Session 9353 / 9394

VM File Systems Overview

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This presentation provides a comparison and contrast of the various file systems available for use in CMS. Characteristics, administration, programming interfaces, and relative performance are discussed.

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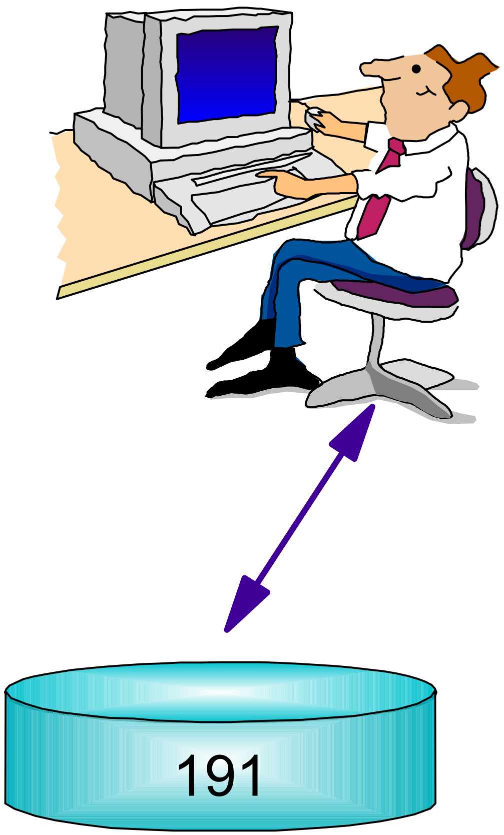
History

- VM available as a product for 26 years!
- Minidisk support since The Beginning
- Shared File System (SFS) introduced in 1988
- Byte File System (BFS) introduced in 1995
- Enhanced Network File System (NFS) support in 1998 and 1999

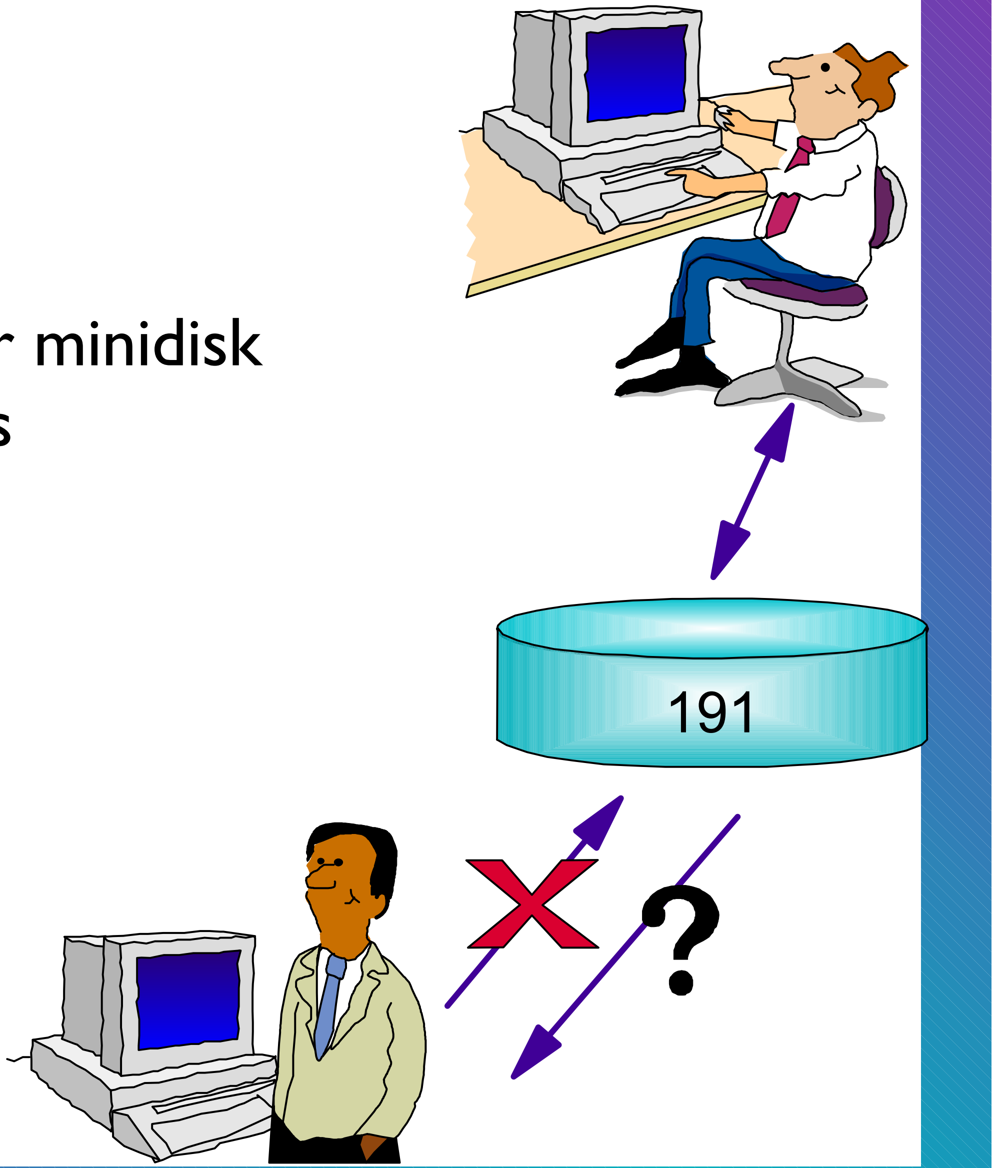
Minidisk

- Direct attachment of disk to user
  - excellent performance
  - writers can cause I/O errors for readers
  - security via minidisk password or ESM
  - mode 0 files are private, not secure!
- Fixed space allocation
  - manual or automated
  - files size limited to dasd size
  - changing size means copying disk



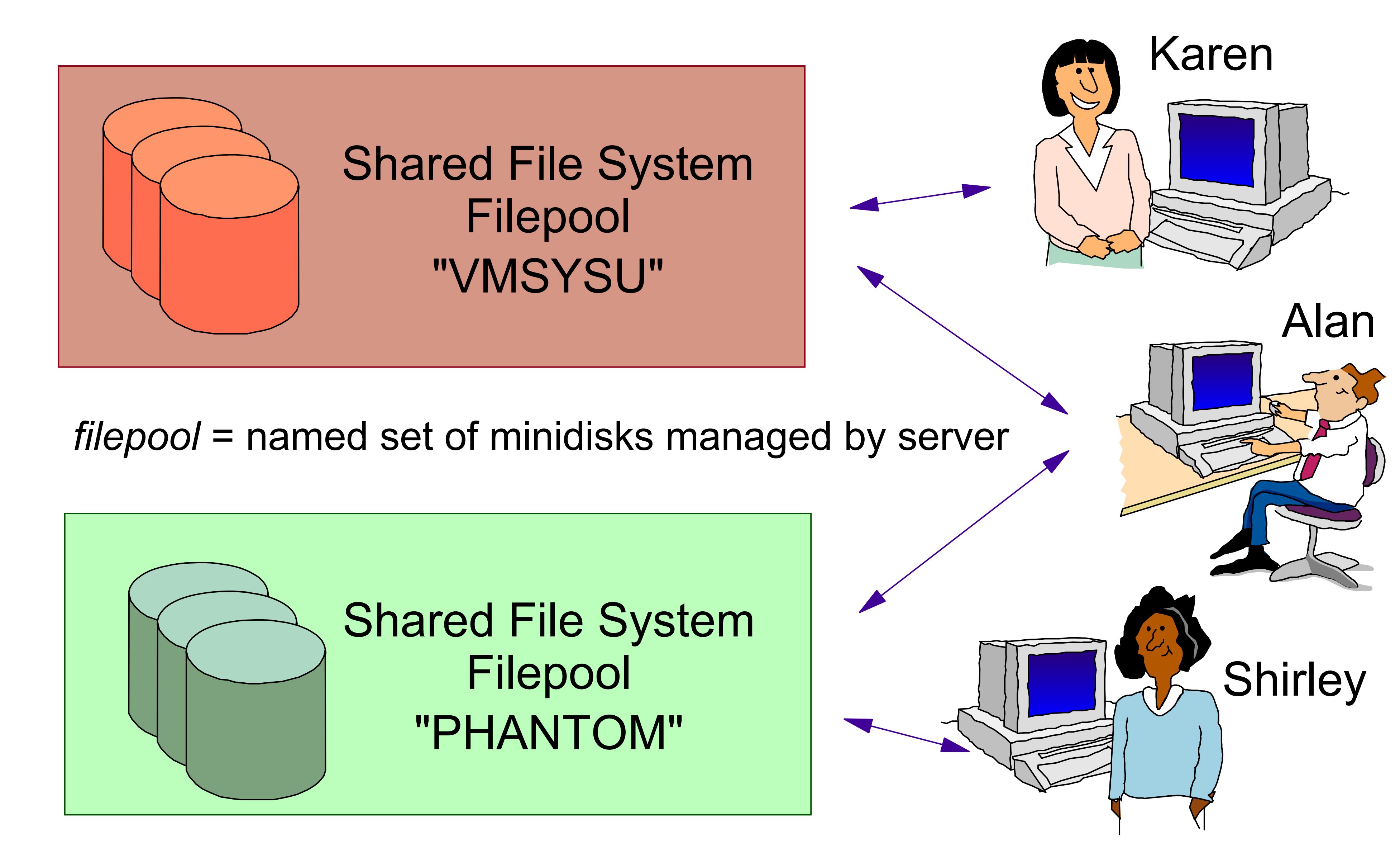
Minidisk

- No subdirectories
- Limited sharing capability
  - one writer, multiple readers per minidisk
  - no data integrity for the readers
  - esoteric programming practices
- Remote access
  - shared dasd
  - NFS



Shared File System

Shared File System (SFS)



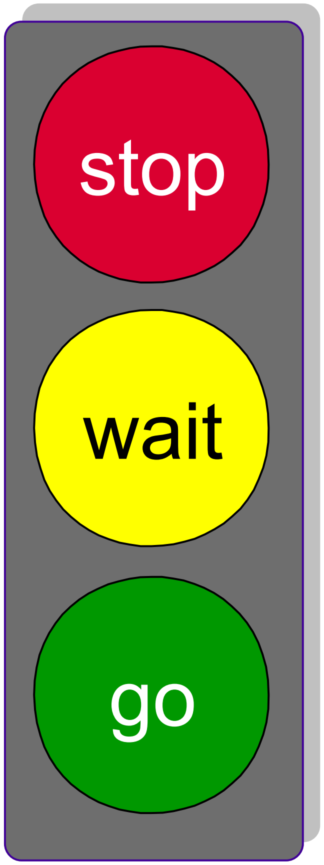
Shared File System Filepool "VMSYSU"

filepool = named set of minidisks managed by server

Shared File System Filepool "PHANTOM"

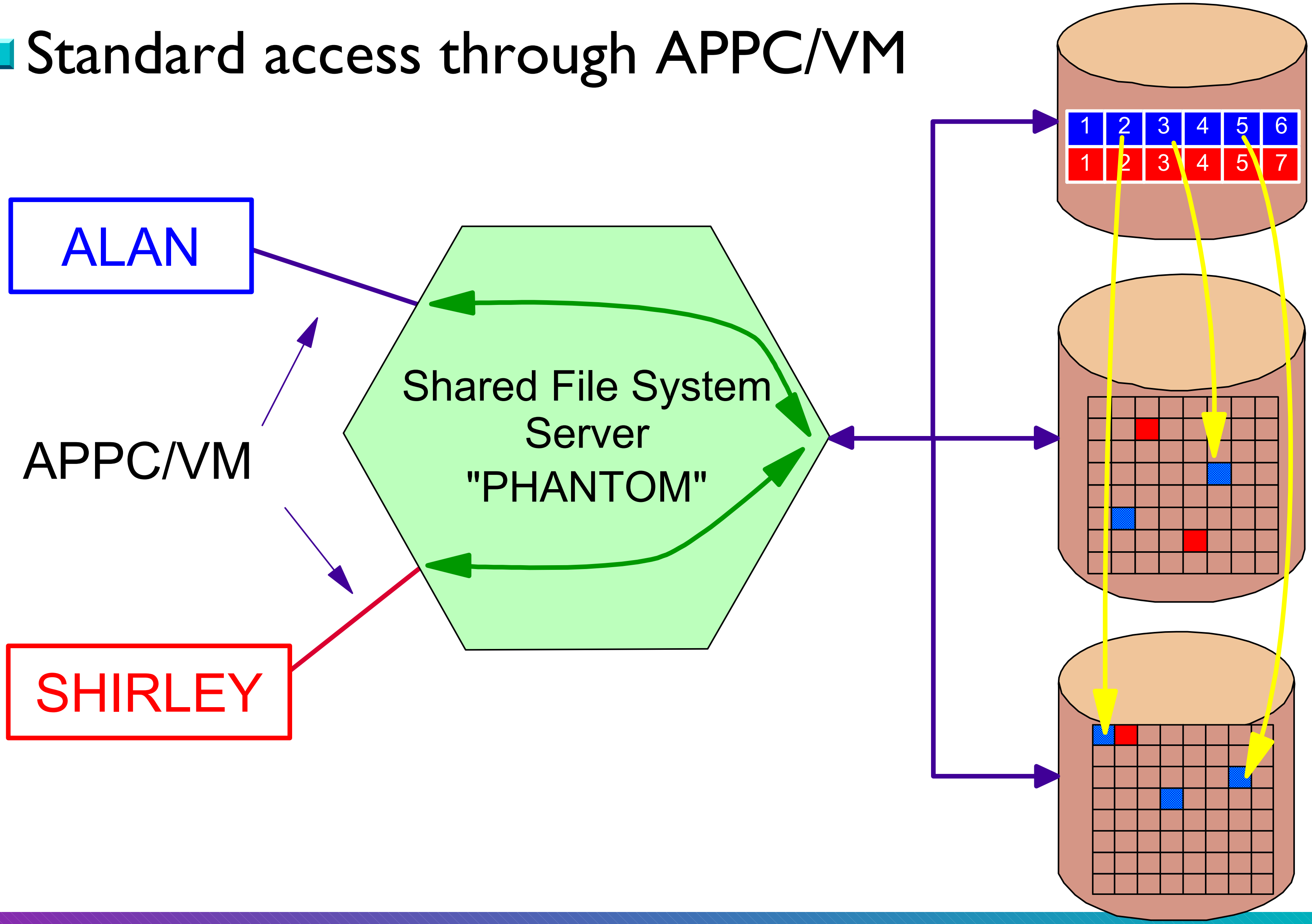
Shared File System

- Server-moderated access to files
  - access control
    - based on VM user ID
    - owner determines permissions
  - space management
  - filepool owned by server
  - file sharing controls
  - backup / restore
- Multiple servers for multiple policies



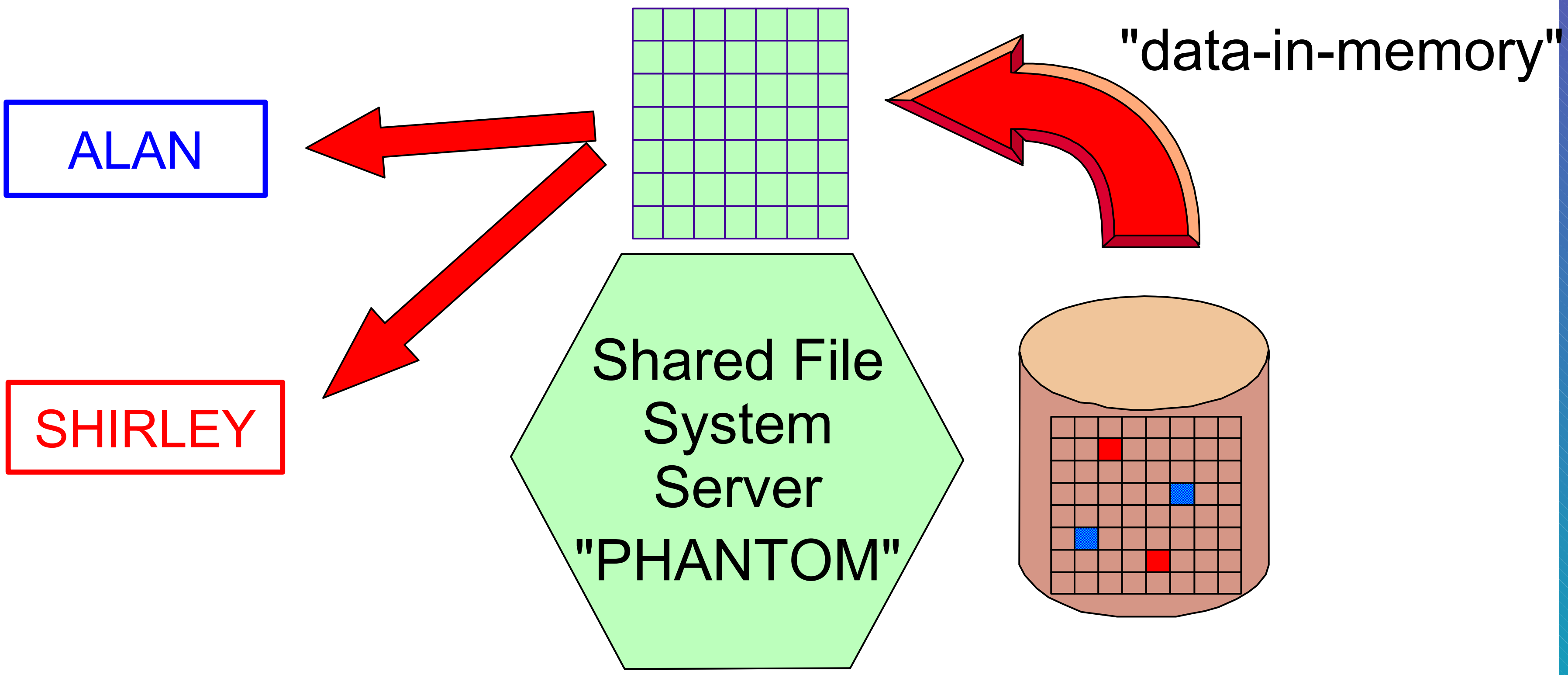
Shared File System

- Standard access through APPC/VM



Shared File System

- VM Data Spaces can be used to avoid trip to server for data
  - data read into memory as needed

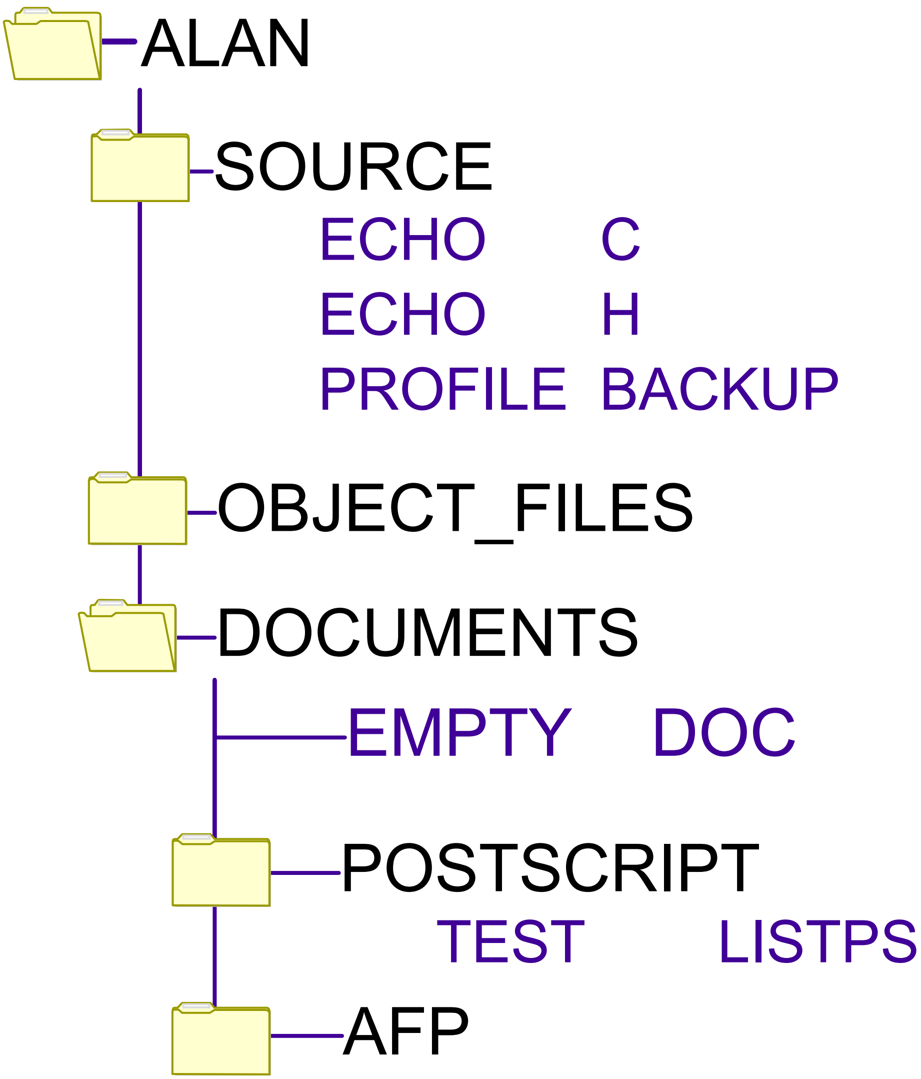


Shared File System

- Hierarchical directory structure
  - File Control
    - File updates shown whenever file is opened
  - Directory Control
    - Access-to-Release consistency for all files
    - Eligible for VM Data Spaces

- File sharing
  - one writer, many readers for a file
  - data integrity
  - no I/O errors

Shared File System File Space



```
ALAN
  SOURCE
        ECHO     C
        ECHO     H
        PROFILE  BACKUP
  OBJECT_FILES
  DOCUMENTS
        EMPTY    DOC
    POSTSCRIPT
          TEST      LISTPS
    AFP
```

```
enroll user alan phantom ( blocks 10000
```

```
> access phantom:alan.source b
> listfile * * b
```

Directories may be empty

Files may be empty, too!

Useful to preserve authorizations

Shared File System Benefits

- Flexible space allocation
  - uses multiple minidisks
  - files may span minidisks
  - blocks allocated as needed
  - can dynamically add minidisks
  - sum of user limits may exceed physical dasd
- May be part of System Managed Storage
  - a better "temp disk" - survives logoff
  - data can expire or be migrated

Shared File System

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- Remote access
  - VM users via collection or VTAM (AVS, LU 6.2)
  - NFS
- Work units allow explicit commit control
  - programs can explicitly rollback or commit work
  - rollback automatic in case of user abend
  - commit automatic when you return to Ready;
  - Coordinated Resource Recovery (CRR) ensures updates across multiple SFS file pools are all committed or all rolled back

Byte File System

Byte File System (BFS)

- Unix** file system
  - streams instead of records
  - multiple users can write to the same file
  - hierarchical directories
  - all users in a single file space
- Access based on POSIX UID and GID
  - defined in CP directory or ESM for each user
  - permissions: owner, group, other
  - authorizations: read, write, execute
  - VM userid translated to POSIX UID/GID

Byte File System File Space

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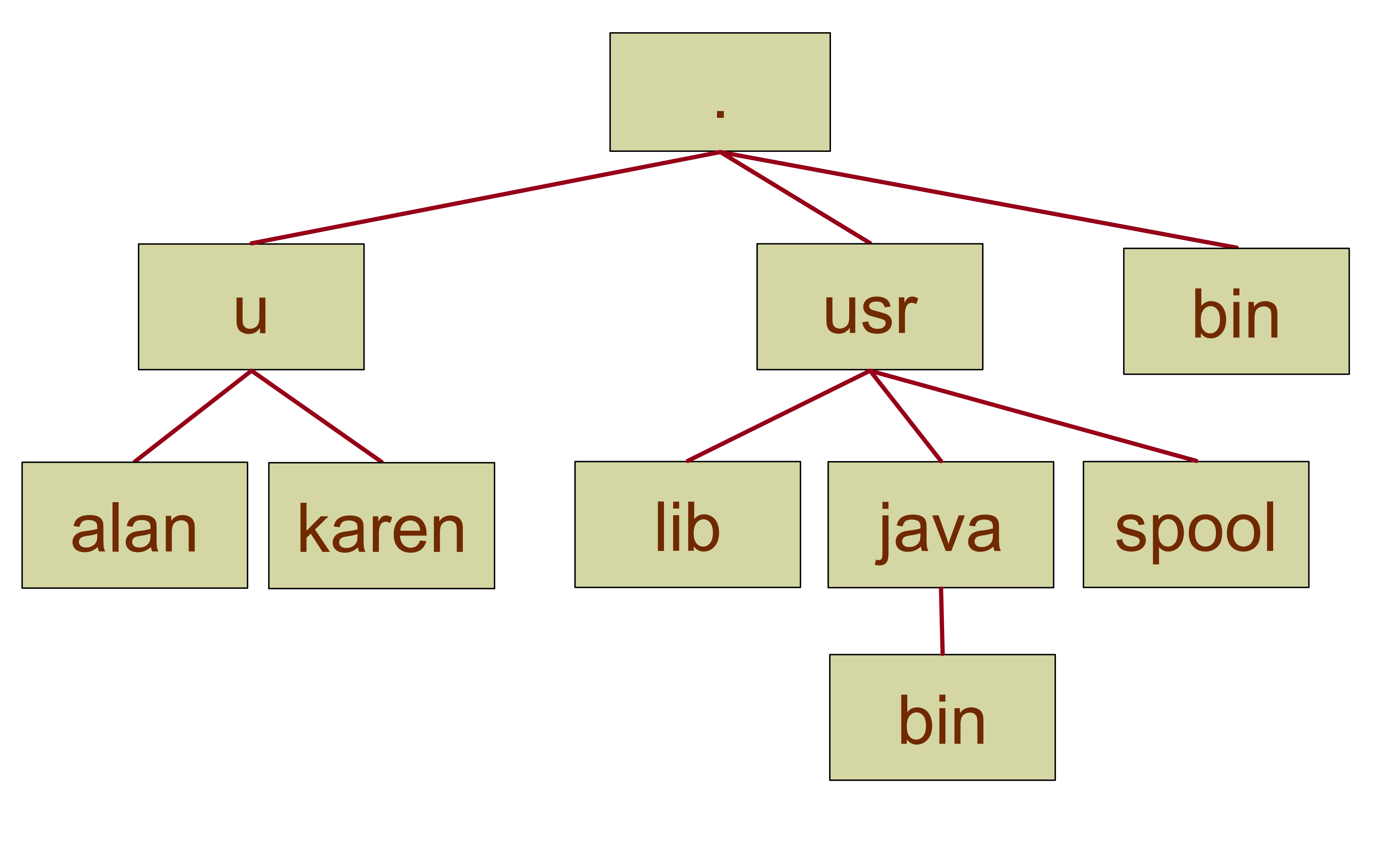
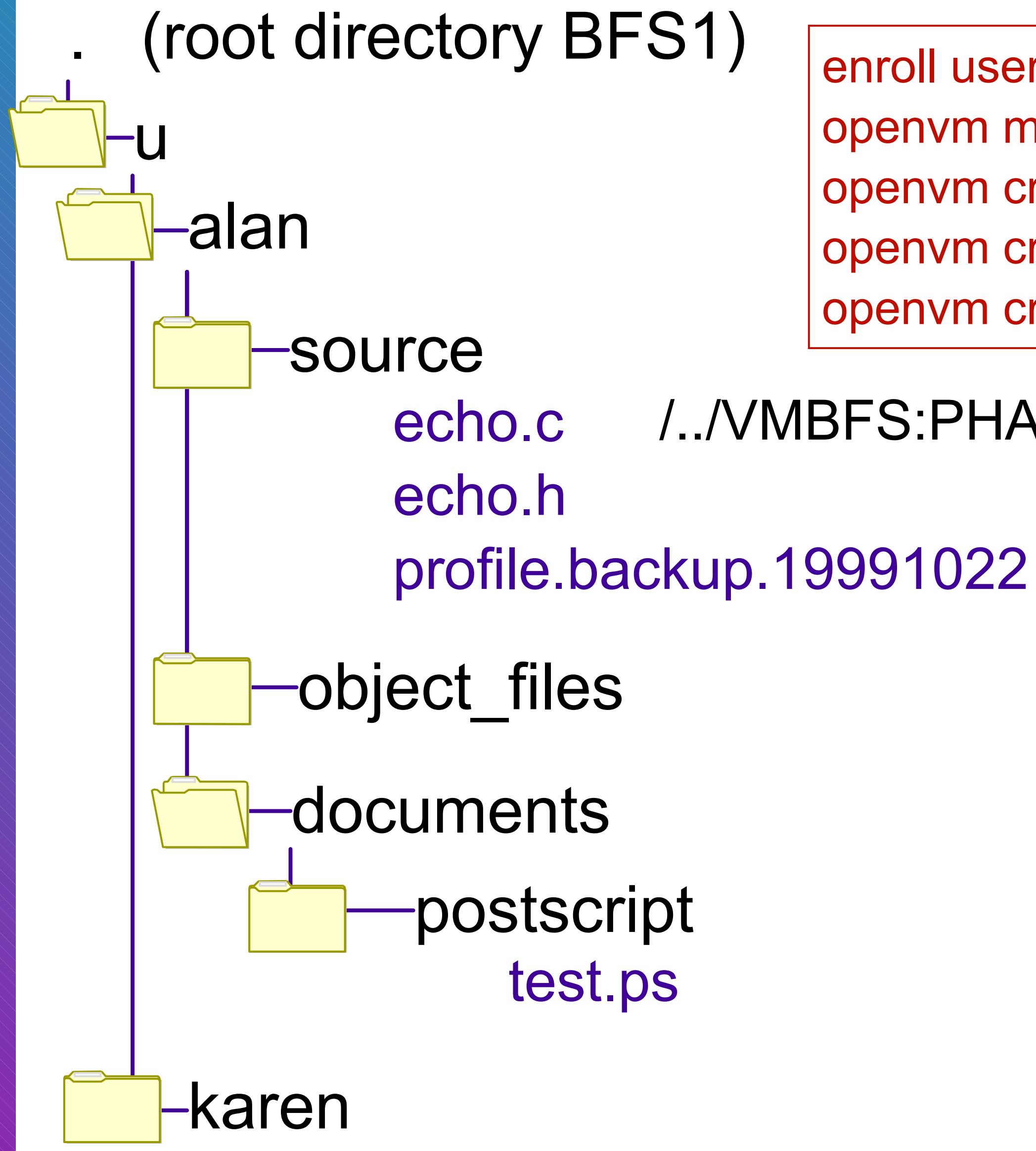


Hierarchical BFS Directory



. (root directory BFS1)

u

alan

source

echo.c

echo.h

profile.backup.19991022

object_files

documents

postscript

test.ps

karen

```
enroll user bfs1 phantom (blocks 200000 bfs
openvm mount /../VMBFS:PHANTOM:BFS1/  /
openvm create directory /u
openvm create directory /u/alan
openvm create directory /u/karen
```

/../VMBFS:PHANTOM:BFS1/u/alan/source/echo.c

Byte File System (BFS)

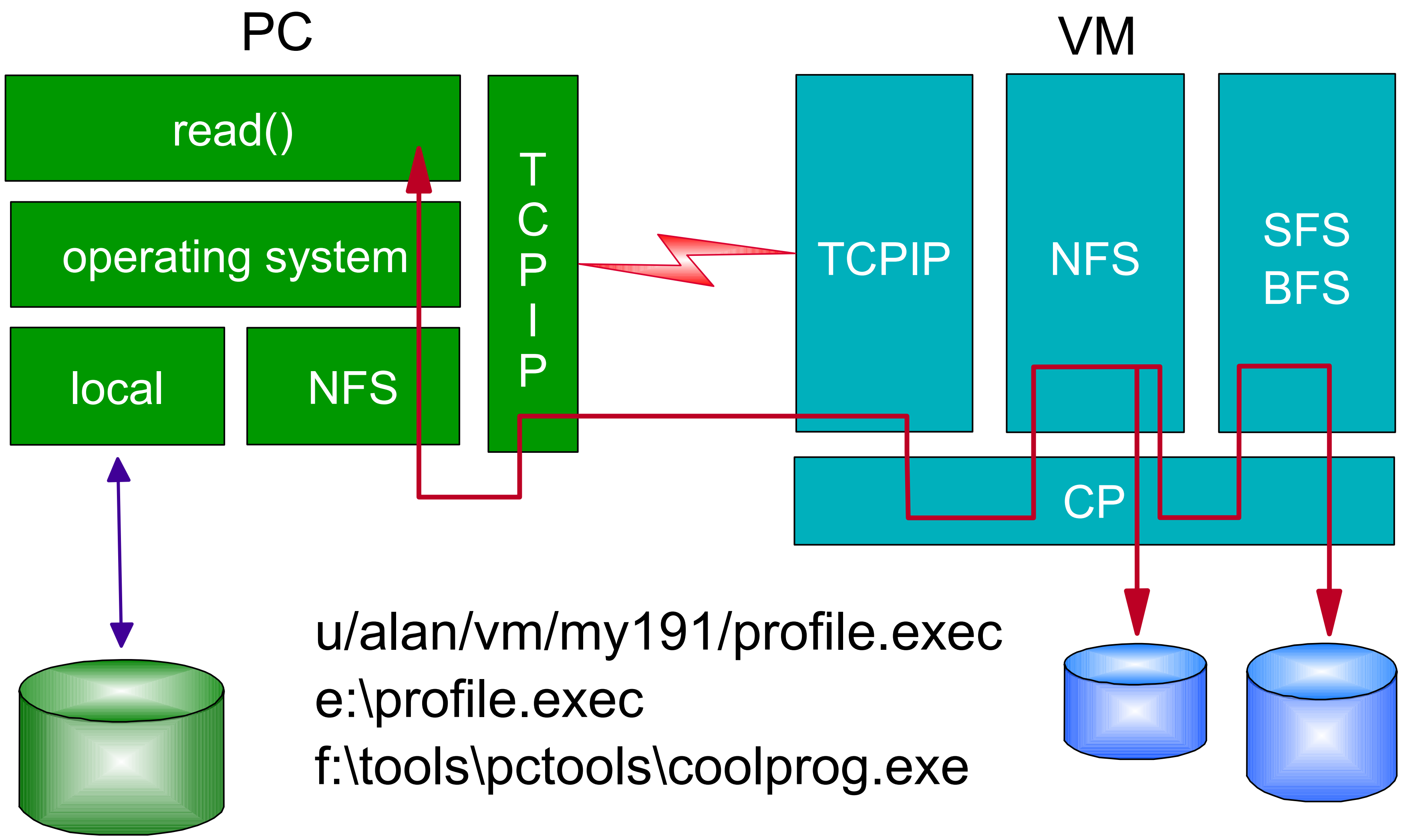
- As for SFS, the server moderates access
  - BFS is just another kind of file space in an SFS filepool
- OPENVM MOUNT
  - Cannot use ACCESS command
  - easiest to use with Shell & Utilities Feature
- Remote access
  - VM users via collection or VTAM (AVS, LU 6.2)
  - NFS

Network File System

Network File System** (NFS)

- Enables VM system to act as open systems file server
- Insert CMS directory or minidisk into the client's directory structure or assign it a new drive letter
- Client applications use local file I/O interfaces
  - device drivers use NFS remote procedure calls
  - transparent to applications

NFS - A Thousand Words



u/alan/vm/my191/profile.exec
e:\profile.exec
f:\tools\pctools\coolprog.exe

Network File System (NFS)

- BFS is an exact match for NFS capabilities
- Ordering note:
  - Separate feature
  - Additional charge

Why NFS?

- Data is available to any system which has an NFS client
- Data is shared, not duplicated
  - everyone sees the same version
  - updates available immediately

Why NFS?

- Enjoy all of the advantages of keeping your data on VM
  - established facilities to back up and recover data
  - System Managed Storage
  - host access control
  - centralized administration of space allocation

How Do I Use NFS?

- NFS clients available for common platforms
  - commonly known as "mount"
  - available for OS/390
  - standard for Unix and AIX
  - add-on for others
    - Hummingbird - NFS Maestro**
    - NetManage - InterDrive**, ViewNow** NFS
- Currently no NFS client for VM

How Do I Use NFS?

- Mount command defines
  - read-only or read-write
  - authentication - VM user ID and password
  - how to perform ASCII-EBCDIC translation

- For SFS and minidisk the Mount command defines how to
  - convert CMS file names into PC file names
  - convert CMS records into Unix streams
  - recognize end of line

Read More About NFS

- Mount command examples available from the VM TCP/IP NFS home page
  - http://www.ibm.com/s390/vm/nfs
- See "Inside NFS" article in Sterling Software's Fall 1998 *VM:News*

Programming Interfaces

Minidisk Programming Interfaces

- Assembler
  - FSSTATE, FSOPEN, FSPOINT, FSREAD, FSWRITE, FSCLOSE
- OS and DOS simulation
  - OPEN, CLOSE, GET, PUT, READ, WRITE
- Callable Services Library (CSL) routines
  - DMSOPEN, DMSREAD, DMSWRITE, DMSCLOSE
- Standard HLL file system APIs

SFS Programming Interfaces

- When directory is accessed, same as for minidisk
- CSL routines work for unaccessed directories
- Work units allow commit control

BFS Programming Interfaces

- Since you cannot ACCESS a BFS directory, traditional file system APIs won't work
- CSL Routines
  - BFS-specific BPX1....
  - SFS using directory name
    - `OPENVM LISTFILE (NAMES`
- C for VM/ESA standard file I/O
  - fopen("./conference.data", "r")
  - read(), fwrite(), scanf(), etc.

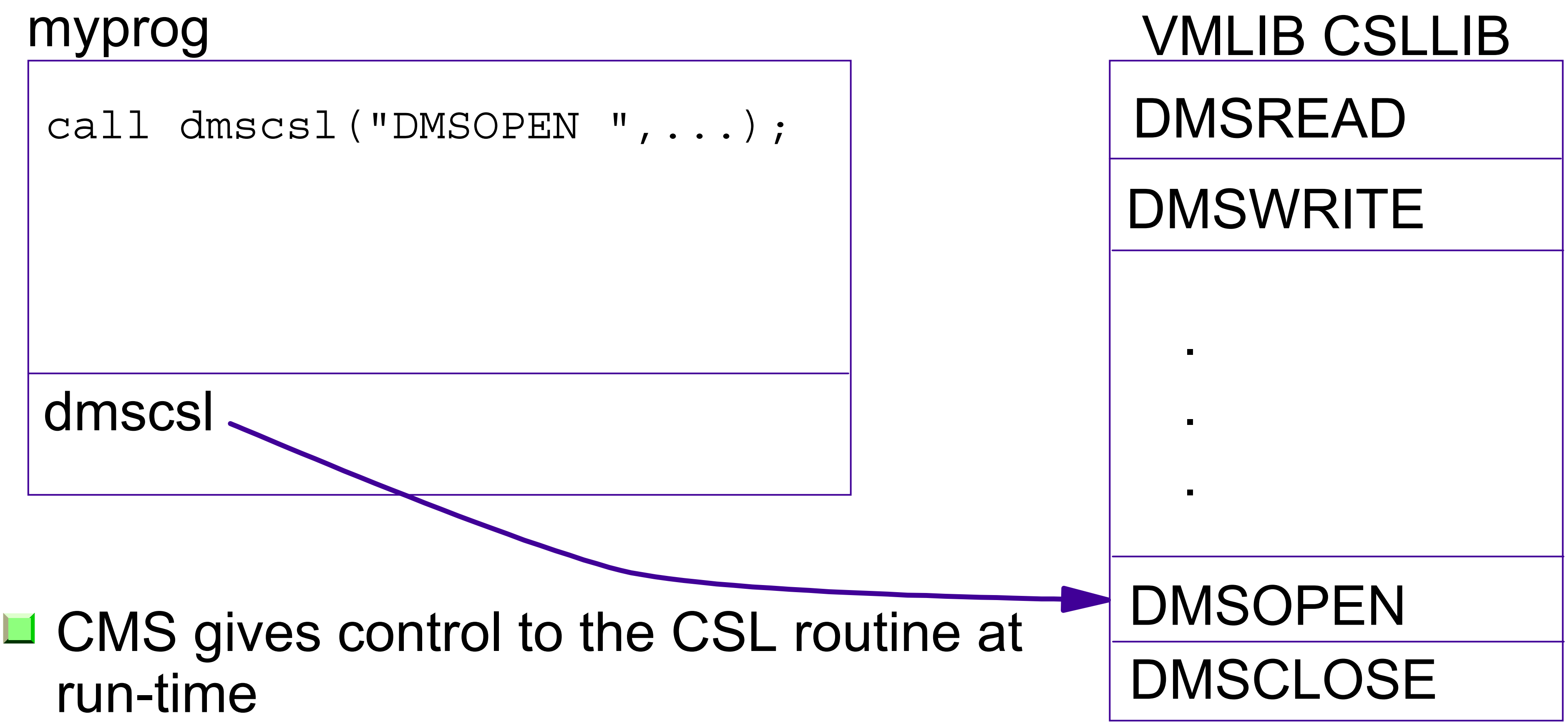
NFS Programming Interfaces

- NFS Version 2 - RFC 1094
- NFS Version 3 - RFC 1813
- Boring unless you are writing an NFS client

Callable Services Library (CSL)

- Introduced in VM/SP Release 6
- Languages supported
  - COBOL
  - FORTRAN
  - Pascal
  - PL/I
  - Rexx
  - C
  - Assembler
  - anything that can use OS CALL interface

Callable Services Library (CSL)



myprog

```
call dmscsl("DMSOPEN ",...);
```

dmscsl

VMLIB CSLLIB

DMSREAD

DMSWRITE

.
.
.

DMSOPEN

DMSCLOSE

- CMS gives control to the CSL routine at run-time
- Different versions of CSL routine can be used without changing your program
  - Similar to a DLL

Callable Services Library (CSL)

- files and directories
- virtual machine settings
- call a Rexx exec
- VM data spaces
- CMS program stack
- workunits
- data compression
- TCP/IP
- date and time
- event management
- timer services
- Monitor data
- more...

Callable Services Library (CSL)

- Create your own CSL libraries
- You can substitute your version for IBM version
- Excellent for creating well-defined interfaces
  - Between different products
  - Between components of same product
  - Exits
    - "If not loaded, don't call it"

File System References

- Usage
  - CMS User's Guide
  - OpenEdition User's Guide
  - OpenEdition Command Reference
- Programming
  - CMS Application Development References
  - CMS Application Multitasking
  - CMS Application Development Guide
  - OpenEdition Callable Services Reference
  - IBM C for VM/ESA Library Reference

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