# A path to OpenAFS 2.0: rxgk, IPv6, and more

Benjamin Kaduk
kaduk@mit.edu bkaduk@akamai.com

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# Things we want

- rxgk
- IPv6 support
- read-write replication
- per-file ACLs

# Things we get

- rxgk?

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- rxgk?
- ~~IPv6 support~~
- ~~read-write replication~~
- ~~per-file ACLs~~
- ...

That's where we want to be (and where we think we'll actually be able to get to).

In order to get there, we have to know where to start — where are we coming from?

# History

People have wanted rxgk for longer than I've been using AFS!

Back in 2006, the Elders published
`https://www.openafs.org/pages/no-more-des.html`.

> *After the 1.6 release, the build system will be modified to build OpenAFS without kaserver unless it is specifically requested.*
> *The OpenAFS Elders endorse the development of the rxk5 and rxgk security classes in order to enable the use of Kerberos 5 ciphers other than single DES for both authentication and data security between AFS clients and servers.*
> *When OpenAFS is capable of supporting Kerberos 5 with non-DES ciphers the major version number will be changed to "2".*

# IPv6

- OpenAFS is getting left behind
- World is running out of v4 addresses
- IPv6 is more and more common
  - cell networks
  - home networks, too!
  - Some ISPs charging more for v4 service
- v6 support is more than just replacing 32 bits with 128 bits

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  - Some ISPs charging more for v4 service
- v6 support is more than just replacing 32 bits with 128 bits
- and more than just keeping both and a way to choose
- (but we do still need to bump the vldb format to do anything)

# IPv6

I'm not an expert on IPv6 for AFS; talk to Jeff or Mike or Simon or some number of other people who know more.
But...

- privacy addresses — callbacks might not be deliverable!
- larger minimum packet sizes; rx must adapt its ideas of MTU handling
- Much larger physical packets possible, but rx jumbograms suck
- fragmentation is not automatic — must be prepared to resend in smaller chunks
- Will the OS let you get the ICMPv6 fragmentation needed notices?
- everybody becomes multihomed

# IPv6

- Many, many RPCs to update
- We're already "in the middle of" and RPC refresh . . . for the past five[1] years
- rxdebug
- happy eyeballs

[1] maybe more?

# Why 1.8?

- `openafs-stable-1_6_x` was branched on August 10, 2010
- 4658 commits on master since then, but only 2033 commits on 1.6 since then. (Most of the commits on 1.6 are cherry-picks from master, but not all; I didn't write the script to check.)
- Those other 2.5k commits have some useful features in them!
- `master` is actually pretty usable right now; rxgk and whatnot will probably break things temporarily. A new release gives a stable baseline to start from.
- We're also overdue for some breaking/intrusive changes that should only be done at a major release boundary.

# What's in 1.8?

Already on master:

- Code cleanup/robustness (e.g., from static analyzers, compiler warnings fixes, and general refactoring) — thanks, Simon!
- libtool in the build system for more reliable shared libraries, and other build system cleanup
- pthreaded dbservers
- Greatly reduced krb5 dependencies
- More reliable autoconf logic
- Windows stuff is quite different
- Some parts of the documentation are not embarassing
- ~~Improvements~~ changes to the rx stack (again, thanks, Simon!)
- libroken and libhcrypto from Heimdal
- Cache bypass on Linux
- OpenAFS Portable Runtime (opr) — thanks, Simon!
- Some afsd.fuse improvements

# What's in 1.8?

Already on master:

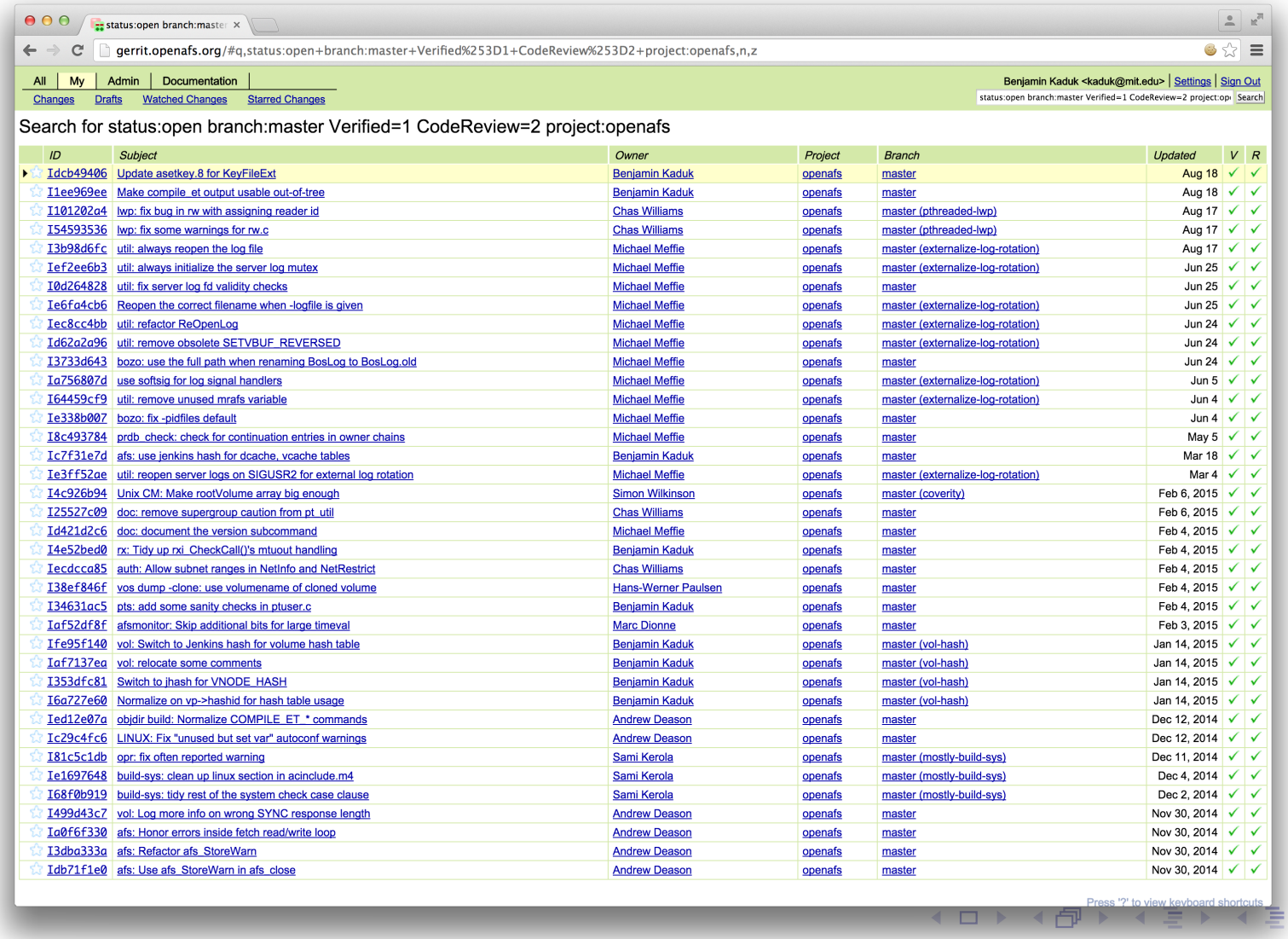
- cmd refactoring
- Something resembling a test suite framework
- New default for ihandle sync-ing behavior
- Some bosserver refactoring
- Ability to control ugen/ubik client flags more closely
- memcache improvements
- rxgen per-opcode stats
- openafs-client.conf and openafs-server.conf
- opr_Assert() vs. opr_Verify()
- More dbserver threads by default
- buserver uses libutil's logging (format changes)
- other changes to server logging, rotation
- CacheTruncateDaemon improvements
- Use Heimdal's rand-fortuna in the kernel

# What's in 1.8?

Already on master:

- ptserver wire format arrays' length is capped
- bos, pts emit error messages on stderr (not stdout)
- vos remaddrs
- opr_softsig

# In gerrit ready to be merged




| ID | Subject | Owner | Project | Branch | Updated | V | R |
|---|---|---|---|---|---|---|---|
| Idcb49406 | Update asetkey.8 for KeyFileExt | Benjamin Kaduk | openafs | master | Aug 18 | ✓ | ✓ |
| I1ee969ee | Make compile_et output usable out-of-tree | Benjamin Kaduk | openafs | master | Aug 18 | ✓ | ✓ |
| I101202a4 | lwp: fix bug in rw with assigning reader id | Chas Williams | openafs | master (pthreaded-lwp) | Aug 17 | ✓ | ✓ |
| I54593536 | lwp: fix some warnings for rw.c | Chas Williams | openafs | master (pthreaded-lwp) | Aug 17 | ✓ | ✓ |
| I3b98d6fc | util: always reopen the log file | Michael Meffie | openafs | master (externalize-log-rotation) | Aug 17 | ✓ | ✓ |
| Ief2ee6b3 | util: always initialize the server log mutex | Michael Meffie | openafs | master (externalize-log-rotation) | Jun 25 | ✓ | ✓ |
| I0d264828 | util: fix server log fd validity checks | Michael Meffie | openafs | master | Jun 25 | ✓ | ✓ |
| Ie6fa4cb6 | Reopen the correct filename when -logfile is given | Michael Meffie | openafs | master (externalize-log-rotation) | Jun 25 | ✓ | ✓ |
| Iec8cc4bb | util: refactor ReOpenLog | Michael Meffie | openafs | master (externalize-log-rotation) | Jun 24 | ✓ | ✓ |
| Id62a2a96 | util: remove obsolete SETVBUF_REVERSED | Michael Meffie | openafs | master (externalize-log-rotation) | Jun 24 | ✓ | ✓ |
| I3733d643 | bozo: use the full path when renaming BosLog to BosLog.old | Michael Meffie | openafs | master | Jun 24 | ✓ | ✓ |
| Ia756807d | use softsig for log signal handlers | Michael Meffie | openafs | master (externalize-log-rotation) | Jun 5 | ✓ | ✓ |
| I64459cf9 | util: remove unused mrafs variable | Michael Meffie | openafs | master (externalize-log-rotation) | Jun 4 | ✓ | ✓ |
| Ie338b007 | bozo: fix -pidfiles default | Michael Meffie | openafs | master | Jun 4 | ✓ | ✓ |
| I8c493784 | prdb_check: check for continuation entries in owner chains | Michael Meffie | openafs | master | May 5 | ✓ | ✓ |
| Ic7f31e7d | afs: use jenkins hash for dcache, vcache tables | Benjamin Kaduk | openafs | master | Mar 18 | ✓ | ✓ |
| Ie3ff52ae | util: reopen server logs on SIGUSR2 for external log rotation | Michael Meffie | openafs | master (externalize-log-rotation) | Mar 4 | ✓ | ✓ |
| I4c926b94 | Unix CM: Make rootVolume array big enough | Simon Wilkinson | openafs | master (coverity) | Feb 6, 2015 | ✓ | ✓ |
| I25527c09 | doc: remove supergroup caution from pt_util | Chas Williams | openafs | master | Feb 6, 2015 | ✓ | ✓ |
| Id421d2c6 | doc: document the version subcommand | Michael Meffie | openafs | master | Feb 4, 2015 | ✓ | ✓ |
| I4e52bed0 | rx: Tidy up rxi_CheckCall()'s mtuout handling | Benjamin Kaduk | openafs | master | Feb 4, 2015 | ✓ | ✓ |
| Iecdcca85 | auth: Allow subnet ranges in NetInfo and NetRestrict | Chas Williams | openafs | master | Feb 4, 2015 | ✓ | ✓ |
| I38ef846f | vos dump -clone: use volumename of cloned volume | Hans-Werner Paulsen | openafs | master | Feb 4, 2015 | ✓ | ✓ |
| I34631ac5 | pts: add some sanity checks in ptuser.c | Benjamin Kaduk | openafs | master | Feb 4, 2015 | ✓ | ✓ |
| Iaf52df8f | afsmonitor: Skip additional bits for large timeval | Marc Dionne | openafs | master | Feb 3, 2015 | ✓ | ✓ |
| Ife95f140 | vol: Switch to Jenkins hash for volume hash table | Benjamin Kaduk | openafs | master (vol-hash) | Jan 14, 2015 | ✓ | ✓ |
| Iaf7137ea | vol: relocate some comments | Benjamin Kaduk | openafs | master (vol-hash) | Jan 14, 2015 | ✓ | ✓ |
| I353dfc81 | Switch to jhash for VNODE_HASH | Benjamin Kaduk | openafs | master (vol-hash) | Jan 14, 2015 | ✓ | ✓ |
| I6a727e60 | Normalize on vp->hashid for hash table usage | Benjamin Kaduk | openafs | master (vol-hash) | Jan 14, 2015 | ✓ | ✓ |
| Ied12e07a | objdir build: Normalize COMPILE_ET * commands | Andrew Deason | openafs | master | Dec 12, 2014 | ✓ | ✓ |
| Ic29c4fc6 | LINUX: Fix "unused but set var" autoconf warnings | Andrew Deason | openafs | master | Dec 12, 2014 | ✓ | ✓ |
| I81c5c1db | opr: fix often reported warning | Sami Kerola | openafs | master (mostly-build-sys) | Dec 11, 2014 | ✓ | ✓ |
| Ie1697648 | build-sys: clean up linux section in acinclude.m4 | Sami Kerola | openafs | master (mostly-build-sys) | Dec 4, 2014 | ✓ | ✓ |
| I68f0b919 | build-sys: tidy rest of the system check case clause | Sami Kerola | openafs | master (mostly-build-sys) | Dec 2, 2014 | ✓ | ✓ |
| I499d43c7 | vol: Log more info on wrong SYNC response length | Andrew Deason | openafs | master | Nov 30, 2014 | ✓ | ✓ |
| Ia0f6f330 | afs: Honor errors inside fetch read/write loop | Andrew Deason | openafs | master | Nov 30, 2014 | ✓ | ✓ |
| I3dba333a | afs: Refactor afs_StoreWarn | Andrew Deason | openafs | master | Nov 30, 2014 | ✓ | ✓ |
| Idb71f1e0 | afs: Use afs_StoreWarn in afs_close | Andrew Deason | openafs | master | Nov 30, 2014 | ✓ | ✓ |

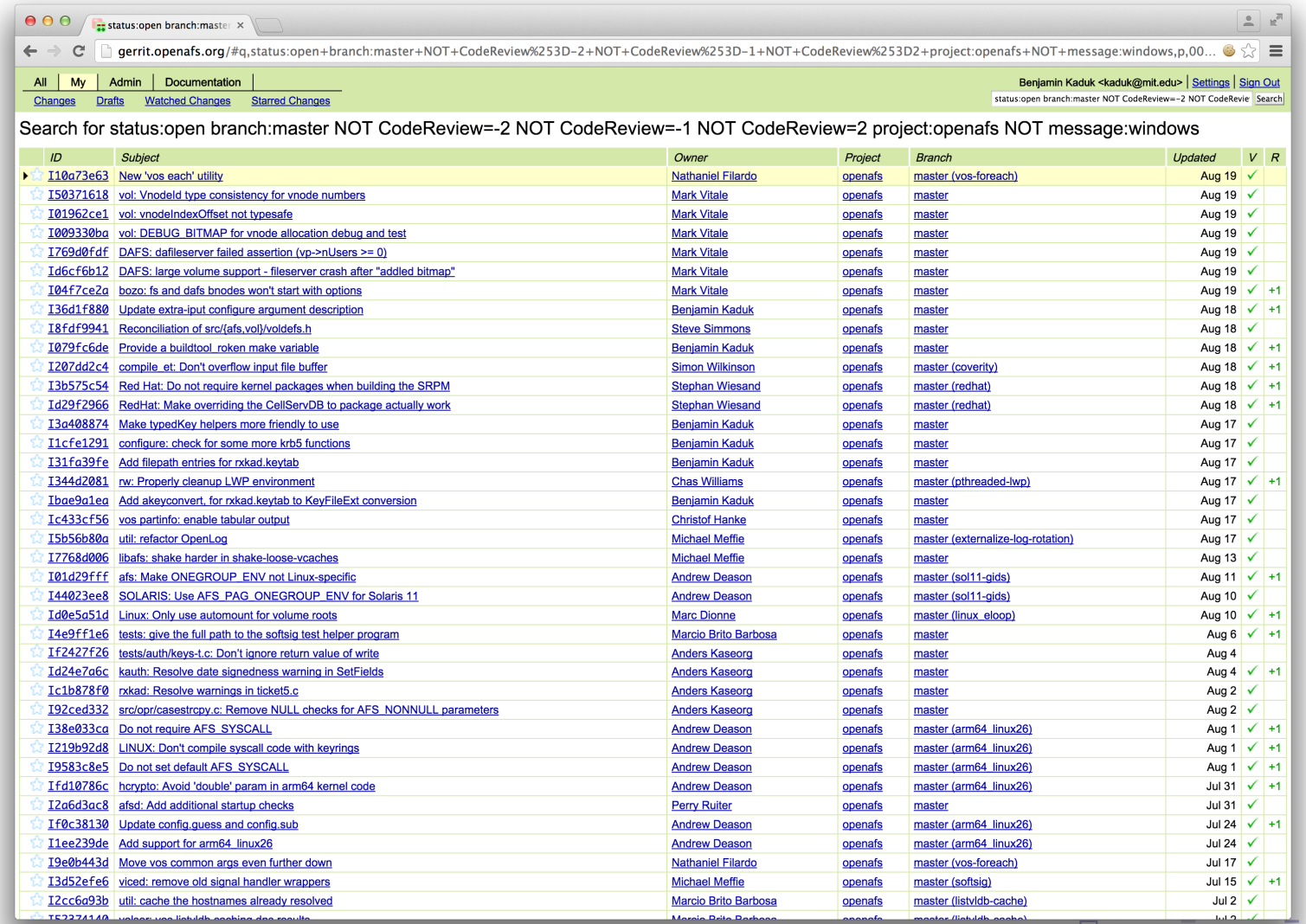
# In gerrit ready to be merged

38 changes with good code review. Need to actually get merged.

# In gerrit ready to be merged

- Jenkins hash in volume, vnode, vcache, dcache hash tables
- Subnet ranges in NetInfo/NetRestrict

# In gerrit needing review



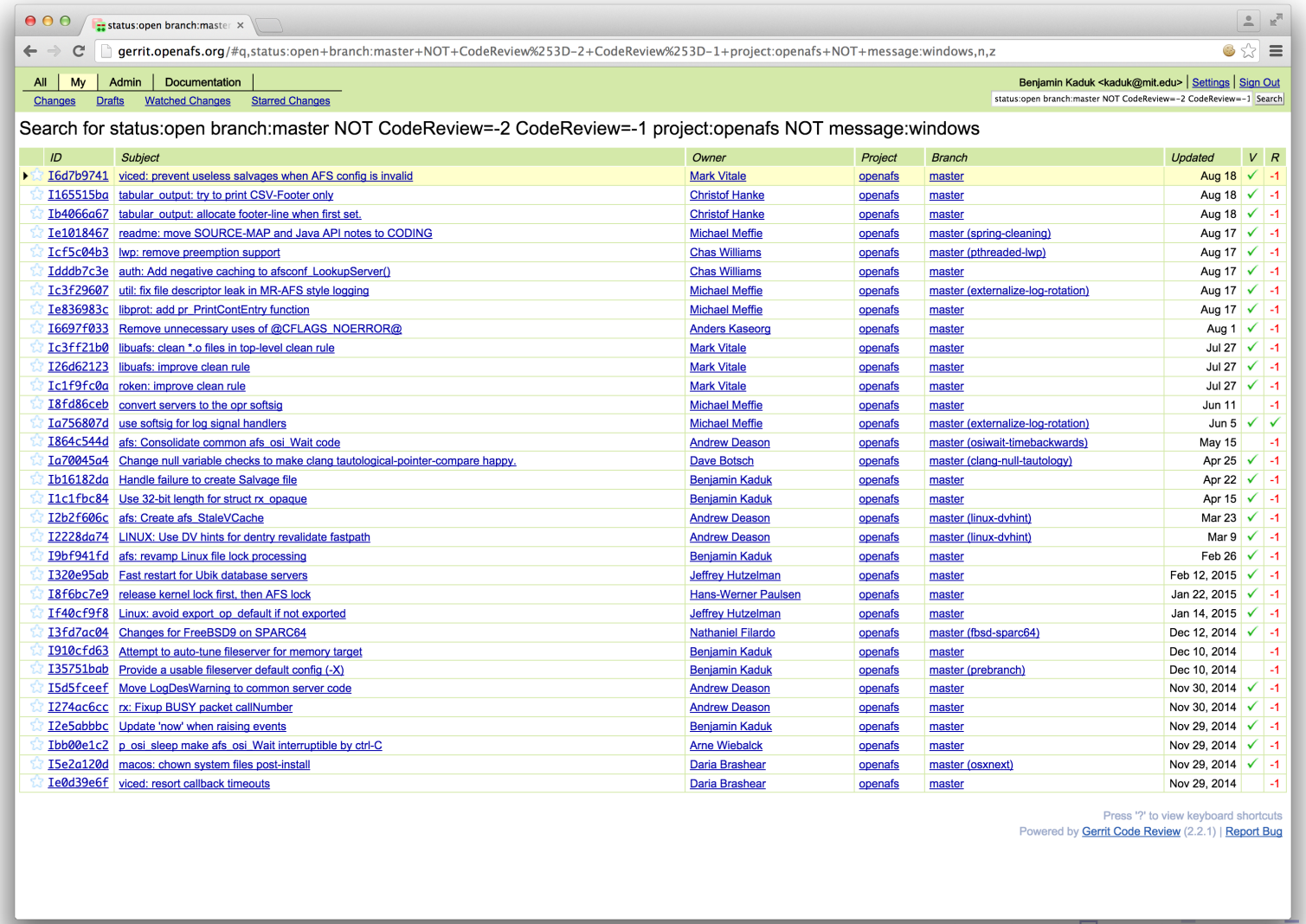

| ID | Subject | Owner | Project | Branch | Updated | V | R |
|---|---|---|---|---|---|---|---|
| I10a73e63 | New 'vos each' utility | Nathaniel Filardo | openafs | master (vos-foreach) | Aug 19 | ✓ | |
| I50371618 | vol: VnodeId type consistency for vnode numbers | Mark Vitale | openafs | master | Aug 19 | ✓ | |
| I01962ce1 | vol: vnodeIndexOffset not typesafe | Mark Vitale | openafs | master | Aug 19 | ✓ | |
| I009330ba | vol: DEBUG_BITMAP for vnode allocation debug and test | Mark Vitale | openafs | master | Aug 19 | ✓ | |
| I769d0fdf | DAFS: dafileserver failed assertion (vp->nUsers >= 0) | Mark Vitale | openafs | master | Aug 19 | ✓ | |
| Id6cf6b12 | DAFS: large volume support - fileserver crash after "addled bitmap" | Mark Vitale | openafs | master | Aug 19 | ✓ | |
| I04f7ce2a | bozo: fs and dafs bnodes won't start with options | Mark Vitale | openafs | master | Aug 19 | ✓ | +1 |
| I36d1f880 | Update extra-iput configure argument description | Benjamin Kaduk | openafs | master | Aug 18 | ✓ | +1 |
| I8fdf9941 | Reconciliation of src/{afs,vol}/voldefs.h | Steve Simmons | openafs | master | Aug 18 | ✓ | |
| I079fc6de | Provide a buildtool_roken make variable | Benjamin Kaduk | openafs | master | Aug 18 | ✓ | +1 |
| I207dd2c4 | compile_et: Don't overflow input file buffer | Simon Wilkinson | openafs | master (coverity) | Aug 18 | ✓ | +1 |
| I3b575c54 | Red Hat: Do not require kernel packages when building the SRPM | Stephan Wiesand | openafs | master (redhat) | Aug 18 | ✓ | +1 |
| Id29f2966 | RedHat: Make overriding the CellServDB to package actually work | Stephan Wiesand | openafs | master (redhat) | Aug 18 | ✓ | +1 |
| I3a408874 | Make typedKey helpers more friendly to use | Benjamin Kaduk | openafs | master | Aug 17 | ✓ | |
| I1cfe1291 | configure: check for some more krb5 functions | Benjamin Kaduk | openafs | master | Aug 17 | ✓ | |
| I31fa39fe | Add filepath entries for rxkad.keytab | Benjamin Kaduk | openafs | master | Aug 17 | ✓ | |
| I344d2081 | rw: Properly cleanup LWP environment | Chas Williams | openafs | master (pthreaded-lwp) | Aug 17 | ✓ | +1 |
| Ibae9a1ea | Add akeyconvert, for rxkad.keytab to KeyFileExt conversion | Benjamin Kaduk | openafs | master | Aug 17 | ✓ | |
| Ic433cf56 | vos partinfo: enable tabular output | Christof Hanke | openafs | master | Aug 17 | ✓ | |
| I5b56b80a | util: refactor OpenLog | Michael Meffie | openafs | master (externalize-log-rotation) | Aug 17 | ✓ | |
| I7768d006 | libafs: shake harder in shake-loose-vcaches | Michael Meffie | openafs | master | Aug 13 | ✓ | |
| I01d29fff | afs: Make ONEGROUP_ENV not Linux-specific | Andrew Deason | openafs | master (sol11-gids) | Aug 11 | ✓ | +1 |
| I44023ee8 | SOLARIS: Use AFS_PAG_ONEGROUP_ENV for Solaris 11 | Andrew Deason | openafs | master (sol11-gids) | Aug 10 | ✓ | |
| Id0e5a51d | Linux: Only use automount for volume roots | Marc Dionne | openafs | master (linux_eloop) | Aug 10 | ✓ | +1 |
| I4e9ff1e6 | tests: give the full path to the softsig test helper program | Marcio Brito Barbosa | openafs | master | Aug 6 | ✓ | +1 |
| If2427f26 | tests/auth/keys-t.c: Don't ignore return value of write | Anders Kaseorg | openafs | master | Aug 4 | | |
| Id24e7a6c | kauth: Resolve date signedness warning in SetFields | Anders Kaseorg | openafs | master | Aug 4 | ✓ | +1 |
| Ic1b878f0 | rxkad: Resolve warnings in ticket5.c | Anders Kaseorg | openafs | master | Aug 2 | ✓ | |
| I92ced332 | src/opr/casestrcpy.c: Remove NULL checks for AFS_NONNULL parameters | Anders Kaseorg | openafs | master | Aug 2 | ✓ | |
| I38e033ca | Do not require AFS_SYSCALL | Andrew Deason | openafs | master (arm64_linux26) | Aug 1 | ✓ | +1 |
| I219b92d8 | LINUX: Don't compile syscall code with keyrings | Andrew Deason | openafs | master (arm64_linux26) | Aug 1 | ✓ | +1 |
| I9583c8e5 | Do not set default AFS_SYSCALL | Andrew Deason | openafs | master (arm64_linux26) | Aug 1 | ✓ | +1 |
| Ifd10786c | hcrypto: Avoid 'double' param in arm64 kernel code | Andrew Deason | openafs | master (arm64_linux26) | Jul 31 | ✓ | +1 |
| I2a6d3ac8 | afsd: Add additional startup checks | Perry Ruiter | openafs | master | Jul 31 | ✓ | |
| If0c38130 | Update config.guess and config.sub | Andrew Deason | openafs | master (arm64_linux26) | Jul 24 | ✓ | +1 |
| I1ee239de | Add support for arm64_linux26 | Andrew Deason | openafs | master (arm64_linux26) | Jul 24 | ✓ | |
| I9e0b443d | Move vos common args even further down | Nathaniel Filardo | openafs | master (vos-foreach) | Jul 17 | ✓ | |
| I3d52efe6 | viced: remove old signal handler wrappers | Michael Meffie | openafs | master (softsig) | Jul 15 | ✓ | +1 |
| I2cc6a93b | util: cache the hostnames already resolved | Marcio Brito Barbosa | openafs | master (listvldb-cache) | Jul 2 | ✓ | |

# In gerrit needing review

54 changes (just barely on two pages)

- update bos restricted mode
- encrypt inter-volser traffic
- Revert "Lockless path through afs_linux_dentry_revalidate"
- afs: Don't retry timed-out RW operations forever

# In gerrit needing rework



status:open branch:master

gerrit.openafs.org/#q,status:open+branch:master+NOT+CodeReview%253D-2+CodeReview%253D-1+project:openafs+NOT+message:windows,n,z

All | My | Admin | Documentation

Changes | Drafts | Watched Changes | Starred Changes

Benjamin Kaduk <kaduk@mit.edu> | Settings | Sign Out

status:open branch:master NOT CodeReview=-2 CodeReview=-1 | Search

Search for status:open branch:master NOT CodeReview=-2 CodeReview=-1 project:openafs NOT message:windows

| ID | Subject | Owner | Project | Branch | Updated | V | R |
|---|---|---|---|---|---|---|---|
| I6d7b9741 | viced: prevent useless salvages when AFS config is invalid | Mark Vitale | openafs | master | Aug 18 | ✓ | -1 |
| I165515ba | tabular_output: try to print CSV-Footer only | Christof Hanke | openafs | master | Aug 18 | ✓ | -1 |
| Ib4066a67 | tabular_output: allocate footer-line when first set. | Christof Hanke | openafs | master | Aug 18 | ✓ | -1 |
| Ie1018467 | readme: move SOURCE-MAP and Java API notes to CODING | Michael Meffie | openafs | master (spring-cleaning) | Aug 17 | ✓ | -1 |
| Icf5c04b3 | lwp: remove preemption support | Chas Williams | openafs | master (pthreaded-lwp) | Aug 17 | ✓ | -1 |
| Idddb7c3e | auth: Add negative caching to afsconf_LookupServer() | Chas Williams | openafs | master | Aug 17 | ✓ | -1 |
| Ic3f29607 | util: fix file descriptor leak in MR-AFS style logging | Michael Meffie | openafs | master (externalize-log-rotation) | Aug 17 | ✓ | -1 |
| Ie836983c | libprot: add pr_PrintContEntry function | Michael Meffie | openafs | master | Aug 17 | ✓ | -1 |
| I6697f033 | Remove unnecessary uses of @CFLAGS_NOERROR@ | Anders Kaseorg | openafs | master | Aug 1 | ✓ | -1 |
| Ic3ff21b0 | libuafs: clean *.o files in top-level clean rule | Mark Vitale | openafs | master | Jul 27 | ✓ | -1 |
| I26d62123 | libuafs: improve clean rule | Mark Vitale | openafs | master | Jul 27 | ✓ | -1 |
| Ic1f9fc0a | roken: improve clean rule | Mark Vitale | openafs | master | Jul 27 | ✓ | -1 |
| I8fd86ceb | convert servers to the opr softsig | Michael Meffie | openafs | master | Jun 11 | | -1 |
| Ia756807d | use softsig for log signal handlers | Michael Meffie | openafs | master (externalize-log-rotation) | Jun 5 | ✓ | ✓ |
| I864c544d | afs: Consolidate common afs_osi_Wait code | Andrew Deason | openafs | master (osiwait-timebackwards) | May 15 | | -1 |
| Ia70045a4 | Change null variable checks to make clang tautological-pointer-compare happy. | Dave Botsch | openafs | master (clang-null-tautology) | Apr 25 | ✓ | -1 |
| Ib16182da | Handle failure to create Salvage file | Benjamin Kaduk | openafs | master | Apr 22 | ✓ | -1 |
| I1c1fbc84 | Use 32-bit length for struct rx_opaque | Benjamin Kaduk | openafs | master | Apr 15 | ✓ | -1 |
| I2b2f606c | afs: Create afs_StaleVCache | Andrew Deason | openafs | master (linux-dvhint) | Mar 23 | ✓ | -1 |
| I2228da74 | LINUX: Use DV hints for dentry revalidate fastpath | Andrew Deason | openafs | master (linux-dvhint) | Mar 9 | ✓ | -1 |
| I9bf941fd | afs: revamp Linux file lock processing | Benjamin Kaduk | openafs | master | Feb 26 | ✓ | -1 |
| I320e95ab | Fast restart for Ubik database servers | Jeffrey Hutzelman | openafs | master | Feb 12, 2015 | ✓ | -1 |
| I8f6bc7e9 | release kernel lock first, then AFS lock | Hans-Werner Paulsen | openafs | master | Jan 22, 2015 | ✓ | -1 |
| If40cf9f8 | Linux: avoid export_op_default if not exported | Jeffrey Hutzelman | openafs | master | Jan 14, 2015 | ✓ | -1 |
| I3fd7ac04 | Changes for FreeBSD9 on SPARC64 | Nathaniel Filardo | openafs | master (fbsd-sparc64) | Dec 12, 2014 | ✓ | -1 |
| I910cfd63 | Attempt to auto-tune fileserver for memory target | Benjamin Kaduk | openafs | master | Dec 10, 2014 | | -1 |
| I35751bab | Provide a usable fileserver default config (-X) | Benjamin Kaduk | openafs | master (prebranch) | Dec 10, 2014 | | -1 |
| I5d5fceef | Move LogDesWarning to common server code | Andrew Deason | openafs | master | Nov 30, 2014 | ✓ | -1 |
| I274ac6cc | rx: Fixup BUSY packet callNumber | Andrew Deason | openafs | master | Nov 30, 2014 | ✓ | -1 |
| I2e5abbbc | Update 'now' when raising events | Benjamin Kaduk | openafs | master | Nov 29, 2014 | ✓ | -1 |
| Ibb00e1c2 | p_osi_sleep make afs_osi_Wait interruptible by ctrl-C | Arne Wiebalck | openafs | master | Nov 29, 2014 | ✓ | -1 |
| I5e2a120d | macos: chown system files post-install | Daria Brashear | openafs | master (osxnext) | Nov 29, 2014 | ✓ | -1 |
| Ie0d39e6f | viced: resort callback timeouts | Daria Brashear | openafs | master | Nov 29, 2014 | | -1 |

Press '?' to view keyboard shortcuts

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# In gerrit needing rework

33 changes with −1 review

- viced: prevent useless salvages when AFS config is invalid
- auth: Add negative caching to afsconf_LookupServer()
- convert servers to the opr softsig
- Fast restart for Ubik database servers

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- convert servers to the opr softsig
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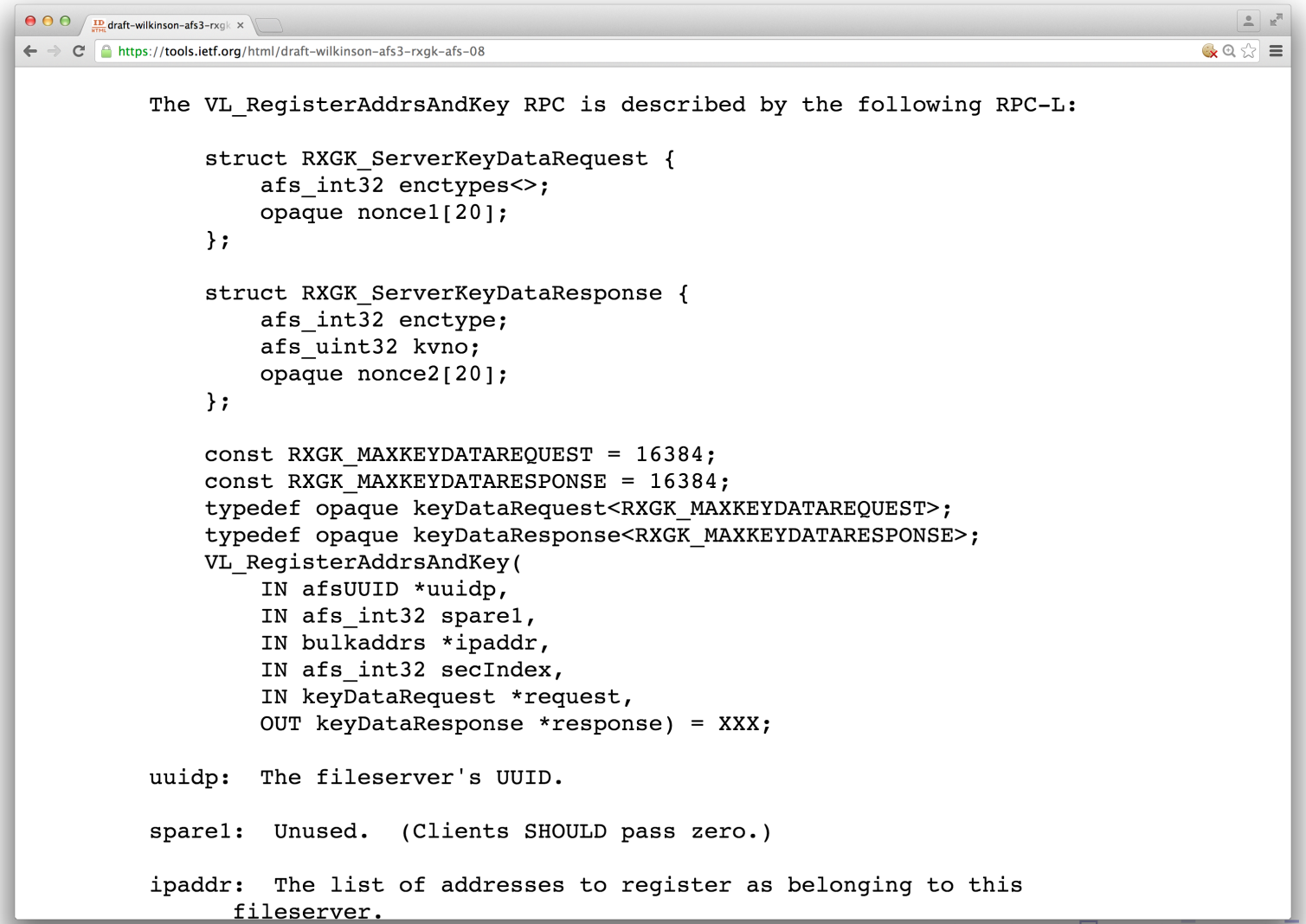
- Attempt to auto-tune fileserver for memory target
- Provide a usable fileserver default config (-X)
- p_osi_sleep make afs_osi_Wait interruptible by ctrl-C

# What's *not* in 1.8?

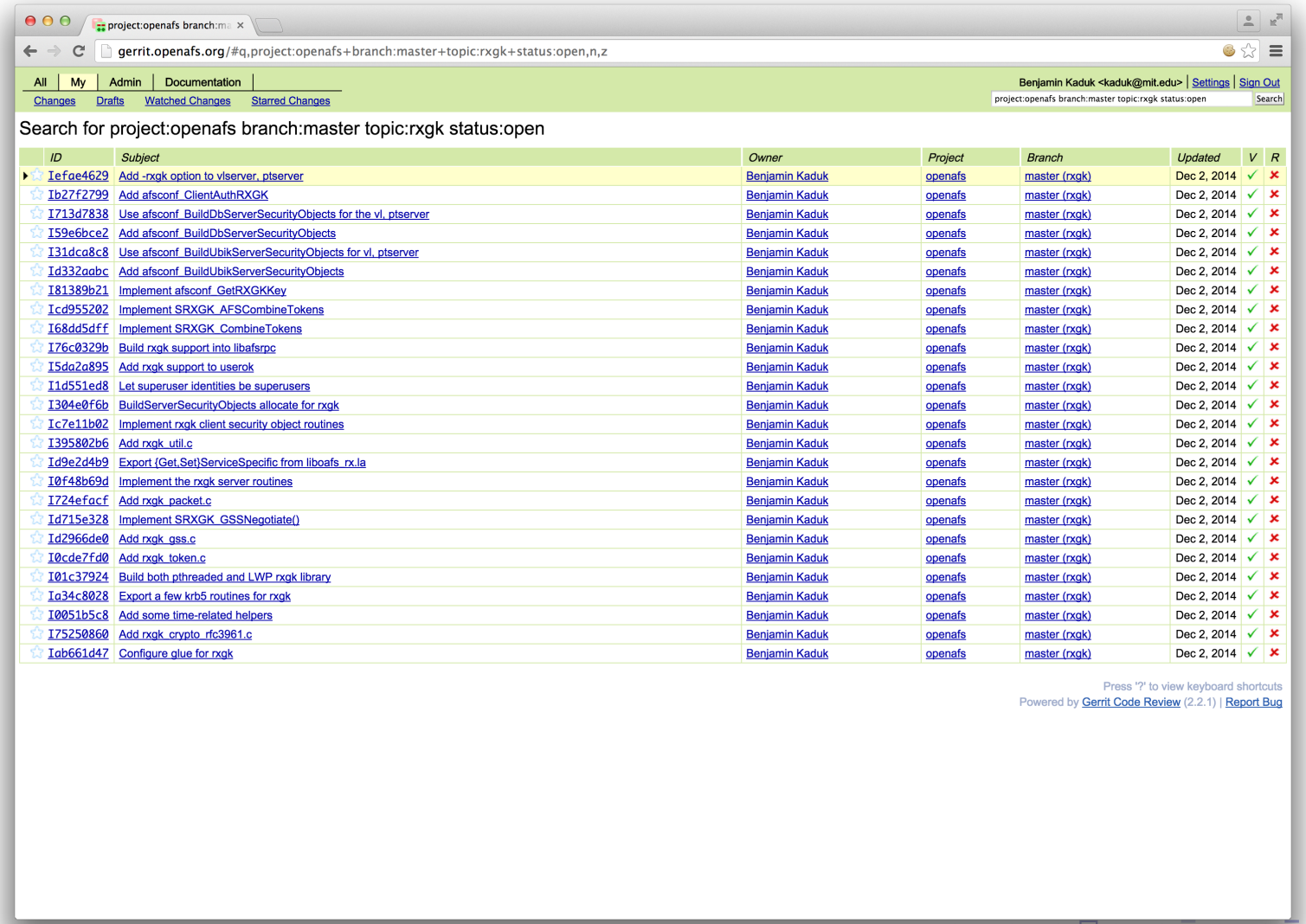
- kaserver (by default)
- pam modules (by default)
- Linux 2.4 support
- Documentation for AIX-, HP-UX, and IRIX-specific installation in the QuickStartGuide
- NFS translator
- A comprehensive test suite
- `afsd -settime`
- `libjuafs.a` — just use `libuafs.a`
- LWP fileserver
- Cruft from MR-AFS in the bos utility
- Netscape plugin (what is it???)
- a `-k` argument to the fileserver
- ZFS_BOZONLOCK_ENV
- sunrpc compatibility in rxgen

# Specification



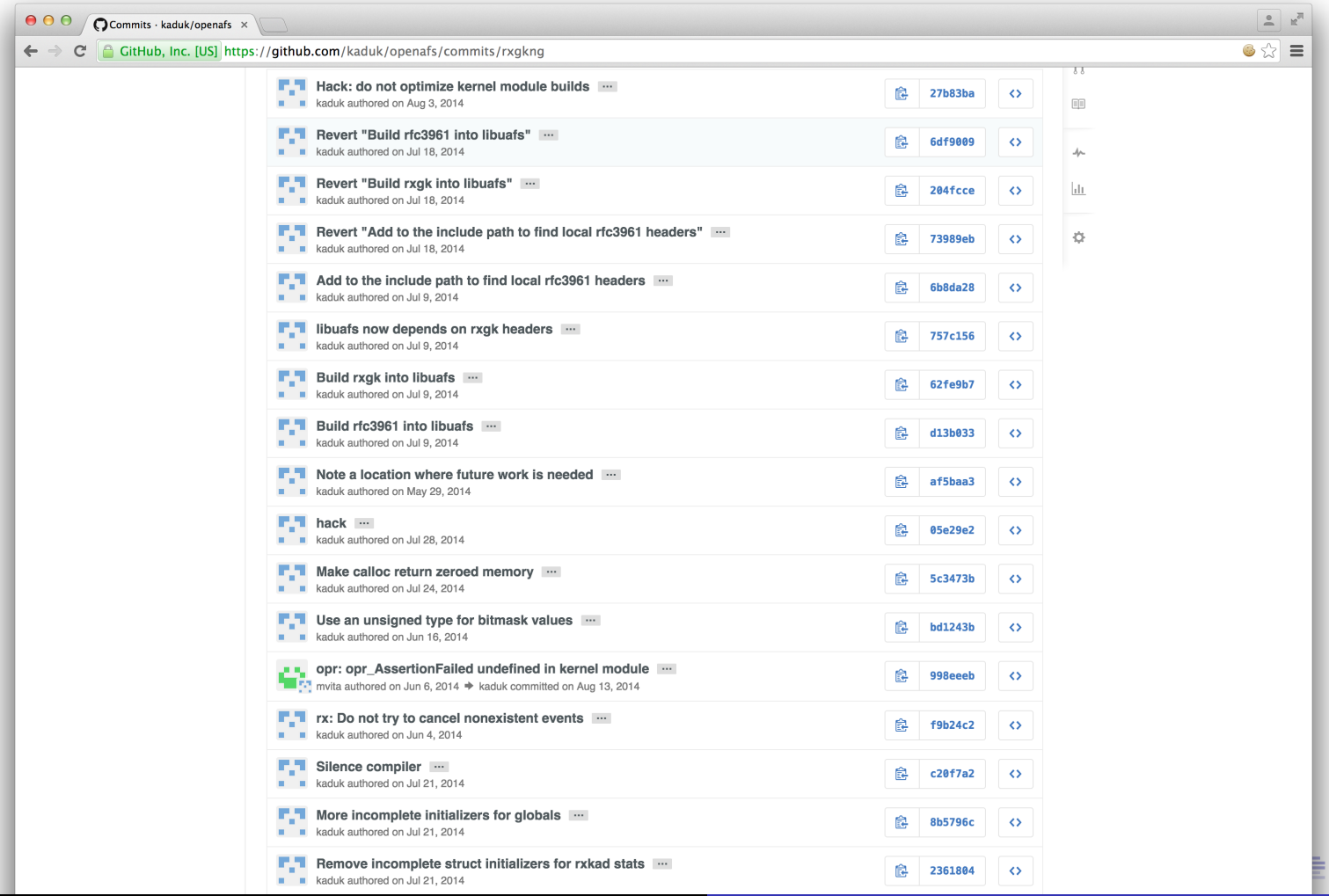

```
The VL_RegisterAddrsAndKey RPC is described by the following RPC-L:

    struct RXGK_ServerKeyDataRequest {
        afs_int32 enctypes<>;
        opaque nonce1[20];
    };

    struct RXGK_ServerKeyDataResponse {
        afs_int32 enctype;
        afs_uint32 kvno;
        opaque nonce2[20];
    };

    const RXGK_MAXKEYDATAREQUEST = 16384;
    const RXGK_MAXKEYDATARESPONSE = 16384;
    typedef opaque keyDataRequest<RXGK_MAXKEYDATAREQUEST>;
    typedef opaque keyDataResponse<RXGK_MAXKEYDATARESPONSE>;
    VL_RegisterAddrsAndKey(
        IN afsUUID *uuidp,
        IN afs_int32 spare1,
        IN bulkaddrs *ipaddr,
        IN afs_int32 secIndex,
        IN keyDataRequest *request,
        OUT keyDataResponse *response) = XXX;

uuidp:  The fileserver's UUID.

spare1:  Unused.  (Clients SHOULD pass zero.)

ipaddr:  The list of addresses to register as belonging to this
      fileserver.
```

# Implementation

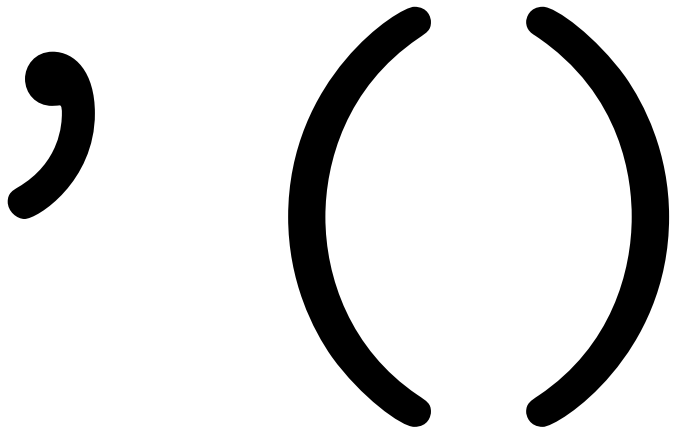


# Implementation

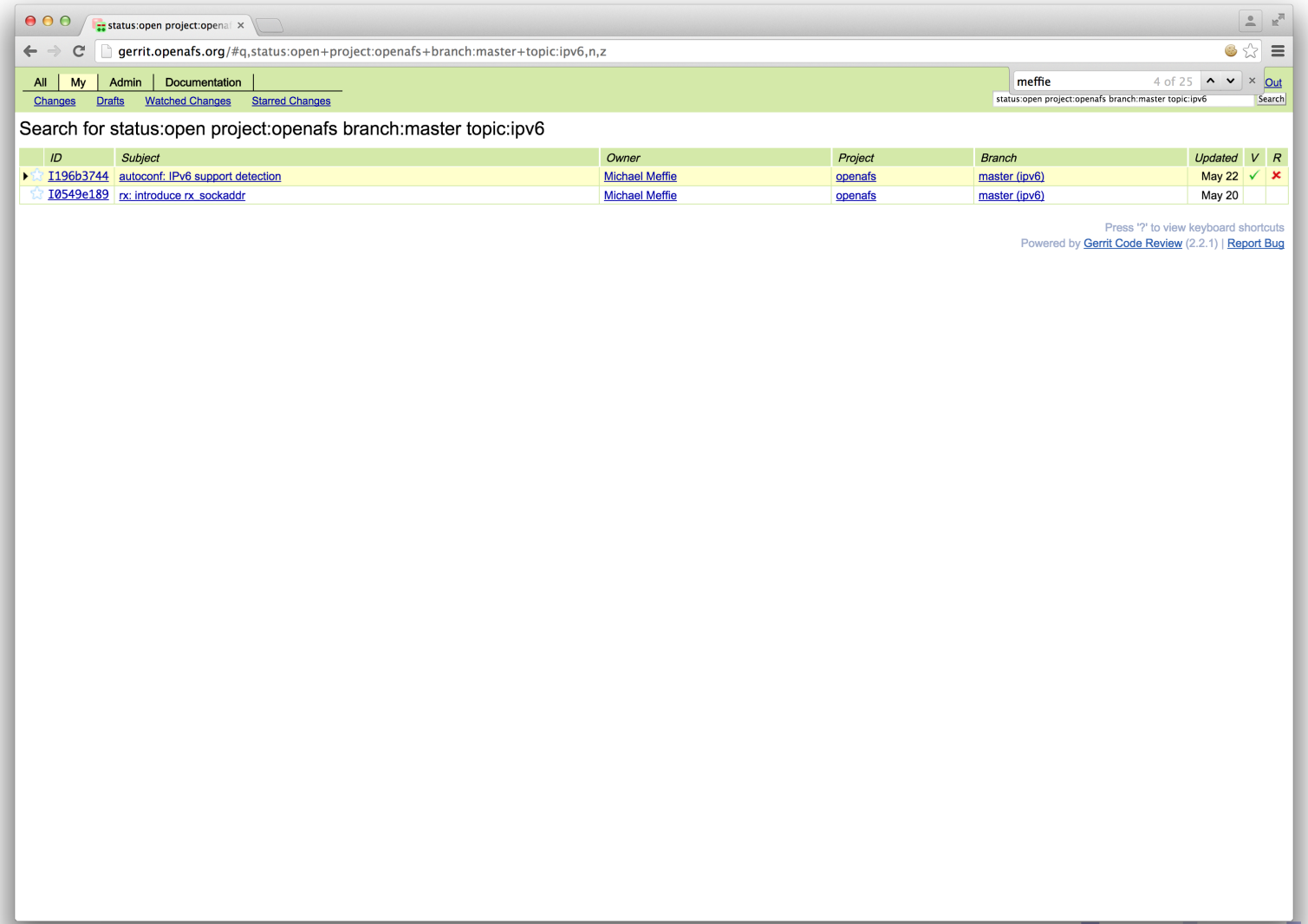
https://github.com/kaduk/openafs/commits/rxgkng



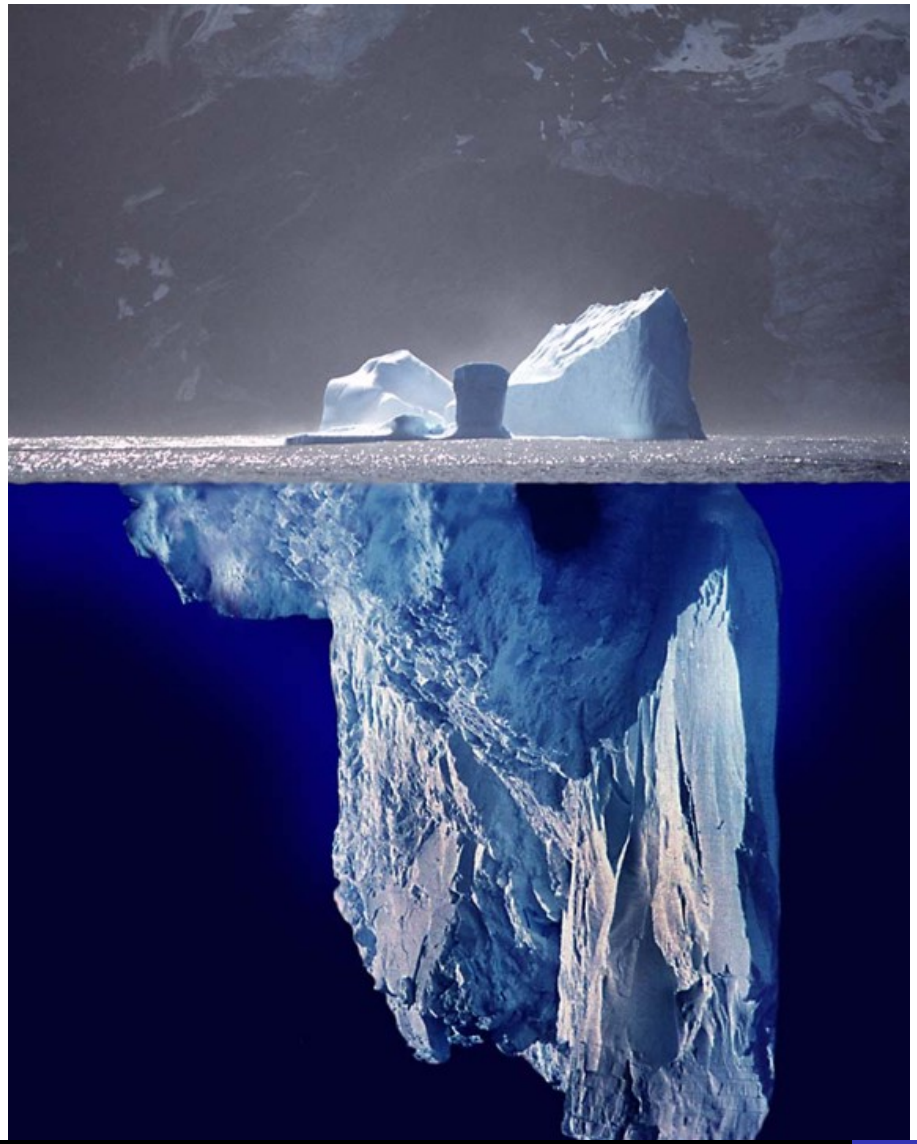
# Specification



# Implementation



# Implementation



# Your Feature Here

- ~~read-write replication~~
- ~~per-file ACLs~~
- ...

Thanks!