Challenges in Testing
How OpenSourceRouting tests Quagga

Martin Winter
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Who is OpenSourceRouting?

- **Who is Open Source Routing?**
  - [www.opensourcerouting.org](http://www.opensourcerouting.org)
  - Project by NetDEF (Network Device Education Foundation)
    - [www.netdef.org](http://www.netdef.org)
    - Non-Profit Company based in California
  - Working on Quagga Routing

- **Who is Martin Winter?**
  - Co-Founder of NetDEF
  - Focusing on Testing Quagga
  - Previously worked for Equipment Vendor & large ISP
What is Quagga?

- **Routing Protocol Stack**
  - RIP / RIPNG / OSPFv2 / OSPFv3 / ISIS / BGP / PIM
  - Running on Linux / FreeBSD / NetBSD / OpenBSD / Solaris
  - Used on low-end OpenWRT boxes, physical and virtual software routers, SDN deployments, distributed routers
  - Originally derived from Zebra
  - GPLv2+ Open Source / “Community” owned & controlled
<table>
<thead>
<tr>
<th>Quagga Community</th>
<th>How it works today</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>No “Owner”</strong></td>
<td>No single entity behind Quagga</td>
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<tr>
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<td>Large community of “Contributers”</td>
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<td></td>
<td>Maintainer = person with commit access</td>
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<td><strong>Simple Git Model</strong></td>
<td>Main source git on Savannah</td>
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<td></td>
<td>Single master branch with development branch merged into every few months</td>
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<td><strong>Email based submissions</strong></td>
<td>Code submissions by email to developer list</td>
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<td>Code review with discussion on list</td>
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</table>
Choosing a CI System

- Are all CI systems designed for Linux & Java?
  - Java clients on agents are NOT cross-platform
  - There are other OS’es than Linux in existence

- Stability

- Hosted vs Local
  - Integrate Dedicated Tester Hardware?
  - Limitations on Parallelization / Runtime?
CI Run Overview

- **Patch Submission**
  - Git Checkout and apply patch(es)

- **Source packaged**
  - Building packages & DejaGNU UnitTests
    - Ubuntu 12.04, 14.04
    - CentOS 6, 7, Debian 8, FreeBSD 8, 9, 10, NetBSD 6, 7, OpenBSD 5.8, OmniOS (Solaris)
  - 2 min
  - 1 VM

- **Packages built**
  - Basic IPv4 & IPv6 Routing Protocol checks
  - Clang Static Analyzer Run (on Ubuntu)
  - 10 min
  - 12 VMs

- **Limited tested**
  - Email Reply to Patch
  - 60 min
  - 2x2+1 VMs

- **Tested**
  - Full RFC Compliance Test
  - 2 days
  - 24x2 VMs
Git Checkout / Patching
All starts with new commit submitted

- Pull code from Git
  - Which revision / branch?

- Add patches
  - Single patch / Series of patches?

- Package Source
  - Add Extra Information (Git Rev, Patches, build time etc)
Building Packages on each OS
Running on parallel VMs

- Running on VMs – start/shut on demand
- Reset VM to clean snapshot at beginning
- Configure the code
  - `./configure` – but which choices?
- Build (make & make install)
- Run Unit tests (DejaGNU [make check])
- Build OS specific packages
  - Different configuration settings? All features?
Basic Protocol checks

› Use RFC compliance checker for a 2..3 selected checks on each protocol
   • Just make sure they don’t immediately crash
   • Parallel/Serialize? Balance between runtime and required resources (multiple CI runs in parallel possible!)

› Rebuild with CLANG
   • Use Clang Static Analyzer
   • How to translate results into pass/fail? Diff to previous run?
Automated reply

- Sent as reply to Patch email
- Reply approx 1..2 hrs after submission
  - Earlier if failing at beginning of tests
- Parse results into easy email
  - Assume submitter is first-timer and doesn’t know tests
  - Simplify results
Example: Successful submission

From: cisystem@netdef.org  
To: sharpd@cumulusnetworks.com  
Cc: mwinter@opensourcerouting.org, quagga-dev@lists.quagga.net  
Subject: CI Testresult: PASSED (Re: [quagga-dev,14658] config: Remove unused library check)  
Date: February 2, 2016 at 7:40 PM

Continuous Integration Result: SUCCESSFUL

Congratulations, this patch passed basic tests

Tested-by: NetDEF CI System <cisystem@netdef.org>

This is an EXPERIMENTAL automated CI system.  
For questions and feedback, feel free to email  
Martin Winter <mwinter@opensourcerouting.org>.

Patches applied:
Patchwork 1811: http://patchwork.quagga.net/patch/1811
[quagga-dev,14658] config: Remove unused library check
Tested on top of Git : eae18d1 (as of 20151209.135437 UTC)
CI System Testrun URL: https://ci1.netdef.org/browse/QUAGGA-QPWORK-231/

Regards,
NetDEF/OpenSourceRouting Continous Integration (CI) System

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OpenSourceRouting.org is a project of the Network Device Education Foundation,
For more information, see www.netdef.org and www.opensourcerouting.org
For questions in regards to this CI System, contact Martin Winter, mwinter@netdef.org
From: cisystem@netdef.org
To: timo.teras@iki.fi
Cc: mwinter@opensourcerouting.org, quagga-dev@lists.quagga.net
Subject: CI Testresult: FAILED (Re: [quagga-dev,14376,v3] lib, zebra: unify link layer type and hardware address handling)
Date: December 26, 2015 at 2:20 AM

Continuous Integration Result: FAILED

See below for issues.
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Martin Winter <mwinter@opensourcerouting.org>.

Patches applied:
Patchwork 1741: http://patchwork.quagga.net/patch/1741
[quagga-dev,14376,v3] lib, zebra: unify link layer type and hardware address handling
Tested on top of Git: eae18d1 (as of 20151209.135437 UTC)
CI System Testrun URL: https://ci1.netdef.org/browse/QUAGGA-QPWORK-204/

Get source and apply patch from patchwork: Successful
-----------------
Building Stage: Failed
-----------------
CentOS7 amd64 build: Successful
Debian8 amd64 build: Successful
Ubuntu1204 amd64 build: Successful
CentOS6 amd64 build: Successful
Ubuntu1404 amd64 build: Successful

Make failed for FreeBSD10 amd64 build: (see full log in attachment freebsd10_amd64_make.log)
  CC       rtread_sysctl.o
  CC       kernel_socket.o
kernel_socket.c:1127:41: error: no member named 'sdl' in 'struct interface'
     gate = (union sockunion *) & ifp->sdl;
          ^
  1 error generated.
  *** Error code 1
  Stop.
make[2]: stopped in /usr/home/ci/cibuild.204/quagga-source/zebra

Make failed for NetBSD6 amd64 build: (see full log in attachment netbsd6_amd64_make.log)
  CC       kernel_socket.o

Example:
Failed
compilation
Continous Integration Result: FAILED

See below for issues.
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Martin Winter <mwinter@opensourcerouting.org>.

Patches applied :
Patchwork 1808: http://patchwork.quagga.net/patch/1808
[quagga-dev,14647] perfect cmd table
Tested on top of Git : eae18d1 (as of 20151209.135437 UTC)
CI System Testrun URL: https://ci1.netdef.org/browse/QUAGGA-QPWORK-228/

Get source and apply patch from patchwork: Successful
------------------
Building Stage: Successful
------------------
Basic Tests: Failed
-------------
Ipv6 protocols: Successful
Static analyzer (clang): Successful

RFC Compliance Test ANVL-BGP4-4.1 failing:
Test Summary
An UPDATE message MAY simultaneously advertise a feasible route and
withdraw multiple unfeasible routes from service.
Test Reference
RFC4271, Sect. 4.3, p 15,
UPDATE Message Format
Test Classification
MAY
Test ANVL-BGP4-4.1: !FAILED!
Received unexpected IP packet
External peer <PEER-AS2-A> incorrectly received IP
packet forwarded by DUT

Example: Failed
Basic Routing Checks
Run Full RFC Compliance Check

- More than just compliance
  - Heavy interaction with CLI -> Good CLI Tester as well
- Requires between 3 and 30 hours per protocol
- Multiple runs required to find inconsistent results
- Feed all results, logs, pcaps into DB
- Create PDF report
  - see https://www.opensourcerouting.org/compliance-test-results/
- Run against commercial/other products to compare
  - (but not publishing results from commercial equipment)
- How to translate to pass/fail Overall?
Protocol Fuzzer

- **Hardware – 4 parallel tests only**
  - No open source solution available

- **Slow. Single pass of BGP takes ~1..2 weeks runtime**
  - For single configuration, when no errors are found

- **How to publish results?**
  - All pass: boring
  - Some fail: Security issue, open CVE first?
Scale / Performance tests

- DUT Hardware needs consistency to compare
  - Anyone having success running performance/scale tests on VMs?

- Expensive Equipment (+ Power + Automation)

- Spin-up/down on demand and automatically building topology with “patchpanels” is painful
  - Ie Using old Cisco 4948 for patchpanel (cheaper than OpenFlow switches)

- Using Ixia IxNetwork and Spirent TestCenter

- Pass/Fail criteria?
Contact Us

Questions?
Comments?
Want to discuss?
Want to Sponsor?

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www.netdef.org  /  www.opensourcerouting.org