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- D. G. Bobrow, J. D. Burchfiel, D. L. Murphy, and R. S. Tomlinson, [TENEX, a Paged Time Sharing System for the PDP-10](#), Communications of the ACM, Vol. 15, No. 3, March 1972, pp. 135-143.

Q: What features in TENEX are reminiscent of features in Unix (a later system)?

- W. Wulf, E. Cohen, W. Corwin, A. Jones, R. Levin, C. Pierson, and F. Pollack, [HYDRA: The Kernel of a Multiprocessor Operating System](#), Communications of the ACM, Vol. 17, No. 6, June 1974, pp. 337-345.

Q: How is a Hydra procedure different from the procedures we are familiar with in a typical language and runtime environment?

Virtual memory →

file system ⇒ EXT4

Access manager ⇒ file

fork ←→ process hierarchy
file descriptor

Scheduler. ←→

terminal , control story.

monitor function

Hydra

main point

- ① Capability-based operating system nucleus
- ② "capabilities on steroids"

Where is
the multi-process — Later

High-Level interesting design principles

- ① Separate mechanism and policy

- Protection is mechanism, security is policy.

★ Difference.

- ② Reject hierarchy (why?)
 - Layers of privilege.
 - Not flexible

Terms what is a secure OS?

- Resources
- Execution Domains
- Protection mechanism controls access to resources in domain

Hydra

how
it
does

Objects

- Unique name 64 bits
- Type: name of another object.
 - Sort of like an inheritance hierarchy representation

DATA: data (the variable)



Capability: pointer/references to other objects with "rights"

- Sometimes capability points to types & abstract capabilities

e.g. read file.

↳ ("PATH", "Mode")

Permission checked when granted
capability.

File handler ("PATH", "CAPABILITY")

→ A Pointer
kernel Structure → user can mess up.

F -- pointer to file

F.delete() preduces to delete file.

But, owner of F must have rights to delete file.

Access control list

- ① Associate file with each other.
- ② May be changed (like a DATABASE)

Capability

- ① Cannot forego (take) (hard to revoke)
- ② Can be passed from one process to another.

Main rights in Hydra

- kernel rights (read, write, exec)
- auxiliary rights (

LNTS

exec domain.

include?

- ① L is at obj
- ② Vars local
- ③ Transire closure of all capabilities.

[All possible
combinations]

procedures

code, ops, objects

Template: define types and capability signatures

Parameters: must match the types and signatures

"check-rights" field used to match capabilities in Dynamic parameters
with signatures

LNs for this procedure has a pointer to parameters
but a rights list defined by template.

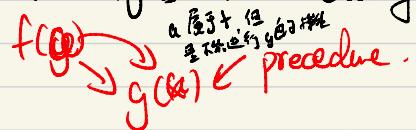
* Side notes :

kernel map itself to any user program so that sys call
won't need to flush the page table.



Called procedure may have more rights than caller.

however, caller cannot use those rights after returning
from the procedures



OS have this today in a monolithic form
e.g. invoke a system call, take on privileges of kernel.

The system does it for you.
but you might just consider this for you.

Trace model

When you call a procedure, you are trusting that it will
do the right thing.

The rights a procedure has to its arguments is defined by
the implementor of procedures.

Tenex

Share of Unix in many places

BBN
payer

PDP-10 micro-coded.

Virtual machine - Virtual Memory is this paper.

↳ real VM

- ① Not distinguishable
- ② can Boot OS

Side Note

Android choose JVM to enable developer quickly build App. like iOS dominate market.

main goal

- memory mapping.

How sharing

a page could appear in the address spaces on more than one process

Direct virtual memory to process.

Back

Compatibility (① New insc CJSX5)

- ② old system calls trap to a compatibility lib
- ③ compatibility lib in user space

Scheduling

- ① Fairness
- ② Efficiency
- ③ Preemptive events
- ④ Allow explicit control

How to decide

- ① See what job w/ highest priority, and fire memory
- ② Working set principle.

↳ e.g. you have a lot of tools, but your bag only has limited stuff to carry around everyday.

How to
determine
working set

inter-fault time is more than two revs of the drum (67ms)
useful

User friendly

FS

5 levels

(revision) lucky today

