Creating a Multinode Hadoop cluster in 4 mins using docker containers

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As a data scientist

- I want to run my analytics jobs
  - Social media analytics
  - Text analytics (Structure and Unstructured)
- I want to run queries on demand
- I want to run R scripts
- I want to submit Spark jobs

- I need a Hadoop cluster on demand to fulfil my jobs
- I do not want to spend time to setup the Hadoop cluster

Can someone give me a Cluster?

I have a Hadoop Cluster

- I do not want to manage it
- I do not want to Patch them for upgrades
- I do not need this cluster running all the time.
- I want to scale and descale the cluster based on job load

Can someone manage this Cluster?

Technical Interpretation of customer needs

- Multi node Hadoop cluster in minutes
- Elasticity – Add or remove data nodes on demand
- Economical
- Fully Managed
  - Choose what to install and keep it running all the time
- Repeatable, scalable & Highly available provisioning infra
- Minimize disruptions during patching
- Support for Service composition
- Auto Heal Services

Typical Hadoop Cluster - Setup

- Get the suitable hardware
- Prepare host machine
- Setup various networks
  - Private
  - Public
  - Management
- Fetch the binaries for the install
- Prepare the blueprint/config file for the install
- Start the install
- Many a times install fails, debug and retry again.

Bluemix

IBM's Open Cloud Architecture implementation based on the Cloud Foundry project

Bluemix is an open-standard, cloud-based platform for building, managing, and running applications of all types

(web, mobile, big data, new smart devices, and so on).

Instant Environments
The developer can choose any language runtime or bring your own. Zero to production in one command.

APIs and Services
A catalog of IBM, third party, and open source API services allow the developer to stitch an application together in minutes.

On-Prem Integration
Build hybrid environments. Connect to on-premise assets plus other public and private clouds.

DevOps
Development, monitoring, deployment, and logging tools allow the developer to run the entire application.

Layered Security
IBM secures the platform and infrastructure and provides you with the tools to secure your apps.

Flexible Pricing
Sign up in minutes. Pay as you go and subscription models offer choice and flexibility.

Bluemix Services

Runtimes
Run an app in the language of your choice

Liberty for Java™ — IBM
SDK for Node.js™ — IBM
XPages — IBM
ASP.NET Core Community BETA
Go Community

PHP Community
Python Community
Ruby Community
Swift Community BETA
Tomcat Community

Mobile
Quickly get started with your next app

Mobile Application Content Manager — IBM
Mobile Client Access — IBM
Mobile Foundation — IBM
Mobile Quality Assurance — IBM
Push Notifications — IBM

Kinetise Third Party
Testdroid Cloud Third Party
Twilio Third Party

Watson
Build cognitive apps that help enhance, scale, and accelerate human expertise

AlchemyAPI — IBM
Concept Insights — IBM
Conversation — IBM
Dialog — IBM
Document Conversion — IBM

Language Translation — IBM
Natural Language Classifier — IBM
Personality Insights — IBM
Retrieve and Rank — IBM
Speech to Text — IBM

Text to Speech — IBM
Tone Analyzer — IBM
Tradeoff Analytics — IBM
Visual Recognition — IBM
Cognitive Commerce™ Third Party

Data and Analytics
Essential data services; limitless possibilities

HELP ME PICK

Apache Spark — IBM
BigInsights for Apache Hadoop — IBM
Cloudant NoSQL DB — IBM
dashDB — IBM
DataWorks — IBM

Elasticsearch by Compose — IBM
Geospatial Analytics — IBM
IBM DataStage on Cloud — IBM
IBM DB2 on Cloud — IBM
IBM Graph — IBM

IBM Master Data Management on Cloud
Insights for Twitter — IBM
MongoDB by Compose — IBM
PostgreSQL by Compose
Predictive Analytics — IBM

BigInsights on cloud (Basic)

Comparison of time to Setup Hadoop cluster

Hadoop Cluster Setup
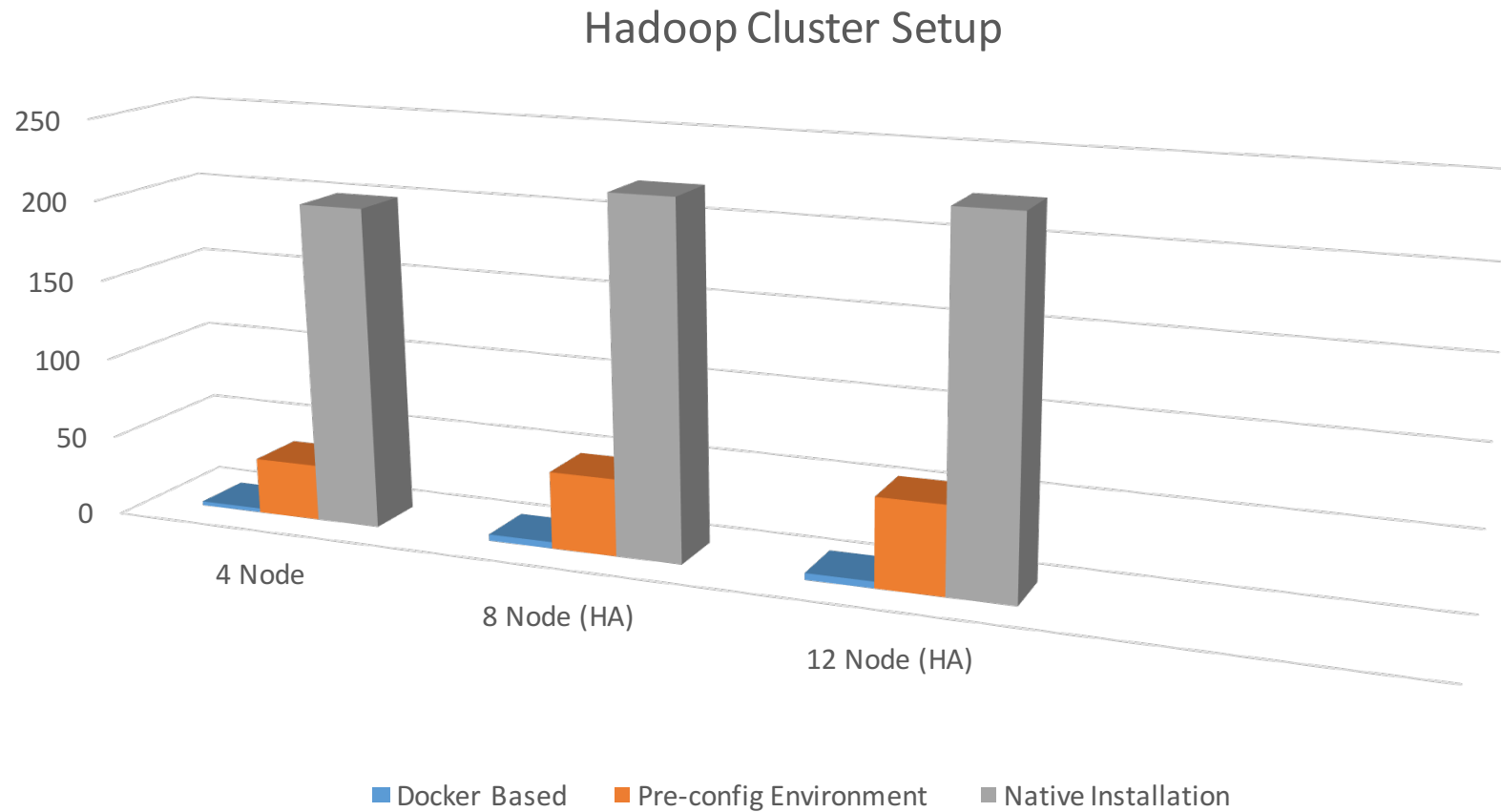
Earlier Experiments

Option	OS Provisioning	Config	Cluster Management / Updates
1	Bare metal	Chef	Chef
2	xCAT – Stateful(Create your own VMs)	PostScripts	xCAT - updateNode
3	xCAT – Sysclone(Image from current system)	Not Needed	xCAT - updateNode
4	Bare metal	PostScripts	xCAT - updateNode
5	Cloud Provider Specific Images	Not Needed	Manual/Scripts
6	Standard-ISO Image	Anaconda -post scripts	Manual/Scripts

Guiding Principles

- Virtualization helps repeatability, lesser failures & speed
- Maintenance
- Performance(Equivalent to Bare metal)
- Use open source from an active community
- Cloud-agnostic

Think Containers!!

Docker : Thinking as VMs ? (mistake)

- **Key Concepts**

  - Containers share host kernel
  - Images & Image registry
  - Build-able Images (make like)
  - Images are layered & hence can be extended

- **Relevant concepts**
  - Host FS directory can be mounted as 'volumes'
  - IP specific port-forwarding

App 1	App 2	App 3
Bins/Libs	Bins/Libs	Bins/Libs
Guest OS	Guest OS	Guest OS

Hypervisor

Host Operating System

Infrastructure

Virtual Machines

App 1	App 2	App 3
Bins/Libs	Bins/Libs	Bins/Libs

Docker Engine

Operating System

Infrastructure
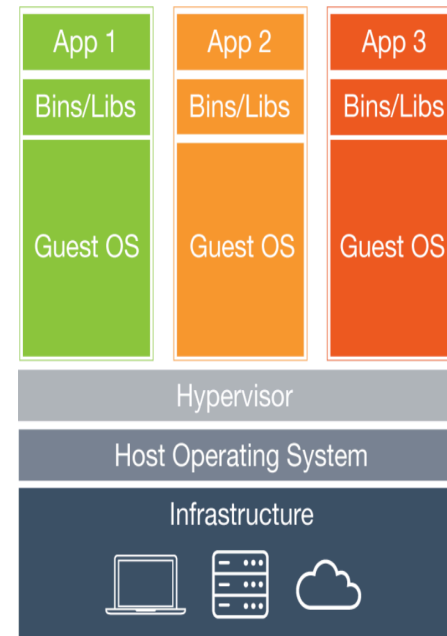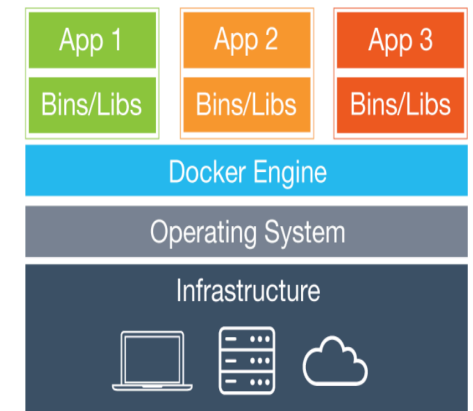
Containers

Docker in Hadoop Cluster on Cloud

- Each cluster node is a virtual node powered by Docker. Each node of the cluster is a Docker container

- Docker containers run on a bunch of **bare metal hosts** (Docker-hosts)

- Each Hadoop cluster will have multiple nodes/Docker containers spanning multiple hosts

- Docker
  - Container management - Custom
  - Multi host networking – Weave (Pluggable architecture to support other solutions)
  - Registry – Private

Typical Clusters
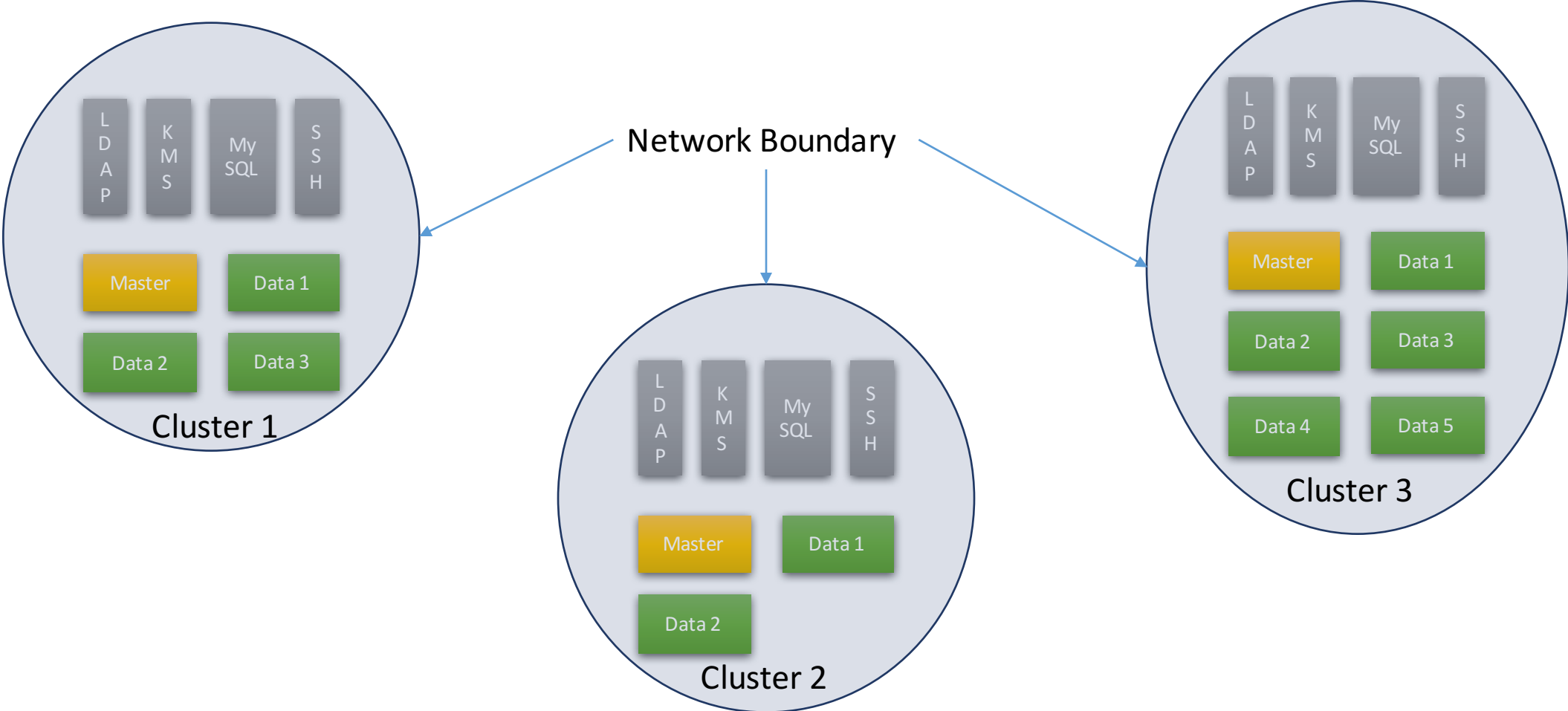
Docker Images

- Master node
- Data Node
- Edge Node
- Auxiliary service images
  - Ldap
  - Mysql
  - Ambari server
  - KMS

Multi host Docker networking with weave

- **Weave** based overlay network among IOP nodes
- One /26 private subnet per cluster (172.x.x.x)
- Master node to have a public IP – ports-forwarding
  - Portable public IPs
  - Network speed (shared with other masters)
- Edge node will be accessible using a public IP
  - User can SSH and run Hive, Hbase, Hadoop & Spark shells
- Private network
  - High Speed
  - Secure

Network Architecture
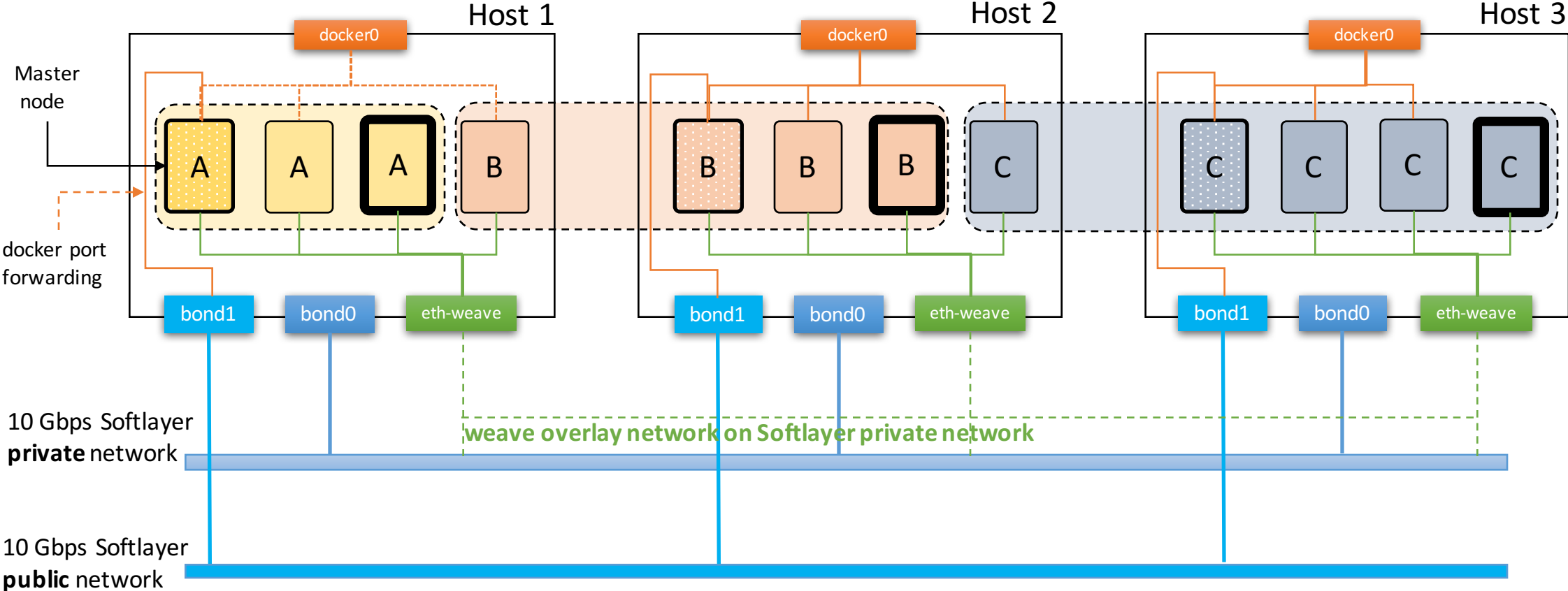
* docker ICC=false (no inter container communication over docker0 network)
* All inter-container communication is through weave network
* One weave's private subnet per cluster (No communication across subnets)
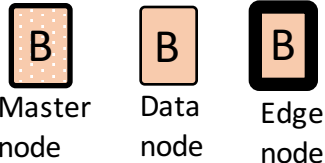
Cluster Provisioning

Provisioning Infrastructure

- Provisioning infrastructure consists of
  - Cluster Manager that provides REST API to create cluster
  - API Gateway application
  - Deployment agent
  - Deployer scripts that actually do all the work
  - And of course the database that holds all metadata related to clusters, hosts, nodes etc.

Phases involved

1. Acquire Hardware

2. Deploy Provisioning Infra

3. Add Hardware to Resource Pool

4. Prepare Host Machines

5. Orchestrate Cluster lifecycle
   1. Create Cluster, Add Nodes, Remove Nodes, Delete Cluster

How is a cluster created?
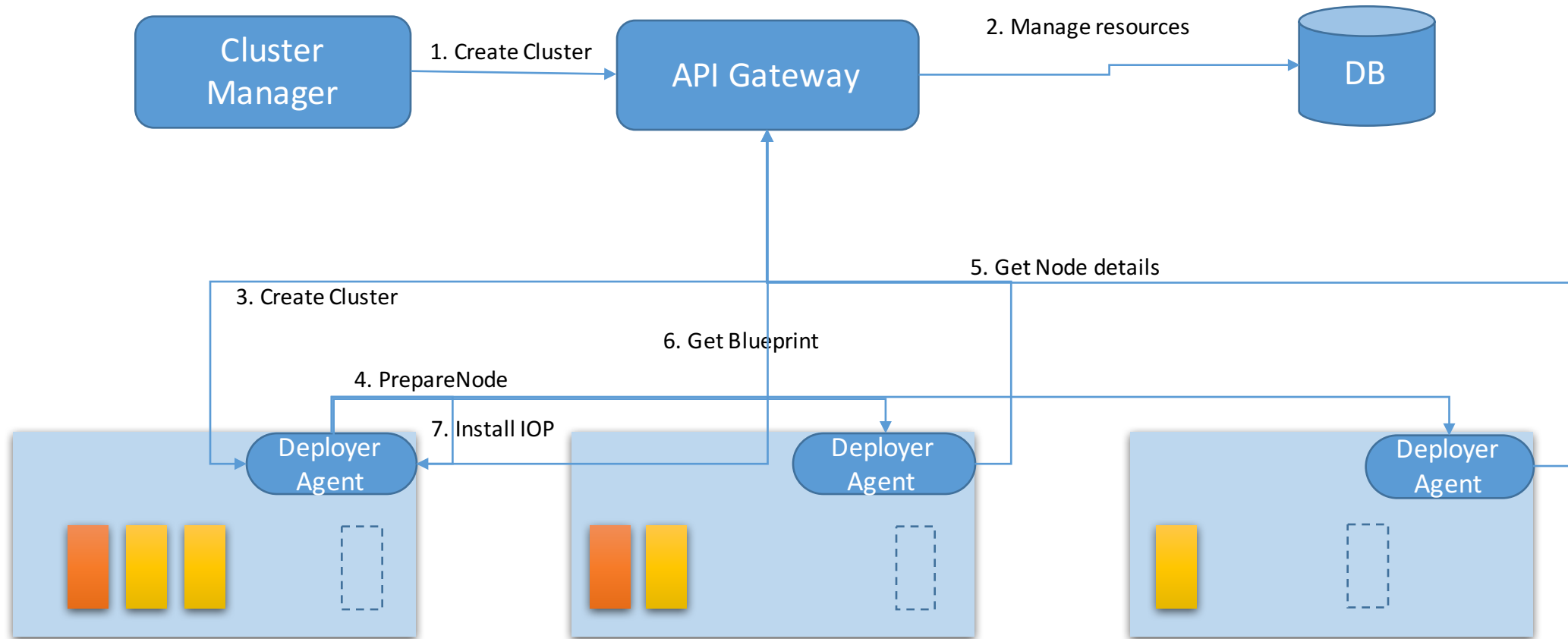
Summary

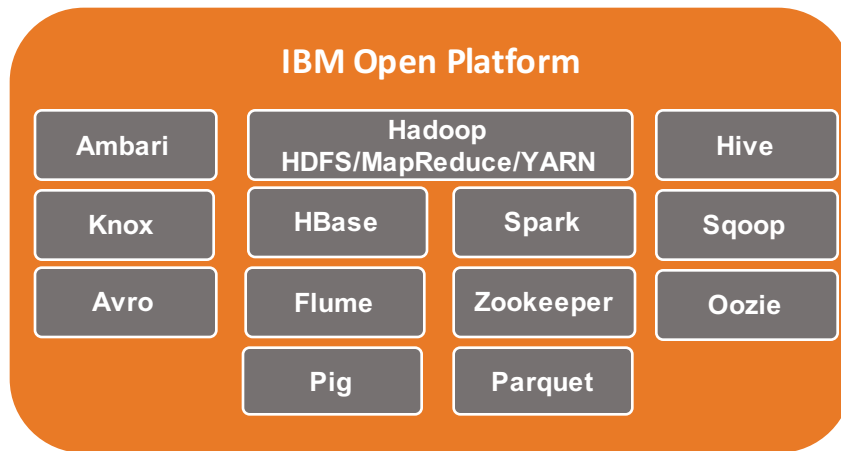- Cluster Creation in around 90 secs , 2-3 mins to start services
- Reliable, repeatable cluster provisioning
- Fully managed
- Highly Secure
- Close to zero failure rates
- Easy Patching
- Optimal use of resources
- Cost effective services

IBM BigInsights on Cloud – Basic Plan

Beta open now !

IBM Open Platform

Ambari	Hadoop HDFS/MapReduce/YARN	Hive
Knox	HBase	Spark	Sqoop
Avro	Flume	Zookeeper	Oozie
	Pig	Parquet	

IBM Bluemix™

Secure, flexible, managed Apache Hadoop clusters

Cheap – Pay for only what you need

Scalable – Add or remove nodes as per your workload

Modular – Compose and deploy applications using data and analytics services on Bluemix

Reliable – Durable SWIFT Object Store service always persists data

References

- Bluemix : http://www.ibm.com/cloud-computing/bluemix
- BigInsights On Cloud
  - http://www-03.ibm.com/software/products/en/ibm-biginsights-for-apache-hadoop

  - https://developer.ibm.com/clouddataservices/docs/biginsights/get-started-in-bluemix/what-is-basic-plan/
  -
    https://www.youtube.com/watch?v=0DN1cDEs6ME

- Tutorials
  - https://www.youtube.com/watch?v=S3n9L2X91xM
  - https://www.youtube.com/watch?v=t1Nuy_zrL7U

- IOP : http://www.ibm.com/analytics/us/en/technology/hadoop/
- Docker
- Weave