"[illegible]menu, "?" for other shortcuts

redhat.

DOCKER PATTERNS

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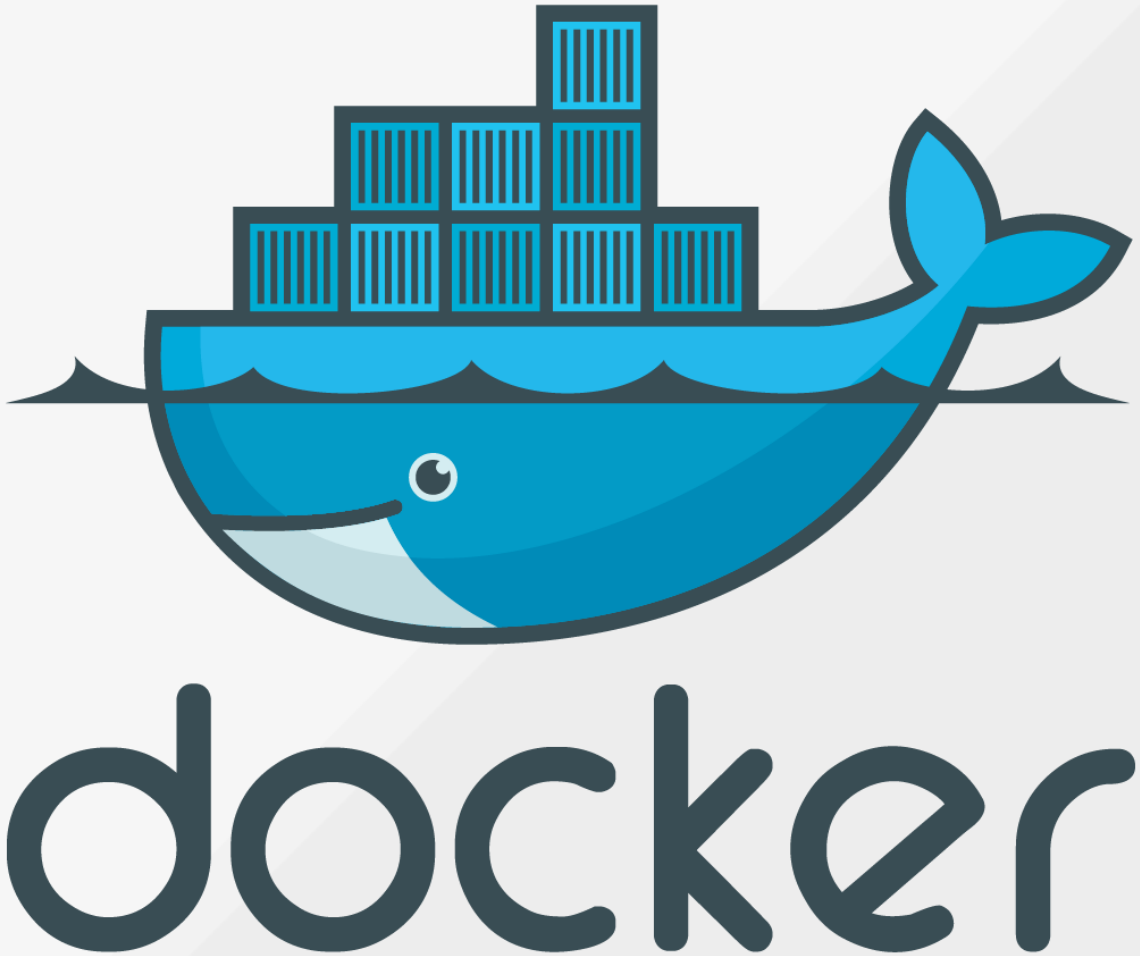
AGENDA

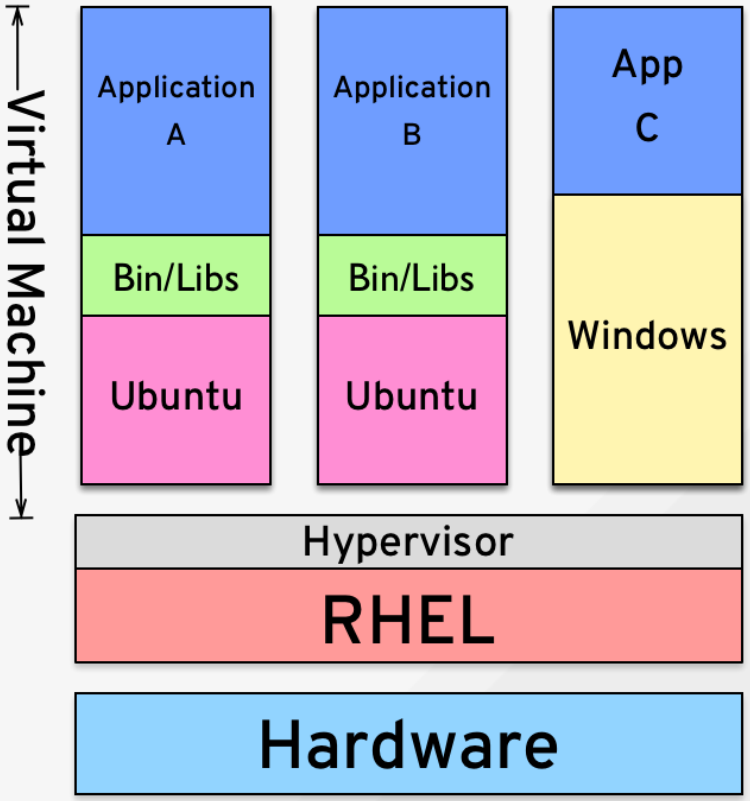
- Intro: Docker & Patterns
- Configuration
- Service Discovery
- Image Builder

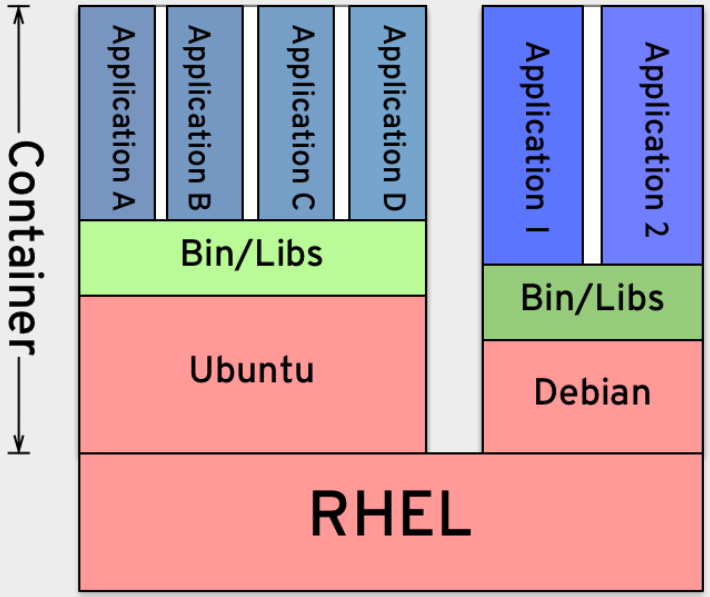

docker

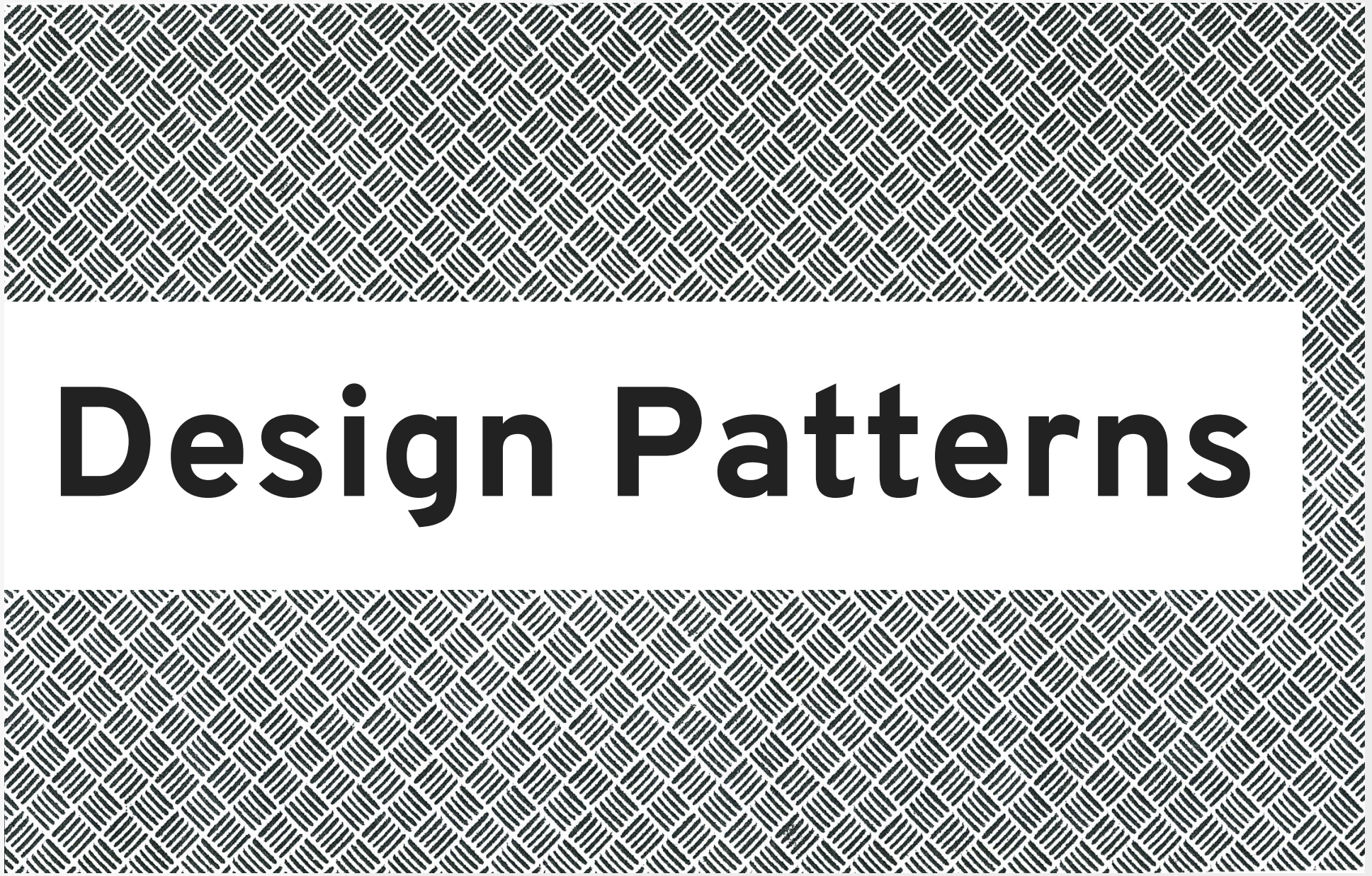
VM VS. CONTAINER

Containers are **isolated**, but share the kernel and (some) files

➜ **lighter** and **faster**







DESIGN PATTERN

A **Design Pattern** describes a **repeatable solution** for a software engineering **problem**.

A Pattern Language

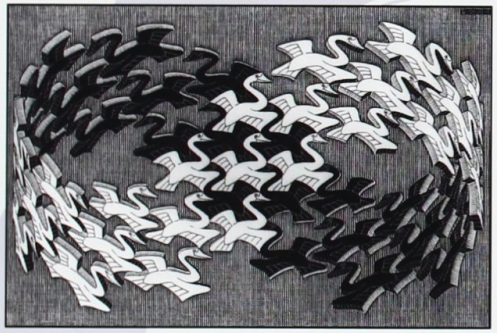
Towns · Buildings · Construction

Christopher Alexander
Sara Ishikawa · Murray Silverstein
WITH
Max Jacobson · Ingrid Fiksdahl-King
Shlomo Angel

Design Patterns

Elements of Reusable Object-Oriented Software

Erich Gamma
Richard Helm
Ralph Johnson
John Vlissides



Foreword by Grady Booch

ADDISON-WESLEY PROFESSIONAL COMPUTING SERIES

STRUCTURE

- Problem
- Patterns:
  - Name
  - Solution
  - Pro & Contra

http://www.martinfowler.com/articles/writingPatterns.html

CONFIGURATION

How to configure containerized applications for different environments ?

- **Env-Var Configuration**
- **Configuration Container**
- **Configuration Service**

ENV-VAR CONFIGURATION

- Standard configuration method for Docker container
- Specified during **build** or **run** time
- Universal

BUILD

```
FROM jboss/base-jdk:8

ENV DB_HOST "dev-database.dev.intranet"
ENV DB_USER "db-develop"
ENV DB_PASSWORD "s3cr3t"
....
```

RUN

```
docker run \
  -e DB_HOST "prod-db.mycompany.com" \
  -e DB_USER "dbuser"
  -e DB_PASSWORD "3QkgbLXWPZ2sJcQ"
  ....
  mycompany/cool-app
```

KUBERNETES

```
---
apiVersion: v1
kind: ReplicationController
spec:
  replicas: 1
  template:
    spec:
      containers:
        - env:
            - name: GALERA_CLUSTER
              value: "true"
            - name: WSREP_CLUSTER_ADDRESS
              value: "gcomm:"
            - name: WSREP_SST_USER
              value: "sst"
            - name: WSREP_SST_PASSWORD
              value: "sst"
            - name: MYSQL_USER
              value: "mysql"
            - name: MYSQL_PASSWORD
              value: "mysql"
```

DOCKER COMPOSE

```
---
version: '2'
services:
  web:
    depends_on:
      - db
    environment:
      DB_USER: "dbuser"
      DB_PASS:
  db:
    image: "orchardup/mysql"
    environment:
      MYSQL_DATABASE: "wordpress"
```

EVALUATION

- `System.getenv()`
- Environment "profiles"
  - Predefined profiles
  - EnvVar selects profile

```
spring:
    profiles: dev
server:
    port: 9001
---
spring:
    profiles: prod
server:
    port: 8080
```

```
docker run \
  -e SPRING_PROFILES_ACTIVE=dev \
  my-springboot-app
```

PRO

- Simple and Easy
- Explicit
- Widely supported

CONTRA

- Static
- Hard to maintain for complex configuration

CONFIGURATION CONTAINER

- Configuration in extra Docker container
- Volume linked during **runtime**
- Example of a **Sidecar Container**

PRO

- Flexible
- Explicit

CONTRA

- Static
- Maintenance overhead
- Custom file layout

CONFIGURATION SERVICE

- Active Configuration lookup
- "Configuration-as-a-Service"
- Tools:
  - Apache ZooKeeper
  - Consul
  - etcd
  - Redis

PRO

- Flexible
- Dynamic

CONTRA

- External Service (Latency)
- Maintenance overhead
- Weakens Immutability

SERVICE DISCOVERY

How can an application discover its runtime dependencies ?

- **Env-Var Injection**
- **Service Lookup**
- **Dynamic DNS**

ENV-VAR INJECTION

- Injection of services as **Environment Variables**
- Must be set during container start
- Examples:
  - Docker links / Docker network
  - Kubernetes
  - Custom (e.g. `envconsul` + `gliderlabs/registrator`)

KUBERNETES

- For each active **Service** sets:
  - *svcname*_`SERVICE_HOST`
  - *svcname*_`SERVICE_PORT`
- Also Docker-style link variables link
- Only when **Pod** starts

FABRIC8 CDI

```
@Factory
@ServiceName
public DataSource create(@ServiceName
                         @Protocol("jdbc:mysql")
                         @Path("db")
                         String url) {
    MysqlDataSource mysqlDS = new MysqlDataSource();
    mysqlDS.setUrl(url);
    mysqlDS.setUser(System.getProperty(USERNAME, "root"));
    mysqlDS.setPassword(System.getProperty(PASSWORD, "pass"));
    return mysqlDS;
}
```

```
@ServiceName("dev-mysql")
DataSource mySqlD;
```

PRO

- Simple
- No lookup required

CONTRA

- Only services during startup available
- Supporting platform required (Kubernetes)

SERVICE REST LOOKUP

- Key-Value Stores
- REST API for Registration & Query
- `gliderlabs/registrator`
  - Automatic registration of Docker containers
  - Backends for Consul, etcd, SkyDNS

PRO

- Explicit
- Dynamic

CONTRA

- Support from platform required
- Vendor lock-in

DYNAMIC DNS

- Standard Protocol for Service Lookup (`SRV` records)
- Tools for DNS service registry:
  - Consul
  - SkyDNS
- DNS Lookup for Java Clients: JNDI or custom

JNDI DNS

```
Hashtable env = new Hashtable();
env.put("java.naming.factory.initial",
        "com.sun.jndi.dns.DnsContextFactory");
env.put("java.naming.provider.url", "dns:");

DirContext ctx = new InitialDirContext(this.env);
Attributes attrs =
  ctx.getAttributes("redis.myproject.svc.cluster.local",
                    new String[] { "SRV" });
NamingEnumeration e = attrs.getAll();

while (e.hasMore()) {
  Attribute attr = (Attribute) e.next();
  System.out.println(attr.get());
}
e.close();
```

```
10 33 6379 _redis._tcp.redis.myproject.svc.cluster.local.
```

SPOTIFY/DNS-JAVA

```
import com.spotify.dns.*;

DnsSrvResolver resolver =
    DnsSrvResolvers.newBuilder()
                   .cachingLookups(true)
                   .retainingDataOnFailures(true)
                   .dnsLookupTimeoutMillis(1000)
                   .build();

List<LookupResult> nodes =
    resolver.resolve(
        "redis.myproject.svc.cluster.local");

for (LookupResult node : nodes) {
    System.out.println(
        node.host() + ":" + node.port());
}
```

PRO

- Dynamic
- Standard
- Good infrastructure support

CONTRA

- Deep interaction with OS
- Rusty

IMAGE BUILDING

How to build Docker images ?

- **Dockerfile Template**
- **Image Factory**
- **Self-contained**
- **Artifact Container**
- **Build Integration**

CLASSIC STYLE

- docker commit

```
docker commit 3e3d3cf39 redis-server:1.0
```

- docker build

```
FROM ubuntu:14.04
RUN apt-get update && \
    apt-get install -y redis-server
EXPOSE 6379
ENTRYPOINT ["/usr/bin/redis-server"]
```

DOCKERFILE TEMPLATE

- Dockerfile generation from templates
- Build with `docker build`
- Simple built-in support (`ARG`)
- Engines:

  fish-pepper, dogen, crane, App::Dockerfile::Template ...

DOCKERFILE ARGS

- Dockerfile variables
- Since Docker 1.9
- Can not be used in `FROM`
- Filled in during runtime

```
FROM busybox
ARG uid
USER ${uid:-jboss}
# ...
```

```
docker run --build-arg uid=daemon ....
```

PRO

- Simple
- Uses Docker builtin mechanism
- Good for many similar builds

CONTRA

- Restricted to Dockerfiles
- Standard solution very limited

IMAGE FACTORY

- Creating images without Dockerfiles
- Flow:
  - Start container from a **base image**
  - **Provision** stuff to the container
  - **Commit** container as image
- Provisioning must be **reproducible** and **automated**

ANSIBLE

```
- name: initialize provisioning
  hosts: docker
  - name: start up target container
    docker:
      image: java:8.0
      name: fis-karaf
      # ....
      command: sleep infinity
      state: started
  # dynamically update inventory
  - name: register new container hostname
    add_host: name=lab
- name: provision container
  connection: docker
  hosts: lab
  tasks:
      # ...
- name: finalize build
  hosts: docker
  tasks:
    - name: stop container
      docker:
        name: fis-karaf
        state: stopped
```

PRO

- Composition
- Parametrisation
- Less image layers

CONTRA

- Extra Tooling
- No builds by Docker Hub

SELF CONTAINED

- JEE Server and Application in **one** Image
- Server base image

```
FROM fabric8/tomcat-8.0
COPY chat-app.war /opt/tomcat/webapps/chat-app.war
```

PRO

- Single deployment unit

CONTRA

- Coupled lifecycle

ARTIFACT CONTAINER

- Container holding the application artifact
- Linked to a JEE container
- JEE Server deploys artifact during startup

PRO

- Independent lifecycles
- Separate responsibilities

CONTRA

- Two images to manage

BUILD INTEGRATION

- Create Docker images from within a build
- Plugins for Maven & Gradle
- Maven:
  - https://github.com/fabric8io/shootout-docker-maven

ASSEMBLY

```
<assembly>
  <dependencySets>
    <dependencySet>
      <includes>
        <include>org.jolokia:jolokia-war</include>
      </includes>
      <outputDirectory>.</outputDirectory>
      <outputFileNameMapping>
          jolokia.war
      </outputFileNameMapping>
    </dependencySet>
  </dependencySets>
</assembly>
```

CONFIGURATION

```
<image>
  <name>jolokia/jolokia-itest</name>
  <build>
    <from>consol/tomcat-7.0</from>
    <assemblyDescriptor>
      assembly.xml
    </assemblyDescriptor>
  </build>
  <run>
    <ports>
      <port>jolokia.port:8080</port>
    </ports>
  </run>
</image>
```

PRO

- Self contained builds
- No external requirements
- Reuse of existing build configuration

CONTRA

- Own configuration syntax
- More than one way

WORMHOLE

How can a container access its managing Docker daemon ?

```
docker run \
  -v /var/run/docker.sock:/var/run/docker.sock  \
  ...
```

- Alternative: "Docker-in-Docker"

https://ro14nd.de/Docker-Wormhole-Pattern

WRAP UP

- Patterns can help in solving recurring Docker challenges.
- Multiple patterns exists for **Configuration**, **Service Discovery** and **Image building** which are complementary.

redhat.

QUESTIONS ?

Blog https://ro14nd.de

Slides `firefox $(curl -sL http://bit.ly/docker-patterns | sh)`