BIG DATA EUROPE

Empowering Communities
with Data Technologies

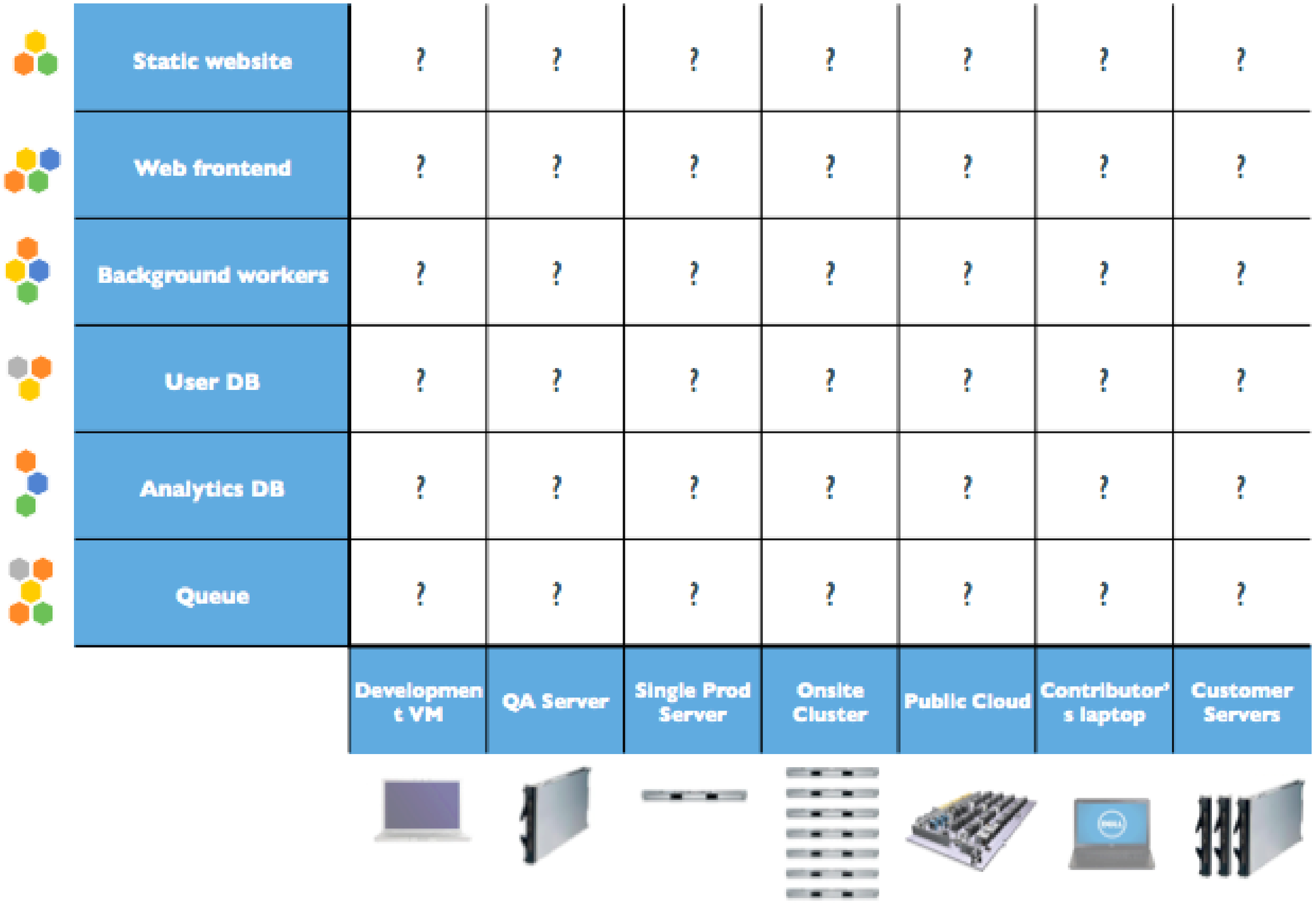
Planning BDI Stack for your Big Data Application

Ivan Ermilov @ ICTCS, Amman, Jordan

Outline

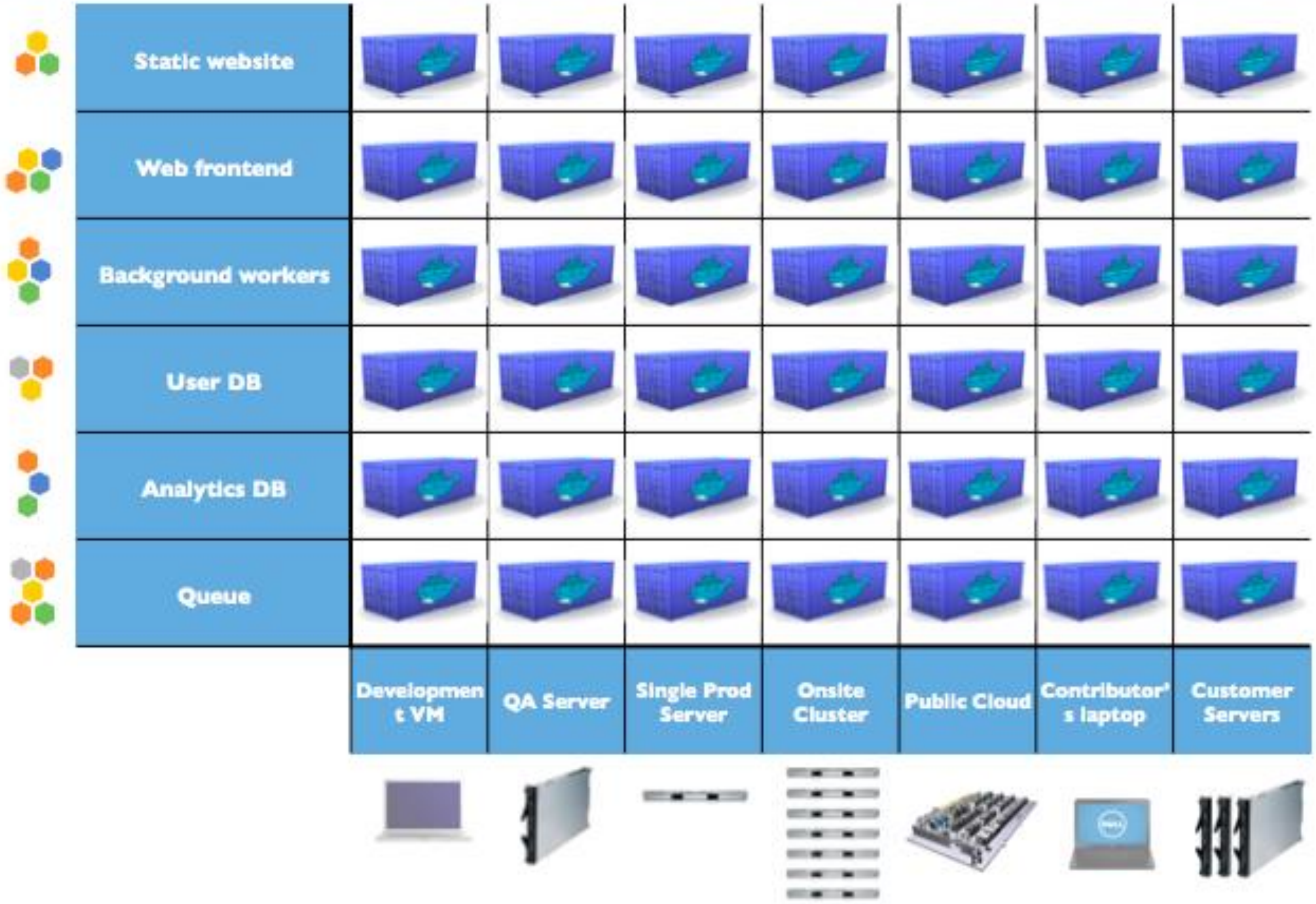
- Dockerization of Big Data Frameworks (BDF): Why
- What is BDI Stack?
- BDI Stack Lifecycle
- BDI Stack Assembly
- Examples
  - New Spark application
  - Existing Spark application

Dockerization of BDF: Why



	Development VM	QA Server	Single Prod Server	Onsite Cluster	Public Cloud	Contributor's laptop	Customer Servers
Static website	?	?	?	?	?	?	?
Web frontend	?	?	?	?	?	?	?
Background workers	?	?	?	?	?	?	?
User DB	?	?	?	?	?	?	?
Analytics DB	?	?	?	?	?	?	?
Queue	?	?	?	?	?	?	?

Dockerization of BDF: Why



Static website

Web frontend

Background workers

User DB

Analytics DB

Queue

Development VM

QA Server

Single Prod Server

Onsite Cluster

Public Cloud

Contributor's laptop

Customer Servers

Dockerization of BDF: Why

- Development environment
- Testing environment
- Staging environment
- Production environment

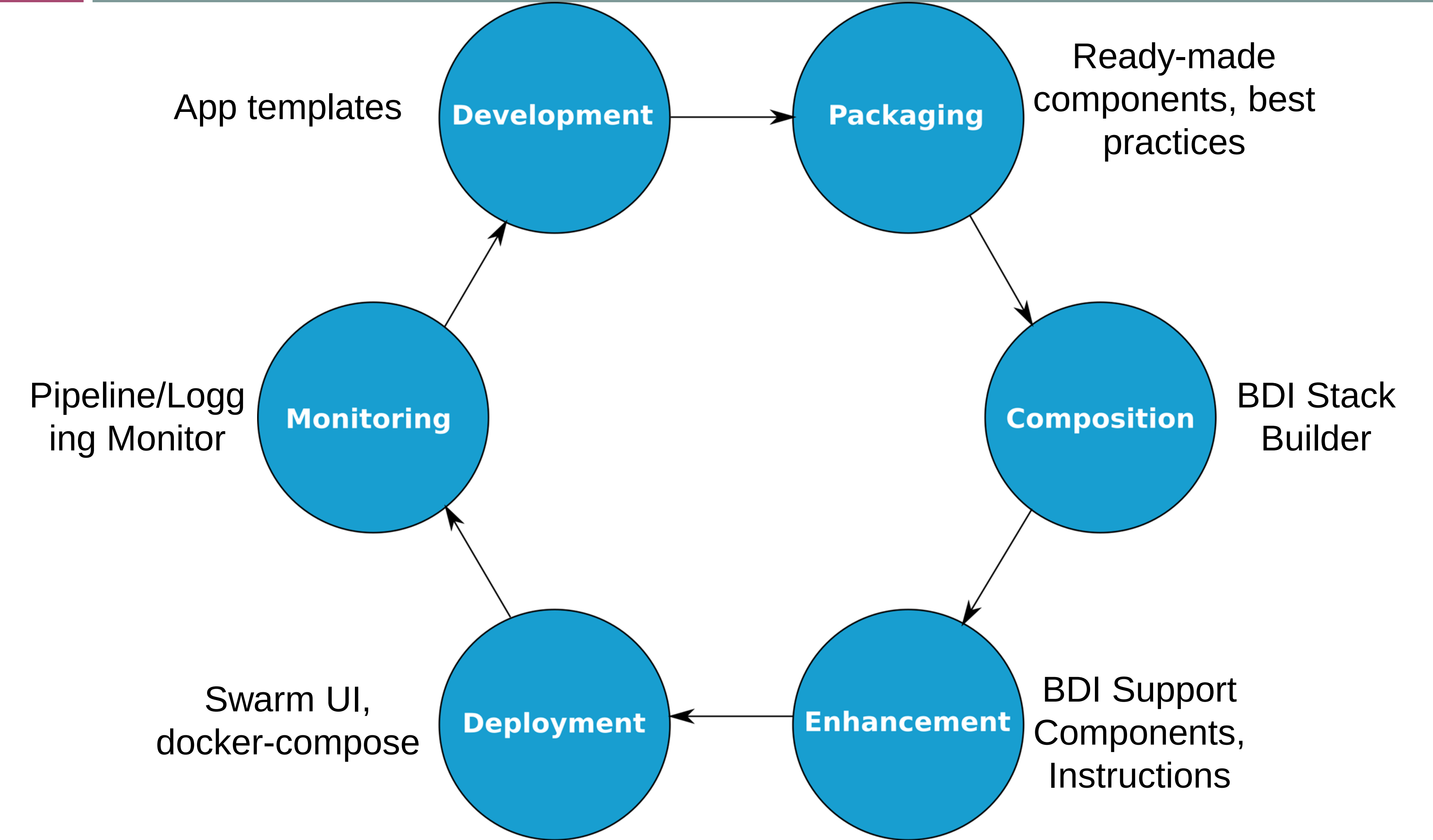
They all the same!

Less Duplication = Less Bugs

What is BDI Stack?

- Dockerized BDF
- In one bundle
- With custom applications
- docker-compose.yml

BDI Stack Lifecycle



App templates

Ready-made components, best practices

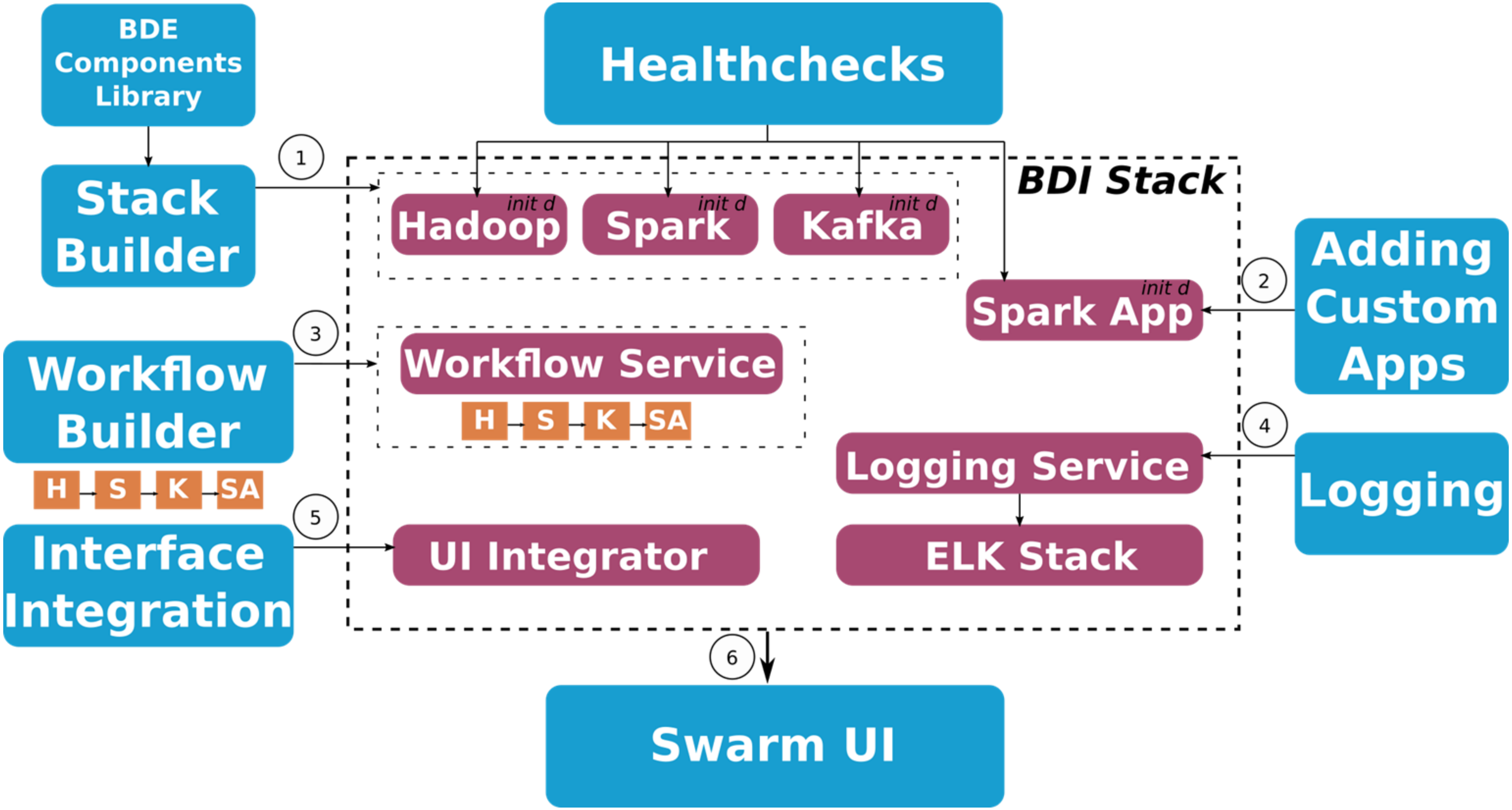
BDI Stack Builder

BDI Support Components, Instructions

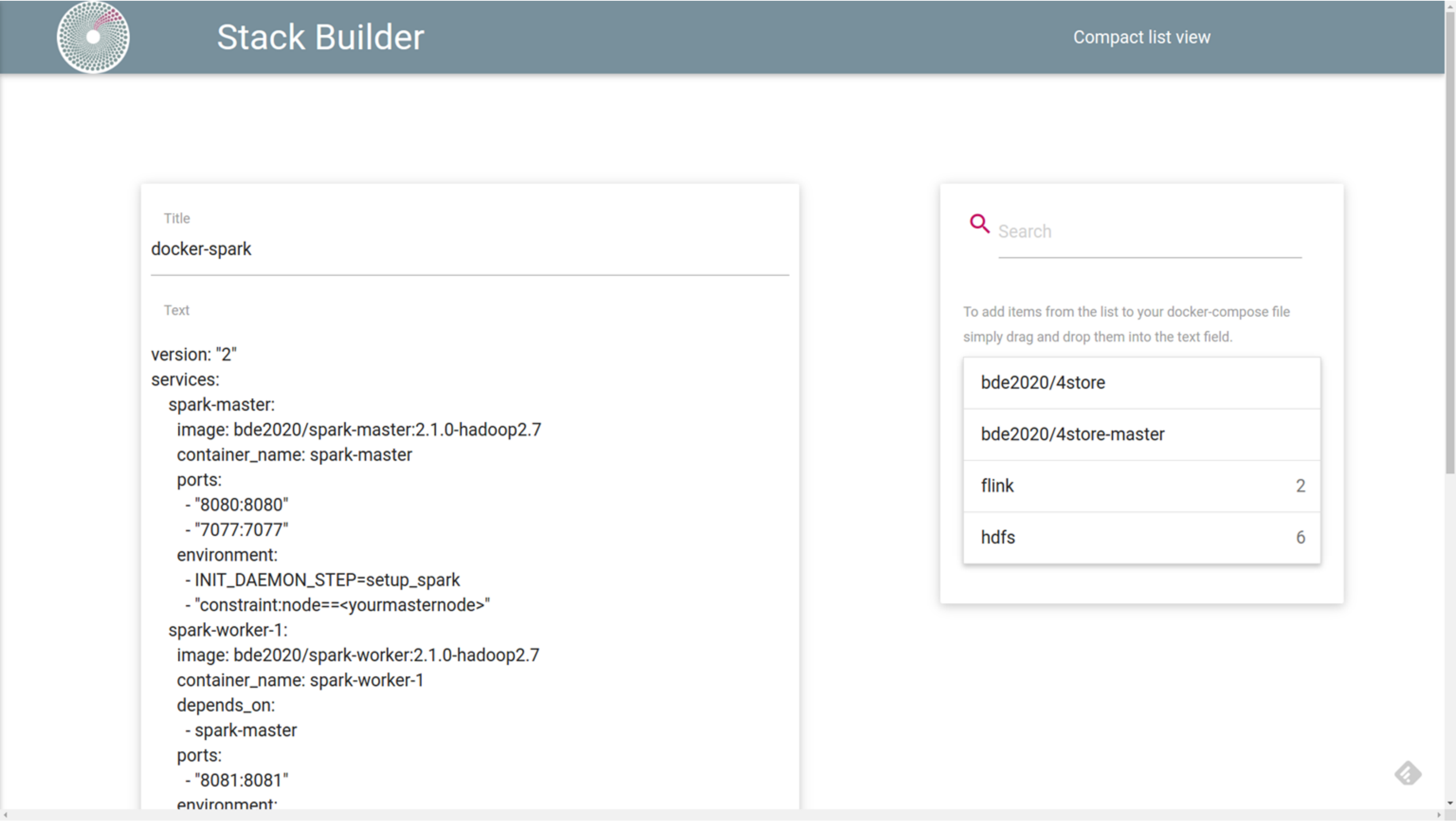
Swarm UI, docker-compose

Pipeline/Logging Monitor

BDI Stack Assembly



Stack Builder



Title

docker-spark

Text

```
version: "2"
services:
  spark-master:
    image: bde2020/spark-master:2.1.0-hadoop2.7
    container_name: spark-master
    ports:
      - "8080:8080"
      - "7077:7077"
    environment:
      - INIT_DAEMON_STEP=setup_spark
      - "constraint:node==<yourmasternode>"
  spark-worker-1:
    image: bde2020/spark-worker:2.1.0-hadoop2.7
    container_name: spark-worker-1
    depends_on:
      - spark-master
    ports:
      - "8081:8081"
    environment:
```

To add items from the list to your docker-compose file simply drag and drop them into the text field.

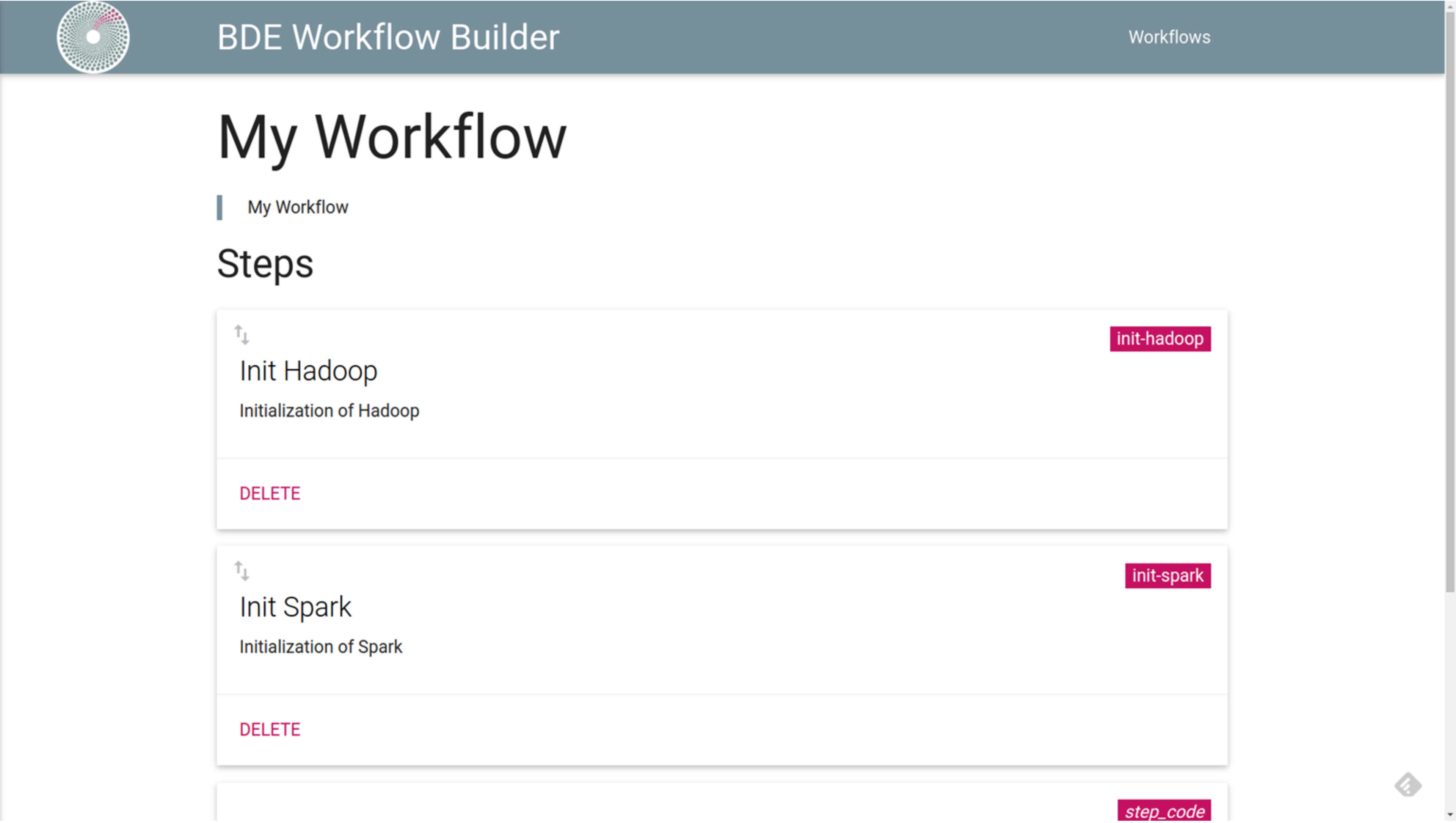
bde2020/4store	
bde2020/4store-master	
flink	2
hdfs	6

Adding Custom Apps

```
FROM bde2020/spark-submit:2.1.0-hadoop2.7

ENV ENABLE_INIT_DAEMON=false
ENV SPARK_APPLICATION_PYTHON_LOCATION=
ENV SPARK_MASTER_NAME=sc6-spark-master
ENV SPARK_APPLICATION_ARGS=
ENV SPARK_MASTER_URL=spark://sc6-spark-master:7077
ENV SPARK_MASTER_PORT=7077
```

WorkFlow Builder



My Workflow

My Workflow

Steps

Init Hadoop

Initialization of Hadoop

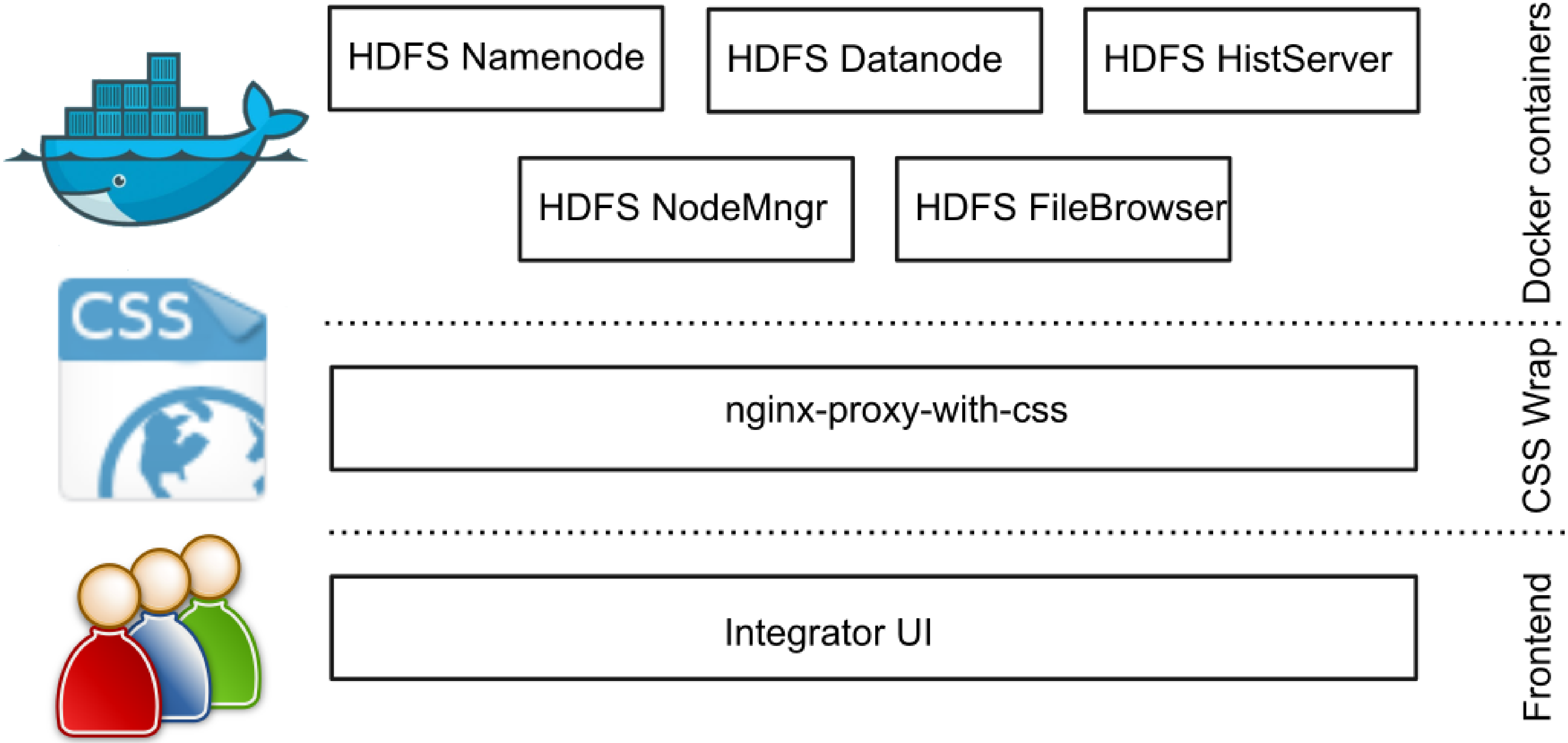
Init Spark

Initialization of Spark

Logging Monitor

- Network logging for HTTP
  - Capture network interface as PCAP
  - Convert to HAR (json)
  - Expand HAR
  - Dump into ELK stack

UI Integrator Application



HDFS Namenode

HDFS Datanode

HDFS HistServer

HDFS NodeMngr

HDFS FileBrowser

Docker containers

nginx-proxy-with-css

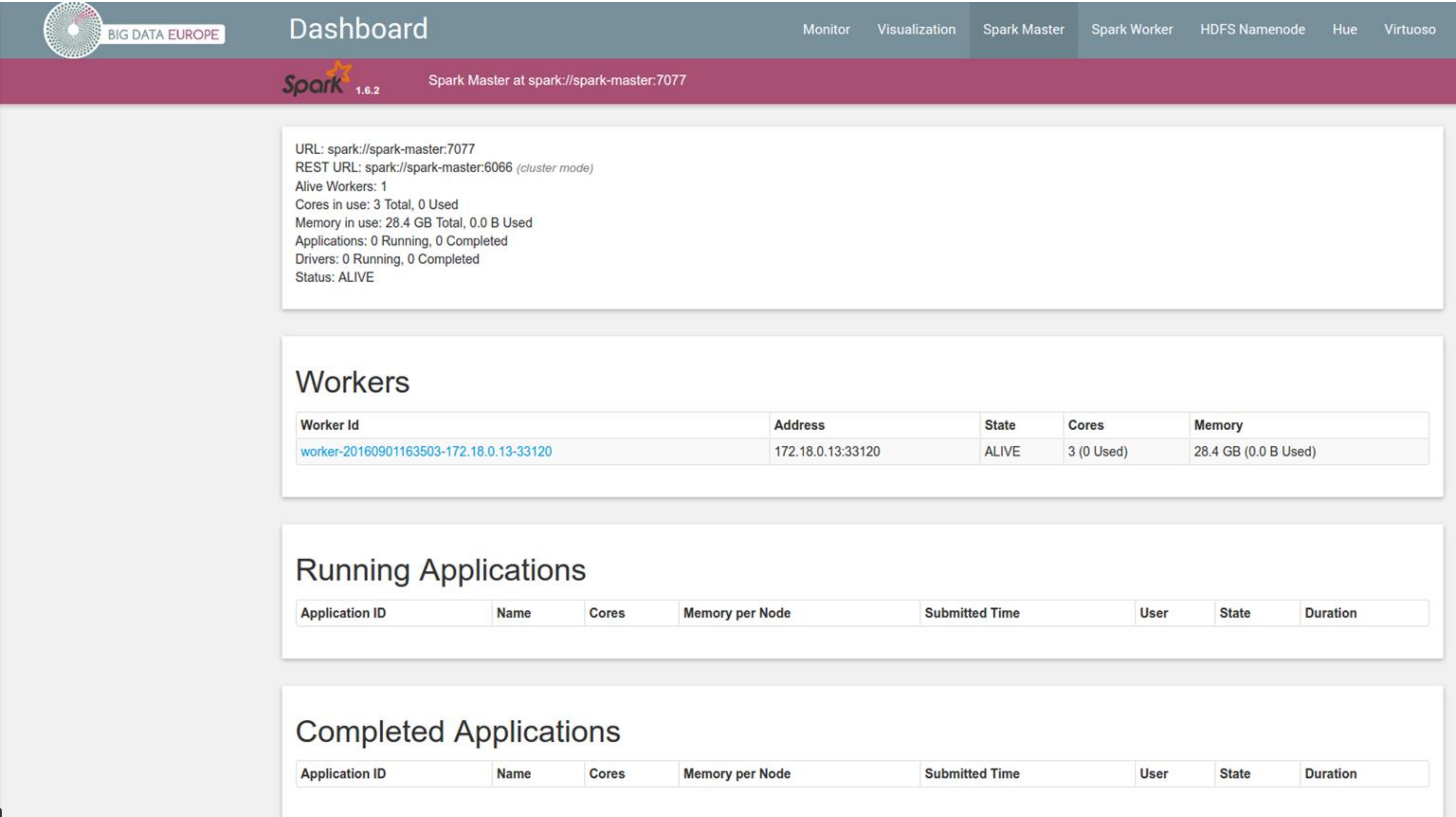
CSS Wrap

Integrator UI

Frontend

https://www.big-data-europe.eu/user-interface-integration-in-bdi-platform-integrator-ui-application/

UI Integrator



Spark Master at spark://spark-master:7077

URL: spark://spark-master:7077
REST URL: spark://spark-master:6066 *(cluster mode)*
Alive Workers: 1
Cores in use: 3 Total, 0 Used
Memory in use: 28.4 GB Total, 0.0 B Used
Applications: 0 Running, 0 Completed
Drivers: 0 Running, 0 Completed
Status: ALIVE

Workers

Worker Id	Address	State	Cores	Memory
worker-20160901163503-172.18.0.13-33120	172.18.0.13:33120	ALIVE	3 (0 Used)	28.4 GB (0.0 B Used)

Running Applications

Application ID	Name	Cores	Memory per Node	Submitted Time	User	State	Duration

Completed Applications

Application ID	Name	Cores	Memory per Node	Submitted Time	User	State	Duration

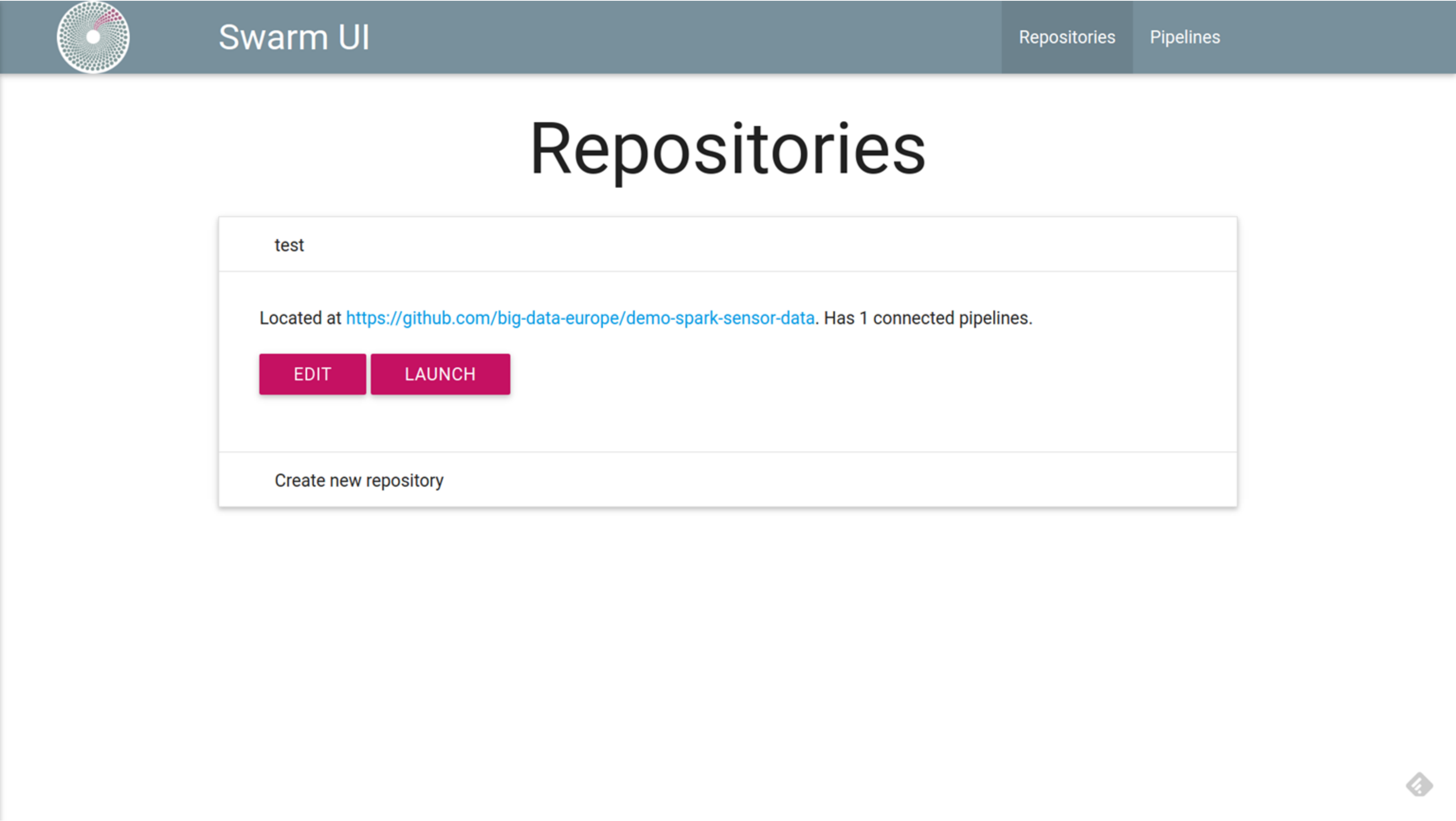
Reverse Proxy/CSSWrapper

- Simple injection of custom CSS

```yaml
strabon:
  image: bde2020/strabon
  links:
    - csswrapper
  expose:
    - "8080"
  environment:
    VIRTUAL_HOST: "strabon.big-data-europe.aksw.org"
    VIRTUAL_PORT: "8080"
    CSS_SOURCE: "strabon"
```

https://www.big-data-europe.eu/using-reverse-proxy-inside-bde-platform-jwildernginx-setup-for-docker-swarm/
https://github.com/big-data-europe/demo-integrator-ui

Swarm UI



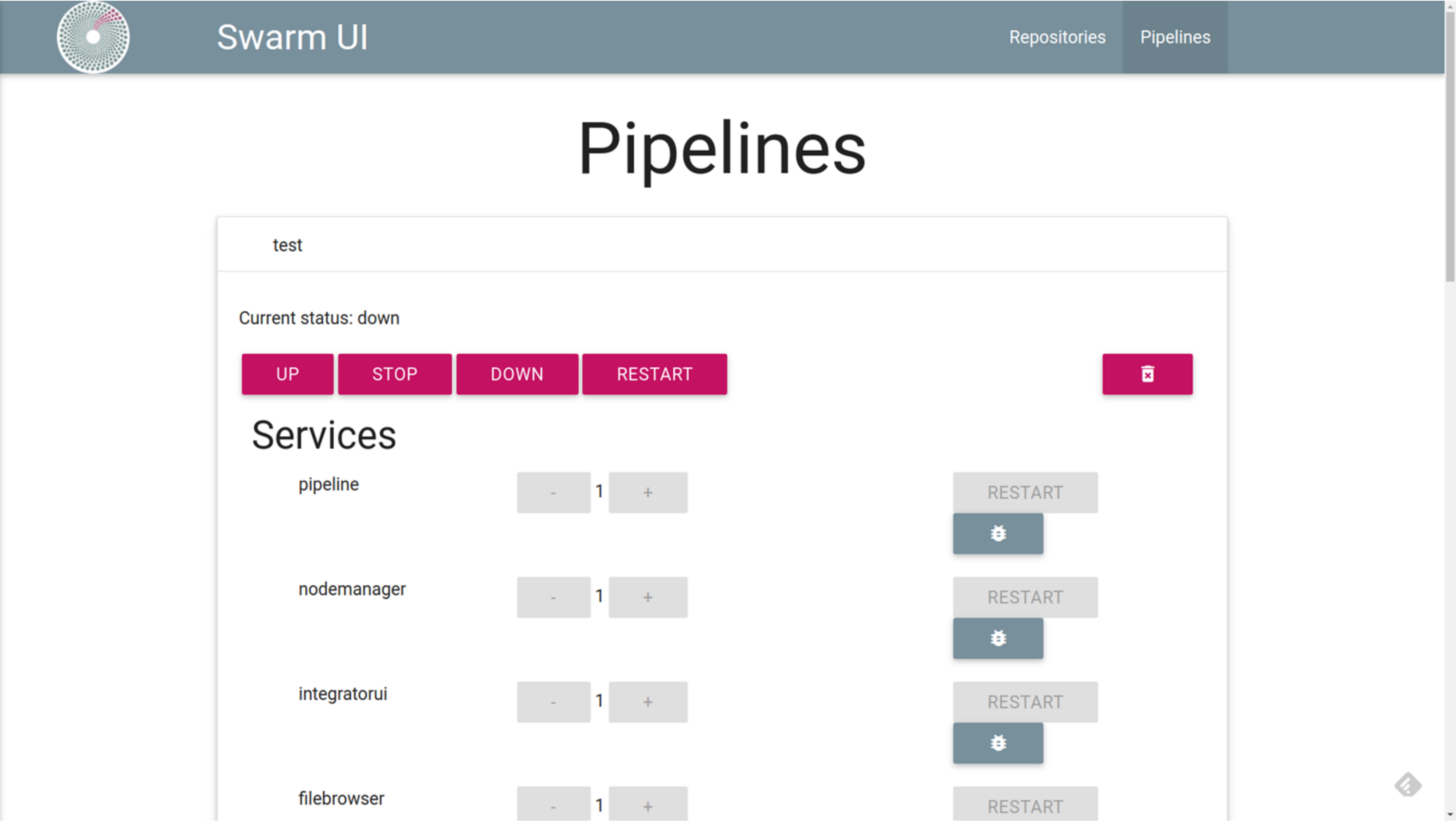
Repositories

test

Located at https://github.com/big-data-europe/demo-spark-sensor-data. Has 1 connected pipelines.

Create new repository

Swarm UI



Pipelines

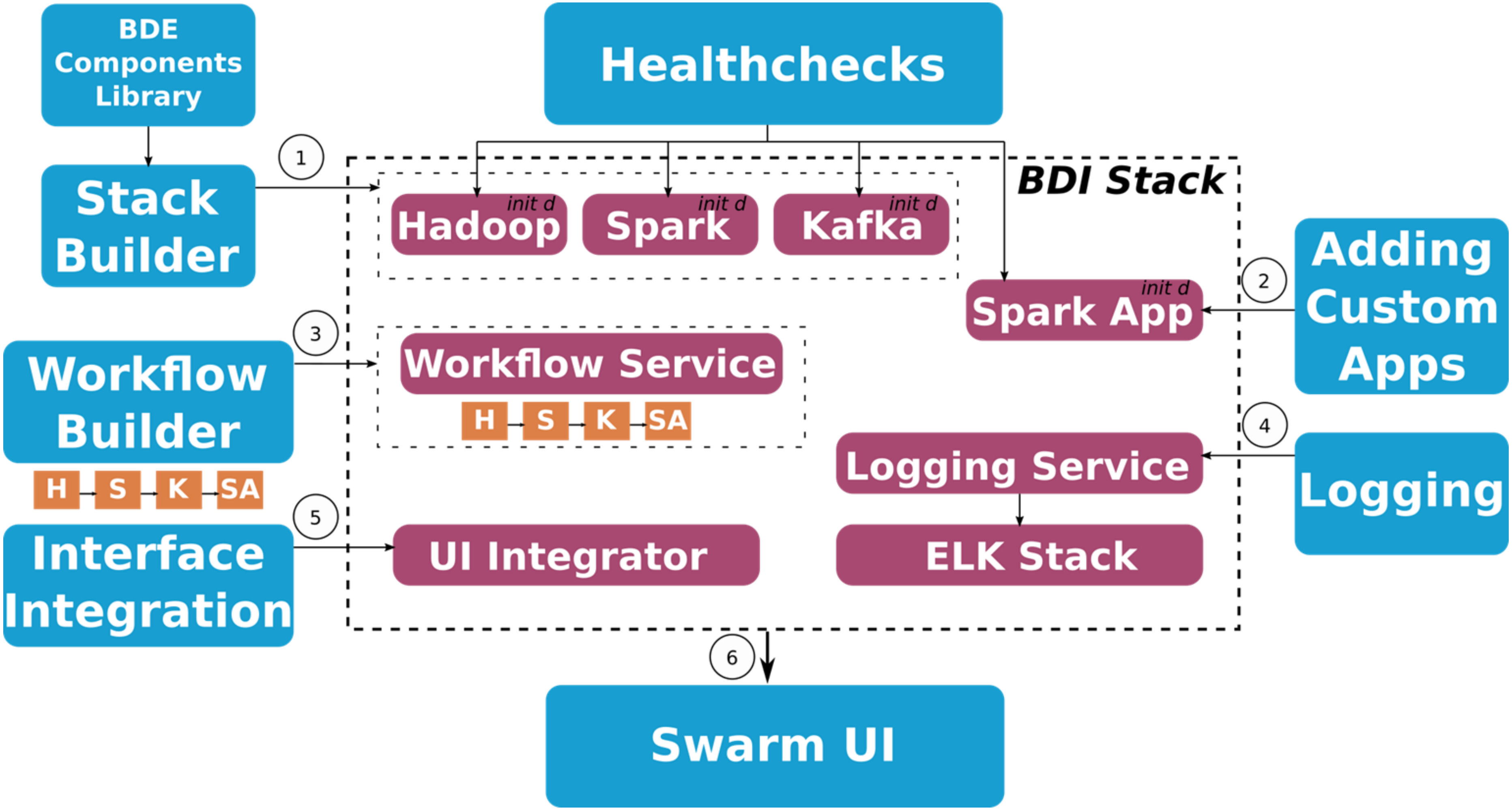
test

Current status: down

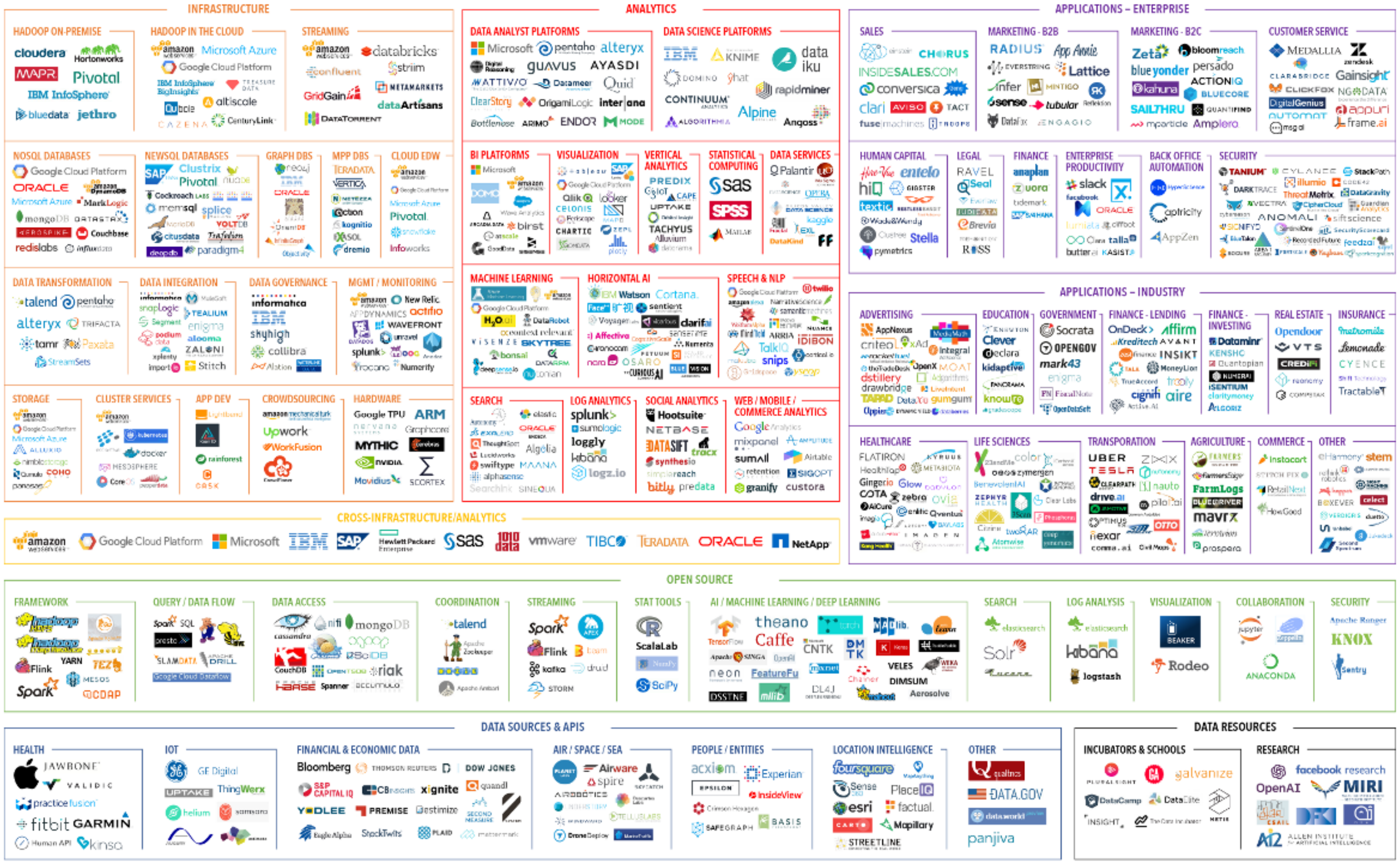
Services

pipeline	- 1 +	RESTART	
nodemanager	- 1 +	RESTART	
integratorui	- 1 +	RESTART	
filebrowser	- 1 +	RESTART	

BDI Stack Assembly



BIG DATA LANDSCAPE 2017



Last updated 4/5/2017

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FIRSTMARK
EARLY STAGE VENTURE CAPITAL

Simplified Workflow

- Outline your application requirements
- Pick up components from BDE github repo
  - If it is not there search Docker Hub
  - Else dockerize it yourself
- Create docker-compose.yml
- Test with simple application
- Develop your application on top of it
- Proceed to enhancement step (if necessary)

Application Requirements

- Create user stories
  - User wants to see the most trending recent hashtags
  - User wants to see the most recent visualization of the hashtags
  - User wants to see past visualizations as well

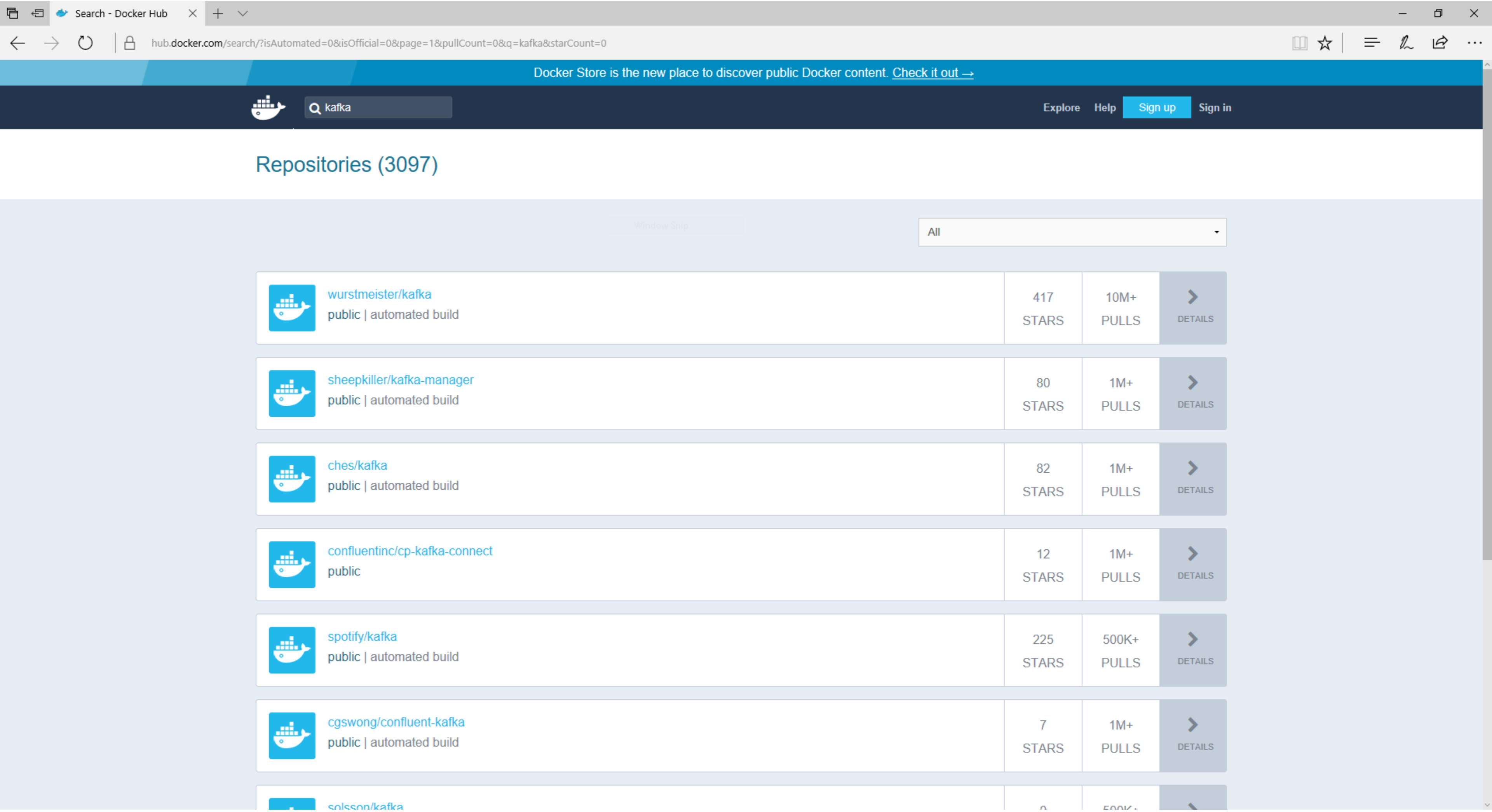
Core Functionality

- Fetch tweets
  - Spark streaming can do that
- Store tweets somewhere (big data)
  - HDFS
- Store trends (not too big)
  - MongoDB
- Visualize the trends
  - Kibana or custom application

Components from BDE github

- HDFS
  - Store data
- Spark
  - Streaming
  - Transformation
  - Save/load data

Searching Docker Hub



hub.docker.com/search/?isAutomated=0&isOfficial=0&page=1&pullCount=0&q=kafka&starCount=0

Docker Store is the new place to discover public Docker content. Check it out →

Repositories (3097)

All

wurstmeister/kafka public | automated build	417 STARS	10M+ PULLS	DETAILS
sheepkiller/kafka-manager public | automated build	80 STARS	1M+ PULLS	DETAILS
ches/kafka public | automated build	82 STARS	1M+ PULLS	DETAILS
confluentinc/cp-kafka-connect public	12 STARS	1M+ PULLS	DETAILS
spotify/kafka public | automated build	225 STARS	500K+ PULLS	DETAILS
cgswong/confluent-kafka public | automated build	7 STARS	1M+ PULLS	DETAILS
solsson/kafka	0	500K+	

Searching Docker Hub

- Create a table (example for HBase)
  - Name
  - Java Version
  - Docs
  - Configurable
  - Standalone
  - Pseudodistributed
  - Distributed

Searching Docker Hub

- Select the best docker image from the table
  - Pay attention to the docker image license!
- Extend if necessary
- Example

Assembling docker-compose

- BDE provides docker-compose.yml snippets
- Docker images which follow the best practices does the same

Assembling docker-compose

- Copy/paste the snippets and adjust

```
version: '2'
services:
  namenode:
    image: bde2020/hadoop-namenode:1.1.0-hadoop2.8-java8
    container_name: namenode
    volumes:
      - ./data/namenode:/hadoop/dfs/name
    environment:
      - CLUSTER_NAME=TwitterTrendsCluster
…
```

Testing your BDI Stack

- Manual testing
  - All containers running?
  - No errors in the initialization logs?
- Automatic testing
  - Deploy a simple application using the BDI stack along it
  - Produce correct results?

Ready to develop your app!

Adding Application to the Stack

- Create Dockerfile
- Expose external interfaces
  - REST
  - SQL
  - SPARQL
- Upload to docker hub
  - Or your enterprise repository (e.g. gitlab)

Demo (15 mins)

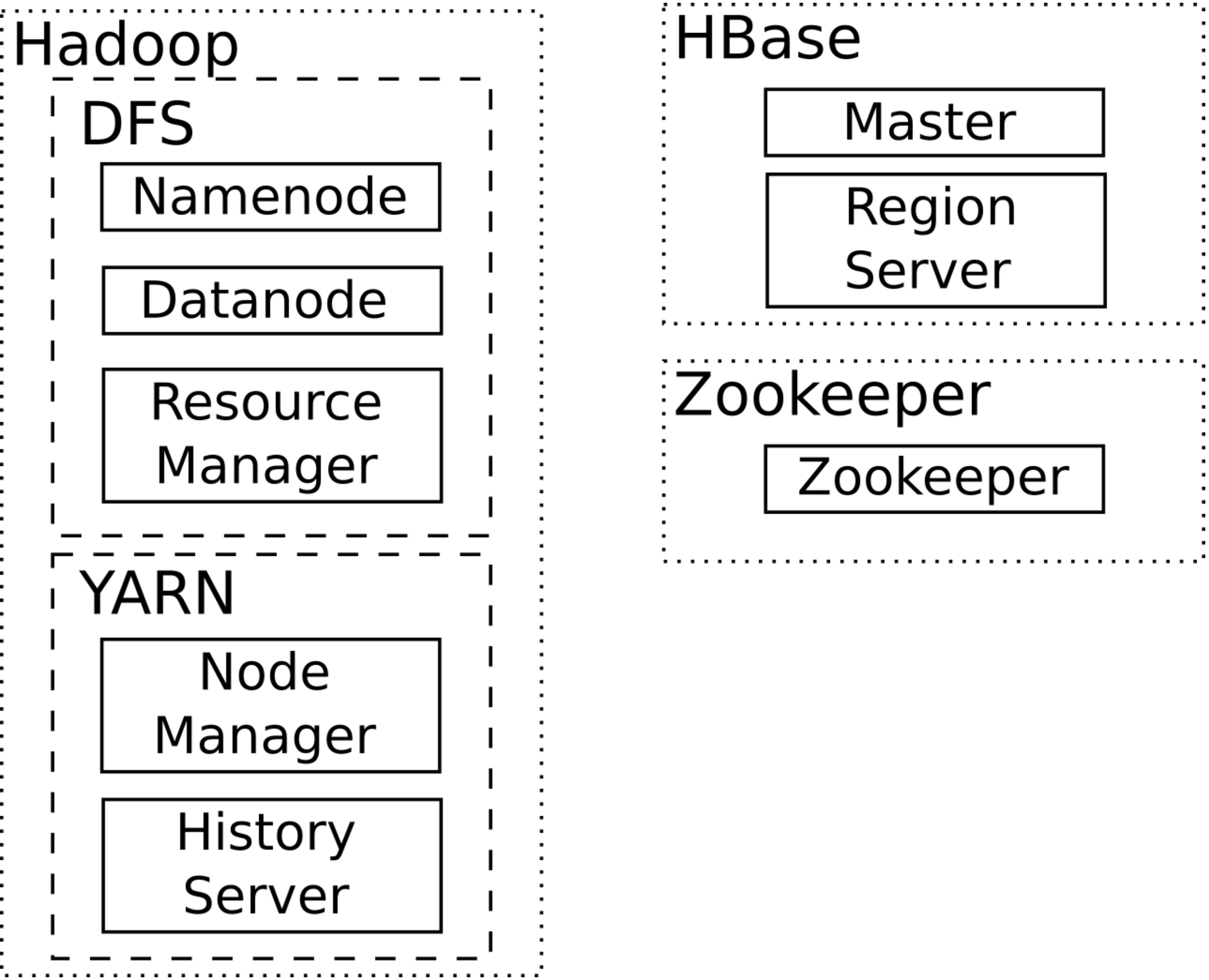
- BDI Stack for
  - Hadoop
  - Spark
  - TwitterTrends
  - VisualizationApp

Packing existing application

Example BDI Stack: Halyard

- Which BD components does Halyard use?
  - HDFS
  - YARN (for MapReduce jobs)
  - HBase
- Which interfaces are supported?
  - Shell scripts (bulkload, export etc)
  - RDF4J console
  - RDF4J REST Server + Workbench

Halyard: BDI Stack



- Hadoop
  - DFS
  - YARN
- HBase
- Zookeeper

Halyard: BDI Stack (yaml)

```yaml
namenode:
  image: bde2020/hadoop-namenode:1.2.0-hadoop2.8-java8
  container_name: namenode
  networks:
    - hbase
  volumes:
    - ./data/hadoop/namenode:/hadoop/dfs/name
  environment:
    - CLUSTER_NAME=test
  ports:
    - "50070:50070"
  env_file:
    - ./hadoop.env
```

Halyard: BDI Stack: Running

Simply execute the command:

```
docker-compose up -d
```

Halyard: BDI Stack: Simple Test

```
$ docker exec -it hbase /bin/bash

$ hbase shell

> list

> create ‘t1’, ‘f1’
```

Adding Halyard to BDI Stack

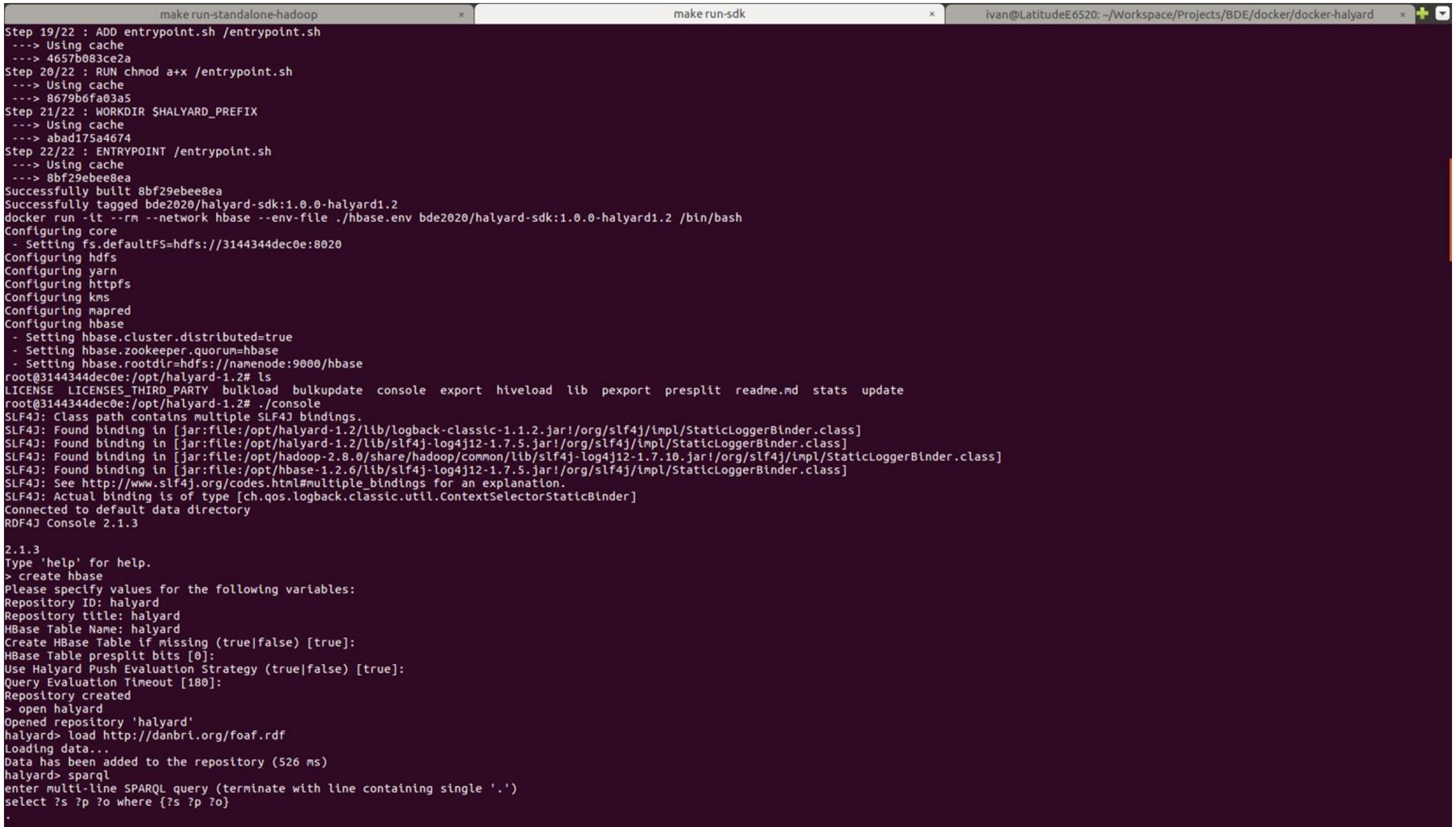
```
FROM bde2020/hadoop-base:1.2.0-hadoop2.8-java8 as hadoop-base
FROM bde2020/hbase-base:1.0.0-hbase1.2.6 as hbase-base
FROM openjdk:8
MAINTAINER Ivan Ermilov <ivan.s.ermilov@gmail.com>
ENV HADOOP_VERSION=2.8.0
COPY --from=hadoop-base /opt/hadoop-$HADOOP_VERSION /opt/hadoop-$HADOOP_VERSION
RUN ln -s /opt/hadoop-$HADOOP_VERSION/etc/hadoop /etc/hadoop
ENV PATH /opt/hadoop-$HADOOP_VERSION/bin:$PATH
ENV HBASE_VERSION=1.2.6
COPY --from=hbase-base /opt/hbase-$HBASE_VERSION /opt/hbase-$HBASE_VERSION
RUN ln -s /opt/hbase-$HBASE_VERSION/conf /etc/hbase
ENV PATH /opt/hbase-$HBASE_VERSION/bin:$PATH
ENV HALYARD_VERSION 1.2
…
```

Running Halyard SDK

```
$ docker run -it --rm --network hbase --
 env-file ./hbase.env bde2020/halyard-
 sdk:1.0.0-halyard1.2 /bin/bash
$ ./console
```

Running Halyard SDK

```
> create hbase
> open halyard
> load http://danbri.org/foaf.rdf
```

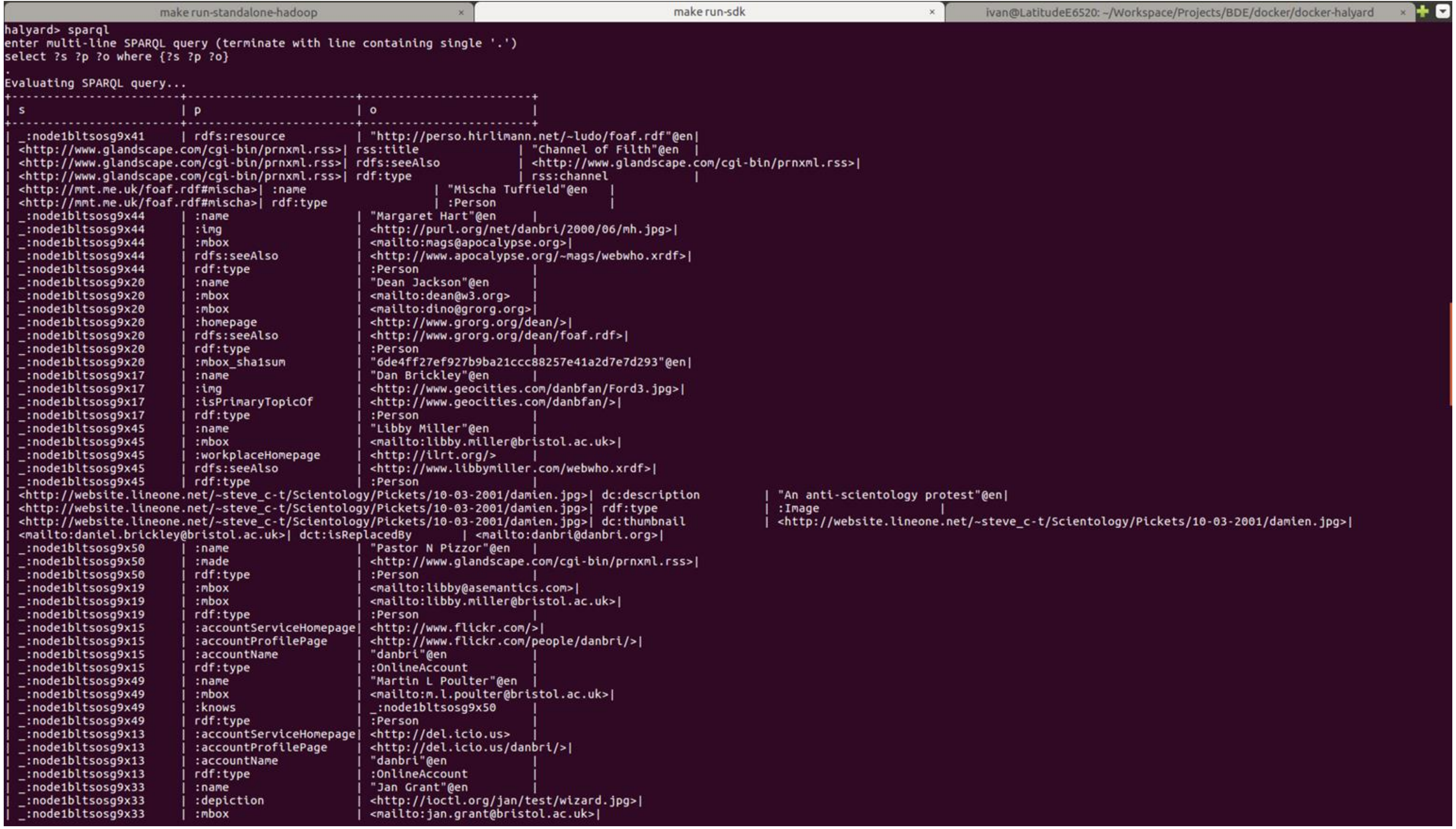

make run-standalone-hadoop
make run-sdk
ivan@LatitudeE6520: ~/Workspace/Projects/BDE/docker/docker-halyard

```
Step 19/22 : ADD entrypoint.sh /entrypoint.sh
 ---> Using cache
 ---> 4657b083ce2a
Step 20/22 : RUN chmod a+x /entrypoint.sh
 ---> Using cache
 ---> 8679b6fa03a5
Step 21/22 : WORKDIR $HALYARD_PREFIX
 ---> Using cache
 ---> abad175a4674
Step 22/22 : ENTRYPOINT /entrypoint.sh
 ---> Using cache
 ---> 8bf29ebee8ea
Successfully built 8bf29ebee8ea
Successfully tagged bde2020/halyard-sdk:1.0.0-halyard1.2
docker run -it --rm --network hbase --env-file ./hbase.env bde2020/halyard-sdk:1.0.0-halyard1.2 /bin/bash
Configuring core
 - Setting fs.defaultFS=hdfs://3144344dec0e:8020
Configuring hdfs
Configuring yarn
Configuring httpfs
Configuring kms
Configuring mapred
Configuring hbase
 - Setting hbase.cluster.distributed=true
 - Setting hbase.zookeeper.quorum=hbase
 - Setting hbase.rootdir=hdfs://namenode:9000/hbase
root@3144344dec0e:/opt/halyard-1.2# ls
LICENSE  LICENSES_THIRD_PARTY  bulkload  bulkupdate  console  export  hiveload  lib  pexport  presplit  readme.md  stats  update
root@3144344dec0e:/opt/halyard-1.2# ./console
SLF4J: Class path contains multiple SLF4J bindings.
SLF4J: Found binding in [jar:file:/opt/halyard-1.2/lib/logback-classic-1.1.2.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/opt/halyard-1.2/lib/slf4j-log4j12-1.7.5.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/opt/hadoop-2.8.0/share/hadoop/common/lib/slf4j-log4j12-1.7.10.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: Found binding in [jar:file:/opt/hbase-1.2.6/lib/slf4j-log4j12-1.7.5.jar!/org/slf4j/impl/StaticLoggerBinder.class]
SLF4J: See http://www.slf4j.org/codes.html#multiple_bindings for an explanation.
SLF4J: Actual binding is of type [ch.qos.logback.classic.util.ContextSelectorStaticBinder]
Connected to default data directory
RDF4J Console 2.1.3

2.1.3
Type 'help' for help.
> create hbase
Please specify values for the following variables:
Repository ID: halyard
Repository title: halyard
HBase Table Name: halyard
Create HBase Table if missing (true|false) [true]:
HBase Table presplit bits [0]:
Use Halyard Push Evaluation Strategy (true|false) [true]:
Query Evaluation Timeout [180]:
Repository created
> open halyard
Opened repository 'halyard'
halyard> load http://danbri.org/foaf.rdf
Loading data...
Data has been added to the repository (526 ms)
halyard> sparql
enter multi-line SPARQL query (terminate with line containing single '.')
select ?s ?p ?o where {?s ?p ?o}
.
```

Running Halyard SDK

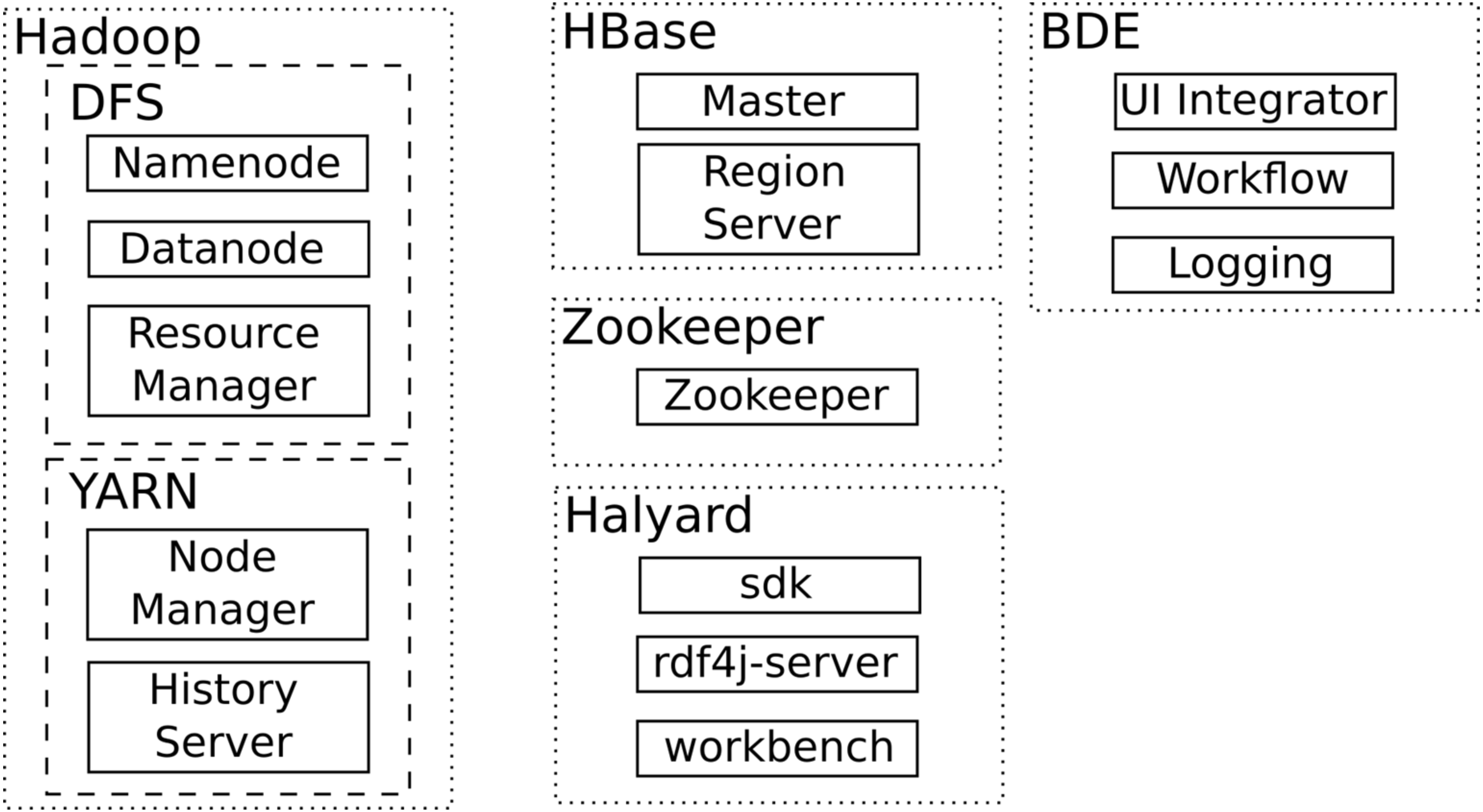
```
> sparql
select ?s ?p ?o {where ?s ?p ?o} .
.
```



make run-standalone-hadoop
make run-sdk
ivan@LatitudeE6520: ~/Workspace/Projects/BDE/docker/docker-halyard

```
halyard> sparql
enter multi-line SPARQL query (terminate with line containing single '.')
select ?s ?p ?o where {?s ?p ?o}
.
Evaluating SPARQL query...
+------------------------+------------------------+------------------------+
| s                      | p                      | o                      |
+------------------------+------------------------+------------------------+
| _:node1bltsosg9x41     | rdfs:resource          | "http://perso.hirlimann.net/~ludo/foaf.rdf"@en|
| <http://www.glandscape.com/cgi-bin/prnxml.rss>| rss:title              | "Channel of Filth"@en  |
| <http://www.glandscape.com/cgi-bin/prnxml.rss>| rdfs:seeAlso           | <http://www.glandscape.com/cgi-bin/prnxml.rss>|
| <http://www.glandscape.com/cgi-bin/prnxml.rss>| rdf:type               | rss:channel            |
| <http://mmt.me.uk/foaf.rdf#mischa>| :name                  | "Mischa Tuffield"@en   |
| <http://mmt.me.uk/foaf.rdf#mischa>| rdf:type               | :Person                |
| _:node1bltsosg9x44     | :name                  | "Margaret Hart"@en     |
| _:node1bltsosg9x44     | :img                   | <http://purl.org/net/danbri/2000/06/mh.jpg>|
| _:node1bltsosg9x44     | :mbox                  | <mailto:mags@apocalypse.org>|
| _:node1bltsosg9x44     | rdfs:seeAlso           | <http://www.apocalypse.org/~mags/webwho.xrdf>|
| _:node1bltsosg9x44     | rdf:type               | :Person                |
| _:node1bltsosg9x20     | :name                  | "Dean Jackson"@en      |
| _:node1bltsosg9x20     | :mbox                  | <mailto:dean@w3.org>   |
| _:node1bltsosg9x20     | :mbox                  | <mailto:dino@grorg.org>|
| _:node1bltsosg9x20     | :homepage              | <http://www.grorg.org/dean/>|
| _:node1bltsosg9x20     | rdfs:seeAlso           | <http://www.grorg.org/dean/foaf.rdf>|
| _:node1bltsosg9x20     | rdf:type               | :Person                |
| _:node1bltsosg9x20     | :mbox_sha1sum          | "6de4ff27ef927b9ba21ccc88257e41a2d7e7d293"@en|
| _:node1bltsosg9x17     | :name                  | "Dan Brickley"@en      |
| _:node1bltsosg9x17     | :img                   | <http://www.geocities.com/danbfan/Ford3.jpg>|
| _:node1bltsosg9x17     | :isPrimaryTopicOf      | <http://www.geocities.com/danbfan/>|
| _:node1bltsosg9x17     | rdf:type               | :Person                |
| _:node1bltsosg9x45     | :name                  | "Libby Miller"@en      |
| _:node1bltsosg9x45     | :mbox                  | <mailto:libby.miller@bristol.ac.uk>|
| _:node1bltsosg9x45     | :workplaceHomepage     | <http://ilrt.org/>     |
| _:node1bltsosg9x45     | rdfs:seeAlso           | <http://www.libbymiller.com/webwho.xrdf>|
| _:node1bltsosg9x45     | rdf:type               | :Person                |
| <http://website.lineone.net/~steve_c-t/Scientology/Pickets/10-03-2001/damien.jpg>| dc:description         | "An anti-scientology protest"@en|
| <http://website.lineone.net/~steve_c-t/Scientology/Pickets/10-03-2001/damien.jpg>| rdf:type               | :Image                 |
| <http://website.lineone.net/~steve_c-t/Scientology/Pickets/10-03-2001/damien.jpg>| dc:thumbnail           | <http://website.lineone.net/~steve_c-t/Scientology/Pickets/10-03-2001/damien.jpg>|
| <mailto:daniel.brickley@bristol.ac.uk>| dct:isReplacedBy       | <mailto:danbri@danbri.org>|
| _:node1bltsosg9x50     | :name                  | "Pastor N Pizzor"@en   |
| _:node1bltsosg9x50     | :made                  | <http://www.glandscape.com/cgi-bin/prnxml.rss>|
| _:node1bltsosg9x50     | rdf:type               | :Person                |
| _:node1bltsosg9x19     | :mbox                  | <mailto:libby@asemantics.com>|
| _:node1bltsosg9x19     | :mbox                  | <mailto:libby.miller@bristol.ac.uk>|
| _:node1bltsosg9x19     | rdf:type               | :Person                |
| _:node1bltsosg9x15     | :accountServiceHomepage| <http://www.flickr.com/>|
| _:node1bltsosg9x15     | :accountProfilePage    | <http://www.flickr.com/people/danbri/>|
| _:node1bltsosg9x15     | :accountName           | "danbri"@en            |
| _:node1bltsosg9x15     | rdf:type               | :OnlineAccount         |
| _:node1bltsosg9x49     | :name                  | "Martin L Poulter"@en  |
| _:node1bltsosg9x49     | :mbox                  | <mailto:m.l.poulter@bristol.ac.uk>|
| _:node1bltsosg9x49     | :knows                 | _:node1bltsosg9x50     |
| _:node1bltsosg9x49     | rdf:type               | :Person                |
| _:node1bltsosg9x13     | :accountServiceHomepage| <http://del.icio.us>   |
| _:node1bltsosg9x13     | :accountProfilePage    | <http://del.icio.us/danbri/>|
| _:node1bltsosg9x13     | :accountName           | "danbri"@en            |
| _:node1bltsosg9x13     | rdf:type               | :OnlineAccount         |
| _:node1bltsosg9x33     | :name                  | "Jan Grant"@en         |
| _:node1bltsosg9x33     | :depiction             | <http://ioctl.org/jan/test/wizard.jpg>|
| _:node1bltsosg9x33     | :mbox                  | <mailto:jan.grant@bristol.ac.uk>|
```

Halyard: BDI Stack (complete)



- Hadoop
  - DFS
    - Namenode
    - Datanode
    - Resource Manager
  - YARN
    - Node Manager
    - History Server
- HBase
  - Master
  - Region Server
- Zookeeper
  - Zookeeper
- Halyard
  - sdk
  - rdf4j-server
  - workbench
- BDE
  - UI Integrator
  - Workflow
  - Logging

Thank you

Questions?

Github: https://github.com/earthquakesan
@AKSW: http://aksw.org/IvanErmilov.html
Email: iermilov@informatik.uni-leipzig.de
Twitter: @earthquakesan
LinkedIn: https://www.linkedin.com/in/iermilov/