





Computing Systems



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Ü An interesting point of view

Ü 1975 rounds of research

Ü 1980s: modularity and microkernels

422 Mach (CMU; Rashid, ...)

ü 1986 Amoeba (Vrije Tannenbaum, 226)

1980's: microkernels

Unix architecture

Mach (CMU: Rashid, Bershad

Mach architecture

Mach design goals

- Support for diverse architectures, including multiprocessors
 - UMA: uniform memory access (like x86 SMP)
 - NUMA: non-uniform memory access (large numbers of processors)
 - NORMA: no remote memory access (Beowulf)
- Transparent access to network resources
- Exploit parallelism in both system and application
- of abstraction
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hCékhépothihs 13

Mach abstractions

Mach processes

- Threads are either Running or Suspended
- Multiprocessor scheduler
 - Quantum varies with number of threads in the system
- *Spinlocks* are used for mutual exclusion
- Some threads are exception handlers

Mach memory management

- There is a *pageout* kernel thread: FIFO with second-chance
- Memory is managed by a *memory server*
 - A page fault generates a request to the server
 - A pageout copies the page to the server, which probably writes it to a file
 - Memory managers are *user* programs

CS134a: Modern OS

- ü An interesting point of view**
- ü Two rounds of research**
- ü 1980's: modularity and micro-kernels**
 - ü Mach (CMU; Rashid, ...)**
 - Amoeba (Vrije; Tannenbaum)**

Amoeba (

Amoeba system model

Amoeba system model

- Pool processors
 - Not owned by any user
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Amoeba processes and threads

Amoeba

- A server allocates a *port*
- RPC request broadcasts a LOCATE message, and a server replies
- RPC primitives
 - do_remote_op: user -> server request
 - get_request: server listens on a port
 - do_reply: server's response to a request

Amoeb0 servers

Amoeba capabilities

- When a client wants to access an object

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Amoeba capabilities



Amoeba Bullet fileserver

Amoeba directory server

- Maps names to capabilities
- Directory contains (name, capability-set) entries
 - Not immutable
- Columns indicate recipient rights (user, group, other)

Amoeba directory server