

System Administration

Week 09, Segment 3 Time Travel and Snapshots

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```
-r-xr-xr-x  1 root  wheel    364 Jan 22 00:44 xdm
-r-xr-xr-x  1 root  wheel    348 Jan 22 00:44 xfs
-r-xr-xr-x  1 root  wheel    417 Jan 22 00:44 ypbind
-r-xr-xr-x  1 root  wheel    539 Jan 22 00:44 yppasswdd
-r-xr-xr-x  1 root  wheel    428 Jan 22 00:44 ypserv
-r-xr-xr-x  1 root  wheel    614 Jan 22 00:44 zfs
```

/usr/local:

total 2

```
drwxr-xr-x  7 1001  1001  512 Apr  3 20:33 working-copy
```

```
server-to-back-up# echo yay
```

yay

```
server-to-back-up# df
```

Filesystem	1K-blocks	Used	Avail	%Cap	Mounted on
/dev/xbd0a	10318062	1232044	8570116	12%	/
ptyfs	1	1	0	100%	/dev/pts
/dev/fss0	10318062	1226792	8575368	12%	/mnt

```
server-to-back-up# umount /mnt
```

```
server-to-back-up# fssconfig -u fss0
```

```
server-to-back-up# ls -l /backup
```

```
-rw-----  1 root  wheel 10736370152 Apr  4 03:40 /backup
```

```
server-to-back-up# rm /backup
```

```
override rw----- root:wheel for '/backup'? y
```

```
server-to-back-up#
```

Filesystem Snapshots

In contrast to other backup mechanisms we've seen:

- snapshot creation is near-instantaneous
- snapshot takes up (virtually) no additional space
- snapshot can be mounted and traversed like any other filesystem
- snapshots are immutable
- since all permissions and protections remain, you effectively get “self-restore” capabilities
- snapshots are bound to the system they were taken on

Filesystem Backup

Example: Mac OS X “Time Machine”

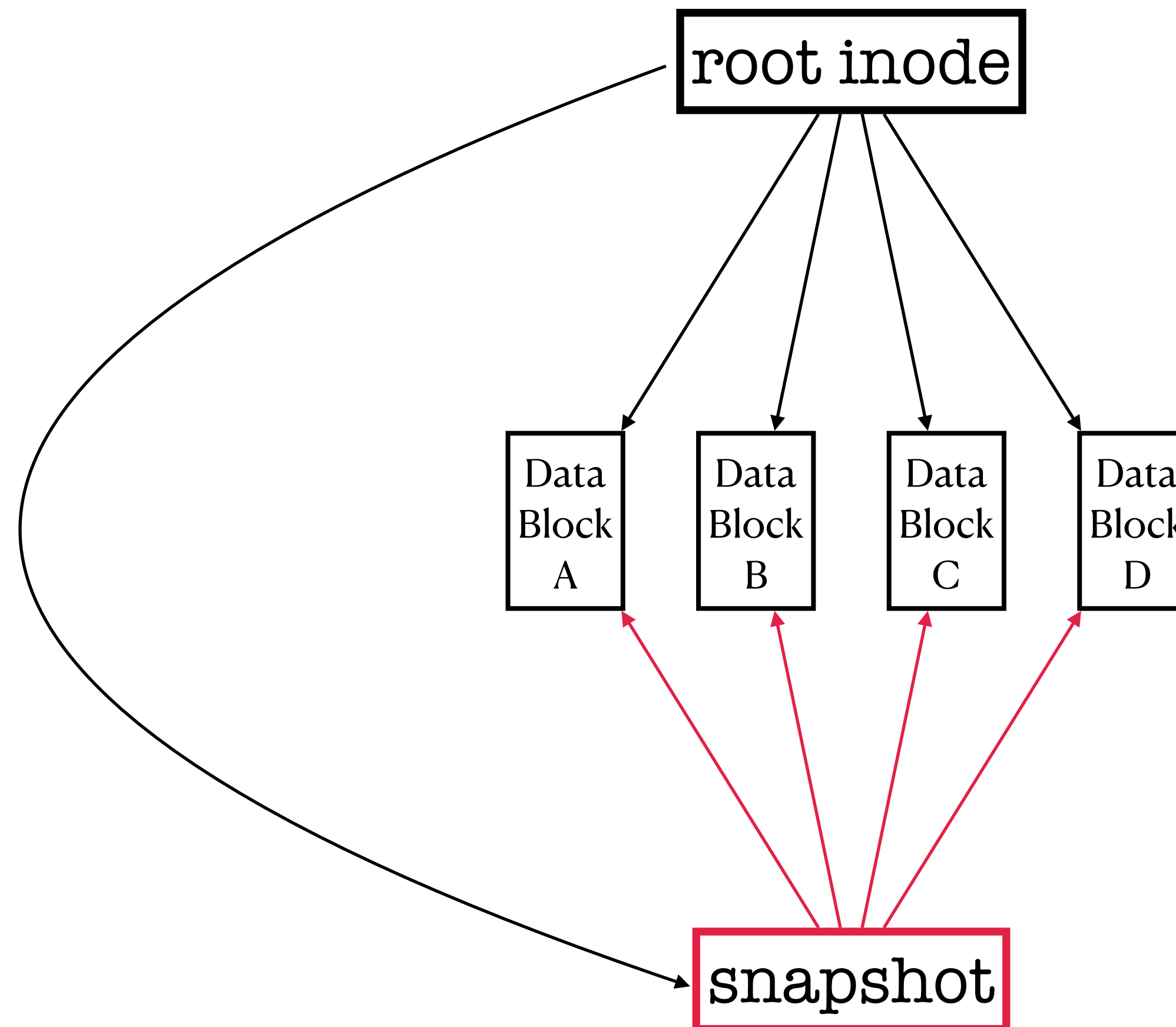
- automatically creates a full backup (equivalent of a “level0 dump”) to separate device or NAS, recording (specifically) last-modified date of all directories
- every hour, creates a full copy via hardlinks (hence no additional disk space consumed) for files that have not changed, new copy of files that have changed
- changed files are determined by inspecting last-modified date of directories (cheaper than doing comparison of all files’ last-modified date or data)
- saves hourly backups for 24 hours, daily backups for the past month, and weekly backups for everything older than a month

Filesystem Backup

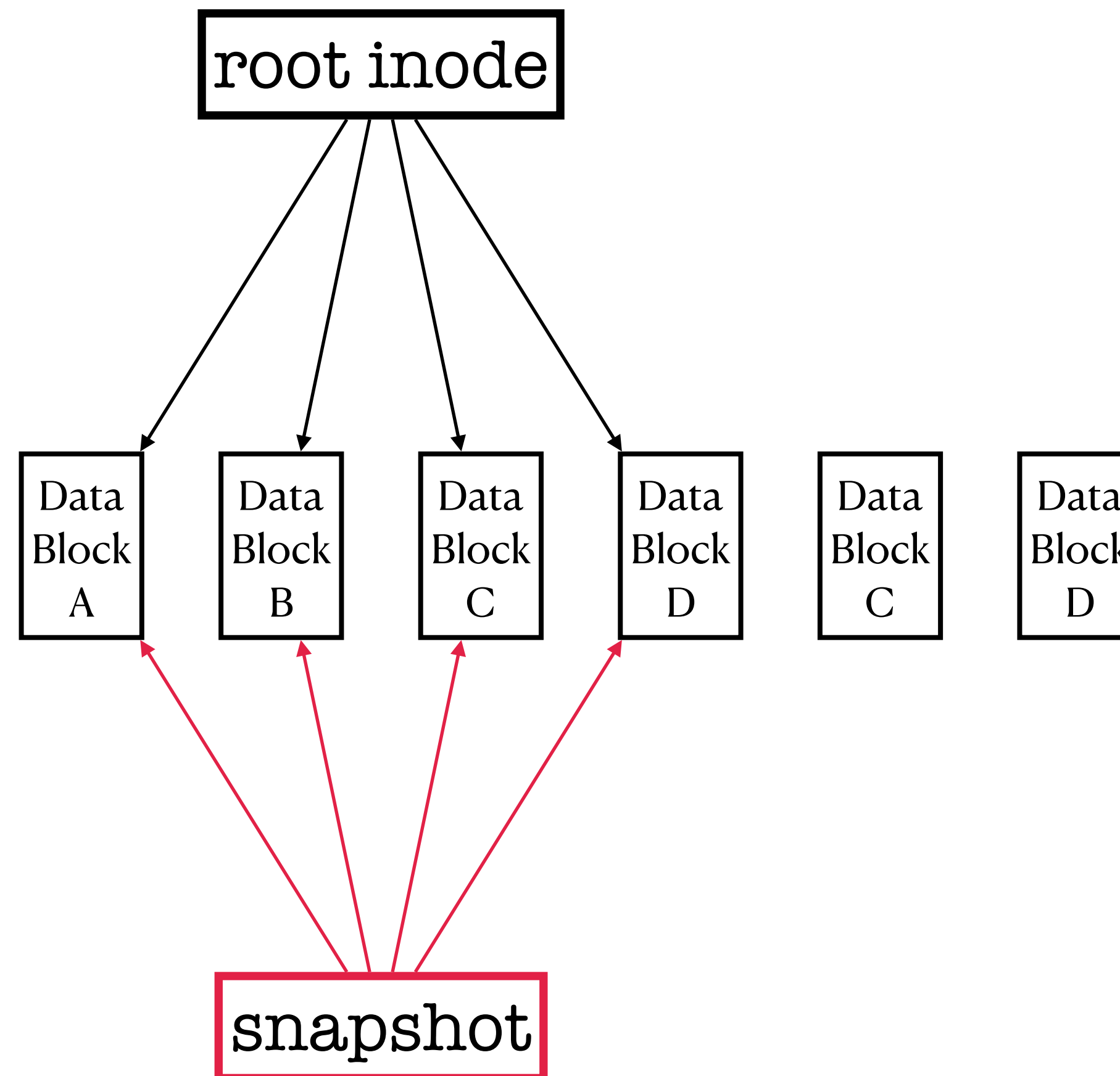
Example: WAFL (Write Anywhere File Layout)

- used by NetApp's "Data ONTAP" OS
- uses regular snapshots ("consistency points", every 10 seconds) to allow for speedy recovery from crashes
- a snapshot is a read-only copy of a file system (cheap and near instantaneous, due to Redirect-on-Write (RoW))

Example: WAFL (Write Anywhere File Layout)

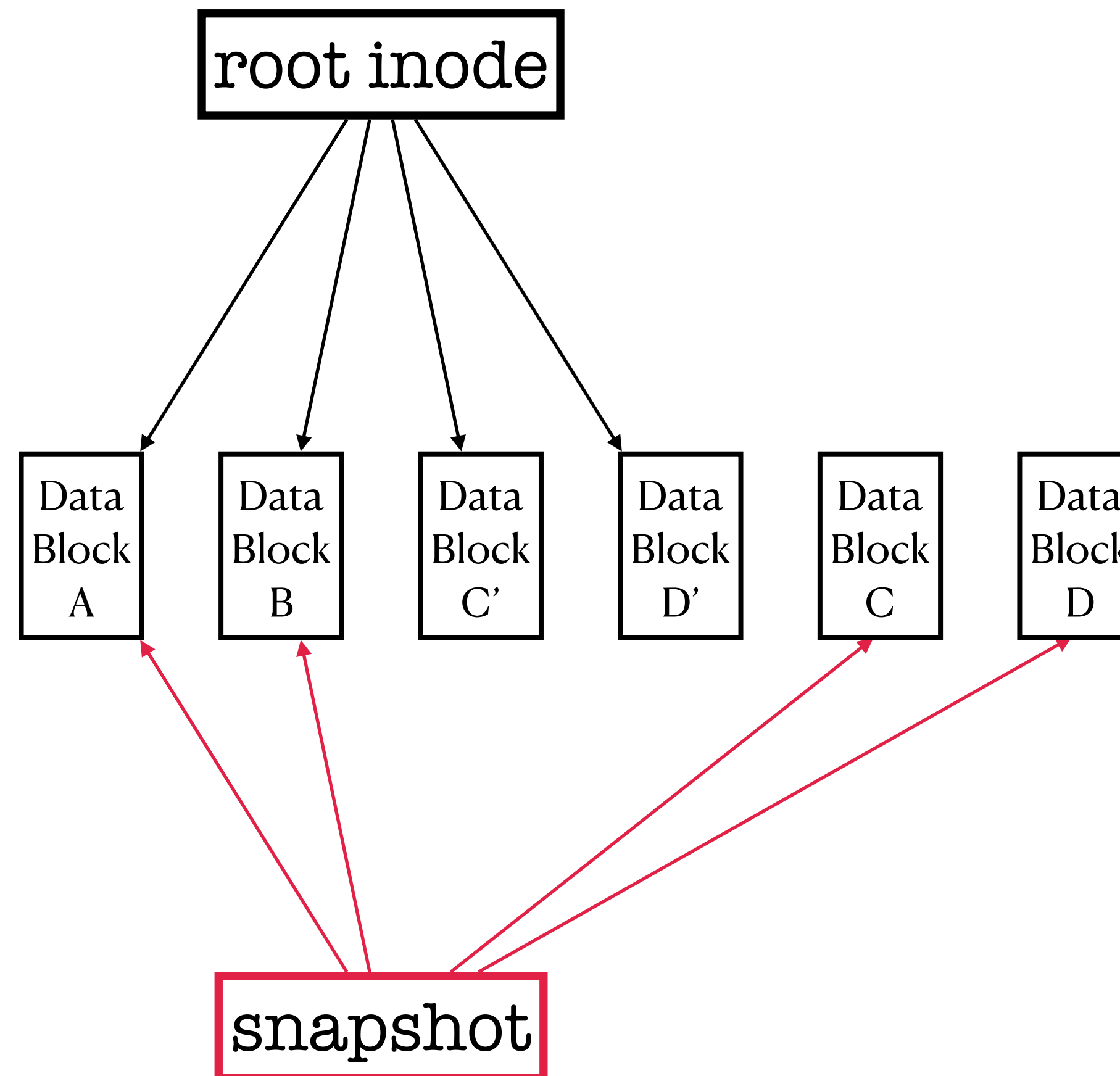


Example: WAFL (Write Anywhere File Layout)



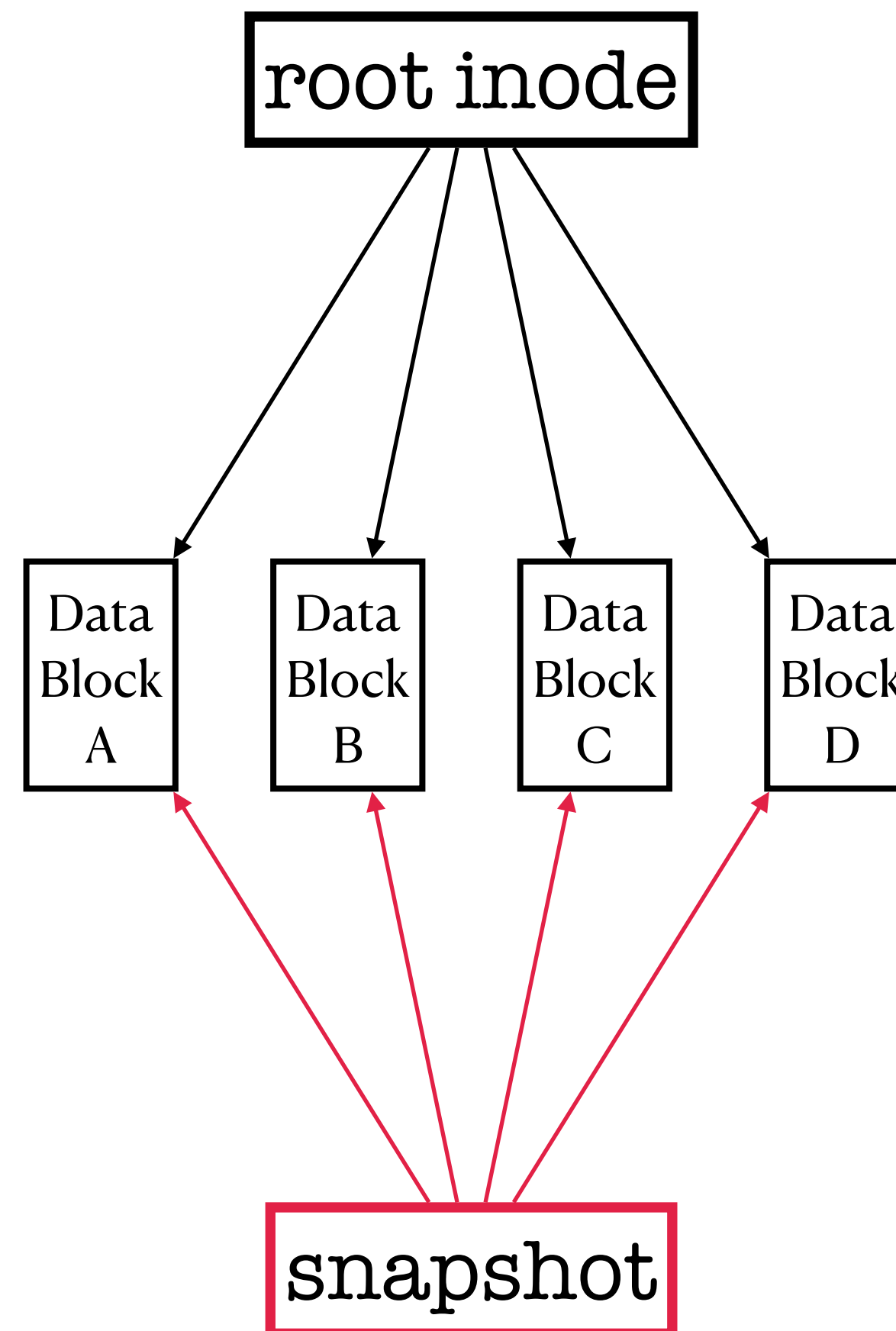
Example: WAFL (Write Anywhere File Layout)

Copy-on-Write



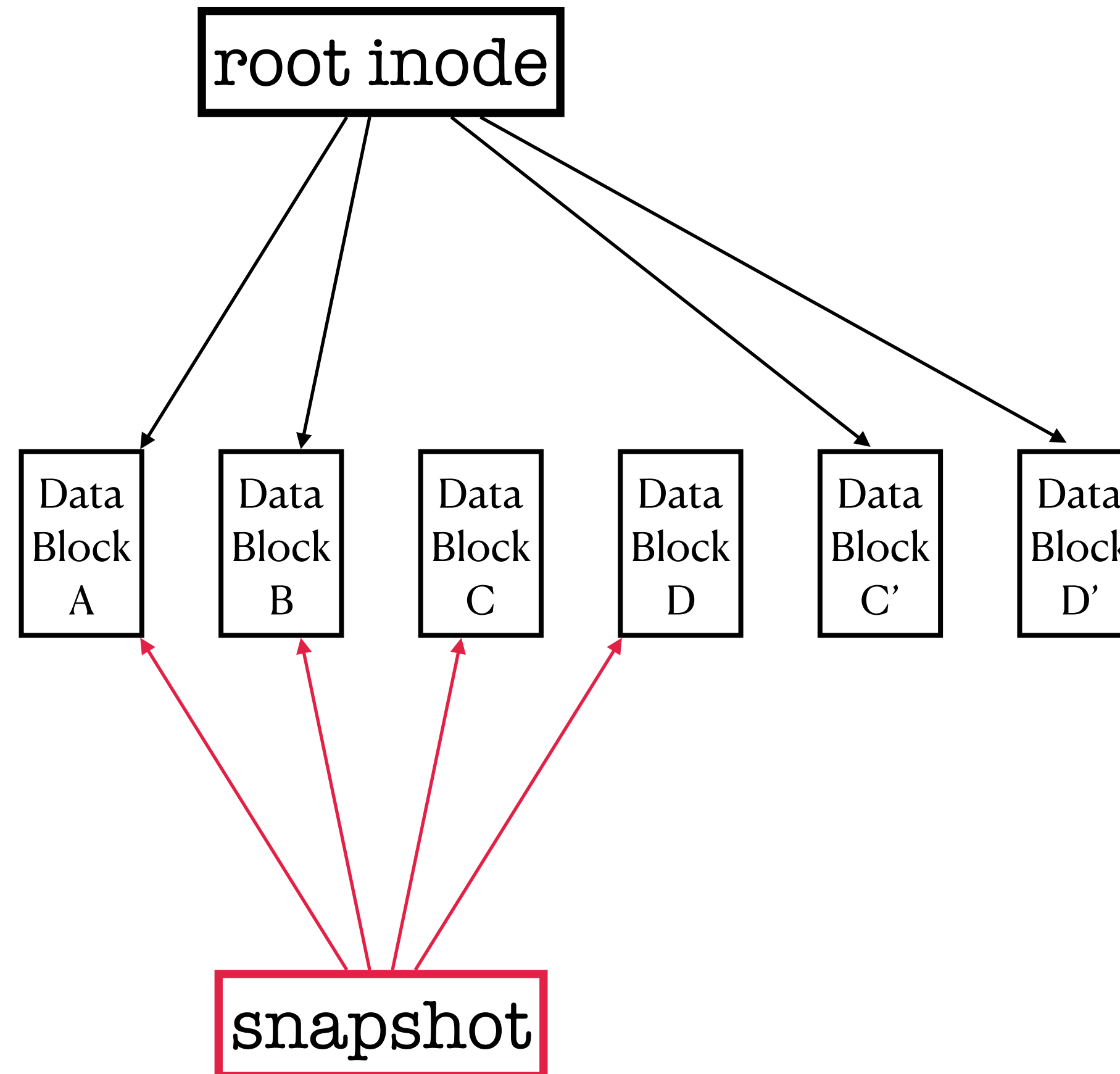
Example: WAFL (Write Anywhere File Layout)

Redirect-on-Write

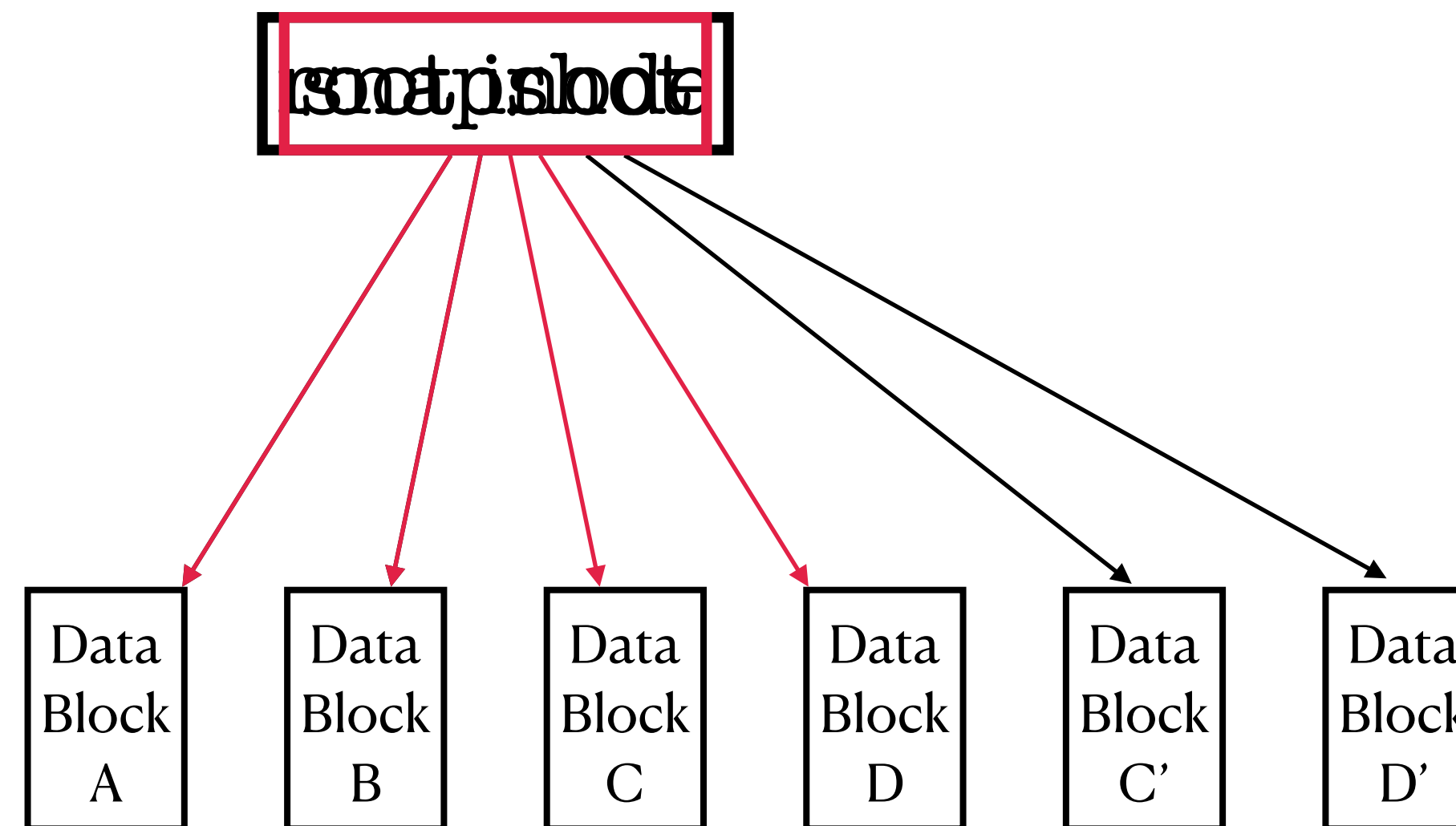


Example: WAFL (Write Anywhere File Layout)

Redirect-on-Write faster
than *Copy-on-Write*



Example: WAFL (Write Anywhere File Layout)



Common subdirectories: /root/./.ssh and /.zfs/snapshot/20210406172012/root/./.ssh

Only in /root/.: date-of-last-incident

Only in /.zfs/snapshot/20210406172012/root/./.ssh: authorized_keys

```
[root@ip-10-10-0-30:~# cp /.zfs/snapshot/20210406172012/root/./.ssh/authorized_keys /root/.ssh
```

```
[root@ip-10-10-0-30:~# date >/root/last-recovered
```

```
[root@ip-10-10-0-30:~# rm /root/.ssh/authorized_keys
```

```
[root@ip-10-10-0-30:~# date >> /root/date-of-last-incident
```

```
[root@ip-10-10-0-30:~# ls /root
```

```
date-of-last-incident  last-recovered
```

```
[root@ip-10-10-0-30:~# zfs list -t snapshot
```

NAME	USED	AVAIL	REFER	MOUNTPOINT
rpool/R00T/omnios-r151034m@kayak	48.3M	-	745M	-
rpool/R00T/omnios-r151034m@20210406172012	224K	-	860M	-

```
[root@ip-10-10-0-30:~# zfs rollback rpool/R00T/omnios-r151034m@20210406172012
```

```
[root@ip-10-10-0-30:~# ls /root
```

```
[root@ip-10-10-0-30:~# ls /root/.ssh
```

```
authorized_keys
```

```
[root@ip-10-10-0-30:~# zfs destroy rpool/R00T/omnios-r151034m@20210406172012
```

```
[root@ip-10-10-0-30:~# zfs list -t snapshot
```

NAME	USED	AVAIL	REFER	MOUNTPOINT
rpool/R00T/omnios-r151034m@kayak	48.3M	-	745M	-

```
root@ip-10-10-0-30:~#
```


Summary

- Snapshots are fast and (comparatively) cheap — use ‘em!
- Snapshots allow for trivial self-restore within the Recovery Point Objective and minimal Recovery Time Objective.
- Snapshots allow for
 - consumer backup solutions (e.g., macOS Time Machine)
 - enterprise scale safety and redundancy (e.g., NetApp OnTAP WAFL)
 - end-user data recovery (e.g., ZFS, BTRFS, FFS)
- Combine with other backup strategies for a comprehensive disaster recovery plan.

Remember: your backups need to be regular, frequent, automated, and regularly verified!

Links

- https://wiki.netbsd.org/tutorials/the_netbsd_system_manager__39__s_manual/#index34h2
- https://wiki.netbsd.org/tutorials/how_to_use_snapshots/
- <https://el7i.github.io/articles-netbsd-backup/>
- https://en.wikipedia.org/wiki/DeLorean_time_machine
- [https://en.wikipedia.org/wiki/Time_Machine_\(macOS\)](https://en.wikipedia.org/wiki/Time_Machine_(macOS))
- https://en.wikipedia.org/wiki/Write_Anywhere_File_Layout
- <https://is.gd/AbHmzQ>
- <https://docs.oracle.com/cd/E19253-01/819-5461/gbcya/index.html>