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# Accessing LINUX file systems from CMS

Metropolitan VM Users Association  
January 24, 2005

# Agenda

Linux and its support of mission critical applications on z/VM has become an important part of many z/VM sites. With this has come the need for existing (and new) VM applications to be able to access Linux-based data quickly and easily. This presentation will focus on three ways VM-based applications can read and write data that resides on Linux file systems. The three methods we'll discuss today are the following:

- 1) CMS NFS client connected to a Linux NFS server
- 2) The Plumber's Workbench for Linux
- 3) The E2 ext2fs access package for CMS

We'll discuss the setup and configuration details for each of these methods as well as where they work best and any gotchas that might come up. Demos of all three methods in operation will be given as well.

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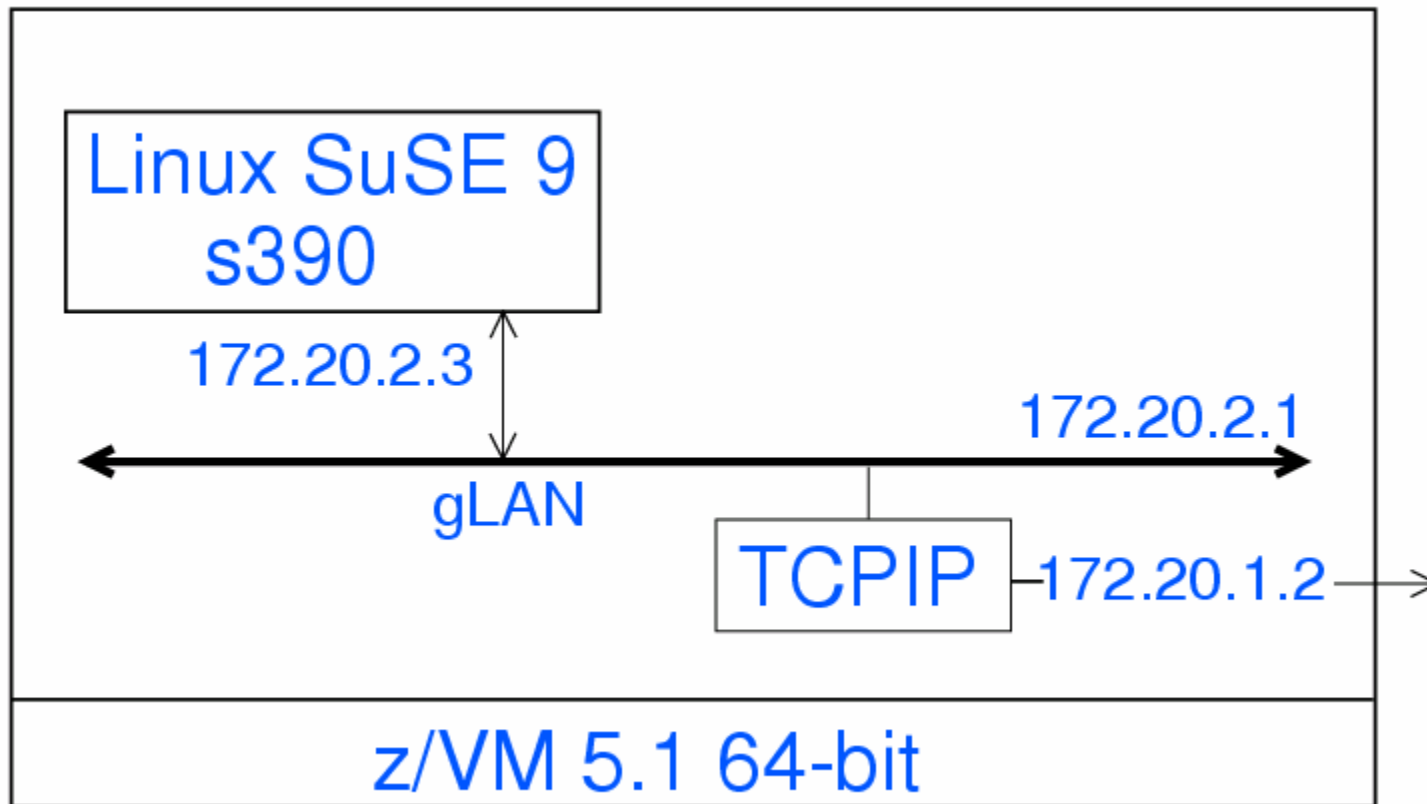
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# System Configuration



# NFS Network File System

## What's NFS (Network File System)?

A protocol developed by Sun Microsystems, and defined in RFC 1094, which allows a computer to access files over a network as if they were on its local disks. This protocol has been incorporated in products by more than two hundred companies, and is now a de facto standard. NFS is implemented using a connectionless protocol (UDP) in order to make it stateless.

# NFS Network File System

- § Most Linux distributions come with a Linux NFS server
- § Usually not installed by default (at least on SuSE distributions....). You need to explicitly select it, e.g., using YaST.
- § Configuration is straight-forward, only one file needs to be edited:
  - /etc/exports

# NFS Configuration

## § /etc/exports

- Lists file systems that NFS clients are allowed to mount, along with client export options
- Each line of /etc/exports contains a file system mount (export) point, followed by a list of clients allowed to mount that file system, separated by white space
- Each client can have a parenthesized list of NFS options immediately following
- Complete details of the /etc/exports file format and contents can be found via:

```
man exports
```

# NFS Configuration

§ Example, allowing full access to all files and directories:

```
/                *(rw,insecure,no_root_squash)
/root           *(rw,insecure,no_root_squash)
```

§ Meanings:

- “/” -- file system mount (export) point
- “\*” -- allow any client
- “insecure” -- let NFS Server use high port numbers
- “no\_root\_squash” – do not map uid 0 (root) on the client to the “anonymous” uid on the server

# NFS Configuration

§ After editing `/etc/exports`, tell Linux NFS server about it:

```
exportfs -a
```

§ Starting and stopping the NFS server:

```
§ /etc/init.d/nfs start
```

```
§ /etc/init.d/nfs stop
```

```
§ /etc/init.d/nfs status
```

```
§ /etc/init.d/nfs reload
```

```
§ /etc/init.d/nfs restart
```

# CMS NFS client

- § Independent of VM NFS Server
- § Introduced in z/VM 3.1, enhanced in z/VM 4.1 to better support Linux NFS server (localport option)
- § Mounts exported NFS file systems into the Byte File System (BFS). Therefore, there must be an BFS enabled shared file pool (SFS) server available
- § OPENVM MOUNT command does the actual mount

# CMS NFS Client

## § Syntax:

```
Openvm mount ../../NFS:host_name/path1 /path2 (options
```

§ `path1` is the exported mount point

§ `path2` is the local mount point inside the BFS

§ Note: BFS mount point can not be an external link (like “`/tmp`” on examples)

§ Note: the uid of the CMS user and the Linux file system owner should be the same

# CMS NFS Client

```
Fullscreen CMS Lines 101 - 120 of 120
Columns 1 - 79 of 81

set filepool vmsys
Ready; T=0.01/0.01 16:45:17
openvm mount ../vmbfs:vmsys:root/ /
Ready; T=0.01/0.02 16:45:33
openvm list
Directory = '/'
Update-Dt  Update-Tm  Type  Links  Bytes  Path name component
01/22/2005 16:32:57  F      1      327  '.sh_history'
07/30/2004 19:25:23  D      -      -    'bin'
07/30/2004 19:25:04  D      -      -    'dev'
07/30/2004 19:25:04  E3     -      -    'etc'
07/30/2004 19:25:04  D      -      -    'home'
07/30/2004 19:25:04  L      -      -    'lib'
01/22/2005 16:32:39  D      -      -    'mnt'
07/30/2004 19:25:04  D      -      -    'opt'
07/30/2004 19:25:04  E3     -      -    'tmp'
07/30/2004 19:25:04  L      -      -    'u'
07/30/2004 19:25:04  D      -      -    'usr'
07/30/2004 19:25:04  E3     -      -    'var'
Ready; T=0.03/0.06 16:45:38

PF1=Help      2=Pop_Msg    3=Quit       4=Clear_Top  5=Filelist   6=Retrieve
PF7=Backward  8=Forward    9=Rdrlist    10=Left      11=Right     12=Cmdline
====>
16:45:38      Enter a command or press a PF or PA key
MA b 42/009
```

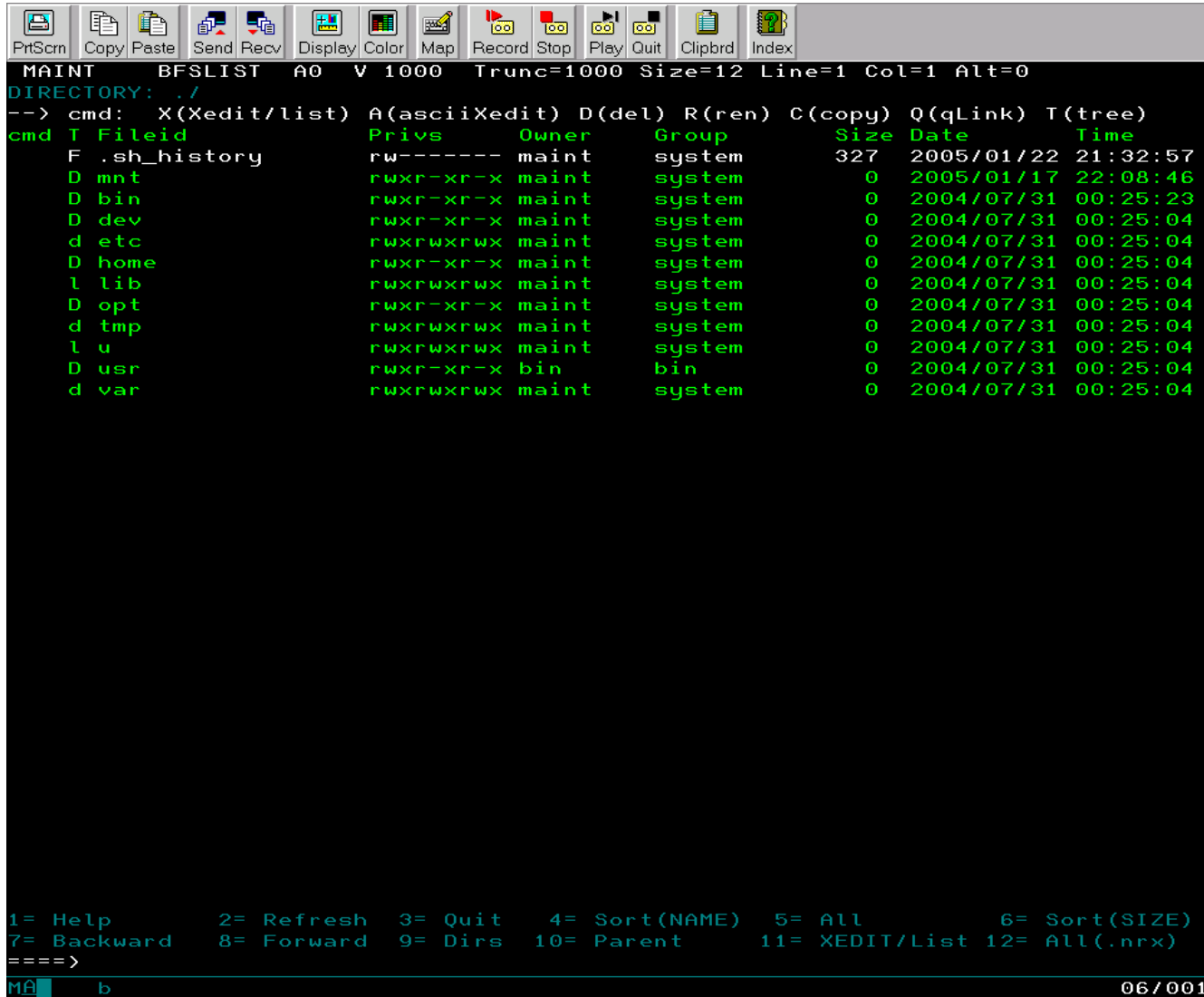
# CMS NFS Client

```
Fullcreen CMS Lines 102 - 120 of 120
Columns 1 - 79 of 81

Ready(00028); T=0.02/0.04 16:35:02
openvm mount ../nfs:172.20.2.3/ /mnt (nonetc timeout 10)
Ready; T=0.30/0.49 16:35:29
openvm list
Directory = '/'
Update-Dt  Update-Tm  Type  Links  Bytes  Path name component
01/22/2005 16:32:57  F     1      327  '.sh_history'
07/30/2004 19:25:23  D     -       -    'bin'
07/30/2004 19:25:04  D     -       -    'dev'
07/30/2004 19:25:04  E3    -       -    'etc'
07/30/2004 19:25:04  D     -       -    'home'
07/30/2004 19:25:04  L     -       -    'lib'
01/22/2005 16:32:39  D     -       -    'mnt'
07/30/2004 19:25:04  D     -       -    'opt'
07/30/2004 19:25:04  E3    -       -    'tmp'
07/30/2004 19:25:04  L     -       -    'u'
07/30/2004 19:25:04  D     -       -    'usr'
07/30/2004 19:25:04  E3    -       -    'var'
Ready; T=0.03/0.06 16:35:43

PF1=Help      2=Pop_Msg    3=Quit       4=Clear_Top  5=Filelist   6=Retrieve
PF7=Backward  8=Forward    9=Rdrlist    10=Left      11=Right     12=Cmdline
====>
16:35:44      Enter a command or press a PF or PA key
MÁ b 42/009
```

# CMS NFS Client



The screenshot shows a terminal window with a menu bar at the top containing icons for various functions: PntScr, Copy, Paste, Send, Recv, Display, Color, Map, Record, Stop, Play, Quit, Clipbrd, and Index. Below the menu bar, the terminal displays the following text:

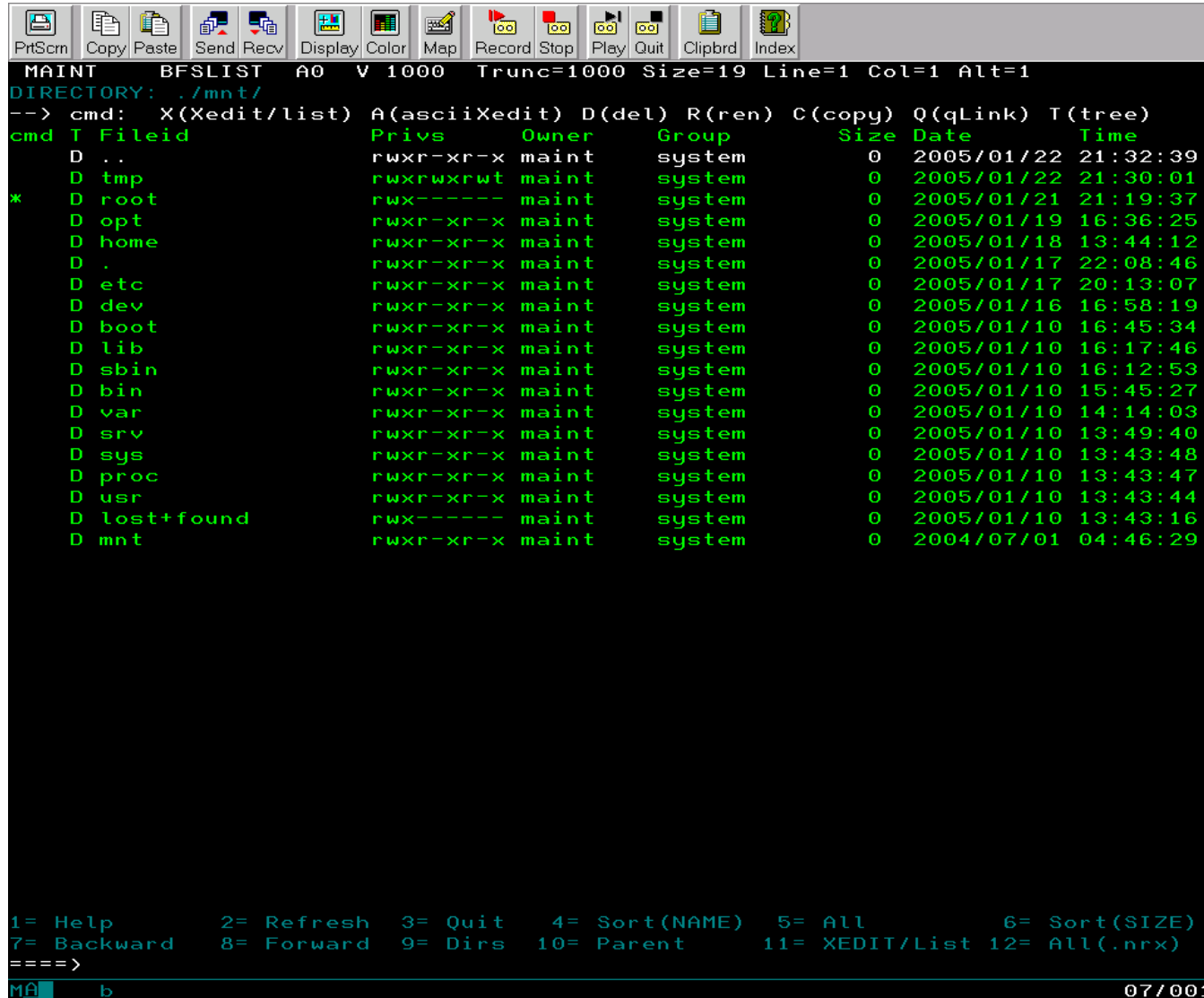
```
MAINT  BFSLIST  A0  V 1000  Trunc=1000  Size=12  Line=1  Col=1  Alt=0
DIRECTORY: ./
--> cmd: X(Xedit/list) A(asciiXedit) D(del) R(ren) C(copy) Q(qLink) T(tree)
cmd T Fileid Prvs Owner Group Size Date Time
F .sh_history rw----- maint system 327 2005/01/22 21:32:57
D mnt rwxr-xr-x maint system 0 2005/01/17 22:08:46
D bin rwxr-xr-x maint system 0 2004/07/31 00:25:23
D dev rwxr-xr-x maint system 0 2004/07/31 00:25:04
d etc rwxrwxrwx maint system 0 2004/07/31 00:25:04
D home rwxr-xr-x maint system 0 2004/07/31 00:25:04
l lib rwxrwxrwx maint system 0 2004/07/31 00:25:04
D opt rwxr-xr-x maint system 0 2004/07/31 00:25:04
d tmp rwxrwxrwx maint system 0 2004/07/31 00:25:04
l u rwxrwxrwx maint system 0 2004/07/31 00:25:04
D usr rwxr-xr-x bin bin 0 2004/07/31 00:25:04
d var rwxrwxrwx maint system 0 2004/07/31 00:25:04
```

At the bottom of the terminal, there is a legend for navigation keys:

```
1= Help      2= Refresh  3= Quit     4= Sort(NAME)  5= All      6= Sort(SIZE)
7= Backward  8= Forward  9= Dirs    10= Parent    11= XEDIT/List  12= All(.nrx)
===>
```

The status bar at the bottom left shows 'MA' and 'b', and the bottom right shows '06/001'.

# CMS NFS Client



The screenshot shows a terminal window with a menu bar at the top containing icons for PrintScreen, Copy, Paste, Send, Recv, Display, Color, Map, Record, Stop, Play, Quit, Clipbrd, and Index. Below the menu bar, the terminal displays the following text:

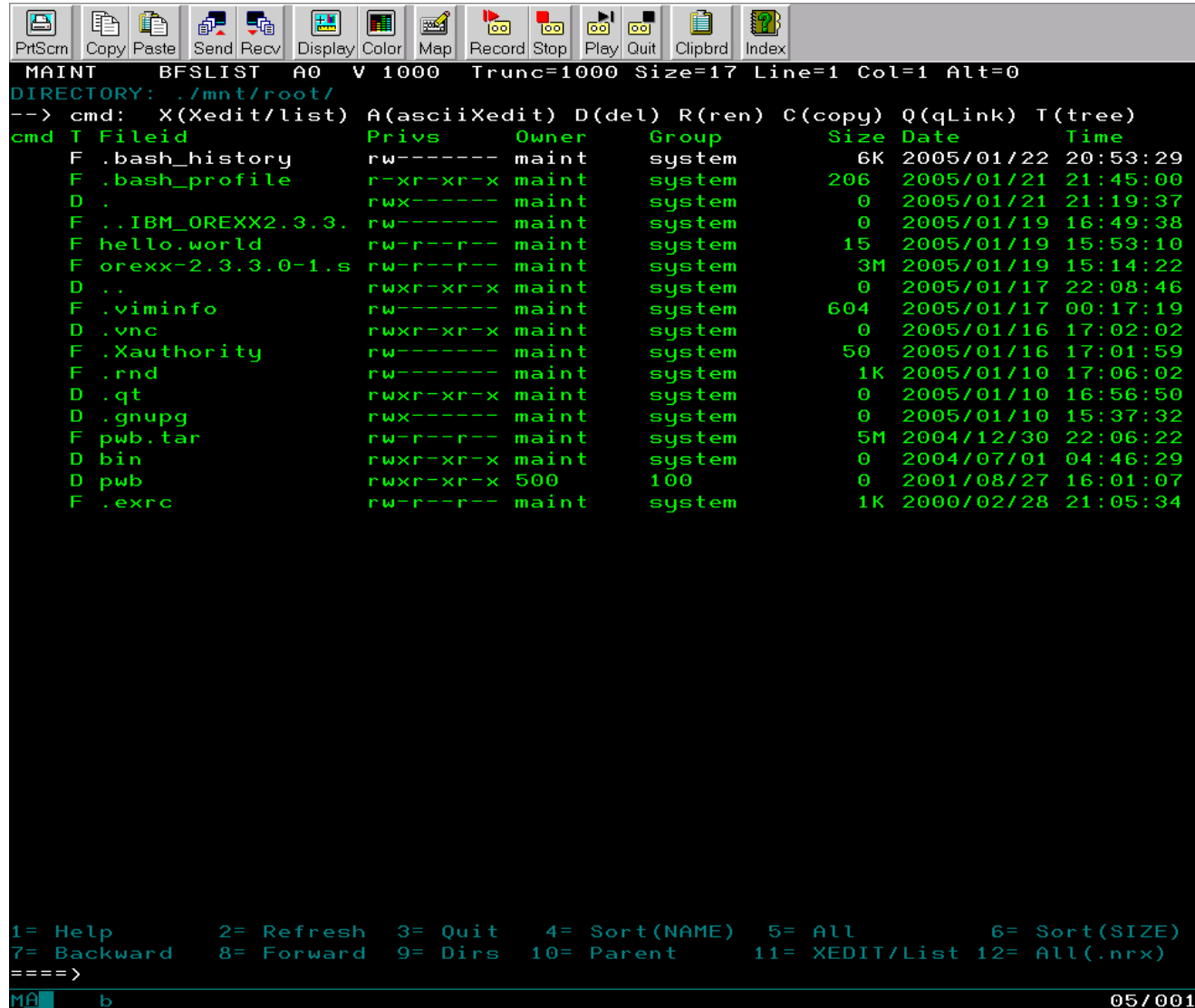
```
MAINT      BFSLIST  A0  V 1000  Trunc=1000  Size=19  Line=1  Col=1  Alt=1
DIRECTORY: ./mnt/
--> cmd: X(Xedit/list) A(asciiXedit) D(del) R(ren) C(copy) Q(qLink) T(tree)
cmd T Fileid      Privs      Owner      Group      Size      Date      Time
D .              rwxr-xr-x maint      system     0          2005/01/22 21:32:39
D tmp           rwxrwxrwt maint      system     0          2005/01/22 21:30:01
* D root        rwx----- maint      system     0          2005/01/21 21:19:37
D opt           rwxr-xr-x maint      system     0          2005/01/19 16:36:25
D home         rwxr-xr-x maint      system     0          2005/01/18 13:44:12
D .            rwxr-xr-x maint      system     0          2005/01/17 22:08:46
D etc          rwxr-xr-x maint      system     0          2005/01/17 20:13:07
D dev          rwxr-xr-x maint      system     0          2005/01/16 16:58:19
D boot         rwxr-xr-x maint      system     0          2005/01/10 16:45:34
D lib          rwxr-xr-x maint      system     0          2005/01/10 16:17:46
D sbin         rwxr-xr-x maint      system     0          2005/01/10 16:12:53
D bin          rwxr-xr-x maint      system     0          2005/01/10 15:45:27
D var          rwxr-xr-x maint      system     0          2005/01/10 14:14:03
D srv          rwxr-xr-x maint      system     0          2005/01/10 13:49:40
D sys          rwxr-xr-x maint      system     0          2005/01/10 13:43:48
D proc         rwxr-xr-x maint      system     0          2005/01/10 13:43:47
D usr          rwxr-xr-x maint      system     0          2005/01/10 13:43:44
D lost+found  rwx----- maint      system     0          2005/01/10 13:43:16
D mnt         rwxr-xr-x maint      system     0          2004/07/01 04:46:29
```

At the bottom of the terminal, there is a legend for navigation keys:

```
1= Help      2= Refresh  3= Quit     4= Sort(NAME)  5= All      6= Sort(SIZE)
7= Backward  8= Forward  9= Dirs     10= Parent     11= XEDIT/List 12= All(.nrx)
====>
```

The terminal prompt is MA and the cursor is at the end of the line.

# CMS NFS Client

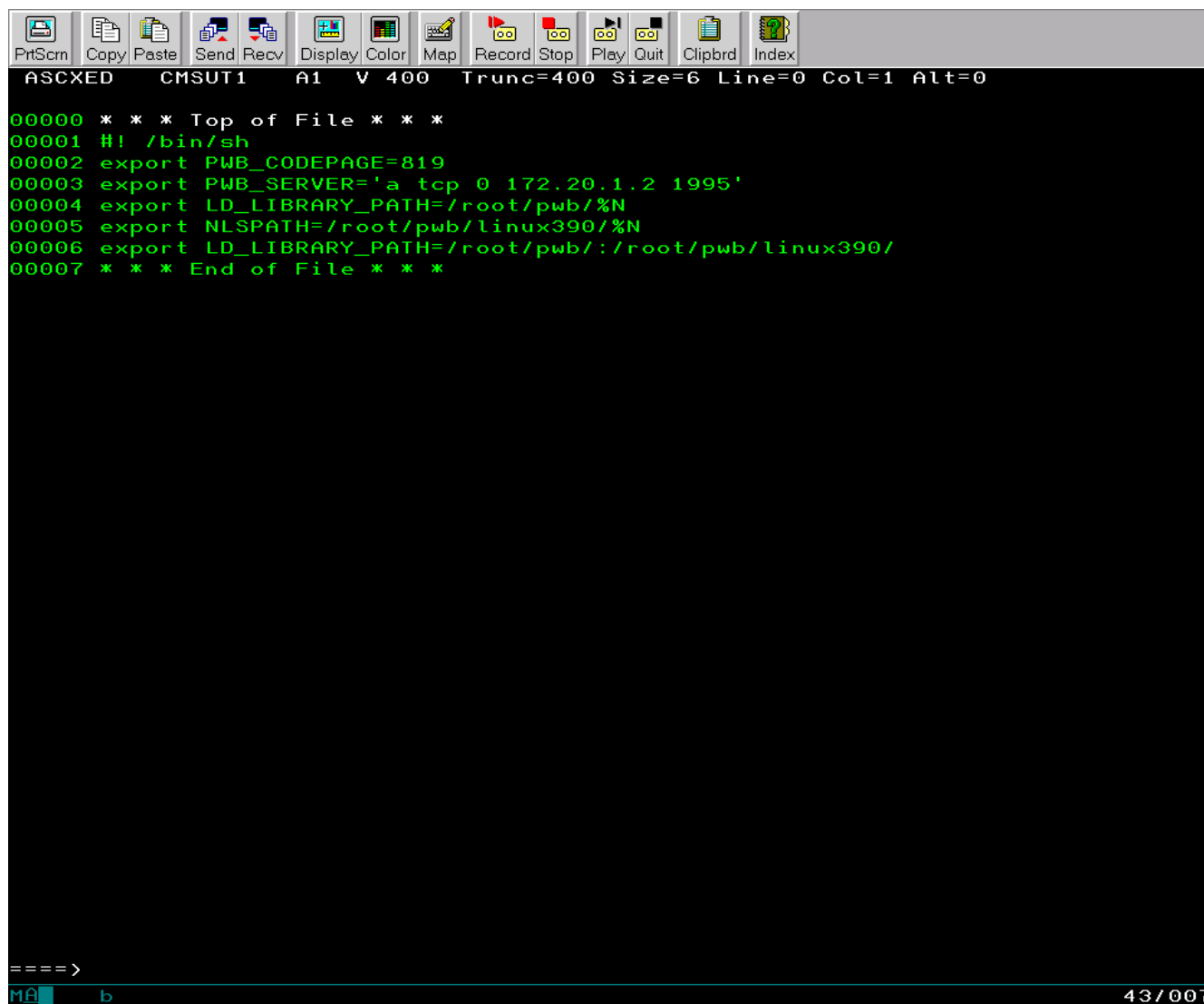


The screenshot shows a terminal window with a menu bar at the top containing icons for various functions like Print Screen, Copy, Paste, Send, Recv, Display, Color, Map, Record, Stop, Play, Quit, Clipbrd, and Index. The terminal content is as follows:

```
MAINT BFSLIST A0 V 1000 Trunc=1000 Size=17 Line=1 Col=1 Alt=0
DIRECTORY: ./mnt/root/
--> cmd: X(Xedit/list) A(asciiXedit) D(del) R(ren) C(copy) Q(qLink) T(tree)
cmd T Fileid Privs Owner Group Size Date Time
F .bash_history rw----- maint system 6K 2005/01/22 20:53:29
F .bash_profile r-xr-xr-x maint system 206 2005/01/21 21:45:00
D . rwx----- maint system 0 2005/01/21 21:19:37
F ..IBM_OREXX2.3.3. rw----- maint system 0 2005/01/19 16:49:38
F hello.world rw-r--r-- maint system 15 2005/01/19 15:53:10
F orexx-2.3.3.0-1.s rw-r--r-- maint system 3M 2005/01/19 15:14:22
D . rwxr-xr-x maint system 0 2005/01/17 22:08:46
F .viminfo rw----- maint system 604 2005/01/17 00:17:19
D .vnc rwxr-xr-x maint system 0 2005/01/16 17:02:02
F .Xauthority rw----- maint system 50 2005/01/16 17:01:59
F .rnd rw----- maint system 1K 2005/01/10 17:06:02
D .qt rwxr-xr-x maint system 0 2005/01/10 16:56:50
D .gnupg rwx----- maint system 0 2005/01/10 15:37:32
F pwb.tar rw-r--r-- maint system 5M 2004/12/30 22:06:22
D bin rwxr-xr-x maint system 0 2004/07/01 04:46:29
D pwb rwxr-xr-x 500 100 0 2001/08/27 16:01:07
F .exrc rw-r--r-- maint system 1K 2000/02/28 21:05:34

1= Help 2= Refresh 3= Quit 4= Sort(NAME) 5= All 6= Sort(SIZE)
7= Backward 8= Forward 9= Dirs 10= Parent 11= XEDIT/List 12= All(.nrx)
====>
MA b 05/001
```

# CMS NFS Client



The screenshot shows a terminal window with a menu bar at the top containing icons for various functions: PntScr, Copy, Paste, Send, Recv, Display, Color, Map, Record, Stop, Play, Quit, Clipbrd, and Index. Below the menu bar, the terminal displays the following text:

```
ASCXED CMSUT1 A1 V 400 Trunc=400 Size=6 Line=0 Col=1 Alt=0  
  
00000 * * * Top of File * * *  
00001 #! /bin/sh  
00002 export PWB_CODEPAGE=819  
00003 export PWB_SERVER='a tcp 0 172.20.1.2 1995'  
00004 export LD_LIBRARY_PATH=/root/pwb/%N  
00005 export NLSPATH=/root/pwb/linux390/%N  
00006 export LD_LIBRARY_PATH=/root/pwb/:/root/pwb/linux390/  
00007 * * * End of File * * *
```

At the bottom left of the terminal, there is a cursor prompt "====>" and a status bar showing "MÂ b". At the bottom right, the page number "43/007" is displayed.

# CMS NFS Client

```

MAINT  BFSLIST  A0  V 1000  Trunc=1000  Size=17  Line=1  Col=1  Alt=6
DIRECTORY: ./mnt/root/
> cmd: X(Xedit/List)  A(asciiXedit)  D(del)  R(ren)  C(copy)  Q(qlink)  T(tree)
cmd: l Fileid      Prior      Owner      Group      Size      Date      Time
* F .bash_history  rw----- maint      system     6K        2005/01/22 20:53:29
* F .bash_profile  rwxr-xr-x maint      system     206       2005/01/21 21:45:00
D .               rw----- maint      system     0         2005/01/21 21:19:37
F ..IBM.OREXX2.3.3.  rw----- maint      system     0         2005/01/19 16:49:38
* F hello.world    *--deleted--*
F orexx-2.3.3.0-1.a  rw-r--r-- maint      system     3M        2005/01/19 15:14:22
D ..             rwxr-xr-x maint      system     0         2005/01/17 22:08:46
F .viminfo        rw----- maint      system     604       2005/01/17 00:17:19
D .vnc           rwxr-xr-x maint      system     0         2005/01/16 17:02:02
F .Xauthority     rw        maint      system     50        2005/01/16 17:01:59
F .rnd            rw        maint      system     1K        2005/01/10 17:00:02
D .qt             rwxr-xr-x maint      system     0         2005/01/10 16:56:50
D .gnupg          rwx       maint      system     0         2005/01/10 15:37:32
F pub.tar         rw-r--r-- maint      system     5M        2004/12/30 22:06:22
D bin            rwxr-xr-x maint      system     0         2004/07/01 04:46:29
D pub            rwxr-xr-x b00       100       0         2001/08/27 16:01:07
F .lock          rw-r--r-- maint      system     1K        2000/02/28 21:06:34

1 Help          2 Refresh      3 Quit        4 Sort(NAME)  5 All          6 Sort(SIZE)
7 Backward     8 Forward     9 Dirs       10 Parent     11 XEDIT/List 12 All(.rnx)
>
M0 b
09/001
  
```

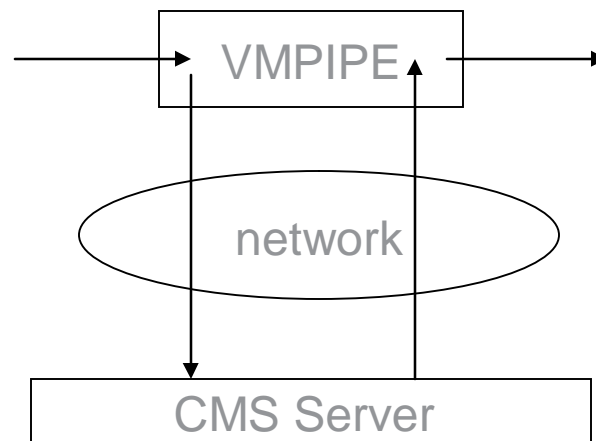
# CMS NFS Client

- § BFSLIST and BFSTREE are your friends
- § CMS Pipelines can process data made available via NFS mounts
- § Works even with Linux systems running on other platforms...workstations, etc.
- § Works with any Linux file system
- § Must have the TCP/IP network up, and the Linux NFS Server running

# Plumber's Workbench

## § What is it?

- A workstation application with a CMS Pipelines server in the basement
- Originally done by John Hartmann for an ITSO project
- First implementation was for OS/2



# Plumber's Workbench

## § PWB available from:

- <http://home.iae.nl/users/revdheij/pwb.tar.Z>

## § Includes the workstation agents for:

§ OS/2 (and eCS 1.x)

§ Windows NT (and 2000)

§ AIX

§ Intel Linux

§ Linux390

## § PWB components for CMS are available at:

- <http://vm.marist.edu/~pipeline/#PWB>

# Plumber's Workbench

## § Other Requirements:

- Rexx on the workstation
  - § Standard Rexx on OS/2
  - § Linux requires IBM's ObjectRexx
  - § Windows NT also requires IBM's ObjectRexx
- However, IBM turned ObjectRexx over to the Rexx Language Association (RexxLA) as an open source project at the end of 2004. Look for ObjectRexx from RexxLA "soon".....
- A working TCP/IP connection and an available port number

# Plumber's Workbench

## § Configuration—

### - On Linux

- export PWB\_CODEPAGE=819
- export PWB\_SERVER='a tcp 0 172.20.1.2 1995'
- export NLSPATH=/root/pwb/linux390/%N
- export LD\_LIBRARY\_PATH=/root/pwb:/root/pwb/linux390/

### - On VM

- PWB CLIENTS file:
  - § a tcp 172.20.2.3 \*
- PWB SERVER
  - § tcp 1995

# Plumber's Workbench

- § PWB server is run in a CMS user id
- § The workstation client is the “vmpipe” command
- § vmpipe takes a pipeline specification as an argument (like CMS pipes)
- § vmpipe's stdin and stdout are connected to CMS PWB server
- § stdin is sent to CMS, output of pipeline is sent back to stdout

# Plumber's Workbench

## § Examples:

```
§ vmpipe /cmd query cmslevel
```

```
§ vmpipe `append < profile exec`
```

```
§ ls | `vmpipe sort fs | pad 20 | join 3`
```

- Warning: both the Linux bash shell and vmpipe use the same special characters...this can lead to “unexpected” results.

# Plumber's Workbench

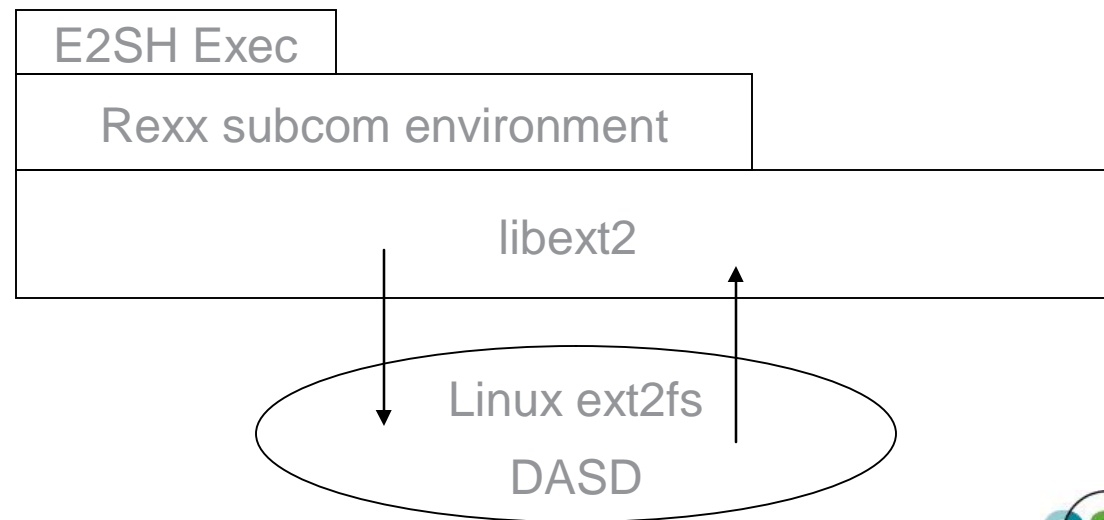
## § Some problems:

- § Linux/390 isn't really a single user workstation (unlike OS/2 or Windows).
- § There are security implications...the VM PWB server does not verify the actual user making the connection from the Linux guest, so any Linux user can access the server.
- § Large parts of the PWB client are written in Rexx; not a problem for OS/2 workstations, but an impediment for Linux and Windows clients
- § Some bugs with ObjectRexx on Linux can cause the PWB to fail

# E2 Direct ext2fs Access

## § What's E2?

- It's a port (by Leland Lucius) of the Linux/390 `libext2fs` file system code to native CMS
- It consists of three parts: the library itself, a Rexx subcommand handler, and a Rexx "shell" exec



# E2 Interface

§ The E2SH exec is the primary user interface. It implements, using standard Linux-style syntax, a number of common file system commands.

- `cat`, `ls`, `chmod`, `rm`, `pwd`, `touch`, etc.

§ Based on the Rexx interface described in the IBM publication: *Using Rexx and z/OS Unix System Services*

§ Exec sets up Rexx subcommand environment named *e2cmd*, which invokes `libext2` functions (`stat`, `write`, `readfile`, `open`, etc.)

# E2 Commands

## § Currently supported commands include:

cat, cd, chgrp, chown, cp, df,

get (get a file from Linux to CMS)

Help, ln, ls, mkdir, mkfifo, mknod, mv

put (opposite of get)

Pwd, quit, rm, rmdir, touch umask, xedit

## § Most common command options are supported as well.

# E2 Caveats and hints

- § Linux disks **must be** linked to CMS user id in “write-mode”, even if you just want to view files.  
(why? If you just browse a file, libext2 updates fields in the file `inode`, such as last access date/time.)
- § If Linux guest is active, it must `umount` the file system before E2 can access it. Best if Linux guest is completely logged off
- § E2 will not automatically follow mount points that reside on other minidisks (e.g., `/usr` on a different minidisk)

## E2 Caveats and hints

- § E2 should work with ext3fs file systems as well, since they are stored on disk as ext2fs.
- § The Rexx subcommand interface calls C routines using the LE “pre-init” interface for performance.
- § Not all file system functions thoroughly tested.
- § But will work when Linux image can't be started, or there is no network.
- § Ext2fs file systems stored in CMS files can be processed as well

# E2 Examples

```
PrtScr Copy Paste Send Recv Display Color Map Record Stop Play Quit Clipbrd Index
Saturday 22 Jan 2005 (05022) IS System CMS DAVE@ZVMV5R10
Ready; T=0.01/0.01 21:44:40
link r1 150 150 mw
Ready; T=0.01/0.01 21:44:44
e2sh /dev/dasd/150/part1
[/]#
pwd
/
[/]#
ls
drwxr-xr-x 2 0 0 4096 04/04/2002 21:25 bin
drwxr-xr-x 5 0 0 4096 06/21/2002 19:10 boot
lrwxrwxrwx 1 0 0 12 04/04/2002 19:45 cdrom -> /media/cdrom
drwxr-xr-x 6 0 0 12288 01/24/2004 18:08 dev
drwxr-xr-x 32 0 0 4096 08/30/2004 15:36 etc
lrwxrwxrwx 1 0 0 13 04/04/2002 19:45 floppy -> /media/floppy
drwxr-xr-x 2 0 0 4096 04/04/2002 19:45 home
drwxr-xr-x 6 0 0 4096 04/04/2002 21:25 lib
drwxr-xr-x 2 0 0 16384 04/04/2002 19:30 lost+found
drwxr-xr-x 4 0 0 4096 04/04/2002 19:45 media
drwxr-xr-x 2 0 0 4096 04/04/2002 19:45 mnt
lrwxrwxrwx 1 0 0 9 04/04/2002 19:42 opt -> ./usr/opt
dr-xr-xr-x 2 0 0 4096 04/04/2002 19:45 proc
drwx----- 12 0 0 4096 05/20/2003 20:07 root
drwxr-xr-x 4 0 0 4096 04/06/2002 15:39 sbin
drwxrwxrwt 32 0 0 4096 11/24/2003 16:30 tmp
drwxr-xr-x 2 0 0 4096 04/04/2002 19:42 usr
drwxr-xr-x 18 0 0 4096 04/04/2002 21:26 var
[/]#

PF1=Help      2=Pop_Msg    3=Quit       4=filelist   5=infolist   6=Retrieve
PF7=backward  8=forward    9=Rdrlist    10=left      11=right     12=Cmdline
===>
21:45:47 Enter your response in vscreen CMS
MÁ a 42/009
```

# E2 Examples

```

Saturday 22 Jan 2005 (05022) IS System      CMS      DAVE@ZVMV5R10

[/]#
cd root
[/root/]#
ls
drwxr-xr-x  2  0  0      4096 04/04/2002 19:45 bin
-rwxr-xr-x  1  0  0      1137 07/10/2002 17:37 chsrp.sh
-rwxr-xr-x  1  0  0      1137 07/10/2002 17:40 chsrp-hsi1.sh
drwxr-xr-x  3 500 500     4096 08/22/2002 19:32 cpint-1.1.2
-rw-r--r--  1  0  0     307200 04/05/2002 16:33 cpint-1.1.2.tar.tar
drwxr-sr-x  9 1000 1000    4096 06/05/2002 17:07 cprof-1.0.1
-rw-r--r--  1  0  0     23360 04/05/2002 16:36 daev.rpm
-rw-r--r--  1  0  0    134761 06/21/2002 21:25 ipchains.spm
-rw-r--r--  1  0  0    294968 06/21/2002 21:05 iptables-1.2.6a.tar.bz2
-rw-r--r--  1  0  0    2690982 06/21/2002 17:43 k_deflt.rpm
-rw-r--r--  1  0  0    2722252 06/21/2002 17:44 k_timer.rpm
drwxr-xr-x  7  500 500     4096 05/20/2003 19:37 keepalived-1.0.3
-rw-r--r--  1  0  0    28771743 06/21/2002 17:44 kernel-source.rpm
-rw-r--r--  1  0  0     697950 04/18/2003 20:22 openssl-devel.rpm
-rw-r--r--  1 4388 4388    70184 06/17/2002 15:07 qdio-2.4.7-s390-9-timer.o
-rw-r--r--  1 4388 4388   158860 06/17/2002 15:07 qeth-2.4.7-s390-9-timer.o
-r--r--r--  1  0  0    1788585 05/20/2003 20:09 sendmail.spm
-rw-r--r--  1  0  0    100923 07/09/2002 21:09 vrrpd-current.tgz
-rwxr-xr-x  1  0  0     7621 12/23/2002 22:09 vrt.sh
-rwxr-xr-x  1  0  0     7613 12/23/2002 22:02 vrt.sh°
-rw-r--r--  1  0  0    20480 12/03/2002 05:02 vrt.tbz
-rwxr-xr-x  1  0  0     7513 12/23/2002 21:51 vrt-0.3.1-b0rken.sh
-rw-r--r--  1  0  0    288697 06/05/2002 14:55 AUTOCONF.RPM
-rw-r--r--  1  0  0    288482 06/05/2002 14:55 AUTOMAKE.RPM
-rw-r--r--  1  0  0     33 01/23/2005 03:02 DAVE3
-rwxrwxr-x  1 4388 4388    3619 06/17/2002 15:35 LICENSE
-rwxrwxr-x  1 4388 4388     223 06/17/2002 15:35 README
drwxr-xr-x  2  0  0     4096 04/05/2002 21:16 TSM
[/root/]#

PF1=Help      2=Pop_Msg    3=Quit      4=filelist   5=infolist   6=Retrieve
PF7=backward  8=forward    9=Rdrlist   10=left      11=right     12=Cmdline
====>
22:05:00
Enter your response in vscreen CMS
Mâ a 42/009
```

# E2 Examples

```

Saturday 22 Jan 2005 (05022) IS System CMS DAVE@ZVMV5R10
-rw-r--r-- 1 0 0 294968 06/21/2002 21:05 iptables-1.2.6a.tar.bz2
-rw-r--r-- 1 0 0 2690982 06/21/2002 17:43 k_deflt.rpm
-rw-r--r-- 1 0 0 2722252 06/21/2002 17:44 k_timer.rpm
drwxr-xr-x 7 500 500 4096 05/20/2003 19:37 keepalived-1.0.3
-rw-r--r-- 1 0 0 28771743 06/21/2002 17:44 kernel-source.rpm
-rw-r--r-- 1 0 0 697950 04/18/2003 20:22 openssl-devel.rpm
-rw-r--r-- 1 4388 4388 70184 06/17/2002 15:07 qdio-2.4.7-s390-9-timer.o
-rw-r--r-- 1 4388 4388 158860 06/17/2002 15:07 qeth-2.4.7-s390-9-timer.o
-r--r--r-- 1 0 0 1788585 05/20/2003 20:09 sendmail.spm
-rw-r--r-- 1 0 0 100923 07/09/2002 21:09 vrrpd-current.tgz
-rwxr-xr-x 1 0 0 7621 12/23/2002 22:09 vrt.sh
-rwxr-xr-x 1 0 0 7613 12/23/2002 22:02 vrt.sh^
-rw-r--r-- 1 0 0 20480 12/03/2002 05:02 vrt.tbz
-rwxr-xr-x 1 0 0 7513 12/23/2002 21:51 vrt-0.3.1-b0rken.sh
-rw-r--r-- 1 0 0 288697 06/05/2002 14:55 AUTOCONF.RPM
-rw-r--r-- 1 0 0 288482 06/05/2002 14:55 AUTOMAKE.RPM
-rw-r--r-- 1 0 0 33 01/23/2005 03:02 DAVE3
-rwxrwxr-x 1 4388 4388 3619 06/17/2002 15:35 LICENSE
-rwxrwxr-x 1 4388 4388 223 06/17/2002 15:35 README
drwxr-xr-x 2 0 0 4096 04/05/2002 21:16 TSM
[/root/]#
x DAVE3
[/root/]#
cat DAVE3
a line of data
so more text here
[/root/]#
x DAVE3
[/root/]#
cat DAVE3
a line of data
some more data
inserted here
a blank lin

so more text here
[/root/]#
PF1=Help 2=Pop_Msg 3=Quit 4=filelist 5=infolist 6=Retrieve
PF7=backward 8=forward 9=Rdrlist 10=left 11=right 12=Cmdline
====>
22:05:52 Enter your response in vscreen CMS
MA a 42/009
```

# E2 Examples

```
Saturday 22 Jan 2005 (05022) IS System CMS DAVE@ZVMV5R10
Ready; T=0.01/0.01 22:07:38
type dave3 data

a line of data
some more data
inserted here
a blank lin

even more data adfded here
and here
so more text here

Ready; T=0.01/0.02 22:07:47
e2sh /dev/dasd/150/part1
[/root/]#
cat DAVE3
a line of data
some more data
inserted here
a blank lin

so more text here
[/root/]#
put -a -n dave3 -t data -m a DAVE3
put: Replace DAVE3? (Y,N,A,?)
Y
[/root/]#
cat DAVE3
a line of data
some more data
inserted here
a blank lin

even more data adfded here
and here
so more text here
[/root/]#
PF1=Help      2=Pop_Msg    3=Quit      4=filelist  5=infolist  6=Retrieve
PF7=backward  8=forward   9=Rdrlist  10=left    11=right   12=Cmdline
====>
22:08:30 Enter your response in vscreen CMS
MA a 42/009
```

# E2 Examples

```

PrtScrn Copy Paste Send Recv Display Color Map Record Stop Play Quit Clipbrd Index
Saturday 22 Jan 2005 (05022) IS System CMS DAVE@ZVMV5R10

even more data adfded here
and here
so more text here
[/root/]#
ls
drwxr-xr-x 2 0 0 4096 04/04/2002 19:45 bin
-rwxr-xr-x 1 0 0 1137 07/10/2002 17:37 chsrp.sh
-rwxr-xr-x 1 0 0 1137 07/10/2002 17:40 chsrp-hsi1.sh
drwxr-xr-x 3 500 500 4096 08/22/2002 19:32 cpint-1.1.2
-rw-r--r-- 1 0 0 307200 04/05/2002 16:33 cpint-1.1.2.tar.tar
drwxr-sr-x 9 1000 1000 4096 06/05/2002 17:07 cprof-1.0.1
-rw-r--r-- 1 0 0 23360 04/05/2002 16:36 daev.rpm
-rw-r----- 1 0 0 134761 06/21/2002 21:25 ipchains.spm
-rw-r--r-- 1 0 0 294968 06/21/2002 21:05 iptables-1.2.6a.tar.bz2
-rw-r--r-- 1 0 0 2690982 06/21/2002 17:43 k_deflt.rpm
-rw-r--r-- 1 0 0 2722252 06/21/2002 17:44 k_timer.rpm
drwxr-xr-x 7 500 500 4096 05/20/2003 19:37 keepalived-1.0.3
-rw-r--r-- 1 0 0 28771743 06/21/2002 17:44 kernel-source.rpm
-rw-r----- 1 0 0 697950 04/18/2003 20:22 openssl-devel.rpm
-rw-r--r-- 1 4388 4388 70184 06/17/2002 15:07 qdio-2.4.7-s390-9-timer.o
-rw-r--r-- 1 4388 4388 158860 06/17/2002 15:07 qeth-2.4.7-s390-9-timer.o
-r--r--r-- 1 0 0 1788585 05/20/2003 20:09 sendmail.spm
-rw-r--r-- 1 0 0 100923 07/09/2002 21:09 vrrpd-current.tgz
-rwxr-xr-x 1 0 0 7621 12/23/2002 22:09 vrt.sh
-rwxr-xr-x 1 0 0 7613 12/23/2002 22:02 vrt.sh°
-rw-r--r-- 1 0 0 20480 12/03/2002 05:02 vrt.tbz
-rwxr-xr-x 1 0 0 7513 12/23/2002 21:51 vrt-0.3.1-b0rken.sh
-rw-r--r-- 1 0 0 288697 06/05/2002 14:55 AUTOCONF.RPM
-rw-r--r-- 1 0 0 288482 06/05/2002 14:55 AUTOMAKE.RPM
-rw-r--r-- 1 0 0 112 01/23/2005 03:08 DAVE3
-rwxrwxr-x 1 4388 4388 3619 06/17/2002 15:35 LICENSE
-rwxrwxr-x 1 4388 4388 223 06/17/2002 15:35 README
drwxr-xr-x 2 0 0 4096 04/05/2002 21:16 TSM
[/root/]#
rm DAVE3
[/root/]#
PF1=Help 2=Pop_Msg 3=Quit 4=filelist 5=infolist 6=Retrieve
PF7=backward 8=forward 9=Rdrlist 10=left 11=right 12=Cmdline
====>
22:08:51 Enter your response in vscreen CMS
MA a 42/009
```

# E2 Examples

```

PtScrn Copy Paste Send Recv Display Color Map Record Stop Play Quit Clipbrd Index
Saturday 22 Jan 2005 (05022) IS System CMS DAVE@ZVMV5R10
-rw-r--r-- 1 0 0 288482 06/05/2002 14:55 AUTOMAKE.RPM
-rw-r--r-- 1 0 0 112 01/23/2005 03:08 DAVE3
-rwxrwxr-x 1 4388 4388 3619 06/17/2002 15:35 LICENSE
-rwxrwxr-x 1 4388 4388 223 06/17/2002 15:35 README
drwxr-xr-x 2 0 0 4096 04/05/2002 21:16 TSM
[/root/]#
rm DAVE3
[/root/]#
ls
drwxr-xr-x 2 0 0 4096 04/04/2002 19:45 bin
-rwxr-xr-x 1 0 0 1137 07/10/2002 17:37 chsrp.sh
-rwxr-xr-x 1 0 0 1137 07/10/2002 17:40 chsrp-hsi1.sh
drwxr-xr-x 3 500 500 4096 08/22/2002 19:32 cpint-1.1.2
-rw-r--r-- 1 0 0 307200 04/05/2002 16:33 cpint-1.1.2.tar.tar
drwxr-sr-x 9 1000 1000 4096 06/05/2002 17:07 cprof-1.0.1
-rw-r--r-- 1 0 0 23360 04/05/2002 16:36 daev.rpm
-rw-r----- 1 0 0 134761 06/21/2002 21:25 ipchains.spm
-rw-r--r-- 1 0 0 294968 06/21/2002 21:05 iptables-1.2.6a.tar.bz2
-rw-r--r-- 1 0 0 2690982 06/21/2002 17:43 k_deflt.rpm
-rw-r--r-- 1 0 0 2722252 06/21/2002 17:44 k_timer.rpm
drwxr-xr-x 7 500 500 4096 05/20/2003 19:37 keepalived-1.0.3
-rw-r--r-- 1 0 0 28771743 06/21/2002 17:44 kernel-source.rpm
-rw-r----- 1 0 0 697950 04/18/2003 20:22 openssl-devel.rpm
-rw-r--r-- 1 4388 4388 70184 06/17/2002 15:07 qdio-2.4.7-s390-9-timer.o
-rw-r--r-- 1 4388 4388 158860 06/17/2002 15:07 qeth-2.4.7-s390-9-timer.o
-r--r--r-- 1 0 0 1788585 05/20/2003 20:09 sendmail.spm
-rw-r--r-- 1 0 0 100923 07/09/2002 21:09 vrrpd-current.tgz
-rwxr-xr-x 1 0 0 7621 12/23/2002 22:09 vrt.sh
-rwxr-xr-x 1 0 0 7613 12/23/2002 22:02 vrt.sh°
-rw-r--r-- 1 0 0 20480 12/03/2002 05:02 vrt.tbz
-rwxr-xr-x 1 0 0 7513 12/23/2002 21:51 vrt-0.3.1-b0rken.sh
-rw-r--r-- 1 0 0 288697 06/05/2002 14:55 AUTOCONF.RPM
-rw-r--r-- 1 0 0 288482 06/05/2002 14:55 AUTOMAKE.RPM
-rwxrwxr-x 1 4388 4388 3619 06/17/2002 15:35 LICENSE
-rwxrwxr-x 1 4388 4388 223 06/17/2002 15:35 README
drwxr-xr-x 2 0 0 4096 04/05/2002 21:16 TSM
[/root/]#
PF1=Help 2=Pop_Msg 3=Quit 4=filelist 5=infolist 6=Retrieve
PF7=backward 8=forward 9=Rdrlist 10=left 11=right 12=Cmdline
====>
22:09:09 Enter your response in vscreen CMS
MÁ a 42/009
```

# E2 Examples

```
PrtScr Copy Paste Send Recv Display Color Map Record Stop Play Quit Clipbrd Index
Saturday 22 Jan 2005 (05022) IS System CMS DAVE@ZVMV5R10
-rw-r--r-- 1 0 0 288697 06/05/2002 14:55 AUTOCONF.RPM
-rw-r--r-- 1 0 0 288482 06/05/2002 14:55 AUTOMAKE.RPM
-rwxrwxr-x 1 4388 4388 3619 06/17/2002 15:35 LICENSE
-rwxrwxr-x 1 4388 4388 223 06/17/2002 15:35 README
drwxr-xr-x 2 0 0 4096 04/05/2002 21:16 TSM
[/root/]#
chmod +x daev.rpm
[/root/]#
ls
drwxr-xr-x 2 0 0 4096 04/04/2002 19:45 bin
-rwxr-xr-x 1 0 0 1137 07/10/2002 17:37 chsrp.sh
-rwxr-xr-x 1 0 0 1137 07/10/2002 17:40 chsrp-hsi1.sh
drwxr-xr-x 3 500 500 4096 08/22/2002 19:32 cpint-1.1.2
-rw-r--r-- 1 0 0 307200 04/05/2002 16:33 cpint-1.1.2.tar.tar
drwxr-sr-x 9 1000 1000 4096 06/05/2002 17:07 cprof-1.0.1
-rwxr-xr-x 1 0 0 23360 04/05/2002 16:36 daev.rpm
-rw-r----- 1 0 0 134761 06/21/2002 21:25 ipchains.spm
-rw-r--r-- 1 0 0 294968 06/21/2002 21:05 iptables-1.2.6a.tar.bz2
-rw-r--r-- 1 0 0 2690982 06/21/2002 17:43 k_deflt.rpm
-rw-r--r-- 1 0 0 2722252 06/21/2002 17:44 k_timer.rpm
drwxr-xr-x 7 500 500 4096 05/20/2003 19:37 keepalived-1.0.3
-rw-r--r-- 1 0 0 28771743 06/21/2002 17:44 kernel-source.rpm
-rw-r----- 1 0 0 697950 04/18/2003 20:22 openssl-devel.rpm
-rw-r--r-- 1 4388 4388 70184 06/17/2002 15:07 qdio-2.4.7-s390-9-timer.o
-rw-r--r-- 1 4388 4388 158860 06/17/2002 15:07 qeth-2.4.7-s390-9-timer.o
-r--r--r-- 1 0 0 1788585 05/20/2003 20:09 sendmail.spm
-rw-r--r-- 1 0 0 100923 07/09/2002 21:09 vrrpd-current.tgz
-rwxr-xr-x 1 0 0 7621 12/23/2002 22:09 vrt.sh
-rwxr-xr-x 1 0 0 7613 12/23/2002 22:02 vrt.sh^
-rw-r--r-- 1 0 0 20480 12/03/2002 05:02 vrt.tbz
-rwxr-xr-x 1 0 0 7513 12/23/2002 21:51 vrt-0.3.1-b0rken.sh
-rw-r--r-- 1 0 0 288697 06/05/2002 14:55 AUTOCONF.RPM
-rw-r--r-- 1 0 0 288482 06/05/2002 14:55 AUTOMAKE.RPM
-rwxrwxr-x 1 4388 4388 3619 06/17/2002 15:35 LICENSE
-rwxrwxr-x 1 4388 4388 223 06/17/2002 15:35 README
drwxr-xr-x 2 0 0 4096 04/05/2002 21:16 TSM
[/root/]#
PF1=Help 2=Pop_Msg 3=Quit 4=filelist 5=infolist 6=Retrieve
PF7=backward 8=forward 9=Rdrlist 10=left 11=right 12=Cmdline
====>
22:09:47 Enter your response in vscreen CMS
Mâ a 42/009
```

# Credit....where credit is due

## § NFS

§ Adam Thornton (SNA), Rick Troth (BMC), Rob van der Heij (IBM), Kris Buelens (IBM)

## § Plumber's Workbench

§ John Hartmann (IBM), Rob van der Heij (IBM)

## § E2

§ Leland Lucius (ECO), Michael Donovan (IBM), Adam Thornton (SNA)

## § General

§ Brian Jagos (CA)

# References

- § *Using Rexx and z/OS Unix System Services* (IBM SA22-7806)
- § *z/VM 5.1 OpenExtensions User's Guide* (IBM SC24-6108)
- § *z/VM V5R1.0 TCP/IP User's Guide* (IBM SC24-6127)
- § *Plumber's Workbench CMS Pipelines and OS/2 Pipes Synergy* (IBM SG24-4523)
- § *Introduction to Plumber's Workbench* (Rob van der Heij, 1996 VM workshop)

# Where to find things

## § For the Plumber's Workbench:

§ workstation agents, including Linux/390:

- <http://home.iae.nl/users/revdheij/pwb.tar.Z>

§ CMS Server components:

- <http://vm.marist.edu/~pipeline/#PWB>

## § For E2:

§ Contact Dave Jones at:

- [dave@vsoft-software.com](mailto:dave@vsoft-software.com)

# And now for something completely different

```
VER      DC      C'&SYSVER',AL1(0)
END      , (0123456789,XXXX,93067)

sles9:~ # la
total 9052
drwx-----  7 root root      4096 Jan 22 21:40 .
drwxr-xr-x  19 root root      4096 Jan 17 16:08 ..
-rw-----  1 root root         0 Jan 19 10:49 ..IBM_DREXX2.3.3.0
-rw-----  1 root root        50 Jan 16 11:01 .Xauthority
-rw-----  1 root root     6213 Jan 22 20:12 .bash_history
-r-xr-xr-x  1 root root      206 Jan 21 15:45 .bash_profile
-rw-r--r--  1 root root     1124 Feb 28 2000 .exrc
drwx-----  2 root root      4096 Jan 10 09:37 .gnupg
drwxr-xr-x  2 root root      4096 Jan 10 10:56 .qt
-rw-----  1 root root     1024 Jan 10 11:06 .rnd
-rw-----  1 root root      604 Jan 16 18:17 .viminfo
drwxr-xr-x  2 root root      4096 Jan 16 11:02 .vnc
drwxr-xr-x  2 root root      4096 Jun 30 2004 bin
-rw-r--r--  1 root root     1306 Jan  6 06:41 jhello2.assemble
-rw-r--r--  1 root root     7897 Jan  6 07:41 jhello2.listing
-rw-r--r--  1 root root      712 Jan  6 07:41 jhello2.o
-rw-r--r--  1 root root  3912165 Jan 19 09:14 orexx-2.3.3.0-1.s390.rpm
drwxr-xr-x  7 500 users      4096 Aug 27 2001 pwb
-rw-r--r--  1 root root  5263360 Dec 30 16:06 pwb.tar
sles9:~ #
```

# And now for something completely different

```
1                                     External Symbol Dictionary
                                     Page    1
-Symbol   Type  Id      Address Length   LD ID Flags Alias-of
          jHLASM 1.1  2004/12/30 14.20
0main      SD 00000001 00000000 00000038      00  MAIN
printf    ER 00000002
DATA      SD 00000003 00000000 00000046      00
1
                                     Page    2
-D-Loc   Object Code   Addr1  Addr2   Stmt Source Statement
          jHLASM 1.1  2004/12/30 14.20
0
          1 * Hello world for Linux/390
          2 *
          3 * Incoming registers. (Forget
all about type-1 calling conventions.)
          4 *
          5 * int main(int argc, char ** a
rgv, char ** env)
          6 *
          7 * R2      argc
          8 * R3      argv
          9 * R4      env
         10 * R14     return address
         11 * R15     caller's stack frame
jhelloworld.listing lines 1-18/106 18%
```

# And now for something completely different

```
preserved.
12 *
13 * R6-R15; y1, y3-y15 must be
14 *
15 * Return value in R2.
16 *
17 * Also note that lowercase let
ters in identifiers are folded so we
18 * need to map external symbols
19 *
20 MAIN      ALIAS C'main'
21 PRINTF    ALIAS C'printf'
22 *
00000000      00000000 00000038 23 MAIN      RSECT ,
Code and readonly strings
00000000 902F F008      00000008 24 STM      2,15,8(15)
Save all
00000004 18DF      25 LR      13,15
save caller's frame
00000006 A7FA FFA0      FFFFFFFA0 26 AHI     15,-96
Minimal stack frame
0000000A 0DA0      27 BASR   10,0
R:A 0000000C 28 USING  *,10
jhello2.listing lines 19-35/106 35%
```

# And now for something completely different

```
-rw-r--r-- 1 root root 5263360 Dec 30 16:06 pwb.tar
sles9:~ # gcc -o jhello2 jhello2.o
sles9:~ # la
total 9064
drwx----- 7 root root 4096 Jan 22 21:44 .
drwxr-xr-x 19 root root 4096 Jan 17 16:08 ..
-rw----- 1 root root 0 Jan 19 10:49 ..IBM_DREXX2.3.3.0
-rw----- 1 root root 50 Jan 16 11:01 .Xauthority
-rw----- 1 root root 6213 Jan 22 20:12 .bash_history
-r-xr-xr-x 1 root root 206 Jan 21 15:45 .bash_profile
-rw-r--r-- 1 root root 1124 Feb 28 2000 .exrc
drwx----- 2 root root 4096 Jan 10 09:37 .gnupg
drwxr-xr-x 2 root root 4096 Jan 10 10:56 .qt
-rw----- 1 root root 1024 Jan 10 11:06 .rnd
-rw----- 1 root root 604 Jan 16 18:17 .viminfo
drwxr-xr-x 2 root root 4096 Jan 16 11:02 .vnc
drwxr-xr-x 2 root root 4096 Jun 30 2004 bin
-rwxr-xr-x 1 root root 8641 Jan 22 21:44 jhello2
-rw-r--r-- 1 root root 1306 Jan 6 06:41 jhello2.assemble
-rw-r--r-- 1 root root 7897 Jan 6 07:41 jhello2.listing
-rw-r--r-- 1 root root 712 Jan 6 07:41 jhello2.o
-rw-r--r-- 1 root root 3912165 Jan 19 09:14 orexx-2.3.3.0-1.s390.rpm
drwxr-xr-x 7 500 users 4096 Aug 27 2001 pwb
-rw-r--r-- 1 root root 5263360 Dec 30 16:06 pwb.tar
sles9:~ #
```

# And now for something completely different

```
sles9:~ # la
total 9064
drwx-----  7 root root    4096 Jan 22 21:44 .
drwxr-xr-x  19 root root    4096 Jan 17 16:08 ..
-rw-----  1 root root      0 Jan 19 10:49 ..IBM_OREXX2.3.3.0
-rw-----  1 root root     50 Jan 16 11:01 .Xauthority
-rw-----  1 root root   6213 Jan 22 20:12 .bash_history
-r-xr-xr-x  1 root root    206 Jan 21 15:45 .bash_profile
-rw-r--r--  1 root root   1124 Feb 28 2000 .exrc
drwx-----  2 root root    4096 Jan 10 09:37 .gnupg
drwxr-xr-x  2 root root    4096 Jan 10 10:56 .qt
-rw-----  1 root root   1024 Jan 10 11:06 .rnd
-rw-----  1 root root    604 Jan 16 18:17 .viminfo
drwxr-xr-x  2 root root    4096 Jan 16 11:02 .vnc
drwxr-xr-x  2 root root    4096 Jun 30 2004 bin
-rwxr-xr-x  1 root root   8641 Jan 22 21:44 jhello2
-rw-r--r--  1 root root   1306 Jan  6 06:41 jhello2.assemble
-rw-r--r--  1 root root   7897 Jan  6 07:41 jhello2.listing
-rw-r--r--  1 root root    712 Jan  6 07:41 jhello2.o
-rw-r--r--  1 root root 3912165 Jan 19 09:14 orexx-2.3.3.0-1.s390.rpm
drwxr-xr-x  7 500 users    4096 Aug 27 2001 pwb
-rw-r--r--  1 root root 5263360 Dec 30 16:06 pwb.tar
sles9:~ # ./jhello2
Hello world was assembled 12/30/04 by jHLASM version 1.1.0.
sles9:~ #
```