dCache.org

dCache and the container

some random thoughts on …

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With some ideas and slides shameless stolen from Tigran

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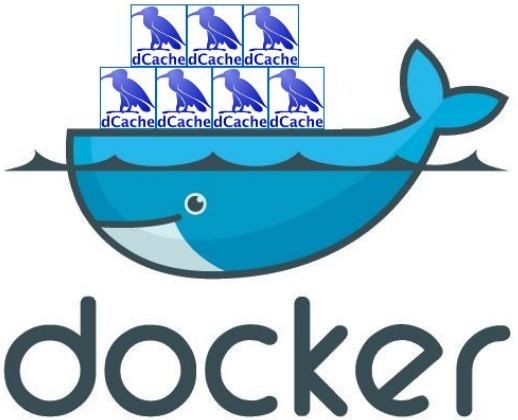
Types of virtualisation

- User-Mode Linux (UML)
- "Real" virtual machines (Intel VT-x; AMD-V)
- chroot, cgroups, namespaces → Containers

Containers (Operating-system-level virtualization)

- Isolate application to improve security
- Little-to-no overhead
- Limited to the same type of OS



Why? Isolation

- Be able to share resources reasonably between different activities.
- Deploy different versions of the same software concurrently.
- Deploy software with different dependency versions.
- Deploy software that require different distributions.
- Make it easy to get started with some software.

The elephant in the room: JVM

- dCache is written in **Java**
- Java programs runs inside JVM

  Hint: JVM → Java **Virtual Machine**
- Don't we already have isolation?

  Yes(-ish): dependencies as jars, multiple JVMs, …
- So what's missing?
  - OS-specific features (cgroups)
  - Non-Java dependent services (e.g., databases)
  - OS-level support scripts

Not just running the server: dev support

- dCache team also provide client software
  - Java (SRM) and C (dcap)
- Building and testing infrastructure
  - currently using virtual machines
- Containers would allow faster deployment and finer-grain control over environment
  - client stress-testing a 2-node dCache instance with simulated 50% packet loss.

Motivation

- In production we need to:
  - run multiple version of dCache on the same host.
  - update some components on the same host.
- In development:
  - run multiple versions at the same time
  - test on multiple OSes
  - run multiple dcache instances in parallel
- Provide easy way for 'Get in touch'

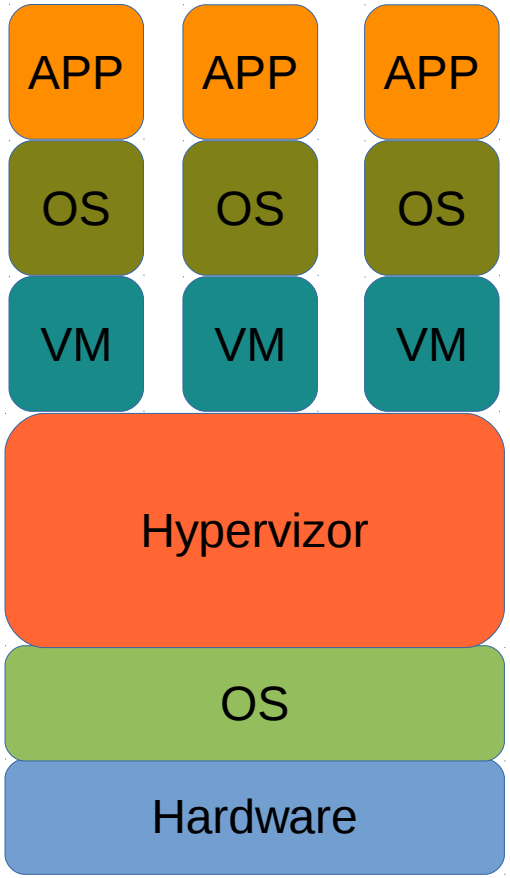
Open questions

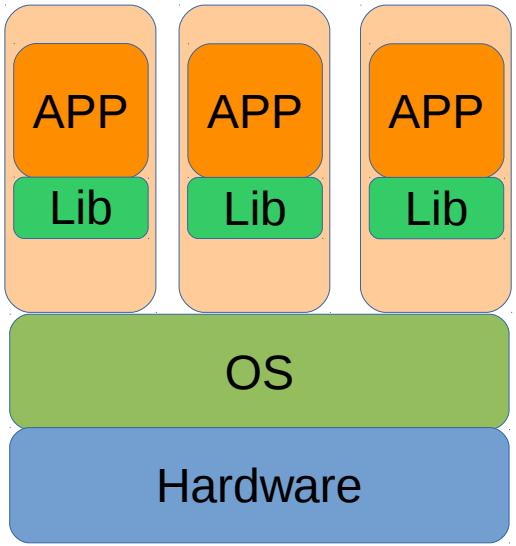
- "Pets vs Cattle"
- Are containers the best solution?

  Given a hammer, everything looks like a thumb!
- Makes the system more complicated:
  - Requires more knowledge,
  - Error prone,
  - Harder to diagnose.

Backup slides

Containers vs. VM





Operating-system-level virtualization

aims to have little to no overhead, because programs in virtual partitions use the operating system's normal system call interface and do not need to be subjected to emulation.

Containers

- Old idea
  - chroot, 1982
  - FreeBDS jails, 2000
  - Solaris Zones, 2005
- New trends
  - PaaS wave
  - Easy to deploy
  - Easy to share
  - Use as a black-box

- A lightweight user tool to automate container management and deployment.
- Uses kernel provided cgroups and namespaces to isolate and limit resources.
- Automatically adopts iptables according network configuration.
- Creates read-only container images with read-write overlay filesystem on top, when running.
- With DockerHub provides a repository to store and share containers.
- Requires linux kernel 3.10.x (CentOS/RHEL/SL 7)

Dockerfile

- The make file for docker image.
- Describes how to build the image.
- Describes how to start the image.
- Defines which network ports must be exposed.
- Each step is saved as intermediate image for incremental builds.

Dockerfile, example

```
# Based on CentOS 7
FROM centos:7
MAINTAINER dCache "https://www.dcache.org"

# install required packages
RUN yum -y install java-1.8.0-openjdk-headless
RUN yum install -y https://www.dcache.org/downloads/dcache-2.14.13-1.noarch.rpm

# add external files into container at the build time
COPY dcache.conf /etc/dcache/dcache.conf
COPY run.sh /etc/dcache/run.sh

# the data log files must survive container restarts
VOLUME /var/log/dcache

# expose TCP ports for network services
EXPOSE 22125 2049

# execute this when container starts
ENTRYPOINT ["/etc/dcache/run.sh"]
```

docker, command

- One stop shop.
- Build and manipulate images.
- Manages container life cycle: start, stop, ...
- Fetches and updates images in the repository.

docker, example

```
$ docker build -t local/dcache-upstream .
Step 1 : FROM centos:7
....
Step 10 : ENTRYPOINT /etc/dcache/run.sh
....
Successfully built dd2648bc7471
$  docker images
REPOSITORY                  TAG       ......      VIRTUAL SIZE
local/dcache-upstream       latest    ......        615.9 MB
docker.io/centos            7         ......        196.6 MB
$
```

Docker, volumes

- Persistent files/directories stored on host filesystem.
- Can be shared between containers.
- A specific file/directory can be injected into container.

docker run, almost real example

```
$ docker run -dt \
        -v /tmp/log:/var/log/dcache \
        -p 22125:22125  \
        local/dcache-upstream \
       dcap
```

Docker, network

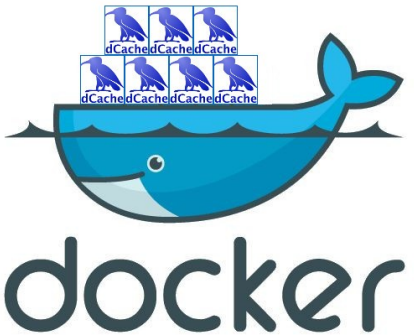
- Three default types
  - none – no external connectivity
  - host – expose host network to container
  - bridge – NAT like network, default
- Mapped Container Mode
  - share network stack between containers

Containerize dCache

```
chimera.db.host=chimera-db-host
chimera.db.dialect=PgSQL95

[dCacheDomain]
[dCacheDomain/poolmanager]
[dCacheDomain/pnfsmanager]
[dCacheDomain/httpd]
[dCacheDomain/nfs]
nfs.version=4.1

[${host.name}]
dcache.broker.host=head

[${host.name}/pool]
pool.plugins.meta=org.dcache.pool.repository.meta.db.BerkeleyDBMetaDataRepository
pool.name=pool-${host.name}
pool.path=//var/lib/dcache/pool
pool.mover.nfs.port.min=32049
pool.mover.nfs.port.max=32049
```

Containerize dCache

```
$ docker run ...  dcache-2.15 poolA

$ docker run ...  dcache-2.14 poolB

$ docker ps

CONTAINER ID        IMAGE                    ...

a1e456849852        local/dcache-2.15  ...
af96afd07103        local/dcache-2.14  ...

$
```



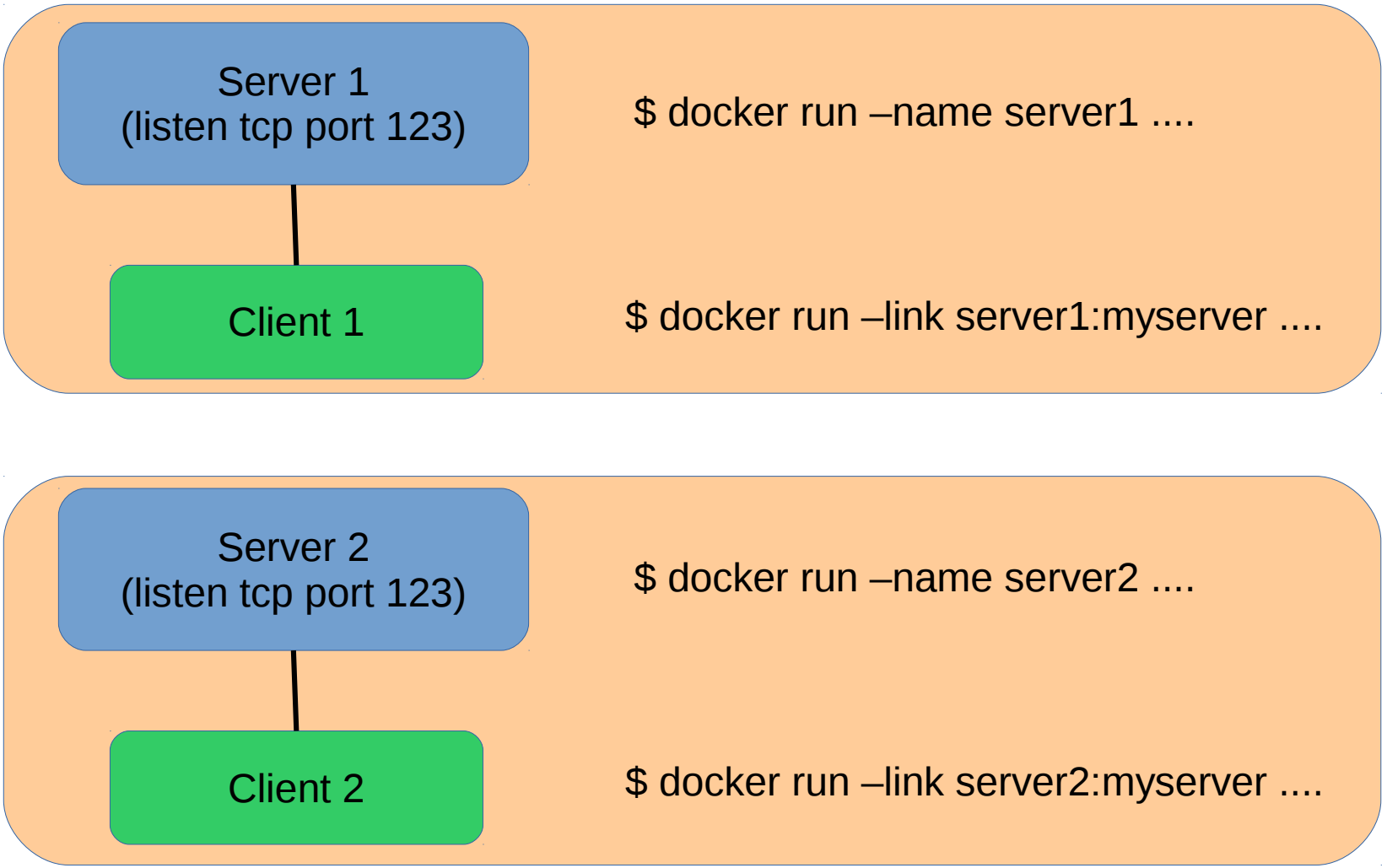
Containerize dCache (full command line)

```
$ docker run -dt --net=host \
  -v /tmp/pools:/dcache \
  -v /tmp/log:/var/log/dcache \
  -v `pwd`/docker-
layout.conf:/etc/dcache/layouts/docker-
layout.conf  \
  local/dcache-2.15 poolA
```

Linked instances (Testing scenario)

- Running multiple versions servers in parallel
- Running multiple clients in parallel
- Each server exposed to it's client only
- Each client sees it server only

Linked instances (Testing scenario)



Under the hood

```
# cat /etc/hosts
172.17.0.9 3469cf96d4aa
127.0.0.1  localhost
::1 localhost ip6-localhost ip6-loopback
fe00::0  ip6-localnet
ff00::0  ip6-mcastprefix
ff02::1  ip6-allnodes
ff02::2  ip6-allrouters
172.17.0.6 myserver d6532c8278a1 server1
```

Under the hood

```
# ping myserver -c 3
PING myserver (172.17.0.6): 56 data bytes
64 bytes from 172.17.0.6: icmp_seq=0 ttl=64 time=0.123 ms
64 bytes from 172.17.0.6: icmp_seq=1 ttl=64 time=0.059 ms
64 bytes from 172.17.0.6: icmp_seq=2 ttl=64 time=0.059 ms
--- myserver ping statistics ---
3 packets transmitted, 3 packets received, 0% packet loss
round-trip min/avg/max/stddev = 0.059/0.080/0.123/0.030 ms
#
```

Summary

- Containers provide light weight environment to run applications in production.
- Docker is a nice tool to create, run and share containers.
- Containers can cover many production use cases as well as test deployments
- REMEMBER: If you have a new hammer, every thing around looks like a big thumb!