#### OpenZFS on Linux Development

OpenZFS Developer Summit

November 6th, 2014

Brian Behlendorf behlendorf1@Ilnl.gov





#### LLNL-PRES-XXXXXX

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. Lawrence Livermore National Security, LLC

# **OpenZFS on Linux**

- Current version 0.6.3 (released June 12<sup>th</sup> 2014)
- Easy to install packages for many distributions.













- Large enthusiastic user community.
  - zfs-discuss@zfsonlinux.org
  - #zfsonlinux on freenode.net
  - http://zfsonlinux.org

#### **OpenZFS on Linux – Version 0.6.3**

- Near feature parity with other OpenZFS implementations.
- Systematically addressing gaps in functionality
- Wide spectrum of users
- Used on diverse hardware
- Contributions (0.6.2-0.6.3)
  - 58 different developers
  - 301 commits

#### **Highlights**

**Updated Write Throttle** 

**ARC Performance Improvements** 

**POSIX ACLs** 

File Attributes (immutable, append-only)

Relatime style updates

SELinux Integration

Systemd Integration

ZFS Event Daemon (ZED)

Aarch64 and Sparc64 Support

Over 200 Bug fixes

# **OpenZFS on Linux – Version 0.6.4**

- Continue to integrate OpenZFS features
- Continue to address known gaps
- Continue to improve Linux integration
- Contributions (0.6.3-HEAD)
  - 37 different developers
  - 141 commits

#### **Planned Highlights**

Feature Flag: Spacemap Histograms

Feature Flag: ZFS Bookmarks

Feature Flag: Hole Birth

Feature Flag: Embedded Data

Metaslab Improvements

Xattr Improvements

AIO and DirectIO Support

Fallocate Hole Punching

Linux Tracepoints

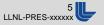
NFS access to .zfs/snapshot

100 bug fixes and counting



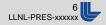
#### The Road to Version 1.0.0

- Minor releases have a development focus
  - 0.6.x Functionality / Integration
  - 0.7.x Memory Management
  - 0.8.x ZFS+SPL Consolidation
  - 0.9.x Stable ABI / Hardening
  - 1.0.x Feature Development / Performance
- Longer term roadmap to guide development
- Current development activities continue in parallel
- Features and bug fixes are merged when ready



#### **OpenZFS on Linux - Version 0.7.x**

- Focus: Memory Management
- Goal: ARC / page cache integration
  - Data buffers will be backed by page vectors
  - Data pages will be mapped in to the page cache
- Benefits:
  - Uses standard Linux memory accounting mechanisms
  - Uses standard Linux memory reclaim mechanisms
  - Eliminates fragmentation overhead
  - Eliminates mmap double caching
  - 32-Bit platform support (x86, ARM)



#### **OpenZFS on Linux - Version 0.8.x**

- Focus: ZFS+SPL Consolidation
- Goal: Merging ZFS+SPL git repositories
  - Existing layering is preserved
  - An opportunity to define the ZFS kernel ABI
- Benefits:
  - Simpler packaging for users and maintainers
  - Eliminates the kmod dependency problem
  - Eliminates the risk of mismatched versions
  - One source tree for developers
  - Improves portability for non-Linux platforms

#### **OpenZFS on Linux - Version 0.9.x**

- Focus: Stable ABI / Hardening
- Goal: Finalize a stable user/kernel ABI
- Benefits:
  - Smoother upgrades / downgrades
  - Establishes a clear a user/kernel ABI for Linux
- Goal: Hardening
  - Gracefully handle a wider range of potential failure modes
  - Fault management via the ZFS Event Daemon (ZED)
- Benefits:
  - Enables deployment of lower end commodity hardware
  - Even more robust operation

#### **OpenZFS on Linux - Version 1.0.x**

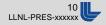
- Focus: Feature development / performance
- Goal: Mature high quality code base
- Benefits:
  - Semantic Versioning
  - New feature development
  - Performance analysis



# **Development Model**

- Project hosted at Github
  - https://github.com/zfsonlinux/
  - 1201 Watchers, 300 Forks
- illumos is tracked as upstream
- Independent of the Linux Kernel
  - Decouples ZFS from kernel updates
  - Linux 2.6.32 3.17 kernels supported
  - Enables use on non-Linux platforms
  - ZFS utilities / kmod can share code
  - Easier to integrate OpenZFS changes from Illumos/FreeBSD/OSX/OSV

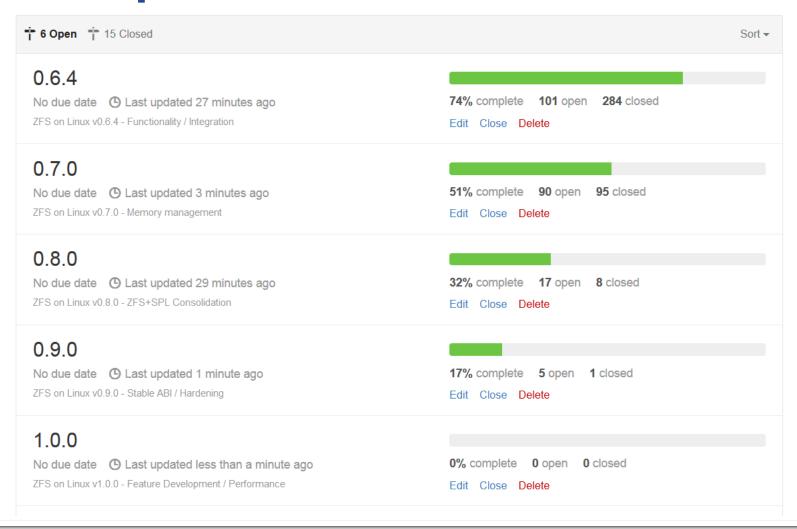




#### **Development Model – Issue Tracker**

- Github issue tracker
  - Feature requests, bug reports, and milestones
    - Developers actively participate on the tracker
    - 539 open issues including 115 feature requests
  - Everything is as open and public as possible
  - Discussion by users and developers is encouraged
  - Issues are cross-linked to relevant git commits

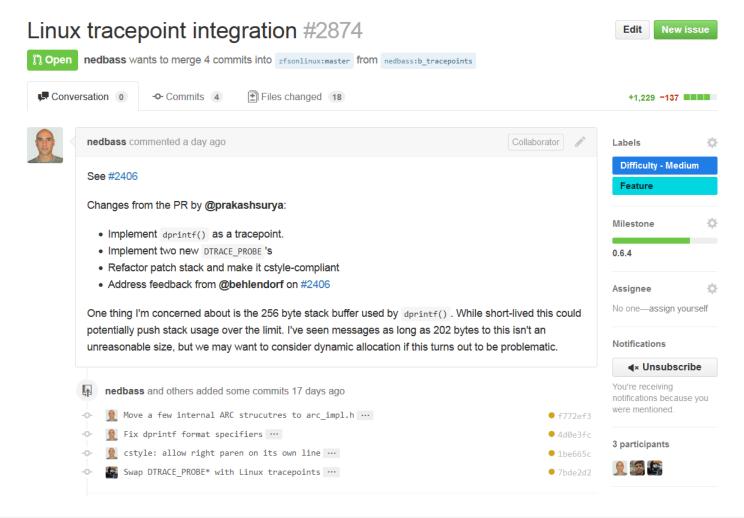
#### **Development Model - Milestones**



# **Development Model – Pull Requests**

- Github pull requests
  - Used to submit proposed code changes
  - All proposed changes must be reviewed
  - Continuous integration development model
    - Proposed changes are automatically tested using buildbot
    - Developers get quick feedback on any proposed change
    - Good test coverage (kernel, architecture, distribution, etc)
    - Changes are tested a second time after being merged
    - The master branch is *always* kept stable
  - Designed to make it easy for anyone to contribute
  - LLNL currently acts as the gatekeeper

#### **Development Model – Pull Requests**



# **Development Model - Buildbot**



#### Join Us, Contributors Welcome

- If you are a developer...
  - Port a change from Illumos/FreeBSD/OSX/OSV
  - Review or comment on a proposed pull requests
  - Implement a requested feature or fix a known issue
  - Help us improve the automated testing
- If you are a user...
  - Open a new issue if you encounter a problem
  - Open pull requests even for trivial fixes
  - Help us rigorously test new features and bug fixes



#### Questions



