

What is Docker

robert.reihs@medunigraz.at



B³
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Overview

TOPIC 1: How to manage BIBBOX virtual machines

- What is VM
- Hypervisor
- BIBBOX VMs
- Connect to VM
- Backup/Snapshot

TOPIC 2: How to manage BIBBOX Dockers and Containers

- What is Docker
- Difference to VMs
- Workflow
- Run
- Dockerfile
- Docker Compose
- Logging
- Backup



B³
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

What is Virtualization

- Virtualization is a broad concept of simulating hardware and/or software (virtual memory, storage, network etc.). The simulated environment is called virtual machine (VM).



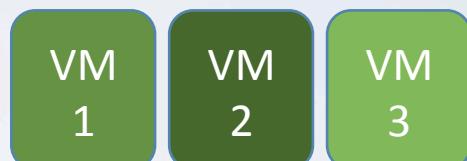
B³
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Hypervisor

Bear Metal

- Runs directly on the host hardware
- Oracle VM Server, Citrix XenServer, Microsoft Hyper-V, VMware ESX/ESXi, KVM, bhyve



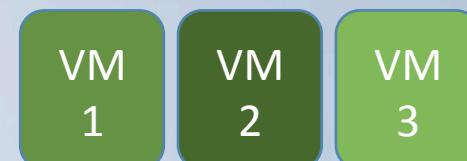
Hypervisor



Hardware:
CPU, RAM, Network, Storage

Host

- Runs on a conventional OS (Windows, Mac, Linux, ...)
- VMware (Workstation/Player), Oracle VirtualBox, Parallels, Microsoft Windows Virtual PC, KVM, bhyve



Hypervisor

Host OS



BIBBOX VM (demo)

Requirements:

- Download Oracle VirtualBox
- Download BIBBOX VM v0.5
- Install VirtualBox
- Import BIBBOXDemoServer
- [https://
www.virtualbox.org](https://www.virtualbox.org)
- [http://bibbox.org/
virtual-machine](http://bibbox.org/virtual-machine)
- Import BIBBOXDemoServer_0.5_20160929.ova



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

BIBBOX VMs

Empty VM

- Startup Script
- Configuration Files
- BIBBOX Base scripts
- BIBBOX Portal (Liferay)
- OrientDB
- iRods
- OpenLDAP/CAS

Demo VMs

- Empty VM
- + BIKA Lims
- + OpenSpecimen
- + Liferay Document
- + iRods
- + Galaxy

Use Case Clinical Biobank – Colon
Cancer Cases



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

<http://bibbox.org/virtual-machine>

BIBBOX VM (demo)

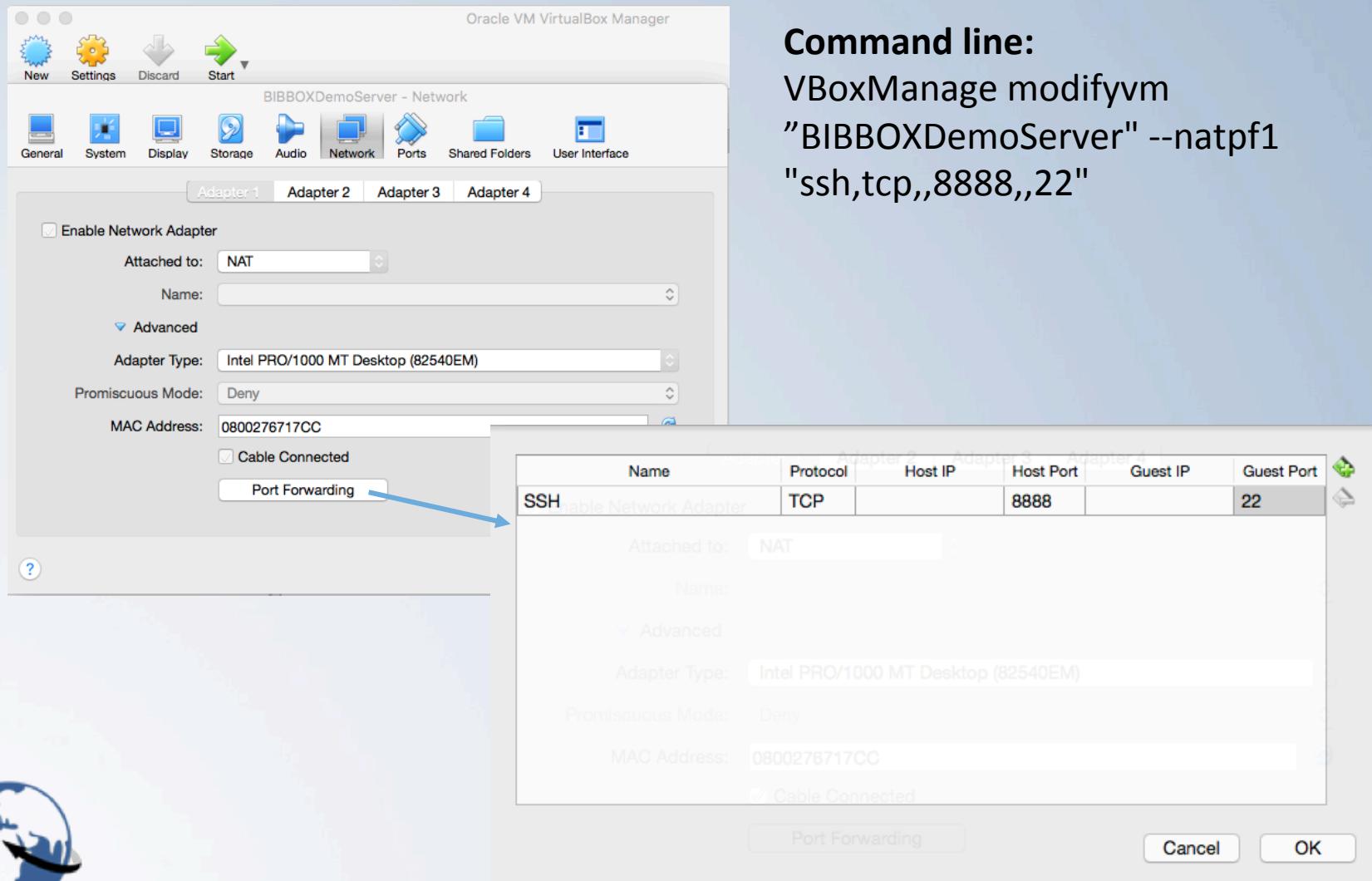
- Debian Script Structure /etc/init.d/bibbox
 /etc/bibbox/bibbox.cfg
 /etc/bibbox/conf.d/*.cfg
- GitHub Scripts /opt/bibbox/bibbox-
 scripts
 /initscripts
 addproxy.sh



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Connect to virtual machine



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Backup/Snapshot VMs

- Install backup software on guest
 - Copy VM files
 - Special Tools for backup and migration
-
- Clone (copy) => make an exact copy (also names and network settings)
 - Export => move to a different host (with running VM called live migration)
 - Import => import to exported VM (Register, Restore or Copy)



B³
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Overview

TOPIC 1: How to manage BIBBOX/eB3kit virtual machines

- What is VM
- Hypervisor
- BIBBOX VMs
- Connect to VM
- Backup/Snapshot

TOPIC 2: How to manage BIBBOX Dockers and Containers

- What is Docker
- Difference to VMs
- Workflow
- Run
- Dockerfile
- Docker Compose
- Logging
- Backup

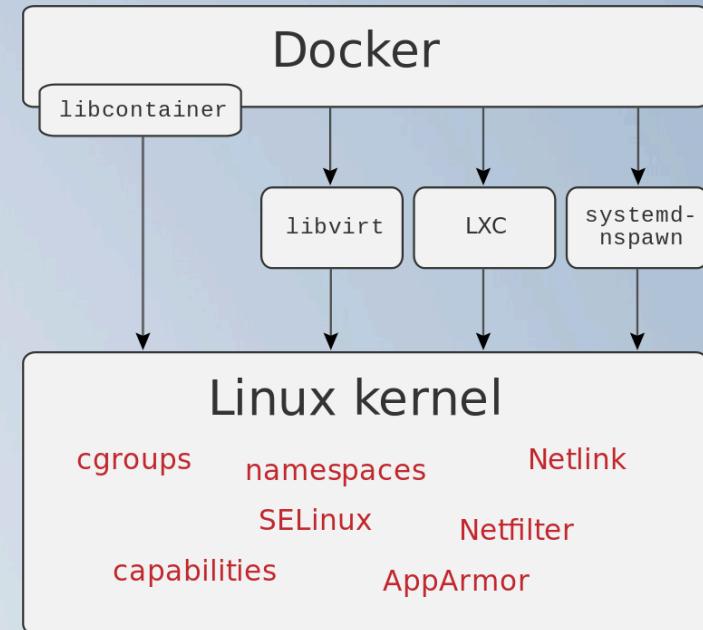


B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

What is Docker

- Solomon Hykes started Docker 2013
- Open-Source
- Implements a high-level API to provide lightweight containers that run processes in isolation.
- Operation System Level Virtualization based on Linux
- Uses cgroups and kernel namespaces for isolation
- Linux virtualization features: LXC Linux container, libcontainer, libvirt and systemd-nspawn



Top Contributors: The Docker team, Red Hat, IBM, Google, Cisco Systems and Amadeus IT Group



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

What is the difference to VMs



Hypervisor



Docker Engine

Includes application,
binaries, libraries and
guest operating
system

Includes application,
binaries, libraries
Share the kernel

Container have similar resource isolation and allocation benefits as virtual machines but a different architectural approach allows them to be much more portable and efficient.



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Docker Workflow Components

Docker Image

- Holds the environment and the application

Docker Container

- Created from the image (start, stop, move, delete)

Docker Registry

- Public and private repository used to store images

Dockerfile

- Automate image construction

Docker Compose

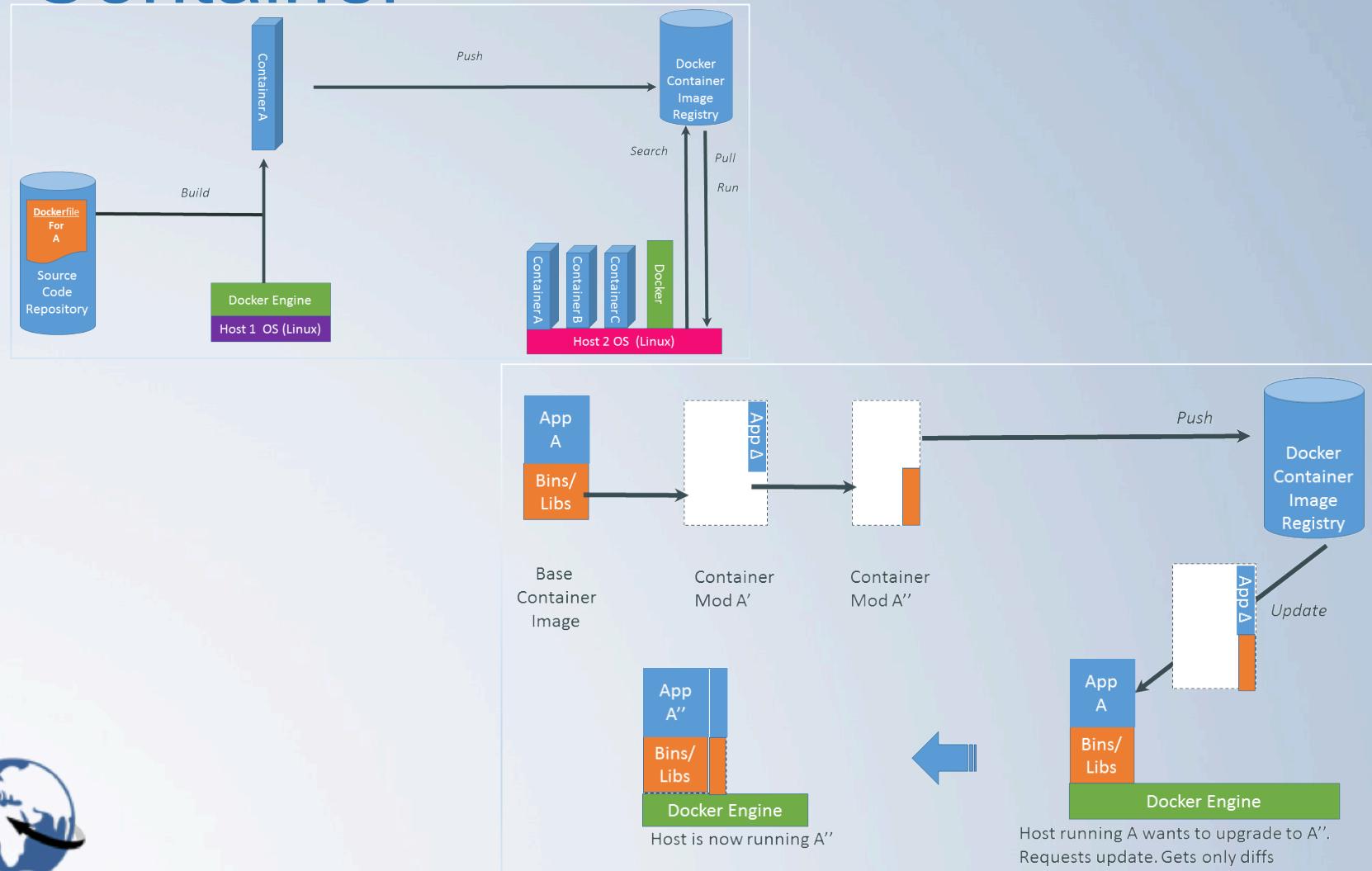
- Defining and running multi-container applications



B³
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Run and Update a Docker Container



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Run Docker (demo)

`docker run [OPTIONS] IMAGE [COMMAND] [ARG...]`

docker run – execute a container

[OPTIONS] – options for executing the container

--name – name of the container

-d – run container in background

-t – allocate a pseudo-TTY

-v – mount a volume

Java:7 – specify the image for the container

Java – execute the command

-jar /opt/test.jar – arguments for the command



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Run Docker (demo)

- docker logs –f CONTAINER
- docker stop CONTAINER
- docker restart CONTAINER [COMMAND]
- docker images
- docker inspect CONTAINER
- docker exec
- docker ps
- docker pull
- docker search
- docker stats



B³
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Dockerfile (demo)

FROM
MAINTAINER
RUN
CMD
ENV
WORKDIR
ADD
COPY
EXPOSE
LABEL
VOLUME
STOP SIGNAL
ONBUILD

Dockerfile

```
FROM busybox
ENV foo /bar
WORKDIR ${foo}      # WORKDIR /bar
ADD . $foo          # ADD . /bar
COPY \${foo} /quux  # COPY ${foo} /quux
```

Build image locally:
`docker build -t bibbox/testapp .`



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Run Docker Compose

Compose is a tool to run and link multiple docker containers together.

Compose contains multiple steps

- Devine the app's with a Dockerfile
- Devine the images that define the app in a docker-compose.yml file
- Run the compose file with docker-compose up



B³
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Docker logging

- What messages are logged?
 - Everything that is written to the container standard output/error
- How do I get my loges shipped to the logging driver?
 - By default to the default logging driver. (**json-file**)
 - **none**: disables any logging for the container
 - **syslog**: writes logging information to syslog or ships it to a syslog server
 - **journald**: ships logging information to a journald (part of systemd)
 - **gelf**: ships logging information to a gelf endpoint (Graylog or Logstash)
 - **fluentd**: ships logging information to fluentd
 - **awslogs**: is the Amazon CloudWatch Logs for docker
 - **splunk**: ships logging information to splunk using HTTP event collector
 - **etwlogs**: writes loggong information as ETW events (Windows)
 - **gcplogs**: ships logging information to Google Cloud Logging



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Docker logging

json-file

- docker run --name demo1 -dt -v "\$PWD/test.jar":/opt/test.jar
java:7 java -jar /opt/test.jar
- docker logs demo1
 - Java Programm Running
 - Java ERROR...
- sudo tail -f /var/lib/docker/containers/8c..5f/8c..5f-json.log
 - {"log":"Java Programm
Running\r\n","stream":"stdout","time":"2016-09-28T11:41:11.065333829Z"}
 - {"log":"Java ERROR...\\r\\n","stream":"stdout","time":"2016-09-28T11:41:11.065578959Z"}
 - {"log":"Java Programm
Running\r\n","stream":"stdout","time":"2016-09-28T11:41:13.066559917Z"}
 - {"log":"Java ERROR...\\r\\n","stream":"stdout","time":"2016-09-28T11:41:13.066681392Z"}
 - {"log":"Java Programm
Running\r\n","stream":"stdout","time":"2016-09-28T11:41:15.067241372Z"}
 - {"log":"Java ERROR...\\r\\n","stream":"stdout","time":"2016-09-28T11:41:15.067357633Z"}



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Docker logging

gelf

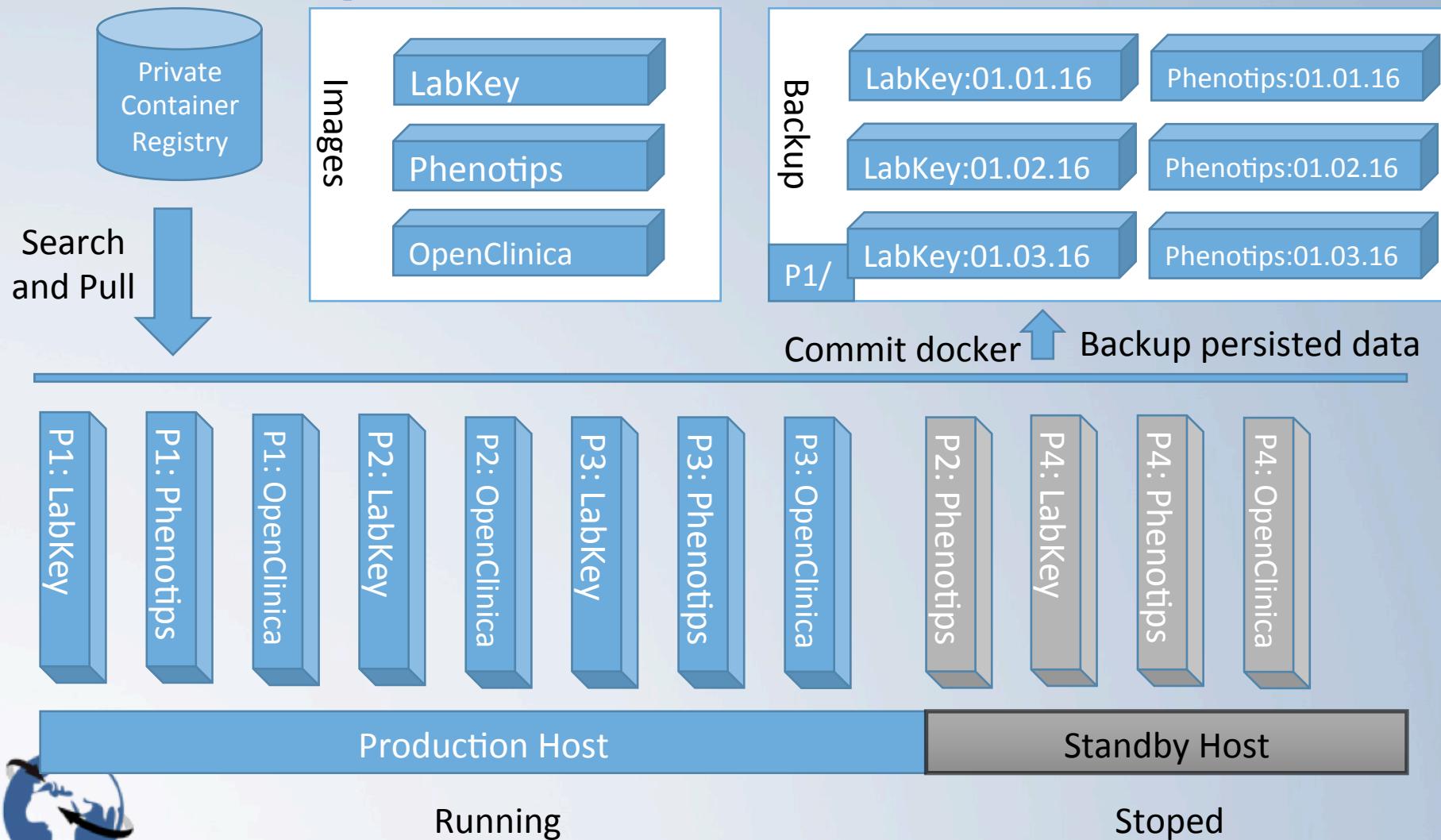
- docker run --name demo2 --log-driver=gelf --log-opt gelf-address=udp://172.23.0.3:12201 --log-opt tag="demo2" -dt -v /opt/webinar/test.jar:/opt/test.jar java:7 java -jar /opt/test.jar



B³
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA

Backup Docker



BIBBOX - Links

- BIBBOX Community
 - <http://bibbox.org>
- Application Repository
 - <https://github.com/bibbox/application-store>
- Script Repository
 - <https://github.com/BiBBox/bibox-scripts>
- Docker Image Repository
 - <https://hub.docker.com/u/bibox/dashboard>



B3
Africa

BRIDGING BIOBANKING AND BIOMEDICAL RESEARCH
ACROSS EUROPE AND AFRICA