Continuous Integration of The FreeBSD Project

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https://lwhsu.org
Something about Me

- 許立文
- From Taiwan, a.k.a. Formosa
- System Administrator
- Instructor
- Programmer
- Traveler
- Diver
- Snowborder
- Cyclist

https://www.google.com/maps/dir/Taipei,+Taiwan/Ottawa,+ON,+Canada
A billion dollars + Linus <= good people with a rigorous engineering process doing BSD

- Karl Lehenbauer, FlightAware
We Need a (more) Higher Quality FreeBSD

- A higher quality Releasee
- Buildable -CURRENT branch
- Reliable -STABLE branch
- Faster development
Test Early, Test Often
Integration Test IS Important

We need to do it continuously.

https://media.giphy.com/media/l0MYSpvx4pnsoMNz2/giphy.gif
Continuous Integration (CI)

Grady Booch, 1991

A software engineering practice of merging all developer working copies to a shared mainline several times a day

- To know conflicts earlier
- To know bugs earlier
CI Best Practices

- Maintain a code repository
- Automate the build
- Make the build self-testing
- Everyone commits to the baseline every day
- Every commit (to baseline) should be built
- Keep the build fast
- Test in a clone of the production environment
- Make it easy to get the latest deliverables
- Everyone can see the results of the latest build
- Automate deployment

https://en.wikipedia.org/wiki/Continuous_integration
We Do This from Beginning

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- Every commit (to baseline) should be built
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We are an Open Source OS Project

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  - Test in a clone of the production environment
- Make it easy to get the latest deliverables
- Everyone can see the results of the latest build
  - Automate deployment
What We Need

- Automate the build
- Make the build self-testing
- Every commit (to baseline) should be built
- Keep the build fast
- Make it easy to get the latest deliverables
- Everyone can see the results of the latest build
What We Do

A good CI system should provide:

- Automate the build
- Make the build self-testing
- Make it easy to get the latest deliverables
- Everyone can see the results of the latest build

Needs help from everyone:

- Every commit (to baseline) should be buildable
- Keep the build fast
Automatic Build & Some History
2002~2014, Tinderbox

- By Dag-Erling Smørgrav <des@FreeBSD.org>
- http://tinderbox.freebsd.org
  - Probably started in March 2002
  - Probably stopped in September 2014
- Open Sourced
  - svn://svn.freebsd.org/base/user/des/tinderbox
- Well Documented
  - https://wiki.freebsd.org/Tinderbox
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2017-06-09 00:59:02 UTC
2013, jenkins-admin@FreeBSD.org

- Founded by Craig Rodrigues in late 2013
  - Current Members:
    - Baptiste Daroussin (bapt@), Brad Davis (brd@), Brooks Davis (brooks@), Craig Rodrigues (rodrigc@), Li-Wen Hsu (lwhsu@), Steve Wills (swills@)
    - https://www.freebsd.org/administration.html#t-jenkins-admin
  - Alumni:
    - Julio Merino (jmmv@), Steven Kreuzer (skreuzer@), R. Tyler Croy, Ahmed Kamal
- First working group was in BSDCan 2014
- Discussions continued in following conferences
  - EuroBSDCon 2016, AsiaBSDCon 2017, BSDCan 2017 (yesterday!)
  - TODO items: https://wiki.FreeBSD.org/Jenkins/TODO
Jenkins

- An open source automation server written in Java
- Created by Kohsuke Kawaguchi
- https://jenkins.io
- Helps automating the non-human part of the whole software development process
  - Continuous Integration
  - Continuous delivery
- Extended by various plugins

- Created and operated by jenkins-admin@ since the group formed
- Independent successor of tinderbox.FreeBSD.org
- Periodically builds and tests FreeBSD src and doc trees
  - Branches: head, stable-11, stable-10, stable-9
  - Architectures: amd64, i386, sparc64
  - Others: build with GCC
    - Leverage the cross toolchain
    - amd64 cross build amd64 itself ;-) 
- Repository: https://github.com/freebsd/freebsd-ci
https://Jenkins.FreeBSD.org
2016, https://CI.FreeBSD.org

- Started in last summer, right after BSDCan 2016
- Also based on Jenkins
- Experiment for some new ideas and features
- Artifact server introduced
  - Pass artifact between stages in a pipeline
  - Open to the public for doing more tests
- Job template
  - Make it easier to add new CI jobs without knowing jenkins configuration
- Codes have been merged back to freebsd/freebsd-ci repository
  - https://github.com/freebsd/freebsd-ci
head-amd64-* Jobs on CI.FreeBSD.org
Automatic Build on https://CI.FreeBSD.org

- **build jobs**
  - scripts/build/build-world-kernel.sh
  - Generalized for different versions and architectures
  - make buildworld & buildkernel
  - Build distribution files

- **-LINT jobs**
  - scripts/build/build-kernel-LINT.sh
  - Build LINT kernel
Self Tests
Kyua

- Testing framework for infrastructure software
- By Julio Merino <jmmv@{NetBSD,FreeBSD}.org>
- Repository
  - https://github.com/jmmv/kyua
- Documentation
  - https://github.com/jmmv/kyua/wiki/Quickstart
  - Julio's talk & tutorial at AsiaBSDCon 2014
    - https://drive.google.com/drive/folders/0B08g-X1kPkSYNmlIEdTB5RjIFbk
bhyve - The BSD Hypervisor

- http://bhyve.org/
- Built in FreeBSD since 10.0
- On ci.FreeBSD.org
  - *-images jobs build virtual machine images installed by distribution files
  - *-testvm jobs build virtual machine with kyua installed
    - Basically the same with above job, but virtual disk size is smaller
- *-test jobs take testvm image from artifact server and run it
  - For RISC-V architecture we use QEMU
Putting Them Together

● Create virtual machine image
  ○ Pre-install kyua package and test files (under /usr/tests)
  ○ Customize /etc/rc.local to:
    ■ Run tests
    ■ Generate reports
    ■ Shutdown virtual machine
  ○ scripts/build/build-test_image.sh

● Run tests in virtual machine
  ○ Fetch the vm image, boot it
  ○ Wait for it completes running tests, or kill it when timeout
  ○ Extract test reports from the vm image
  ○ scripts/test/run-tests.sh
Access to Results
JUnit Format Output

<testcase classname="bin.cat.cat_test" name="align" time="0.018">
  <system-out>Executing command [ /bin/sh -c cat -be /usr/tests/bin/cat/d_align.in ]</system-out>
  <system-err>Test case metadata
  ------------------
  allowed_architectures is empty
  allowed_platforms is empty
  description = Test that cat(1) aligns the output right with options '-be' (PR bin/4841)
  has_cleanup = false
  is_exclusive = false
  required_configs is empty
  required_disk_space = 0
  required_files is empty
  required_memory = 0
  required_programs is empty
  required_user is empty
  timeout = 300

  Timing information
  ------------------
  Start time: 2016-09-23T01:22:37.490230Z
  End time:   2016-09-23T01:22:37.508471Z
  Duration:   0.018s

  Original stderr
  ---------------
  &lt;EMPTY&gt;
  </system-err>
</testcase>
## Test Result

0 failures (-3), 64 skipped (-81)

### All Tests

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<th>Package</th>
<th>Duration</th>
<th>Fail</th>
<th>(diff)</th>
<th>Skip</th>
<th>(diff)</th>
<th>Pass</th>
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<td>0</td>
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<td>bin.date</td>
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<td>0</td>
<td>0</td>
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<td>39</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>0</td>
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<td>bin.sh.builtins</td>
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Failed Test Case Display

Failed

sys.geom.class.gate.ggate_test.ggate_file (from (test-report.xml))

Failing for the past 3 builds (Since #1505)
Took 60 ms.

Error Message

work md5 checksum didn't match

Standard Output

Executing command [ ggate create -u 0 work ]

Standard Error

Test case metadata
-------------------
Test Result Trend

Project FreeBSD-head-amd64-test

Recent Changes

Latest Test Result (1 failure / -3)

Upstream Projects

- FreeBSD-head-amd64-testvm

Permalinks

- Last build (#1508), 34 min ago
- Last stable build (#1504), 8 hr 22 min ago
- Last successful build (#1507), 3 hr 14 min ago
- Last failed build (#1387), 7 days 7 hr ago
- Last unstable build (#1507), 3 hr 14 min ago
- Last unsuccessful build (#1507), 3 hr 14 min ago
- Last completed build (#1507), 3 hr 14 min ago

(just show failures) enlarge
Artifacts

- ***.txz**
  - From *-build jobs
  - Distribution files just like what on https://download.FreeBSD.org

- **disk.img.xz**
  - From *-images jobs
  - Virtual machine disk image file, installed from above *.txz files

- **disk-test.img.xz**
  - From *-testvm jobs
  - Virtual machine disk image file, with test script and test case
artifact.ci.FreeBSD.org

- ftpes://artifact.ci.FreeBSD.org
  - Serves files upload from jobs
    - Through Jenkins "Publish Over FTP" Plugin
    - Add FTP over TLS support
- https://artifact.ci.FreeBSD.org
  - Serves files download for downstream jobs in pipeline or external users
  - snapshots/
    - <branch>/<svn_revision>/<target>/<target_arch>
      - head/r123456/amd64/amd64
Open Configurations
Make Creating New Job Easier

- Not everyone knows (and has to know) how to configure Jenkins
- Build jobs have most parts in common
- Create a "job template"
  - Environment setup
    - Check out latest source code
    - Setup needed version of FreeBSD
    - Install required packages
  - Execute specified build script for that job
  - Environment cleanup
Jenkins Job Builder

- By OpenStack project
  - http://docs.openstack.org/infra/jenkins-job-builder/
- Before that, Jenkins job can only be edited on web interface
- Jenkins Job Builder provides YAML -> Jenkins configurations
- Create / update job through Jenkins’ web service
- Make jenkins configurations trackable and reproducible
- https://github.com/freebsd/freebsd-ci/tree/master/jjb
- job:
  name: FreeBSD-head-scan_build
  scm:
    - FreeBSD-src-head
  builders:
    - checkout-scripts
    - setup-jail
    - execute-in-jail
  publishers:
    - clean-jail
  wrappers:
    - timestamps
Build-in-jail Script Sets

- Simplify clean environment setup and job execution
  - Three phase: setup.sh, execute.sh, clean.sh
  - sudo installed by default
- A typical job configuration
  - build.sh
    - Main build script, which is executed by execute.sh in the jail
  - jail.conf
    - Jail environment configuration: version, arch, etc.
  - pkg-list
    - Package needs to be installed (from pkg.FreeBSD.org)
Adding a New Job

- Submitters bring their own build scripts and configs:
  - jail.conf, pkg-list, build.sh
  - Other configurations (ex: src.conf, make.conf)
- Jenkins-admin merges scripts to freebsd-ci/jobs/<job name>/
- Jenkins-admin creates a new entry jenkins job builder, push it
- Done! Our restless Jenkins executes it around the clock
Example: FreeBSD-head-aarch64-build

- **jail.conf**
  ```
  TARGET=amd64
  TARGET_ARCH=amd64
  WITH_32BIT=0
  OSRELEASE=11.0-RELEASE
  ```

- **pkg-list**
  ```
  aarch64-binutils
  ```

- **build.sh**
  ```
  #!/bin/sh
  env \
    JFLAG=${{BUILDER_JFLAG}} \
    TARGET=arm64 \
    TARGET_ARCH=aarch64 \
  sh -x freebsd-ci/scripts/build/build-world-kernel.sh
  ```
Quarantine Mode

● Used to build with patch from external
● QUARANTINE=1 in jail.conf
● Config jail to be an isolated environment
  ○ Remove internet connection after required packages installed
● Limit job resource from job configuration
  ○ Limit execution time
    wrappers:
      - timeout:
        timeout: 90
        fail: true
        type: absolute
Other Integrations
Notifications

- When to notify
  - Build failed
  - Build unstable (compile successfully, but some test cases failed)
  - Build back to stable

- How to notify
  - Email
  - IRC

- What to notify
  - Changes since last build (who & what)
  - Tail of the console output
  - What are the test cases failed
Email Notification

- Double-edged sword
- If nobody reads, it's totally no use
- Email-ext plugin

freebsd-current mailing list, July 2016

- Jenkins build is still unstable: FreeBSD HEAD #500  
  jenkins-admin@FreeBSD.org
- Jenkins build is still unstable: FreeBSD HEAD #501  
  jenkins-admin@FreeBSD.org
- bhyve with lagg failover doesn't work on wifi  
  Randy Westlund
- Jenkins build is still unstable: FreeBSD HEAD #502  
  jenkins-admin@FreeBSD.org
- FreeBSD HEAD i386 - Build #3721 - Failure  
  jenkins-admin@FreeBSD.org
- Build failed in Jenkins: FreeBSD HEAD #503  
  jenkins-admin@FreeBSD.org
- ARR8327 Etherswitch led control patch  
  Dan Nelson
- FreeBSD HEAD i386 - Build #3722 - Still Failing  
  jenkins-admin@FreeBSD.org
- EARLY_AP_STARTUP hangs during boot  
  Gary Jennejohn
- FreeBSD HEAD i386 - Build #3723 - Fixed  
  jenkins-admin@FreeBSD.org
- Jenkins build is unstable: FreeBSD HEAD #504  
  jenkins-admin@FreeBSD.org
- Jenkins build is still unstable: FreeBSD HEAD #505  
  jenkins-admin@FreeBSD.org
- Jenkins build is still unstable: FreeBSD HEAD #506  
  jenkins-admin@FreeBSD.org
- ARR8327 Etherswitch led control patch  
  Dan Nelson
- EARLY_AP_STARTUP hangs during boot  
  John Baldwin
- Jenkins build is still unstable: FreeBSD HEAD #507  
  jenkins-admin@FreeBSD.org
- FreeBSD 11.0-BETA3 Now Available  
  Glen Barber
- resolvenf needs @RESTARTCMD@ to be replaced after r303062  
  Guy Yar
- Jenkins build is still unstable: FreeBSD HEAD #508  
  jenkins-admin@FreeBSD.org
- resolvenf needs @RESTARTCMD@ to be replaced after r303062  
  Pedro Giffuni
- resolvenf needs @RESTARTCMD@ to be replaced after r303062  
  Pedro Giffuni
- resolvenf needs @RESTARTCMD@ to be replaced after r303062  
  Glen Barber
- Jenkins build is still unstable: FreeBSD HEAD #509  
  jenkins-admin@FreeBSD.org
- ACPI errors when booting laptop  
  Ben Woods
- Jenkins build is still unstable: FreeBSD HEAD #510  
  jenkins-admin@FreeBSD.org
- EFI boot: can we make loader.elf work as BOOT(x64,aaa64,arm,ia32).elf?  
  Xin Li
- EFI boot: can we make loader.elf work as BOOT(x64,aaa64,arm,ia32).elf?  
  Nathan Whitehorn
- Jenkins build can be back to stable: FreeBSD HEAD #511  
  jenkins-admin@FreeBSD.org
- EARLY_AP_STARTUP hangs during boot  
  Gary Jennejohn
- [PATCH] randomized delay in locking primitives, take 2  
  Mateusz Guzik
- [PATCH] randomized delay in locking primitives, take 2  
  Konstantin Belousov
- Jenkins build is back to normal: FreeBSD HEAD spare64 #185  
  jenkins-admin@FreeBSD.org
Reduce False Alert

- Be more careful before sending
- Pre-send script
  - Filter out the internal errors of the jenkins cluster
Notification Contents

- Use email-ext plugin to customize mail body
Template for Failed/Unstable Build Jobs

$PROJECT_NAME - Build #$BUILD_NUMBER - $BUILD_STATUS:

Build information: ${BUILD_URL}
Full change log: ${BUILD_URL}changes
Full build log: ${BUILD_URL}console

Change summaries:

${CHANGES, format="$r by %a: $\n$m$$\n"}

The end of the build log:

${BUILD_LOG}
Example: Build Failed Mail

FreeBSD HEAD i386 - Build #3987 - Failure:

Build information: https://jenkins.FreeBSD.org/job/FreeBSD_HEAD_i386/3987/
Full change log: https://jenkins.FreeBSD.org/job/FreeBSD_HEAD_i386/3987/changes
Full build log: https://jenkins.FreeBSD.org/job/FreeBSD_HEAD_i386/3987/console

Change summaries:
306148 by jpaetzell:
Update oce driver to 11.0.50.0

Submitted by: Venkat Duvvuru <venkatkumar.duvvuru at broadcom.com>

The end of the build log:

[...truncated 190386 lines...]
--- oce_if.o ---
/usr/src/sys/modules/oce/../../../dev/oce/oce_if.c:45:10: fatal error: 'oce_user.h' file not found
#include "oce_user.h"

1 error generated.
*** [oce_if.o] Error code 1

bmake[4]: stopped in /usr/src/sys/modules/oce

$PROJECT_NAME - Build #$BUILD_NUMBER - $BUILD_STATUS:

Build information: ${BUILD_URL}
Full change log: ${BUILD_URL}changes
Full build log: ${BUILD_URL}console

Change summaries:

${CHANGES, format="%r by %a:\n%n%m\n"}

The failed test cases:

${FAILED_TESTS,showStack=false,showMessage=true, maxTests=100}
Example: Test Failed Mail

FreeBSD_HEAD-tests - Build #1746 - Still Unstable:

Build information: https://jenkins.FreeBSD.org/job/FreeBSD_HEAD-tests/1746/
Full change log: https://jenkins.FreeBSD.org/job/FreeBSD_HEAD-tests/1746/changes
Full build log: https://jenkins.FreeBSD.org/job/FreeBSD_HEAD-tests/1746/console

Change summaries:
No changes

The failed test cases:
2 tests failed.
FAILED: sys.mqueue.mqueue_test.mqtest3

Error Message:
atf-check failed; see the output of the test for details

FAILED: sys.mqueue.mqueue_test.mqtest4

Error Message:
atf-check failed; see the output of the test for details
Integration with Code Review System

- https://ci.freebsd.org/job/phabric-FreeBSD-head-amd64-build
- Phabricator Differential Plugin
  - From Uber
    - https://github.com/uber/phabricator-jenkins-plugin
    - Good readme.md
  - We patched it to support Subversion
    - https://github.com/uber/phabricator-jenkins-plugin/pull/214
    - Basically provide option to select the main SCM
    - Conditionally issue SCM-specified options to arc
<table>
<thead>
<tr>
<th>Patch Number</th>
<th>Date/Time</th>
<th>Build ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>#148</td>
<td>Sep 23, 2016 9:30 AM</td>
<td>D8011</td>
</tr>
<tr>
<td>#147</td>
<td>Sep 23, 2016 8:50 AM</td>
<td>D8010</td>
</tr>
<tr>
<td>#146</td>
<td>Sep 22, 2016 6:31 PM</td>
<td>D8003</td>
</tr>
<tr>
<td>#145</td>
<td>Sep 22, 2016 6:27 PM</td>
<td>D8003</td>
</tr>
<tr>
<td>#144</td>
<td>Sep 22, 2016 5:47 PM</td>
<td>D7903</td>
</tr>
<tr>
<td>#143</td>
<td>Sep 22, 2016 5:05 PM</td>
<td>D7903</td>
</tr>
<tr>
<td>#142</td>
<td>Sep 22, 2016 12:55 PM</td>
<td>D8005</td>
</tr>
<tr>
<td>#141</td>
<td>Sep 22, 2016 12:15 PM</td>
<td>D8004</td>
</tr>
<tr>
<td>#140</td>
<td>Sep 22, 2016 11:35 AM</td>
<td>D8004</td>
</tr>
<tr>
<td>#139</td>
<td>Sep 22, 2016 10:14 AM</td>
<td>D8003</td>
</tr>
<tr>
<td>#138</td>
<td>Sep 22, 2016 8:12 AM</td>
<td>D7951</td>
</tr>
</tbody>
</table>
Build #17 (Sep 3, 2016 2:24:56 PM)

Revision: 49365
No changes.

Started by remote host 2001:1900:2254:206a::16:75

This was a build of D7749 by unknown (unknown)

Igor fix

Reviewers: bcr, wblock

Reviewed By: bcr, wblock

Subscribers: wblock, bcr

Differential Revision: https://reviews.freebsd.org/D7749
Checkstyle: 66.114 warnings from one analysis.

- 1 fixed warning
## Patch Build Status

### On Phabricator:

**Diff Detail**

<table>
<thead>
<tr>
<th>Repository</th>
<th>FreeBSD src repository</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lint</td>
<td>Lint OK</td>
</tr>
<tr>
<td>Unit</td>
<td>No Unit Test Coverage</td>
</tr>
<tr>
<td>Build Status</td>
<td><strong>Buildable 5112</strong></td>
</tr>
<tr>
<td></td>
<td>Build 5205: CI src build</td>
</tr>
<tr>
<td></td>
<td>Build 5204: arc lint + arc unit</td>
</tr>
</tbody>
</table>

**Build Status**

- Buildable 5112
- Build 5205: CI src build | Jenkins
- Build 5204: arc lint + arc unit

- Buildable 5172
- Build 5294: CI src build | Jenkins
Clang scan-build

- https://ci.freebsd.org/job/FreeBSD-head-scan_build/
- Static analysis tool provided by clang
- Clang Scan-Build Plugin
- bsd clang-analyze.mk
  - Imported from NetBSD

```make
make analyze \
CLANG_ANALYZE_OUTPUT_DIR=clangScanBuildReports \
CLANG_ANALYZE_OUTPUT=html
```
## Clang scan-build Bug Report

### Clang scan-build bug report for build #4

<table>
<thead>
<tr>
<th>Group</th>
<th>Type</th>
<th>File</th>
<th>Path Length</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Security</td>
<td>Potential insecure memory buffer bounds</td>
<td>workspace/usr.sbin/ctm/ctm_rmail/ctm_rmail.c</td>
<td>1</td>
<td>Call to function ‘strncpy’ is insecure as it does not provide bounding of the memory buffer. Replace unbounded copy functions with analogous functions that support length arguments such as ‘strncpy’ . CWE-119</td>
</tr>
<tr>
<td>Dead store</td>
<td>Dead assignment</td>
<td>workspace/usr/sys/modules/sys/.dev/sym/sym_hipd.c</td>
<td>1</td>
<td>Value stored to ‘f1’ is never read</td>
</tr>
<tr>
<td>Dead store</td>
<td>Dead assignment</td>
<td>workspace/usr/sys/modules/sound/sound/.dev/sound/pcm/mixer.c</td>
<td>1</td>
<td>Value stored to ‘ret’ is never read</td>
</tr>
<tr>
<td>Security</td>
<td>Potential insecure memory buffer bounds</td>
<td>workspace/usr.sbin/ess/.contrib/ess/FILENAME</td>
<td>1</td>
<td>Call to function ‘strncpy’ is insecure as it does not provide bounding of the memory buffer. Replace unbounded copy functions with analogous functions that support length arguments such as ‘strncpy’ . CWE-119</td>
</tr>
<tr>
<td>Logic error</td>
<td>Dereference of null pointer</td>
<td>workspace/src/lib/n curses/panelw/.contrib/n curses/panel/p_bottom.c</td>
<td>4</td>
<td>Access to field ‘_begy’ results in a dereference of a null pointer (loaded from field ‘win’)</td>
</tr>
<tr>
<td>Dead store</td>
<td>Dead assignment</td>
<td>workspace/usr/sys/modules/drm/radeon/.dev/drm/r600_op.c</td>
<td>1</td>
<td>Value stored to ‘num_backends’ is never read</td>
</tr>
</tbody>
</table>
/*
 * Recheck that ".." entry in the vdp directory points
 * to the inode we looked up before vdp lock was
 * dropped.
 */
error = ufs_lookup_ino(pdp, NULL, cnp, &ino);
if (error) {
    vput(tdp);
    return (error);
}
if (ino1 != ino) {
    vput(tdp);
    goto restart;
}
*vpp = tdp;

43 → Assuming 'error' is 0 →

44 → Taking false branch →

45 → Taking false branch →

46 ← Dereference of null pointer (loaded from variable 'vpp')
Igor + Checkstyle

- **textproc/igor**
  - By Warren Block <wblock@FreeBSD.org>
  - Automated proofreader for text files, man pages, and DocBook SGML source files

- **Checkstyle**
  - A tool to help programmers write Java code that adheres to a coding standard
  - Output an XML can be parsed by Jenkins Checkstyle Plugin

We added a new option (-X) to igor to output checkstyle XML
### CheckStyle Result

#### Warnings Trend

<table>
<thead>
<tr>
<th></th>
<th>All Warnings</th>
<th>New Warnings</th>
<th>Fixed Warnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>66116</td>
<td></td>
<td>45</td>
<td>45</td>
</tr>
</tbody>
</table>

#### Summary

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>High Priority</th>
<th>Normal Priority</th>
<th>Low Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>66116</td>
<td>0</td>
<td>66116</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Details

<table>
<thead>
<tr>
<th>Source Folder</th>
<th>Total</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>doc/en_US/ISO8859-1/articles/bsd1-gpl</td>
<td>113</td>
<td></td>
</tr>
<tr>
<td>doc/en_US/ISO8859-1/articles/building-products</td>
<td>641</td>
<td></td>
</tr>
<tr>
<td>doc/en_US/ISO8859-1/articles/contributing</td>
<td>144</td>
<td></td>
</tr>
<tr>
<td>doc/en_US/ISO8859-1/articles/contributors</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>doc/en_US/ISO8859-1/articles/cups</td>
<td>39</td>
<td></td>
</tr>
<tr>
<td>doc/en_US/ISO8859-1/articles/explaining-bsd</td>
<td>225</td>
<td></td>
</tr>
<tr>
<td>doc/en_US/ISO8859-1/articles/fonts</td>
<td>91</td>
<td></td>
</tr>
</tbody>
</table>
Checkstyle Result Trend

- Compare with previous build
- Overall Trend
### LLVM/Clang Warnings

#### Warnings Trend

<table>
<thead>
<tr>
<th></th>
<th>All Warnings</th>
<th>New Warnings</th>
<th>Fixed Warnings</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>853</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

#### Summary

<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>High Priority</th>
<th>Normal Priority</th>
<th>Low Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>853</td>
<td>2</td>
<td>851</td>
<td>0</td>
</tr>
</tbody>
</table>

#### Details

<table>
<thead>
<tr>
<th>Folders</th>
<th>Total</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>.</code></td>
<td>116</td>
<td></td>
</tr>
<tr>
<td><code>usr/obj/usr/src/lib32/usr/include/netinet</code></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><code>usr/obj/usr/src/lib32/usr/include/sys</code></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><code>usr/obj/usr/src/tmp/usr/include/netinet</code></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><code>usr/obj/usr/src/tmp/usr/include/sys</code></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td><code>usr/src/oddi/lib/libzfs</code></td>
<td>30</td>
<td></td>
</tr>
<tr>
<td><code>usr/src/oddi/priv/zfs</code></td>
<td>25</td>
<td></td>
</tr>
<tr>
<td><code>usr/src/oddi/priv/zpool</code></td>
<td>17</td>
<td></td>
</tr>
<tr>
<td><code>usr/src/oddi/priv/zpool /usr/obj/usr/src/lib32/usr/include/sys</code></td>
<td>14</td>
<td></td>
</tr>
<tr>
<td><code>usr/src/oddi/priv/zpool /usr/obj/usr/src/lib32/usr/include/sys</code></td>
<td>17</td>
<td></td>
</tr>
</tbody>
</table>
Compiler Warnings Trend
Build Status Badge

- https://wiki.freebsd.org/arm64:

- https://riscv.org/software-tools/freebsd/

**FreeBSD/RISC-V**

This is a port of *FreeBSD Operating System* to RISC-V instruction set architecture.

- https://<job url>/badge/icon
- https://<job url>/lastCompletedBuild/badge/icon
Other Jenkins Plugins Used

● SCM Sync configuration
  ○ Use post-commit hook to notify administrators

● SafeRestart
  ○ Schedule restart jenkins when all current jobs complete
  ○ Save and resume the build queue

● Green balls
  ○ People like green
  ○ Everything is fine
Jenkins REST API

Most Jenkins URLs can be append "/api" to get REST API document

- Append "/api/json" for JSON
- Append "/api/json?pretty=true" for human readable
- Get the latest good-to-build revision: (jq package needed)
  - curl -s
    https://ci.freebsd.org/job/FreeBSD-head-amd64-build/lastStableBuild/api/json
    | jq '.changeSet.revisions[0].revision'
Tinderbox view

- https://ci.freebsd.org/tinderbox/
- By foundation intern, Siva Mahadevan

<table>
<thead>
<tr>
<th>Architecture</th>
<th>head</th>
<th>stable/11</th>
<th>stable/10</th>
</tr>
</thead>
<tbody>
<tr>
<td>aarch64</td>
<td>2017-06-09 17:28 UTC</td>
<td>2017-06-09 01:20 UTC</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>r319756</td>
<td>r319728</td>
<td></td>
</tr>
<tr>
<td></td>
<td>details</td>
<td>details</td>
<td></td>
</tr>
<tr>
<td>amd64</td>
<td>2017-06-09 16:40 UTC</td>
<td>2017-06-09 00:33 UTC</td>
<td>2017-06-08 17:09 UTC</td>
</tr>
<tr>
<td></td>
<td>r319755</td>
<td>r319728</td>
<td>r319701</td>
</tr>
<tr>
<td></td>
<td>details</td>
<td>details</td>
<td>details</td>
</tr>
<tr>
<td>i386</td>
<td>2017-06-09 17:26 UTC</td>
<td>2017-06-09 00:46 UTC</td>
<td>2017-06-08 17:31 UTC</td>
</tr>
<tr>
<td></td>
<td>r319756</td>
<td>r319728</td>
<td>r319701</td>
</tr>
<tr>
<td></td>
<td>(failing since r319860)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>last successful build</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>details</td>
<td>details</td>
<td></td>
</tr>
<tr>
<td>riscv64</td>
<td>2017-06-09 17:41 UTC</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>r319756</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>details</td>
<td></td>
<td></td>
</tr>
<tr>
<td>sparc64</td>
<td>2017-06-09 17:27 UTC</td>
<td>2017-06-09 00:33 UTC</td>
<td>2017-06-08 17:40 UTC</td>
</tr>
<tr>
<td></td>
<td>r319756</td>
<td>r319728</td>
<td>r319701</td>
</tr>
<tr>
<td></td>
<td>details</td>
<td>details</td>
<td>details</td>
</tr>
</tbody>
</table>

Last updated: Fri Jun 09 2017 14:15:13 GMT-0400 (EDT)
Epilogue
Summary

- Continuous Integration does help development of the FreeBSD project
- Hope these experience and codes can also help other projects
Future Work

- Have you to work on testing FreeBSD!
  - freebsd-testing@
  - EFNet/#freebsd-ci
- Check for reproducible build
- More tests, even some are not enabled by default
  - Dtrace
- Build for project branches
  - Make testing feature branches easier
- CI for ports
  - Collaboration with "redports"
  - Automatically "exp-run"
- Performance tests
- Work with other projects
Acknowledgement

- jenkins-admin@FreeBSD.org
- The FreeBSD Foundation
- clusteradmin@FreeBSD.org
- phabric-admin@FreeBSD.org
- People on -testing, -current, -stable mailing lists