XrootdFS:
a Posix Filesystem for Xrootd

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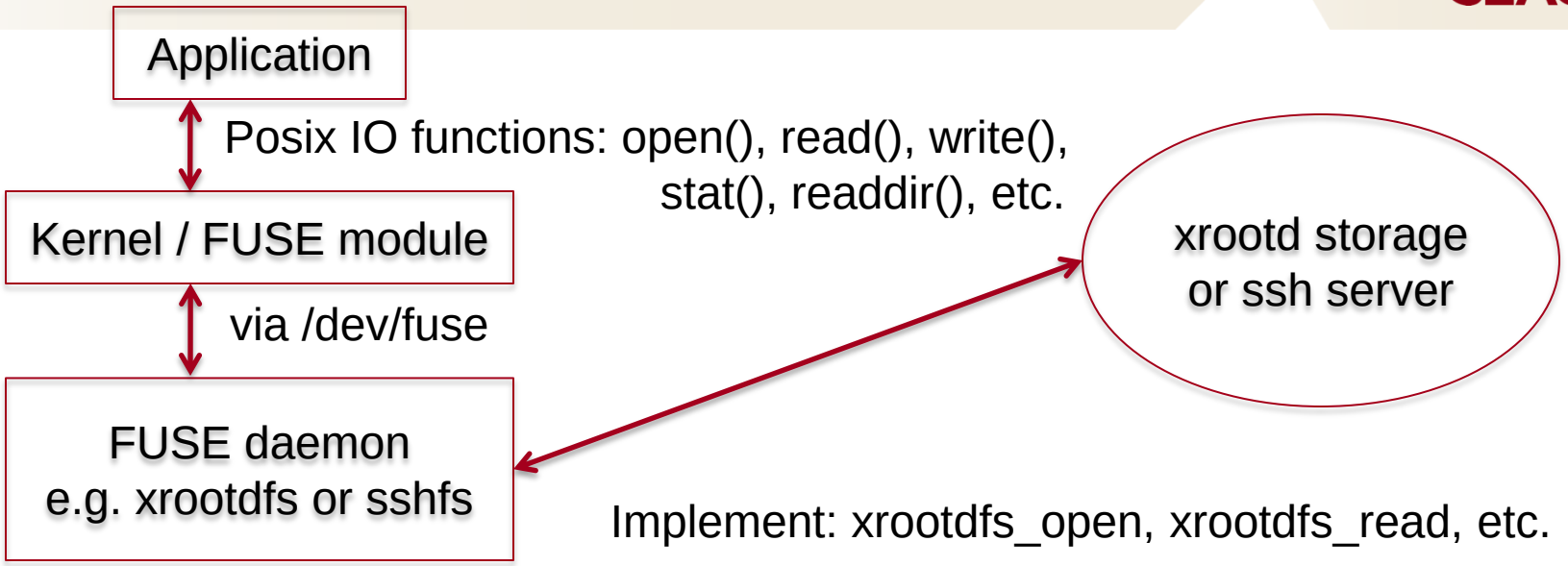
Introduction

- Xrootdfs is a posix file system for the xrootd storage
  - » Mount the xrootd storage and use standard Unix commands
  - » Implement most of the posix functions supported by the xrootd posix IO API
  - » Use the FUSE framework
    - Imagine how much work we need to do if there is no FUSE
- Applications access xrootd storage without knowledge of the xroot protocol
  - » Initially motivation was to use Berkeley SRM with xrootd storage
  - » Many other applications also work on xrootdfs:
    - Gridftp, bbcp, scp/sftp, root/proofLite

FUSE in one slide



- A daemon running in user space and communication between kernel and storage. **It is a xrootd client**
- Applications talk to the kernel, not the daemon
- The daemon implement a set of posix-like functions under the FUSE framework
  - » Customized for the specific storage:
  - » Example: xrootdfs, sshfs, ftpfs, etc.

Xrootdfs daemon detail

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Three categories of functions

- Data IO, Meta Data IO, Query and Control

- Data IO functions:
  - open(), read(), write(), release() (async close)
  - Assign each file a 128KB cache to capture sequential writes
    - Note linux kernel breaks large write into 4KB blocks
      (except very recent kernel and FUSE combination)

- Query & Control of xrootdfs internal parameters
  - Via filesystem extended attribute (xattr)
    - For example, refresh the internal list of xrootd data servers
      getfattr –n xrootdfs.fs.dataserverlist -–only-value /mountpoint
      setfattr –n xrootdfs.fs.dataserverlist /mountpoint
    - Change the # of threads working on meta data operations

Xrootdfs daemon detail, cont'd

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- Meta data operation functions
  - » Meta data on all of xrootd data servers need to be handled, e.g.
    - readdir() combines directory entries from all data servers, with duplicated ones removed.
    - unlink() need to delete an item from all data servers.
    - Return code, errno from each data server need to be combined.
  - » Implemented a queue to handle the meta data IO
    - To prevent overwhelming the data servers by meta data IO
    - A number of worker threads dedicated to handle them
      - The number is queried/adjusted via xattr.
  - » Special considerations
    - Brute force stat() (on all data servers via the queue) to avoid the 5 second delay on non-existing files
      - Why? Consider an application searching a .so on a xrootdfs path
    - Caching directory entries to avoid brute force stat() on common usages
      - ls -l dir or find /dir -mtime +10 –exec … {} \;

Security

- Can use any xrootd security plugin
  - » “unix”, “gsi”, none, etc.
  - » Only “sss” allows xrootdfs to pass the actual usernames (not uid) to the xrootd server
    - Servers and xrootdfs instances share a predefined “sss” key: the servers trust the xrootdfs
- Xrootd use ACL based authorization
  - » Defined at the Xrootd server side
  - » chmod, chown, chgrp won’t work
  - » Query your own access privilege

```
$ getfattr –n xrootdfs.file.permission
  /xrootd/atlas/atlasdatadisk
getfattr: Removing leading '/' from absolute path names
# file: xrootd/atlas/atlasdatadisk
xrootdfs.file.permission="lr"
```

Other things supported/unsupported

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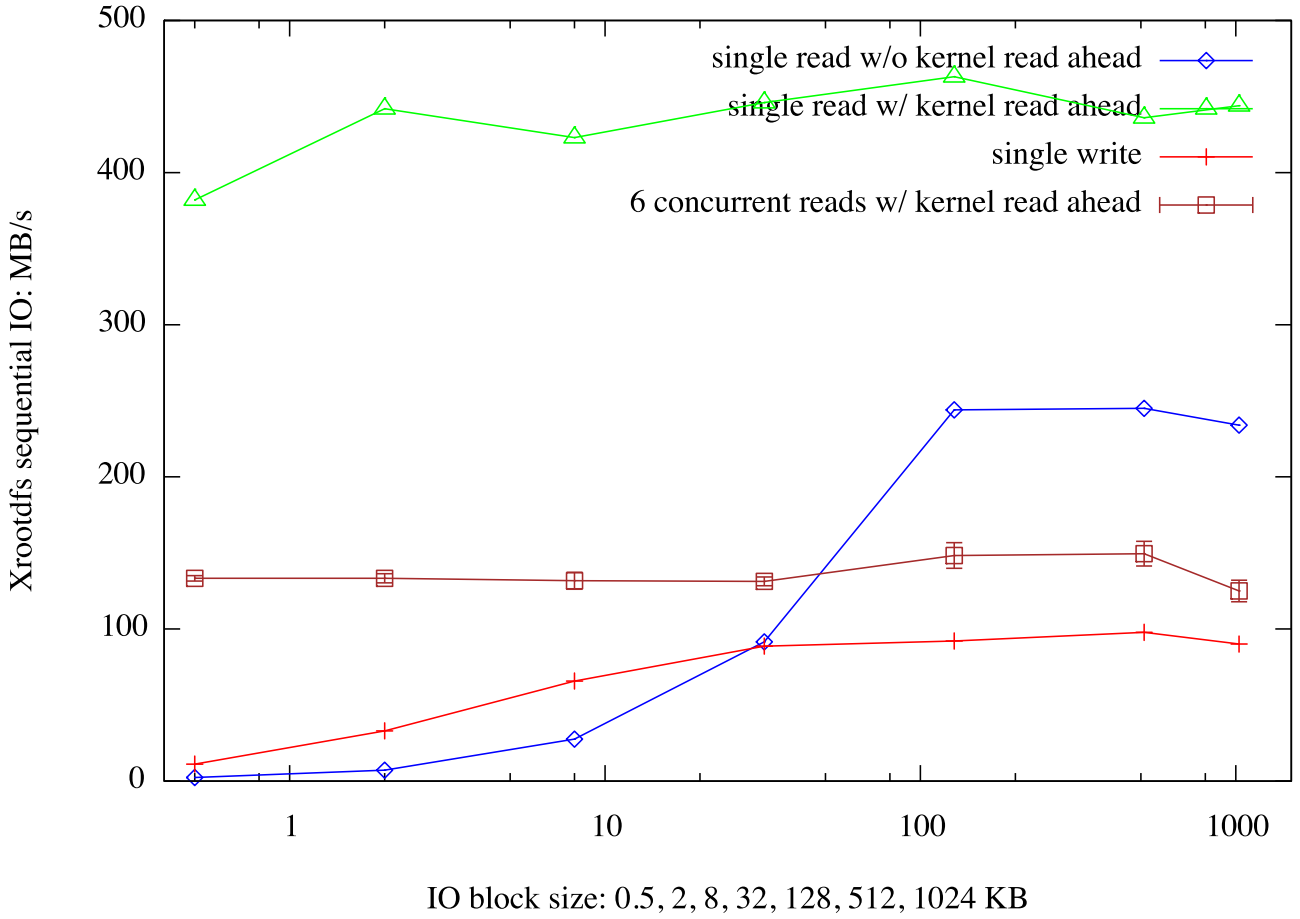
- Support Composite Name Space (CNS)
  - » CNS hosts the complete file system metadata info
    - on one auxiliary xrootd server that is not part of the cluster.
  - » Some files may not be available for access immediately (even thought their meta data is available), e.g. files on tape.
  - » In a disk only environment, CNS is seldom used nowadays
- Don’t support changing mtime, atime, etc.
- Don’t support file locking
- close() are asynchronous
  - » Though xrootd sync() and close() will be called eventually

IO Performance



Meta data IO performance depends on the number of data servers and the number of worker threads

How to use it

Documented in “man xrootdfs”

- run from command line with debugging output

```
xrootdfs -d -o rdr=root://rdr:port//data,uid=daemon /mnt
```

- use with autofs

  add a line to /etc/auto.master

```
/- /etc/auto.fuse
```

  create /etc/auto.fuse with the following one line

```
/mnt -fstype=fuse,uid=2,rdr=root://rdr\:port//data :xrootdfs.sh
```

  create script /usr/bin/xrootdfs.sh (and set the +x bit)

```
#!/bin/sh
exec /usr/bin/xrootdfs $@ >/dev/null 2>&1
```

- Now you can cd, df, ls, rm

Backup Slides

Old measurement from 2009