Section 1. A zSeries Linux file system test script

1.1 Overview

I was presented with a question regarding disk space efficiency, small files and block sizes with ext3 file systems on zSeries Linux. I decided to write a simple script to test how many files could be written to two ext3 file systems of the same size with block sizes of 1024 and 4096. I figured it would take a couple of hours.

Then I decided to add the Reiser file system and JFS while I was at it because it should be quick to just add a couple more tests.

I asked a question on the linux-390 list server about 1024 byte block sizes and a lot of other considerations were discussed.

Then I decided to add testing copying different file sizes - 20, 200 and 2000 bytes, given that different file sizes will behave differently.

Then I decided to add using FCP disks instead of the more common ECKD.

Then I decided to test read and write performance, in addition to disk space efficiency.

Now this had turned into more than a couple of hour job. In fact, the script ran for more than half a day. But hopefully the results are worth the effort.

1.2 Setup

The minidisk setup is more traditional than setting up the FCP disk. I created four 500 cylinder minidisks on a z/VM Linux userid, all from the same 3390-3 DASD. The directory statements in the USER DIRECT file are as follow:

```
MDISK 103 3390 0510 0500 VM5308 MR LINUX390 LINUX390 LINUX390
MDISK 104 3390 1010 0500 VM5308 MR LINUX390 LINUX390 LINUX390
MDISK 105 3390 1510 0500 VM5308 MR LINUX390 LINUX390 LINUX390
MDISK 106 3390 2010 0500 VM5308 MR LINUX390 LINUX390 LINUX390
```

FCP disks are new to zSeries. I asked the hardware guys for this and they said, "Yes we believe that can be done". Five months later I finally got my disks. To be fair it is a complicated setup and new to S/390 guys. The following script loads the appropriate modules and the specific FCP-accessed disk. Details are outside the scope of this paper.

```
# cat usefcp
#!/bin/bash
echo "inserting all FCP/SCSI modules"
rmmod zfcp
modprobe qdio
modprobe scsi_mod
insmod zfcp map="\
0x300 0x01:0x20010060451618C5 0x00:0x0001000000000000"
modprobe sd_mod
modprobe st
```

While the **fdasd** command is used to partition ECKD DASD, the **fdisk** command is used to partition the FCP disks. I wanted to create them the same size. The assumption used calculates the number of bytes on DASD before issuing the **dasdfmt** command:

```
500 cyls * 15 trks/cyl * 56664 bytes/trk = 424980000bytes = 405.3MB
```

So the value **+405m** is used with the fdisk command to create 4 primary partitons:

```
fdisk
Command (m for help): n
Command action
   e   extended
   p   primary partition (1-4)
p
Partition number (1-4): 1
First cylinder (1-15258, default 1):
Using default value 1
Last cylinder or +size or +sizeM or +sizeK (1-15258, default 15258): +405m
...
Command (m for help): n
Command action
   e   extended
   p   primary partition (1-4)
p
Partition number (1-4): 4
First cylinder (1219-15258, default 1219):
Using default value 1219
Last cylinder or +size or +sizeM or +sizeK (1219-15258, default 15258): +405m

The new partition table is viewed with the p subcommand:

Command (m for help): p

Disk /dev/sda: 64 heads, 32 sectors, 15258 cylinders
Units = cylinders of 2048 * 512 bytes

   Device Boot    Start       End    Blocks   Id  System
/dev/sda1             1       406    415728   83  Linux
/dev/sda2           407       812    415744   83  Linux
/dev/sda3           813      1218    415744   83  Linux
/dev/sda4          1219      1624    415744   83  Linux

Now the partition table is written with the w subcommand:

Command (m for help): w
The partition table has been altered!

Calling ioctl() to re-read partition table.
Syncing disks.
```

1.3 Assumptions

There are 8 file systems tested - a set of 4 using conventional DASD and a set of 4 using the newer FCP access method.

File system type	Block size	Hardware type	
ext3	4096	DASD	

File system type	Block size	Hardware type	
ext3	1024	DASD	
Reiser	4096	DASD	
JFS	4096	DASD	
ext3	4096	FCP	
ext3	1024	FCP	
Reiser	4096	FCP	
JFS	4096	FCP	

1.4 The script

Here the script is described. If you want to skip the details and go straight to the results see (xref). First global variables are defined for the devices, both DASD and FCP, and the file system mount points. Also, a variable is defined for the temporary file that will be copied many times.

```
#!/bin/bash
# script to test disk utilization, read/write performance of file systems

# define variables for devices, file system mount points and files
DEV1=/dev/dasdd1
DEV2=/dev/dasde1
DEV3=/dev/dasdf1
DEV4=/dev/dasdg1
DEV5=/dev/sda1
DEV6=/dev/sda2
DEV7=/dev/sda3
DEV8=/dev/sda4
FS1=/ext3-4k
FS2=/ext3-1k
FS3=/reiser-4k
FS4=/jfs-4k
FS5=/ext3-4k-FCP
FS6=/ext3-1k-FCP
FS7=/reiser-4k-FCP
FS8=/jfs-4k-FCP
TMPF=/tmp/foo
```

The function **header** is defined to print a heading in the output file.

```
header()
 {
  echo ""
  echo "$1 byte files"
  echo "=============="
 }
```

The function **makeDirectories** will create empty mount points if they are not already defined.

```
makeDirectories()
 {
```

```
 if [ ! -d $FS1 ]; then mkdir $FS1; fi
 if [ ! -d $FS2 ]; then mkdir $FS2; fi
 if [ ! -d $FS3 ]; then mkdir $FS3; fi
 if [ ! -d $FS4 ]; then mkdir $FS4; fi
 if [ ! -d $FS5 ]; then mkdir $FS5; fi
 if [ ! -d $FS6 ]; then mkdir $FS6; fi
 if [ ! -d $FS7 ]; then mkdir $FS7; fi
 if [ ! -d $FS8 ]; then mkdir $FS8; fi
}
```

The function **unmountFileSystems** will unmount any mounted file systems. TODO: test for a bad rc - if a process has one of these as its current directory,

```
unmountFileSystems()
 {
  umount $FS1
  umount $FS2
  umount $FS3
  umount $FS4
  umount $FS5
  umount $FS6
  umount $FS7
  umount $FS8
 } 8
```

The function **makeFileSystems** makes 8 file systems out of the 8 devices. The flag **-i 1024** is used with the **mke2fs** command with ext3 file systems that have a block size of 1024 so as to give them more inodes.

```
makeFileSystems()
 {
  echo "y" > /tmp/yes
  mke2fs -j -m 0 -b 4096 $DEV1 > /dev/null 2>&1
  if [ $? != 0 ]; then echo "1!"; exit; fi
  mke2fs -j -m 0 -b 1024 -i 1024 $DEV2 > /dev/null 2>&1
  if [ $? != 0 ]; then echo "2!"; exit; fi
  mkreiserfs $DEV3 < /tmp/yes > /dev/null  2>&1
  if [ $? != 0 ]; then echo "3!"; exit; fi
  mkfs.jfs $DEV4 < /tmp/yes  > /dev/null 2>&1
  if [ $? != 0 ]; then echo "4!"; exit; fi
  mke2fs -j -m 0 -b 1024 -i 1024 $DEV5 > /dev/null 2>&1
  if [ $? != 0 ]; then echo "5!"; exit; fi
  mke2fs -j -m 0 $DEV6  > /dev/null 2>&1
  if [ $? != 0 ]; then echo "6!"; exit; fi
  mkreiserfs $DEV7 < /tmp/yes > /dev/null 2>&1
  if [ $? != 0 ]; then echo "7!"; exit; fi
  mkfs.jfs $DEV8 < /tmp/yes > /dev/null 2>&1
  if [ $? != 0 ]; then echo "8!"; exit; fi
  rm /tmp/yes
 }
```

The function **mountFileSystems** uses the mount command to mount the 8 file systems.

```
mountFileSystems()
 {
  mount $DEV1 $FS1
  if [ $? != 0 ]; then echo "9!"; exit; fi
  mount $DEV2 $FS2
  if [ $? != 0 ]; then echo "a!"; exit; fi
```



```
 mount $DEV3 $FS3
 if [ $? != 0 ]; then echo "b!"; exit; fi
 mount $DEV4 $FS4
 if [ $? != 0 ]; then echo "c!"; exit; fi
 mount $DEV5 $FS5
 if [ $? != 0 ]; then echo "d!"; exit; fi
 mount $DEV6 $FS6
 if [ $? != 0 ]; then echo "e!"; exit; fi
 mount $DEV7 $FS7
 if [ $? != 0 ]; then echo "f!"; exit; fi
 mount $DEV8 $FS8
 if [ $? != 0 ]; then echo "g!"; exit; fi
}
```

The function **copyIn** copies the temporary files to the directory specified in the first argument ($1) for the number specified in the second argument ($2).

```
copyIn()
 {
  for ((i=0; $i<$2; i++))
   do
    cp $TMPF $1/$i.txt
    if [ $? != 0 ]; then return; fi
   done
 }
```

The function **countFiles** counts the number of files after in a file system. This is important after the file systems have been filled to the maximum.

```
countFiles()
 {
  echo "Number of files:"
  cd $FS1
  numFiles=`ls -l | wc  | cut -b 1-7`
  echo "\"ext3\", $numFiles"
  cd $FS2
  numFiles=`ls -l | wc  | cut -b 1-7`
  echo "\"ext3-1k\", $numFiles"
  cd $FS3
  numFiles=`ls -l | wc  | cut -b 1-7`
  echo "\"reiser\", $numFiles"
  cd $FS4
  numFiles=`ls -l | wc  | cut -b 1-7`
  echo "\"JFS\", $numFiles"
  cd $FS5
  numFiles=`ls -l | wc  | cut -b 1-7`
  echo "\"ext3-FCP\", $numFiles"
  cd $FS6
  numFiles=`ls -l | wc  | cut -b 1-7`
  echo "\"ext3-1k-FCP\", $numFiles"
  cd $FS7
  numFiles=`ls -l | wc  | cut -b 1-7`
  echo "\"reiser-FCP\", $numFiles"
  cd $FS8
  numFiles=`ls -l | wc  | cut -b 1-7`
  echo "\"JFS-FCP\", $numFiles"
  cd /root/
 }
```

The function **testDiskSpaceEfficiency** continues to copy files until the file system is filled for each of the 8 file systems. The functions **unmountFileSystem**, **makeFileSystem** and **mountFileSystems** are first called to start with clean file systems. The **copyIn** function is called for each file system for two million iterations, though each file system will fill up much earlier. The **time** command is used to track the time it takes to fill up each file system.

```
testDiskSpaceEfficiency()
# arg1 - number of 200 byte records in file to be copied
 {
  unmountFileSystems
  makeFileSystems
  mountFileSystems

  echo "File systems before copying:"
  df | grep -

  dd if=/dev/zero of=$TMPF bs=200 count=$1
  time copyIn $FS1 2000000
  time copyIn $FS2 2000000
  time copyIn $FS3 2000000
  time copyIn $FS4 2000000
  time copyIn $FS5 2000000
  time copyIn $FS6 2000000
  time copyIn $FS7 2000000
  time copyIn $FS8 2000000
  rm $TMPF
  echo "File systems after copying:"
  df | grep -
  countFiles
```

The function **testWrite**

The function **copyOut** is called to test the read performance of file systems. The output is simply copied to the null device /dev/null.

```
copyOut()
 {
  for ((i=0; $i<$2; i++))
   do
    cp $1/$i.txt /dev/null
    if [ $? != 0 ]; then return; fi
   done
 }
```

The function **testRead** is called

```
testRead()
# arg1 - number of 200 byte records in file to be copied
 {
  echo "File systems before copying:"
  df | grep -
  dd if=/dev/zero of=$TMPF bs=200 count=$1
  time copyOut $FS1 $2
  time copyOut $FS2 $2
  time copyOut $FS3 $2
  time copyOut $FS4 $2
```



```
  time copyOut $FS5 $2
  time copyOut $FS6 $2
  time copyOut $FS7 $2
  time copyOut $FS8 $2
  rm $TMPF
  echo "File systems after copying:"
  df | grep -
 }
```

Now that all the functions are defined, it's time to get to work

```
# main()
date
echo "TESTING DISK SPACE EFFICIENCY"
header 200
testWrite 1 2000000
header 2000
testWrite 10 2000000
header 20000
testWrite 100 2000000
header 200000
testWrite 1000 2000000
echo ""
echo "TESTING WRITE AND READ PERFORMANCE"
header 200
testWrite 1 78000
testRead 1 78000
header 2000
testWrite 10 78000
testRead 10 78000
header 20000
testWrite 100 10000
testRead 100 10000
header 200000
testWrite 1000 1000
testRead 1000 1000
date
```

1.5 The output

The script is run via the nohup command that allows you to log off and still continue the command:

```
# nohup testfs &
```

Here is the output

1.5.1 Testing disk space efficiency

```
TESTING DISK SPACE EFFICIENCY

200 byte files
==============
umount: /ext3-4k: not mounted
umount: /ext3-1k: not mounted
umount: /reiser-4k: not mounted
umount: /jfs-4k: not mounted
```

```
umount: /ext3-4k-FCP: not mounted
umount: /ext3-1k-FCP: not mounted
umount: /reiser-4k-FCP: not mounted
umount: /jfs-4k-FCP: not mounted
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608     16428    332180   5% /ext3-4k
/dev/dasde1             216417      4127    212290   2% /ext3-1k
/dev/dasdf1             359888     32840    327048  10% /reiser-4k
/dev/dasdg1             357640       176    357464   1% /jfs-4k
/dev/sda1               363629      8239    355390   3% /ext3-4k-FCP
/dev/sda2               402609      8239    394370   3% /ext3-1k-FCP
/dev/sda3               415724     32840    382884   8% /reiser-4k-FCP
/dev/sda4               413476       184    413292   1% /jfs-4k-FCP
```

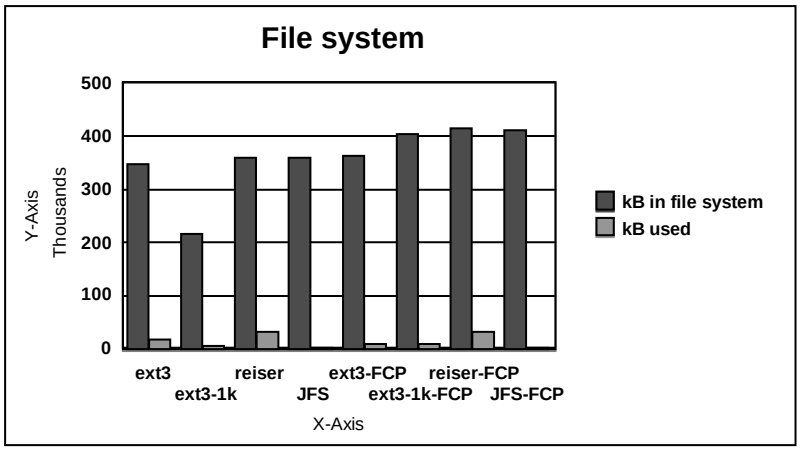

Figure 1. Basics

What is worth noting here - ext3 with 1Kb block size on DASD loses almost half. **TODO**: further analysis (why is ext3-4k almost identical between DASD and FCP?)

```
1+0 records in
1+0 records out
cp: writing `/ext3-4k/82649.txt': No space left on device

real        17m50.813s
user        1m20.490s
sys         15m57.300s
cp: writing `/ext3-1k/208230.txt': No space left on device

real        110m26.526s
user        3m24.110s
sys         106m21.950s
cp: writing `/reiser-4k/972875.txt': No space left on device

real        76m10.003s
user        15m34.180s
sys         25m57.780s
cp: writing `/jfs-4k/78229.txt': No space left on device

real        3m24.335s
user        1m17.430s
```



```
sys         1m43.030s
cp: writing `/ext3-4k-FCP/348568.txt': No space left on device

real        312m38.850s
user        5m48.080s
sys         305m27.160s
cp: cannot create regular file `/ext3-1k-FCP/104029.txt': No space left on device

real        30m40.516s
user        1m40.960s
sys         28m38.130s
cp: writing `/reiser-4k-FCP/1142606.txt': No space left on device

real        62m15.803s
user        18m23.040s
sys         30m13.160s
cp: writing `/jfs-4k-FCP/90445.txt': No space left on device

real        3m45.086s
user        1m28.710s
sys         2m5.300s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    348608         0 100% /ext3-4k
/dev/dasde1             216417    216417         0 100% /ext3-1k
/dev/dasdf1             359888    357892      1996 100% /reiser-4k
/dev/dasdg1             357640    357640         0 100% /jfs-4k
/dev/sda1               363629    363629         0 100% /ext3-4k-FCP
/dev/sda2               402609    114276    288333  29% /ext3-1k-FCP
/dev/sda3               415724    413728      1996 100% /reiser-4k-FCP
/dev/sda4               413476    413476         0 100% /jfs-4k-FCP
Number of files:
"ext3",   82652
"ext3-1k",  208233
"reiser",  972877
"JFS",   78231
"ext3-FCP",  348571
"ext3-1k-FCP",  104031
"reiser-FCP", 1142608
"JFS-FCP",   90447
```

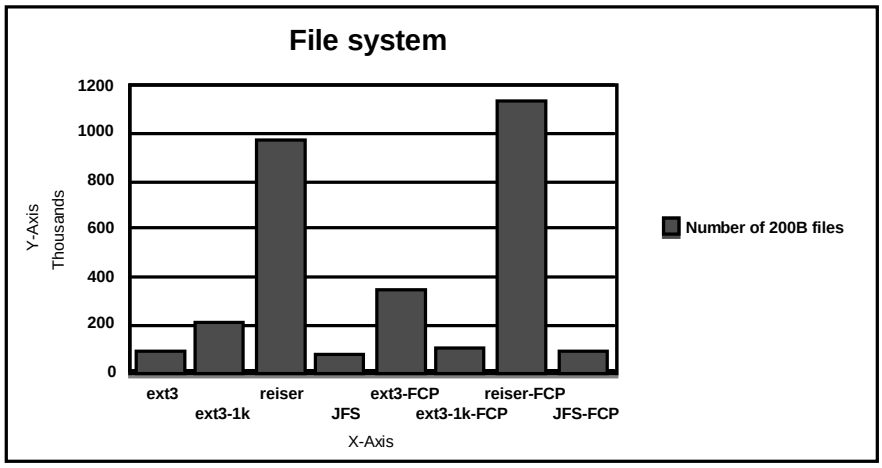

Figure 2. Number of 200 byte files created

Analysis:

```
2000 byte files
==============
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608     16428    332180   5% /ext3-4k
/dev/dasde1             216417      4127    212290   2% /ext3-1k
/dev/dasdf1             359888     32840    327048  10% /reiser-4k
/dev/dasdg1             357640       176    357464   1% /jfs-4k
/dev/sda1               363629      8239    355390   3% /ext3-4k-FCP
/dev/sda2               402609      8239    394370   3% /ext3-1k-FCP
/dev/sda3               415724     32840    382884   8% /reiser-4k-FCP
/dev/sda4               413476       184    413292   1% /jfs-4k-FCP
10+0 records in
10+0 records out
cp: writing `/ext3-4k/82649.txt': No space left on device

real        17m53.203s
user        1m20.850s
sys         15m51.900s
cp: writing `/ext3-1k/105130.txt': No space left on device

real        32m46.566s
user        1m44.510s
sys         30m12.240s
cp: writing `/reiser-4k/153257.txt': No space left on device

real        7m42.402s
user        2m26.530s
sys         4m6.310s
cp: writing `/jfs-4k/78229.txt': No space left on device

real        3m26.572s
user        1m16.800s
```



```
sys         1m47.510s
cp: writing `/ext3-4k-FCP/175982.txt': No space left on device

real        80m29.453s
user        2m56.870s
sys         76m49.820s
cp: cannot create regular file `/ext3-1k-FCP/104029.txt': No space left on device

real        30m44.973s
user        1m42.420s
sys         28m40.970s
cp: writing `/reiser-4k-FCP/179418.txt': No space left on device

real        8m6.927s
user        2m53.910s
sys         4m42.310s
cp: writing `/jfs-4k-FCP/90445.txt': No space left on device

real        3m47.631s
user        1m29.290s
sys         2m6.950s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    348608         0 100% /ext3-4k
/dev/dasde1             216417    216417         0 100% /ext3-1k
/dev/dasdf1             359888    357892      1996 100% /reiser-4k
/dev/dasdg1             357640    357640         0 100% /jfs-4k
/dev/sda1               363629    363628         1 100% /ext3-4k-FCP
/dev/sda2               402609    218305    184304  55% /ext3-1k-FCP
/dev/sda3               415724    413728      1996 100% /reiser-4k-FCP
/dev/sda4               413476    413476         0 100% /jfs-4k-FCP
Number of files:
"ext3",   82652
"ext3-1k",  105133
"reiser",  153259
"JFS",   78231
"ext3-FCP",  175985
"ext3-1k-FCP",  104031
"reiser-FCP",  179420
"JFS-FCP",   90447
```

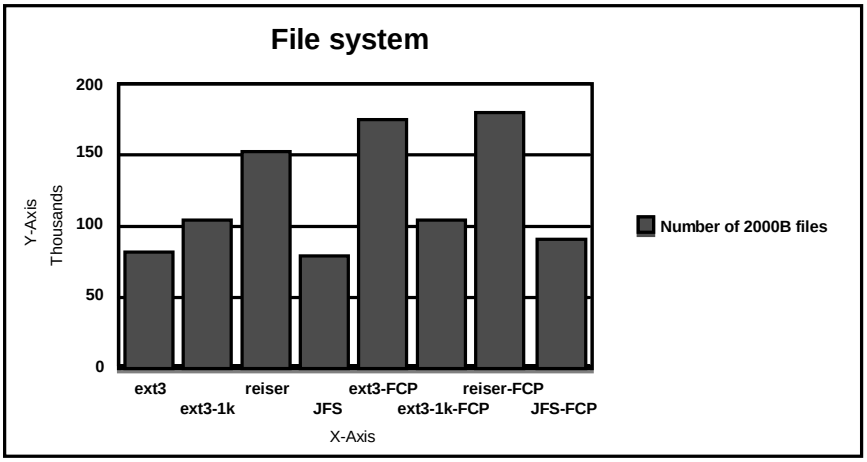

Figure 3. Number of 2000 byte files created

```
20000 byte files
==============
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608     16428    332180   5% /ext3-4k
/dev/dasde1             216417      4127    212290   2% /ext3-1k
/dev/dasdf1             359888     32840    327048  10% /reiser-4k
/dev/dasdg1             357640       176    357464   1% /jfs-4k
/dev/sda1               363629      8239    355390   3% /ext3-4k-FCP
/dev/sda2               402609      8239    394370   3% /ext3-1k-FCP
/dev/sda3               415724     32840    382884   8% /reiser-4k-FCP
/dev/sda4               413476       184    413292   1% /jfs-4k-FCP
100+0 records in
100+0 records out
cp: writing `/ext3-4k/16594.txt': No space left on device

real        2m14.093s
user        0m15.580s
sys         0m53.190s
cp: writing `/ext3-1k/10101.txt': No space left on device

real        2m11.995s
user        0m9.370s
sys         0m31.130s
cp: writing `/reiser-4k/16137.txt': No space left on device

real        0m41.908s
user        0m15.590s
sys         0m26.320s
cp: writing `/jfs-4k/17378.txt': No space left on device

real        1m56.080s
user        0m16.840s
sys         0m24.320s
cp: writing `/ext3-4k-FCP/16909.txt': No space left on device

real        1m43.500s
```



```
user        0m16.320s
sys         1m5.890s
cp: writing `/ext3-1k-FCP/18763.txt': No space left on device

real        2m1.520s
user        0m18.590s
sys         1m18.080s
cp: writing `/reiser-4k-FCP/18909.txt': No space left on device

real        0m50.162s
user        0m17.710s
sys         0m32.360s
cp: writing `/jfs-4k-FCP/20092.txt': No space left on device

real        1m4.290s
user        0m19.390s
sys         0m30.080s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    348608         0 100% /ext3-4k
/dev/dasde1             216417    216415         2 100% /ext3-1k
/dev/dasdf1             359888    357892      1996 100% /reiser-4k
/dev/dasdg1             357640    357640         0 100% /jfs-4k
/dev/sda1               363629    363626         3 100% /ext3-4k-FCP
/dev/sda2               402609    402605         4 100% /ext3-1k-FCP
/dev/sda3               415724    413728      1996 100% /reiser-4k-FCP
/dev/sda4               413476    413476         0 100% /jfs-4k-FCP
Number of files:
"ext3",   16597
"ext3-1k",   10104
"reiser",   16139
"JFS",   17380
"ext3-FCP",   16912
"ext3-1k-FCP",   18766
"reiser-FCP",   18911
"JFS-FCP",   20094
```

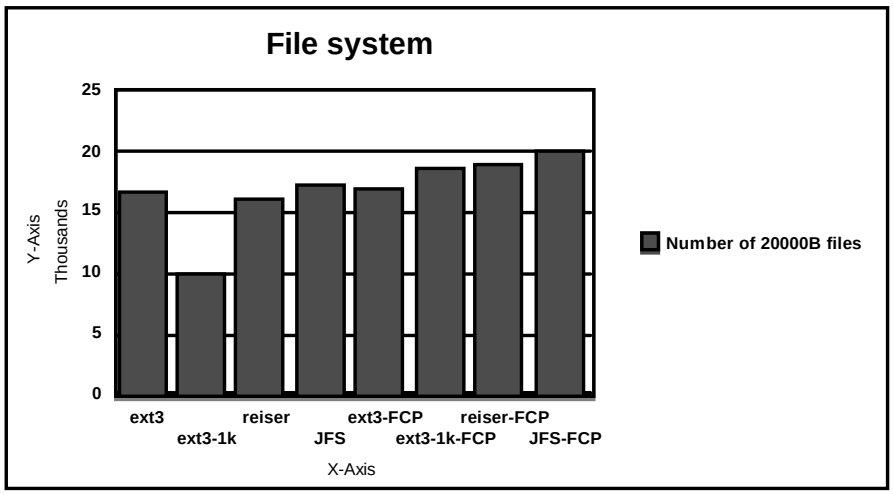

Figure 4. Number of 20000 byte files created

```
200000 byte files
==============
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608     16428    332180   5% /ext3-4k
/dev/dasde1             216417      4127    212290   2% /ext3-1k
/dev/dasdf1             359888     32840    327048  10% /reiser-4k
/dev/dasdg1             357640       176    357464   1% /jfs-4k
/dev/sda1               363629      8239    355390   3% /ext3-4k-FCP
/dev/sda2               402609      8239    394370   3% /ext3-1k-FCP
/dev/sda3               415724     32840    382884   8% /reiser-4k-FCP
/dev/sda4               413476       184    413292   1% /jfs-4k-FCP
1000+0 records in
1000+0 records out
cp: writing `/ext3-4k/1660.txt': No space left on device

real        0m32.383s
user        0m1.570s
sys         0m4.770s
cp: writing `/ext3-1k/1077.txt': No space left on device

real        0m53.881s
user        0m1.070s
sys         0m5.210s
cp: writing `/reiser-4k/1655.txt': No space left on device

real        0m16.198s
user        0m1.630s
sys         0m4.940s
cp: writing `/jfs-4k/1818.txt': No space left on device

real        0m49.541s
user        0m2.020s
sys         0m3.380s
cp: writing `/ext3-4k-FCP/1803.txt': No space left on device

real        0m21.603s
user        0m1.700s
sys         0m9.100s
cp: writing `/ext3-1k-FCP/2001.txt': No space left on device

real        0m23.131s
user        0m2.000s
sys         0m10.040s
cp: writing `/reiser-4k-FCP/1940.txt': No space left on device

real        0m17.547s
user        0m1.880s
sys         0m6.400s
cp: writing `/jfs-4k-FCP/2102.txt': No space left on device

real        0m23.317s
user        0m1.930s
sys         0m4.710s
File systems after copying:
```



```
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    348608         0 100% /ext3-4k
/dev/dasde1             216417    216414         3 100% /ext3-1k
/dev/dasdf1             359888    357892      1996 100% /reiser-4k
/dev/dasdg1             357640    357640         0 100% /jfs-4k
/dev/sda1               363629    363628         1 100% /ext3-4k-FCP
/dev/sda2               402609    402609         0 100% /ext3-1k-FCP
/dev/sda3               415724    413728      1996 100% /reiser-4k-FCP
/dev/sda4               413476    413476         0 100% /jfs-4k-FCP
Number of files:
"ext3",    1663
"ext3-1k",    1080
"reiser",    1657
"JFS",    1820
"ext3-FCP",    1806
"ext3-1k-FCP",    2004
"reiser-FCP",    1942
"JFS-FCP",    2104
```

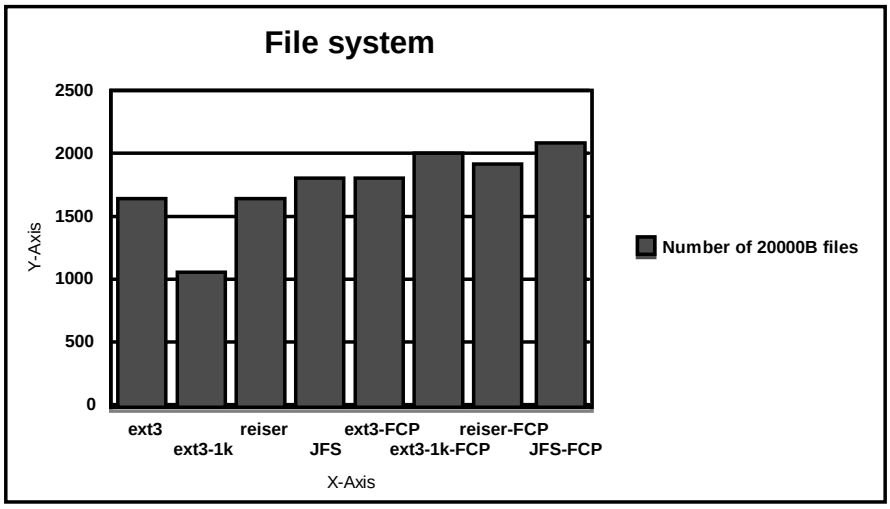

Figure 5. Number of 200000 byte files created

1.5.2 Testing Read and Write performance

TODO: analysis

```
200 byte files
==============
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608     16428    332180   5% /ext3-4k
/dev/dasde1             216417      4127    212290   2% /ext3-1k
/dev/dasdf1             359888     32840    327048  10% /reiser-4k
/dev/dasdg1             357640       176    357464   1% /jfs-4k
/dev/sda1               363629      8239    355390   3% /ext3-4k-FCP
/dev/sda2               402609      8239    394370   3% /ext3-1k-FCP
/dev/sda3               415724     32840    382884   8% /reiser-4k-FCP
/dev/sda4               413476       184    413292   1% /jfs-4k-FCP
1+0 records in
1+0 records out
```

```
real         15m51.512s
user         1m15.320s
sys          14m20.410s

real         18m36.300s
user         1m18.670s
sys          16m58.240s

real         3m17.081s
user         1m15.350s
sys          2m0.230s

real         3m28.344s
user         1m16.720s
sys          1m49.040s

real         18m38.050s
user         1m17.190s
sys          17m5.720s

real         18m18.255s
user         1m17.150s
sys          16m46.310s

real         3m13.821s
user         1m15.870s
sys          1m57.210s
cp: cannot create regular file `/jfs-4k-FCP/65463.txt': Input/output error

real         2m46.319s
user         1m5.050s
sys          1m33.280s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    329920     18688  95% /ext3-4k
/dev/dasde1             216417     83623    132794  39% /ext3-1k
/dev/dasdf1             359888     58396    301492  17% /reiser-4k
/dev/dasdg1             357640    356596      1044 100% /jfs-4k
/dev/sda1               363629     87735    275894  25% /ext3-4k-FCP
/dev/sda2               402609     87735    314874  22% /ext3-1k-FCP
/dev/sda3               415724     58396    357328  15% /reiser-4k-FCP
/dev/sda4               413476    299304    114172  73% /jfs-4k-FCP
Number of files:
"ext3",   78002
"ext3-1k",   78002
"reiser",   78001
"JFS",   78001
"ext3-FCP",   78002
"ext3-1k-FCP",   78002
"reiser-FCP",   78001
"JFS-FCP",   61587
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    329920     18688  95% /ext3-4k
```



```
/dev/dasde1             216417     83623    132794  39% /ext3-1k
/dev/dasdf1             359888     58396    301492  17% /reiser-4k
/dev/dasdg1             357640    356596      1044 100% /jfs-4k
/dev/sda1               363629     87735    275894  25% /ext3-4k-FCP
/dev/sda2               402609     87735    314874  22% /ext3-1k-FCP
/dev/sda3               415724     58396    357328  15% /reiser-4k-FCP
/dev/sda4               413476    299304    114172  73% /jfs-4k-FCP
1+0 records in
1+0 records out

real        3m41.969s
user        1m15.080s
sys         1m44.560s

real        3m18.726s
user        1m14.270s
sys         1m45.530s

real        2m56.889s
user        1m14.500s
sys         1m39.650s

real        3m36.493s
user        1m14.930s
sys         1m45.050s

real        4m46.980s
user        1m13.970s
sys         1m49.400s

real        4m46.831s
user        1m14.890s
sys         1m49.180s

real        2m57.360s
user        1m15.690s
sys         1m40.070s
cp: cannot stat `/jfs-4k-FCP/655.txt': Input/output error

real        0m3.368s
user        0m0.520s
sys         0m0.830s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    329920     18688  95% /ext3-4k
/dev/dasde1             216417     83623    132794  39% /ext3-1k
/dev/dasdf1             359888     58396    301492  17% /reiser-4k
/dev/dasdg1             357640    356596      1044 100% /jfs-4k
/dev/sda1               363629     87735    275894  25% /ext3-4k-FCP
/dev/sda2               402609     87735    314874  22% /ext3-1k-FCP
/dev/sda3               415724     58396    357328  15% /reiser-4k-FCP
/dev/sda4               413476    299304    114172  73% /jfs-4k-FCP

2000 byte files
==============
```

```
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608     16428    332180   5% /ext3-4k
/dev/dasde1             216417      4127    212290   2% /ext3-1k
/dev/dasdf1             359888     32840    327048  10% /reiser-4k
/dev/dasdg1             357640       176    357464   1% /jfs-4k
/dev/sda1               363629      8239    355390   3% /ext3-4k-FCP
/dev/sda2               402609      8239    394370   3% /ext3-1k-FCP
/dev/sda3               415724     32840    382884   8% /reiser-4k-FCP
/dev/sda4               413476       184    413292   1% /jfs-4k-FCP
10+0 records in
10+0 records out

real        15m50.859s
user        1m17.540s
sys         14m17.260s

real        19m6.036s
user        1m17.460s
sys         17m12.660s

real        3m39.234s
user        1m16.930s
sys         2m1.390s

real        3m26.246s
user        1m17.060s
sys         1m46.880s

real        18m40.442s
user        1m16.910s
sys         17m6.210s

real        18m19.309s
user        1m19.800s
sys         16m41.560s

real        3m24.242s
user        1m16.780s
sys         2m1.470s

real        3m16.466s
user        1m17.550s
sys         1m49.590s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    329920     18688  95% /ext3-4k
/dev/dasde1             216417    161623     54794  75% /ext3-1k
/dev/dasdf1             359888    197908    161980  55% /reiser-4k
/dev/dasdg1             357640    356596      1044 100% /jfs-4k
/dev/sda1               363629    165735    197894  46% /ext3-4k-FCP
/dev/sda2               402609    165735    236874  42% /ext3-1k-FCP
/dev/sda3               415724    197908    217816  48% /reiser-4k-FCP
/dev/sda4               413476    356604     56872  87% /jfs-4k-FCP
Number of files:
```



```
"ext3",   78002
"ext3-1k",   78002
"reiser",   78001
"JFS",   78001
"ext3-FCP",   78002
"ext3-1k-FCP",   78002
"reiser-FCP",   78001
"JFS-FCP",   78001
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    329920     18688  95% /ext3-4k
/dev/dasde1             216417    161623     54794  75% /ext3-1k
/dev/dasdf1             359888    197908    161980  55% /reiser-4k
/dev/dasdg1             357640    356596      1044 100% /jfs-4k
/dev/sda1               363629    165735    197894  46% /ext3-4k-FCP
/dev/sda2               402609    165735    236874  42% /ext3-1k-FCP
/dev/sda3               415724    197908    217816  48% /reiser-4k-FCP
/dev/sda4               413476    356604     56872  87% /jfs-4k-FCP
10+0 records in
10+0 records out

real         3m40.535s
user         1m15.580s
sys          1m44.470s

real         3m38.759s
user         1m14.890s
sys          1m46.110s

real         3m25.990s
user         1m16.190s
sys          1m38.880s

real         3m36.419s
user         1m16.660s
sys          1m43.190s

real         4m58.394s
user         1m14.500s
sys          1m43.830s

real         4m58.074s
user         1m18.380s
sys          1m43.860s

real         3m17.853s
user         1m18.900s
sys          1m45.270s

real         5m6.057s
user         1m20.760s
sys          1m41.230s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    329920     18688  95% /ext3-4k
```

```
/dev/dasde1             216417    161623     54794  75% /ext3-1k
/dev/dasdf1             359888    197908    161980  55% /reiser-4k
/dev/dasdg1             357640    356596      1044 100% /jfs-4k
/dev/sda1               363629    165735    197894  46% /ext3-4k-FCP
/dev/sda2               402609    165735    236874  42% /ext3-1k-FCP
/dev/sda3               415724    197908    217816  48% /reiser-4k-FCP
/dev/sda4               413476    356604     56872  87% /jfs-4k-FCP

20000 byte files
==============
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608     16428    332180   5% /ext3-4k
/dev/dasde1             216417      4127    212290   2% /ext3-1k
/dev/dasdf1             359888     32840    327048  10% /reiser-4k
/dev/dasdg1             357640       176    357464   1% /jfs-4k
/dev/sda1               363629      8239    355390   3% /ext3-4k-FCP
/dev/sda2               402609      8239    394370   3% /ext3-1k-FCP
/dev/sda3               415724     32840    382884   8% /reiser-4k-FCP
/dev/sda4               413476       184    413292   1% /jfs-4k-FCP
100+0 records in
100+0 records out

real        0m55.637s
user        0m9.770s
sys         0m26.700s

real        1m55.843s
user        0m10.030s
sys         0m30.720s

real        0m26.281s
user        0m9.550s
sys         0m16.720s

real        0m52.113s
user        0m9.940s
sys         0m14.160s

real        0m56.091s
user        0m10.090s
sys         0m31.550s

real        0m54.495s
user        0m10.110s
sys         0m31.460s

real        0m26.507s
user        0m9.730s
sys         0m16.760s

real        0m29.186s
user        0m9.890s
sys         0m15.310s
File systems after copying:
```



```
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    216588    132020  63% /ext3-4k
/dev/dasde1             216417    214284      2133 100% /ext3-1k
/dev/dasdf1             359888    234216    125672  66% /reiser-4k
/dev/dasdg1             357640    205864    151776  58% /jfs-4k
/dev/sda1               363629    218396    145233  61% /ext3-4k-FCP
/dev/sda2               402609    218396    184213  55% /ext3-1k-FCP
/dev/sda3               415724    234216    181508  57% /reiser-4k-FCP
/dev/sda4               413476    205872    207604  50% /jfs-4k-FCP
Number of files:
"ext3",   10002
"ext3-1k",   10002
"reiser",   10001
"JFS",   10001
"ext3-FCP",   10002
"ext3-1k-FCP",   10002
"reiser-FCP",   10001
"JFS-FCP",   10001
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    216588    132020  63% /ext3-4k
/dev/dasde1             216417    214284      2133 100% /ext3-1k
/dev/dasdf1             359888    234216    125672  66% /reiser-4k
/dev/dasdg1             357640    205864    151776  58% /jfs-4k
/dev/sda1               363629    218396    145233  61% /ext3-4k-FCP
/dev/sda2               402609    218396    184213  55% /ext3-1k-FCP
/dev/sda3               415724    234216    181508  57% /reiser-4k-FCP
/dev/sda4               413476    205872    207604  50% /jfs-4k-FCP
100+0 records in
100+0 records out

real        0m49.817s
user        0m9.510s
sys         0m14.360s

real        1m23.418s
user        0m9.560s
sys         0m15.420s

real        0m51.243s
user        0m9.800s
sys         0m15.910s

real        0m50.787s
user        0m9.540s
sys         0m14.220s

real        1m11.101s
user        0m10.030s
sys         0m15.270s

real        1m11.017s
user        0m10.190s
sys         0m15.260s
```

```
real         0m58.168s
user         0m9.840s
sys          0m15.720s

real         0m57.167s
user         0m9.870s
sys          0m14.240s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    216588    132020  63% /ext3-4k
/dev/dasde1             216417    214284      2133 100% /ext3-1k
/dev/dasdf1             359888    234216    125672  66% /reiser-4k
/dev/dasdg1             357640    205864    151776  58% /jfs-4k
/dev/sda1               363629    218396    145233  61% /ext3-4k-FCP
/dev/sda2               402609    218396    184213  55% /ext3-1k-FCP
/dev/sda3               415724    234216    181508  57% /reiser-4k-FCP
/dev/sda4               413476    205872    207604  50% /jfs-4k-FCP

200000 byte files
==============
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608     16428    332180   5% /ext3-4k
/dev/dasde1             216417      4127    212290   2% /ext3-1k
/dev/dasdf1             359888     32840    327048  10% /reiser-4k
/dev/dasdg1             357640       176    357464   1% /jfs-4k
/dev/sda1               363629      8239    355390   3% /ext3-4k-FCP
/dev/sda2               402609      8239    394370   3% /ext3-1k-FCP
/dev/sda3               415724     32840    382884   8% /reiser-4k-FCP
/dev/sda4               413476       184    413292   1% /jfs-4k-FCP
1000+0 records in
1000+0 records out

real         0m20.054s
user         0m1.050s
sys          0m2.680s

real         0m51.085s
user         0m0.890s
sys          0m4.900s

real         0m3.994s
user         0m1.000s
sys          0m2.990s

real         0m24.426s
user         0m0.830s
sys          0m2.210s

real         0m12.948s
user         0m1.010s
sys          0m4.940s

real         0m11.565s
user         0m0.940s
```



```
sys         0m4.950s

real        0m4.100s
user        0m0.980s
sys         0m3.100s

real        0m12.445s
user        0m1.030s
sys         0m2.200s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    216440    132168  63% /ext3-4k
/dev/dasde1             216417    201143     15274  93% /ext3-1k
/dev/dasdf1             359888    229156    130732  64% /reiser-4k
/dev/dasdg1             357640    196744    160896  56% /jfs-4k
/dev/sda1               363629    205255    158374  57% /ext3-4k-FCP
/dev/sda2               402609    205255    197354  51% /ext3-1k-FCP
/dev/sda3               415724    229156    186568  56% /reiser-4k-FCP
/dev/sda4               413476    196752    216724  48% /jfs-4k-FCP
Number of files:
"ext3",    1002
"ext3-1k",    1002
"reiser",    1001
"JFS",    1001
"ext3-FCP",    1002
"ext3-1k-FCP",    1002
"reiser-FCP",    1001
"JFS-FCP",    1001
File systems before copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    216440    132168  63% /ext3-4k
/dev/dasde1             216417    201143     15274  93% /ext3-1k
/dev/dasdf1             359888    229156    130732  64% /reiser-4k
/dev/dasdg1             357640    196744    160896  56% /jfs-4k
/dev/sda1               363629    205255    158374  57% /ext3-4k-FCP
/dev/sda2               402609    205255    197354  51% /ext3-1k-FCP
/dev/sda3               415724    229156    186568  56% /reiser-4k-FCP
/dev/sda4               413476    196752    216724  48% /jfs-4k-FCP
1000+0 records in
1000+0 records out

real        0m28.240s
user        0m1.120s
sys         0m1.960s

real        0m58.434s
user        0m0.840s
sys         0m1.930s

real        0m28.188s
user        0m0.960s
sys         0m2.380s

real        0m27.815s
user        0m1.150s
```

```
sys         0m2.080s

real        0m19.136s
user        0m0.960s
sys         0m2.520s

real        0m19.131s
user        0m0.930s
sys         0m2.510s

real        0m19.321s
user        0m1.180s
sys         0m2.660s

real        0m18.690s
user        0m1.070s
sys         0m2.120s
File systems after copying:
Filesystem           1K-blocks      Used Available Use% Mounted on
/dev/dasdd1             348608    216440    132168  63% /ext3-4k
/dev/dasde1             216417    201143     15274  93% /ext3-1k
/dev/dasdf1             359888    229156    130732  64% /reiser-4k
/dev/dasdg1             357640    196744    160896  56% /jfs-4k
/dev/sda1               363629    205255    158374  57% /ext3-4k-FCP
/dev/sda2               402609    205255    197354  51% /ext3-1k-FCP
/dev/sda3               415724    229156    186568  56% /reiser-4k-FCP
/dev/sda4               413476    196752    216724  48% /jfs-4k-FCP
Mon Mar  1 22:09:57 EST 2004
```

