

The Digital Revolution and the Hackers Culture.

Elective course
3rd module (Feb-Mar) 2019

Fabio Grazioso

Lecture 9/10

summary

- Historical perspective
 - the history of Apple and Microsoft
- Technological perspective
 - networking

I think that I will develop in parallel those themes all along the course

History of Apple and Microsoft

Apple

- Apple was founded by **Steve Jobs**, **Steve Wozniak**, and **Ronald Wayne** in April 1976 to develop and sell **Apple I** personal computer.



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Apple][

- In 1977 the company started to produce and sell the Apple II.
- It had MOS 6502 was an 8-bit microprocessor running at 1.023 MHz, 4 KB of RAM
- The original retail price of the computer was \$1,298 (with 4 KB of RAM) and \$2,638 (with the maximum 48 KB of RAM).
- To reflect the computer's color graphics capability, the Apple logo on the casing has rainbow stripes, which remained a part of Apple's corporate logo until early 1998.
- The Apple II was a catalyst for personal computers across many industries



In 1977 the company started to produce and sell the Apple II. This was MOS Technology 6502 microprocessor running at 1.023 MHz, two game paddles[12] (no longer bundled as of 1980 because they violated FCC regulations[13]), 4 KB of RAM, an audio cassette interface for loading programs and storing data, and the Integer BASIC programming language built into the ROMs. The video controller displays 24 lines by 40 columns of monochrome, upper-case-only (the original character set matches ASCII characters 20h to 5Fh) text on the screen, with NTSC composite video output suitable for display on a TV monitor, or on a regular TV set by way of a separate RF modulator. The original retail price of the computer was \$1,298[14] (with 4 KB of RAM) and \$2,638 (with the maximum 48 KB of RAM).[15] To reflect the computer's color graphics capability, the Apple logo on the casing has rainbow stripes,[16] which remained a part of Apple's corporate logo until early 1998. Perhaps most significantly, the Apple II was a catalyst for personal computers across many industries; it was responsible for opening the doors to software marketed at consumers.[7] , and sales of its computers, including the Apple II, grew quickly. Within a few years, Jobs and Wozniak had hired a staff of computer designers and had a production line.

**the personal-computer
“revolution”**

Supercomputers

- A **supercomputer** is a big and powerful computing device, with the **top levels** of computing power.
- The first computers ever built can be considered to belong to this category.
- They are used for scientific applications, in different fields. Examples are:
 - weather forecasting,
 - climate research,
 - oil and gas exploration,
 - molecular modeling
 - simulations of astrophysics models,
 - airplane and spacecraft aerodynamics,
 - the detonation of nuclear weapons,
 - cryptanalysis



Cray 1 - introduced 1976

Differences between mainframes and supercomputers

A supercomputer is a computer at the leading edge of data processing capability, with respect to calculation speed. Supercomputers are used for scientific and engineering problems (high-performance computing) which crunch numbers and data,[26] while mainframes focus on transaction processing. The differences are: Mainframes are built to be reliable for transaction processing (measured by TPC-metrics; not used or helpful for most supercomputing applications) as it is commonly understood in the business world: the commercial exchange of goods, services, or money.[citation needed] A typical transaction, as defined by the Transaction Processing Performance Council,[27] updates a database system for inventory control (goods), airline reservations (services), or banking (money) by adding a record. A transaction may refer to a set of operations including disk read/writes, operating system calls, or some form of data transfer from one subsystem to another which is not measured by the processing speed of the cpu. Transaction processing is not exclusive to mainframes but is also used by microprocessor-based servers and online networks.

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IBM Blue Gene system

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Mainframes

- The **mainframe** computers have been the most commercialized form of computers from the 1950s through the 1970s.
- They are used by large organizations (e.g. government agencies, big corporations) for data processing, and can handle several users at the same time.
- The difference with supercomputers is that their computing power is lower, but their **reliability**, **availability** and **serviceability** are optimized
- They can run uninterrupted for very long periods of time, with mean time between failures (MTBF) measured in **decades**.



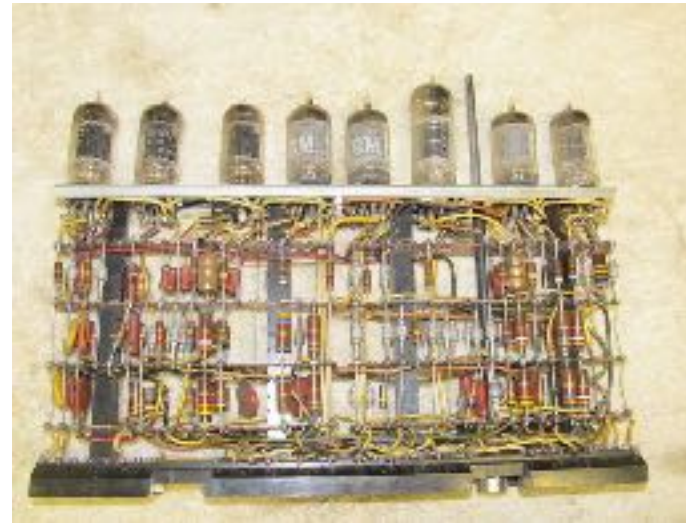
IBM 704 - introduced 1954

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IBM mainframe circuit board with vacuum tubes (1950)

what is in the cabinets? consider that at that time there was no **transistors**, and the electronics was based on bulk components and **vacuum tubes**.

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IBM System z9 - introduced 2005

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Minicomputers

- In the '60s started to be introduced smaller, cheaper computers, based on transistors instead of vacuum tubes.
- The term "minicomputer" is little used today; the contemporary term for this class of system is "midrange computer".



IBM System z9 - introduced 2005

The PDP-8 was a 12-bit minicomputer produced by Digital Equipment Corporation (DEC). It was the first commercially successful minicomputer, with over 50,000 examples being sold over the model's lifetime.

Minicomputers

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- By the year 2000, Compaq (which had bought DEC) announced that VAX models would be discontinued.



DEC VAX11/750 - introduced 1980

this is a VAX/VMS system, in particular a microVAX, one of the last VAX models

Microcomputers

- The term microcomputer is intended as a smaller version of minicomputers
- The minicomputer had many separate components that made up the CPU, while the microcomputer had one integrated microprocessor chip.



Commodore Vic20 - introduced 1980

this is a VAX/VMS system, in particular a microVAX, one of the last VAX models

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MOS 6802 microprocessor - introduced 1975

The MOS microprocessor price was \$25. The Motorola 6800 price was around \$300.

Apple //

- The Apple II series is a family of **home computers**, one of the first highly successful **mass-produced microcomputer** products, launched in 1977.
- In terms of ease of use, features, and expandability, the Apple II was a major advancement over its predecessor, the Apple I.
- Through 1988, a number of models were introduced, with the most popular, the Apple IIe, remaining changed relatively little into the 1990s. A 16-bit model with much more advanced graphics and sound, the Apple IIGS, was added in 1986.
- Between 1977 and 1993, somewhere between five and six million Apple II series computers had been produced. The Apple II was one of the longest running mass-produced home computer series, with models in production for just under 17 years.
- The Apple II became one of several recognizable and successful computers during the 1980s and early 1990s, although this was mainly limited to the USA.
- It was aggressively marketed through volume discounts and manufacturing arrangements to educational institutions, which made it the first computer in widespread use in American secondary schools.
- The effort to develop educational and business software for the Apple II, including the 1979 release of the popular VisiCalc **spreadsheet**, made the computer especially popular with business users and families.



The original Apple II operating system was in ROM along with Integer BASIC. Programs were entered, then saved and loaded on cassette tape. When the Disk II was implemented in 1978 by Steve Wozniak, a Disk Operating System or DOS was commissioned from the company Shepardson Microsystems[8][9] where its development was done by Paul Laughton.[10] The final and most popular version of this software was Apple DOS 3.3. Some commercial Apple II software booted directly and did not use standard DOS formats. This discouraged the copying or modifying of the software on the disks and improved loading speed. Apple DOS was superseded by ProDOS, which supported a hierarchical filesystem and larger storage devices. With an optional third-party Z80-based expansion card,[11] the Apple II could boot into the CP/M operating system and run WordStar, dBase II, and other CP/M software. With the release of MousePaint in 1984 and the Apple IIGS in 1986, the platform took on the look of the Macintosh user interface, including a mouse.

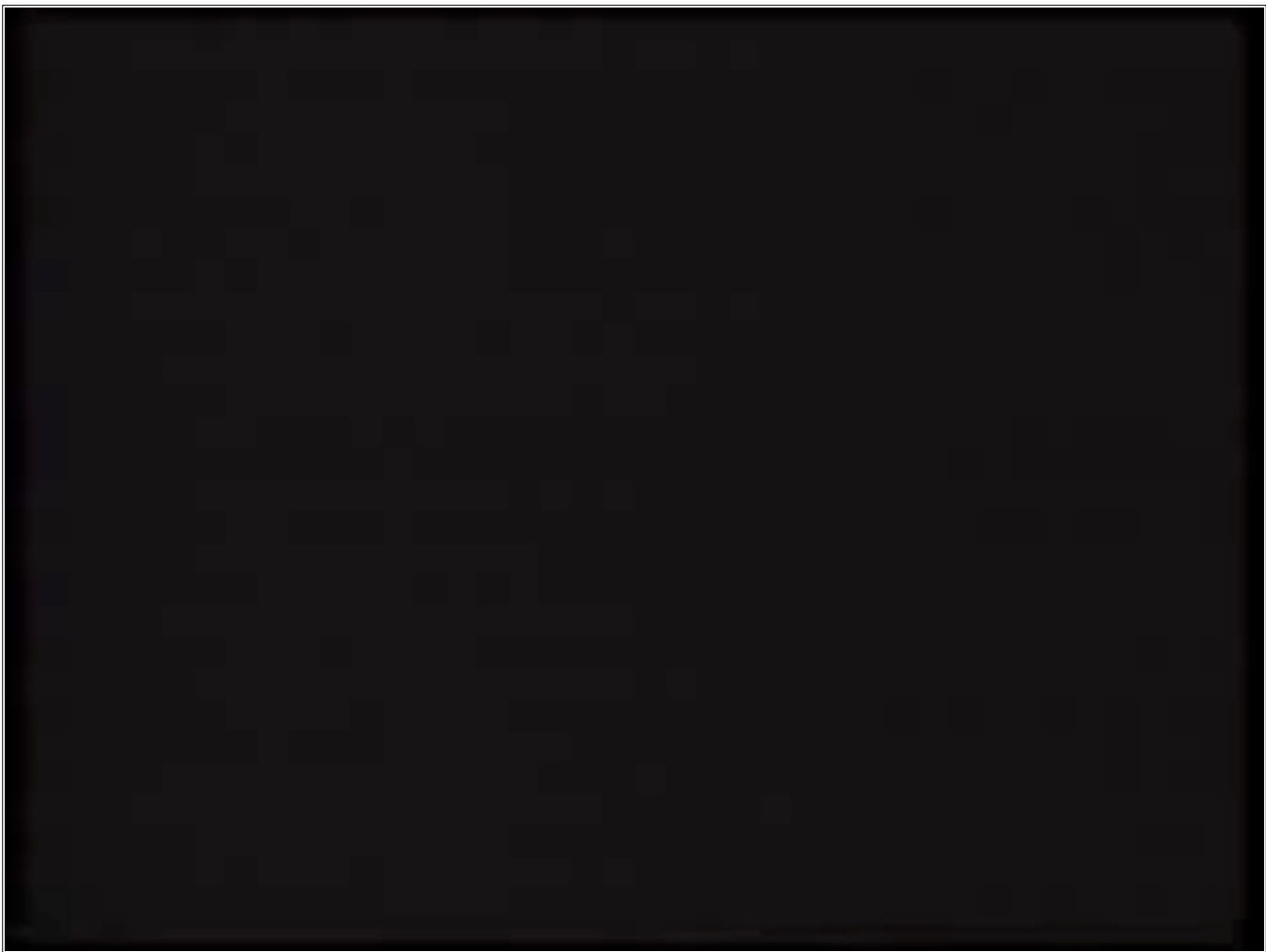
Despite the introduction of the Motorola 68000-based Macintosh in 1984 the Apple II series still reportedly accounted for 85% of the company's hardware sales in the first quarter of fiscal 1985.[12] Apple continued to sell Apple II systems alongside the Macintosh until terminating the IIGS in December 1992[13] and the IIe in November 1993.[14] The last II-series Apple in production, the IIe card for Macintoshes, was discontinued on October 15, 1993. The total Apple II sales of all of its models during its 16-year production run were about 6 million units, with the peak occurring in 1983 when 1 million were sold.

Apple //c

- The Apple IIc was released in April 1984, billing it as a **portable** Apple II, because it could be easily carried.
- But unlike modern portables it lacked a built-in display and battery.
- It had an integrated 5.25" floppy disk drive.









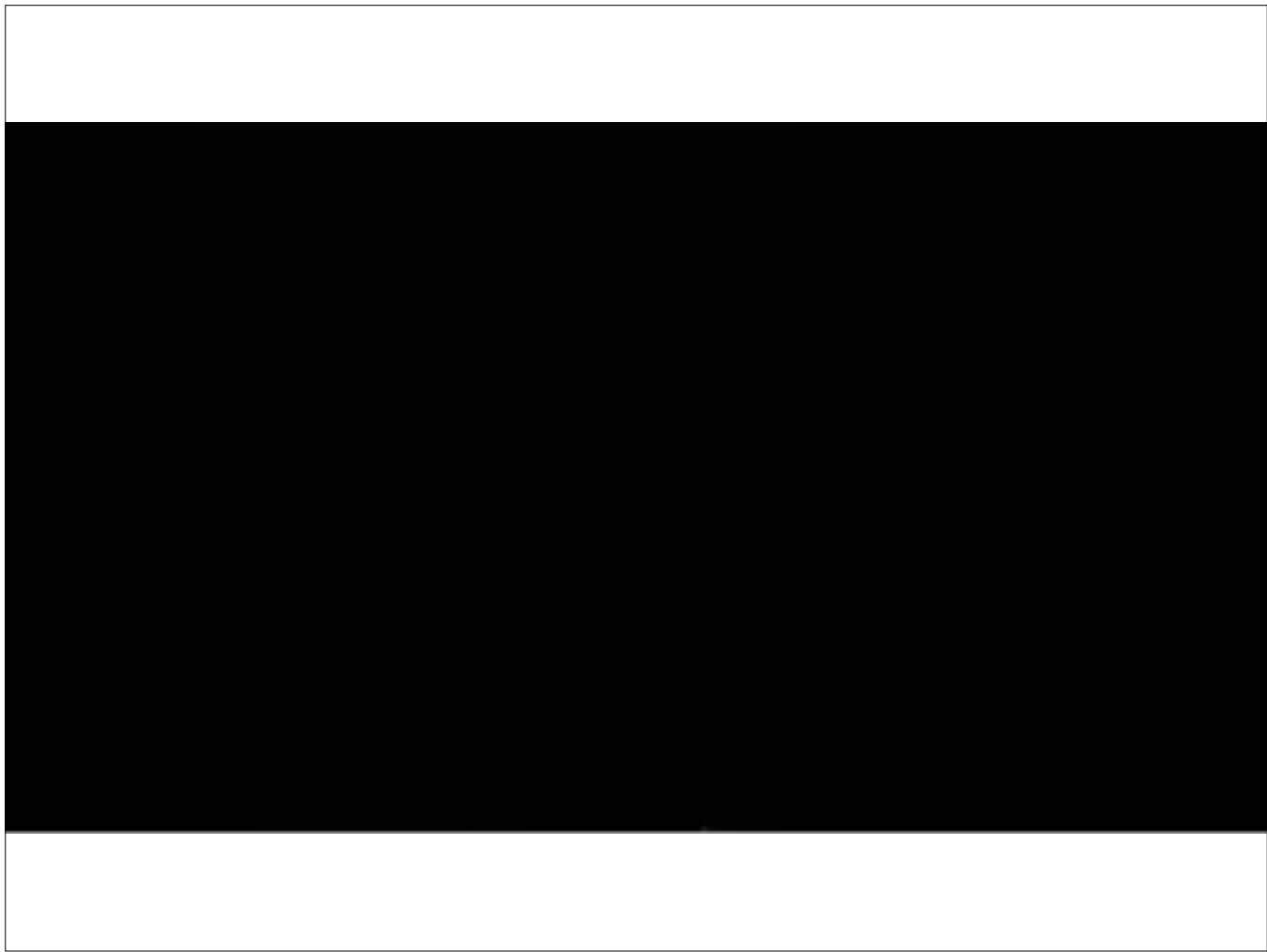


The Macintosh

Macintosh

- On January 24, 1984 released the original Apple Macintosh personal computer.
- It had an initial selling price of \$2,495 (equivalent to \$6,017 in 2018).
- Sales of the Macintosh were strong from its initial release, and reached 70,000 units on May 3, 1984.





"1984" is an American television commercial that introduced the Apple Macintosh personal computer. It was conceived by Steve Hayden, Brent Thomas and Lee Clow at Chiat\Day, produced by New York production company Fairbanks Films, and directed by Ridley Scott. English athlete Anya Major performed as the unnamed heroine and David Graham as Big Brother.[1] It first aired in 10 local outlets,[2] including Twin Falls, Idaho, where Chiat\Day ran the ad on December 31, 1983, at the last possible break before midnight on KMVT, so that the advertisement qualified for 1983 advertising awards.[3][4] Its second televised airing, and only national airing, was on January 22, 1984, during a break in the third quarter of the telecast of Super Bowl XVIII by CBS.[5]

Macintosh

- Early Macintosh models were **expensive**, and the market was dominated by the **Commodore 64** for consumers, and the **IBM Personal Computer** for businesses.
- Macintosh systems found success in education and desktop publishing and kept Apple as the **second-largest PC manufacturer** for the next decade.
- In the early 1990s, Apple introduced models such as the Macintosh LC II and Color Classic which were price-competitive with Wintel machines at the time.
- However, the introduction of Windows 3.1 and Intel's **Pentium processor** gradually took market share from Apple.
- By the end of 1994 Apple was relegated to **third place** as Compaq became the top PC manufacturer.



The IBM Personal Computer

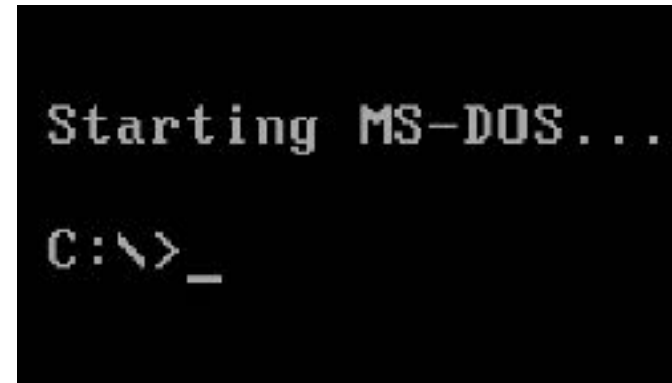
IBM 5150 PC

- The IBM Personal Computer, is the original version and progenitor of the **IBM PC compatible hardware platform**.
- It is IBM model number 5150, and was introduced on August 12, 1981. It was created by a team of engineers and designers in Florida.
- The generic term "personal computer" ("PC") was in use years before 1981, but because of the success of the IBM Personal Computer, the term "PC" came to also mean more specifically a desktop microcomputer compatible with IBM's Personal Computer branded products.
- Since the machine was based on open architecture, within a short time of its introduction, third-party suppliers of peripheral devices, expansion cards, and software proliferated;
- the influence of the IBM PC on the personal computer market **standardized** a platform for personal computers. "IBM compatible".
- After the 1980s, only the Apple Macintosh family kept a significant share of the microcomputer market **without compatibility with the IBM personal computer**.



MS DOS

- MS-DOS (Microsoft Disk Operating System) is an operating system for x86-based personal computers mostly developed by Microsoft.
- Collectively, MS-DOS, its rebranding as IBM PC DOS.
- MS-DOS was the main operating system for IBM PC compatible personal computers during the 1980s and the early 1990s.
- Then it was gradually superseded by operating systems offering a **graphical user interface** (GUI), e.g. Microsoft **Windows** and **Mac OS** operating system.

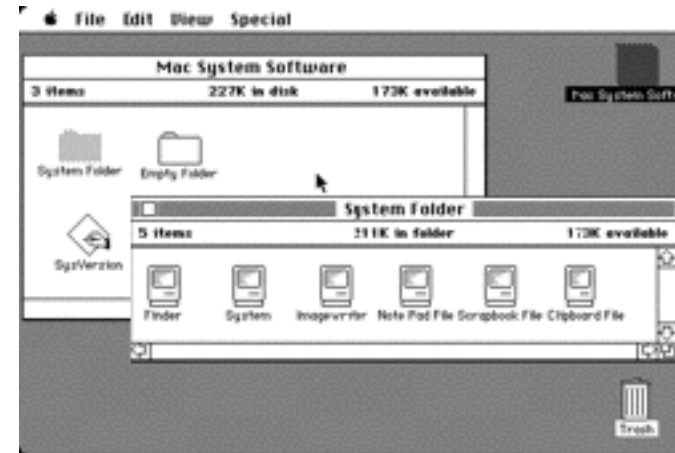




MacOS and Windows

Mac OS

- The family of Macintosh **operating systems** developed by Apple Inc. is a graphical user interface-based operating systems, introduced in 1984.
- The first series is now known as the "**Classic**" Mac OS.
- The system, rebranded "Mac OS" in 1996, was **preinstalled** on every Macintosh until 2002.
- Noted for its ease of use, it was also criticized for its **lack of modern technologies** compared to its competitors.



Mac OS X

- macOS (originally named "Mac OS X" until 2012 and then "OS X" until 2016) is the current Mac operating system that officially succeeded the classic Mac OS in 2001.
- The system was originally marketed as simply "version 10" of Mac OS, but it has a history that is largely independent of the classic Mac OS.
- It is a **Unix-based** operating system built on NeXTSTEP and other technology developed at **NeXT** from the late 1980s until early 1997, when Apple purchased the company and its **CEO Steve Jobs** returned to Apple.
- macOS makes use of the BSD codebase and the XNU kernel, and its core set of components is based upon Apple's open source **Darwin operating system**.



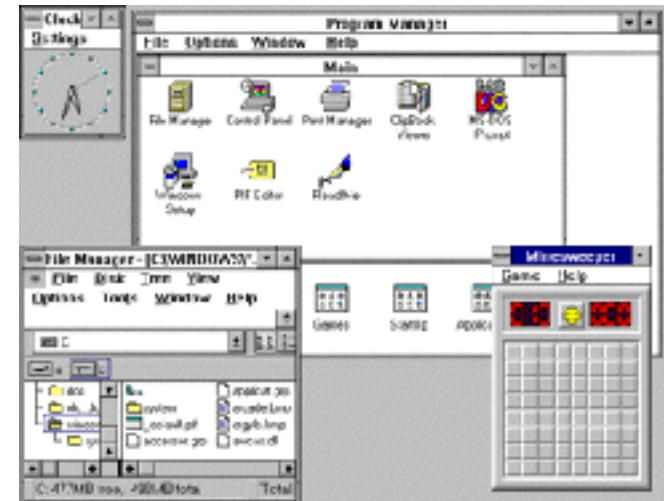
MS Windows

- Windows 1.0 is a graphical personal computer operating environment developed by Microsoft.
- Microsoft had worked with Apple Computer to develop applications for Apple's January 1984 original Macintosh, the first mass-produced personal computer with a graphical user interface (GUI) that enabled users to see user friendly icons on screen.
- Windows 1.0 was released on November 20, 1985, as the first version of the Microsoft Windows line. It runs as a graphical, 16-bit multi-tasking shell on top of an existing MS-DOS installation.
- It provides an environment which can run graphical programs designed for Windows, as well as existing MS-DOS software.



Windows 3.1x

- Windows 3.1x is a series of 16-bit operating environments produced by Microsoft for use on personal computers.
- The series began with Windows 3.1, which was first sold during April 1992. Subsequent versions were released between 1992 and 1994 until the series was superseded by Windows 95.
- During its lifespan, Windows 3.1 introduced several enhancements to the **still MS-DOS-based platform**, including improved system stability, expanded support for multimedia, TrueType fonts, and workgroup networking.
- Windows 3.1 was originally released on April 6, 1992; official support for Windows 3.1 ended on December 31, 2001, and OEM licensing for Windows for Workgroups 3.11 on embedded systems continued to be available until November 1, 2008.



PC platform

- **IBM PC compatible** computers are computers similar to the original IBM PC, XT, and AT, able to use the same software and expansion cards.
- Such computers used to be referred to as PC **clones**, or IBM clones. They duplicate almost exactly all the significant features of the PC architecture.
- The term "IBM PC compatible" is now a historical description only, since IBM has ended its personal computer sales.



Windows 10

- Windows 10 is part of its Windows NT family of operating systems.
- It is the successor to Windows 8.1, and was released to manufacturing on July 15, 2015, and broadly released for retail sale on July 29, 2015.
- Windows 10 receives new builds on an ongoing basis, which are available at no additional cost to users.
- Devices in enterprise environments can receive these updates at a slower pace, or use long-term support milestones that only receive critical updates, such as security patches, over their ten-year lifespan of extended support.
- The Windows user interface was revised to handle transitions between a mouse-oriented interface and a touchscreen-optimized interface based on available input devices.
- Critics praised Microsoft's decision to provide a desktop-oriented interface in line with previous versions of Windows, contrasting the tablet-oriented approach of 8
- However, media outlets have been critical of changes to operating system behaviours:
 - mandatory update installation,
 - privacy concerns over data collection performed by the OS for Microsoft and its partners
 - adware-like tactics used to promote the operating system on its release.
- The Anniversary Update adds Windows Subsystem for **Linux**, which allows the installation of a user space environment from a supported Linux distribution that **runs natively on Windows**.



Principles of Networking

Internet



The goal of today's lecture is to understand the general structure of internet computer networks.

Fault tolerance

- In the early 1960s, American computer scientist Paul Baran developed the concept Distributed Adaptive Message Block Switching with the goal to provide a **fault-tolerant**, efficient routing method for telecommunication messages as part of a research program at the RAND Corporation, funded by the US Department of Defense.
- The new concept found little resonance among network implementers until the independent work of British computer scientist Donald Davies at the National Physical Laboratory (United Kingdom) in 1965. Davies is credited with coining the modern name **packet switching** and inspiring numerous packet switching networks in the decade following, including the incorporation of the concept in the early ARPANET in the United States.

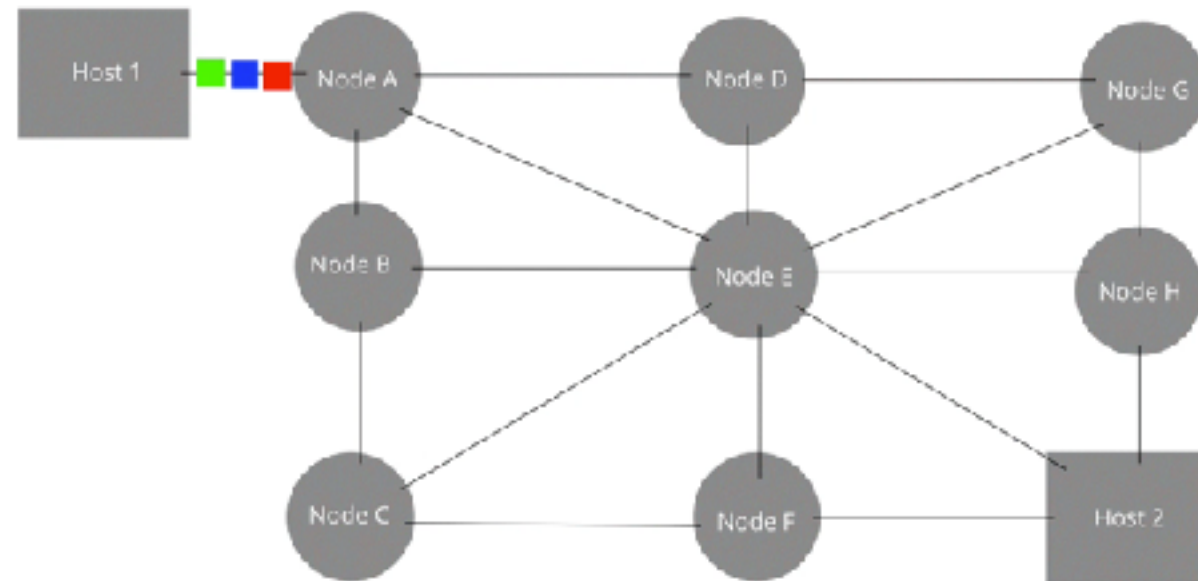
Internet is a military project. Therefore one of the main characteristics is to build an information exchange network **resilient to partial damage**, e.g. the failure of some of the nodes or some of the links.

Packet switching

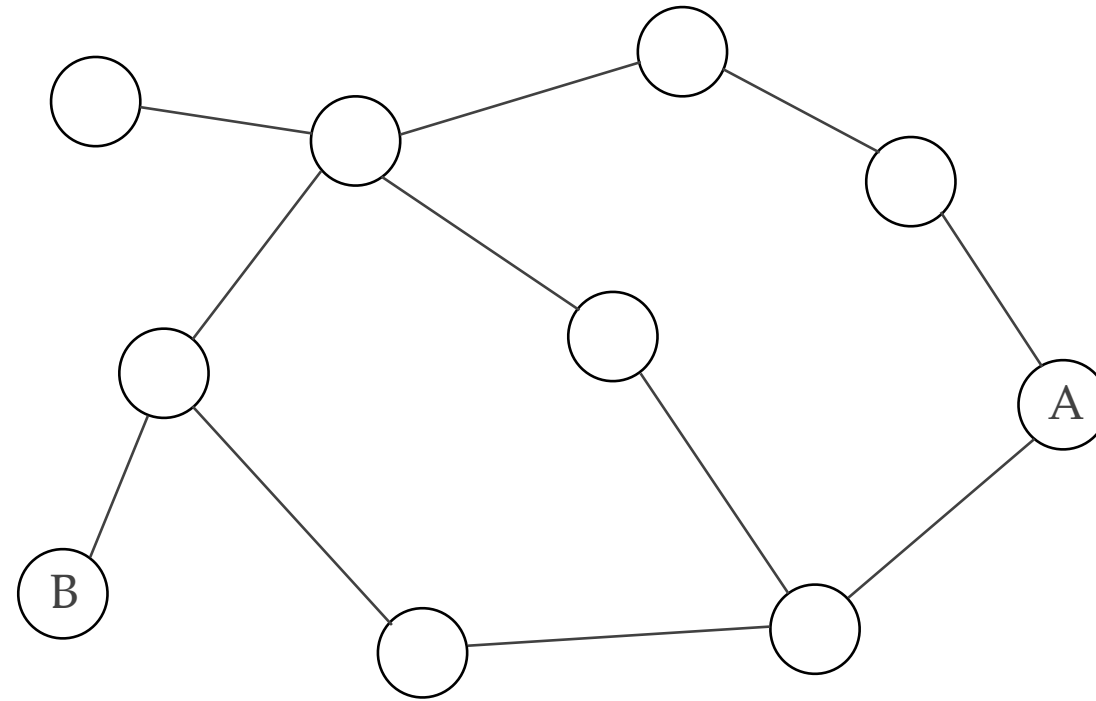
- Packet switching is a method of grouping data which is transmitted over a digital network into packets which are made of a header and a payload. Data in the header is used by networking hardware to direct the packet to its destination where the payload is extracted and used by application software.

Packet switching

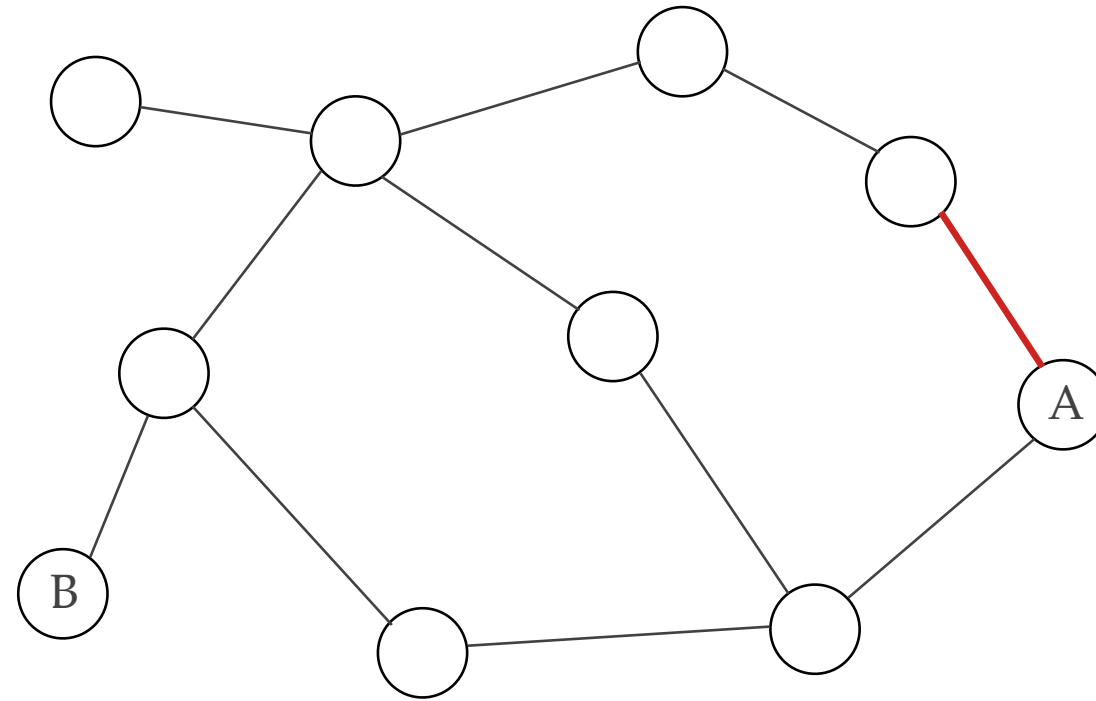
The original message is Green, Blue, Red.



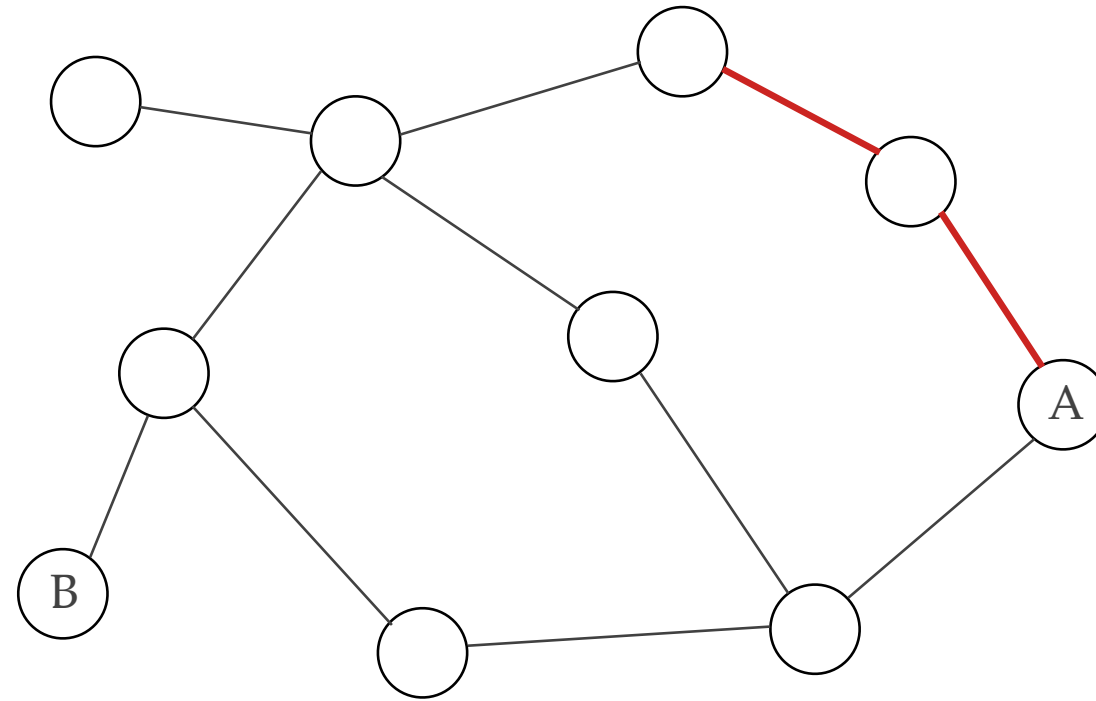
Routing



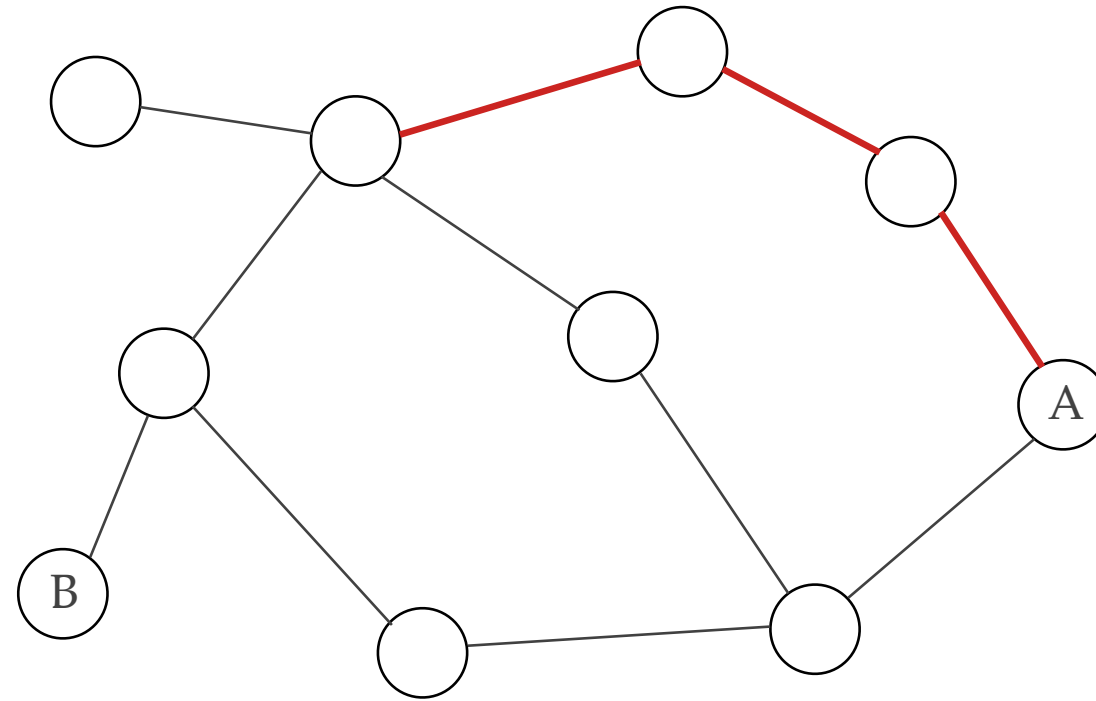
Routing



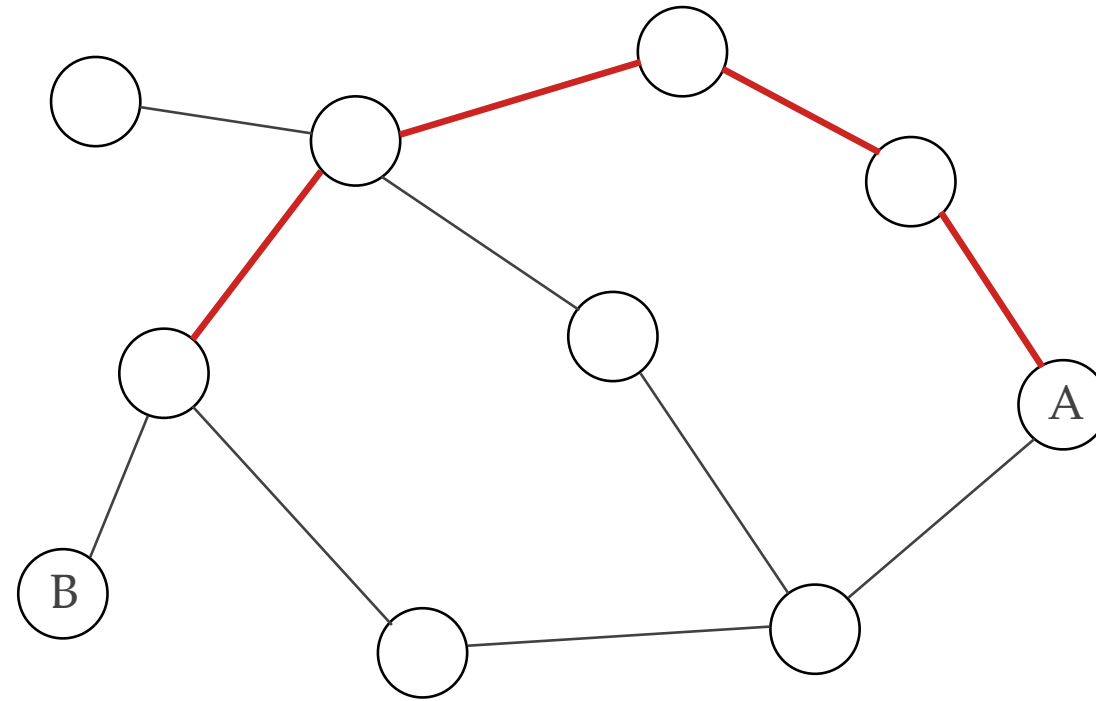
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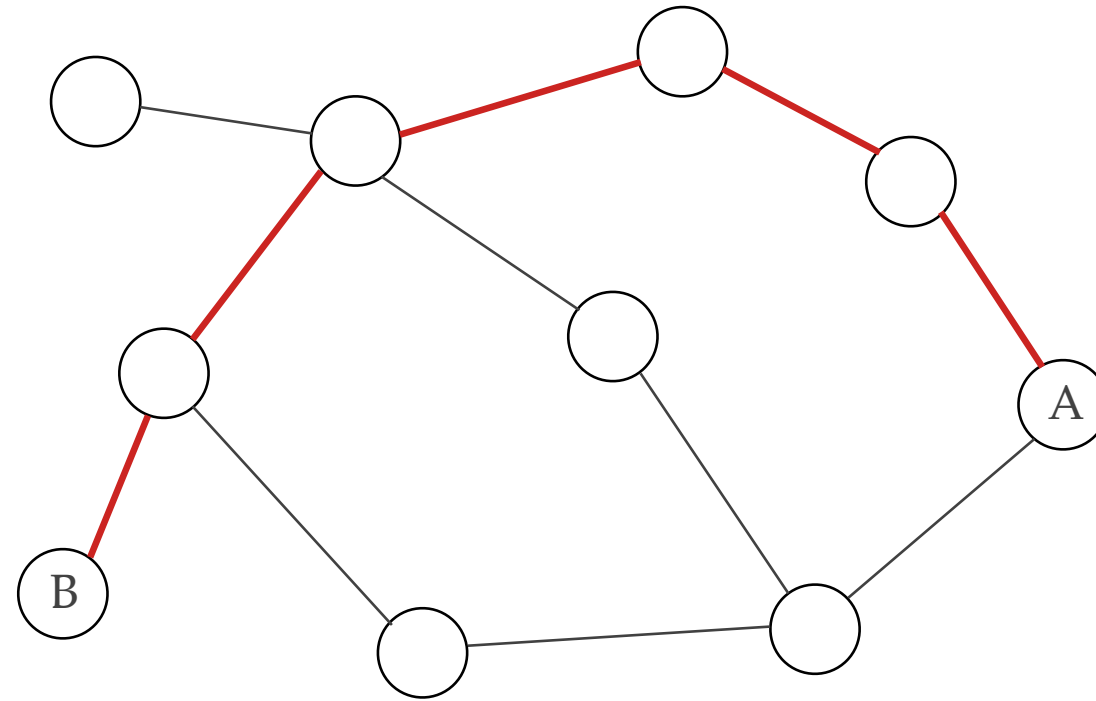
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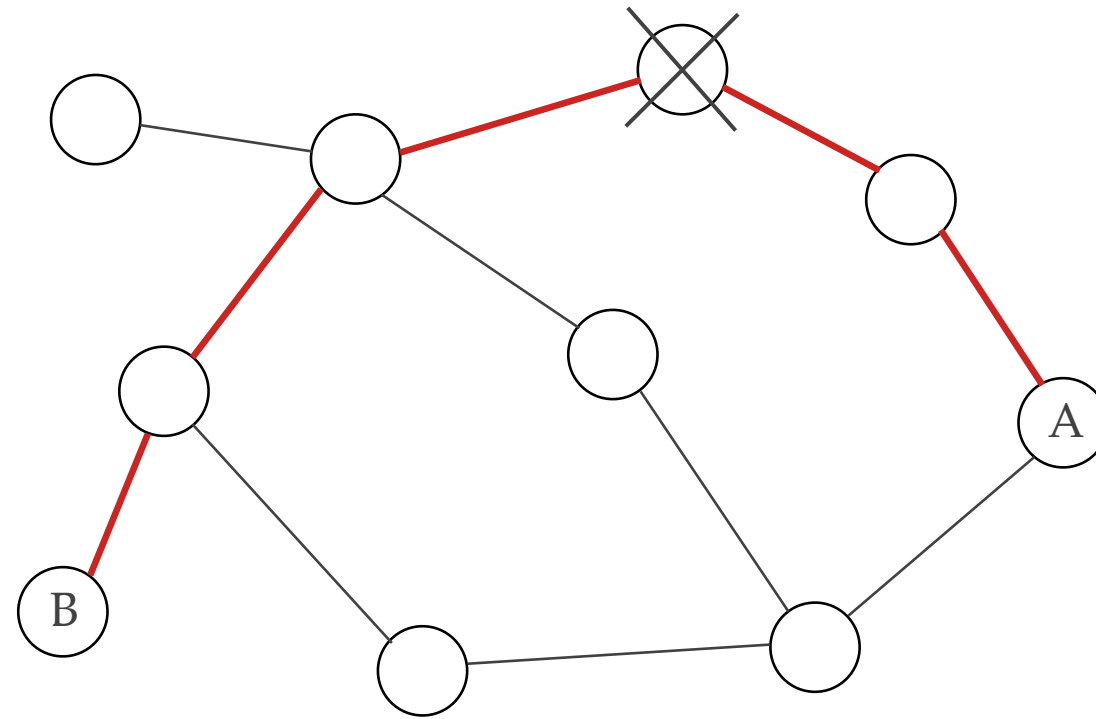
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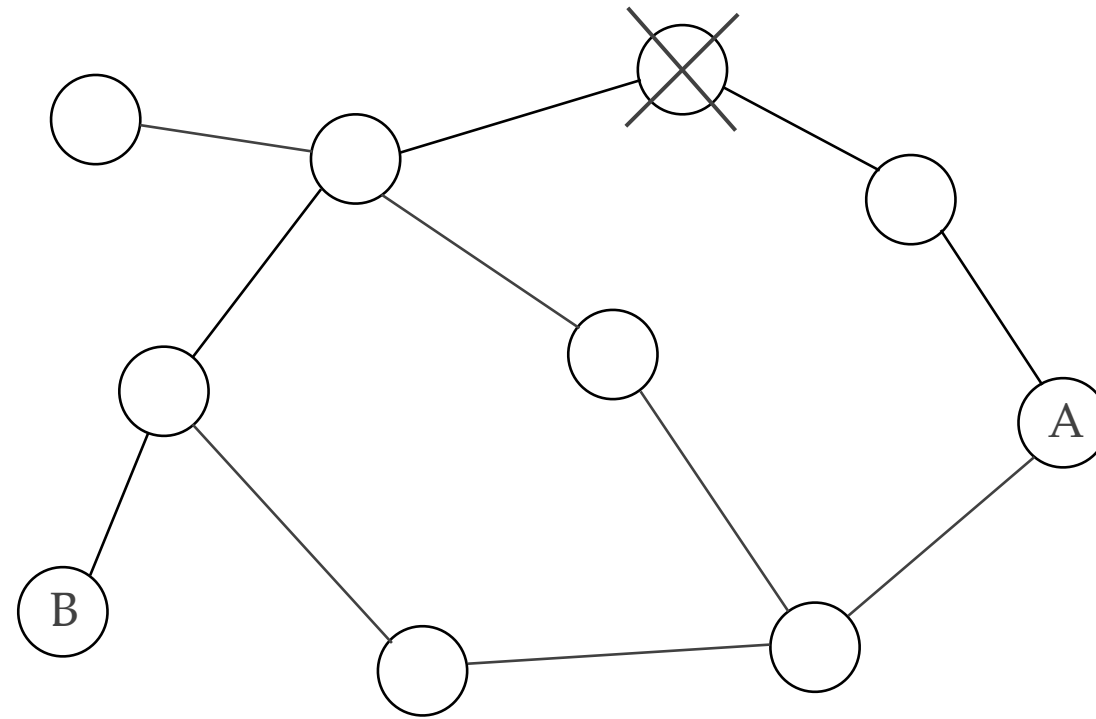
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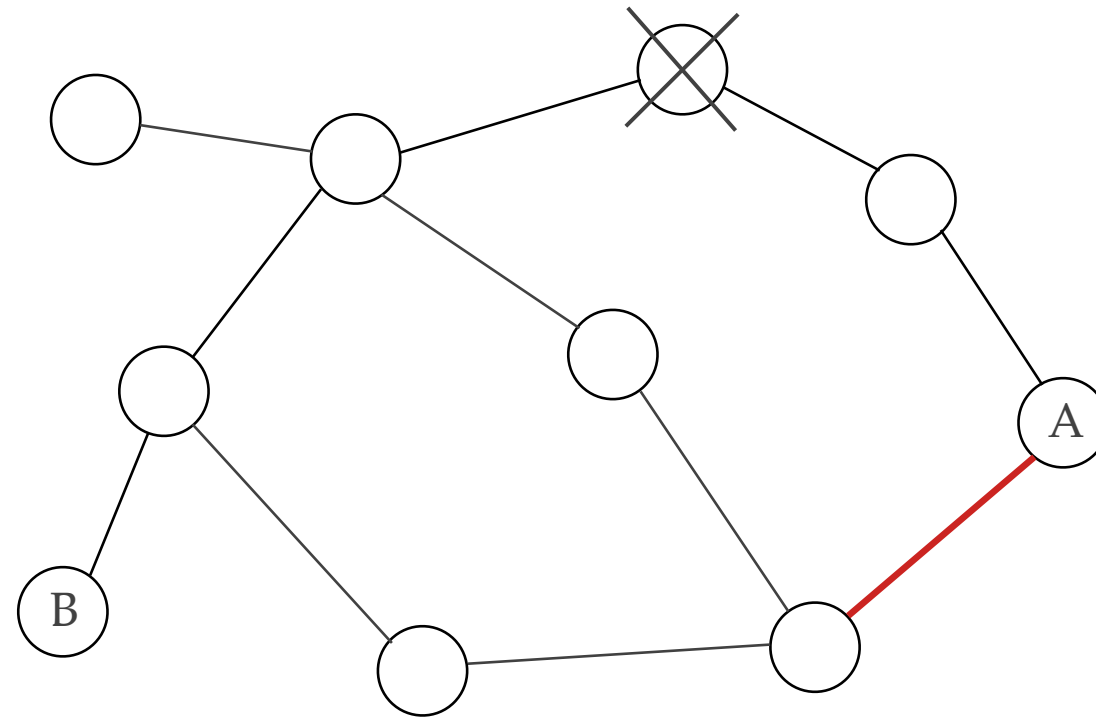
Fault tolerance



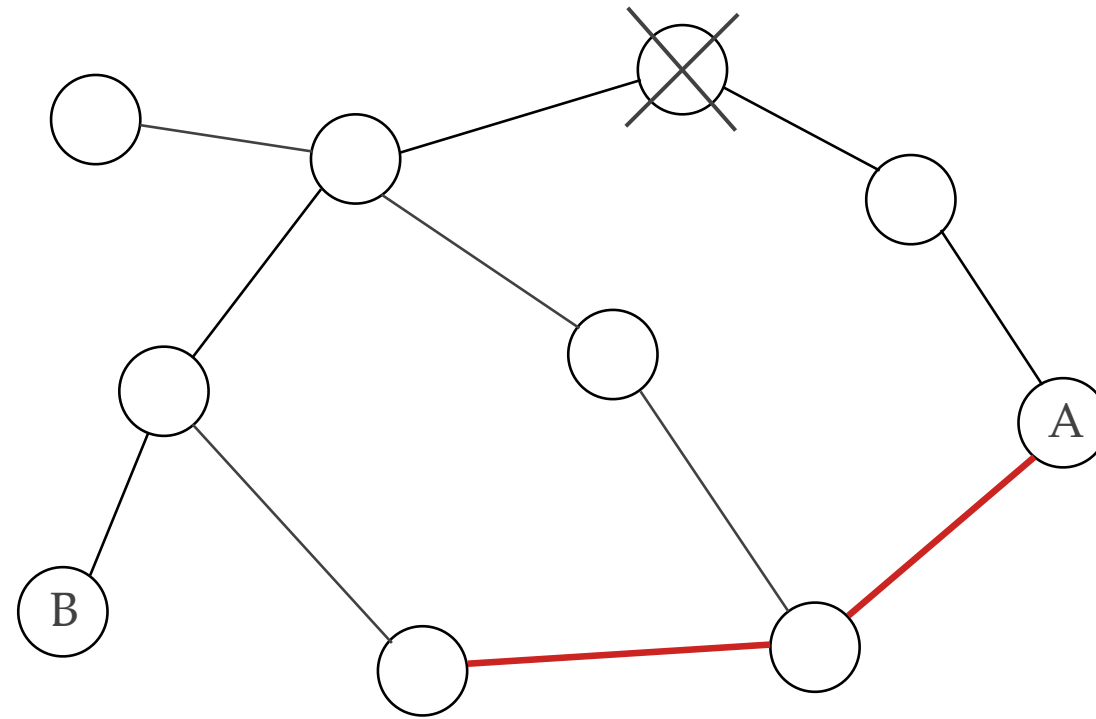
Fault tolerance



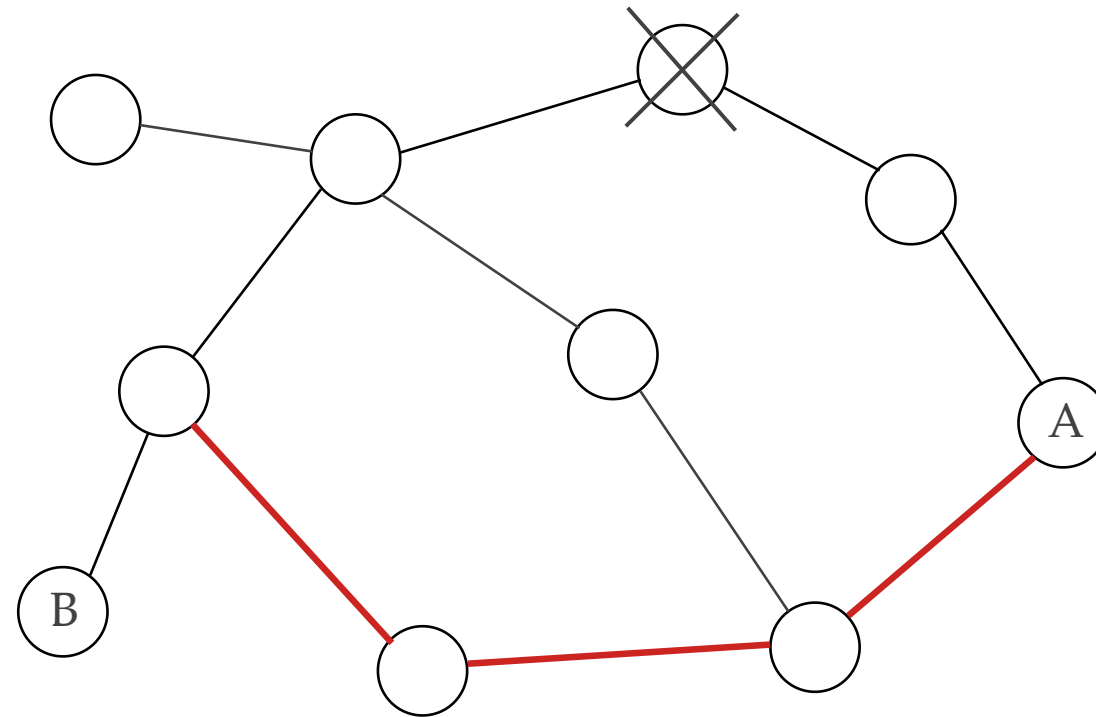
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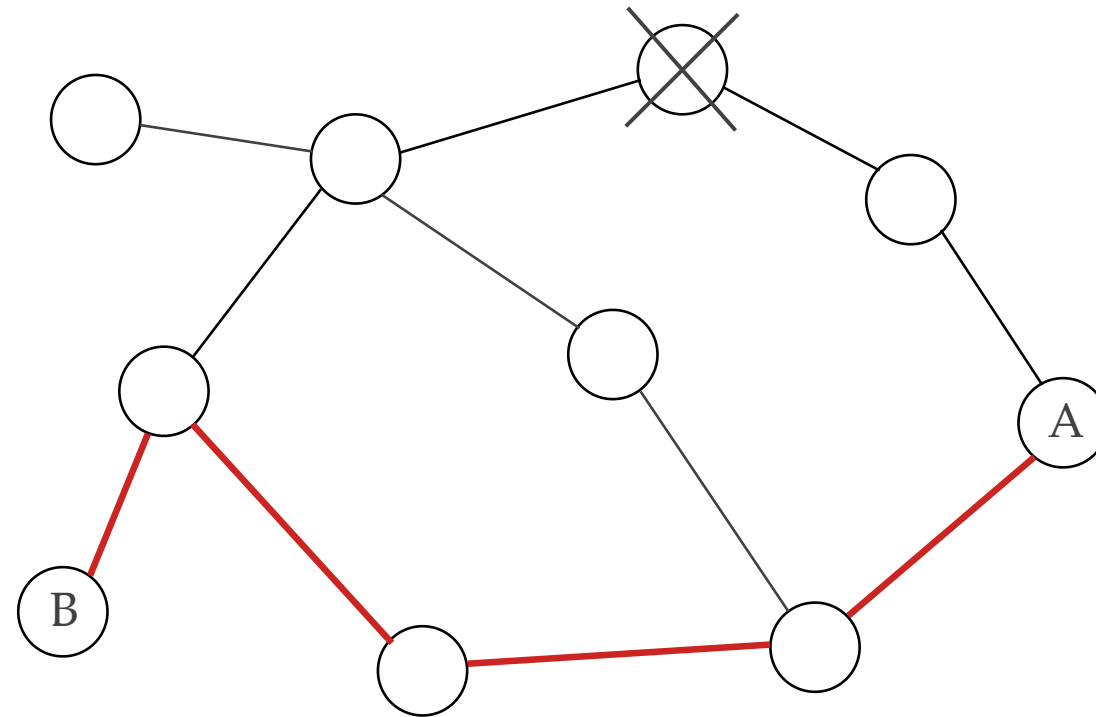
Fault tolerance



Fault tolerance



Fault tolerance



Protocols layers

protocol

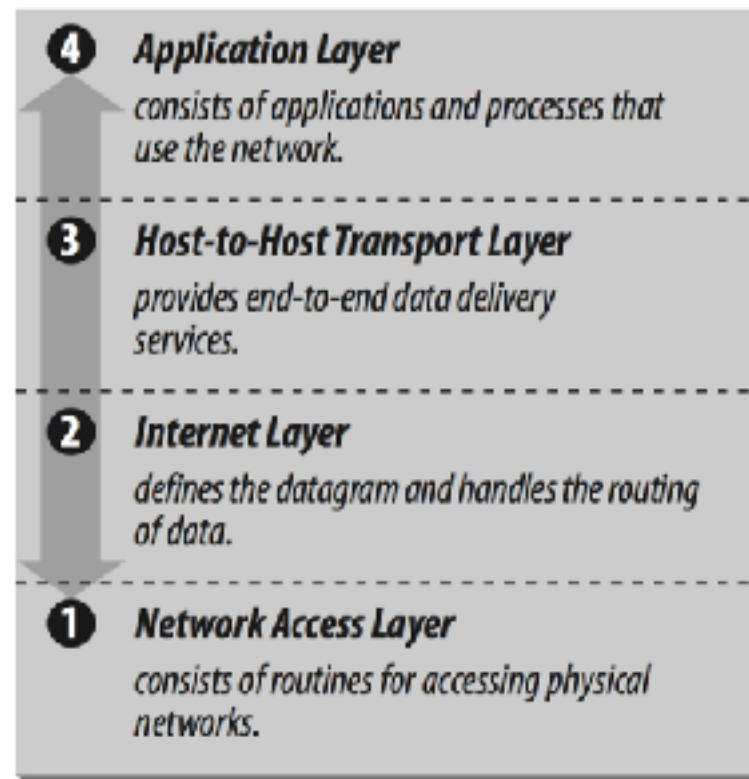
protocol	ˈprɒdəʊkəl ˈprɒdəʊkəl
noun	
1	the official procedure or system of rules governing affairs of state or diplomatic occasions: <i>protocol forbids the prince from making any public statement in his defense.</i> <ul style="list-style-type: none">• the accepted or established code of procedure or behavior in any group, organization, or situation: <i>what is the protocol at a conference if one's neighbor dozes off during the speeches?</i>• <i>Computing</i>: a set of rules governing the exchange or transmission of data between devices.
2	the original draft of a diplomatic document, especially of the terms of a treaty agreed to in conference and signed by the parties. <ul style="list-style-type: none">• an amendment or addition to a treaty or convention: <i>a protocol to the treaty allowed for this Danish referendum.</i>
3	a formal or official record of scientific experimental observations. <ul style="list-style-type: none">• a procedure for carrying out a scientific experiment or a course of medical treatment.

There is an heavy use of metaphors

TCP/IP

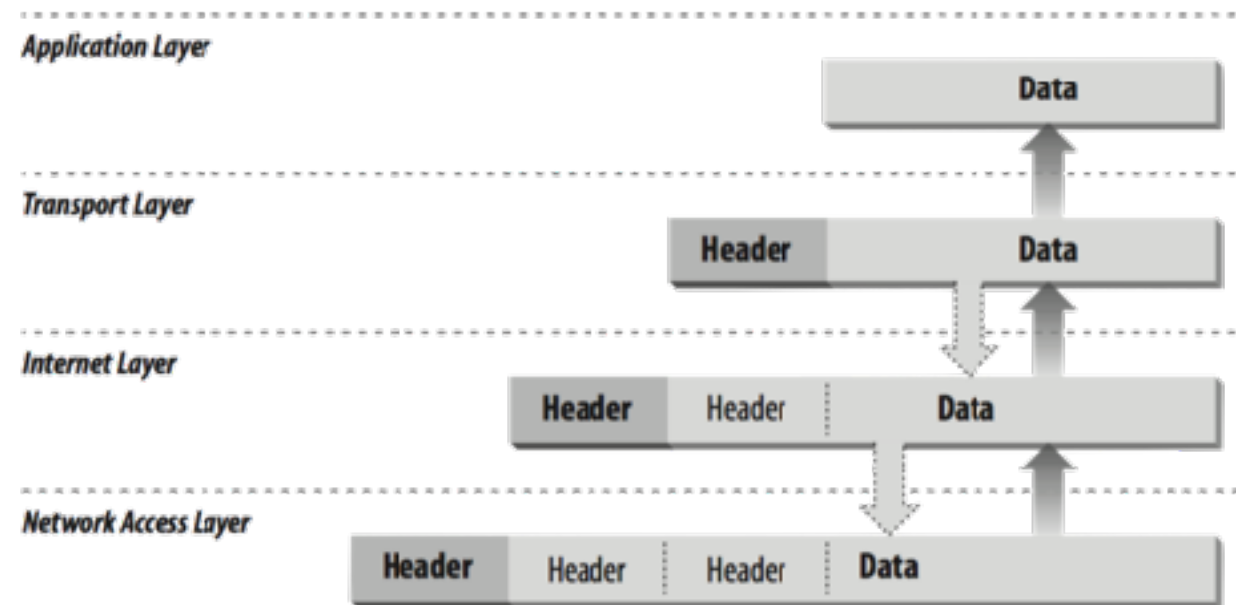
(Transmission Control Protocol /Internet Protocol)

TCP/IP



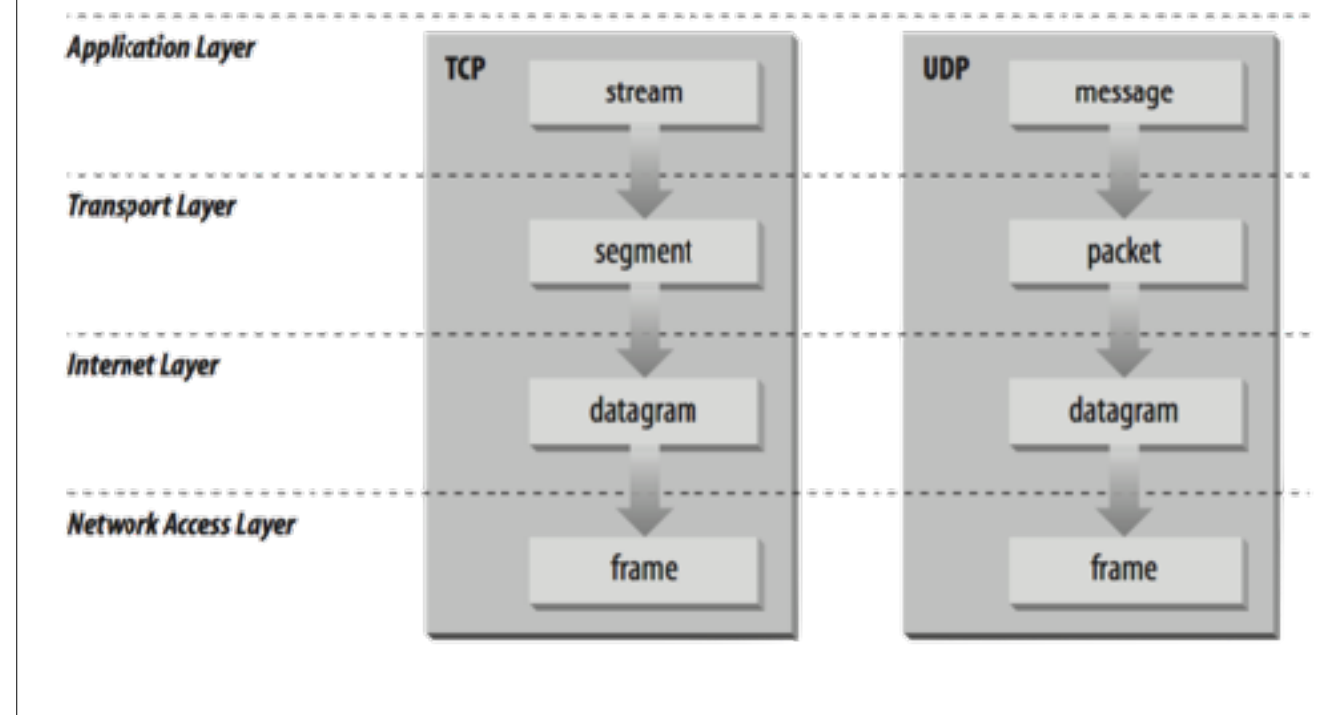
the TCP/IP protocol suite (a set of protocols) has less layers, so, the structure is more simple.

data encapsulation



Each layer in the stack adds control information to ensure proper delivery. This control information is called a *header* because it is placed in front of the data to be transmitted. Each layer treats all the information it receives from the layer above as data, and places its own header in front of that information. The addition of delivery information at every layer is called *encapsulation*.

layers



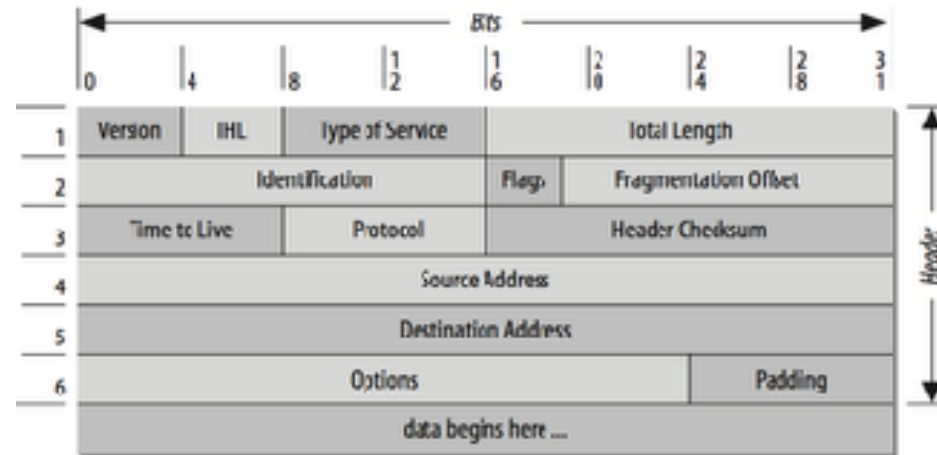
Notice that the term **packet** is in the transport layer, and the term **datagram** (that is explained in the next slide) is in the internet layer.

Figure 1-4 shows the terms used by different layers of TCP/IP to refer to the data being transmitted. Applications using TCP refer to data as a stream, while applications using UDP refer to data as a message. TCP calls data a segment, and UDP calls its data a packet. The Internet layer views all data as blocks called datagrams. TCP/IP uses many different types of underlying networks, each of which may have a different terminology for the data it transmits. Most networks refer to transmitted data as packets or frames. Figure 1-4 shows a network that transmits pieces of data it calls frames.

Packets (internet layer)

We have said that the important characteristic of TCP/IP protocol is **packet switching**. So, let's look at the **packets**.

TCP/IP datagram



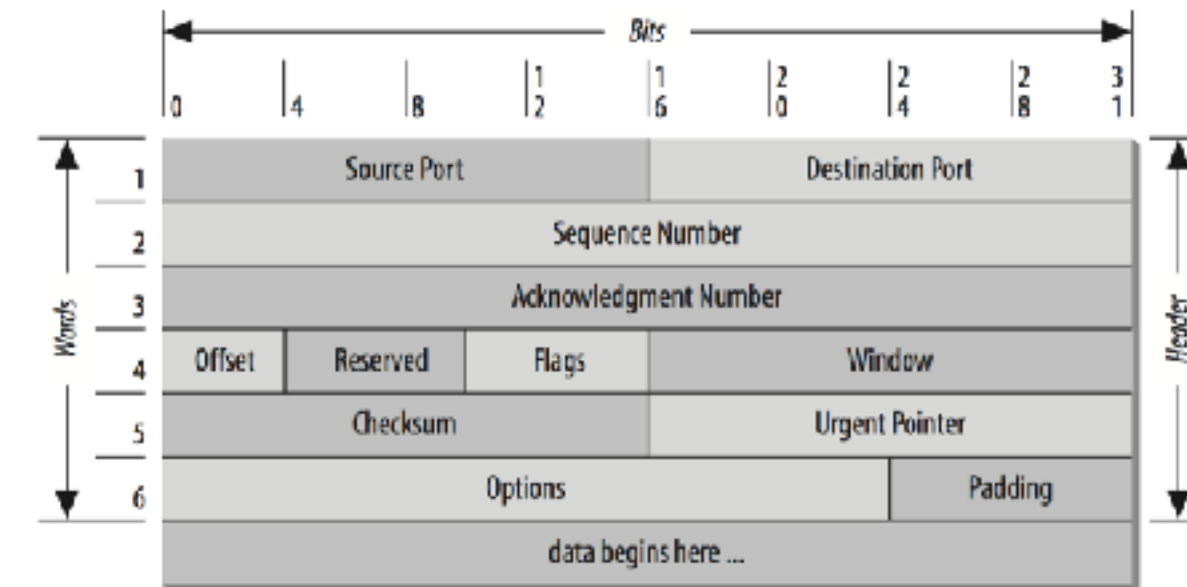
Datagram is the “graphic representation” of a packet.

- this is the type of data passed on the **internet layer**.
- source address and destination address
 - the format of the addresses will be shown in few slides

Routing

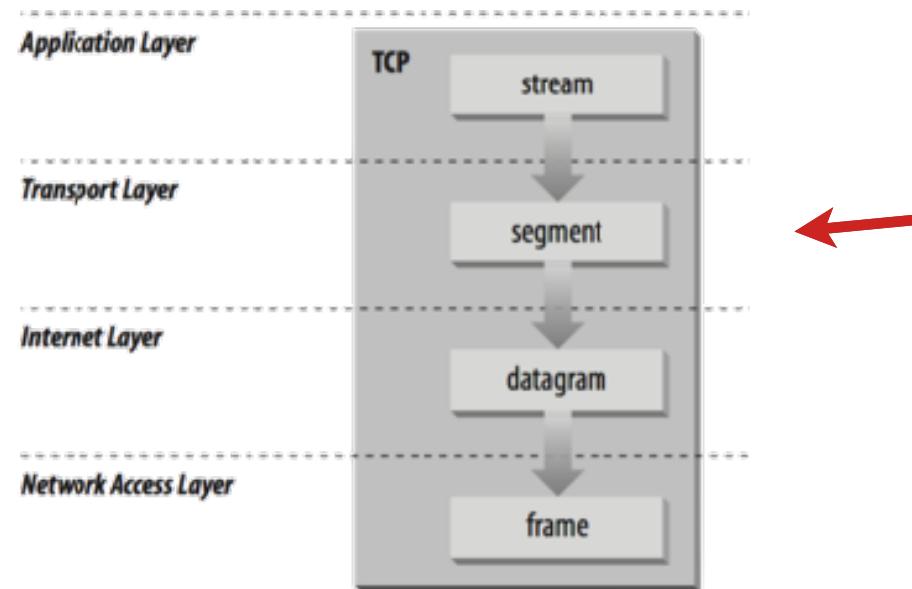
- If the Destination Address is the address of a host on the local network, the packet is delivered directly to the destination. If the Destination Address is not on the local network, the packet is passed to a gateway for delivery.
- Gateways are devices that switch packets between the different physical networks.
- Deciding which gateway to use is called routing. IP makes the routing decision for each individual packet.

TCP/IP segment



this is another example of “packets”, from another layer.

TCP/IP segment



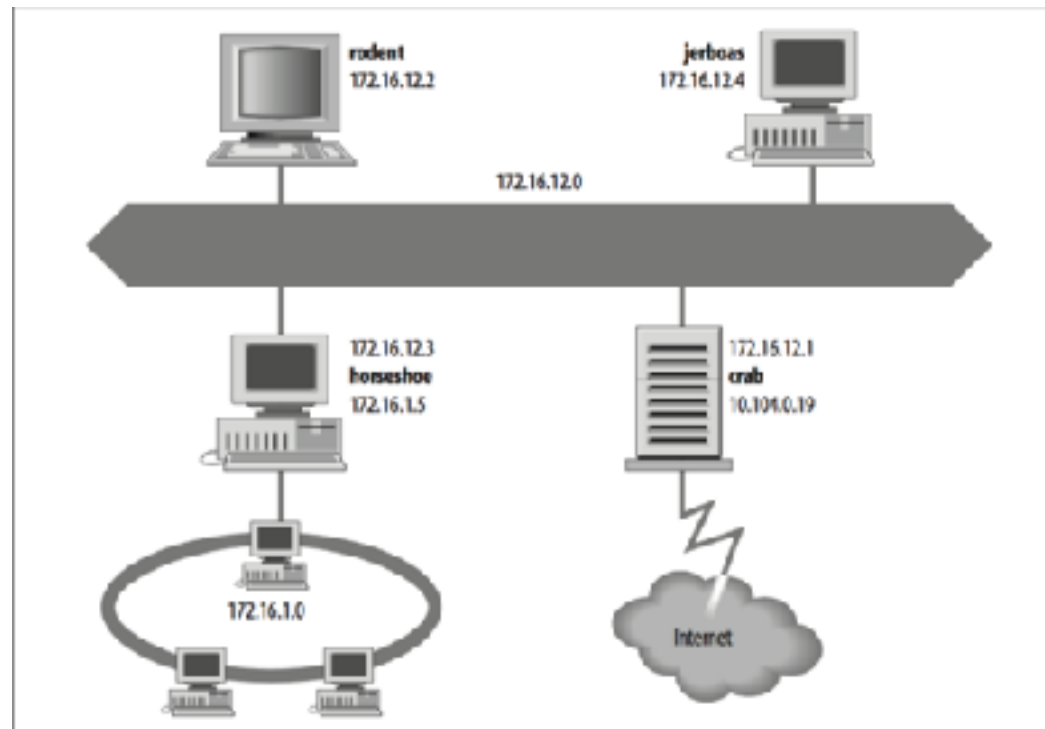
I remind you that the “segment” is in the transport layer.
Those are just names, it is important to remember the concepts.

Addresses

The IP Address

- An IP address is a 32-bit value that uniquely identifies every device attached to a TCP/IP network.
- IP addresses are usually written as four decimal numbers separated by dots (periods) in a format called dotted decimal notation.
- Each decimal number represents an 8-bit byte of the 32-bit address, and each of the four numbers is in the range 0–255 (the decimal values possible in a single byte).

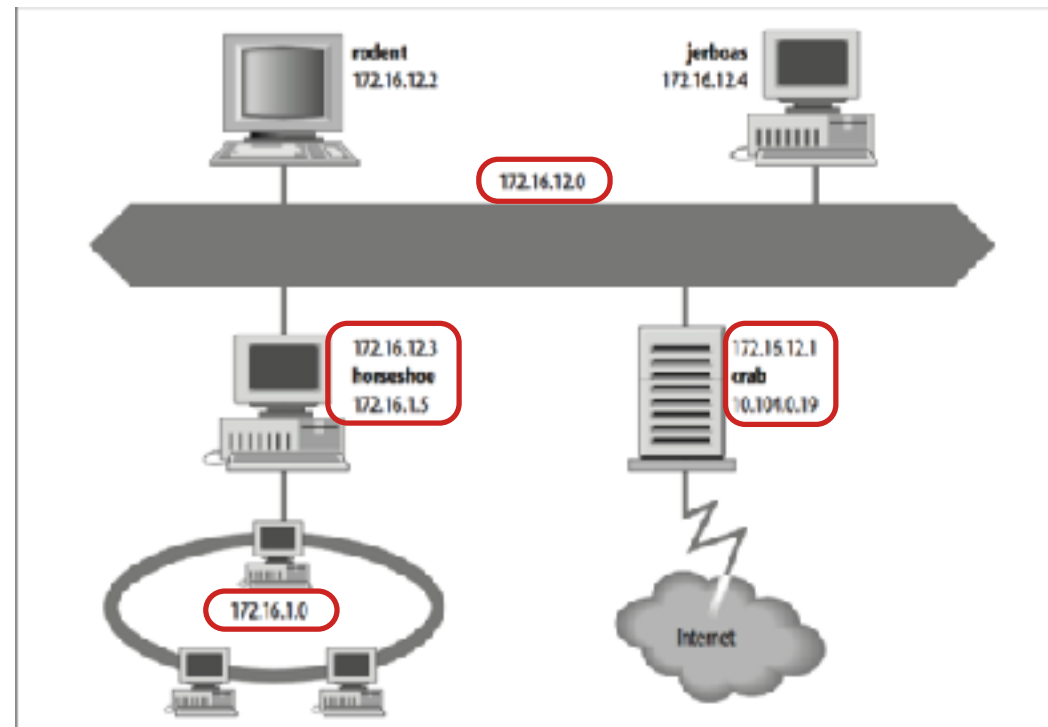
The IP Address



The IP Address

- An IP address contains a **network part** and a **host part**.
- The number of address bits used to identify the **net- work** and the number used to identify the **host** vary according to the **prefix length** of the address.
- The prefix length is determined by the **address bit mask**.
- The address bit mask is interpreted like this:
 - if a bit is **on** in the mask, that corresponding bit in the address is interpreted as a **network bit**;
 - if a bit in the mask is **off**, the corresponding in the address is interpreted as a **host bit**.
- Example:
 - address 172.22.12.4 is given the
 - network mask 255.255.255.0,
 - the first 24 bits (first three bits, i.e. decimal numbers) are the **network number** and
 - the last 8 bits are the **host address**.
 - This tells us that this is the address of **host 4** on network 172.22.12.

The IP Address



so, in the picture, the network is 172.16.12

- in bottom left there is a separate network.
- Notice that the “gateway”, the computer that connects the two networks, has two addresses, one for the “external network”, and one for the internal network.
- same thing for this other node.

Routing

dictionary

route | ˈruːt, ˈraʊt |

noun

a way or course taken in getting from a starting point to a destination:
the most direct route is via Los Angeles.

- the line of a road, path, railroad, etc.
- *N. Amer.* a circuit traveled in delivering, selling, or collecting goods.
- a method or process leading to a specified result: *the many routes to a healthier diet will be described.*

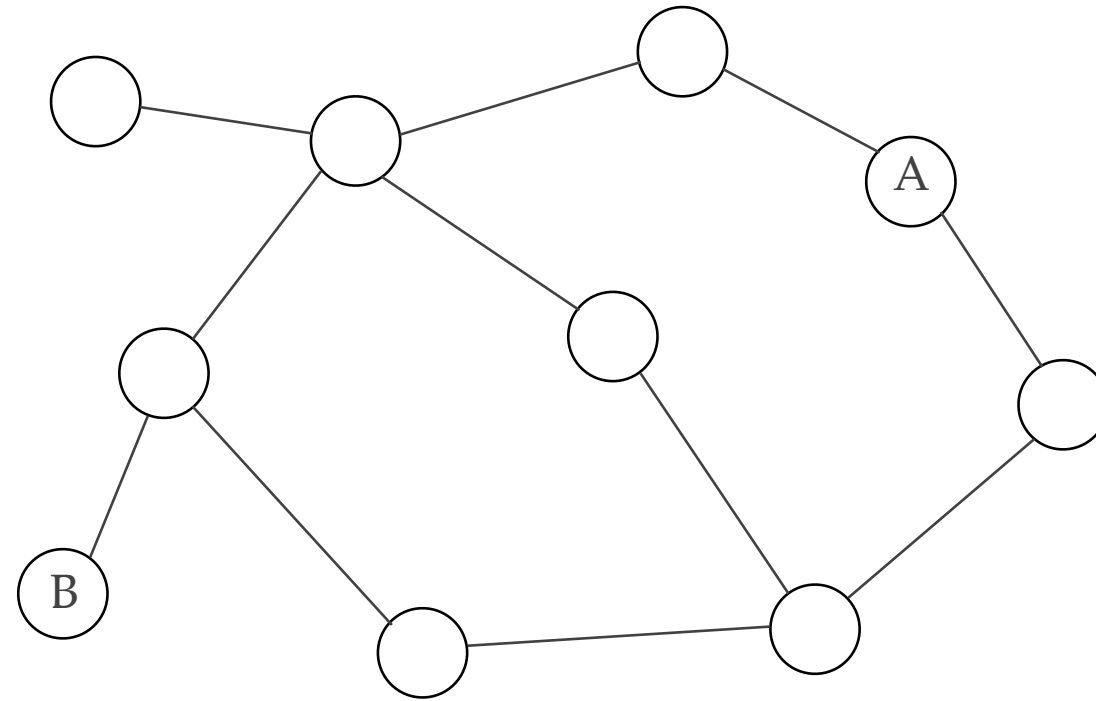
verb (routes, routing or *Brit.* routeing, routed) *[with obj.]*

send or direct along a specified course: *all lines of communication were routed through Atlanta.*

ORIGIN

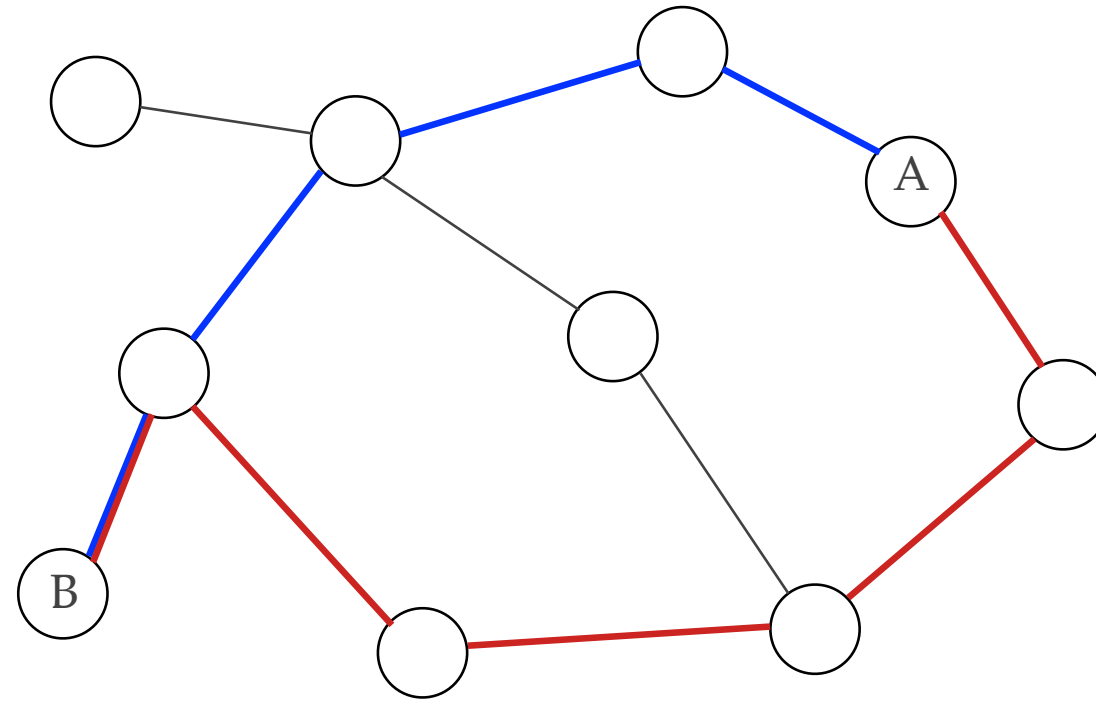
Middle English, from Old French *route* 'road,' from Latin *rupta* (way) 'broken (way),' feminine past participle of *rompere*.

Routing



different possible routes to go from node A to node B

Routing



the blue **route** is shorter.

DNS

DNS

- In most cases, **hostnames** and **numeric addresses** can be used interchangeably. A user wishing to see a webpage at IP address 172.16.12.2 can enter:

```
http://172.16.12.2
```

- or use the hostname associated with that address and enter the equivalent command:

```
http://rodent.wrotethebook.com
```

- There are two common methods for translating names into addresses. The **older method** simply looks up the hostname in a table called the host table. The **newer technique** uses a distributed database system called the **Domain Name System (DNS)** to translate names to addresses.
- The old host table system is inadequate for the global Internet for two reasons: **inability to scale** and lack of an **automated update process**.

DNS

- DNS is a distributed hierarchical system for resolving **hostnames** into **IP addresses**.
- Under DNS, there is no central database with all of the Internet host information. The information is distributed among thousands of **name servers** organized into a **hierarchy** similar to the hierarchy of the OS filesystem.
- DNS has a **root domain** at the top of the domain hierarchy that is served by a group of name servers called the root servers.
- Just as directories in the OS filesystem are found by following a **path** from the **root directory** through subordinate directories to the **target directory**, information about a domain is found by tracing pointers from the root domain through subordinate domains to the target domain.
- Directly under the root domain are the top-level domains. There are two basic types of top-level domains—**geographic** and **organizational**.

DNS

- Examples of generic top-level domains are:

- organizational

`com` - Commercial organizations

`edu` - Educational institutions

`gov` - Government agencies

`mil` - Military organizations

`net` - Network support organizations

- geographic

`ru` - Russia

`it` - Italy

`uk` - United Kingdom