Samba and Btrfs

A Snapshot of Progress

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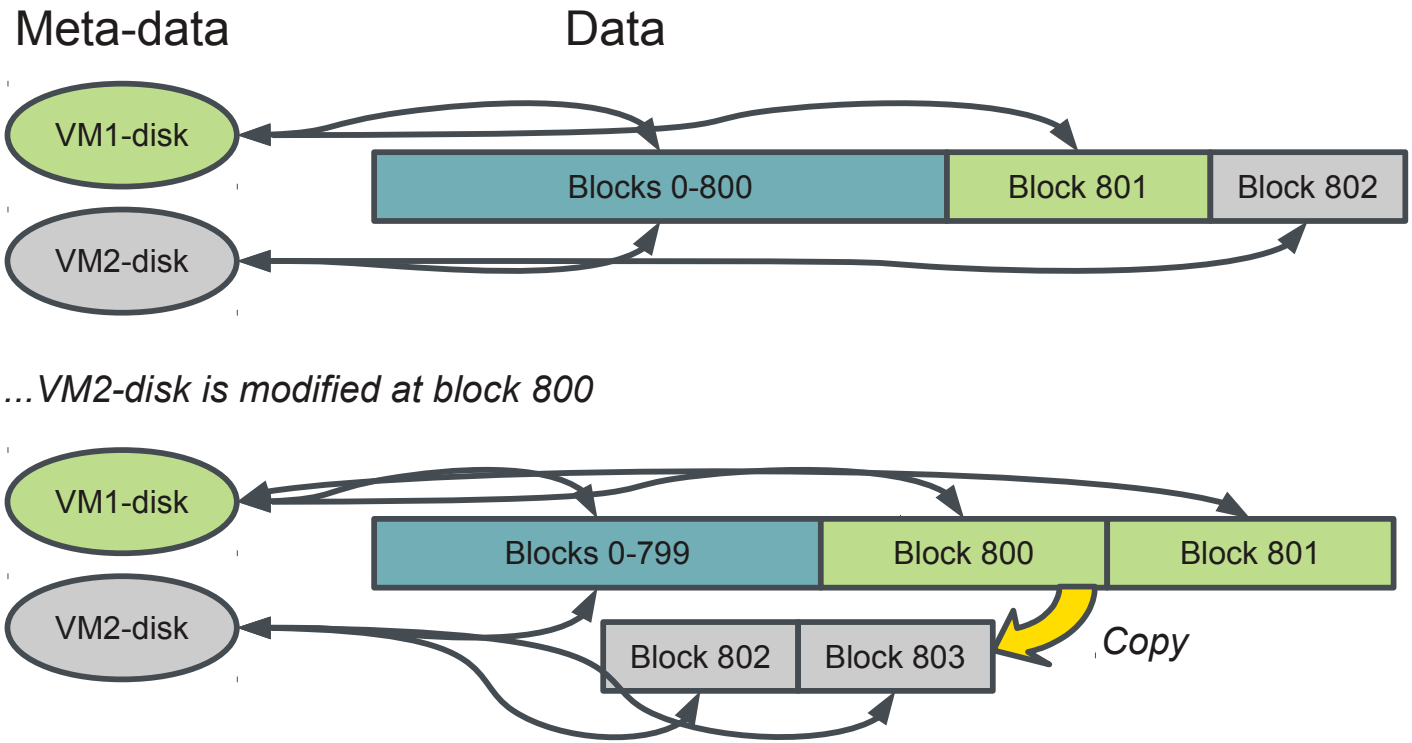
What is Btrfs?

- New filesystem for Linux
- Fully featured
  - Resiliency
    - Checksumming of data and meta-data
  - Redundancy
    - Multi-device support (mirrored data and meta-data, striped data)
  - Compression
  - Snapshots
  - De-duplication through shared data extents
    - Block, files or subvolume (snapshot) granularity

Shared Data Extents

Copy on Write



Benefits for Samba

- Shadow copies (snapshots)
  - Previous versions in Explorer
  - @GMT- token as path component
  - Management via File Server Remote VSS Protocol (FSRVP)
- Efficient server-side copy offload
- De-duplication
  - Data duplication avoidance from client to server

File Share Shadow Copies
Introduction

- File Server Remote VSS Protocol
  - MS-FSRVP new with Windows Server 2012
  - DCE/RPC requests via \pipe\FssagentRpc
  - Introduced by Molly Brown at SNIA SDC 2011

- Clients can manage shadow copies remotely
  - Determine which shares may be shadow copied
  - Request the creation of a shadow copy for a given share
  - Request the exposure of a shadow copy as a new share

File Share Shadow Copies
Windows

- Volume Shadow Copy Service (VSS) ecosystem
  - Application consistent shadow-copies for backup
  - Providers, Requestors and Writers
    - File Share Shadow Copy provider
    - VSS aware applications "Writers" on client flush to disk prior to snapshot
- Microsoft File Server Shadow Copy Agent Service
  - diskshadow.exe
  - System Center Data Protection Manager (DPM) 2012

File Share Shadow Copies
Samba FSRVP Client Implementation

- fsrvp.idl
  - Based on preliminary MS-FSRVP documentation
- rpcclient
  - fss_is_path_supported, fss_create_expose, fss_delete, etc.
  - Shadow copy identifiers need to be retained by the client
    - Strangely no shadow copy enumeration RPC
- Smbtorture test suite
  - rpc.fsrvp

File Share Shadow Copies
Samba FSRVP Server Implementation

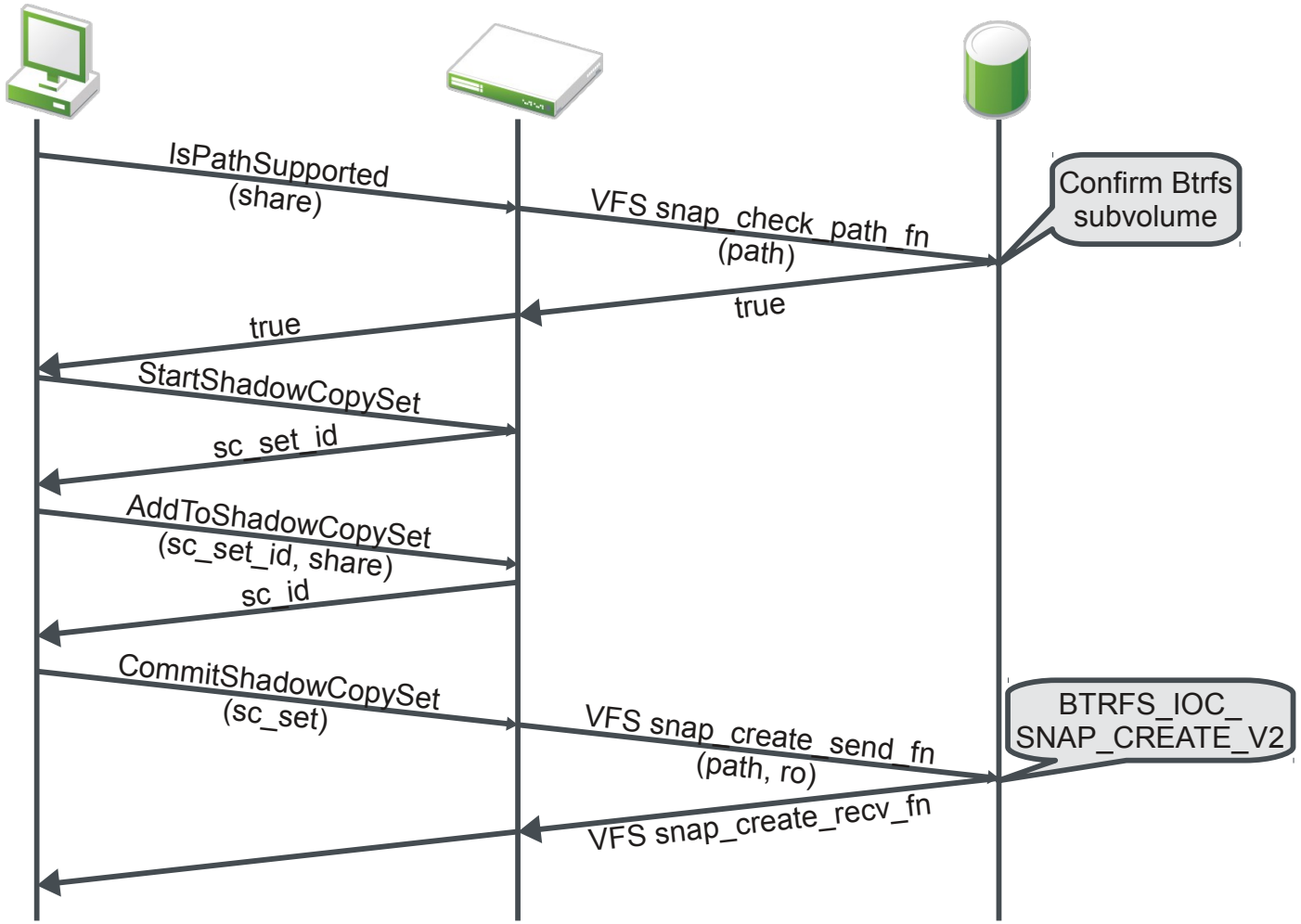
- Fssd forked on start-up
  - *rpc_daemon:fssd = fork*
  - *registry shares = yes*
- Snapshot requests propagated to VFS
  - Check whether path supports shadow copies
  - Asynchronous create/delete shadow copy requests
- Shadow copy shares defined in the registry
  - Clone of base share definition
  - libsmbconf

File Share Shadow Copies
Samba FSRVP Server Implementation

- vfs_btrfs
  - Issues Btrfs ioctls for snapshot creation and destruction
- vfs_snapper
  - System wide snapshot management and rollback
    - Module work in progress
- vfs_shadow_copy
  - Presents FSRVP snapshots as previous versions in Explorer
  - “@GMT-” path component

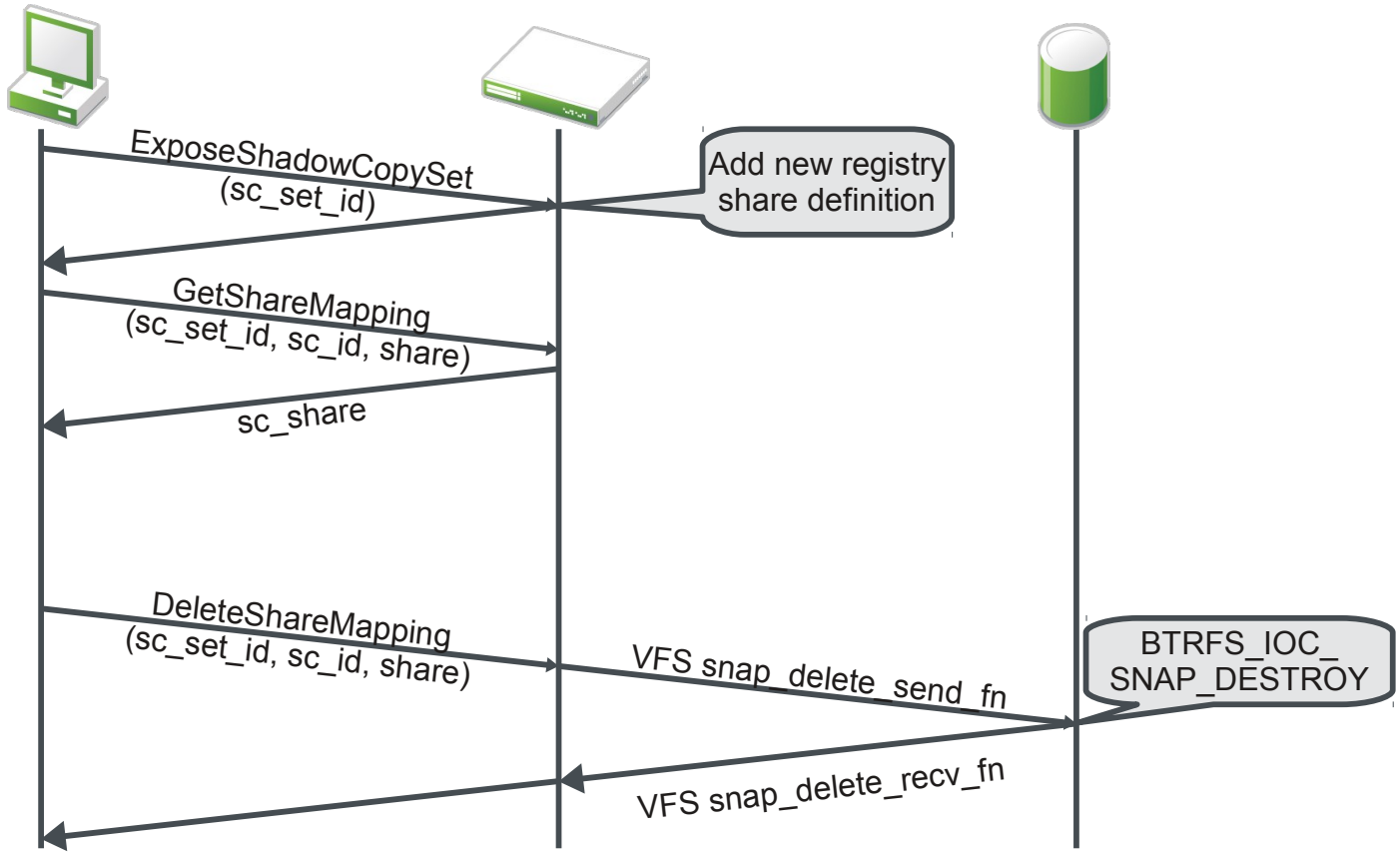
FSRVP on the Wire

Shadow Copy Creation



FSRVP on the Wire

Shadow Copy Exposure & Deletion



FSRVP Client Demo

- Server = Windows Server 2012 Beta
- Client = Samba rpcclient

FSRVP Server Demo

- Server = Samba with FSRVP changes
- Client = Samba rpcclient

Server-Side Copy

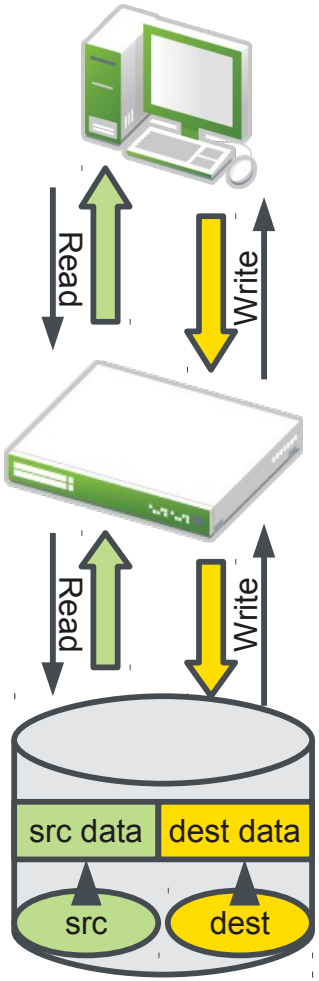
- Regular copy
  - Client reads data from the server
  - Client writes same data back to the server
  - Disk and network round trip
- Server-side copy
  - Client offloads the copy operation to the server
  - Server reads data from disk, then writes back
  - Disk round trip only
- Server-side copy SMBs
  - FSCTL_SRV_COPYCHUNK
    - FSCTL_SRV_REQUEST_RESUME_KEY (obtain source file identifier)
  - FSCTL_OFFLOAD_READ / FSCTL_OFFLOAD_WRITE

Server-Side Copy
Samba with Btrfs Enhancements

- Client offloads the copy operation to the server
  - SMB2 FSCTL_SRV_COPYCHUNK supported
    - Multiple chunks per request, 16M maximum offload per request
- Samba request Btrfs clone the range of bytes
  - BTRFS_IOC_CLONE_RANGE
  - Meta-data operation only, no network or disk round trip
    - Duplicate data does not consume disk space
  - Must be Btrfs block-size aligned

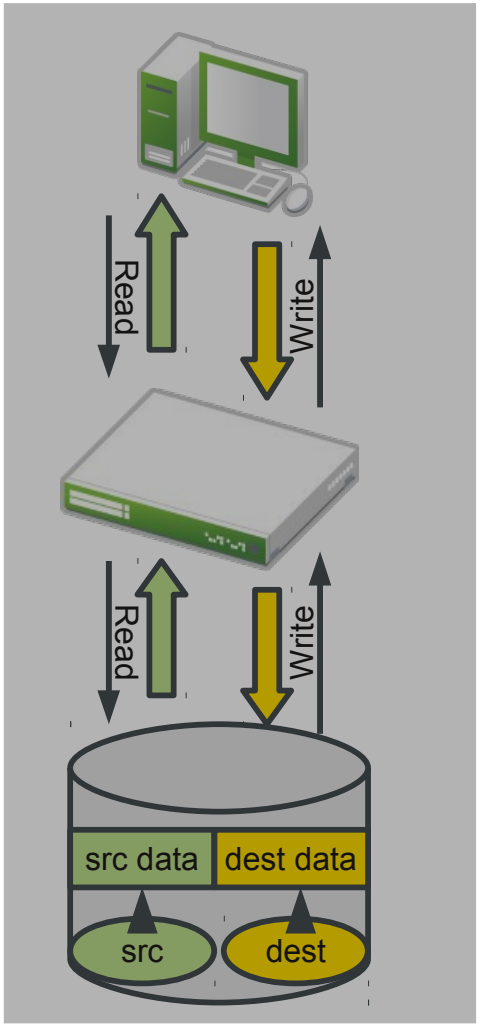
Server-Side Copy on the Wire

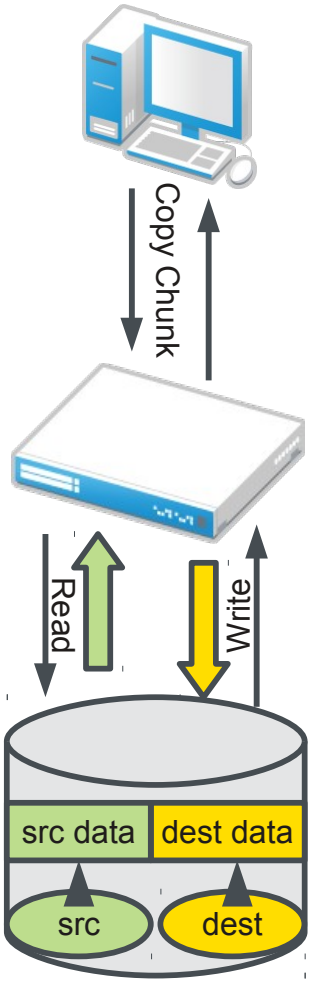
Client-Server exchange



Server-Side Copy on the Wire

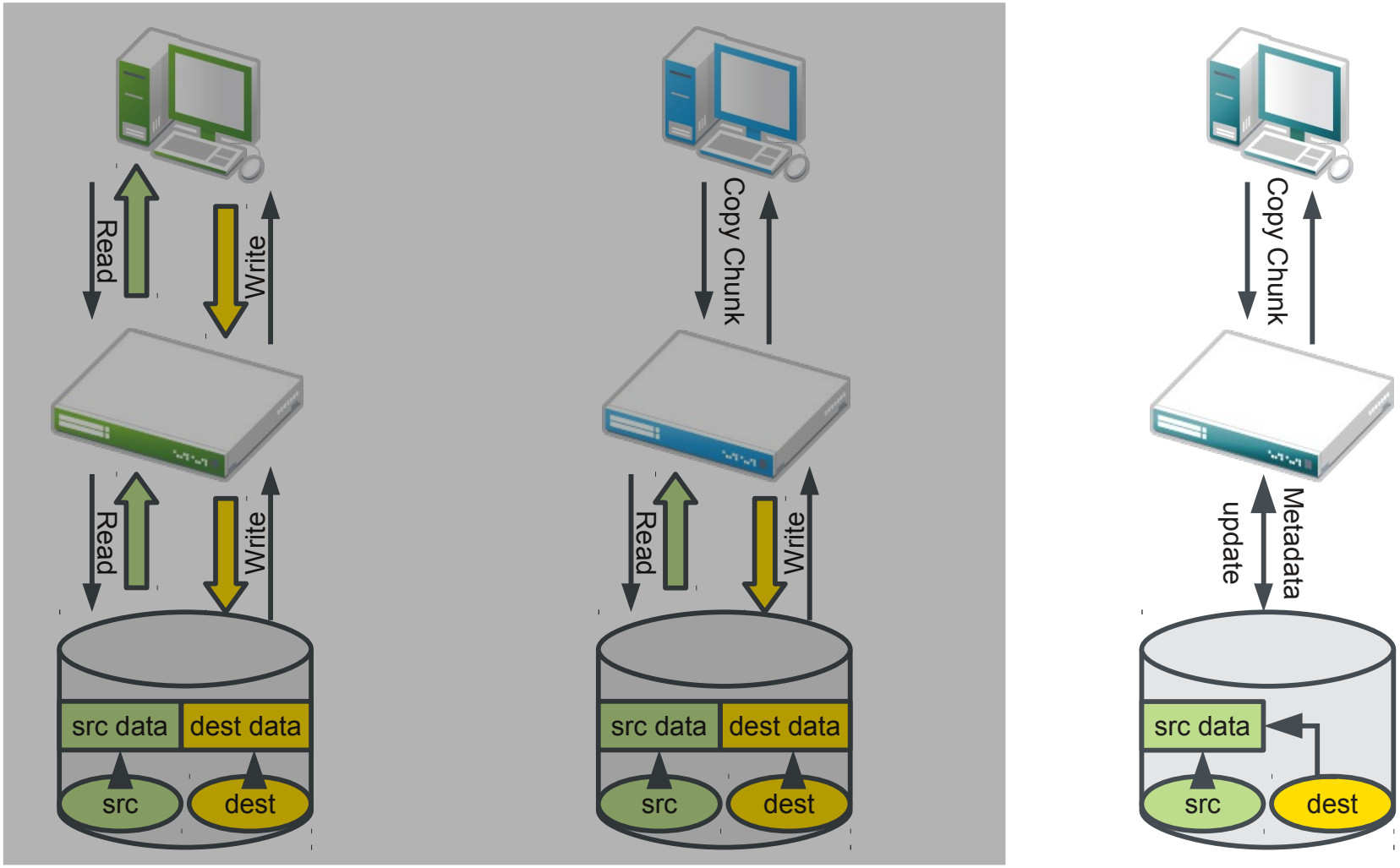
Client-Server exchange





Server-Side Copy on the Wire

Client-Server exchange



Server-Side Copy Demo

- Client = Windows Server 2012 Beta
- Server = Samba with server-side copy changes

Implementation State
Server-Side Copy

- Changes tested and (mostly) reviewed
  - Disjoint between SMB1 and SMB2 ioctl handlers
- Potential improvements
  - Encourage client Copy Chunk request alignment
    - IOCTL_STORAGE_QUERY_PROPERTY FileFSSectorSizeInformation
  - Linux CIFS kernel client support
  - Add support for new offload read/write ioctls
  - Support for other filesystems where possible
    - OCFS2, ZFS, etc.

Implementation State
FSRVP Server

- Further work required
  - Privilege checks
  - Thorough asynchronous RPC-server testing and review
  - Asynchronous dispatch of Btrfs snapshot ioctls
  - Store persistent FSRVP state in a TDB
  - Request and state timeouts

- Support for other filesystems
  - LVM + XFS, ZFS, etc

Questions?

Code: http://git.samba.org/?p=ddiss/samba.git
Slides: http://www.samba.org/~ddiss/

Thank you.

References

- Demonstrated Samba code
  - git://git.samba.org/ddiss/samba.git async_fsrvp_srv_wip_sxp2012
- MS-FSRVP preliminary documentation
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  - http://www.snia.org/sites/default/files2/SDC2011/presentations/tuesday/MollyBrown_Advancements_In_Backup.pdf
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- I Can't Believe This is Butter! A tour of btrfs by Avi Miller
  - http://www.youtube.com/watch?v=hxWuaozpe2I

References

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  - http://download.microsoft.com/download/6/7/6/676CCB32-8ECC-4793-A698-68D0AFD2F1A9/WS8%20Beta%20Storage%20and%20Availability%20White%20Paper.pdf
- Offline Deduplication for Btrfs
  - http://thread.gmane.org/gmane.comp.file-systems.btrfs/8448


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