How Bigtop Leveraged Docker for Build Automation and One-Click Hadoop Provisioning

Evans Ye

Apache Big Data 2015
Budapest
Who am I

- Apache Bigtop PMC member
- Software Engineer at Trend Micro
- Develop Big Data platform
- Develop cyber security solutions using Big Data
Outline

- What is Apache Bigtop?
- Achieving Build Automation
- One-Click Hadoop Provisioning
- Bigtop at Trend Micro
What is Apache Bigtop?
Bigtop is a project for

Packaging  Testing  Deployment  Virtualization

for you to easily build your own Big Data Stack
Packaging

- **Build RPM, DEB packages for Hadoop ecosystem**
  - `$ yum -y install hadoop`
  - `$ apt-get upgrade hbase`

- **Why not just untar?**
  - Version control, upgrade/downgrade, dependency management
  - Unified view of configuration, log, binary directories
  - Daemons for better process management
Supported Linux distro.

You can find binary repos here:

- [http://www.apache.org/dist/bigtop/bigtop-1.0.0/repos/](http://www.apache.org/dist/bigtop/bigtop-1.0.0/repos/)
Supported components
A fundamental testing problem may happen in your Big Data Stack, too.
• A fundamental testing problem may happen in your Big Data Stack, too

Hadoop 2.4.1 + Tez 0.6.0 + Hive 1.1.0
Hadoop 2.6.0 + Tez 0.6.2 + Hive 1.2.0
Hadoop 2.7.1 + Tez 0.7.0 + Hive 1.2.1
A fundamental testing problem may happen in your Big Data Stack, too.

Does this combination still work?

Hadoop 2.6.0 + Tez 0.6.2 + Hive 1.2.0

Hadoop 2.7.1 + Tez 0.7.0 + Hive 1.2.1
There’s a need for integration tests!
Bigtop Tests

- Bigtop has a testing framework that provides APIs
- Built-in tests that Bigtop provides:
  - **smoke-tests**
    - Basic Hadoop ecosystem interoperability
  - **integration tests**
    - Advanced tests runs from jar files
Okay, then how to run those tests?
Deployment

- Use Bigtop Puppet to deploy a fully functional, distributed Hadoop cluster

- Integration tests running on a fully distributed cluster

- **Bigtop Puppet**
  - Masterless Puppet
  - Numbers of components are supported
  - Kerberos enabled cluster deployment
Where to deploy?
Virtualization

- Automate the infrastructure creation & setup
  - **Bigtop Provisioner**
    - Virtualbox VMs auto-provisioning
    - Docker containers auto-provisioning
From user point of view

- **Hadoop App developers**
  - Provision Hadoop cluster to test your code on

- **Cluster administrators**
  - Use Bigtop Puppet to deploy and manage your cluster
  - Run Bigtop tests to ensure your cluster is working

- **Vendors**
  - Build your own Hadoop distribution, customized from Bigtop bits
What is Apache Bigtop?

Achieving Build Automation

One-Click Hadoop Provisioning

Bigtop at Trend Micro
What’s the challenge?

- As you can see, we support a number of Linux distributions (m)

Bigtop supports all major Linux distributions

[Logos of various Linux distributions: openSUSE, debian, ubuntu, redhat, CentOS, fedora]
What’s the challenge?

- Numbers of components \((n)\)
We need to build them all

\[ \rightarrow m \times n \]
Preparing build environment

## Tool requirements for building Bigtop

<table>
<thead>
<tr>
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<td>sharutils</td>
<td>craterepo</td>
<td>dh-make</td>
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<td>xmlto</td>
<td>rehash-config (Fedora only)</td>
<td>debhelper</td>
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<td>devscripts</td>
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Bigtop Toolchain

- Puppet recipes automatically install required libraries, build tools
- To transform a machine into a build environment, simply do
  - $ gradle toolchain
- Prerequisites:
  - Puppet 3.x
  - Java 7
CI infra

Jenkins

- CentOS slave
- Fedora slave
- Ubuntu slave
- Debian slave
- OpenSuSE slave
CI infra

Jenkins

- CentOS slave
  - Bigtop Toolchain
- Fedora slave
  - Bigtop Toolchain
- Ubuntu slave
  - Bigtop Toolchain
- Debian slave
  - Bigtop Toolchain
- OpenSuSE slave
  - Bigtop Toolchain
ALL DONE!

https://www.flickr.com/photos/kit4na/6385016345
Hi Bigtop, How do I test my packaging code?

We got Bigtop Toolchain for you.

A contributor

A committer
I need to setup all the Linux environments on my laptop?

(Don’t want to answer…)
Docker - How it works

• Three key techniques in Docker

  • Use Linux Kernel’s **Namespaces** to create isolated resources

  • Use Linux Kernel’s **cgroups** to constrain resource usage

  • **Union file system** that supports git-like image creation
The nice things about it

- Lightweight
- Fast creation
- Repeatable
- Portability
  - runs on *any* Linux environment
Best fit in our use case

- Run on any kind of Linux distribution in one single machine
Ship build environment in Docker images
Bigtop/slaves images

Dockerhub official images
One click to build packages

- $ git clone https://github.com/apache/bigtop.git
- $ docker run \
  --rm \
  --volume `pwd`/bigtop:/bigtop \
  --workdir /bigtop \
  bigtop/slaves:centos-7 \
  bash -l -c `./gradlew rpm`
Now, easy to build & test on your laptop

CentOS slave  |  Ubuntu slave
---------  |  
Docker engine

Linux

CentOS slave  |  Ubuntu slave
---------  |  
Docker engine
boot2docker
Mac OS X
Windows
Flexible CI infra

- Fault tolerance
- Immutable

Jenkins

- CentOS slave
- Fedora slave
- Ubuntu slave
- Debian slave
- OpenSuSE slave
Flexible CI infra

- Fault tolerance
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**Jenkins**

- CentOS slave
- Fedora slave
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What is Apache Bigtop?

Achieving Build Automation

One-Click Hadoop Provisioning

Bigtop at Trend Micro
Bigtop Provisioner

- A tool to demonstrate the full life cycle of Bigtop
The goal

- **Fast iterative development**
  - Test your code in the cluster, on your laptop, w/o human intervention

- **Flexibility**
  - Choose any combination of components as you want

- **Responsive CI**
  - Integration tests that get you the result in mins

- **A Big Data Stack playground**
  - Spark + Tachyon, Spark + Ignite, etc
One-click Hadoop Provisioning

Vagrant\(^w/\) provider
+ Automation Code
+ Bigtop Puppet

Bigtop Provisioner
• We use Vagrant as an abstraction layer to support different kind of resource providers
One click Hadoop provisioning

/docker-hadoop.sh -c 3
One click Hadoop provisioning

bigtop/deploy image on Docker hub

VAGRANT

.docker-hadoop.sh -c 3
One click Hadoop provisioning

bigtop/deploy image on Docker hub

puppet apply

puppet apply

puppet apply

./docker-hadoop.sh -c 3
Bigtop/deploy images

- install Vagrant ssh key
- install Puppet

Dockerhub official images
Bigtop image hierarchy

- `bigtop/slaves`
- `bigtop/puppet`

Dockerhub official images
All on the Docker hub

https://hub.docker.com/u/bigtop/
A demo is worth 1k words

Oops! demo fail…
https://asciinema.org/a/55aw3zl2g3dzsfe69198homrl
Bigtop Provisioner

- Supported providers in Bigtop 1.0.0 release
  - Virtualbox VM
  - Docker container
- OpenStack support is in master branch now
Use cases

• For Hadoop app developers, cluster admins, users
  • Run a Hadoop cluster to test your code on
  • Try & test configurations before applying to Production
  • Play around with Bigtop Big Data Stack

• For contributors
  • Easy to test your packaging, deployment, testing code

• For vendors
  • CI out of the box —> patch upstream code made easier
What is Apache Bigtop?
Achieving Build Automation
One Click Hadoop Provisioning

Bigtop at Trend Micro
Trend Micro Hadoop (TMH)

- Use Bigtop as the basis for our internal custom distribution of Hadoop

- Apply **community, internal patches** to upstream projects for business and operational need

- Newest TMH7 is based on Bigtop 1.0 SNAPSHOT
Working with community made our life easier

- Knowing community status made TMH7 release based on Bigtop 1.0 SNAPSHOT possible
Working with community made our life easier

- Knowing community status made TMH7 release based on Bigtop 1.0 SNAPSHOT possible
- Contribute Bigtop Provisioner, packaging code, puppet recipes, bugfixes, CI infra, anything!
Working with community made our life easier

- Leverage Bigtop smoke tests and integration tests with Bigtop Provisioner to evaluate TMH7
Working with community made our life easier

- Leverage Bigtop smoke tests and integration tests with Bigtop Provisioner to evaluate TMH7

- Contribute feedback, evaluation, use case through Production level adoption
Trend Micro Big Data Stack
Powered by Bigtop

In-house Apps
App A
App B
App C
App D

APIs and Interfaces
Ad-hoc Query UDFs
Pig
Wuji

Processing Engine
Mapreduce
Hadoop HDFS

Storage
Hadoop YARN

Resource Management
Kerberos

Solr Cloud

Trend Micro
Powered by Bigtop
Challenges we’re facing!
Migration x Upgrade

• We’re moving our cluster to another Data Center

• New cluster will be running TMH7

• Need Distcp to sync data from old TMH6 cluster

• Both are Kerberos enabled secure clusters
Sync data between clusters
Distcp between TMH6 and TMH7?

Hadoop 2.0.0  Hadoop 2.6.0
Factors that matter

- Hadoop version
- Protocols (hdfs, hftp, webhdfs)
- Where to issue Distcp (Where to run MR job)
- Secure or not
Things always get complicated with Kerberos...
Kerberos cross realm authentication

- We need to do Distcp across 4 secure clusters
  —> Kerberos cross realm auth across 4 clusters

- Our Hadoop management tool needs to support this through auto-configuring

- Developing the management tool is challenging!
Docker comes to the rescue

- Run multiple secure HA clusters on Docker
- Dev & test the management tool iteratively
Hadoop apps
dev & test on Docker
Hadoocker

• A Devops toolkit for Hadoop app developer to develop and test its code on

• Provides fixed Big Data Stack preload images
  —> dev & test env up and running w/o deployment
  —> support end-to-end CI test for apps

• A Hadoop env for apps to test against our new Hadoop distribution

• Same features are also delivered in Vagrant boxes

• https://github.com/evans-ye/hadoocker
Docker based dev & test env

- internal Docker registry
- Hadoop server
- Hadoop client
- data
- .execute.sh
- TMH7
- Hadoop app
- Restful APIs
- sample data
- hadoop fs put
Docker based dev & test env

- Internal Docker registry
- Hadoop server
- Hadoop client
- Solr
- Dependency service
- TMH7
- Hadoop app
- Restful APIs
- Sample data
- Hadoop fs put...
Summary
Summary

• Bigtop helps you to build your own Big Data Stack

• Building packages made easier by offering immutable build environment through Docker images

• Bigtop Provisioner creates you a Hadoop cluster by one click with flexibility

• Use Docker to simulate complex environment to ease development and testing efforts

• Ship apps in Docker images to dev & test anywhere
Wait,
how’s the demo?
Thank you!

Questions?