Cloud Native Applications Workshop

What is Cloud Native?

WW Developer Advocacy

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- App Modernization
- Docker Overview
- Kubernetes Overview
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- 12 Factor Apps

App Modernization is inevitable

Evolution of application architectures

Late 90's	**Enterprise Application (EAI) Services and Models** Addressed integration and transactional challenges primarily by using message oriented middleware. Mostly proprietary systems needing a proliferation of custom interfaces.
Mid 00's	**Service Oriented Architectures** Based on open protocols like SOAP and WSDL making integration and adoption easier. Usually deployed on an Enterprise ESB which is hard to manage and scale.
Early 10's	**API Platforms and API Management** REST and JSON become the defacto standard for consuming backend data. Mobile apps become major consumers of backend data. New Open protocols like OAuth become available further simplifying API development .
2015 and beyond	**Cloud Native and Microservice Architecture** Applications are composed of small, independently deployable processes communicating with each other using language-agnostic APIs and protocols.

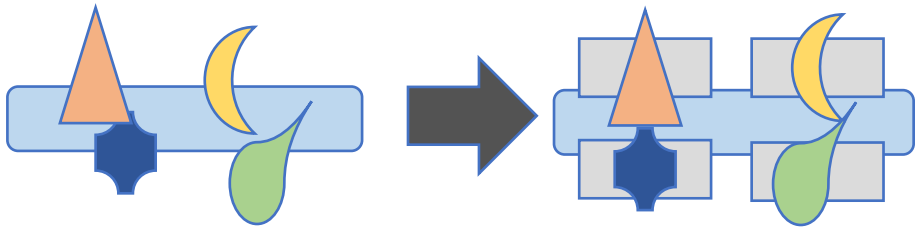
Key tenets of a cloud native application

1. Packaged as light weight **containers**
2. Developed with best-of-breed languages and frameworks
3. Designed as loosely coupled **microservices**
4. Centered around **APIs** for interaction and collaboration
5. Architected with a clean separation of stateless and stateful services
6. Isolated from server and operating system dependencies
7. Deployed on self-service, elastic, **cloud infrastructure**
8. Managed through agile **DevOps** processes
9. Automated capabilities
10. Defined, policy-driven resource allocation

https://thenewstack.io/10-key-attributes-of-cloud-native-applications/

Key tenets of a microservices architecture

1. Large monoliths are broken down into many small services
2. Services are optimized for a single function or business capability
3. Teams that write the code should also deploy the code
4. Smart endpoints, dumb pipes (message brokers)
5. Decentralized governance
6. Decentralized data management

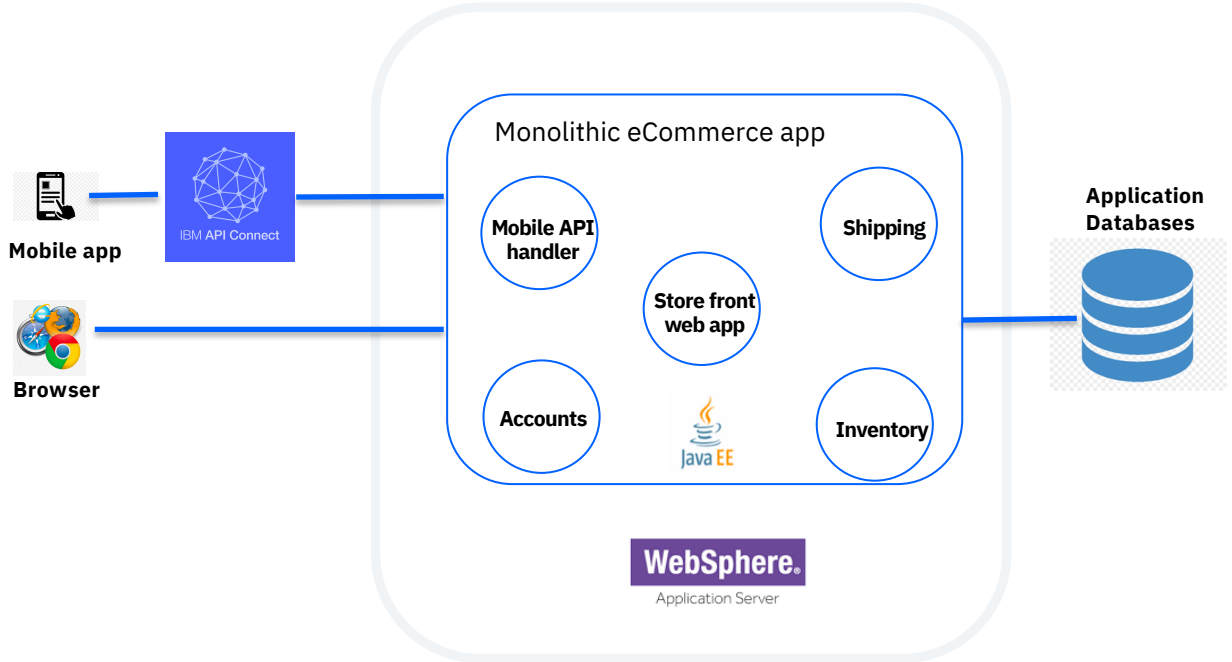


https://martinfowler.com/articles/microservices.html

Example monolithic application

eCommerce app

- Store front web interface
- Customer Accounts
- Inventory
- Shipping
- Back end for mobile app

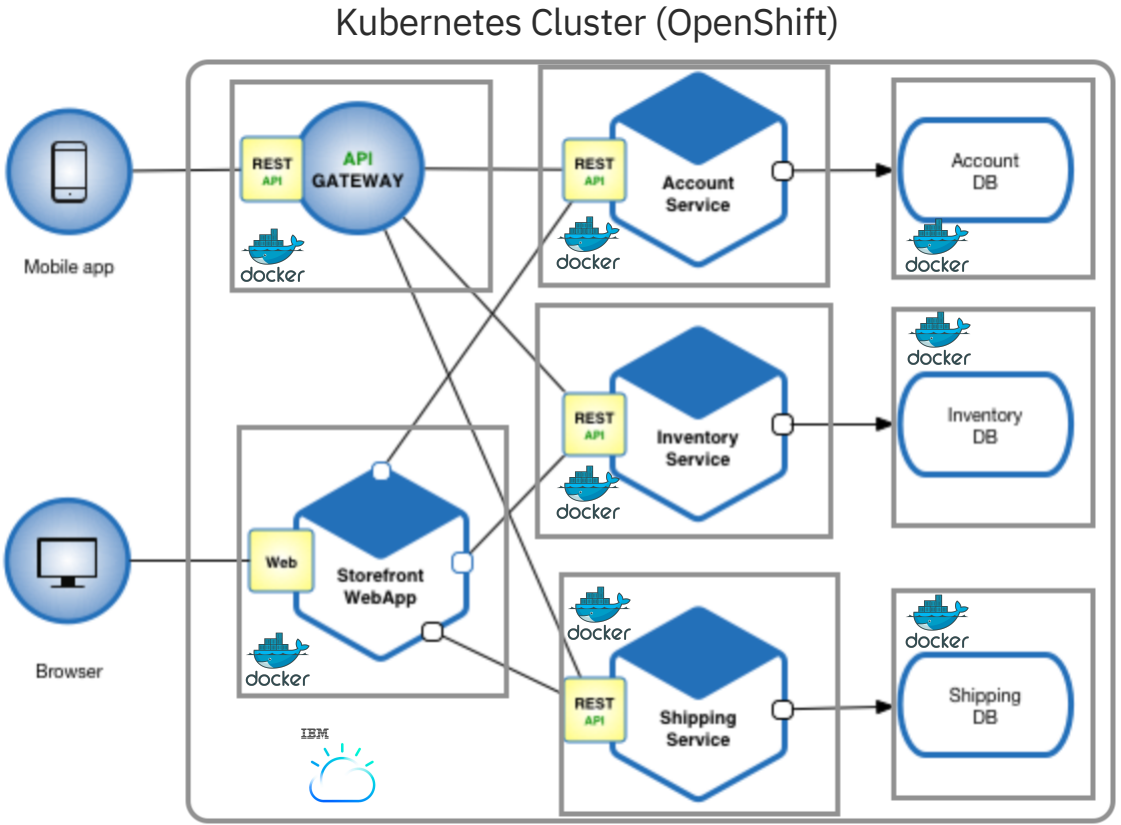


An eCommerce Java EE app on Websphere

Transformed application

Key technologies

- Containers (Docker)
- Container orchestration (Kubernetes)
- Transformation Advisor
- 12-Factor Best Practices
- CI/CD tools (e.g Jenkins)



An eCommerce microservices app on a Kubernetes cluster

Why microservices and cloud native?

Efficient teams	Simplified deployment	Right tools for the job	Improved application quality	Scalability
• End to end team ownership of relatively small codebases	• Each service is individually changed, tested, and deployed without affecting other services	• Teams can use best of breed technologies, libraries, languages for the job at hand	• Services can be tested more thoroughly in isolation	• Services can be scaled independently at different rates as needed
➢Teams can innovate faster and fix bugs more quickly	➢Time to market is accelerated.	➢Leads to faster innovation	➢Better code coverage	➢Leads to better overall performance at lower cost

Cultural change considerations

- **Smaller teams with broader scope**
  - Mini end to end development orgs in each team vs large silos across the entire development team
- **Top down support with bottom up execution**
  - Change can't happen effectively w/o executive sponsorship
  - Change needs to be executed at the smallest organizational unit to take hold
- **Teams own all metrics related to operations and development**
  - Have to minimize downtime + number of bugs while also maximizing the rate at which needed features are added and minimizing the time to market of those new features
- **Trust**
  - Teams need to build trust with other teams that they collaborate with rather than relying on one size fits all checklists and rules
- **Reward based on results not compliance**
  - Cultures only change when people are measured and rewarded for outcomes consistent with the changes
  - Smaller more autonomous teams work better with less central micromanagement and more focus on broad measurable goals

12 Factor Apps

12 Factor is a methodology for building software

Tenets for a 12 Factor App

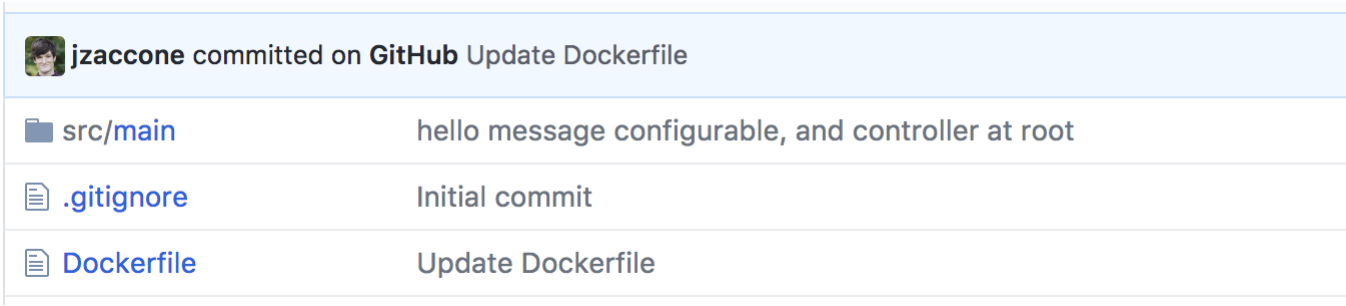
1. Codebase
2. Dependencies
3. Config
4. Backing Services
5. Build, Release, Run
6. Processes
7. Port Binding
8. Concurrency
9. Disposability
10. Dev/Prod Parity
11. Logs
12. Admin processes

https://12factor.net

I. Codebase

Code for a single application should be in a single code base

- Track running applications back to a single commit
- Use Dockerfile Maven, Gradle, or npm to manage external dependencies
- Version pinning! Don’t use latest
- No changing code in production



II. Dependencies

Explicitly declare and isolate dependencies. AKA: Remove system dependencies

How?

- Step 1: Explicitly declare dependencies (Dockerfile)
- Step 2: Isolate dependencies to prevent system dependencies from leaking in (containers)

```
1  FROM openjdk:8-jdk-alpine
2  EXPOSE 8080
3  WORKDIR /data
4  CMD java -jar *.jar
5  COPY target/*.jar /data/
```

III. Config

Store config in the environment (not in the code).

How?

- Inject config as environment variables (language agnostic)
- ConfigMap in Kubernetes does this ^

```
$ docker run -e POSTGRES_PASSWORD=abcd postgres
```

IV. Backing Services

Treat backing resources as attached services. Swap out resources.

How?

- Pass in URLs via config (see III.)
- K8s built in DNS allows for easy service discovery

```
services:

  account-api:
    build:
      context: ./compute-interest-api
    environment:
      DATABASE_URL: http//account-database

  account-database:
    image: jzaccone/account-database
```

V. Build, Release, Run

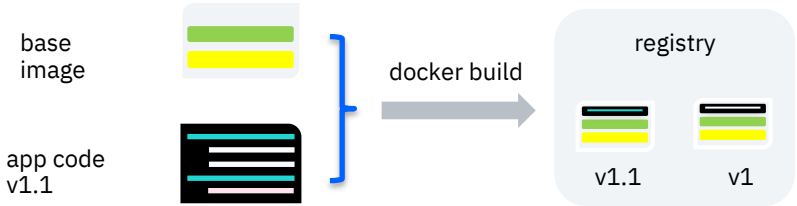
Strictly separate build and run stages.

Why?

Rollbacks, elastic scaling without a new build

How?

- Use Docker images as your handoff between build and run
- Tag images with version. Trace back to single commit (see I. Codebase)
- Single command rollbacks in Kubernetes



VI. Process

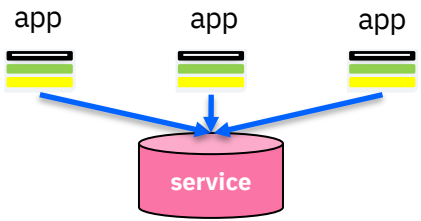
Execute app as stateless process

Why?

Stateless enables horizontal scaling

How?

- Remove sticky sessions
- Need state? Store in volume or external data service
- Use persistent volumes in Kubernetes for network wide storage



VII. Port Binding

Export services via port binding. Apps should be self-contained.

Why?

Avoid “Works on my machine”

How?

- Web server dependency should be included inside the Docker Image
- To expose ports from containers use the —publish flag

VIII. Concurrency

Scale out via the process model. Processes are **first-class citizens**

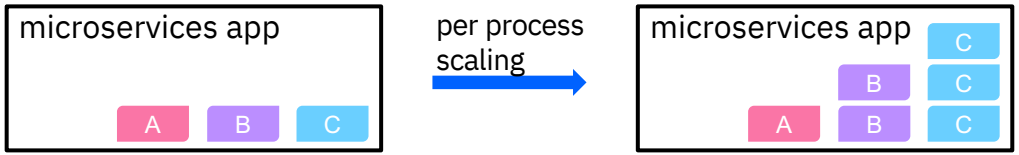
Why?

Follow the Unix model for scaling, which is simple and reliable

How?

- Scale by creating more processes
- **Docker**: really just a process running in isolation
- **Kubernetes**: Acts as process manager: scales by creating more pods

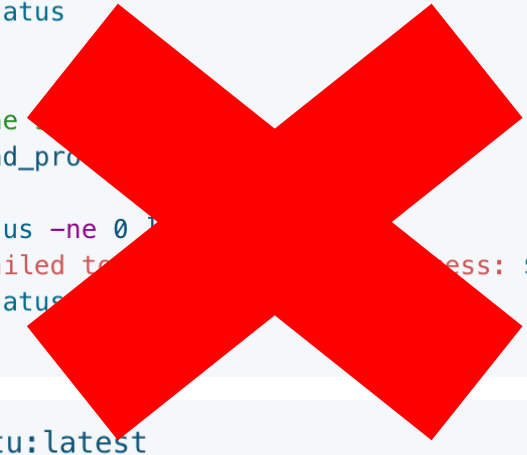
  Don't put process managers in your containers



Bad Example

```
# Start the first process
./my_first_process -D
status=$?
if [ $status -ne 0 ]; then
  echo "Failed to start my_first_process: $status"
  exit $status
fi

# Start the
./my_second_pro
status=$?
if [ $status -ne 0
  echo "Failed t                ess: $status"
  exit $status
fi
```



```
FROM ubuntu:latest
COPY my_first_process my_first_process
COPY my_second_process my_second_process
COPY my_wrapper_script.sh my_wrapper_script.sh
CMD ./my_wrapper_script.sh
```

Containers should be a single process!

IX. Disposability

Maximize robustness with fast startup and graceful shutdown

Why?

- Enables fast elastic scaling, robust production deployments. Recover quickly from failures.

How?

- multi-minute app startups!
- Docker enables fast startup: Union file system and image layers
- In best practice: Handle SIGTERM in main container process.

X. Dev/Prod Parity

Keep development, staging and production as similar as possible. Minimize time gap, personnel gap and tools gap

How?

- **Time gap:** Docker supports delivering code to production faster by enabling automation and reducing bugs caused by environmental drift.
- **Personnel gap:** Dockerfile is the point of collaboration between devs and ops
- **Tools gap:** Docker makes it very easy to spin up production resources locally by using `docker run ...`

XI. Logs

Treat logs as event streams

How?

- Write logs to stdout (Docker does by default)
- Centralizes logs using ELK or [your tool stack here]

  Don’t

  Don’t retroactively inspect logs! Use ELK to get search, alerts

  Don’t throw out logs! Save data and make data driven decisions

XII. Admin Processes

Run admin/management tasks as one-off processes.

Don’t treat them as special processes

How?

- Follow 12-factor for your admin processes (as much as applicable)
- Option to collocate in same source code repo if tightly coupled to another app
- “Enter” namespaces to run one-off commands via `docker exec ...`