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

Docker CLI

Other Mgmt SW

Control via REST(ish) API

Docker Daemon

Communicates to

Registry

Controls

Containers
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

- 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](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/lozopensourc](https://www.ibm.com/developerworks/community/groups/community/lozopensourc)
  - [https://github.com/linux-on-ibm-z](https://github.com/linux-on-ibm-z) (e.g. for cAdvisor)

- Tutorial with z in mind at [http://containerz.blogspot.com/](http://containerz.blogspot.com/)
  - first steps and ecosystem
THANK YOU