Containers in Linux on z Systems: Docker

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Agenda

Containers and Docker

Containers and Virtualization

Docker on z

Containers and Docker

What are Containers?

- Virtual environment within Linux OS instance
  - So applications share OS kernel
  - Only application is started, not entire Linux environment
- Efficiency: no virtualization overhead
  - No full system or para-virtualization, but only isolation in the kernel
- Own file system tree via chroot environment
- Container separation of OS objects via „name spaces“
  - Process IDs, network devices, mount points, users, and more

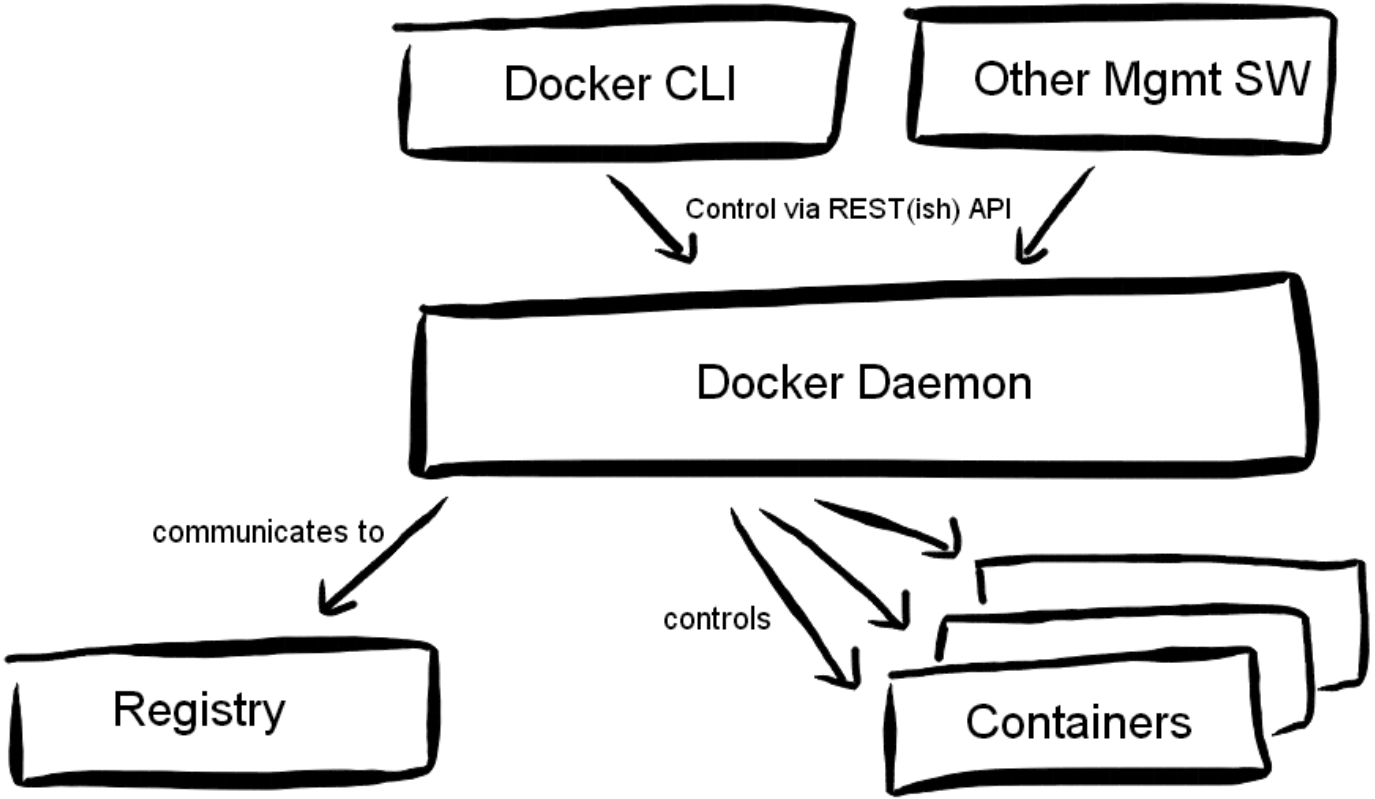
Typical Container Attributes

- Self contained sets of files – escape dependency hell, reduce test matrix
- Serve a single task
- Can build on top of each other
  - efficiency: only differences are stored
- Can be deployed simple and quickly
- Can easily be customized, re-packaged and versioned
- Can use synergies in the kernel, if images eventually base on the same libraries (same file in underlying images)
  - without having to use KSM (Kernel Samepage Merging)

Docker

- One implementation of a container solution
- Powerful tool to build, modify, deploy, run, manage containers
  - Extreme focus on efficiency, fast response times
  - Stores incremental differences and caching whenever possible
- Registries serve as central places for images
  - Efficient distribution, versioning
- Terminology
  - image: a self contained set of files, base for a container
  - container: runnable instance, based on an image
- Maintained by Docker, Inc.

Docker Structure



Dockerfile Example

- Use Dockerfiles for controlled builds of images:

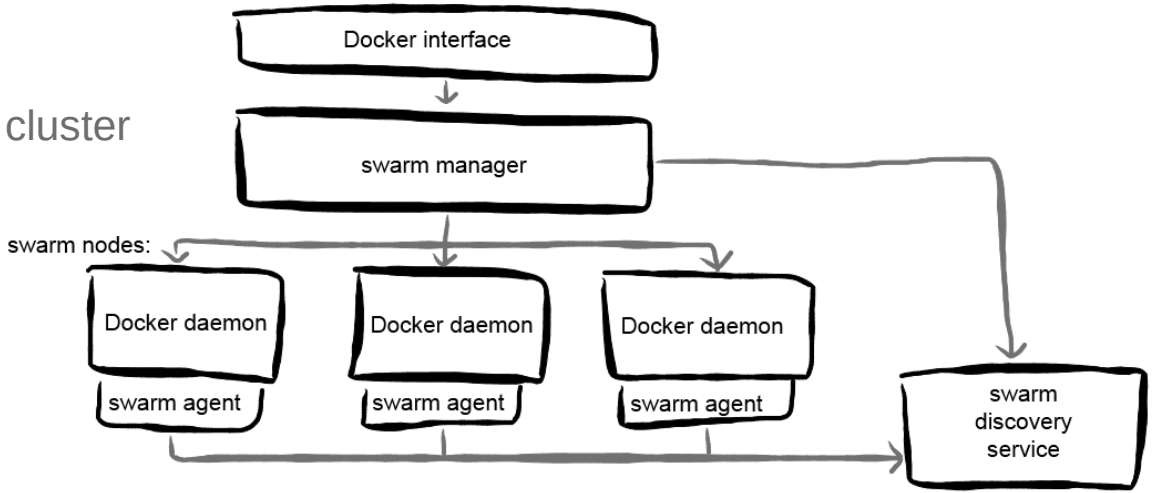
```
# use this base image. Downloaded if not present.
FROM rhel71

MAINTAINER Whatever my name is <some@address.com>

# run commands:
RUN yum install -y httpd

# copy files into the image
ADD index.html /var/www/html/

# publish a port of the container
EXPOSE 80

# how the container is started
ENTRYPOINT ["/usr/sbin/apachectl","-DFOREGROUND"]
```

Docker Ecosystem (1)

- Docker Hub
  - Docker’s public registry with 100,000+ public images
  - Private areas available
  - Contains ~100 official images of companies (Ubuntu, MongoDB, …)
  - Automated builds possible
- Private registries possible
- Docker Trusted Registry as on-premise, private registry offering by Docker

Docker Ecosystem (2)

- Additional Docker projects (some still in beta), e.g.
  - registry: central image repository with versioning
  - machine: make a virtual server a Docker host
  - compose: create multi-container applications, manage and scale them
  - swarm:
    place containers in a Docker cluster



Docker Ecosystem (3)

- Monitoring
  - cAdvisor
  - Datadog
- (Docker) Container Orchestrating and Clustering solutions
  - Kubernetes: cluster manager by Google
    - Grouping/placement, scheduling, state management
    - Builds on etcd (key value store for state and cluster coordination)
  - Apache Mesos: cluster manager
    - Builds on top of Linux nodes
    - Cluster resource and service management, resource isolation

Docker Ecosystem (4)

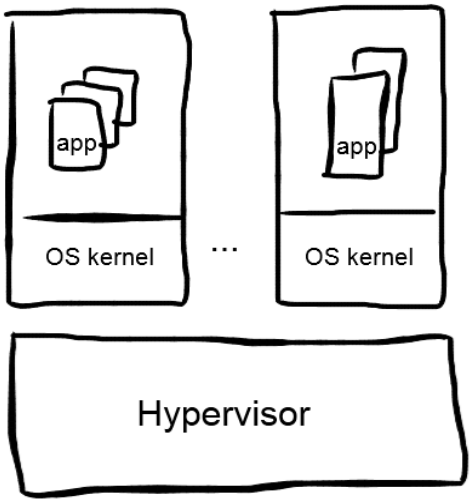
- OpenStack (components currently out of tree)
  - Management integration and standardization (keystone etc.)
    - But giving up on Docker CLI flexibility
  - Nova: Docker virt driver
    - Runs Docker images on hosts, images stored in glance
  - Heat: Docker plugin
    - Use Docker containers in Heat templates
  - Magnum project: control orchestration via Docker and Kubernetes
    - Goal to fully leverage Docker efficiency
    - Multi-tenancy for Docker and Kubernetes

Open Container Project

- Docker is de-facto container format standard
  - CoreOS launched competitive and open approach (rocket container runtime, appc container format)
- Open Container Project to define industry standard container format and runtime
  - Housed under the Linux Foundation, sponsored by many IT companies
    - Including CoreOS, Docker, Google, IBM, the Linux Foundation, Mesosphere, Microsoft, Red Hat, SUSE, VMWare, and many more
- Docker donated their container format and runtime („runc“)
- OCP standards principles:
  - Not bound to specific higher level stack (e.g. orchestration)
  - Not bound to particular client, vendor, or project
  - Portable across OS, hardware, CPU architectures, public clouds

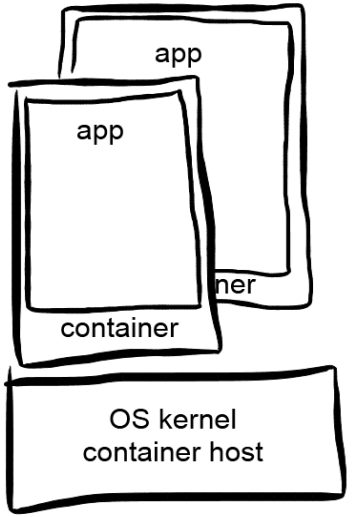
Containers and Virtualization

Virtualization vs. Containers



Infrastructure oriented:

- coming from servers, now virtualized
- virtual server resource management
- several applications per server
- isolation
- persistence

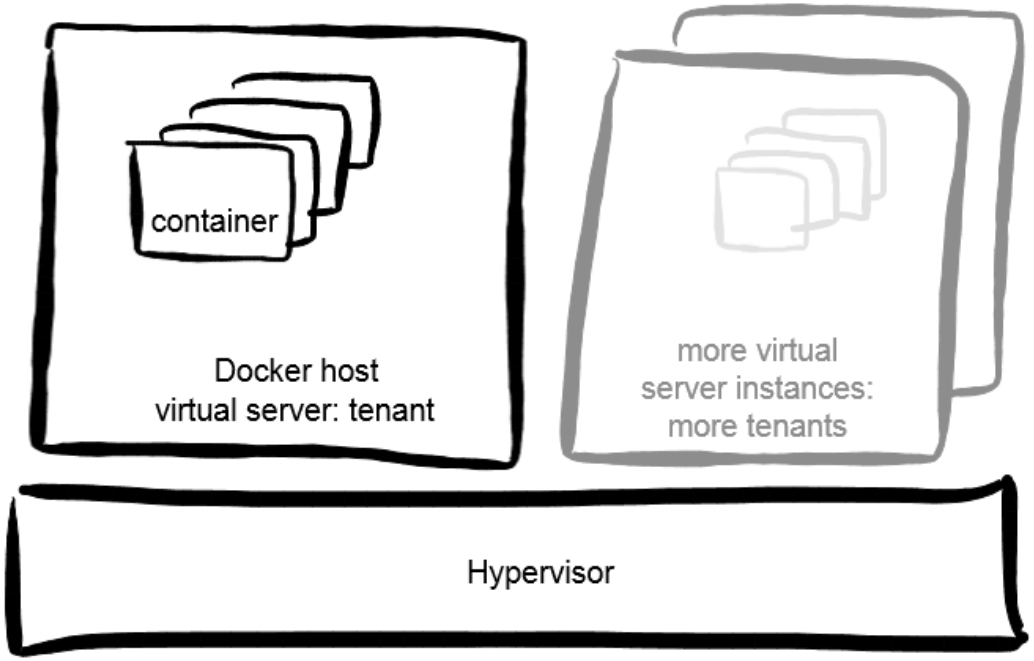


Service oriented:

- application-centric
- application management
- solution decomposed
- DevOps
- dynamic

Virtualization and Containers

- Virtual machine separation between tenants
  - Virtualization management for infrastructure
  - Isolation
- Many containers within tenants
  - Container efficiency
  - Docker management and ecosystem



Docker on z

Docker – Linux on z Systems

- Docker is written in Go
  - started with Google‘s golang on x86
  - gcc 5 comes with Go support for s390
  - gcc 5.2 used for Docker builds
  - Docker recently accepted patches for full gcc support
- Tech preview binaries available via UNICAMP
  - Anchor page http://www.ibm.com/developerworks/linux/linux390/docker.html
- Talk to your distribution partner representative for details re. z Systems distributions ;-)

Docker And Cross-Platform Portability (1)

- Docker user experience (CLI, REST API) is identical across platforms
- Containers in binary form are not portable
- Microservice architectures often have clean structure and simple individual components
- Containers are often created through Dockerfiles (build descriptions) containing:
  - Specification of base image
    - If same distribution is available on s390, usually simple
    - Currently, closest thing to Ubuntu on x86 is Debian on z
    - If base image is not available, need some workarounds to get there (e.g. „golang“)
  - Additional steps to modify image. Very often platform independent:
    - Add packages (need adaptions when using different base distro)
    - Download files
    - Perform build

Docker And Cross-Platform Portability (2)

- Usual porting considerations (not Docker-specific)
  - Source code available?
  - Most code runs on s390 already, or consists of plain C, Java, python, ruby, Go, ...
  - Platform specific behavior (e.g. application checks for CPU frequency)
  - Non-portable code (endianness, assembler)
- „Upstream work“ alleviates the pain for future updates

Docker on z: Getting Started

- Base images
  - Create based on your host distro (e.g. with a script from blog below)
  - Use a public z Systems image from Docker hub (no warranty for content!): https://registry.hub.docker.com/search?q=s390x
- A lot of Open Source applications being made available, linked from
  - https://www.ibm.com/developerworks/community/groups/community/lozopensource/
  - https://github.com/linux-on-ibm-z/ (e.g. for cAdvisor)
- Tutorial with z in mind at http://containerz.blogspot.com/
  - first steps and ecosystem

THANK YOU