RALPH BÖHME / SAMBA TEAM

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Juicing the Fruit

NO TESTS
NO PROBLEMS

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„IMPLEMENT TEST CASES [WIP(ISN'T IT ALWAYS?...)]“

Anonymous Developer

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State of OS X support

STATE OF OS X SUPPORT

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- Apple’s SMB2 protocol extension: AAPL
- Spotlight
- Interoperability with Netatalk

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AAPL

STATE OF OS X SUPPORT / AAPL

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- Name of an SMB2_CREATE context
- Refer to Apple’s SMB2 extensions as AAPL
- How is it used ?
- After first tcon do SMB2_CREATE on share base directory
- AAPL request/response blob used to negotiate certain capabilities (see next slide)

STATE OF OS X SUPPORT / AAPL

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http://opensource.apple.com/source/smb/smb-759.40.1/kernel/netsmb/smb_2.h:

```
/* Define Client/Server Capabilities bitmap */
enum {
    kAAPL_SUPPORTS_READ_DIR_ATTR = 0x01,
    kAAPL_SUPPORTS_OSX_COPYFILE = 0x02,
    kAAPL_UNIX_BASED = 0x04,
    kAAPL_SUPPORTS_NFS_ACE = 0x08
};

/* Define Volume Capabilities bitmap */
enum {
    kAAPL_SUPPORT_RESOLVE_ID = 0x01,
    kAAPL_CASE_SENSITIVE = 0x02
};
```

STATE OF OS X SUPPORT / AAPL

What can we do with it?

- Faster Finder browsing
- Poors man’s POSIX extensions

STATE OF OS X SUPPORT / AAPL

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Faster Finder browsing:

- in extreme cases 5 seconds instead of 2 minutes for 5000 files in a single directory (ctdb cluster or high-latency network link)
- changes how the OS X client retrieves metadata

Without AAPL:

- SMB2_FIND to get list of files, then 5000 requests to retrieve metadata

With AAPL:

- Single SMB2_FIND request and response, done!
- Hack alert: ***FILE_ID_BOTH_DIR_INFORMATION*** structure elements repurposed

STATE OF OS X SUPPORT / AAPL

Poor man's SMB2 POSIX Extensions:

- read POSIX mode, uid and gid
- change mode
- SMB2_{GET|SET}INFO security descriptors with ACEs using special SIDs:
  - S-1-5-88-1-<uid>
  - S-1-5-88-2-<gid>
  - S-1-5-88-3-<mode>
- Used by MS for Services for UNIX (NFS)

STATE OF OS X SUPPORT

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SPOTLIGHT

STATE OF OS X SUPPORT / SPOTLIGHT

What is Spotlight?

- searchable index of files and their metadata
- searching locally on a Mac, or remotely on a server
- SMB connection to server
- search protocol uses MS-RPC as transport
- similar to MS-WSP
- Samba is just a search query proxy

STATE OF OS X SUPPORT / SPOTLIGHT

So if Samba is just a proxy, who does the hard work?

- server backend is Gnome Tracker
- limitations: not cluster aware, primary focus is desktop
- possible other backends: Apache SOLR, ElasticSearch
- targetting servers, enterprisy, clustered
- Samba backend code for SOLR found in NAS vendor GPL source drop
- code is here, needs upsteam integration work

STATE OF OS X SUPPORT

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INTERop

STATE OF OS X SUPPORT / INTEROP

- Many still run Netatalk based AFP servers
- Samba VFS module vfs_fruit adds interop sugar to be compatible with Netatalk:
  - metadata storage
  - filename encoding
  - locking
- It mostly works, some known issues:
  - OS X xattrs are lost when vfs_fruit is added to a share (Finder tags)
  - xattrs incompatible between Netatalk and Samba
    (streams_xattr stores a trailing 0 byte)

STATE OF OS X SUPPORT

Great new features:

- Apple’s SMB2 protocol extension: AAPL
- Spotlight
- Interoperability with Netatalk

How many tests do we have for this stuff?

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NO TESTS
NO PROBLEMS

bad_fruit ?

NO TESTS / NO PROBLEMS

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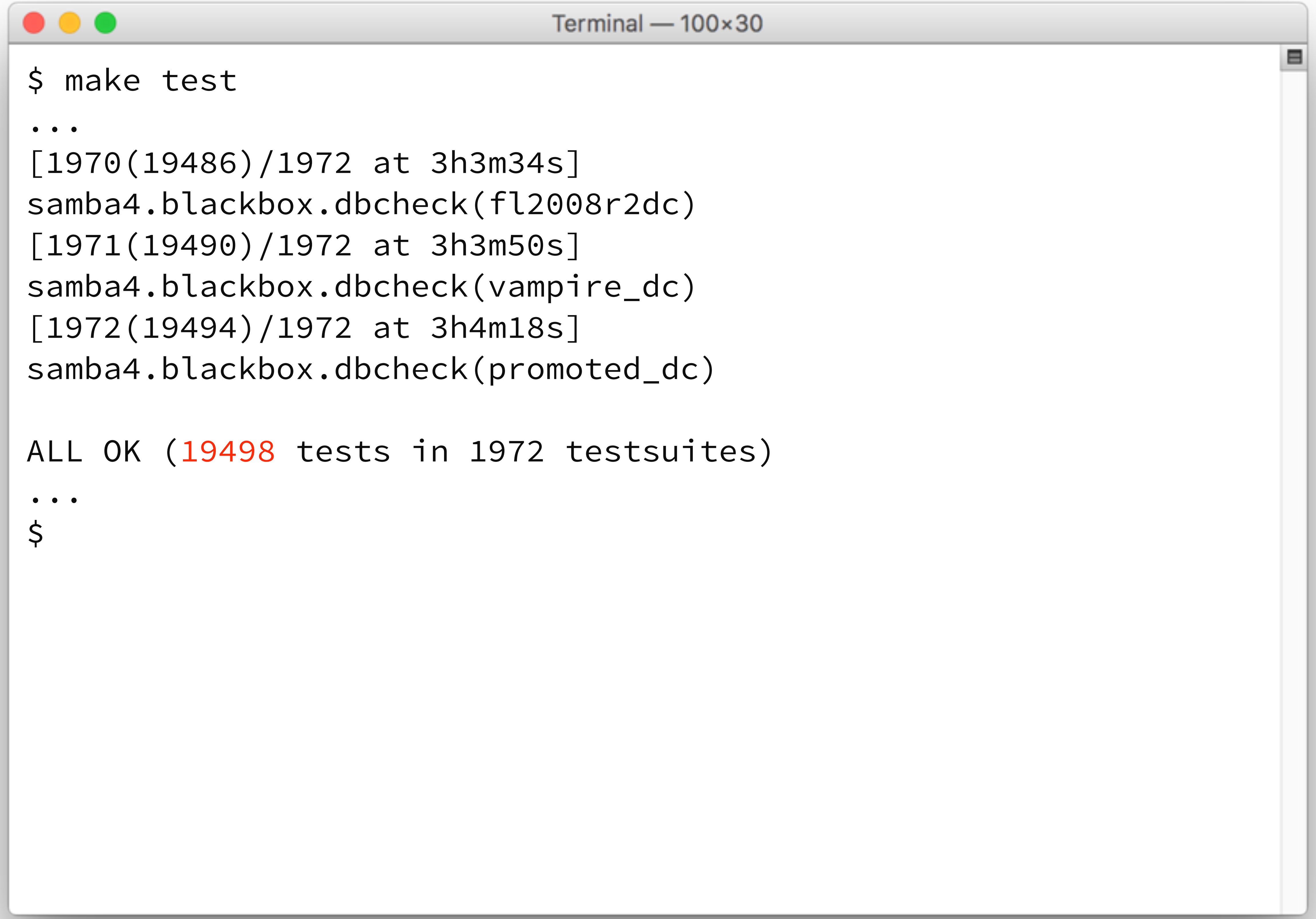
Terminal — 100×30

```
$ make test
...
[1970(19486)/1972 at 3h3m34s]
samba4.blackbox.dbcheck(fl2008r2dc)
[1971(19490)/1972 at 3h3m50s]
samba4.blackbox.dbcheck(vampire_dc)
[1972(19494)/1972 at 3h4m18s]
samba4.blackbox.dbcheck(promoted_dc)

ALL OK (19498 tests in 1972 testsuites)
...
$
```

NO TESTS / NO PROBLEMS

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- large number protocol conformance test
- this ensures we provide Windows semantics
- for OS X clients what matters is OS X semantics
- when OS X exports HFS+ via SMB it does not care about conforming to specs
- just dumps HFS+ filesystem behaviour on the network
- as a result it subtly deviates from the specs and that’s where the fun begins…
- …and all this is undocumented: there’s no spec

NO TESTS / NO PROBLEMS

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The shocking truth:

NO TESTS / MANY BUGS

The story of four bugs found and fixed in the last year:

- #1: Copying a directory to server
- #2: Resource fork
- #3: Rename behaviour
- #4: FileIDs

NO TESTS / NO PROBLEMS

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BUG#1

COPY DIRECTORY TO SERVER

NO TESTS / NO PROBLEMS / BUG#1

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- copying directory to server failed with specific OS X version
- when implementing vfs_fruit some research on OS X semantics was done
- found behaviour that OS X always returns ***AFP_AfpInfo*** stream
- this was wrong, but worked until it broke subtly with specific OS X release
- lesson learned: *some* research with no tests is not good

NO TESTS / NO PROBLEMS

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BUG#2

RESOURCE FORK

NO TESTS / NO PROBLEMS / BUG#2

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- Resource fork is a second data stream that can exist per file in HFS+ filesystem
- for SMB connections mapped to ***AFP_Resource*** stream

Where can it go wrong?

- server: a Mac
- client 1: create ***AFP_Resource*** stream on a file
- client 2: stat() the stream
- What would you expect?

NO TESTS / NO PROBLEMS / BUG#2

- Shocking answer: **ENOENT**
- As long as no data is written to stream, other clients won’t see it
- Lesson learned: added tests for OS X semantics of their two special streams *AFP_AfpInfo* and *AFP_Resource*

NO TESTS / NO PROBLEMS

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BUG#3

RENAME BEHAVIOUR

NO TESTS / NO PROBLEMS / BUG#3

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- Windows doesn’t allow renaming of directories with open files (MS-FSA 2.1.5.14.11)
- POSIX does allow it, so does OS X
- Samba? Doesn’t allow it, OS X clients unhappy
- happens frequently because OS X Finder opens a special file ***.DS_Store*** for every open Finder window
- solution: add optional POSIX directory rename behaviour, disabled by default, enabled for OS X clients
- OS X clients now happy?

NO TESTS / NO PROBLEMS / BUG#3

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- No!
- turns out there's a bug in the OS X SMB kernel client:
- applications with open files in renamed directories subsequently fail to save
- happens with OS X SMB server as well
- workaround: add just another option to disable directory renames again
- lesson learned: when you actually know the semantics (POSIX in this case), be systematic, write many, many test

NO TESTS / NO PROBLEMS

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BUG#4

FILE ID’S

NO TESTS / NO PROBLEMS / BUG#4

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- two clients using an application to work on a project file on the server
- occasionally one client saves and the file is gone
- Locking? No. Oplocks? No. ***FileIDs***!
- ***FileID:*** Number that uniquely identifies a file (or directory):
- returned as part of file metadata in FIND or GETINFO requests
- OS X calls it ***CNID*** (Catalog Node ID)

NO TESTS / NO PROBLEMS / BUG#4

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What’s the problem?

- HFS+ doesn’t reuse ***CNIDs*** over the lifetime of a filesystem
- Internal OS X file lookup use ***CNID/FileID*** as primary key
- Samba uses filesystem inode number
- inode numbers are reused
- Do you see the problem?

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- network trace showed that the saving client deleted the original file at the beginning after querying its ***FileID***
- saving involved three steps: save to a temp file, remove the original file, finally rename temp file to original name
- client got confused by the previous save that changed the ***FileID***
- good news: workaround available, client can be configured not to trust ***FileIDs*** from the server
- problem also seem to be fixed in latest OS X release
- lesson learned: some things you just can’t test, can you?

NO TESTS / NO PROBLEMS

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- Bugs found and fixed:

  #1: Copying a directory to server

  #2: Resource fork

  #3: Rename behaviour

  #4: FileIDs

- Do we have tests now so we won’t break again?

NO TESTS / NO PROBLEMS

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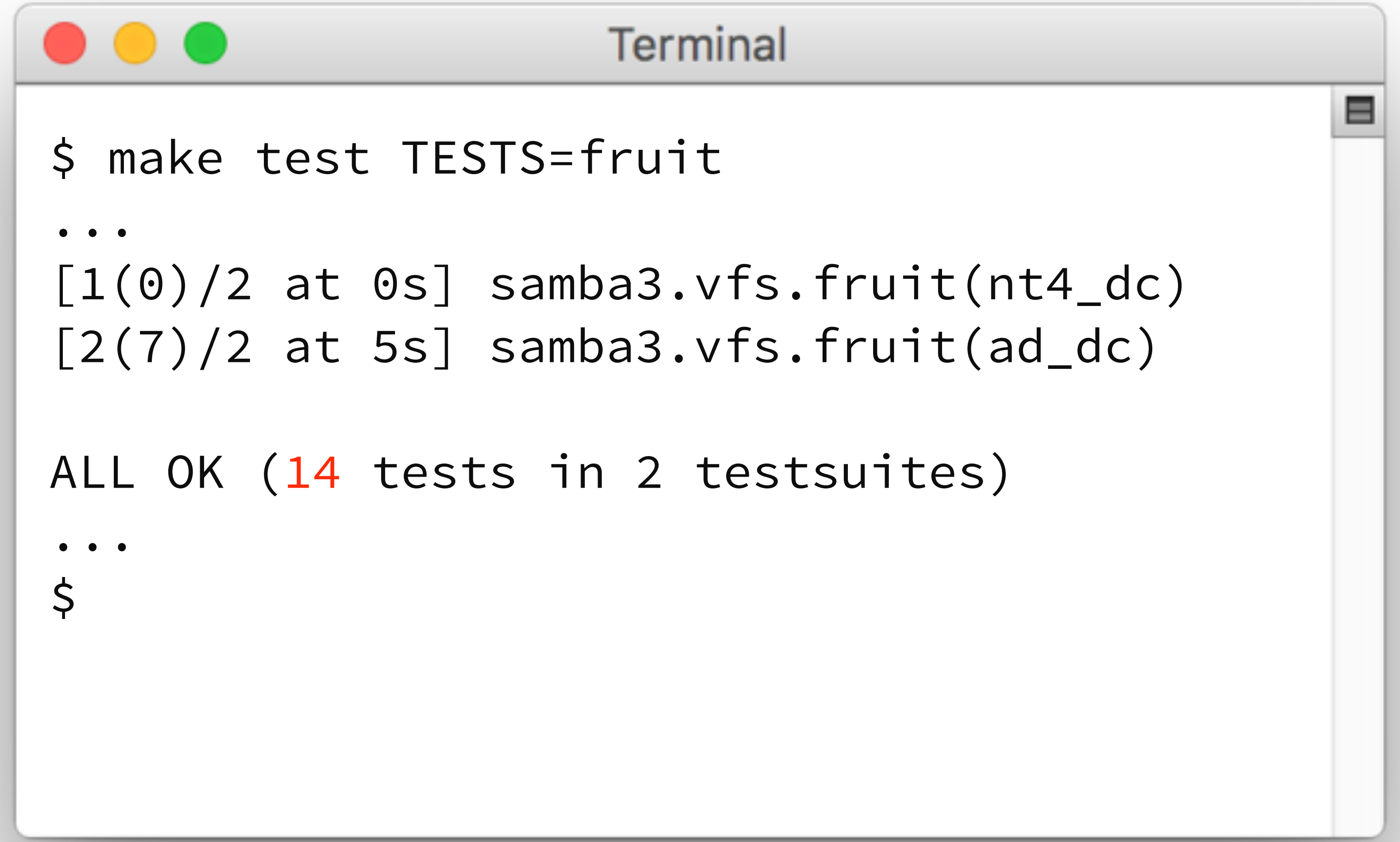
MID 2015



```
$ make test TESTS=fruit
...
[1(0)/2 at 0s] samba3.vfs.fruit(nt4_dc)
[2(7)/2 at 5s] samba3.vfs.fruit(ad_dc)

ALL OK (14 tests in 2 testsuites)
...
$
```

NO TESTS / NO PROBLEMS

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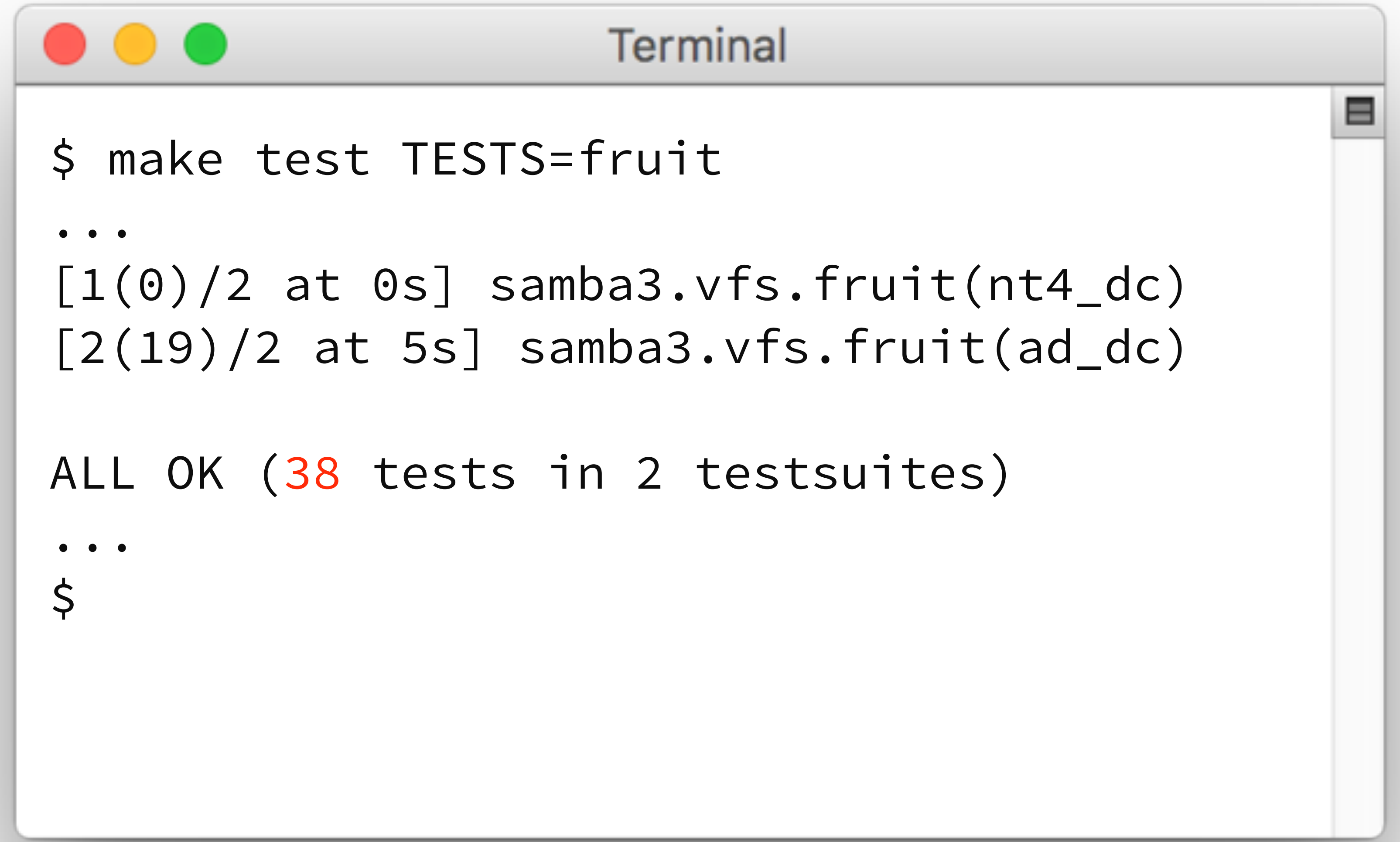
FAST FORWARD TO TODAY


Terminal

```
$ make test TESTS=fruit
...
[1(0)/2 at 0s] samba3.vfs.fruit(nt4_dc)
[2(19)/2 at 5s] samba3.vfs.fruit(ad_dc)

ALL OK (38 tests in 2 testsuites)
...
$
```

NO TESTS / NO PROBLEMS

- 19 tests, 14 test covering OS X spec deviations
- 0 tests cover Spotlight
- tl;dr: we need tests, tests, tests!

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THANK YOU!

QUESTIONS?

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