

Windows 2000

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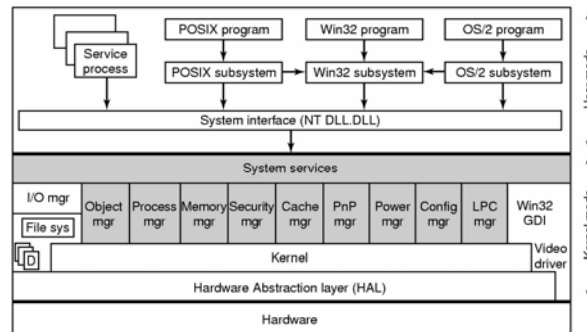
Dept. of Computer Science, University of Rochester

Windows 2000

Year	AT&T	BSD	MINIX	Linux	Solaris	Win NT
1976	V6 9K					
1979	V7 21K					
1980		4.1 38K				
1982	Sys III 58K					
1984		4.2 98K				
1986		4.3 179K				
1987	SVR3 92K		1.0 13K			
1989	SVR4 280K					
1991				0.01 10K		
1993		Free 1.0 235K			5.3 850K	3.1 6M
1994		4.4 Lite 743K		1.0 165K		3.5 10M
1996				2.0 470K		4.0 16M
1997			2.0 62K		5.6 1.4M	
1999				2.2 1M		
2000		Free 4.0 1.4M			5.8 2.0M	2000 29M

Comparison of some operating system sizes
(line of the source code)

The Structure of Windows 2000

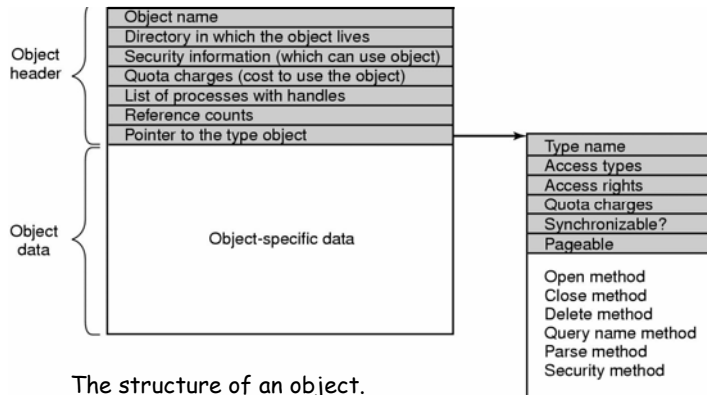


- Shaded area is the executive
- Boxes, D, are device drivers
- Service processes are user-level system daemons

Main Components of the OS

- Here OS we mean the part of system running in the privileged mode
- Hardware abstraction layer (hardware-dependent stuff)
 - device register addressing/access, interrupt, DMA, timers, spin locks, ...
- The kernel (in Windows 2000 jargon)
 - more hardware-dependent stuff such as context switches (I know it is confusing)
 - some basic system functionalities such as scheduling
- The executive (completely hardware-independent)
 - process management, memory management, file system, ...

Objects Inside the OS

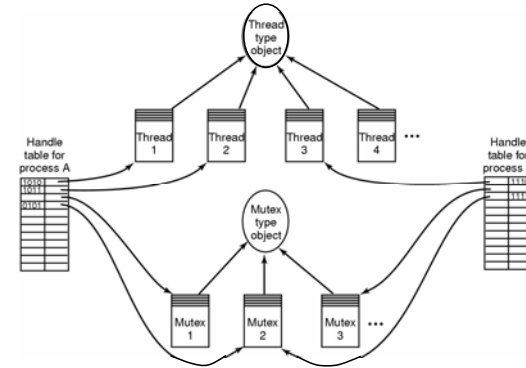


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Objects & Handles



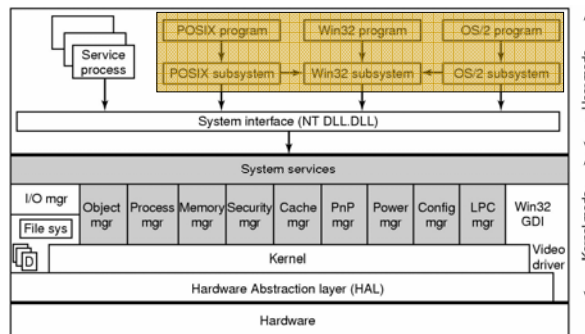
Handles allow user programs to refer to kernel objectives, like file descriptors in UNIX.

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Environment Subsystems



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Processes and Threads

Name	Description
Job	Collection of processes that share quotas and limits
Process	Container for holding resources
Thread	Entity scheduled by the kernel
Fiber	Lightweight thread managed entirely in user space

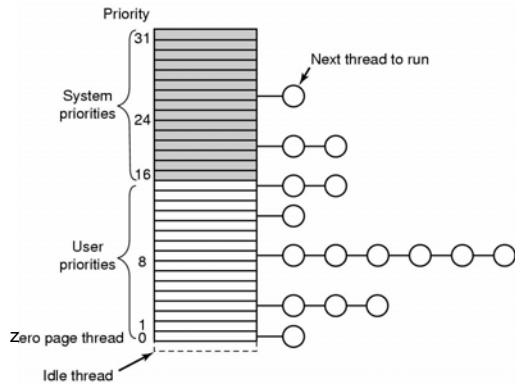
Basic concepts used for CPU and resource management

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Scheduling



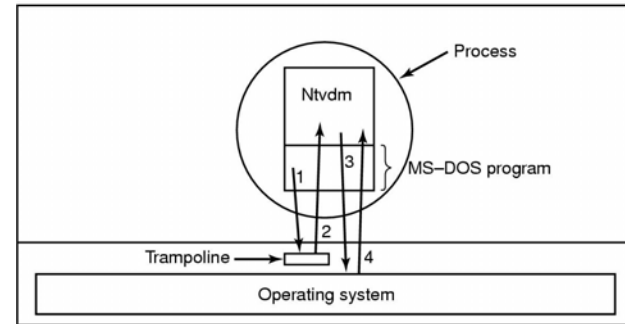
thread priorities are boosted after returning from blocking I/O or synchronization

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MS-DOS Emulation



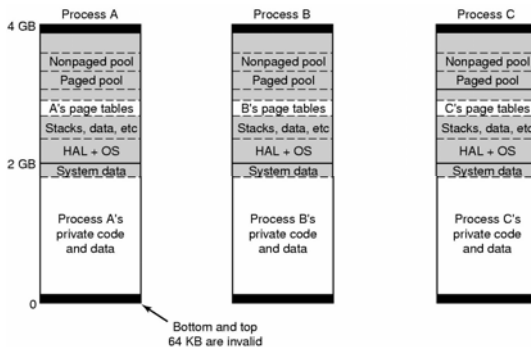
How old MS-DOS programs are run under Windows 2000?

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Virtual Memory Layout



- Virtual address space layout for 3 user processes
- White areas are private per process
- Shaded areas are shared among all processes

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Memory Page Replacement

- A "working set"-based page replacement algorithm.
 - Every process has a memory page working set size
- when a page fault occurs
 - if the current number of memory pages exceeds the working set size, then replace one of its own pages
 - otherwise, replace some other pages
- the working set size is dynamically adjusted depending on the process page fault rate in the recent past

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File System

- The fundamental structure of the 2000 file system (NTFS) is a *volume*.
 - Like a logical disk partition.
 - May occupy a portions of a disk, an entire disk, or span across several disks.
- NTFS uses *clusters* as the unit of disk allocation.
 - The cluster size is a tradeoff between management overhead and internal fragmentation.
- A file in NTFS is not a simple byte stream, as in UNIX, rather, it is a structured object consisting of *attributes/value* pairs.

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Journaling File System — Recovery

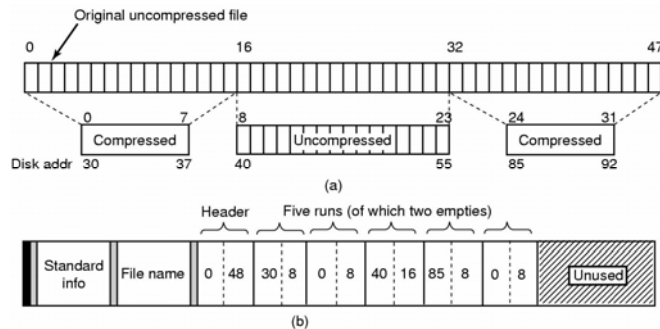
- All file system data structure updates are performed inside transactions that are logged.
 - Before a data structure is altered, the transaction writes a log record that contains redo and undo information.
 - After the data structure has been changed, a commit record is written to the log to signify that the transaction succeeded.
 - After a crash, the file system data structures can be restored to a consistent state by processing the log records.
- This scheme does not guarantee that all the user file data can be recovered after a crash, just that the file system data structures (the metadata files) are undamaged and reflect some consistent state prior to the crash.

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File Compression



- (a) An example of a 48-block file being compressed to 32 blocks
 (b) The file meta-data after compression

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Security in Windows 2000

- Secure login with anti-spoofing measures
 - Ctrl-Alt-Delete.
- Discretionary access controls
 - The file attribute contains the identifier of the file owner, and an access control list that states the access privileges that are granted to each user that has access to the file.
- New pages must be zeroed before being mapped in
 - preventing accidental information leaks

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