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History of Computing

Mini-computers, workstations and
advances in portable memory

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The Minicomputer

A class of multi-user computers

In terms of size & computing power, in the middle
range of the computing spectrum

in between mainframes (the largest) and the
personal computers (the smallest)

emerged in the 1970s (before the PC)

the term evolved in the 1960s to describe the
"small" 3rd generation computers that
became possible with the use of the
newly invented IC technology

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The Minicomputer

took up one or a few cabinets, compared with mainframes that would usually fill a room

led to the microcomputer (the PC)

Some consider Seymour Cray's CDC-160 the first minicomputer

The PDP-8 was the definitive minicomputer

as important to computer architecture as the EDVAC report

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Digital Equipment Corporation

Founded in 1957 by Ken Olsen, a Massachusetts engineer who had been working at MIT Lincoln Lab on the TX-0 and TX-2 projects.

Began operations in Maynard, MA in an old textile mill

Digital started with the manufacturing of logic modules.

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Digital Equipment Corp. (DEC)

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DEC PDP-1

In 1961 DEC started construction of its first computer, the PDP-1.

PDP = Programmable Digital Processor

18-bit word size

Prototype shown at the Eastern Joint Computer Conference in December 1959

Delivered the first PDP-1 to Bolt, Beranek and Newman (BBN) in November 1960
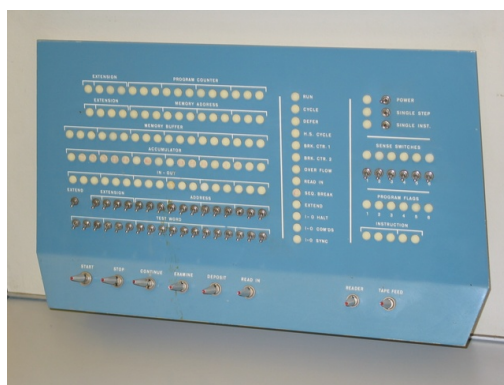(BBN plays a role in the development of the Internet, stay tuned!)

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PDP-1

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PDP-1

**console and
program tapes for PDP-1
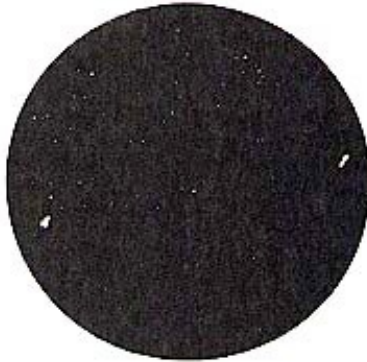(Computer History
Museum)**

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PDP-1
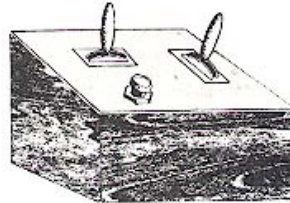

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PDP-1 Demonstration

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Spacewar!
The first computer game, created on the PDP-1

`http://www.atarimagazines.com/cva/v1n1/spacewar.php`

The original control boxes looked something
like this. The controls are a) right-left rota-
tion, b) acceleration (pulled back) and
hyperspace (pushed forward), and
c) torpedo button.

The Starting Position.
The ships are in the centers of diagonally opposite quadrants.The vee of stars at
top center is the horns of Taurus. You should be able to pick out the stars of
Orion at the left (the bright star just above the wedge-ship is Rigel).

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PDP-8

True success for DEC followed with the introduction of the famous PDP-8 in 1965
- under the leadership of C. Gordon Bell
- the first to be called a minicomputer
  - taken from miniskirt, also popular in the 1960s?
- 50,000 units would be sold
- weighed 250 lbs.
- Initially priced at $18,000

the first computer that was regularly purchased by a handful of end users as an alternative to using a larger system in a data center

far simpler architecture than mainframes

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PDP-8 and PDP-11

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PDP-8 and PDP-11

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PDP-8 Demonstration

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PDP-11 Demonstration

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PDP Influence

Architecturally: allowed I/O to go directly from input device to core memory

  Allowed fast I/O with minimal impact on processor

  Called Direct Memory Access (DMA)

  Defined the architecture of the minicomputer

  Is built into the microprocessors used in PCs today

Culturally: encouraged customer modification of its models

  Provided catalogs with self-instruction

    Done out of necessity, but appreciated by clients

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Digital Tidbits

1965 - $15 million in revenues (876 employees)

1970 - $135 million in revenues (5,800 employees)

DEC was shipping as many PDP-8s as IBM was of 360s

Digital would also produce the popular 32-bit VAX computer family

The first versions of the C programming language and the UNIX system ran on Digital's PDP series of computers

At its peak in the late 1980s, Digital was the second-largest computer company in the world, with over 100,000 employees.

Later acquired by Compaq, which subsequently merged with Hewlett-Packard.

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J.C.R. Licklider

1915-1990

In 1950, Licklider moved from Harvard to MIT

Wrote his famous paper *Man-Computer Symbiosis* in 1960, which outlined the need for simpler interaction between computers and computer users.

http://memex.org/licklider.pdf

The earliest ideas of a global computer network were formulated by Licklider at MIT in August 1962

The Computer as a Communications Device (w/ R.W. Taylor)

In October 1962 Licklider was appointed head of the DARPA information processing office

set up initial funding that led to the Internet years later

In 1968, he became director of Project MAC at MIT

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Project MAC

A research laboratory, started at MIT in 1963 with initial funding from a two-million-dollar DARPA grant.

Project MAC's major founders – Robert Fano, Fernando J. Corbató, John McCarthy, and Marvin Minsky

Project MAC envisioned the creation of a "computer utility"

computer utility - as reliable as source of computational power as the electric utility was a source of electrical power.

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Timesharing

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Multics

Initial planning and development for Multics started in 1964.

Corbató brought the first computer time-sharing system, CTSS, with him from the MIT Computation Center

One of the early focuses of Project MAC would be the development of Multics, a successor to CTSS.

Multics was to be the first high availability computer system

Developed as a part of an industry consortium including General Electric and Bell Laboratories.

In 1970 GE's computer business, including Multics, was taken over by Honeywell.

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UNIX

Thompson   Richie   Kernigham

Bell Labs dropped out of Multics in 1969

The UNIX operating system is produced in 1970 by Ken Thompson & Dennis Richie of Bell Labs who had worked on Multics

- This project was called UNICS, short for Uniplexed Information and Computing System
- The name has been attributed to Brian Kernighan, as a pun on Multics.
- The name was later changed to UNIX.

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UNIX: AT&T Archives

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UNIX (cont'd)

Rewritten in C in 1973 to be more portable

UNIX Variants:

- BSD – University of California at Berkeley
- SunOS – Sun Microsystems
- Xenix – Microsoft Corporation
- LINUX - written as a hobby by Finnish university student Linus Torvalds, who was attending the University of Helsinki in 1991
  - free software
  - open-source software

UNIX was the one of the most popular operating systems of the 1970s and 1980s

The BSD Daemon

The LINUX Penguin

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Computer Memory Revisited

From the 1970s to the 2000s, many new devices were invented to increase the operating memory and archival storage of a computer.

New inventions:
- floppy disk
- hard drive
- removable disk
- compact disc
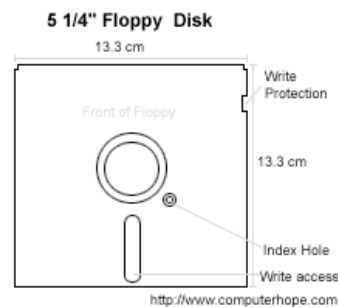- flash drive

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Diskettes (Floppy Disks)

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8" Floppy Disks

1971 – IBM uses 8" read-only floppy disk for the System 370 that holds 80KB
- invented by Alan Shugart, an IBM engineer

1973 – IBM uses 8" read-write floppy disks for the IBM 3740 Data Entry System
- Each disk holds 256KB
- CP/M, an operating system by Gary Kildall (story coming soon), originally shipped on 8" floppy disks
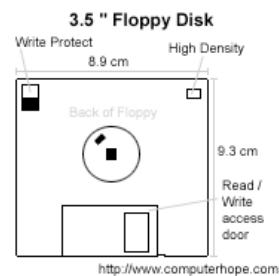- 8" diskettes eventually were improved to 800KB

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5¼" Floppy Disks

1976 – Reportedly, An Wang suggests that the floppy size is too big and feels a better size would be the size of a napkin (5¼")

Initially manufactured by Shugart Associates

Single-density(160KB)

Double-density (360KB)

Double-Sided
High Density (1.2MB)

5 1/4" Floppy Disk
13.3 cm
Front of Floppy
Write Protection
13.3 cm
Index Hole
Write access
http://www.computerhope.com

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3½" Floppy Disks

A number of solutions were developed, with drives at 2", 2½", 3" and 3½" all being offered by various companies.

In 1984, Apple Computer selected the Sony 3½" format (90 mm) for their Macintosh computers

Double-Density (720KB)

High-Density (1.44MB)

The end of the diskette

1998 – Apple Imac

2003 – Dell computers

3.5 " Floppy Disk
Write Protect   High Density
8.9 cm
Back of Floppy
9.3 cm
Read / Write access door
http://www.computerhope.com

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Hard Disk Drive

A **hard disk** uses rigid rotating magnetic platters.

RAMAC (developed in the mid 1950s by IBM)

- Occupied the space of two refrigerators and weighed a ton.
- Stored those 5 million characters on 50 hefty aluminum disks coated on both sides with a magnetic iron oxide.
- In February 1954, a team in San Jose successfully transferred data from cards to disks and back.
- In September 1956, RAMAC was featured as the IBM 355

Most of the world's hard disks are now manufactured by just a handful of large firms: Seagate, Maxtor, Western Digital, Samsung, and the former drive manufacturing division of IBM, now sold to Hitachi.

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Hard Disk Drive

An air traffic controller is reflected in the cover of the IBM 355 Disk Storage unit, part of an IBM RAMAC 650 data processing system at the Indianapolis air route traffic control center in November 1959 to aid the U.S. Federal Aviation Agency in keeping tabs on an increasing volume of daily flights. The disks held a reservoir of data, including geographical locations of airways and beacons, reference tables and a complete record of flight plans. The information was constantly updated and instantly available for automatic computations and for reference by controllers. Capacity of the disk memory was six million digits.
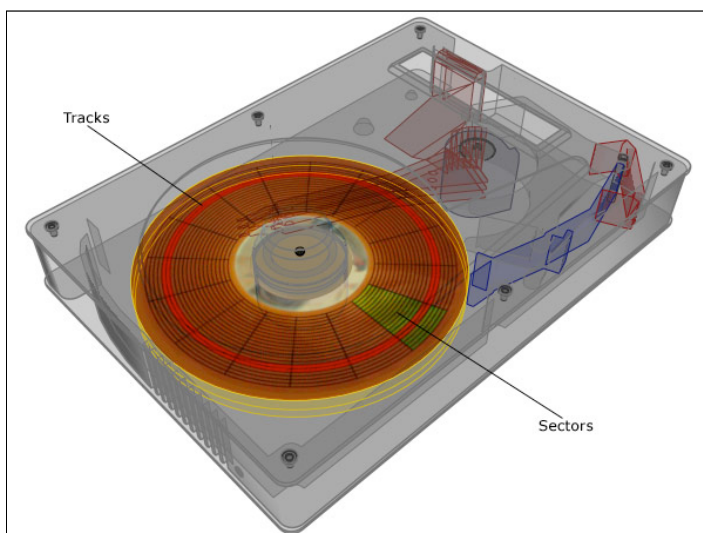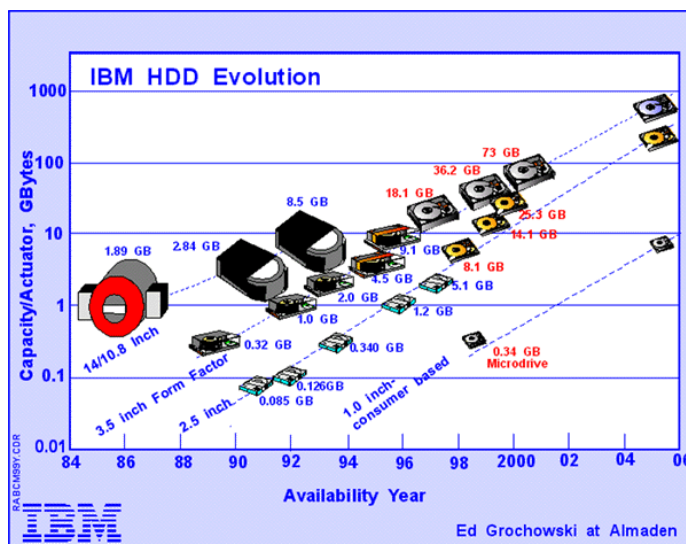
(IBM Archives)

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IBM RAMAC

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Hard Disk Drive

from LinuxPlanet

Tracks

Sectors

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Hard Disk Drive Evolution

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Other Drives

The Iomega Zip drive was a removable disk storage system in late 1994.

Capacity: 100MB, 250MB and later 750MB.

Popularity fades around the year 2000.

A keydrive is a small removable data storage device that uses flash memory and a USB connector.

Invented in 1999-2000 by M-Systems & IBM

The CD-ROM is a non-volatile optical data storage medium using the same physical format as audio compact discs.

Capacity: 700MB

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DECTalk (1983)

DECtalk was a new type of output device, it accepted ASCII text from an RS232C terminal port and spoke the text rather than printing it.

It was the first such device offered by any major computer manufacturer.

Entertainer Stevie Wonder introduced DECtalk at Park Plaza Hotel in Boston.
(Digital Computing Timeline)

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Back to Digital: The VAX series

VAX-11/780 introduced in 1977 by Digital

VAX = Virtual Address eXtension

Its architecture was designed to alleviate the PDP-11's most severe limitation: an address space that was too small for many applications.

The VAX increased the address from 16 to 32 bits.

The number of general registers also doubled from 8 to 16.

The instruction set had both two and three operand formats for many common operations with either a register or memory operand allowable.

VAX was an example of a CISC (Complex Instruction Set Computer)

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The VAX series

VAX-11/780 (Digital Computing Timeline)

VAX-11/750 introduced in 1980 - the industry's first Large Scale Integration (LSI) 32-bit minicomputer. (Digital Computing Timeline)

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The RISC Revolution

RISC (Reduced Instruction Set Computer)

a technology that has revolutionized the computer architecture industry by increasing performance while reducing costs.

John Hennessy – Stanford University

In 1984, he cofounded MIPS Computer Systems, now MIPS Technologies, which produces microprocessors.

former President of Stanford University

David Patterson – UC Berkeley

Led the design and implementation of RISC I

This research became the foundation of the SPARC architecture

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Sun and the SPARC

Incorporated in 1982 with 4 employees

1985 – Sun begins work on its SPARC processor

SPARC = Scalable Processor ARChitecture

RISC (Reduced Instruction Set Computer)

1987 - introduces its first SPARC-based system, the Sun-4/260, with 10 MIPS performance.

1989 – first SPARC workstation introduced

rated at 12.5 MIPS 20-MHz, 1.4 MFLOPS, for a base price of US$9000.

1991 – Sun becomes leader in RISC workstations with 63% of market

Sun is bought by Oracle in 2010

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Sun Workstations

Sun SPARCstation 2
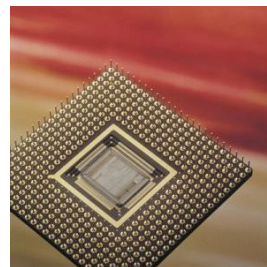
Sun Ultra 5

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Sun Workstations

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Digital's Alpha (1992)

Alpha was a totally new, open, 64-bit RISC architecture, engineered to support multiple operating systems and designed to increase performance by a factor of 1000 over its anticipated 25-year life.

The first Alpha chip was the 21064, which provided a record-setting 200-MHz performance.

Alpha was a commercial failure. Digital's reign at #2 was over.

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