Performance Tuning best pracitces and performance monitoring with Zabbix

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Overview

- Introduction
- Performance tuning is Science!
- A little Law and some things to monitor
- Let's find peak performance
- Conclusion
  - Source code availability
  - Test environment information

$ whoami

- Andrew Nelson
- anelson@redhat.com
- Senior Linux Consultant with Red Hat North America
- Active in the Zabbix community for approximately 10 years
- Known as “nelsonab” in forums and IRC
- Author of the Zabbix API Ruby library zbxapi


Performance Tuning
and SCIENCE!

Performance tuning and the Scientific Method

- Performance tuning is similar to the Scientific method
  - Define the problem
  - State a hypothesis
  - Prepare experiments to test the hypothesis
  - Analyze the results
  - Generate a conclusion

Understanding the problem

- Performance tuning often involves a multitude of components
- Identifying problem areas is often challenging
- Poorly defined problems can be worse than no problem at all

These are not (necessarily) the solutions you want.

Understanding the problem

- Why?
  - Better utilization of resources
  - Capacity Planning and scaling
- For tuning to work, you must define your problem
  - But don't be defined **by** the problem.

You can't navigate somewhere when you don't know where you're going.

Defining the problem

- Often best when phrased as a declaration with a reference
  - Poor Examples
    - “The disks are too slow”
    - “It takes too long to log in”
    - “It's Broken!”
  - Good Examples
    - “Writes for files ranging in size from X to Y must take less than N seconds to write.”
    - “Customer Login's must take no longer than .5 seconds”
    - “The computer monitor is dark and does not wake up when moving the mouse”

Define your tests

- Define your tests and ensure they are repeatable
  - Poor Example (manually run tests)

```
1 $ time cp one /test_dir
2 $ time cp two /test_dir
```

  - Good Example (automated tests with parsable output)

```
$ run_test.sh
Subsystem A write tests
Run    Size        Time (seconds)
1      100KB       0.05
2      500KB       0.24
3        1MB       0.47
```

Define your tests

- A good test is comprised to two main components
  a) It is representative of the problem
  b) It has easy to collate and process output.
- Be aware of external factors
  - Department A owns application B which is used by group C but managed by department D.
    - Department D may feel that application B is too difficult to support and may not lend much assistance placing department A in a difficult position.

Perform your tests

- Once the tests have been agreed upon get a set of baseline data
- Log all performance tuning changes and annotate all tests with the changes made
- If the data is diverging from the goal, stop and look closer
  - Was the goal appropriate?
  - Where the tests appropriate?
  - Were the optimizations appropriate?
  - Are there any external factors impacting the effort?

Perform your tests and DOCUMENT!

- When the goal is reached, stop
  - Is there a need to go on?
  - Was the goal reasonable?
  - Were the tests appropriate?
  - Were there any external issues not accounted for or foreseen?
- DOCUMENT DOCUMENT DOCUMENT

If someone ran a test on a server, but did not log it, did it really happen?

When testing, don't forget to...

DOCUMENT!

Story time!

- Client was migrating from Unix running on x86 to RHEL5 running on x86
- Client claimed the middleware stack they were using was “slower” on RHEL
- Some of the problems encountered
  - Problem was not clearly defined
    - There were some external challenges observed
  - Tests were not representative and mildly consistent
  - End goal/performance metric “evolved” over time
  - Physical CPU clock speed was approximately 10% slower on newer systems

More Story time!

- Client was migrating an application from zOS to RHEL 6 with GFS2
- Things were “slow” but there was no consistent quantification of “slow”.
  - Raw testing showed GFS2 to be far superior to NFS, but Developers claimed NFS was faster.
- Eventually GFS2 was migrated to faster storage, developers became more educated about performance and overall things are improved.
- Developers are learning to quantify the need for something before asking for it.


A little Law and some things to monitor

Little's Law

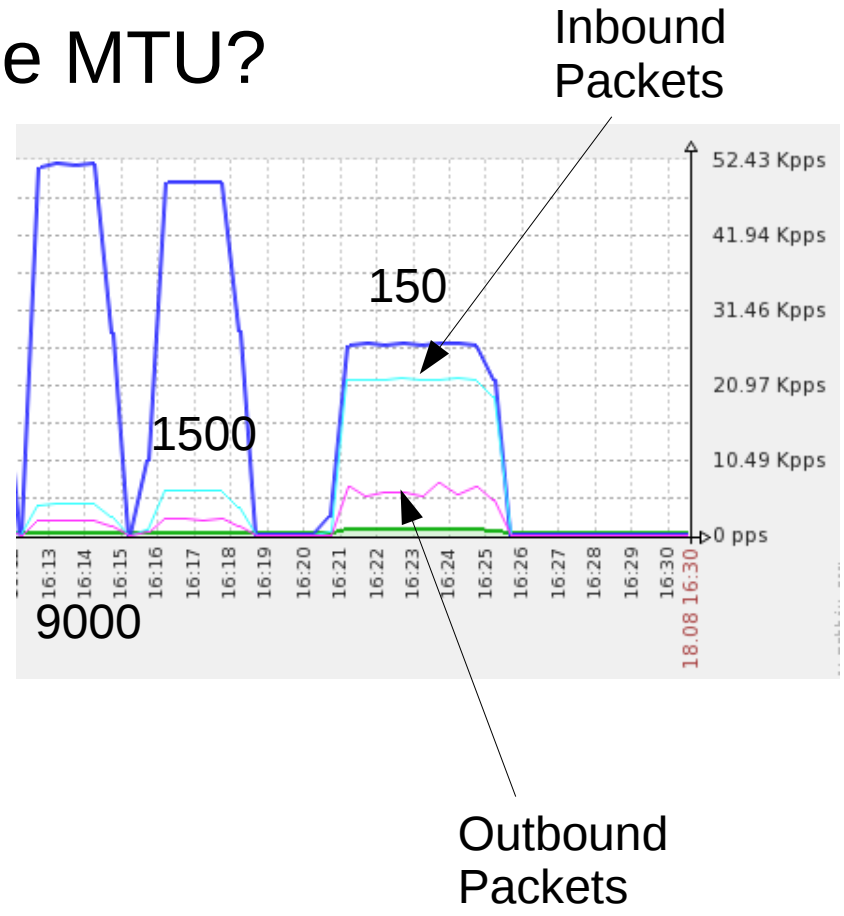
- $L=\lambda h$
  - L = Queue length
  - h = Time to service a request
  - λ=arrival rate
- Networking provides some good examples of Little's Law in action.
- MTU (Maximum Transmission Unit) and Speed can be analogous to lambda.
- The Bandwidth Delay Product (BDP) is akin to L, Queue length

Little's Law

- BDP is defined as: Bandwidth * End_To_End_Delay (or latency)
- Example
  - 1GB/s Link with 2.24ms Round Trip Time (RTT)
  - 1Gb/s * 2.24ms = 0.27MB
  - Thus, a buffer of at least 0.27MB is required to buffer all of the data on the wire.

Little's Law

- What happens when we alter the MTU?
- 9000
  - 6,000 Packets per second
  - 939.5MB/s
- 1500
  - 6,000 Packets per second
  - 898.5MB/s
- 150
  - 22,000 Packets per second
  - 493MB/s



Little's law in action.

- There are numerous ways to utilize Little's law in monitoring.
  - IO requests in flight for disks
  - Network buffer status
  - Network packets per second.
  - Processor load
  - Time to service a request

Little's law in action.

- Apache is the foundation for many enterprise and SAS products, so how can we monitor it's performance in Zabbix?
- Normal approaches involved parsing log files, or parsing the status page
- The normal ways don't tend to work well with Zabbix, however we can use a script to parse the logs in realtime from Zabbix and use a file socket for data output.

Little's law in action.

- Two pieces are involved in pumping data from Apache into Zabbix.
- First we build a running counter via a log pipe to a script

```
# YYYYMMDD-HHMMSS Path BytesReceived BytesSent TimeSpent
MicrosecondsSpent

LogFormat "%{%Y%m%d-%H%M%S}t %U %I %O %T %D" zabbix-log

CustomLog "|$/var/lib/zabbix/apache-log.rb >>var/lib/zabbix/errors"
zabbix-log
```

- This creates a file socket:

```
$ cat /var/lib/zabbix/apache-data-out

Count Received Sent total_time  total_microsedonds

4150693 573701315 9831930078 0 335509340
```

Little's law in action.

- Next we push that data via a client side script using Zabbix_sender

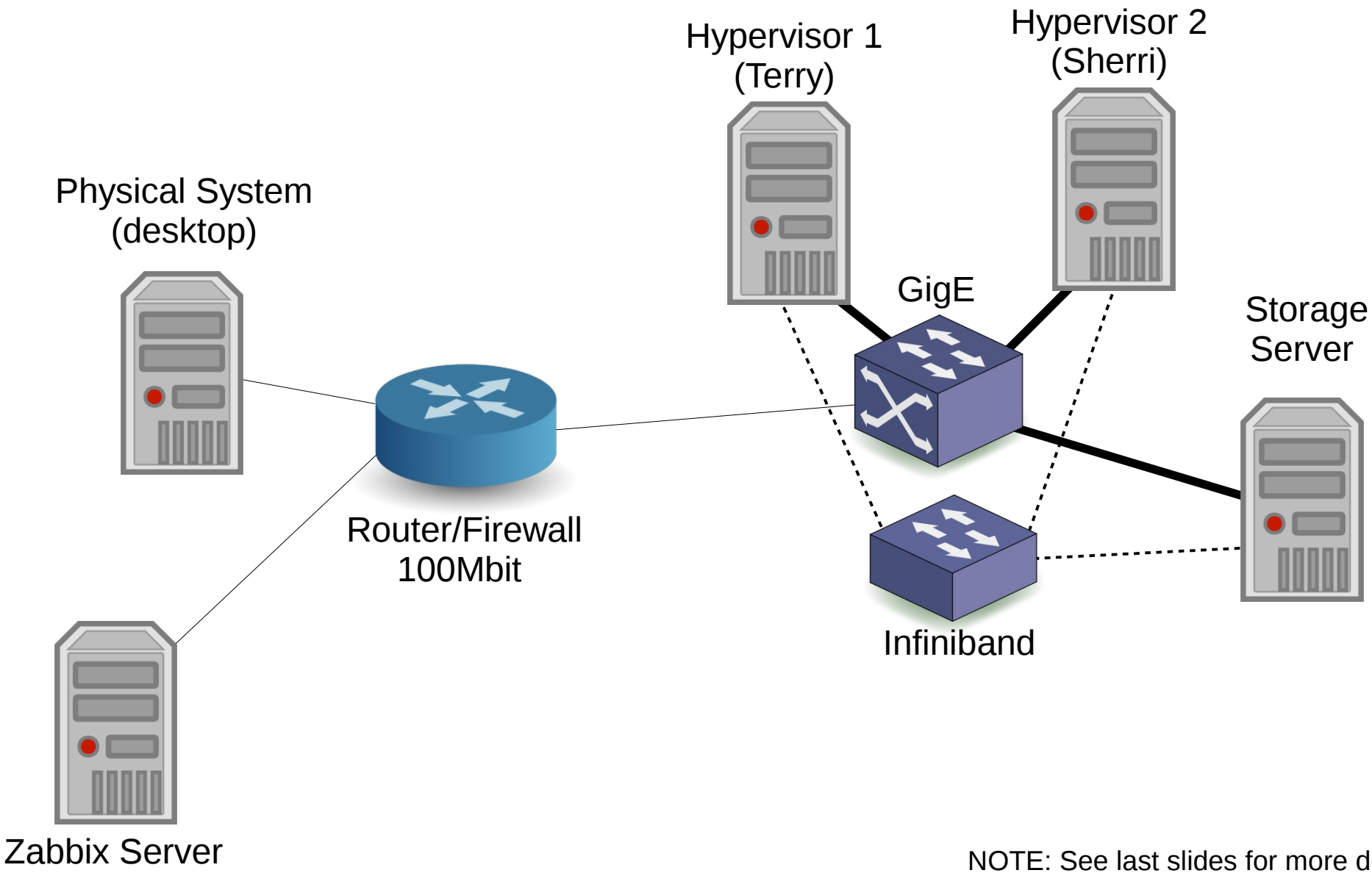
```
$ crontab -e

*/1 * * * * /var/lib/zabbix/zabbix_sender.sh
```

- And import the template

apache (15 Items)				
Apache Bytes Received	29 Aug 2014 12:44:39	151 B	-	Graph
Apache Bytes Sent	29 Aug 2014 12:44:39	151 B	-	Graph
Apache Miliseconds Per Connection	29 Aug 2014 12:44:39	128 ms	+33 ms	Graph
Apache Received Bytes Per Connection	29 Aug 2014 12:44:39	151 B	-	Graph
Apache Second per Connection	29 Aug 2014 12:44:39	0	-	Graph
Apache Sent Bytes Per Connection	29 Aug 2014 12:44:39	151 B	-	Graph
Apache Total Miliseconds spent	29 Aug 2014 12:44:39	128 ms	+33 ms	Graph
Apache Total Seconds spent	29 Aug 2014 12:44:39	0	-	Graph
Download speed for scenario "Load Main Page".	29 Aug 2014 12:45:27	91.15 KBps	+46.15 KBps	Graph
Download speed for step "Main Page" of scenari...	29 Aug 2014 12:45:27	91.15 KBps	+46.15 KBps	Graph
Failed step of scenario "Load Main Page".	29 Aug 2014 12:45:27	0	-	Graph
Response code for step "Main Page" of scenari...	29 Aug 2014 12:45:27	200	-	Graph
Response time for step "Main Page" of scenario...	29 Aug 2014 12:45:27	3.8ms	-	Graph
Total Apache Treads	29 Aug 2014 12:45:27	21	-	Graph
URL Count	29 Aug 2014 12:44:39	1	-	Graph


Let's see if we can find the peak performance with Zabbix

The test environment



NOTE: See last slides for more details

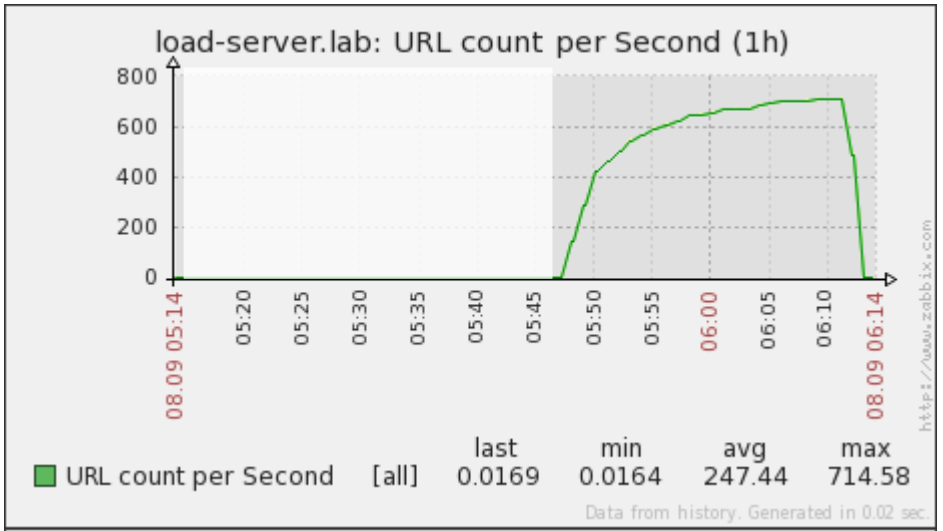
What are we looking for

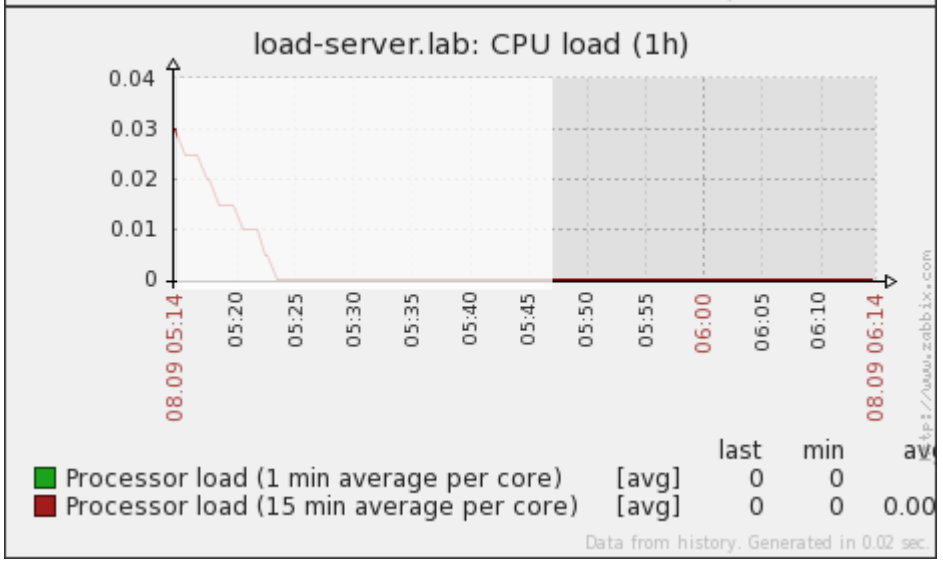
- It is normal to be somewhat unsure initially, investigative testing will help shape this.
- Some form of saturation will be reached, hopefully on the server.
- Saturation will take one or both of the following forms
  - Increased time to service
    - Request queues (or buffers) are full, meaning overall increased time to service the queue
  - Failure to service
    - Queue is full and the request will not be serviced. The server will issue an error, or the client will time out.

Finding Peak Performance, initial test

Test Window

- Tests were run from system “Desktop”
- Apache reports 800 connections per second.
- Processor load is light.

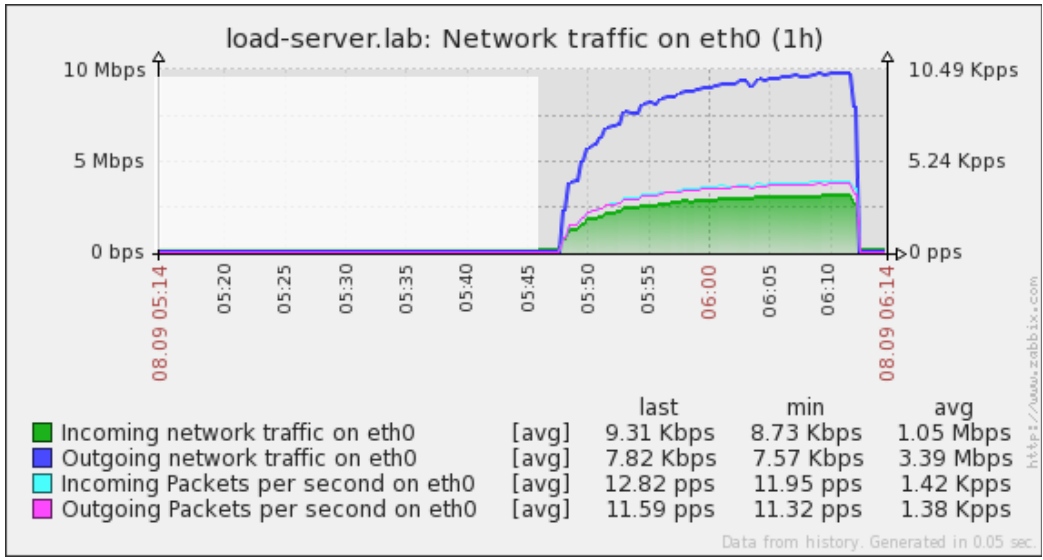


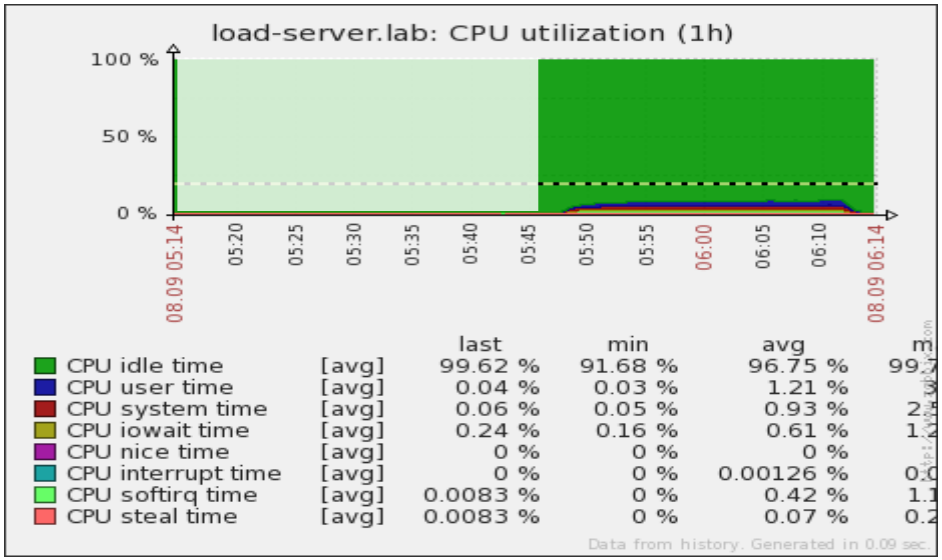


Finding Peak Performance, initial test

- Network shows a plateau, but not saturation on the client.
  - Plateau is smooth in appearance
- Neither of the two cores appears very busy.

Test Window

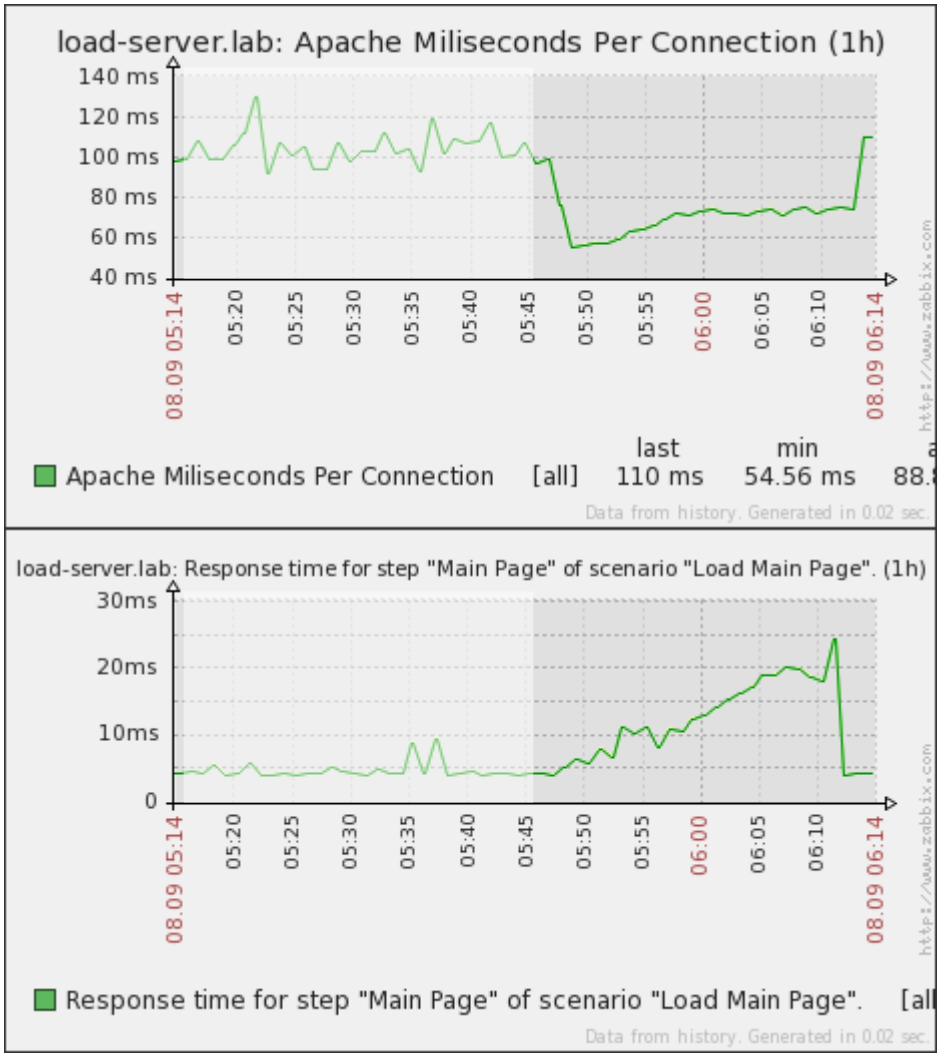




Finding Peak Performance, initial test

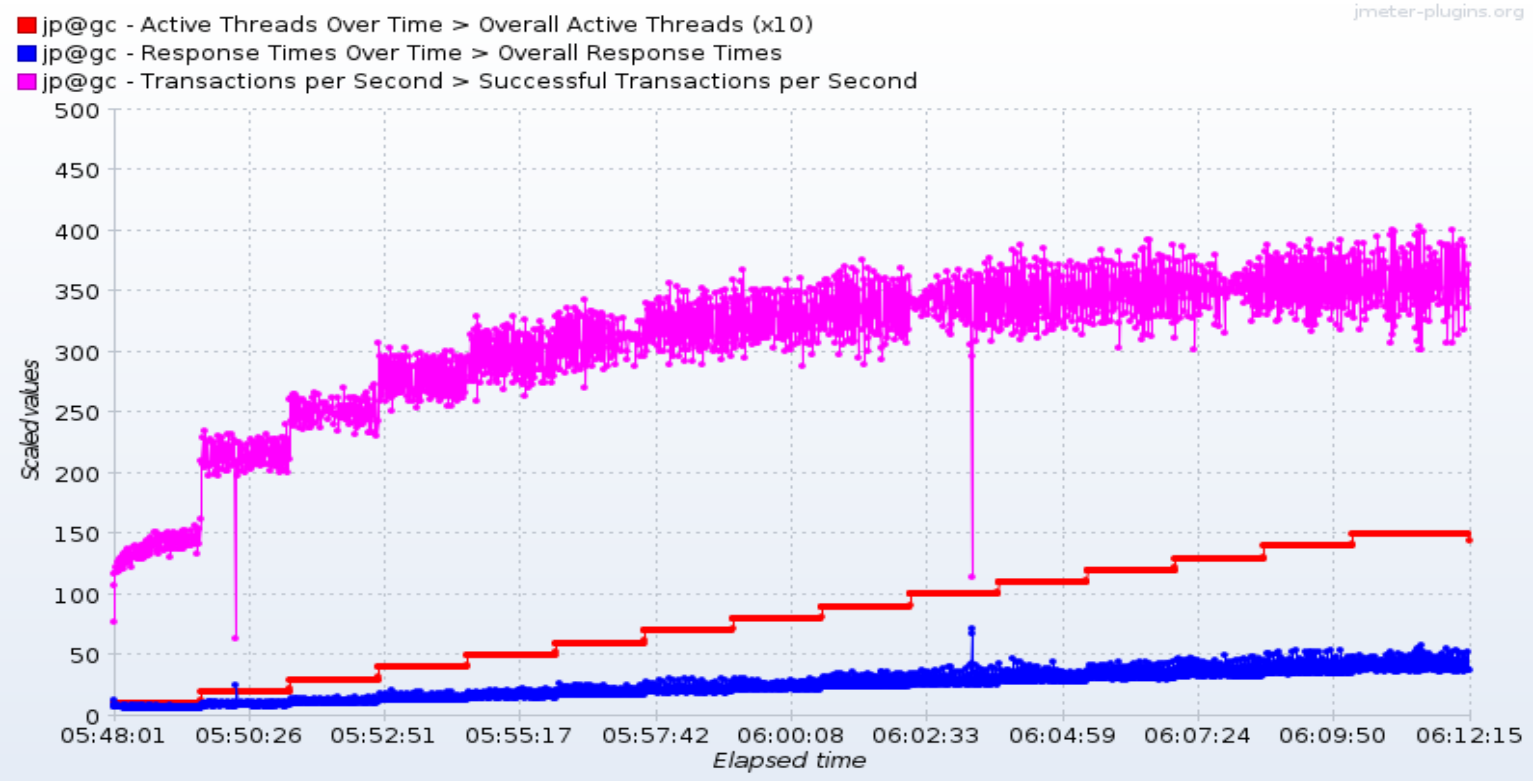
- Apache server seems to report that it responds faster with more connections
- Zabbix web tests show increased latency

Test Window



Finding Peak Performance, initial test

- The actual data from Jmeter
  - Appearance of smooth steps and plateau



Finding Peak Performance, Initial analysis

- Reduced response latency may be due to processor cache.
  - Connections are repetitive potential leading to greater cache efficiency.
- Network appears to be the bottleneck.
  - During tests some Zabbix checks were timing out to the test server and other systems behind the firewall/router
  - Router showed very high CPU utilization.
- Jmeter does not show many connection errors.
  - Network layer is throttling connections

Finding Peak Performance, Initial analysis

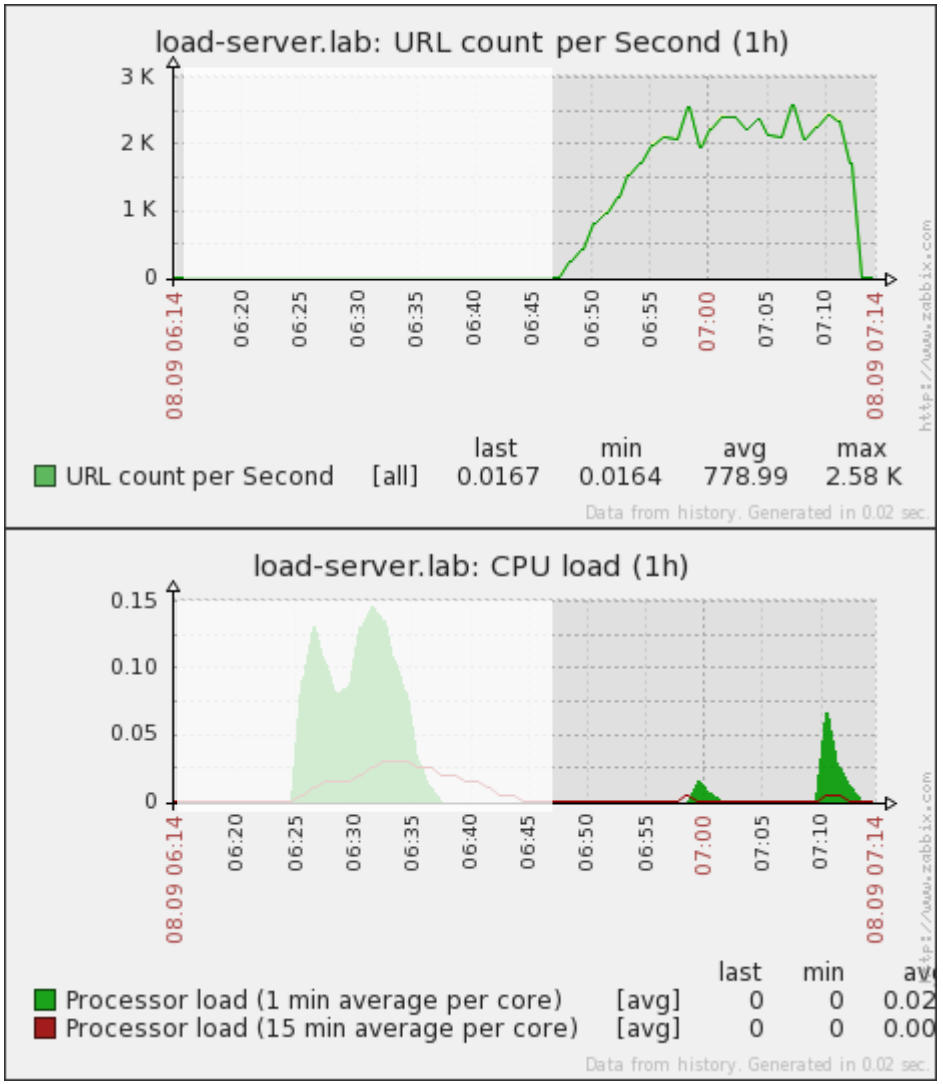
- More testing needed
  - Tests need to come from a system on the same VLAN and switch as the server and not traverse the router.
- A wise man once said:

I need a little more Cowbell (aka testing)

Finding Peak Performance, second test

- Testing from another VM with full 1Gb links to test server
- Based on concurrent connections count, it seems an upper limit has again been found.
  - Graph is not smooth at plateau
- CPU exhibits greater load, but overall still low

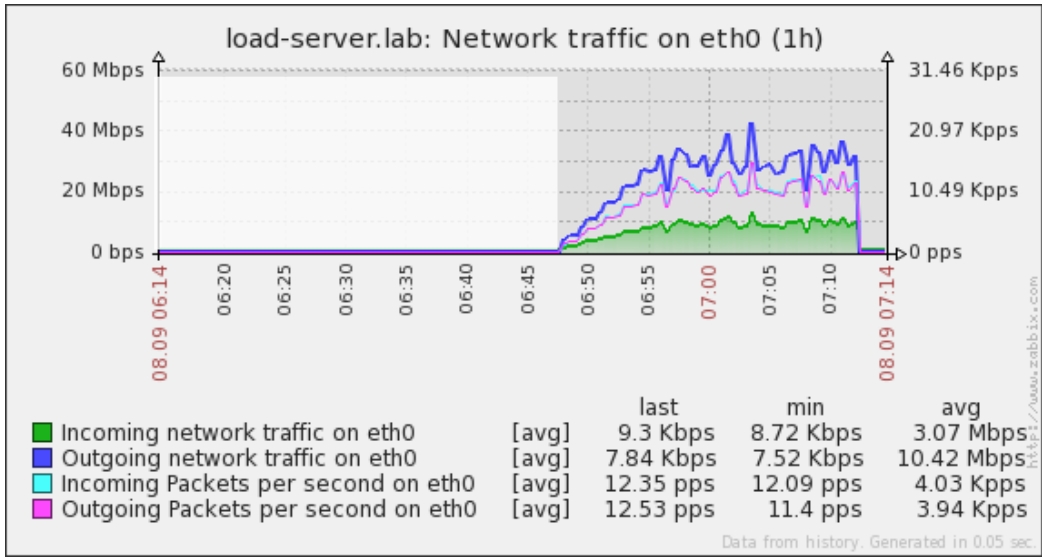
Test Window

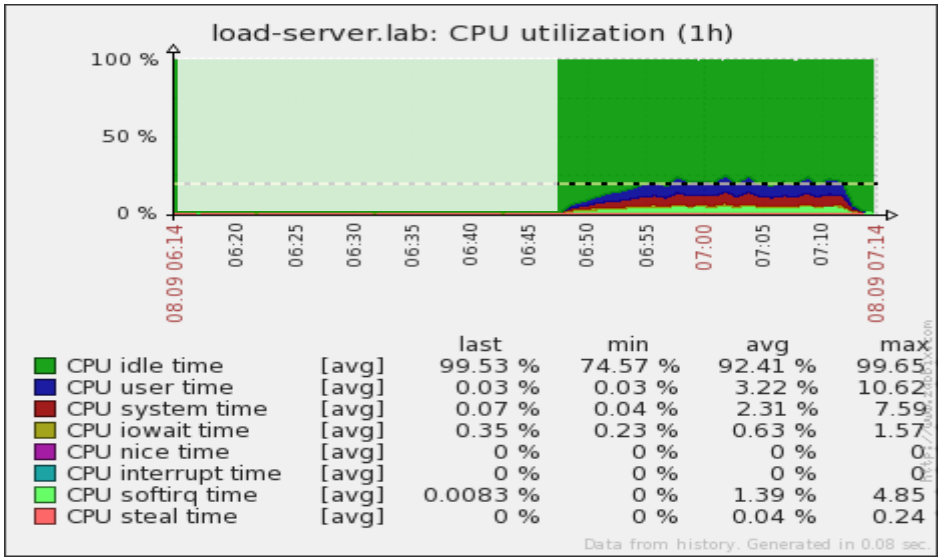


Finding Peak Performance, second test

- Network no longer appears to be the bottleneck
  - Rough “saw-tooth” plateau noted
- CPU Utilization follows picture of load, but it would seem there is still CPU capacity left.

Test Window

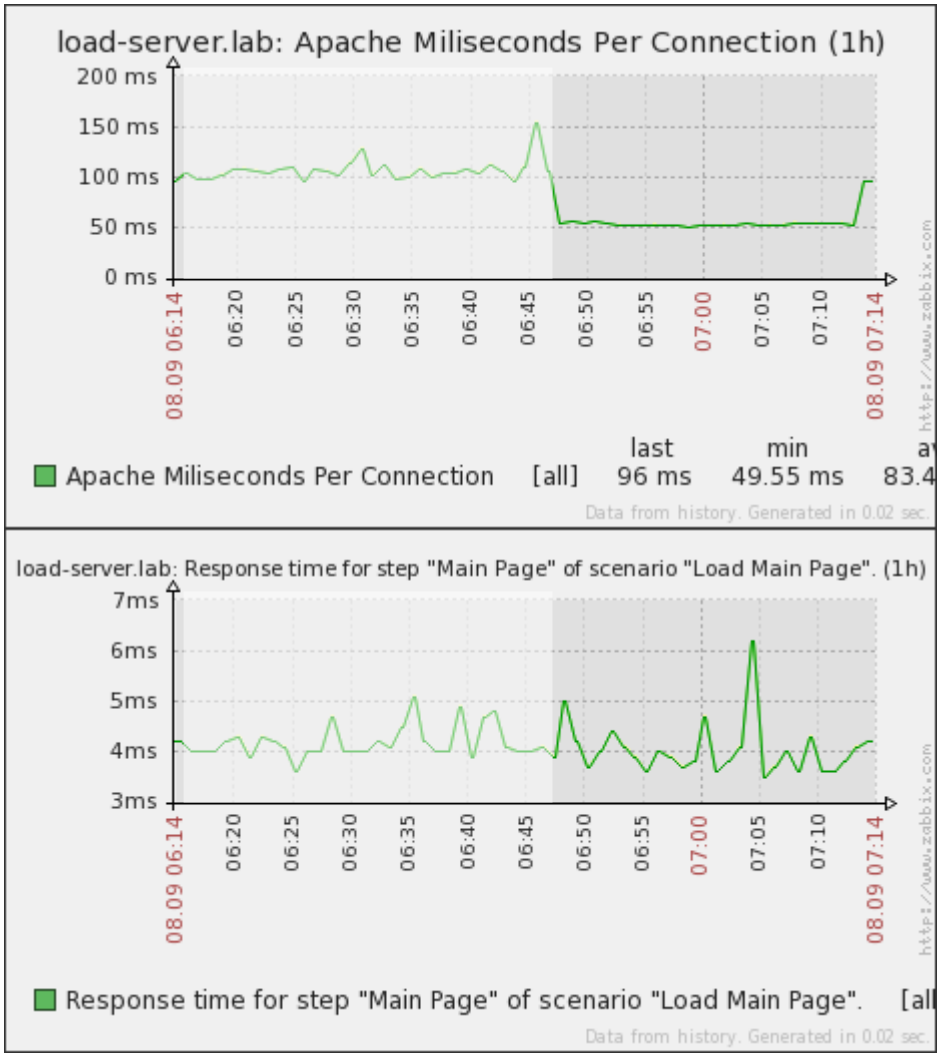




Finding Peak Performance, second test

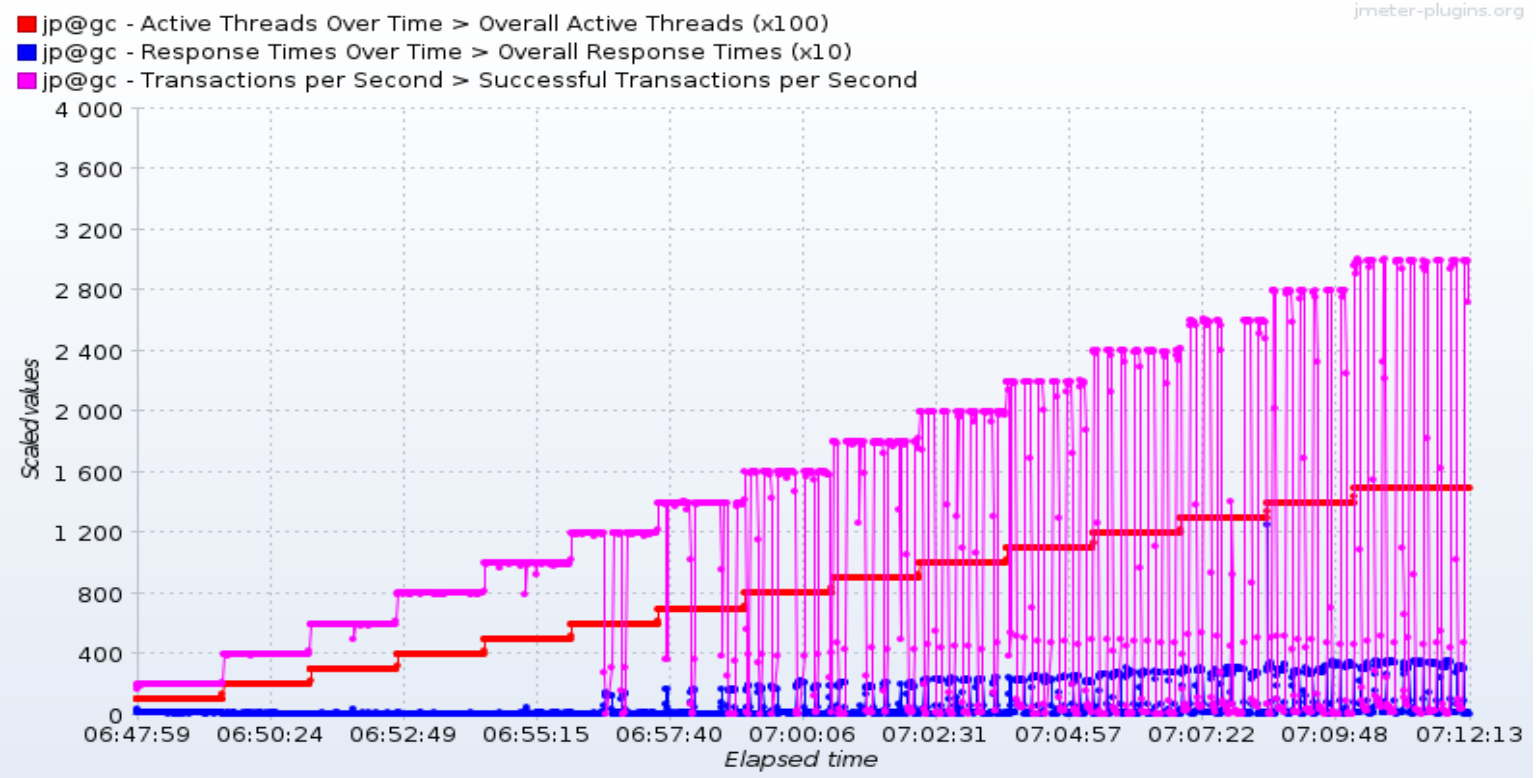
- Apache again appears to respond faster under load than when idle
  - Reduced latency shows smooth appearance
- Zabbix tests do not show any change in Apache performance. The router is back to “normal” load.

Test Window



Finding Peak Performance, second test

- Steps are smooth and uneventful below 1200 TPS.
  - Wild TPS graph above 1200 is due to connection errors
    - Jmeter graph above 1200TPS does not appear coherent with Zabbix graphs.



Finding Peak Performance, Second analysis

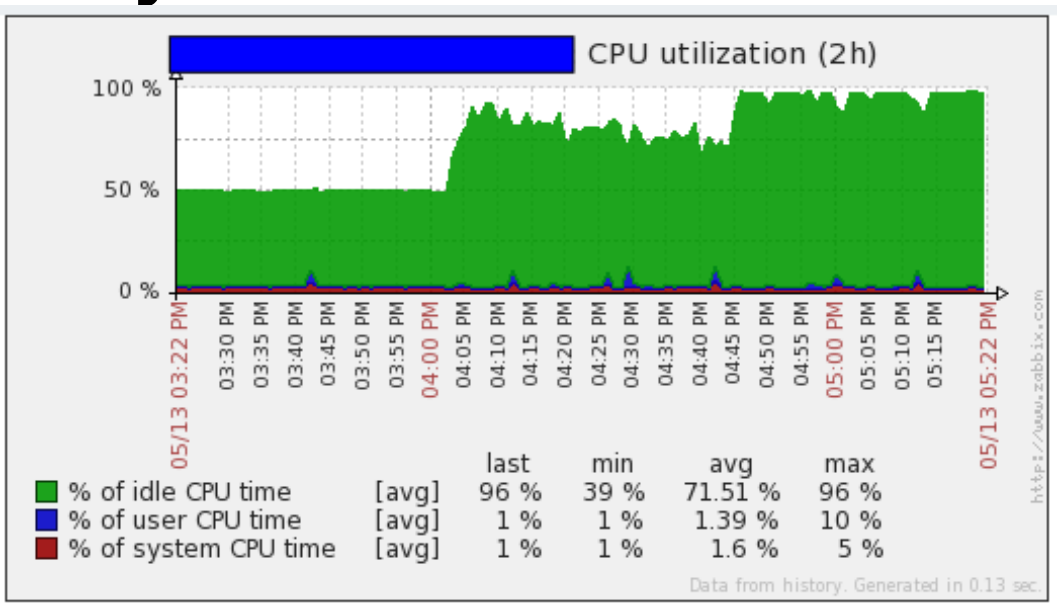
- It would appear reduced response latency is likely due to to processor cache as noted before.
  - Increased rate of repetitiveness reduced latency further.
- Network did not appear to be the bottleneck
- Connection errors were noted in Jmeter tests as would be expected for a saturated server.
- Based on Jmeter and Zabbix data peak performance for this server with the test web page is about 1,200 pages per second
- What if we couldn't max out performance, are there other ways to find it?

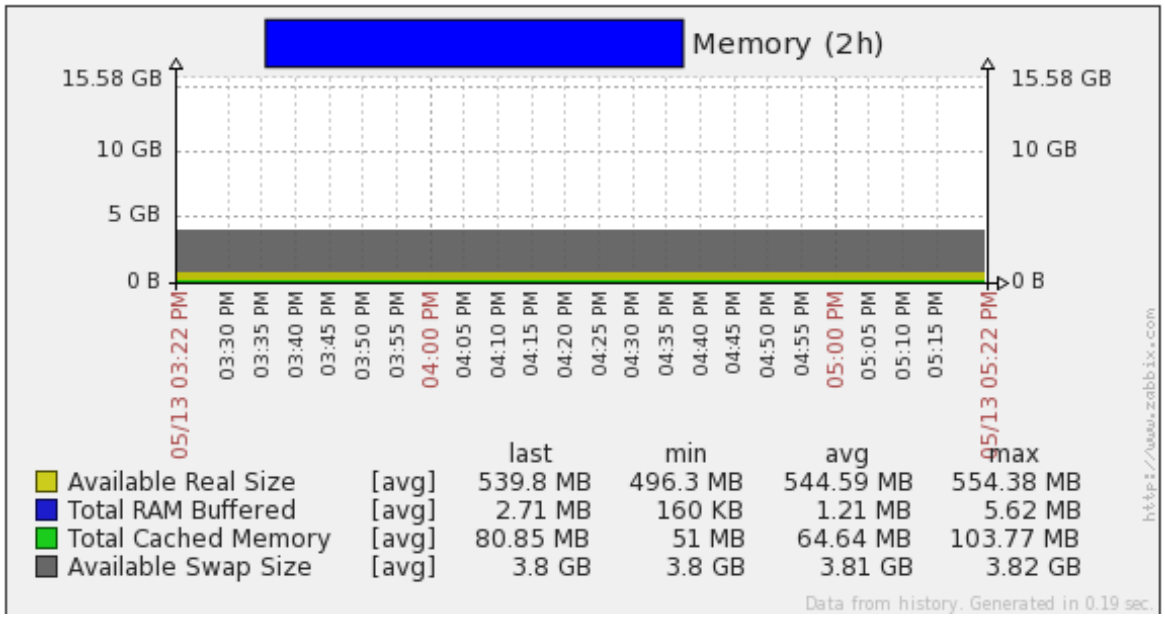

Conclusion

One more story...

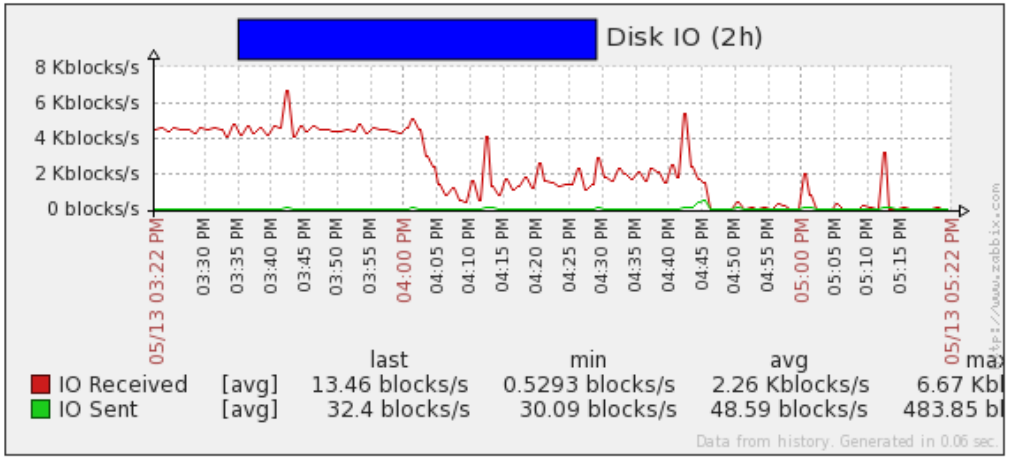
- Host was a member of a 16 node GFS2 Cluster
- Java containers were running on the host which pre-allocated memory.
- vm.swappiness was set to 0
- OS had about 200MB of memory available for itself and appeared to spend 100% of one core's time in IO wait.

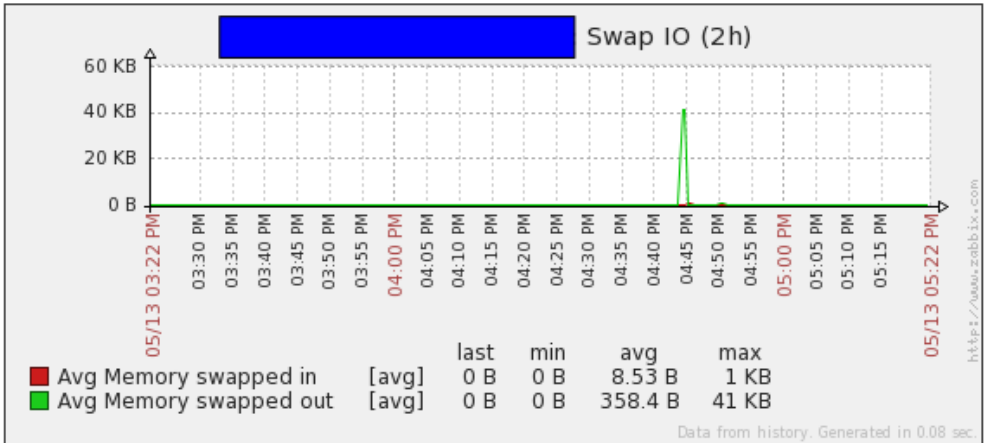
One more story...

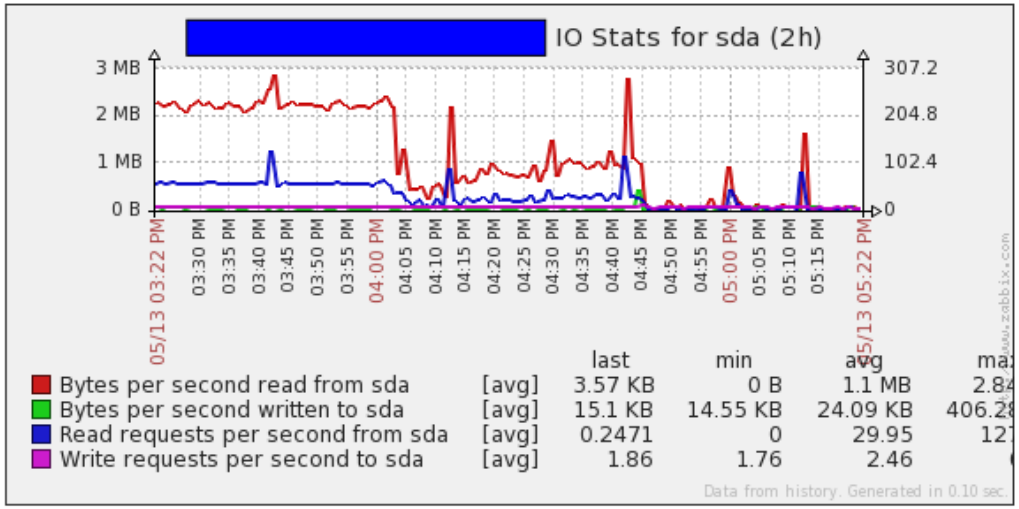




One more story...







Conclusion

- Clearly define the problem
- Understand what the tests are before testing
- It is possible to use similar techniques to tuning for long term monitoring
- Sometimes the results you get are not what you expected.
- Software developers are bad at exposing performance metrics for use by external software.
- DOCUMENT, DOCUMENT, DOCUMENT!

Questions

Fragen

jautājumi

vragen

питання

вопросы

pytania

otázky

質問

preguntas

spørgsmål

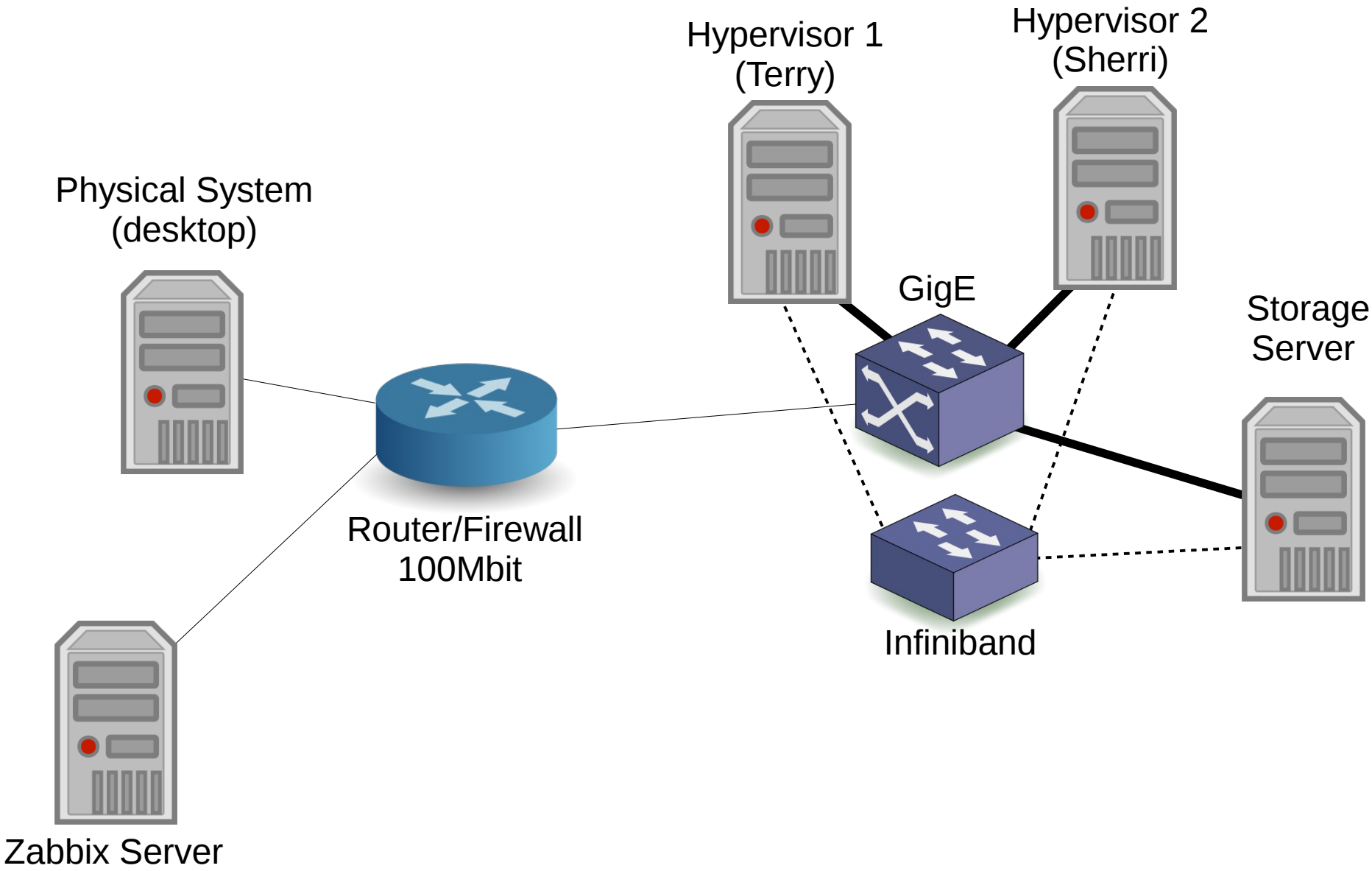
domande

kysymykset

Source Code

- Scripts and template used are available on GitHub
  - https://github.com/red-tux/zbx-apache

The test environment (More details)



The test environment (More details)

- Hypervisors are Red Hat Virtualization 3.3 (RHEV)
  - Guests are RHEL6
    - Test server is configured with 2GB of RAM and 2 CPU cores
- Storage for guests is via iSCSI over Infiniband
- Switch and Firewall are small Enterprise grade Juniper equipment.
  - Main Router/Firewall has 100Mbit interfaces
  - All networks are VLANed
  - Hypervisors are LACP bonded to the internal network

The test environment (More details)

- Test page is a simple “Hello world” with a small embedded graphic. Two connections equals one page load.
- Apache was configured to use the aforementioned logging script
- JMeter was used to generate the client test loads
- Zabbix was configured perform a web test as well to track response times from the Zabbix server.