QAWARE SOFTWARE ENGINEERING

# Docker
# Patterns & Anti-Patterns

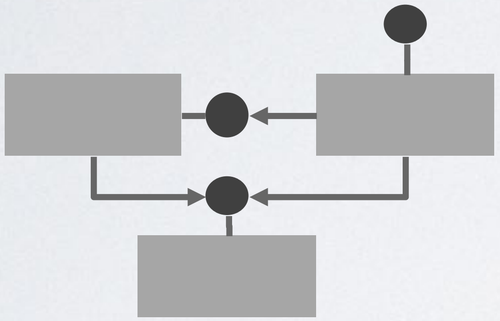
# OPS COMPONENT


## DESIGN

## BUILD

## RUN

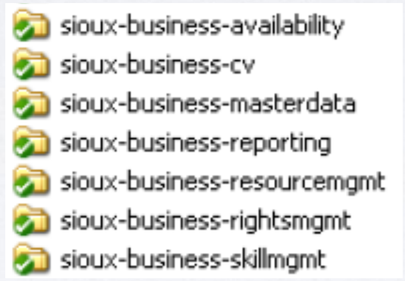
Design Components



- Complexity unit
- Data integrity unit
- Cohesive feature unit
- Decoupled unit

+

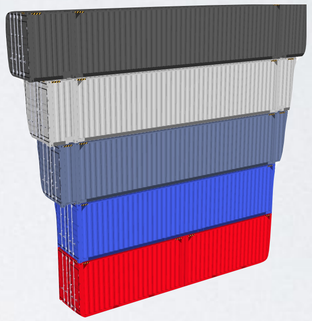
Dev Components



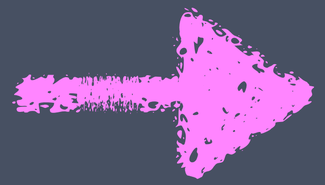

- Planning unit
- Team assignment unit
- Development unit
- Integration unit

+

Ops Components



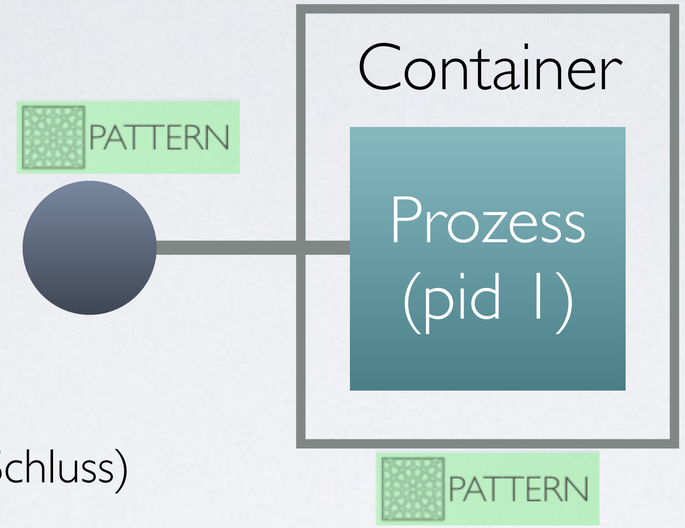
- Release unit
- Deployment unit
- Runtime unit
- Scaling unit




- **Container** = Verpackung für Ops Components
- **Standard-Schnittstellen** für Standard-Betriebsprozeduren
- **Einfach zu transportierende, schnell zu startende und mit wenig Overhead ausführbare** Software-Einheiten

# Container Interface

- EXPOSE von allen
  von außen zugänglichen Ports
  `EXPOSE 80 443`
- Alle Umgebungsvariablen,
  die von außen gesetzt werden können
  per ENV definieren und möglichst mit
  sinnvollem Default-Wert besetzen
  `ENV NGINX_VERSION 1.9.9`
- Dockerfile als Interface Definition
  - Kommentare und `LABEL` [5]
  - `ENV`, `EXPOSE` und `VOLUME`
    (möglichst im Block und ganz am Schluss)
- ENTRYPOINT für Prozessstart und
  CMD für Default-Argumente
  `ENTRYPOINT ["/entrypoint.sh"]`
  `CMD ["--db", "localhost","--user", “root”]`
- Standard-Entrypoints
  (z.B. `docker run my-container /usr/bin/test`)
  - `run`: Container produktiv laufen lassen (default)
  - `run-dev`: im Dev-Modus laufen mit z.B. Verbose Log
  - `test`: Testfälle im Container durchlaufen lassen
  - `HEALTHCHECK`: einen Healthcheck durchführen
  - `debug`: eine passende interaktive Shell öffnen
  - `help`: einen Hilfe zur Verwendung anzeigen




# Well-behaved Process

- reagiert auf SIGTERM [1] oder
  definiert ein `STOPSIGNAL` [2] für einen
  würdevollen Abgang
- gibt sinnvolle Exit Codes zurück [3]:
  0 = OK, 1 = allgemeiner Fehler, …
- schreibt Log-Ausgaben auf
  STDOUT/STDERR [4], damit sie per
  Docker Log Driver verschifft werden
  können
- Vordergrund-Prozess, kein
  Daemon- oder Hintergrund-Prozess
  `CMD ["nginx", "-g", "daemon off;"]`


[1] https://medium.com/@gchudnov/trapping-signals-in-docker-containers-7a57fdda7d86
[2] https://docs.docker.com/engine/reference/builder/#stopsignal
[3] http://tldp.org/LDP/abs/html/exitcodes.html
[4] https://success.docker.com/article/Docker_Reference_Architecture-_Docker_Logging_Design_and_Best_Practices
[5] http://label-schema.org/rc1
[6] https://alexei-led.github.io/post/docker_testing

# BEISPIEL: LABELS

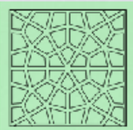
| | | |
|---|---|---|
| `docker.cmd` | `org.label-schema.docker.cmd= "docker run -d -p 5000:5000 -v config.json:/etc/config.json myapp"` | How to run a cont… the image under th… runtime. |
| `docker.cmd.devel` | `org.label-schema.docker.cmd.devel = "docker run -d -p 5050:5050 -e ENV=DEV myapp"` | How to run the co… development mod… Docker runtime e.g… tooling or more ve… |
| `docker.cmd.test` | `org.label-schema.docker.cmd.test = "docker run myapp runtests"` | How to run the bu… suite for the image… Docker runtime. M… tests then exit, retu… on stdout and exit… zero exit code on f… |
| `docker.cmd.debug` | `org.label-schema.docker.debug = "docker exec -it $CONTAINER /bin/redis-cli"` | How to get an app… interactive shell fo… the container unde… |
| `docker.cmd.help` | `org.label-schema.docker.cmd.help = "docker exec -it $CONTAINER /bin/app --help"` | How to output help… image under the d… The container MUS… information to stdo… exit. |

| | | |
|---|---|---|
| Tags | latest 0.9.1 | |
| Created | January 18, 2017 at 10:49 AM | |
| ID | 63271c99d6fb | |
| Maintainer | Ross Fairbanks "ross@[hidden]" | |
| Download Size | 23.4 MB | |
| Git Commit | 45b22cb | |
| License | Apache-2.0 | |
| Labels | com.microscaling.docker.dockerfile | /Dockerfile |
| | com.microscaling.license | Apache-2.0 |
| | org.label-schema.build-date | 2017-01-18T09:49:02Z |
| | org.label-schema.description | Our Microscaling Engine provides automation, resilience and efficiency for microservice architectures. Experiment with microscaling at app.microscaling.com. |
| | org.label-schema.name | Microscaling Engine |
| | org.label-schema.schema-version | 1.0 |
| | org.label-schema.url | https://microscaling.com |
| | org.label-schema.vcs-ref | 45b22cb |
| | org.label-schema.vcs-url | https://github.com/microscaling/microscaling.git |
| | org.label-schema.vendor | Microscaling Systems |
| | org.label-schema.version | 0.9.1 |

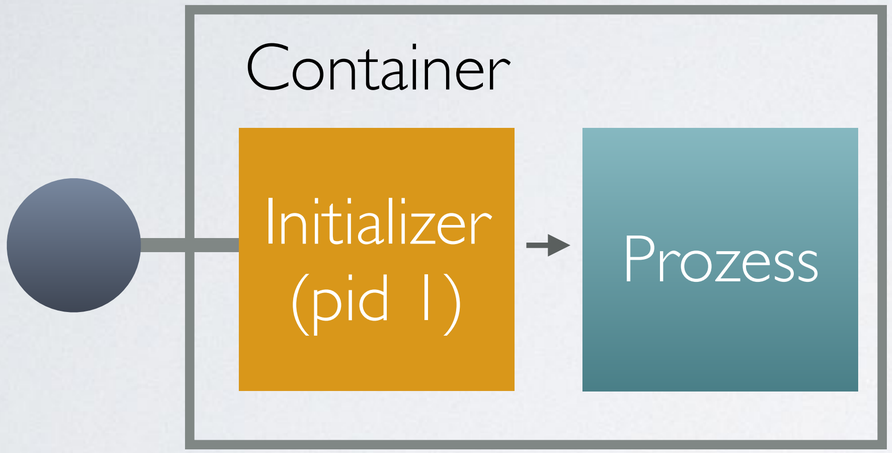
https://github.com/opencontainers/image-spec/blob/master/annotations.md
http://label-schema.org

https://microbadger.com/images/microscaling/microscaling

# CONTAINER INITIALIZER



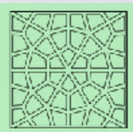
PATTERN

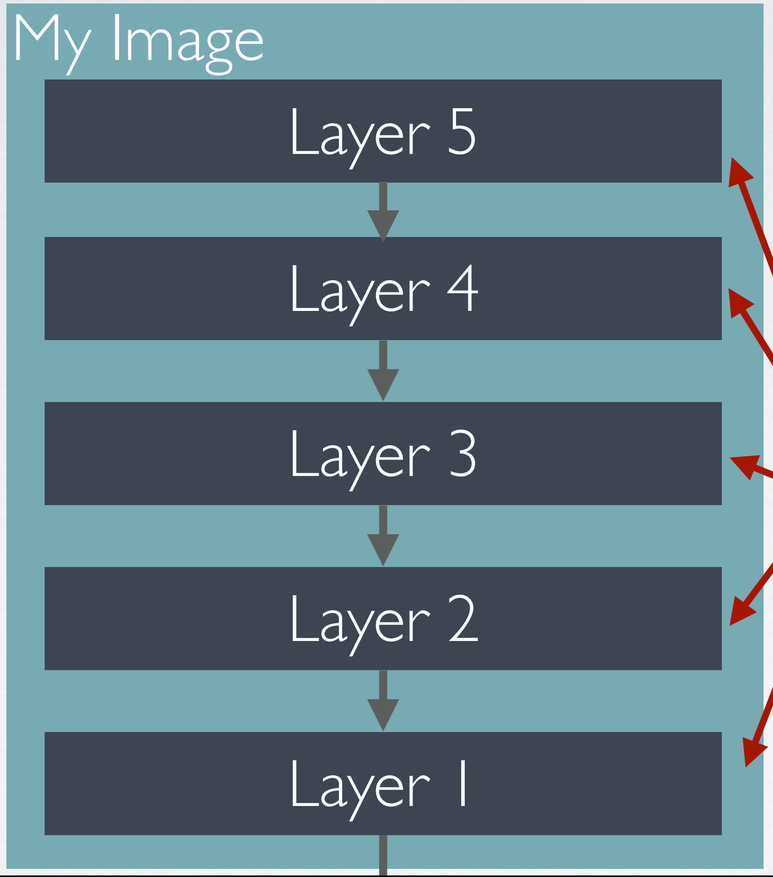



| | Prozess-management (Exit, SIG, Zombies) | Log-Umleitung (syslog, files) | Config-Dateien schreiben | Cron | Warten auf TCP/HTTP Endpunkt |
|---|---|---|---|---|---|
| Chaperone (veraltet) | x | x | x | x | |
| Dockerize | | x | x | | x |
| Tini (in Docker > 1.13 enthalten) | x | | | | |
| dumb-init | x | | | | |
| pid1 | x | | | | |
| TrivialRC | x | | | | |
| phusion baseimage | x | x | | x | |

… oder eigenes Shell-Skript oder Go-Programm (aber Achtung: Prozess stets mit `exec` starten!)

# IMAGE LAYER ARCHITECTURE



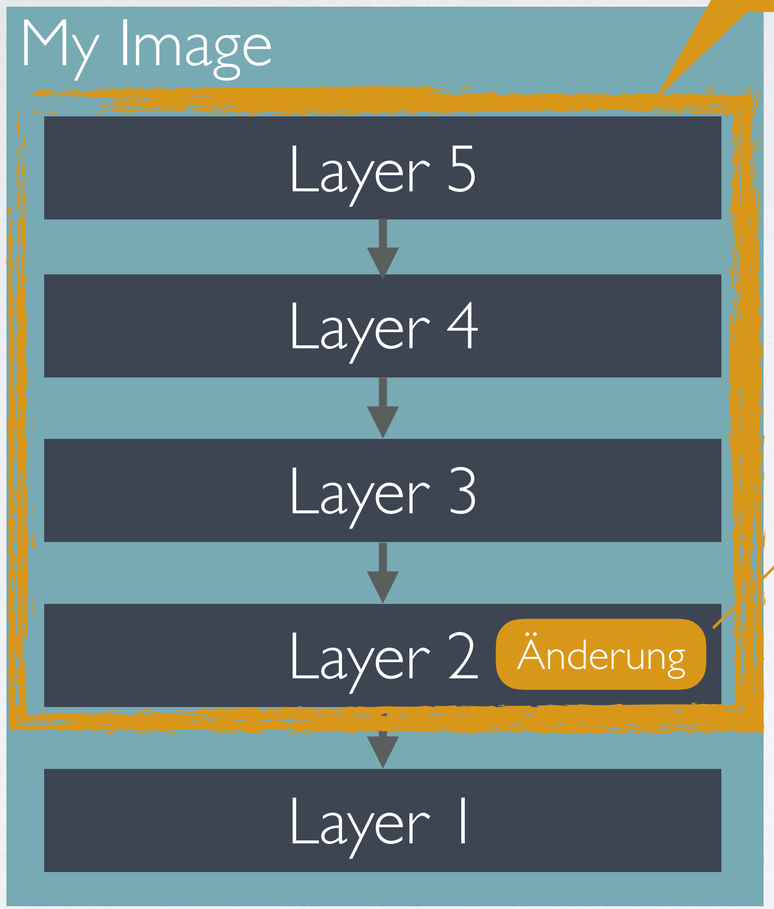

Niemals `latest` Tag nutzen!


```
FROM debian:jessie

ENV NGINX_VERSION 1.12.2-1~jessie

RUN apt-get update && \
    apt-get install -y ca-certificates && \
    nginx=${NGINX_VERSION} && \
    rm -rf /var/lib/apt/lists/*

RUN ln -sf /dev/stderr /var/log/nginx/error.log

EXPOSE 80 443

CMD ["nginx", "-g", "daemon off;"]
```

jede Instruktion im Dockerfile erzeugt einen neuen Layer (manche einen mit 0 Bytes)

```
$ docker history --no-trunc c3e0e82fb8ec
IMAGE                                                                       CREATED             CREATED BY                                                                                                SIZE
sha256:c3e0e82fb8ec8175b34a412b47b41f642e29c72dee61f2338062aa436c50ef6d     About a minute ago  /bin/sh -c #(nop)  CMD ["nginx" "-g" "daemon off;"]                                                       0B
sha256:885bbf498551d8ef13a3d79eb2a8d658f7e931d79e070d843f1dbc3fe8248cf1     About a minute ago  /bin/sh -c #(nop)  EXPOSE 443 80                                                                         0B
sha256:86a1ceb9b25982eb599233cd1dee0b0d1616ea52498403aed100615cf66de402     About a minute ago  /bin/sh -c ln -sf /dev/stderr /var/log/nginx/error.log                                                   11B
sha256:e31a00b43629ebcc4893736f70deda5539863a06fc80657bec745078d34c75c8     About a minute ago  /bin/sh -c apt-get update &&     apt-get install -y ca-certificates nginx &&     rm -rf /var/lib/apt/lists/*   63.7MB
sha256:9fa8f57f57fa492fdceb20127649852a90360afa3440adc560507b44c468f68e     4 minutes ago       /bin/sh -c #(nop)  ENV NGINX_VERSION=1.12.2-1~jessie                                                     0B
sha256:ce40fb3adcc648d2e2c6bdb602cdbee35156bc2a41cb3e73b069f0b1bf1bcf97     3 weeks ago         /bin/sh -c #(nop)  CMD ["bash"]                                                                          0B
<missing>                                                                   3 weeks ago         /bin/sh -c #(nop) ADD file:f1509ab9c2cd3810736e26739fa0f78ee1ba942e14498ba5f266d8a78e664acc in /          123MB
```

Cache wird invalidiert [1]:
Muss neu gebaut und
transportiert werden!

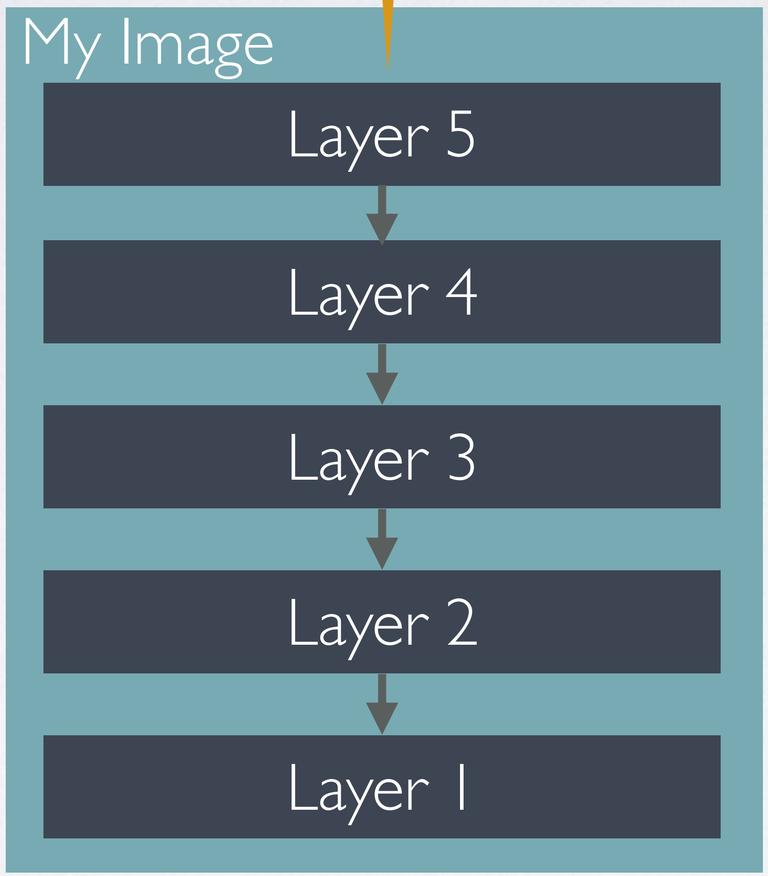


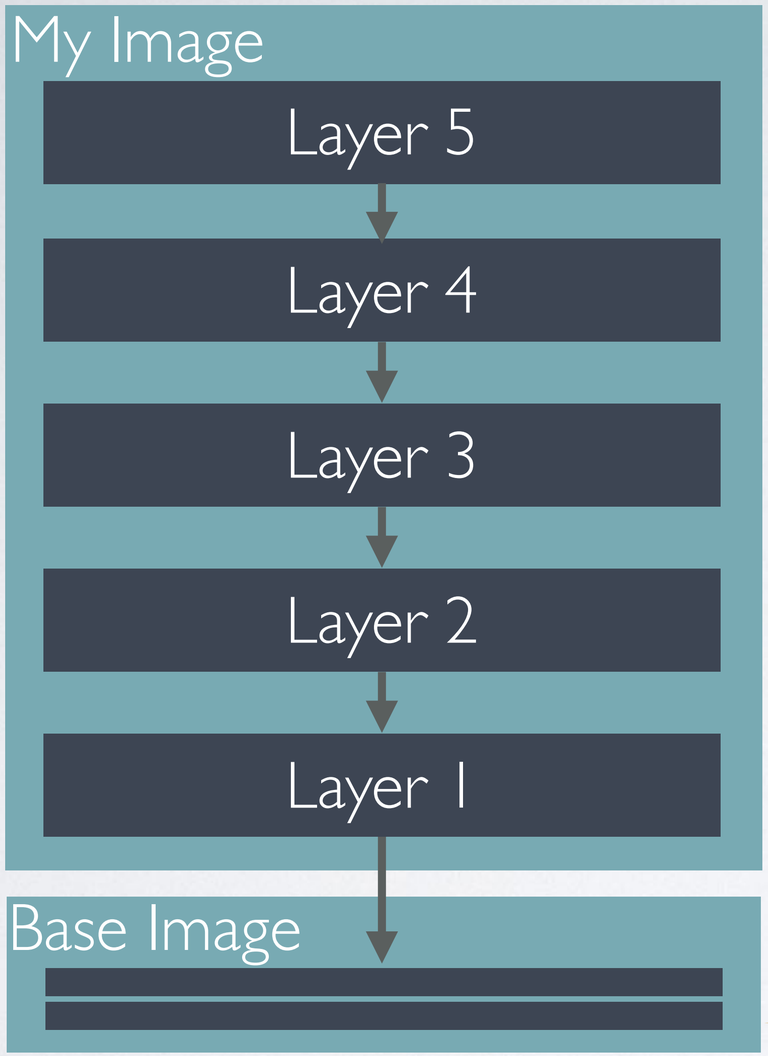

```
FROM debian:jessie

ENV NGINX_VERSION 1.12.2-1~jessie

RUN apt-get update && \
    apt-get install -y ca-certificates && \
    wget nginx=${NGINX_VERSION} && \
    rm -rf /var/lib/apt/lists/*

RUN ln -sf /dev/stderr /var/log/nginx/error.log

EXPOSE 80 443

CMD ["nginx", "-g", "daemon off;"]
```

[1] mehr zu Docker Caching: https://www.ctl.io/developers/blog/post/caching-docker-images

**Änderungs- und Transporteinheit**

- klein
- geringer Impact von Änderungen






volatil

stabil

klein

groß

1. Abhängigkeiten
2. Applikation
3. Konfiguration
4. Metadaten / Schnittstelle

klein: Alpine-*, Baseimage-Docker, Busybox, Scratch

- Minimale Docker Images mit Java 9: https://blog.dekstroza.io/building-minimal-docker-containers-with-java-9
- Security Checks von Docker Images: Clair & docker-bench-security & dockscan

# IMAGE SHRINKING 101

- Unnötige Layer vermeiden
  - **RUN** Chaining:

    ```
    RUN apk add --update wget git && rm -rf /var/cache/apk/*
    ```
  - Alle Layer verschmelzen zu einem (nur bei Basis-Images empfehlenswert):

    **docker** export + **docker** import

- Platzschonende Installation von Paketen

  ```
  RUN apt-get update && apt-get install -y –no-install-recommends apache2 wget && apt-get clean && rm -rf /var/lib/apt/lists/*
  ```

# IMAGE METAMORPHOSIS

ANTIPATTERN

**DEV**

**INT**

**PROD**

myimage-dev

myimage-int

myimage-prod

myimage

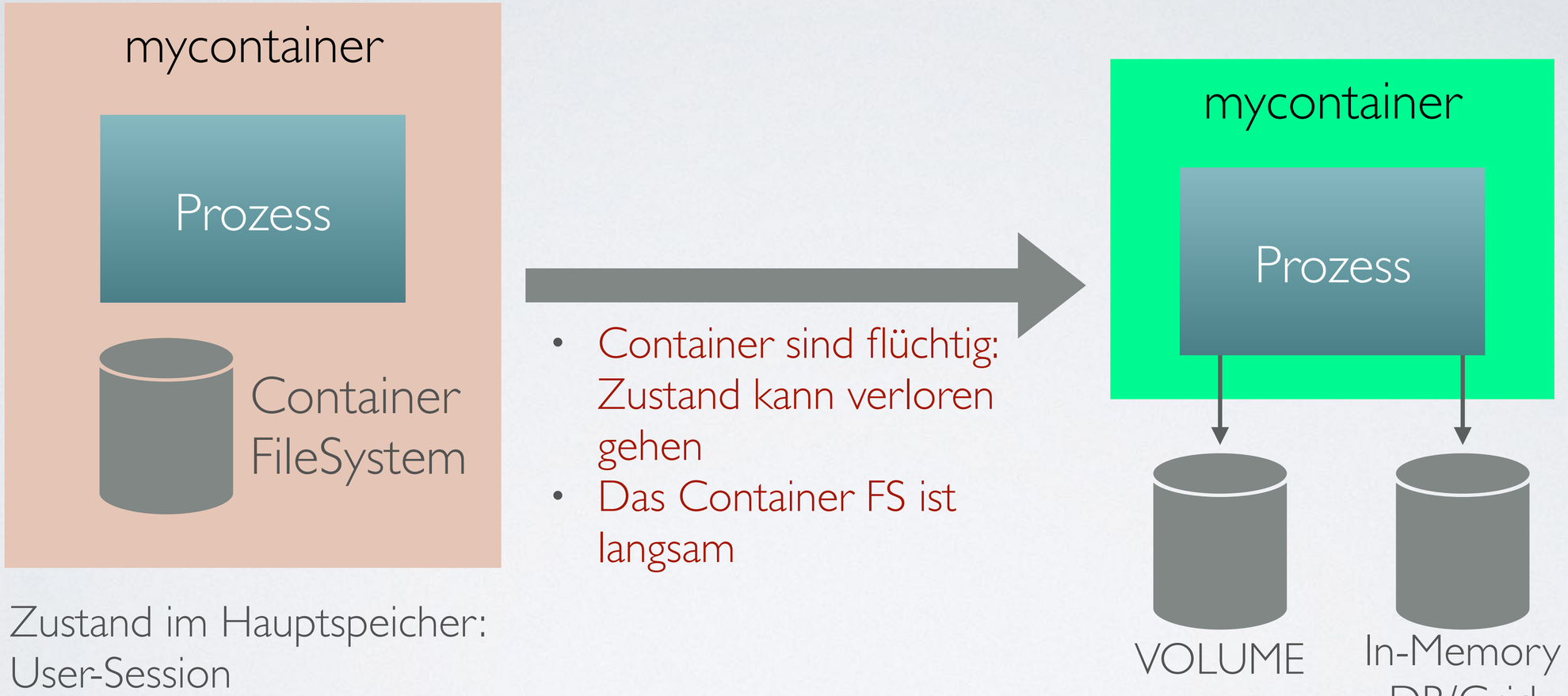
DEV.config

INT.config

PROD.config

# STATEFUL CONTAINER

ANTIPATTERN




- Container sind flüchtig: Zustand kann verloren gehen
- Das Container FS ist langsam

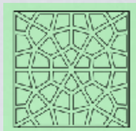
- Zustand im Hauptspeicher: User-Session
- Zustand auf Platte: Logs, Anwendungsdaten

(z.B. redis, Ignite, Hazelcast)

Für Log-Dateien:

```
RUN ln -sf /proc/1/fd/1 /var/log/test.log
```

# CONTAINER UNIT TESTING



PATTERN

**nginx-container-test.rb**

```
describe package('nginx') do
  it { should be_installed }
end

describe port(80) do
  it { should be_listening }
end
```

```
$ inspec exec nginx-container-test.rb -t docker://f80443273223

Profile: tests from nginx-container-test.rb (tests from nginx-container-test.rb)
Version: (not specified)
Target:  docker://f804432732231fc24f696cf7527ce458d3799ec7769961b6fc72021893921945

  System Package nginx
     ✔  should be installed
  Port 80
     ×  should be listening
     expected `Port 80.listening?` to return true, got false

Test Summary: 1 successful, 1 failure, 0 skipped
```

INSPEC

https://www.inspec.io

Alternativen: goss+dgoss, ServerSpec, Bats, Testinfra

# QUELLEN

- Generell
  - Container Patterns: https://l0rd.github.io/containerspatterns/#1
- Docker
  - DockerFile Best Practices: https://docs.docker.com/develop/develop-images/dockerfile_best-practices/#use-a-dockerignore-file
  - Docker Tools: https://github.com/veggiemonk/awesome-docker
  - OpenShift General Docker Guidelines: https://docs.openshift.com/enterprise/3.0/creating_images/guidelines.html
  - Common Docker Mistakes: https://runnable.com/blog/9-common-dockerfile-mistakes