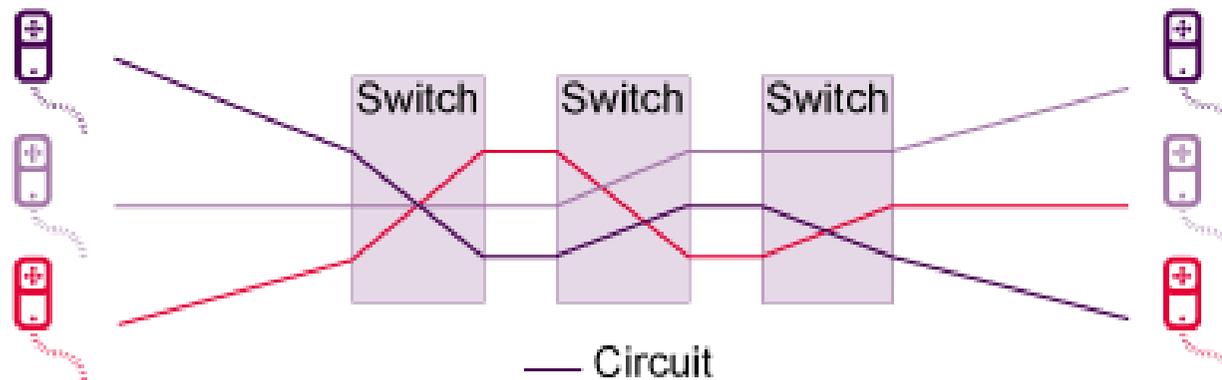
Cross-section of a cable
Cables of this strength are typically 69 mm in diameter and weigh over 10,000 kilograms a kilometre. In deeper waters, lighter and less insulated cables are used
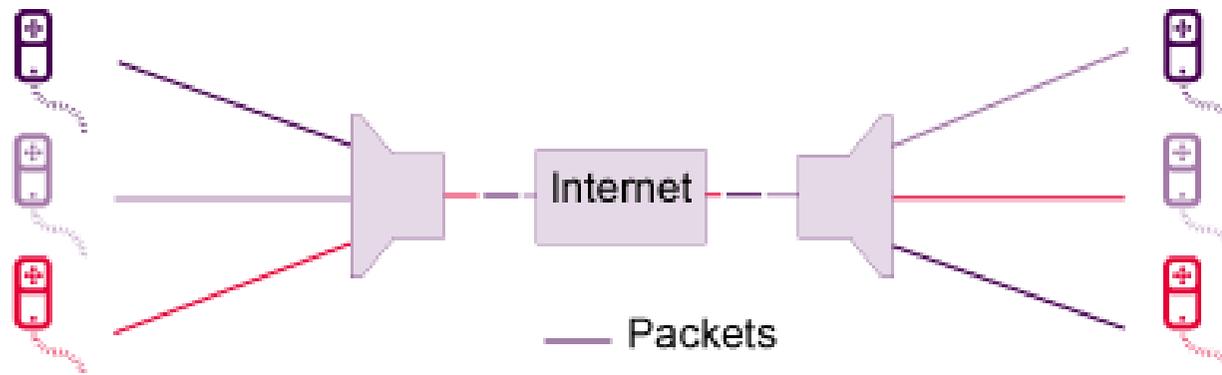
Galvanised armour wires
Tar-soaked nylon yarn
Optical fibres
Silicon gel
Buffering material (plastic/steel)
Nylon yarn bedding
Ultra-high strength steel wires
Copper sheath

Packet vs. Circuit Switching


- In any conversation (or exchange of information) there is going to be a lot of time when nothing is being said or exchanged.
- Packet switching allows multiple conversations to share one wire, by breaking up large pieces of data into small packets and then "sharing" a cable among all clients who want to use a cable.

Packet Switching... cont

Packet routing through WAN/Internet
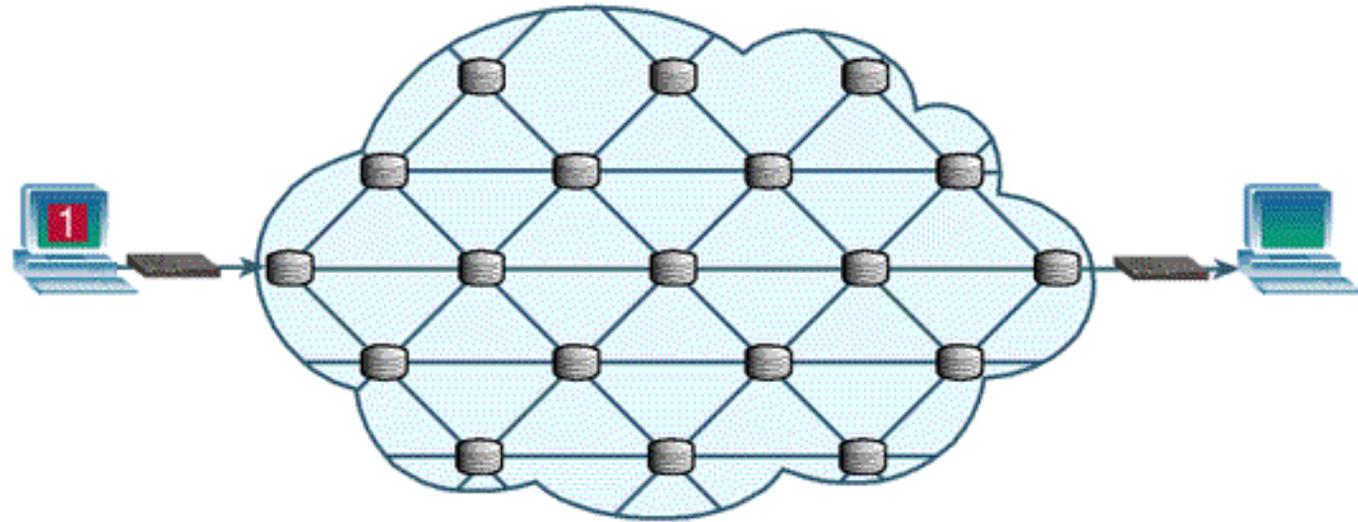
- In packet switching, large messages (emails, web-pages, even sections of speech in a phone conversation) are broken up into multiple addressed packets.

- These packets are sent separately across the Internet (they may take separate routes) and reassembled when the reach their destination.

Internet Service Provider (ISP)

- Every Tier 1 and Tier 2 provider leases connections to the Internet to companies called Internet service providers (ISPs).
- ISPs essentially sit along the edges of the Tier 1 and Tier 2 Internet and tap into the flow.
- You can, in turn, lease some of the connections from the ISP and thus get on the Internet.
- ISP's provide a number of different ways to connect to the Internet (different combinations of hardware and software may be required).

Protocols

- Protocol = set of rules for how computers communicate with each other.

- <u>Lower Level Protocols</u> (device to device)
  - IP: internet protocol (the address of a machine)
  - TCP: transmission control protocol (proof of delivery, rules or reassembling partitioned messages)

- <u>Higher Level Protocols</u> (program to program)
  - FTP: file transfer protocol
  - SMTP: simple mail transfer protocol
  - HTTP: hypertext transfer protocol

    - For more information: http://en.wikipedia.org/wiki/Internet_protocol_suite

Protocols...

- Internet packets rely on multiple layers of protocols.
- This is comparable to how a traditional letter might be delivered using a range of physical mediums.

- Stop... give examples.
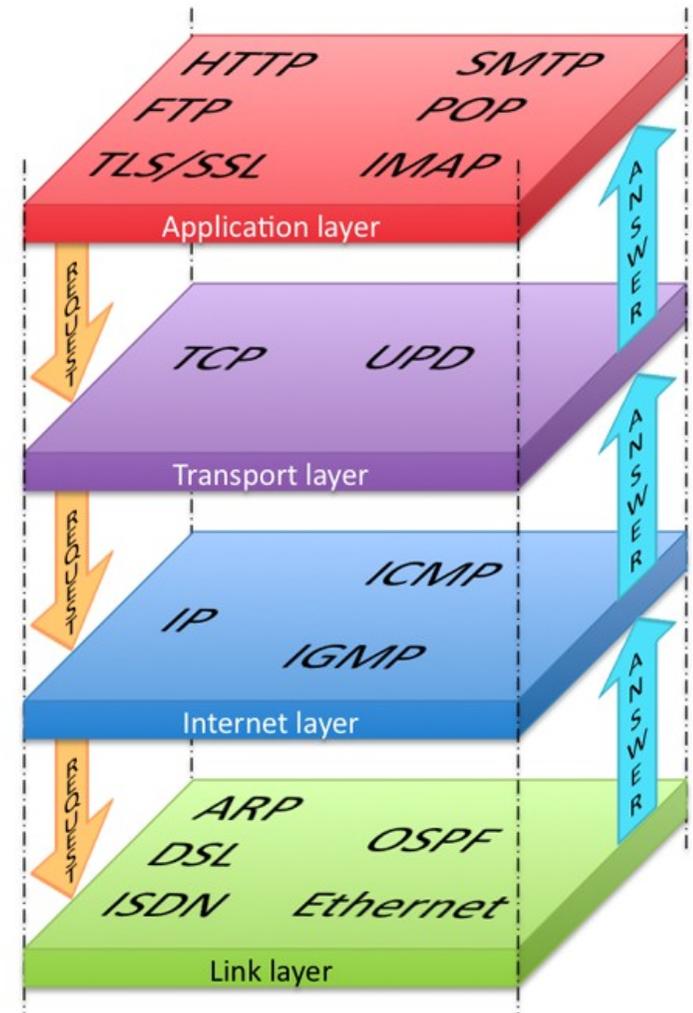
Internet Software

- FTP (file transfer protocol)
    - download
    - upload
- Email (SMTP)
- Bitorrent (File Sharing)
- Newsgroups
    - posting
    - thread
- VoIP (Digital phone)
- Streaming Digital Content (movies)
- Botnets
    - Spam
    - DOS attacks

Clients and Servers

- Server: computer on a network which carries out some service for another computer.
- Client: the other computer for whom the server is carrying out the service
- Types of servers:
  - file server
  - database server
  - web server
  - groupware server (lotus notes, Bittorrent)
  - mail server
  - application server (provides access to particular applications e.g., game servers of a web site)

Client-Server Architecture

- Advantages:
  - Isolates data storage technology.
    - Places more burden on server (instead of client)
    - Allows for distributing tasks amongst server(s)
  - Follows object-oriented and modular programming paradigms
    - Example: HTML documents, CSS files, images, video clips, etc.

- Disadvantages:
  - Multiple points of failure.
  - Multiple points of attack.

Client-Server Architecture Types
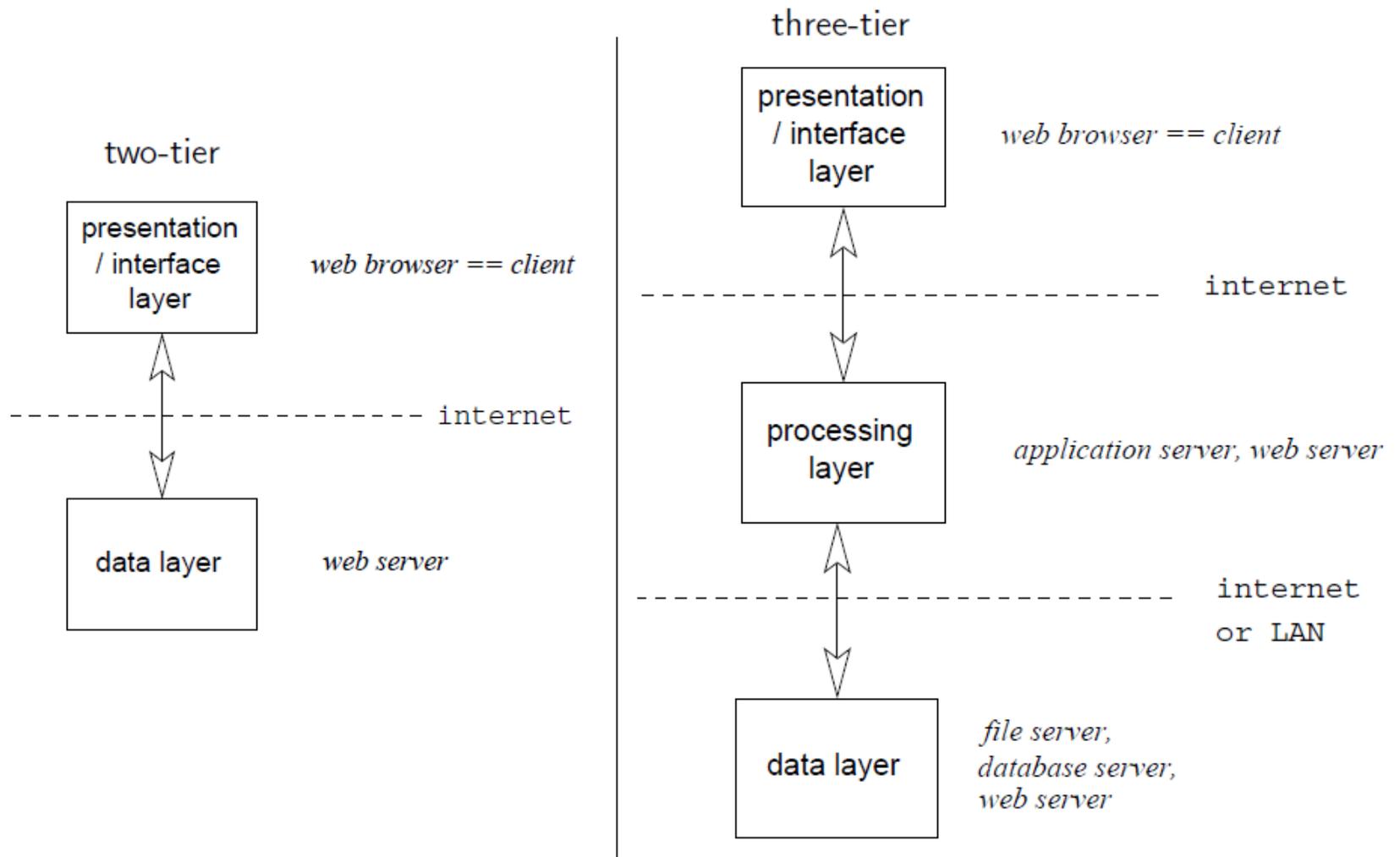
What is the World Wide Web?

- The world-wide web (WWW) is NOT the internet!
- History:
  - The idea of the world-wide web was conceived by Sir Tim Berners-Lee
  - Developed and discussed at CERN in Switzerland from about 1989
  - Made public in 1994
- Fundamentals:
  - The WWW uses the Internet, but is not the Internet itself.
  - The WWW is a way of organizing and viewing data that is accessible through the Internet.

World Wide Web... cont

- The Web provides a graphical interface to digital content stored on the Internet.
- Server Side:
  - Web servers are computers running specialized software programs (Apache, IIS).
  - Web servers provide access to collections of digital documents (mostly .html files) called websites.
  - Web sites are accessed by using the HTTP protocol on port 80.

World Wide Web... cont

- The Web provides a graphical interface to digital content stored on the Internet.
- Client Side:
  - Web-browser software, such as Internet Explorer or Mozilla Firefox, can make requests for web-pages.
  - These requests are in HTTP, and use DNS (Domain Name Resolution).
  - DNS allows us to use "web addresses" (www.google.com) instead of IP addresses (72.14.204.103:80)

Web Programming Languages

- Client Side:
  - Programs are run by the clients browser/application.
  - Example -> Javascript
    - scripting language based on Java
    - write programs using a text editor,.
    - programs are embedded/stored with HTML.
- Server Side:
  - Programs are run by a web server program.
  - Example -> PHP
    - scripting language (HyperText PreProcesser)
    - write programs using a text editor,.
    - programs are embedded/stored with HTML.

The End