



How TubeMogul Handles over One Trillion HTTP Requests a Month

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usenix

LISA15

November 8–13, 2015 | Washington, D.C.

www.usenix.org/lisa15

#lisa15

Who are we?

TubeMogul

- Enterprise software company for digital branding
- Over **27 Billions** Ads served in 2014
- Over **30 Billions** Ad Auctions per day
- Bid processed in less than **50 ms**
- Bid served in less than **80 ms** (include network round trip)
- **5 PB** of monthly video traffic served

Who are we?

Operations Engineering

- Ensure the **smooth day to day** operation of the platform infrastructure
- Provide a **cost effective** and **cutting edge** infrastructure
- Team composed of SREs, SEs and DBAs
- Managing over **2,500 servers** (virtual and physical)

Our Infrastructure

Multiple locations with a mix of Public Cloud and On Premises

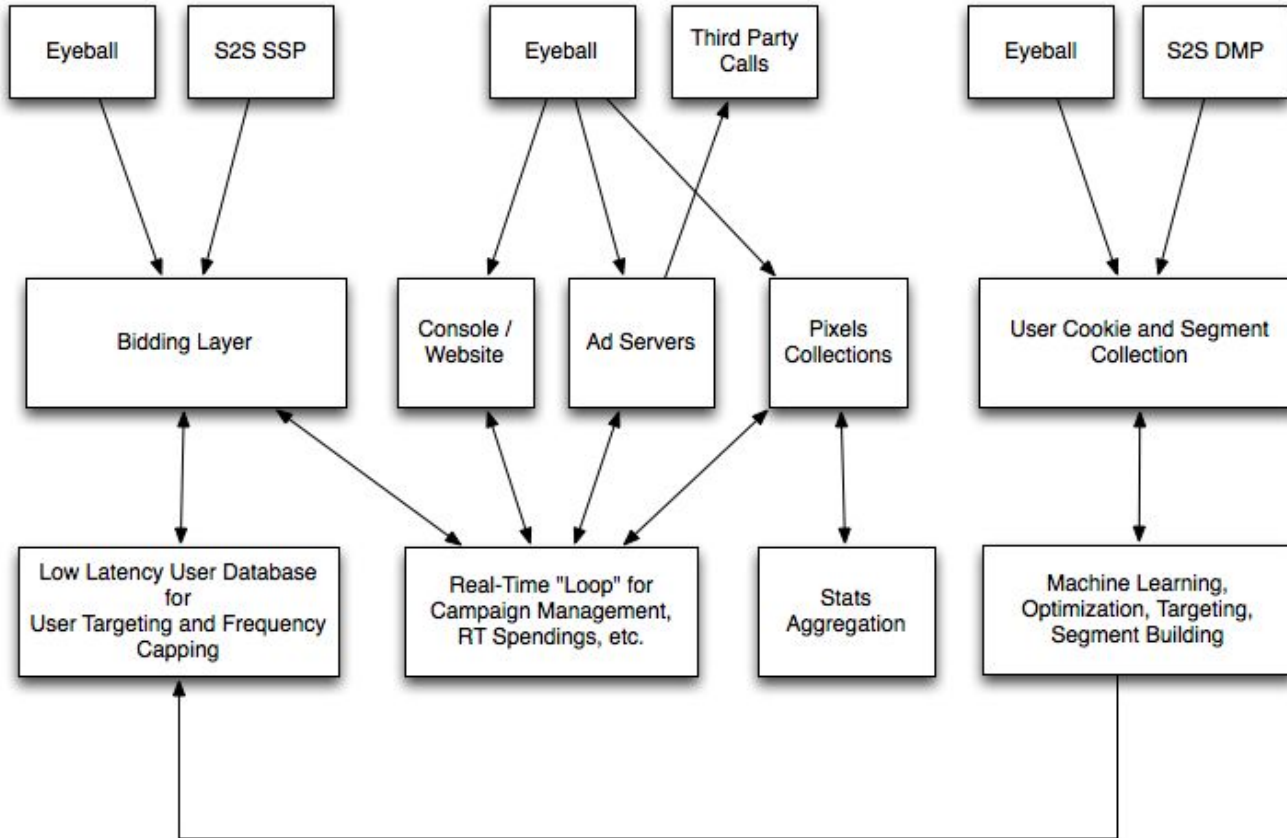


● *Public Cloud* ● *On Premises*

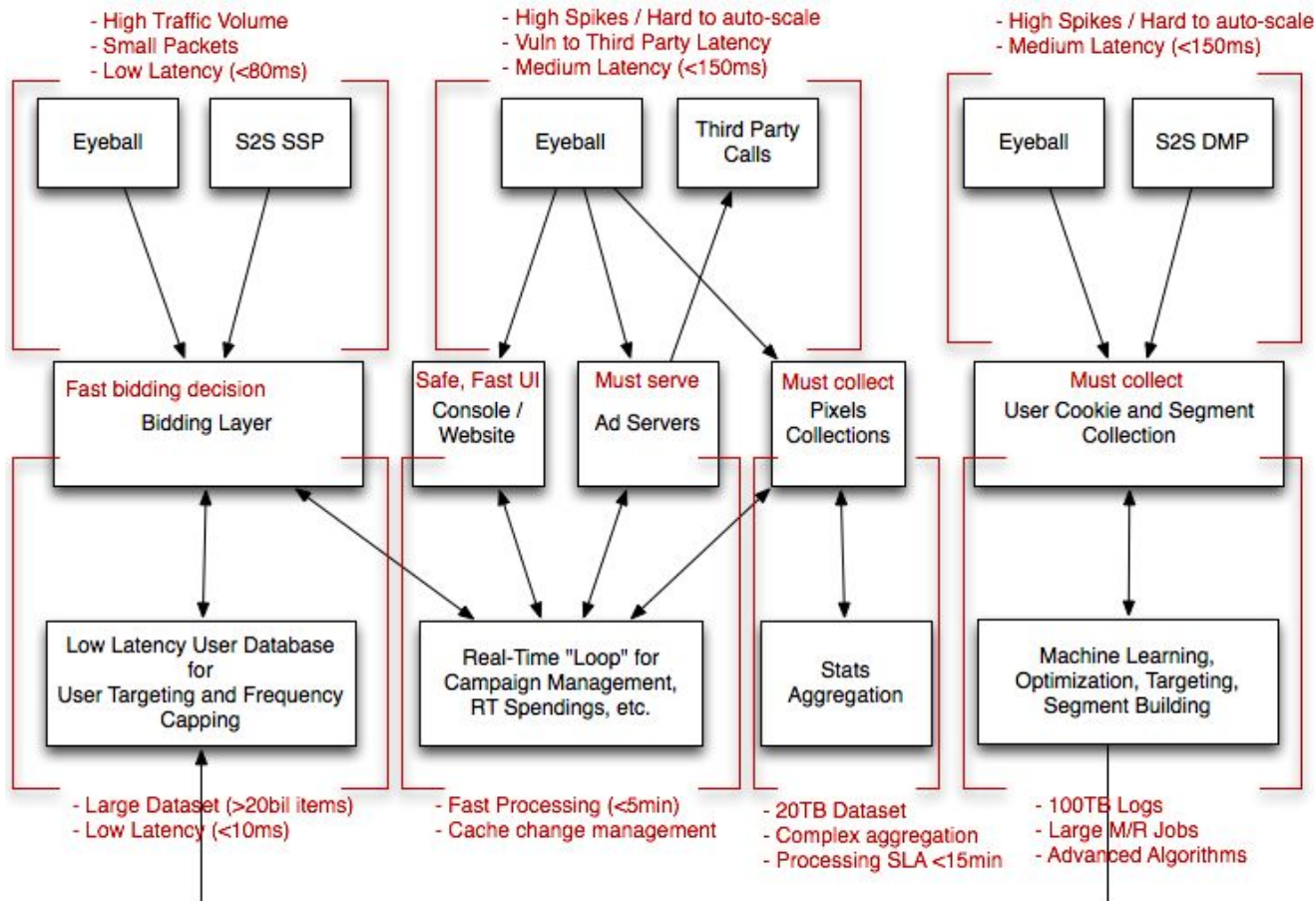
Technology Hoarders

- Java (a lot!)
- MySQL
- Couchbase
- Vertica
- Kafka
- Storm
- Zookeeper, Exhibitor
- Hadoop, HBase, Hive
- Terracotta
- ElasticSearch, Logstash, Kibana
- Varnish
- PHP, Python, Ruby, Go...
- Apache httpd
- Nagios
- Ganglia
- Graphite
- Memcached
- Puppet
- HAproxy
- OpenStack
- Git and Gerrit
- Gor
- ActiveMQ
- OpenLDAP
- Redis
- Blackbox
- Jenkins, Sonar
- Tomcat
- Jetty (embedded)
- AWS DynamoDB, EC2, S3...

High Level Technical Overview



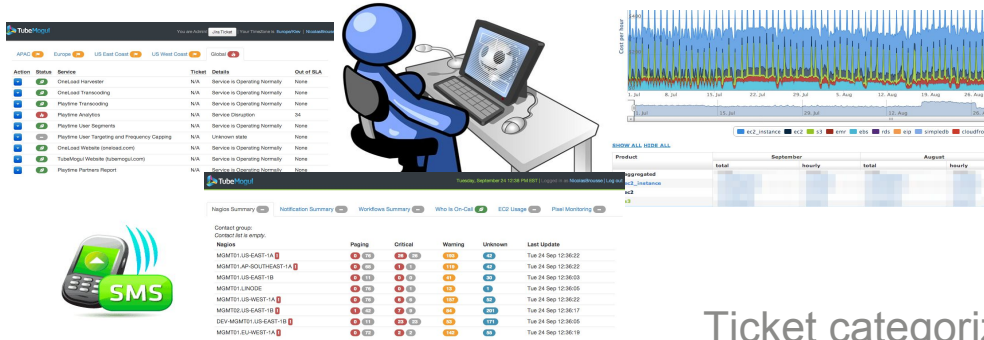
Technical Challenges



How do we manage all this?

- Tight day to day operations
- Configuration Management and Automation
- Change Management with Peer Review and CI
- Measure and Monitor a lot

OnCall Team Process

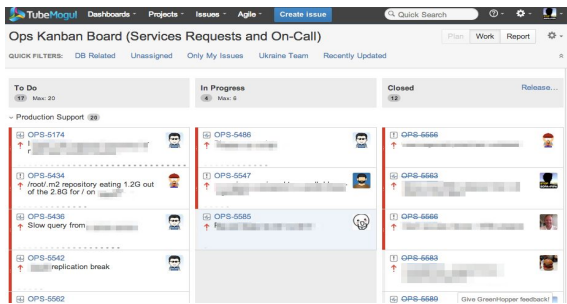


Request based on Dashboards, Monitoring, Paging or Engineers.



Ticket categorized in two swimlanes:

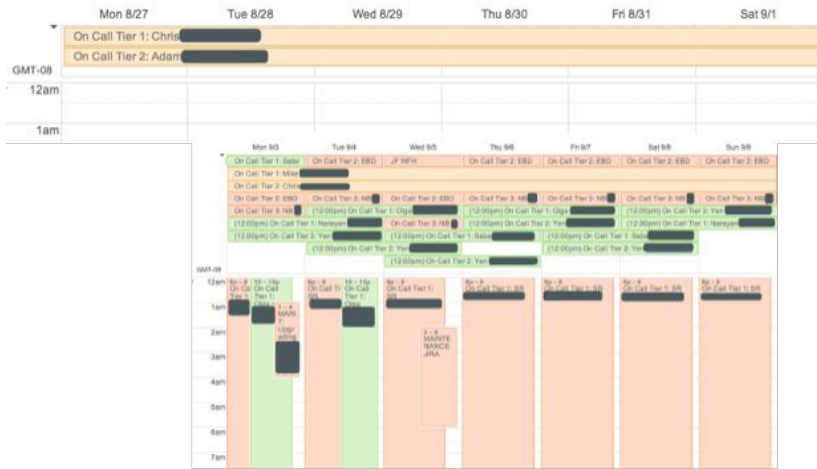
- Production Support
 - High Priority: Top to Bottom
 - On-call 24/7 (follow the sun)
 - Incident are handled 1st
 - Maintenance are handled 2nd
- Developer Support
 - Best Effort: Top to Bottom
 - Long effort request moved to Infrastructure pipeline



Alerting

- Large Nagios installation
- Introducing Sensu for scalability and as an easy Monitoring API for Developers
- Centralized OnCall Dashboard

Using Google Calendar...



The screenshot shows the Nagios On-Call Dashboard. The top navigation bar includes 'Nagios Summary', 'Notification Summary', 'Workflows Summary', 'Who Is On-Call', 'EC2 Usage', and 'Pixel Monitoring'. The main content area displays a table of on-call status for different contact groups. The table columns are 'Paging', 'Critical', 'Warning', 'Unknown', and 'Last Update'. The contact groups listed are 'US-EAST-1A', 'AP-SOUTHEAST-1A', 'US-EAST-1B', 'LINODE', 'US-WEST-1A', 'US-EAST-1B', 'DEV-US-EAST-1B', and 'EU-WEST-1A'. The dashboard also shows a 'Contact group: Contact list is empty.' message.

Contact group	Paging	Critical	Warning	Unknown	Last Update
US-EAST-1A	0 76	2 2	172	487	Wed 02 Oct 21:36:23
AP-SOUTHEAST-1A	0 68	3 3	107	306	Wed 02 Oct 21:36:23
US-EAST-1B	0 11	0 0	42	30	Wed 02 Oct 21:36:02
LINODE	0 76	2 4	9	1	Wed 02 Oct 21:36:09
US-WEST-1A	0 76	6 6	148	52	Wed 02 Oct 21:36:16
US-EAST-1B	0 43	4 5	72	223	Wed 02 Oct 21:36:19
DEV-US-EAST-1B	0 11	8 8	124	131	Wed 02 Oct 21:36:07
EU-WEST-1A	0 72	2 2	141	55	Wed 02 Oct 21:36:19

On-Call Dashboard 1.2.1 © 2013 TubeMogul, Inc

Which Cloud Provider? Private or Public?

- TL;DR doesn't matter as long as you keep the flexibility for your dev team
- We leverage AWS for many different workload and scenarios
 - Using EC2, DynamoDB, SQS, SES, SNS, RDS, SWF, etc.
 - Workload varies from ephemeral computes to always on
- We moved part of our low latency dependent workload out of AWS to our On Premises Cloud
 - Data Center proximity to key partners
 - Performance Investigation and Tuning
 - Network Visibility
 - Business Accountability

CloudMogul with OpenStack



05/2013

03/2014

05/2015

08/2015

First Dev Environment

Release: Grizzly
Nodes: 12
Cores: 240
RAM: 1 TB

First Prod Environment

Release: Havana
Nodes: 40
Cores: 1136
RAM: 8 TB

First Production Switch

Release: Icehouse

Full Production

Release: Icehouse
Nodes: 144
Cores: 4464
RAM: 22 TB

Challenge of Low Latency Globally

- Geo based DNS isn't based on network performance
- Proximity to user is key
 - Reduce Latency of standard TCP Handshake
 - Reduce Latency of SSL Handshake
- Mobile Networks...
- Require a global footprint
- Large footprint means unlikely to benefit from TLS session resumption

How to ensure pixel delivery at 50ms globally on the 50th percentile while keeping a small server footprint?

Leverage CDN for Fast Pixel Collection at the Edge



Standard pixel

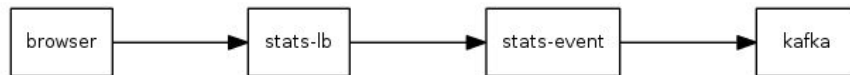
Browser HTTP call conv.tubemogul.com ->

AWS US East:

Stats LB HTTP ->

Stats Event HTTP ->

Push to Kafka



Fast pixel

Browser HTTP call convf.tubemogul.com ->

Fastly CDN: Edge generate cookie or reuse cookie and return blank pixel to browser ->

Async syslog call (contain base64 string of HTTP request with headers) from Fastly to AWS US East:

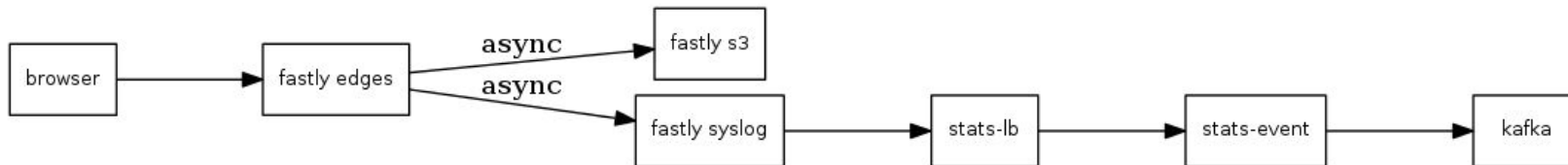
Stats LB Syslog ->

Stats Event Syslog ->

Reuse Stats Event HTTP Handler ->

Push to Kafka, etc.

- [Fast.ly](#) also push all logs to S3 with data as we send via syslog. The s3 bucket can be used for troubleshooting.
- [Fast.ly](#) behavior is configured via a VLC that can be found in [Gerrit](#).



Further Improvement

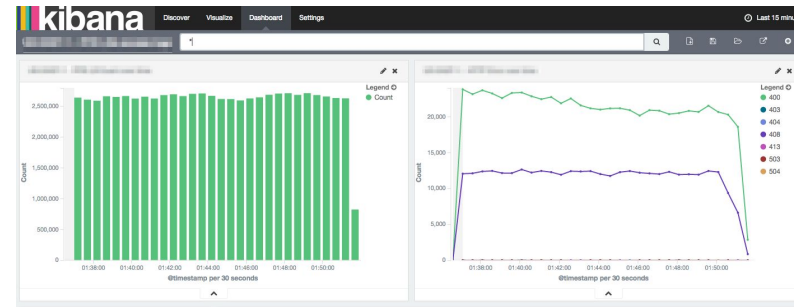
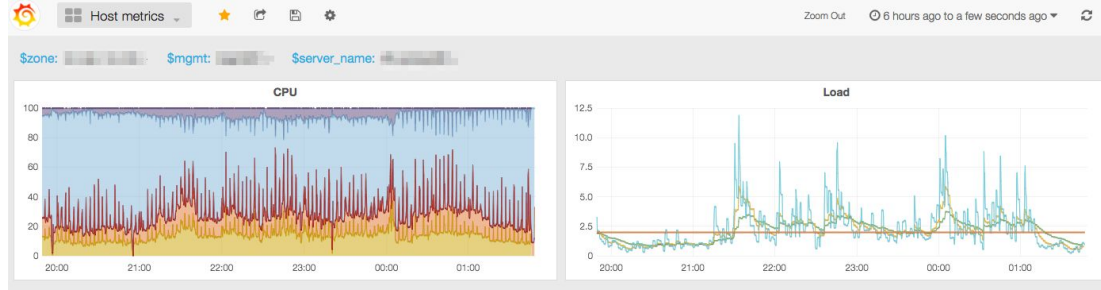
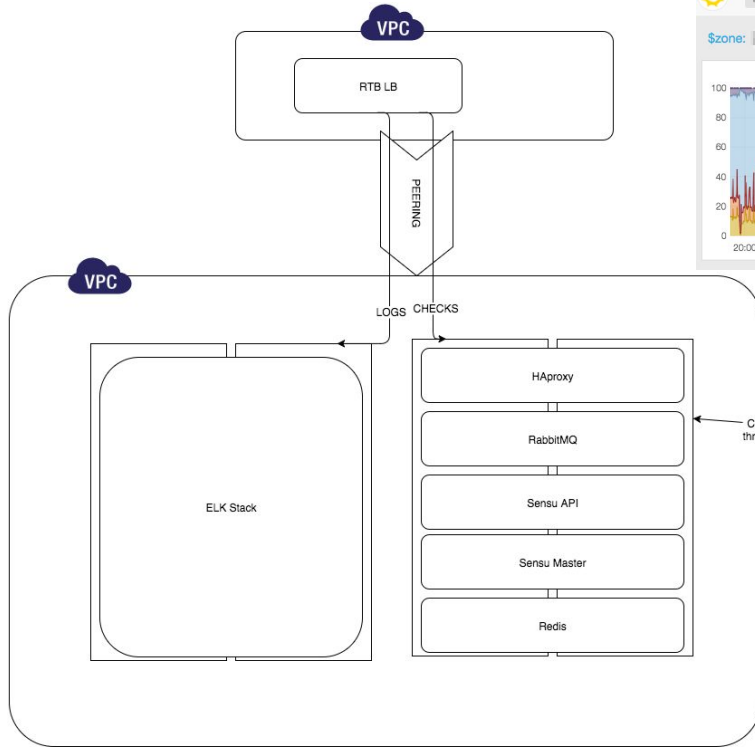
- Leverage CDN capabilities even further
 - First layer of protection against DDoS
 - Fast.ly VCL is very powerful
- Evaluate routing solution based on RUM (Cedexis)
- Evaluate smarter DNS routing (NS1)

Load Balancing with HAproxy

- Round Robin DNS is great
 - Until your DNS entries are too large and client start using DNS thru TCP
- In US West, we went from 31 EC2 instances (c3.2xlarge) to two SuperMicro servers
 - 32 Cores E5-2667 v3 @ 3.20GHz and 128 GB RAM
 - Use baremetal and leveraging VLAN to access OpenStack Tenant
- Managing SSL session is the most consuming in our workload (CPU and RAM)
 - A TLS connection can use up to 64Kb RAM
- CPU Pinning for network interrupts (4 Core), HAproxy (28 Core)
 - Disable irqbalance
 - Various sysctl config tuning (TCP, VM)
- One frontend for HTTP and HTTPS
- Crossdomain.xml files are served directly by HAproxy (no call to backend)
- All logs sent directly in json to ELK
- Home made process (HAVOC) to generate config and scaling of backend

Graphing and Logging As A Service

- Ganglia / Graphite / Grafana / ELK



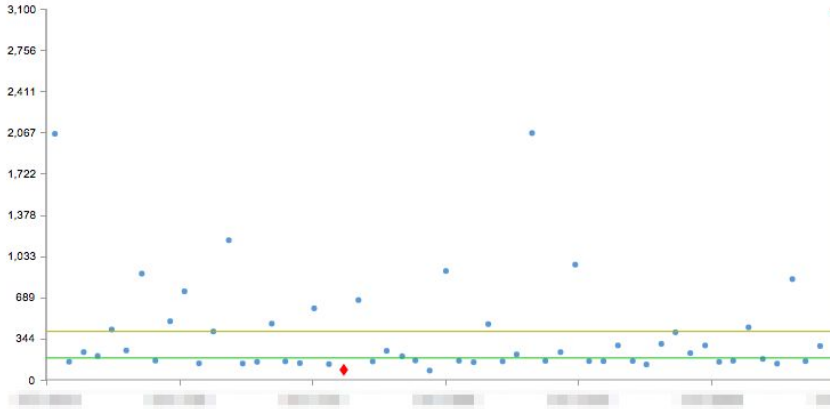
Network Visibility: Catchpoint

Script *:

```
1 // Step - 1
2 open("http://[redacted]/crossdomain.xml")
3 setStepName("1-[redacted] crossdomain.xml")
4 assertHttpStatusCode("200")
5
6 // Step - 2
7 open("https://[redacted]")
8 setStepName("2-RTB bid request")
9 assertHttpStatusCode("200")
10
11 // Step - 3
12 open("https://[redacted]")
13 setStepName("3-AS wrapper request")
14 assertHttpStatusCode("200")
15
16 // Step - 4
17 open("https://[redacted]")
18 setStepName("4-CDN swf")
19 assertHttpStatusCode("200")
20
21 // Step - 5
22 open("http://[redacted]:crossdomain.xml")
23 setStepName("5-AS crossdomain.xml")
24 assertHttpStatusCode("200")
25
26 // Step - 6
27 open("https://[redacted]")
28 setStepName("6-ad server placement.js")
29 assertHttpStatusCode("200")
30
```

Test: [redacted]

Webpage Response (ms): 75 Percentile (404.00) Median (182.50)



[110371] - [redacted]

[49] - San Jose, CA - AWS

Webpage Response (ms)

3,093

# Test Failures	1
Response (ms)	3,093
DNS (ms)	6
Connect (ms)	44
Wait (ms)	3,010

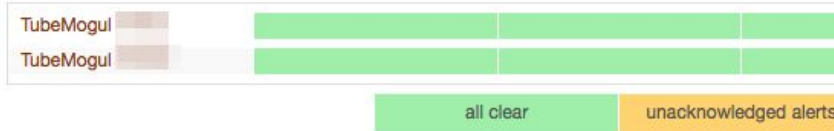
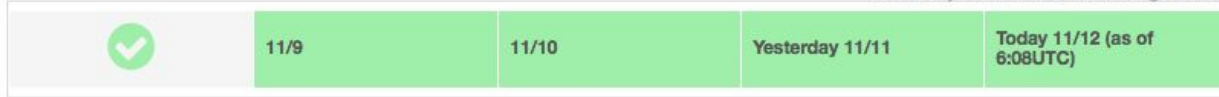
[50014] - Server responded with a 40X or 50X response code.

Waterfall Alerts

Monitor from multiple location globally, complex test, trace routes, alerts, etc.

Network Visibility: Dyn Internet Intelligence

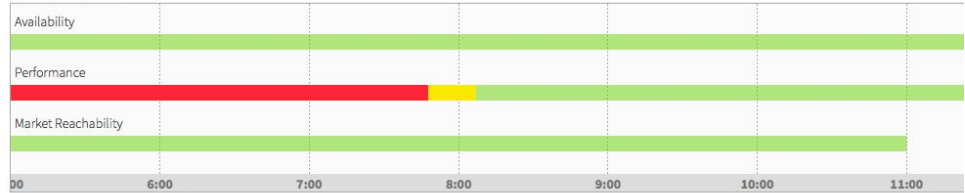
Note: Day boundaries are midnight UTC.



Cloud Report Details: AWS Singapore Zone A

Current Status: AVAILABILITY ● PERFORMANCE ● MARKET REACHABILITY ●

Recent Status



Top Watchlist Issues

Recent increases in latency from vantage point collectors to market cities are displayed

ms %	11/11	11/10	7 days	Vantage Point	Market C
200 % SLOWER	3	1		San Jose	→ Santa C NTT (AS

Alerts

Alert Type	Start Time	End Time	From
Performance (latency)	Nov 11th, 1:51 PM	Nov 11th, 7:47 PM	Digital Ocean London
Performance (latency)	Nov 11th, 1:51 PM	Nov 11th, 7:47 PM	Digital Ocean London
Performance (latency)	Nov 11th, 1:51 PM	Nov 11th, 7:17 PM	Digital Ocean Amsterdam 2
Performance (latency)	Nov 11th, 1:52 PM	Nov 11th, 7:47 PM	Rackspace London
Performance (latency)	Nov 11th, 1:52 PM	Nov 11th, 7:47 PM	Rackspace London
Performance (latency)	Nov 11th, 6:00 PM	Nov 11th, 6:46 PM	Digital Ocean Amsterdam 2
Performance (latency)	Nov 11th, 7:19 PM	Nov 11th, 8:32 PM	Digital Ocean Amsterdam 2
Performance (latency)	Nov 11th, 7:19 PM	Nov 11th, 8:06 PM	Digital Ocean Amsterdam 2

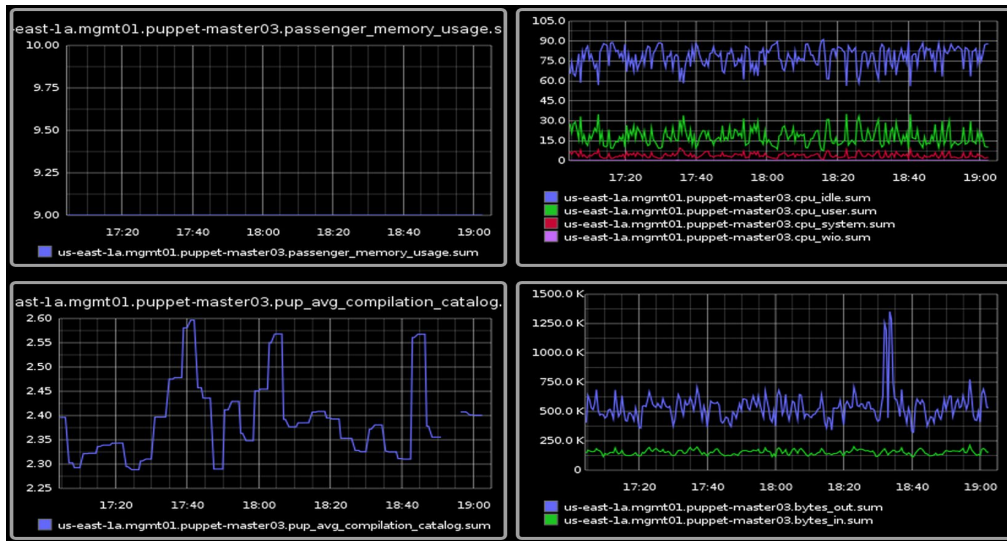
Alerts on bgp route changes, prefix changes, latency variation, internet disruptions, etc.

Five Years Of Puppet!

- 2008 - 2010: Use SVN, Bash scripts and custom templates.
- 2010: Managing about **250 instances**. Start looking at Puppet.
- 2011: Puppet 0.25 then 2.7 by EOY on **400 servers** with **2 contributors**.
- 2012: **800 servers** managed by Puppet. **4 contributors**.
- 2013: **1,000 servers** managed by Puppet. **6 contributors**.
- 2014: **1,500 servers** managed by Puppet. Introduced Continuous Delivery Workflow. **9 contributors**. Start 3.7 migration.
- 2015: **2,000 servers** managed by Puppet. **13 contributors**.

Puppet Stats

- **2000** nodes
- **225** unique nodes definition
- **1** puppetmaster
- **112** Puppet modules



Where and how do we use Puppet ?

- Virtual and Physical Servers Configuration : **Master mode**
- Building AWS AMI with Packer : **Master mode**
- Local development environment with Vagrant : **Master mode**
- OpenStack deployment : **Masterless mode**

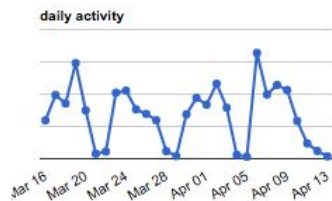
Infrastructure As Code: Code Review?



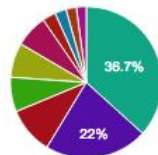
A Powerful Gerrit Integration

- Gerrit, an **industry standard** : Eclipse, Google, Chromium, OpenStack, WikiMedia, LibreOffice, Spotify, GlusterFS, etc...
- Fine Grained Permissions Rules
- Plugged to LDAP
- Code Review **per commit**
- Stream Events
- Use GitBlit
- Integrated with Jenkins and Jira
- Managing about **600 Git repositories**

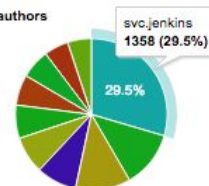
recent activity last 28 days / 9,731 commits by 91 authors



active repositories

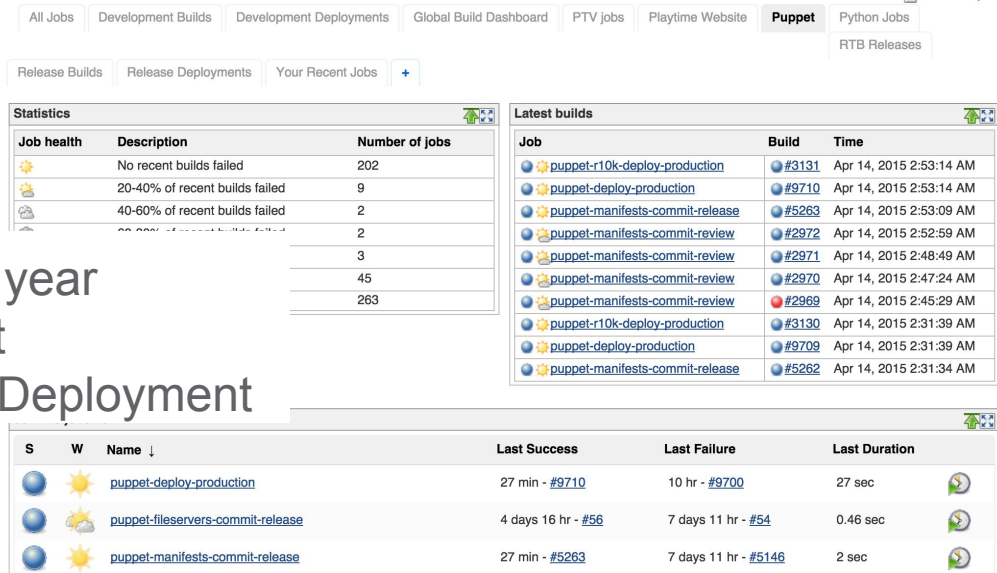


active authors



Continuous Delivery with Jenkins

- 1 job per module
- 1 job for the manifests and hiera data
- 1 job for the Puppet fileserver
- 1 job to deploy



Global Jenkins stats for the past year

- ~10,000 Puppet deployment
- Over 8,500 Production App Deployment

Jenkins job DSL : code your Jenkins jobs

Plugin : github.com/jenkinsci/job-dsl-plugin

- **Automate** the jobs creation
- Ensure a **standard** across all the jobs
- **Versioned** the configuration
- Apply changes to all your jobs **without pain**
- **Test** your configuration changes


Team Awareness: HipChat Integration with Hubot

The screenshot shows a HipChat chat interface for a room named "Puppet". The chat history includes several messages from "Regis Bot" reporting on puppet jobs. The messages are as follows:

- Message 1:** puppet-deploy-production #9685 /job/puppet-deploy-production /9685/ - upstream tm_nagios (Apr-11 2:46 AM)
- Message 2:** puppet-r10k-deploy-production /3100/ R10K[all] /job/puppet-r10k-deploy-production (Apr-11 2:47 AM)
- Message 3:** puppet-r10k-deploy-production /3101/ R10K[all] /job/puppet-r10k-deploy-production (Apr-11 2:48 AM)
- Message 4:** puppet-manifests-commit-review #2964 /job/puppet-manifests-commit-review/2964/ : INF-3329 (Apr-11 10:33 AM)
- Message 5:** puppet-r10k-deploy-production /3102/ R10K[none] /job/puppet-r10k-deploy-production (Apr-11 10:33 AM)
- Message 6:** puppet-deploy-production #9686 /job/puppet-deploy-production /9686/ - upstream manifests (Apr-11 10:34 AM)
- Message 7 (Failure):** puppet-manifests-commit-review #2965 (FAILURE) /job/puppet-manifests-commit-review/2965/ : INF-3329 (Apr-11 10:37 AM)
- Message 8:** puppet-manifests-commit-review #2966 /job/puppet-manifests-commit-review/2966/ : INF-3329 (Apr-11 10:38 AM)
- Message 9:** puppet-r10k-deploy-production /3103/ R10K[none] /job/puppet-r10k-deploy-production (Apr-11 10:38 AM)
- Message 10:** puppet-deploy-production #9687 /job/puppet-deploy-production /9687/ - upstream manifests (Apr-11 10:39 AM)




The chat interface also shows a sidebar with a list of rooms (TubeMogul, DBA Support, Puppet, OPS On-Call, INF Project) and a list of people. The "Puppet" room is currently selected.

Team Awareness: HipChat Integration with more bots!

 **CloudMogul**
CloudMogul [redacted]

[redacted] @serge reboot OPS-18567 rtb-bidder11 5:52 PM

Serge @ [redacted] Checking ticket OPS-18567 for instance rtb-bidder11 5:52 PM

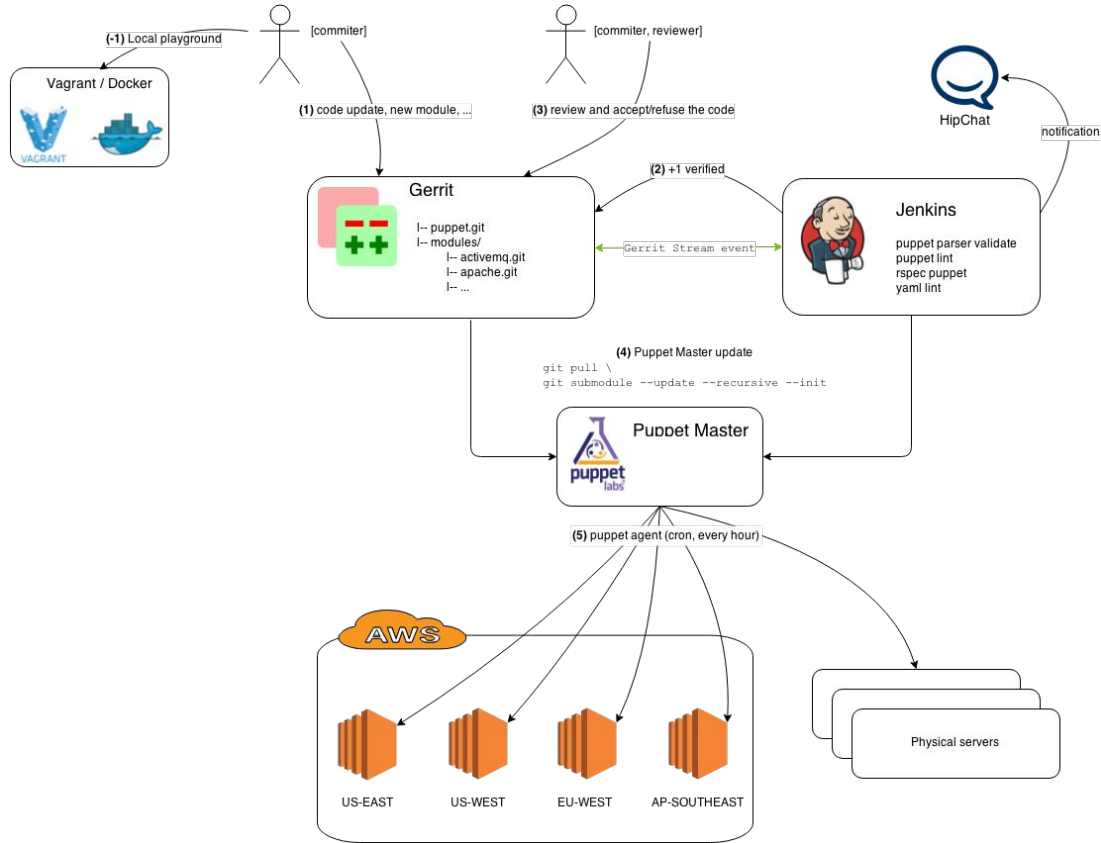
JIRA  **OPS-18567 : Cannot SSH into bidder10.tm-sjc** Reported by [redacted] 5:52 PM
Type:  Access Request - Engrg Priority:  Major Status: Open

Serge @ [redacted] Searching for the uuid of rtb-bidder11 5:52 PM

Serge @ [redacted]; Fetching the console of eef2ce1b-d173-4daa-b6e2-c09615780b77 5:52 PM

Serge @ [redacted] Ticket is in status Open, console log added 5:52 PM

The Workflow



OPS @ TubeMogul

All This Wouldn't Be Possible Without a Strong Team.
Thank You.

SRE

Aleksey Mykhailov
Oleg Galitskiy
Brandon Rochon
Stan Rudenko
Julien Fabre
Joseph Herlant

SE

Alan Barnes
Aleksander Stepanov
Matt Cupples
Yurii Rochniak
Yurii Varvynets
Manasi Limbachiya

Cloud Engineer

Mykola Mogylenko
Pierre Gohon
Pierre Grandin

DBA

Alina Alexeeva

THANK YOU

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