History of Computers and Operating Systems

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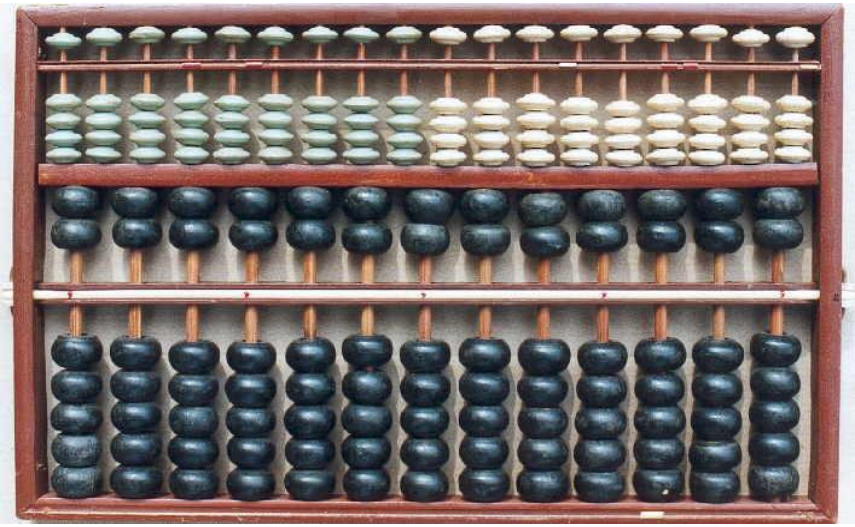
What is the First Computer ?

❒ From B.C 4000

기계식 컴퓨터의 효시

- **Input and Output**
  - Physical movements by hands and read by eyes
  - No programming and no special I/O devices
- **Very volatile memory and slow**



Abacus !

The first hand-held computer ?

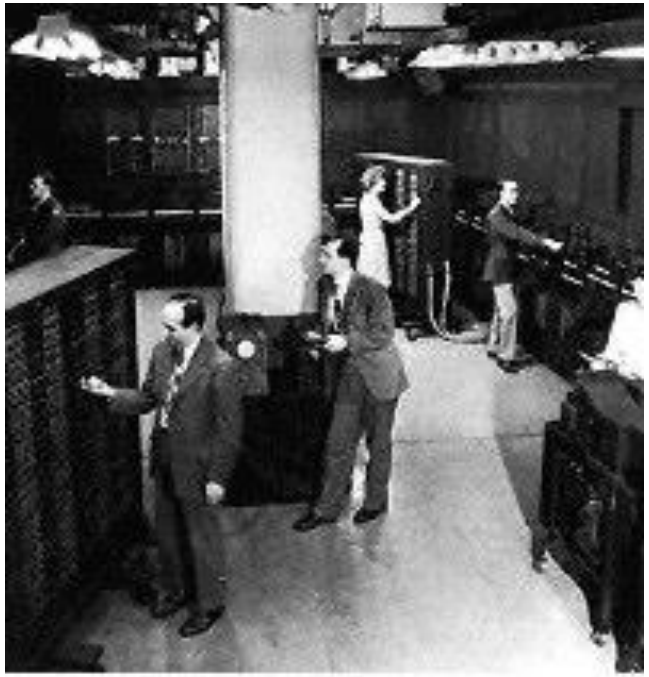
The ENIAC (1946)

전기식 컴퓨터의 효시

❒ **The first computer that uses electricity**

핵심기술 : 진공관
→ 부피大, 무게大

- **Technology**
  - Vacuum tubes
- **Floor space**
  - 1,000 square feet
- **Weight**
  - 30 tons
- **Input/Output**
  - Cards, lights, switches
  - Human operators
- **Speed**
  - Less than 5,000 operations per second



The History of Computers and OS

❒ Why history?

- **Hard to define and explain the notion of operating system**
- **Learning about the OS history will help you understand what it is and how it works**

❒ Three phases of History

- **Phase I: early ’50s – late ‘60s**
  - Mainframe computers ← transistor 기능이 중요하게 작용
  - Monitor + human operators 운영체제의 원시인 모니터라는 개념 등장
- **Phase II: late ’60s – late ‘90s (modern OS concepts)**
  - Minicomputers and personal computers 마이크로프로세서의 등장으로 컴퓨터 소형화
  - Advent of UNIX 현대 운영체제의 시작
- **Phase III: late ‘90s – present (mobile, cloud, and multicore)**

기술적 배경: 반도체 집적 기술이 굉장히 많이 발전함,
초고속 인터넷, 무선통신의 등장

Phase I. Mainframe Computers

- **From 1950s to 1970s**
  - **Technology**
    - Transistors 소형화된 장치로, 진공관을 대체함
  - **Input devices**
    - Panel switches, paper tape, punched cards
    - Card readers, magnetic tape
  - **Output devices**
    - Display lights on the console
    - Line printers

Human Operators

- **Cost vs. performance of mainframes**
  - **Computers were very expensive**
    - $750,000 plus $185,000 for a high speed printer
  - **Humans were cheap**
    - Significant amount of setup time

여기서 말하는 셋업은 컴파일 작업, 로더링, 디버깅.

- **Human programmer/operator**
  - **Program, setup, monitor, and debug**
  - **Significant amount of setup time**

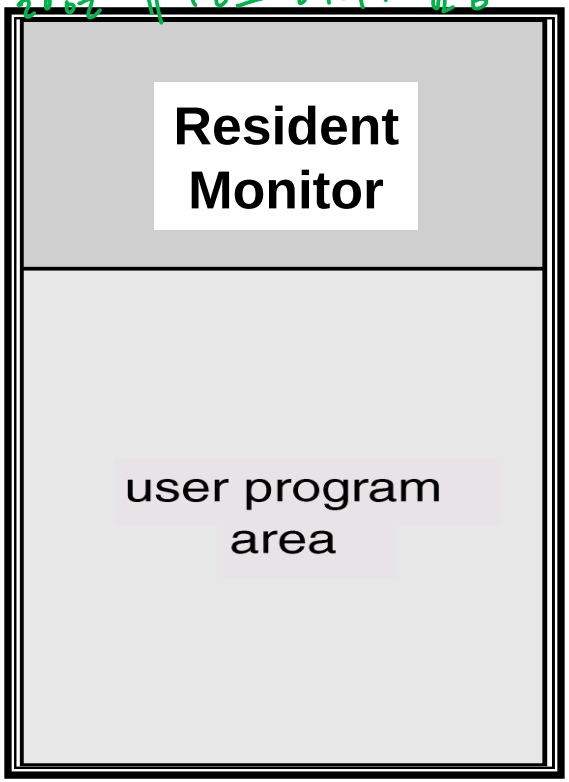
Resident Monitor

운영체제의 효시!

소프트웨어를 하드웨어와 연결시켜주는 개념

여러개의 프로그램을 메모리에 올리고 실행시켜야 프로그램의 실행을 레지던트 모니터가 담당

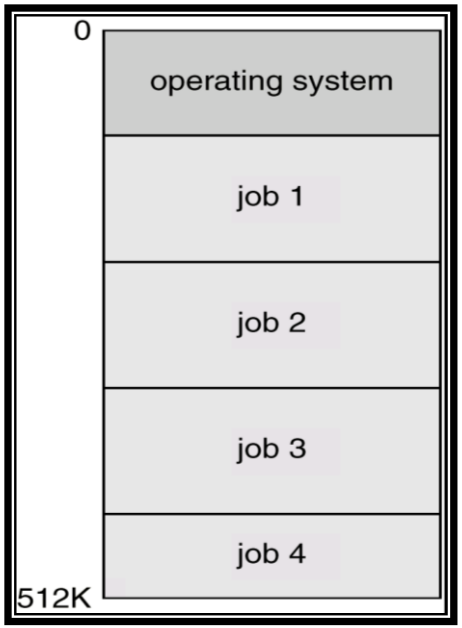
- A resident monitor can be considered a primitive precursor to the operating system
  - It governed the machine before and after each job control card was executed, loaded and interpreted each control card, and acted as a job sequencer for batch processing operations



Multiprogrammed Batch Systems

배치 프로세싱
(여러개의 작업들을 묶어서 한번에 실행하도록 함)

- Several jobs are kept
  - in main memory
  - at the same time
- CPU is multiplexed among them
  - Eventually a job may have to wait for some task such as I/O operation
  - CPU is switched to another job
- Benefit
  - Increase of CPU utilization
  - Reduction of CPU idle time
- Job scheduling is required
  - When multiple programs are ready




IBM 701

Spooling

스풀링

❒ Emergence of faster I/O devices

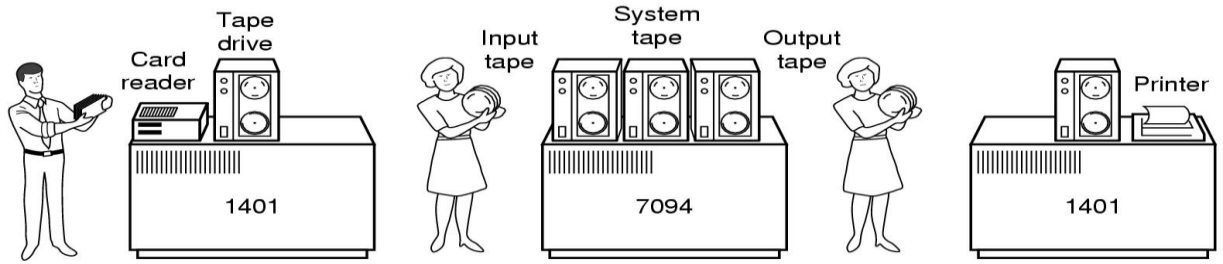
- **Slow mechanical devices**
  - Card reader -> CPU -> line printer
- **Fast magnetic devices**
  - Card reader -> tape drives -> CPU -> tape drives -> line printer

마그네틱 디바이스의 등장으로 입출력 장치에 많은 변화

→ CPU 작업과 입출력 작업이 동시에 진행될 수 있다. 컴퓨터 성능↑

❒ Performance improvement by Spooling

- **Simultaneous Peripheral Operation On-Line**
- **Spooling overlaps I/O and computation**



Phase II. Modern Computers

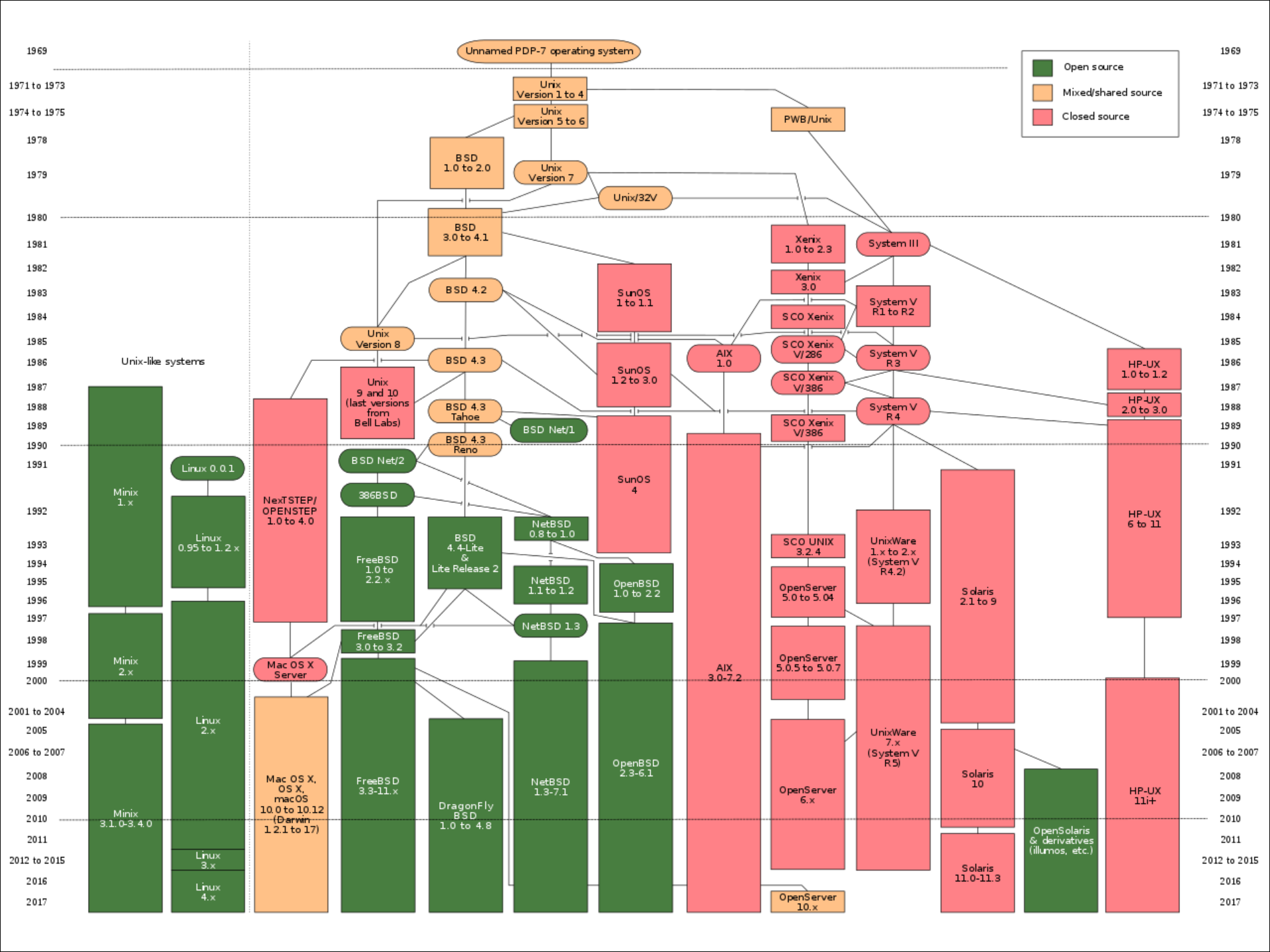
- **Since late 1960s**
  - **With the advent of microprocessor chips**
  - **Minicomputers, workstations, and personal computers**

1965	1977	1998
		
IBM System 360/50 0.15 MIPS 64 KB $1M $6.6M per MIPS $16M per MB	DEC VAX11/780 1 MIPS (reported) 0.5 MIPS (actual) 1 MB $200K $200K to $400 per MIPS $200K per MB	Apple iMac 700 MIPS (peak) 427 MIPS (estimated) 32 MB $1229 (September 1998) $1.75 to $2.90 per MIPS $38 per MB

UNIX

- Unix is a family of multitasking, multiuser computer operating systems that derive from the original AT&T Unix
  - Development started in the 1970s at the Bell Labs research center by Ken Thompson, Dennis Ritchie, and others

- The pre-history of Unix dates back to the mid-1960s
  - MIT, Bell Labs, and General Electric were developing an innovative time-sharing operating system called Multics for the GE-645 mainframe
  - Multics introduced many innovations, but had many problems (the size and complexity)
  - Bell Labs slowly pulled out of the project and decided to redo the work on a much smaller scale


Unnamed PDP-7 operating system
Unix Version 1 to 4
Unix Version 5 to 6
Unix Version 7
PWB/Unix
Unix/32V
BSD 1.0 to 2.0
BSD 3.0 to 4.1
BSD 4.2
BSD 4.3
BSD 4.3 Tahoe
BSD 4.3 Reno
BSD Net/1
BSD Net/2
386BSD
4.4-Lite & Lite Release 2
Unix Version 8
Unix 9 and 10 (last versions from Bell Labs)
SunOS 1 to 1.1
SunOS 1.2 to 3.0
SunOS 4
AIX 1.0
AIX 3.0-7.2
Xenix 1.0 to 2.3
Xenix 3.0
SCO Xenix
SCO Xenix V/286
SCO Xenix V/386
SCO UNIX 3.2.4
OpenServer 5.0 to 5.04
OpenServer 5.0.5 to 5.0.7
OpenServer 6.x
OpenServer 10.x
System III
System V R1 to R2
System V R3
System V R4
UnixWare 1.x to 2.x (System V R4.2)
UnixWare 7.x (System V R5)
HP-UX 1.0 to 1.2
HP-UX 2.0 to 3.0
HP-UX 6 to 11
HP-UX 11i+
Solaris 2.1 to 9
Solaris 10
Solaris 11.0-11.3
OpenSolaris & derivatives (illumos, etc.)
NeXTSTEP/ OPENSTEP 1.0 to 4.0
Mac OS X Server
Mac OS X, OS X, macOS 10.0 to 10.12 (Darwin 1.2.1 to 17)
FreeBSD 1.0 to 2.2.x
FreeBSD 3.0 to 3.2
FreeBSD 3.3-11.x
DragonFly BSD 1.0 to 4.8
NetBSD 0.8 to 1.0
NetBSD 1.1 to 1.2
NetBSD 1.3
NetBSD 1.3-7.1
OpenBSD 1.0 to 2.2
OpenBSD 2.3-6.1
Unix-like systems
Minix 1.x
Minix 2.x
Minix 3.1.0-3.4.0
Linux 0.0.1
Linux 0.95 to 1.2.x
Linux 2.x
Linux 3.x
Linux 4.x
Open source
Mixed/shared source
Closed source
1969
1971 to 1973
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2011
2012 to 2015
2016
2017

Multitasking and Multi Users

- **Multi-programming and multi-tasking**
  - Several programs are kept in main memory
  - They run at the same time (time-sharing)

- **Interactive and on-line system**
  - User enters a command and the system executes them
  - The system seeks the next “control statement” from the user’s keyboard or mouse

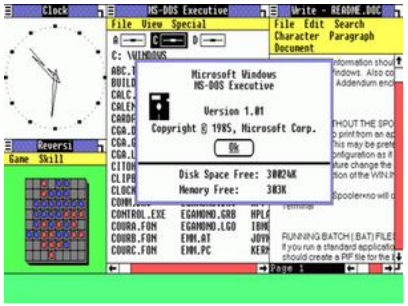
- **Multi-user environment**
  - Different users can use the computer at the same time

Mouse and GUI

- The Xerox Alto, developed at Xerox PARC in 1973, was the first computer to use a mouse, the desktop metaphor, and a graphical user interface (GUI), concepts first introduced by Douglas Engelbart

Xerox Alto (1973)

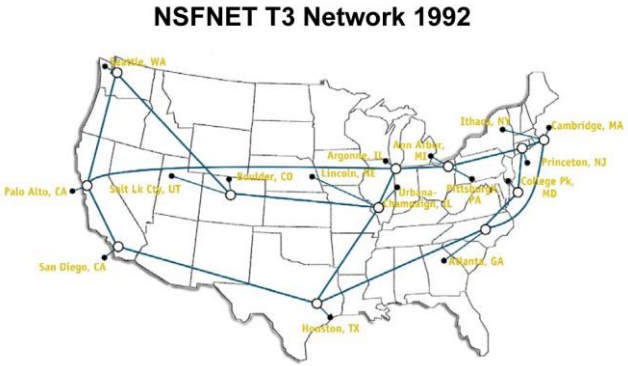
Atari ST (1985)



Windows 1.0 (1985)

Internet and WWW

- ARPANET was the precursor network for academic and military purposes (1980s)
- NSF funding and private funding led to worldwide participation in the Internet
- The World Wide Web is the primary application
  - A NeXT Computer was used by Tim Berners-Lee at CERN and became the world's first Web server (1991)



The first Web server (HTTP daemon)

Personal Computers

- Personal computers such as the Atari 800, released in 1978, and the BBC Micro, released in 1981

- The history of the personal computer as a mass-market consumer electronic device began in 1981 with the launch of the IBM Personal Computer that coined both the term Personal Computer and PC

Atari 800 (1978)

Xerox Alto (1973)

Apple II (1977)

IBM 5150 (1981)

Phase III. Mobile, Cloud, and Multicore

- The first PDA was released in 1984 by Psion, the Organizer

- Typical features
  - Touch screens and memory cards
  - Wireless connectivity
  - Battery-operated

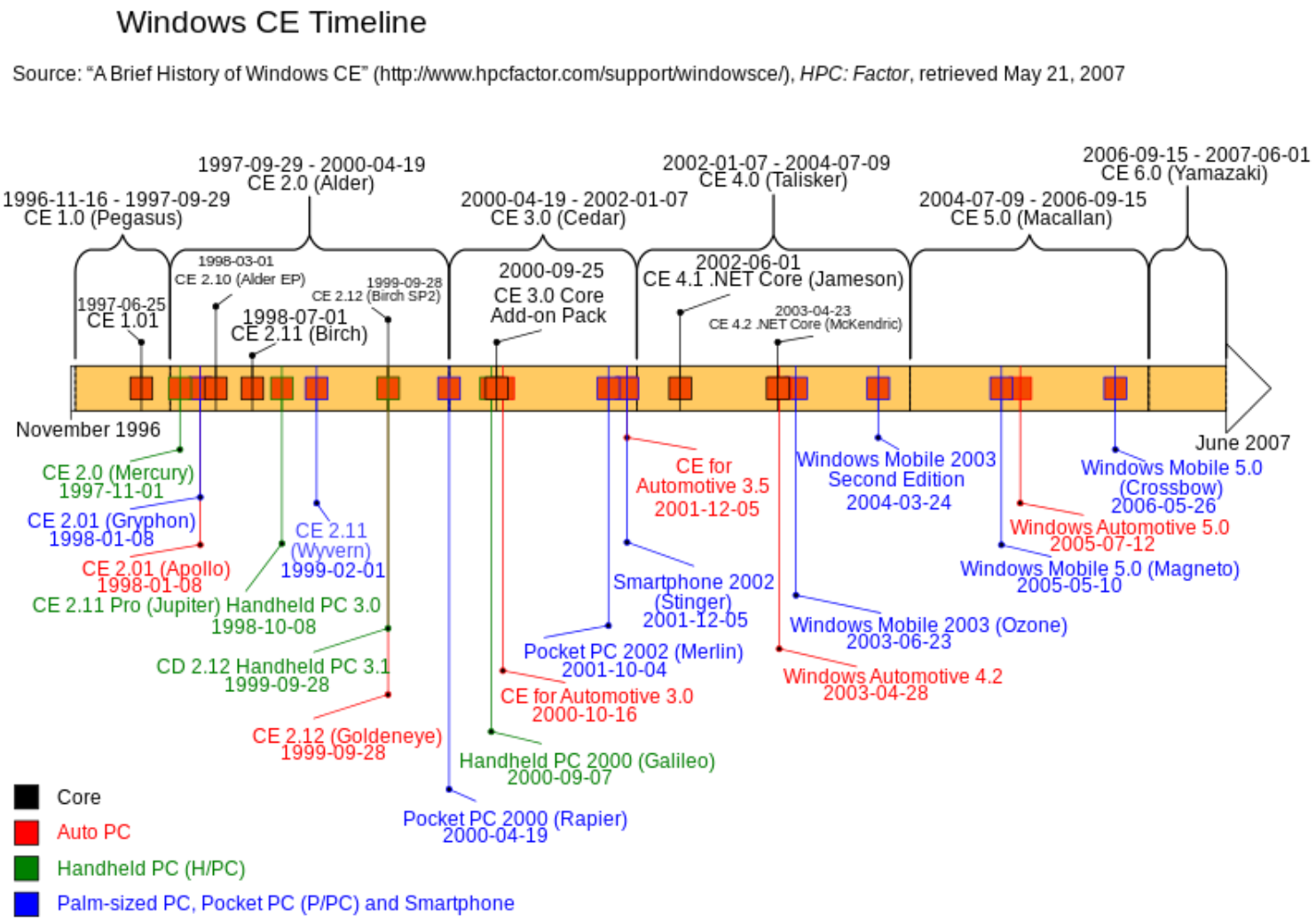
- Mobile OSes
  - Palm OS
  - Microsoft Windows Mobile with a Windows CE kernel

Motorola DynaTAC (1984)

Palm TX (2005)

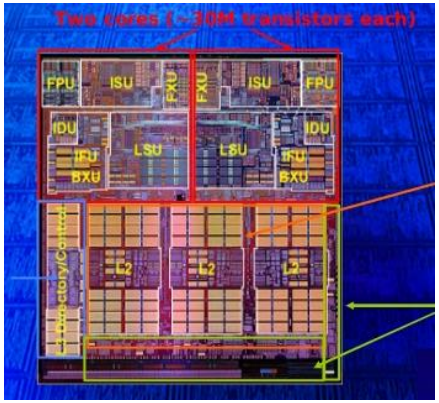
Apple iPhone (2007)

Windows CE

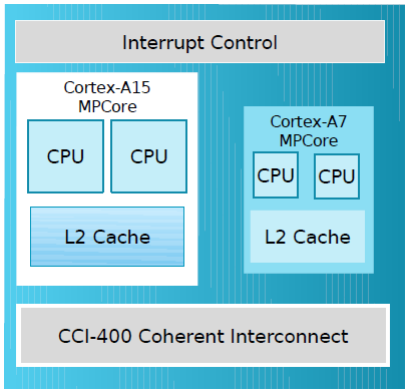

Windows CE Timeline
Source: "A Brief History of Windows CE" (http://www.hpcfactor.com/support/windowsce/), HPC: Factor, retrieved May 21, 2007
1996-11-16 - 1997-09-29
CE 1.0 (Pegasus)
1997-09-29 - 2000-04-19
CE 2.0 (Alder)
2000-04-19 - 2002-01-07
CE 3.0 (Cedar)
2002-01-07 - 2004-07-09
CE 4.0 (Talisker)
2004-07-09 - 2006-09-15
CE 5.0 (Macallan)
2006-09-15 - 2007-06-01
CE 6.0 (Yamazaki)
1997-06-25
CE 1.01
1998-03-01
CE 2.10 (Alder EP)
1998-07-01
CE 2.11 (Birch)
1999-09-28
CE 2.12 (Birch SP2)
2000-09-25
CE 3.0 Core
Add-on Pack
2002-06-01
CE 4.1 .NET Core (Jameson)
2003-04-23
CE 4.2 .NET Core (McKendric)
November 1996
June 2007
CE 2.0 (Mercury)
1997-11-01
CE 2.01 (Gryphon)
1998-01-08
CE 2.01 (Apollo)
1998-01-08
CE 2.11 Pro (Jupiter) Handheld PC 3.0
1998-10-08
CE 2.11
(Wyvern)
1999-02-01
CD 2.12 Handheld PC 3.1
1999-09-28
CE 2.12 (Goldeneye)
1999-09-28
Pocket PC 2000 (Rapier)
2000-04-19
Handheld PC 2000 (Galileo)
2000-09-07
CE for Automotive 3.0
2000-10-16
Pocket PC 2002 (Merlin)
2001-10-04
Smartphone 2002
(Stinger)
2001-12-05
CE for
Automotive 3.5
2001-12-05
Windows Automotive 4.2
2003-04-28
Windows Mobile 2003 (Ozone)
2003-06-23
Windows Mobile 2003
Second Edition
2004-03-24
Windows Mobile 5.0 (Magneto)
2005-05-10
Windows Automotive 5.0
2005-07-12
Windows Mobile 5.0
(Crossbow)
2006-05-26
Core
Auto PC
Handheld PC (H/PC)
Palm-sized PC, Pocket PC (P/PC) and Smartphone

Multicore Computing

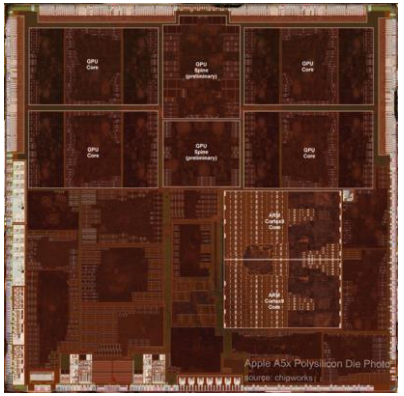
- Released in 2001, the POWER4 was a multicore microprocessor, with two cores on a single die, the first non-embedded microprocessor
  - In October 2011, a heterogeneous computing architecture, called big.LITTLE, was announced by ARM Holdings
  - Linux kernel version 2.0 was released in 1996, the major feature of 2.0 was multiprocessor support



POWER4



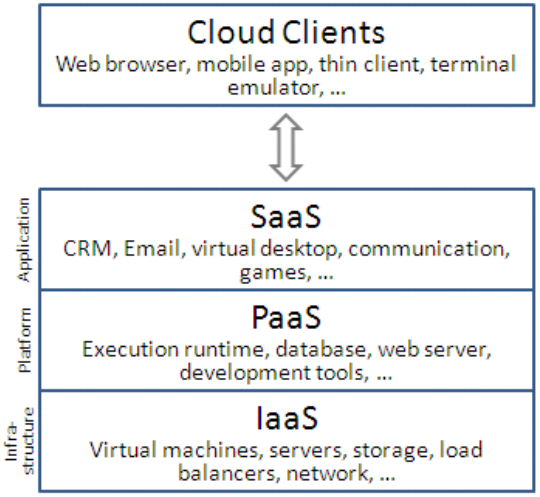
big.LITTLE

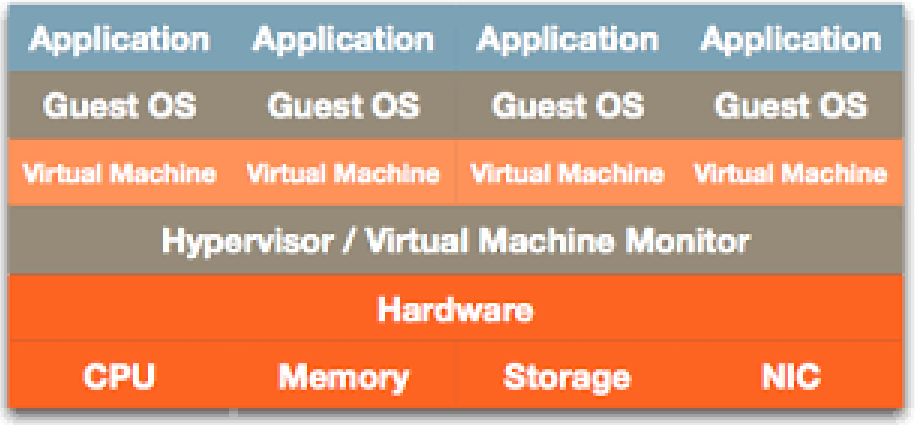


Apple A5

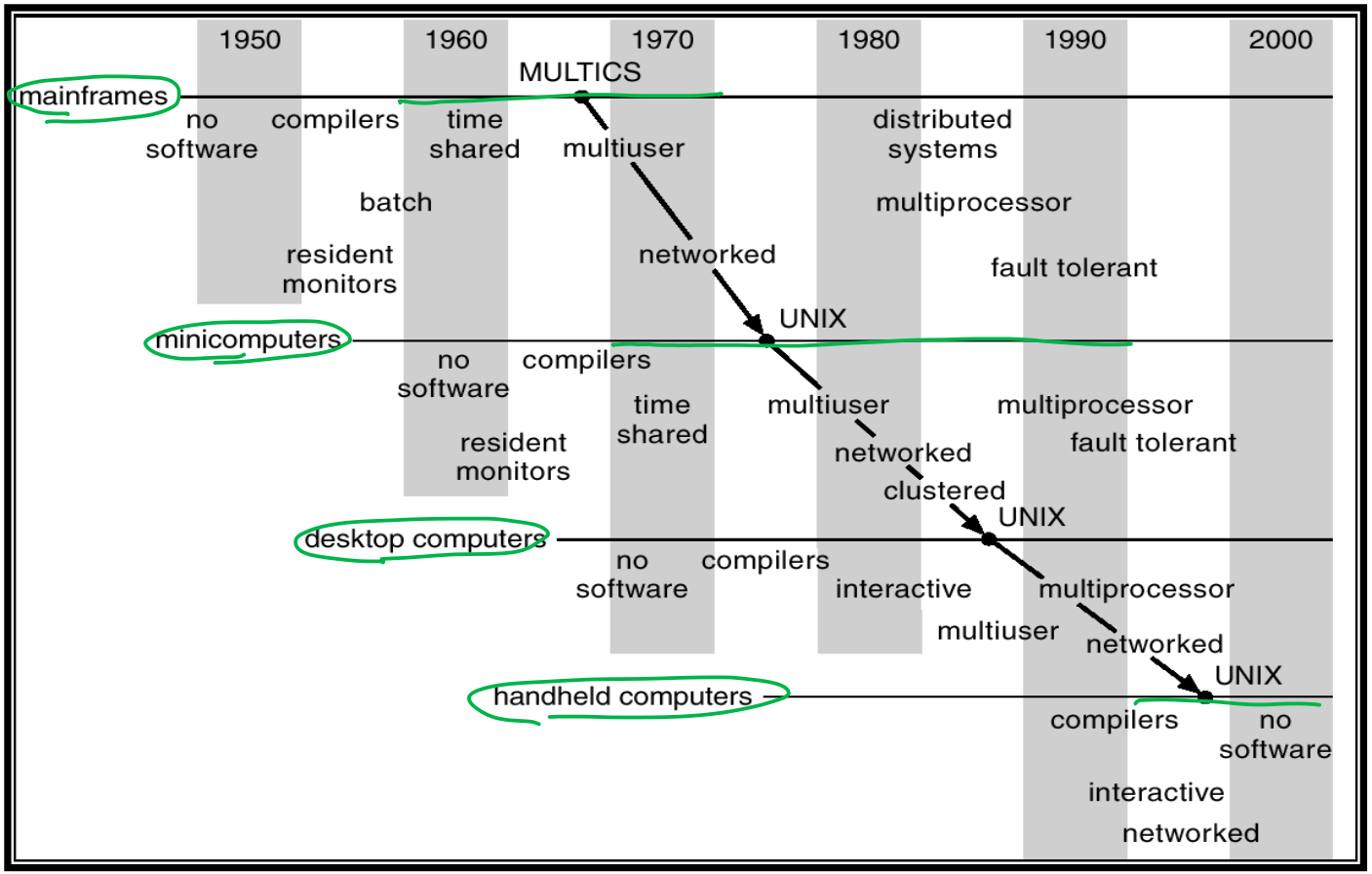
Cloud Computing

- The origin of the term cloud computing in computing is unclear
  - The cloud symbol was used to represent networks of computing equipment in the original ARPANET by as early as 1977 and the CSNET by 1981
  - The popularization of the term can be traced to 2006 when Amazon.com introduced its Elastic Compute Cloud





Migration of Operating-System Concepts and Features



thank you!