

Refactor your applications using Container and Microservices



Arun Gupta, @arungupta
Red Hat

Advantages

Standardization



ISO standard (modes and equipment). Unique identification number and size type code.

Flexibility



Commodities, manufactured goods, liquids and refrigerated goods.

Costs



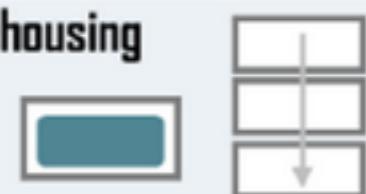
Low transport costs. Economies of scale at modes and terminals.

Velocity



Fast transshipment operations. Low terminal turnaround times.

Warehousing



Own warehouse; simpler and less expensive packaging. Stacking capability.

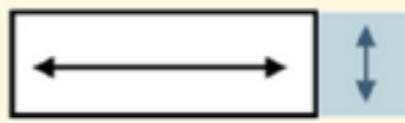
Security & Safety



Contents unknown to carriers. Reduced spoilage and losses.

Drawbacks

Site Constraints



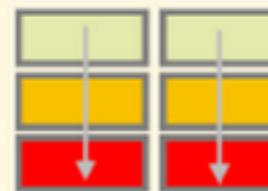
Large consumption of terminal space. Draft issues with larger containerships.

Capital Intensiveness



Container handling infrastructures and equipment are important investments.

Stacking



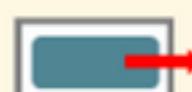
Complexity of arrangement of containers, both on the ground and on modes.

Repositioning



Divergence between production and consumption; repositioning. 20% of all containers.

Theft and Losses



High value goods vulnerable to thefts, particularly between terminal and final destination.

Illicit Trade

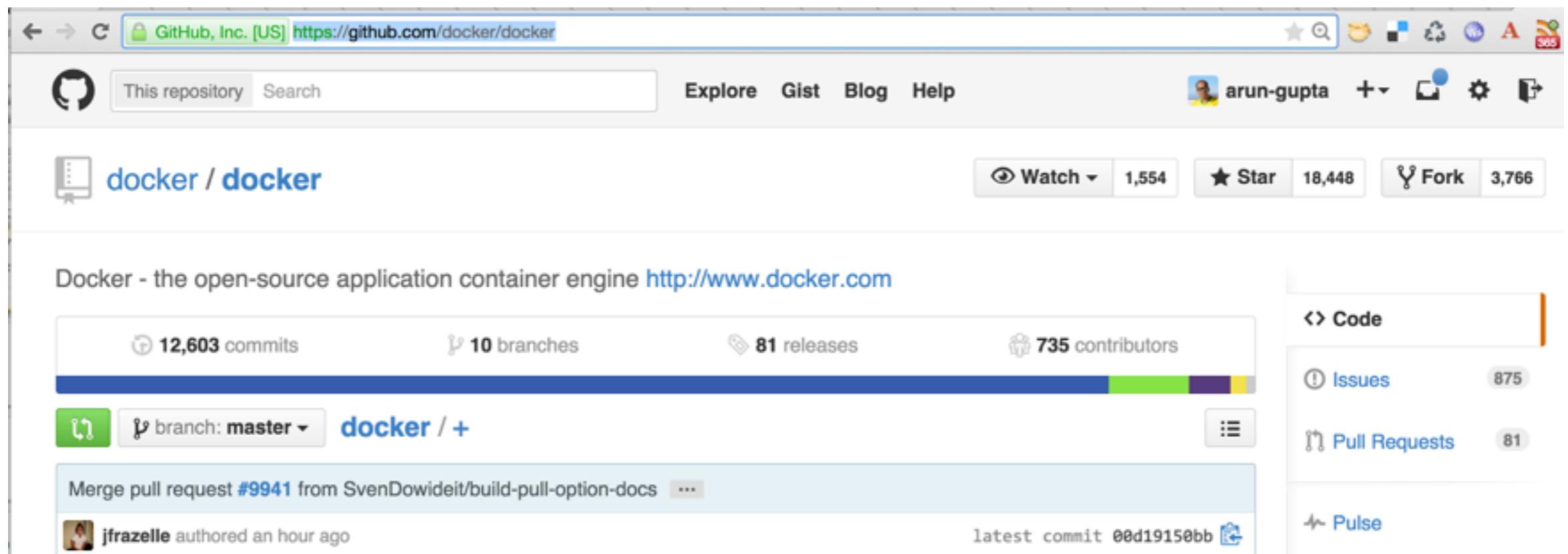


Illicit trade of goods, drugs and weapons, as well as for illegal immigration.

What is Docker?

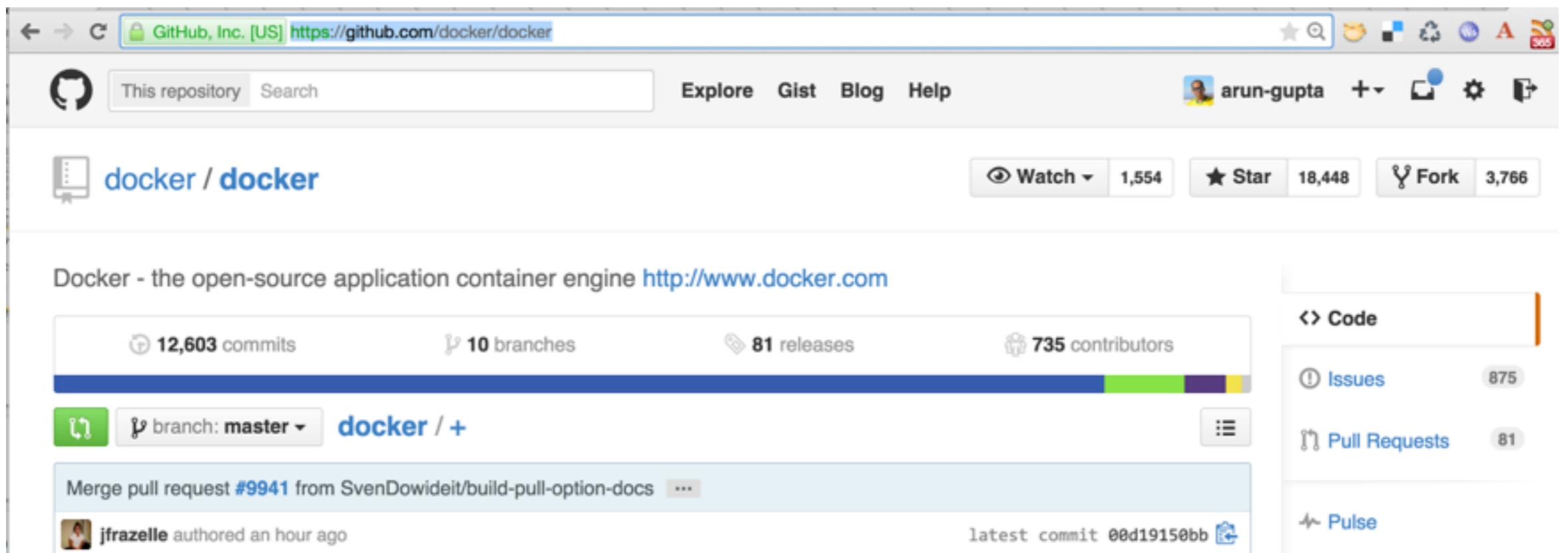
What is Docker?

- Open source project and company



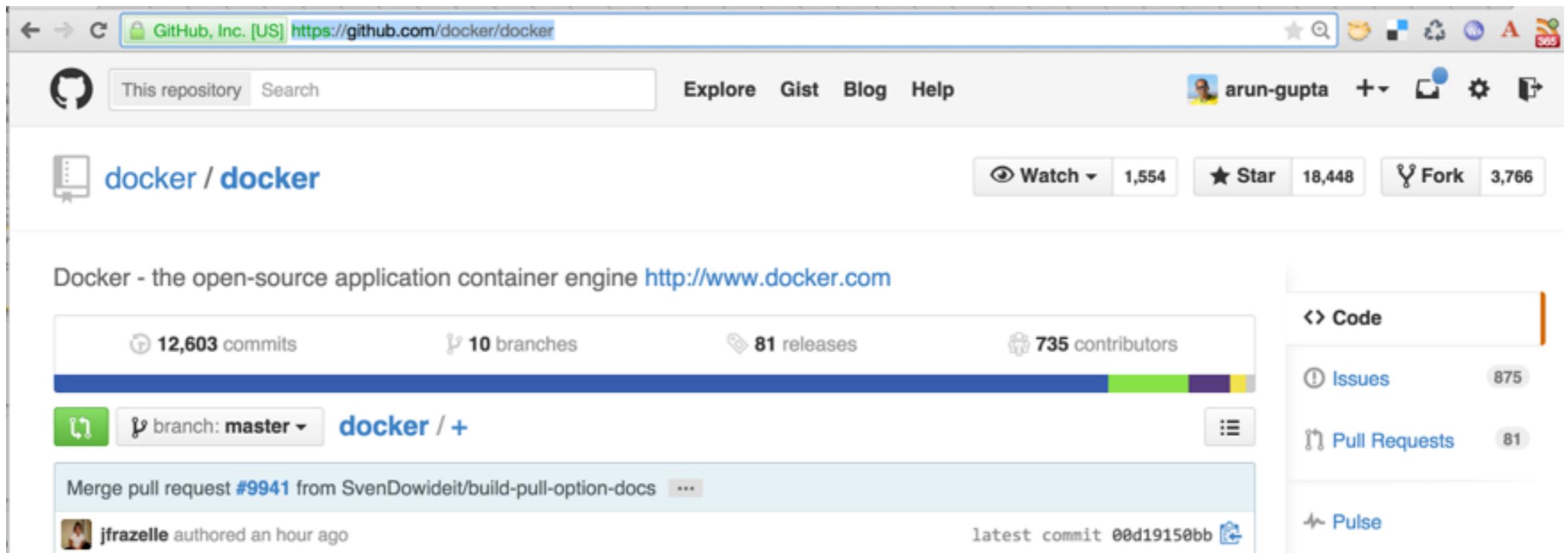
What is Docker?

- Open source project and company
- Used to create containers for software applications



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- Used to create containers for software applications
- Package Once Deploy Anywhere (PODA)



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- Sharing
- Faster Deployments

Underlying Technology

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 - **Namespaces** to provide isolation
 - **Control groups** to share/limit hardware resources
 - **Union File System** makes it light and fast
 - **libcontainer** defines container format

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- Natively supported in Linux

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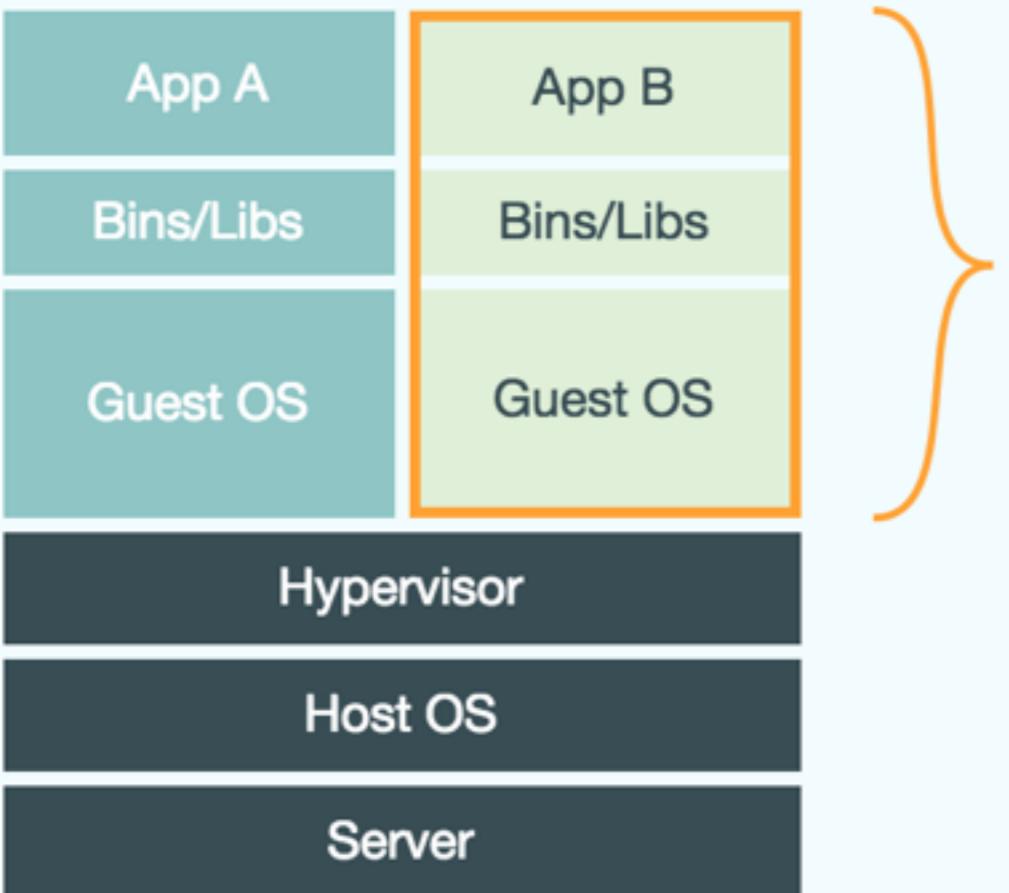
- Natively supported in Linux
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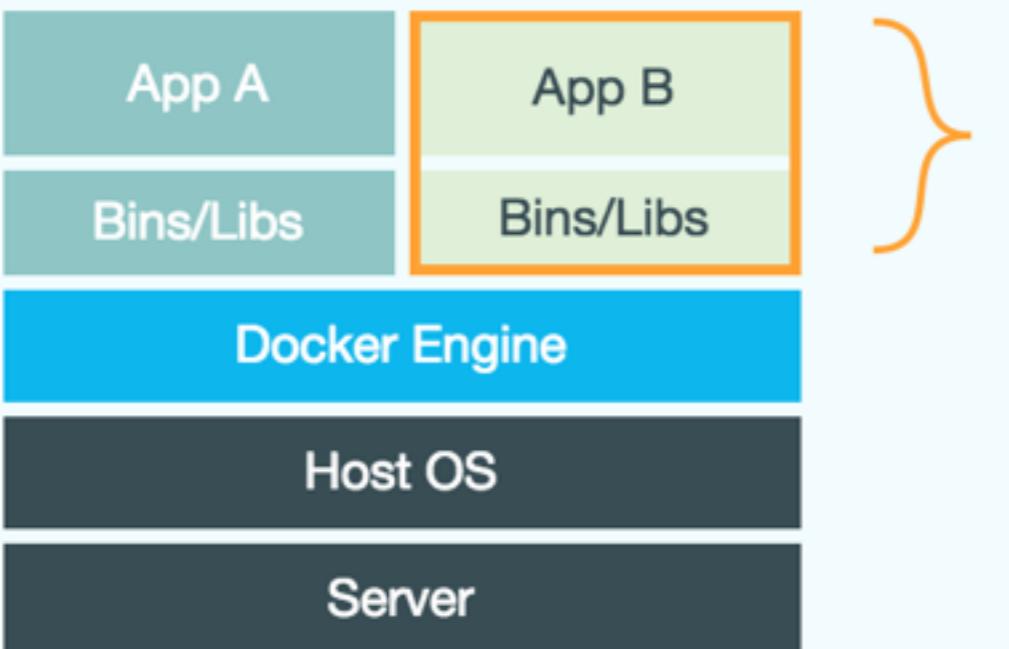
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 - Tiny Core Linux VM





Virtual Machines

Each virtualized application includes not only the application - which may be only 10s of MB - and the necessary binaries and libraries, but also an entire guest operating system - which may weigh 10s of GB.



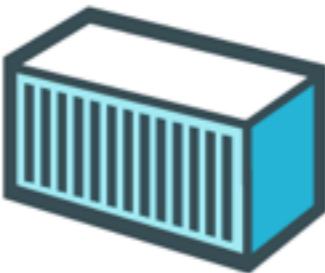
Docker

The Docker Engine container comprises just the application and its dependencies. It runs as an isolated process in userspace on the host operating system, sharing the kernel with other containers. Thus, it enjoys the resource isolation and allocation benefits of VMs but is much more portable and efficient.



Build

Develop an app using Docker containers with
any language and any toolchain.



Ship

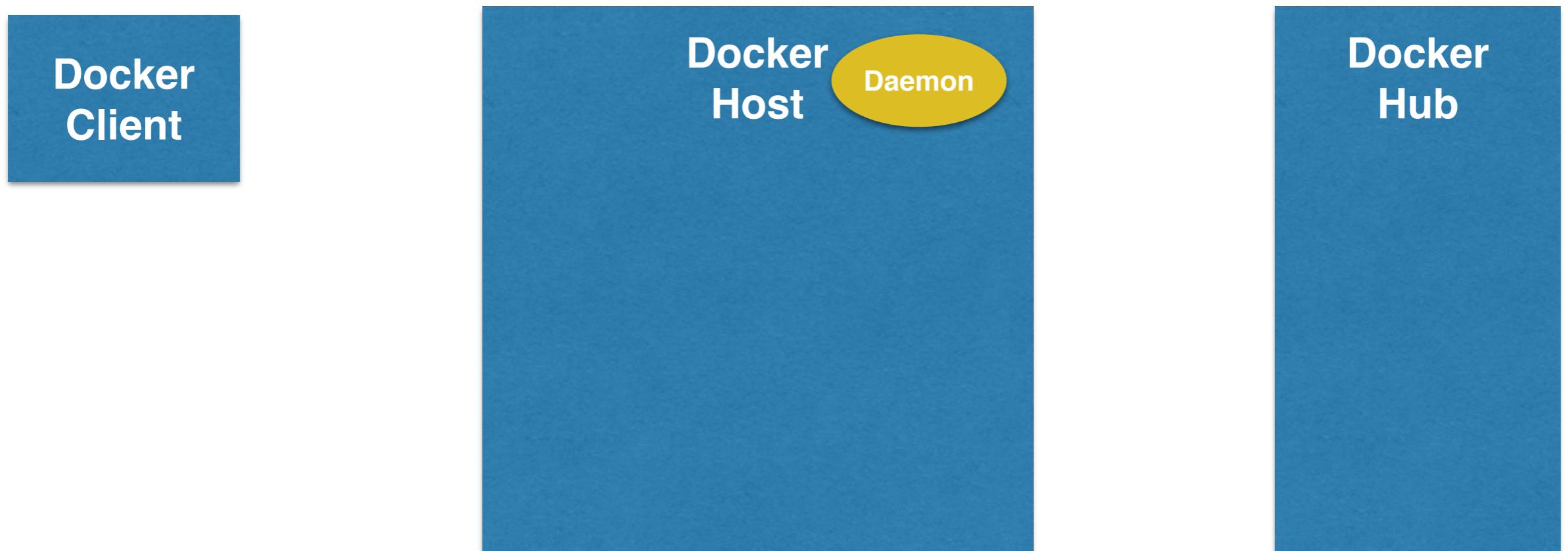
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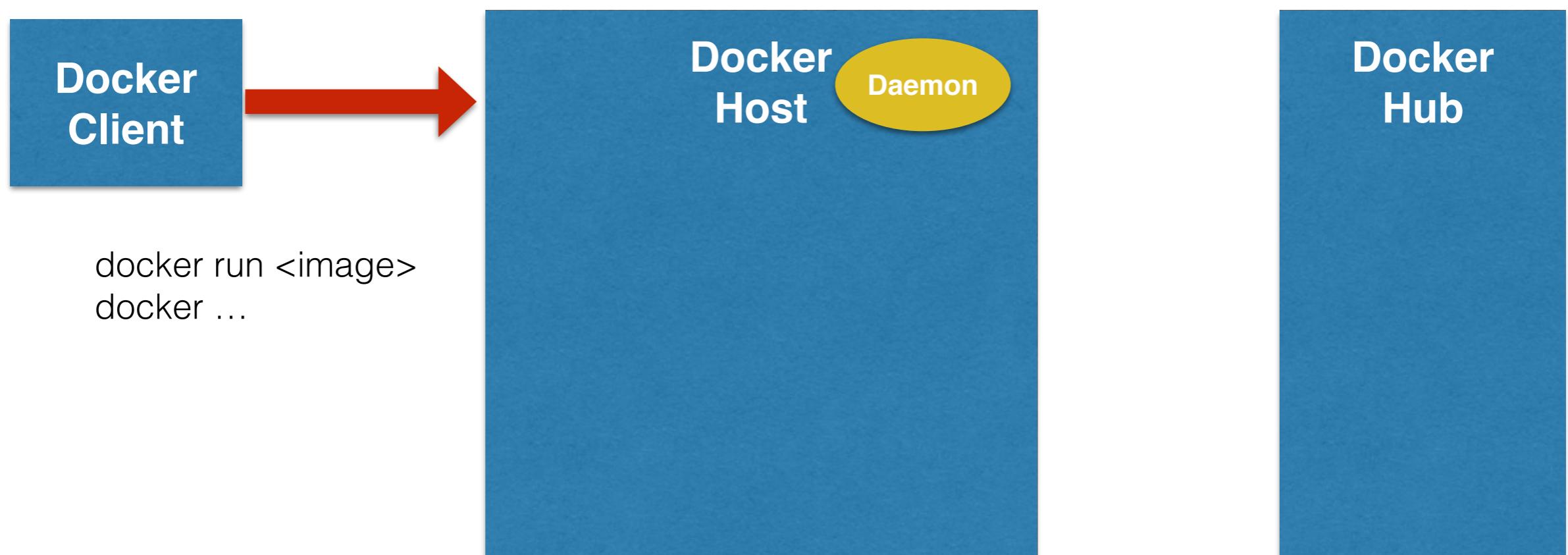
Run

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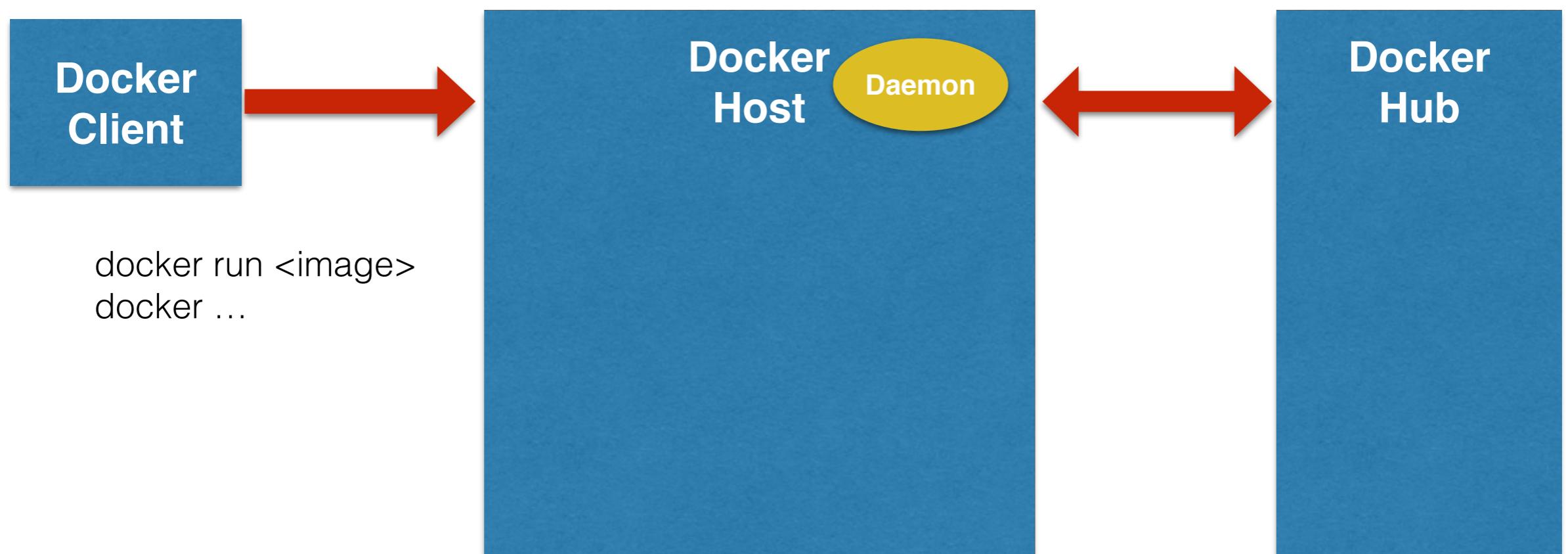
Docker Workflow



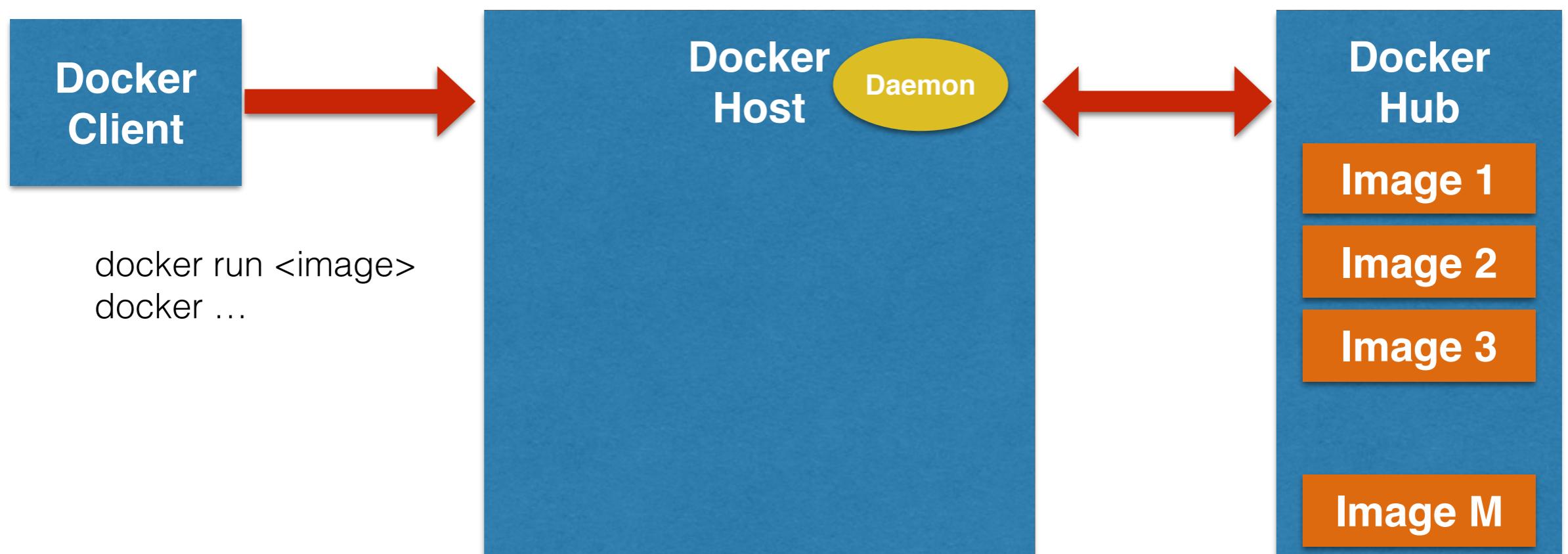
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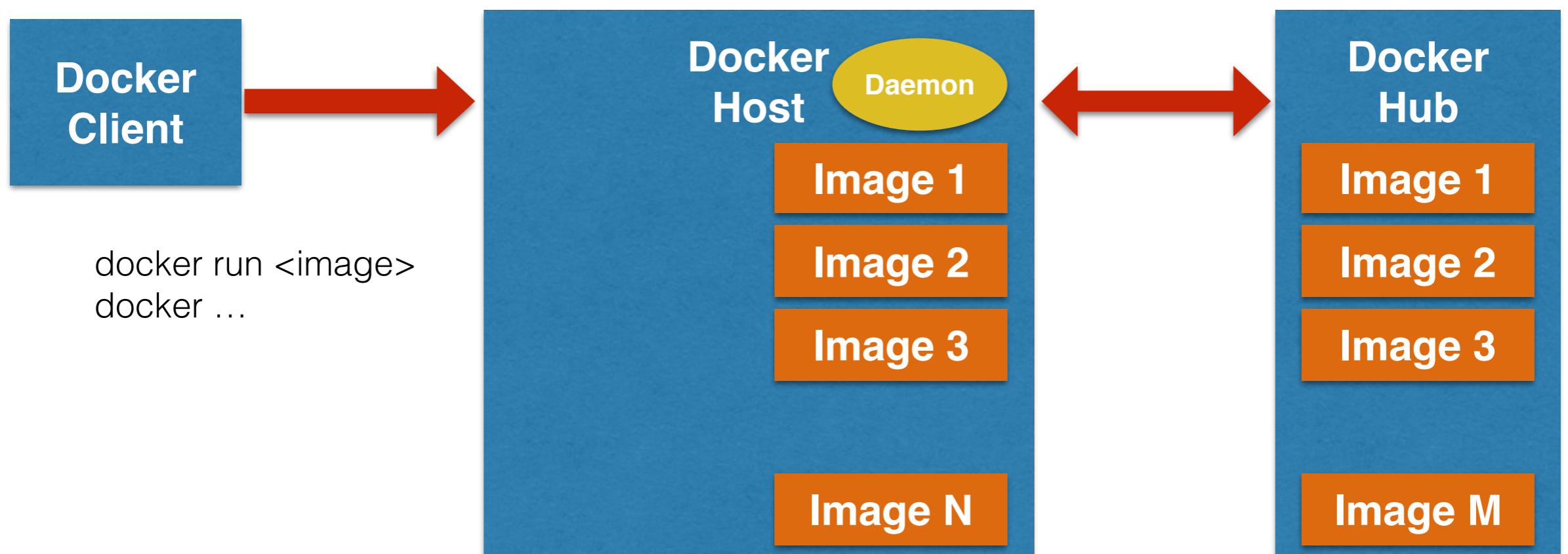
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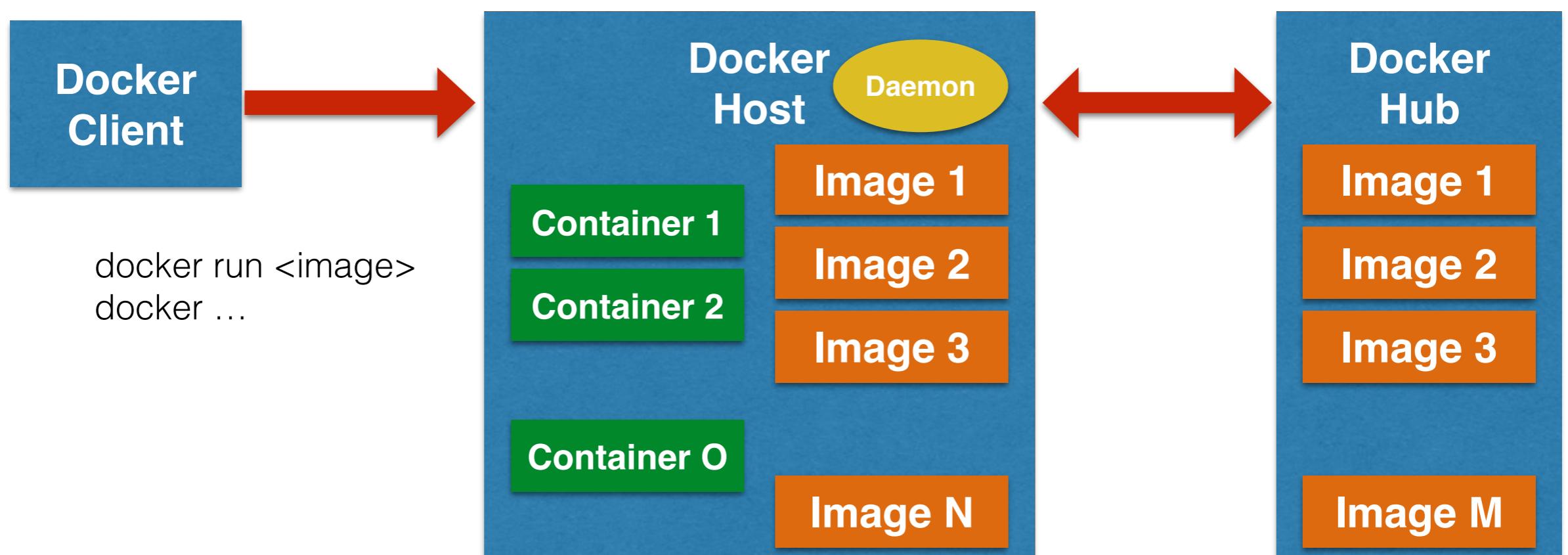
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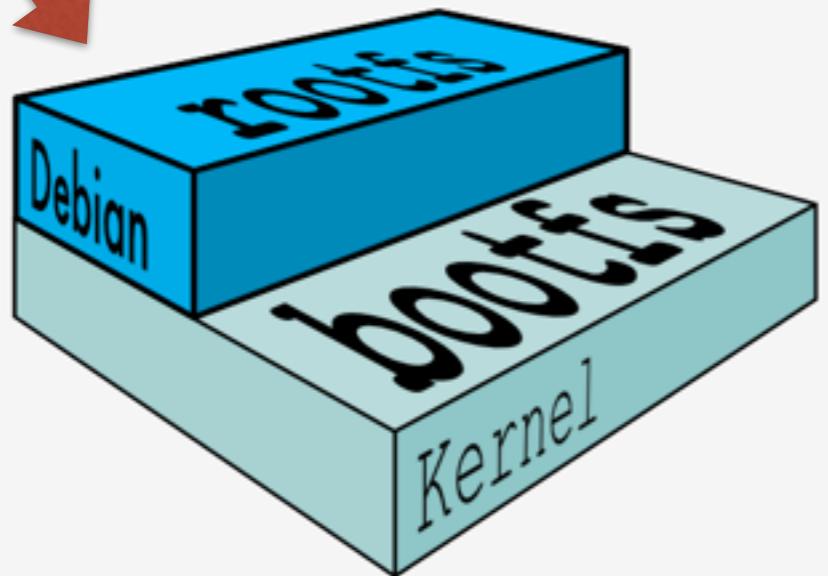
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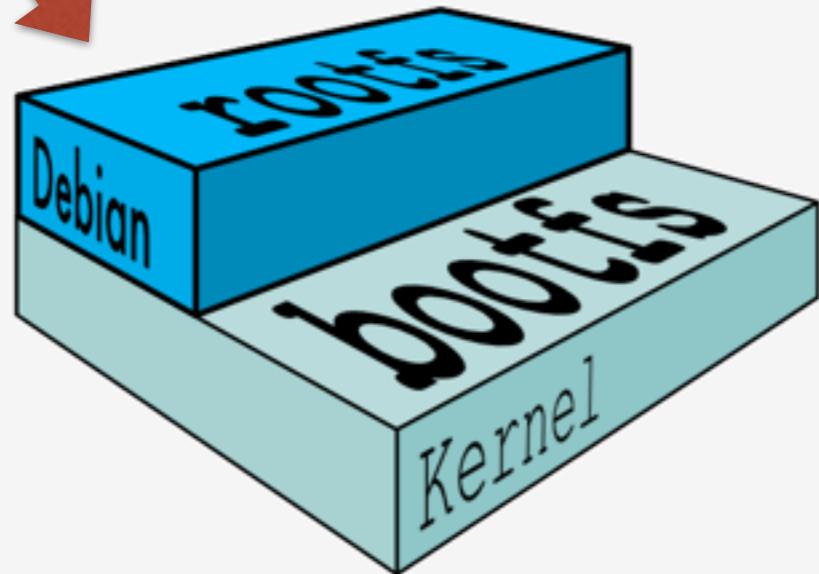
Docker Workflow



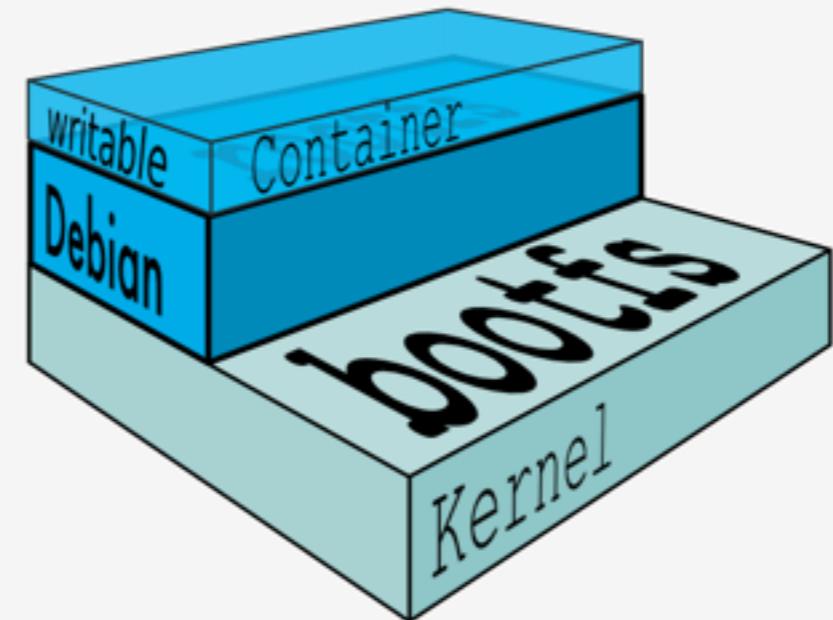
read-only



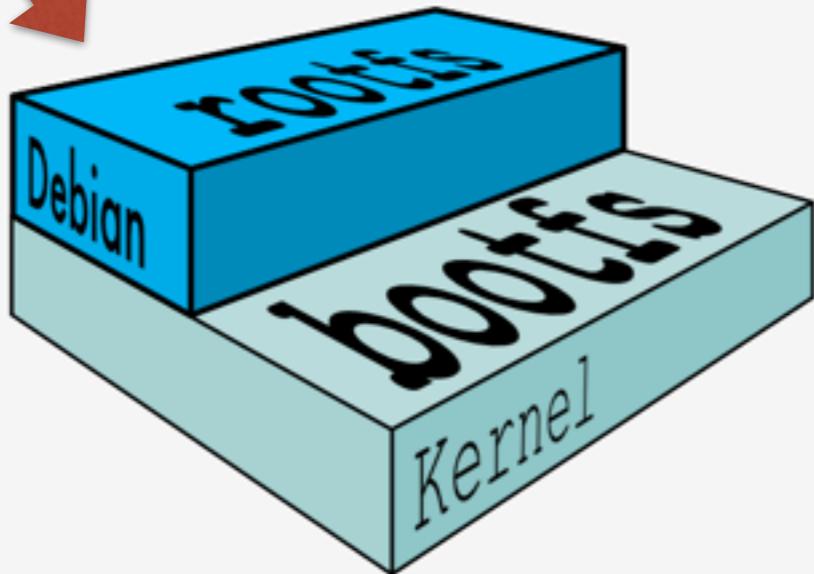
read-only



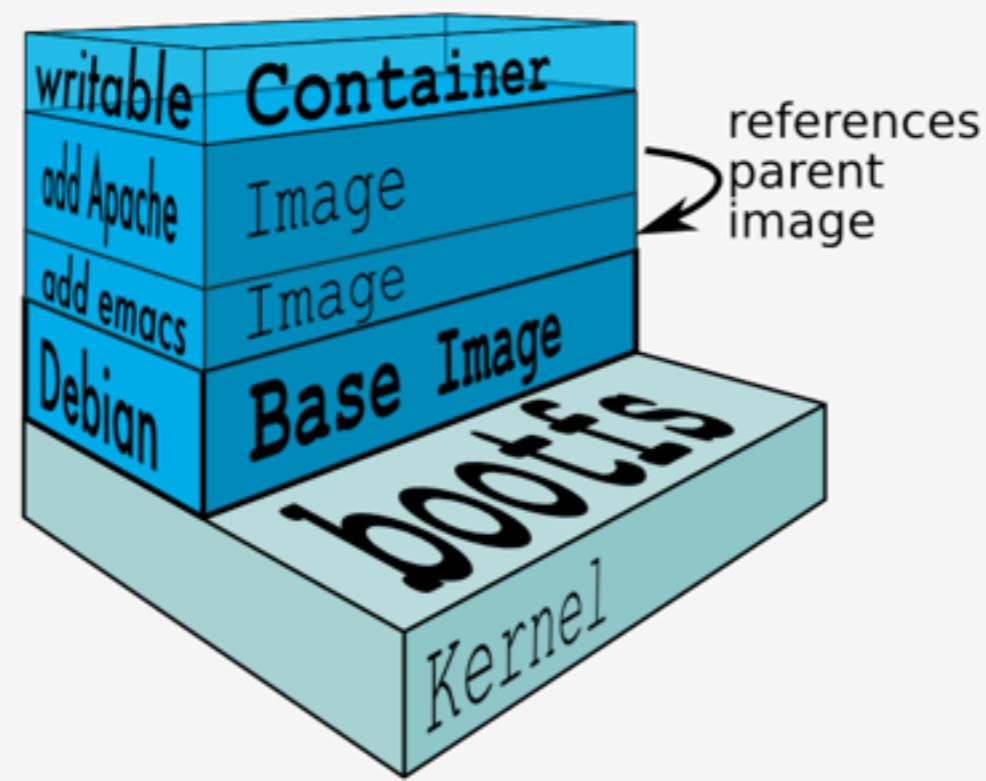
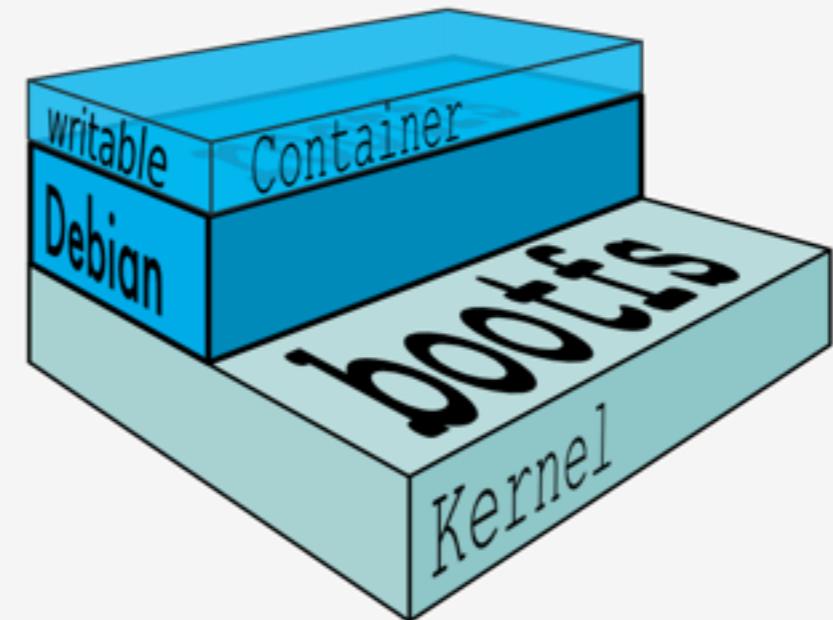
Union File System



read-only



Union File System





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FROM fedora:latest

CMD echo "Hello world"
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FROM jboss/wildfly
MAINTAINER Arun Gupta <arungupta@redhat.com>

RUN curl -L https://github.com/javaee-samples/javaee7-hol/raw/master/solution/
movieplex7-1.0-SNAPSHOT.war -o /opt/jboss/wildfly/standalone/deployments/
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- Image defined in text-based **Dockerfile**
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- `docker build` or `pull`

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```

```
1 FROM centos
2 MAINTAINER Arun Gupta <arungupta@redhat.com>
3
4 # Execute system update
5 RUN yum -y update && yum clean all
6
7 # Install packages necessary to run EAP
8 RUN yum -y install xmlstarlet saxon augeas bsdtar unzip && yum clean all
9
10 # Create a user and group used to launch processes
11 # The user ID 1000 is the default for the first "regular" user on Fedora/RHEL,
12 # so there is a high chance that this ID will be equal to the current user
13 # making it easier to use volumes (no permission issues)
14 RUN groupadd -r jboss -g 1000 && useradd -u 1000 -r -g jboss -m -d /opt/jboss -s /sbin/nologin -c "JBoss user" jboss
15
16 # Set the working directory to jboss' user home directory
17 WORKDIR /opt/jboss
18
19 # User root user to install software
20 USER root
21
22 # Install necessary packages
23 RUN yum -y install java-1.7.0-openjdk-devel && yum clean all
24 #RUN yum -y install java-1.8.0-openjdk-devel && yum clean all
25
26 # Switch back to jboss user
27 USER jboss
28
29 # Set the JAVA_HOME variable to make it clear where Java is located
30 ENV JAVA_HOME /usr/lib/jvm/java
31
32 # Set the WILDFLY_VERSION env variable
33 ENV WILDFLY_VERSION 8.2.0.Final
34
35 # Add the WildFly distribution to /opt, and make wildfly the owner of the extracted tar content
36 # Make sure the distribution is available from a well-known place
37 RUN cd $HOME && curl -O http://download.jboss.org/wildfly/$WILDFLY_VERSION/wildfly-$WILDFLY_VERSION.zip && unzip wildfly-$WILDFLY_
38
39 # Set the JBOSS_HOME env variable
40 ENV JBOSS_HOME /opt/jboss/wildfly
41
42 # Expose the ports we're interested in
43 EXPOSE 8080 9990
44
45 # Set the default command to run on boot
46 # This will boot WildFly in the standalone mode and bind to all interface
47 CMD ["/opt/jboss/wildfly/bin/standalone.sh", "-c", "standalone-full.xml", "-b", "0.0.0.0"]
```



[What is Docker?](#) [Use Cases](#) [Try It!](#) [Browse](#) [Install & Docs](#)[Log In](#)[Sign Up](#)

jboss



Show:

All

Sort by:

Last Updated

Repositories

Filter by name...

**jboss/forge**

8 hours ago



1



17

**jboss/liveoak-server**

4 days ago



3



140

**jboss/switchyard-wildfly**

a month ago



0



49

**jboss/keycloak**

a month ago



0



540

**jboss/keycloak-adapter-wildfly**

a month ago



0



195

**jboss/infinispan-server**

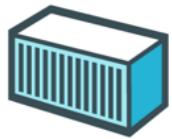
2 months ago



0



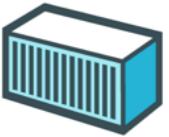
87



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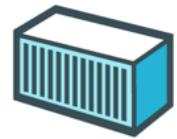
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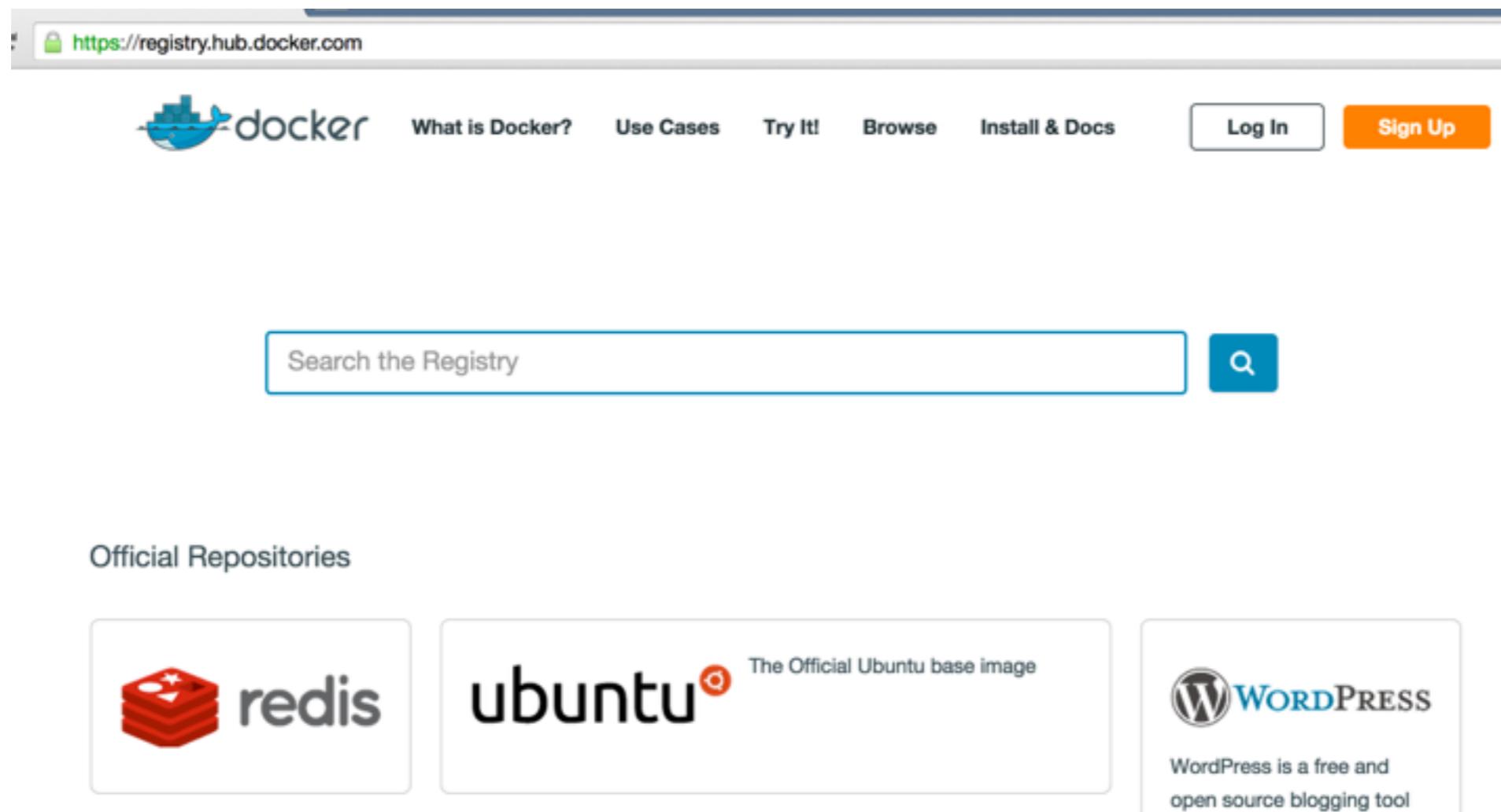
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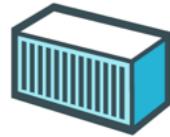
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The screenshot shows the Docker Hub Registry homepage. At the top, there's a navigation bar with links for "What is Docker?", "Use Cases", "Try It!", "Browse", "Install & Docs", "Log In", and "Sign Up". Below the navigation is a search bar with the placeholder "Search the Registry" and a magnifying glass icon. The main content area is titled "Official Repositories" and features three cards: 1) "redis" with its logo, 2) "ubuntu" with the text "The Official Ubuntu base image", and 3) "WORDPRESS" with the text "WordPress is a free and open source blogging tool".

- Images shared using registry
- Docker Hub is public SaaS
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The screenshot shows the Docker Hub homepage at <https://registry.hub.docker.com>. The top navigation bar includes links for "What is Docker?", "Use Cases", "Try It!", "Browse", "Install & Docs", "Log In", and "Sign Up". A search bar at the top right contains the placeholder "Search the Registry" and a magnifying glass icon. Below the search bar, the heading "Official Repositories" is displayed. Three repository cards are visible: "redis" (with a red cube icon), "ubuntu" (with a black "ubuntu" logo and the text "The Official Ubuntu base image"), and "WORDPRESS" (with a white "W" icon and the text "WordPress is a free and open source blogging tool").

- Images shared using registry
- Docker Hub is public SaaS
- Private registries can be setup inside firewall
- `docker push or pull <IMAGE_ID>`



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- Container built from image



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- Self contained execution environment
- `docker run <IMAGE_ID>`



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Docker commands

- **docker ps**: List running containers
- **docker stop**: Stop a running container
- **docker rm**: Remove a running container
- **docker rmi**: Remove an image
- ...

<https://docs.docker.com/reference/commandline/cli/>

DOCKER ECOSYSTEM

YEAR IN REVIEW 2014



\$15
million

JAN 21
DOCKER CLOSES
\$15M FUNDING

Series B round of funding led by
Greylock Partners

v0.9

MAR 10
DOCKER 0.9

Drops LXC and replaces it with
libcontainer library written in Go



MAR 15
WAVEMAKER PREVIEWS
DOCKER-ARCHITECTED CLOUD

Developer preview of Wavemaker Cloud.
Provisions 5k+ instances to 500+ developers
in over 50 countries

1st
birthday

MAR 20
DOCKER TURNS ONE

370 contributors,
1 million downloads,
27 countries



dockercon14

June 9-10, 2014 • San Francisco



GOOGLE ANNOUNCES
KUBERNETES

An open source orchestration system for
Docker containers. Receives support from
Microsoft, IBM, Docker, CoreOS and others

v1.0

DOCKER 1.0 AND
ENTERPRISE SUPPORT

Availability of commercial support,
integration with Docker Hub



ADDITIONAL
LAUNCHES

libnetwork: network services toolkit
libcontainer: ultra-lightweight networking library
libcontainer: standard interface to Linux D-Bus
sandboxing, made a standalone project



APR 23
AWS LAUNCHES
SUPPORT FOR DOCKER

AWS Elastic Beanstalk supports running
and managing dockerized applications



APR 15
RED HAT FAST-TRACKS
DOCKER FOR ENTERPRISE

Integrates Docker and Linux container
elements in Red Hat Enterprise Linux 7



DOCKER ACQUIRES
ORCHARD LABS

Developers of Fig, a composition and
orchestration tool for multi-container
Docker apps



DOCKER SELLS
DOTCLOUD PLATFORM

Sells dotCloud PaaS to CloudControl to
focus on the Docker project



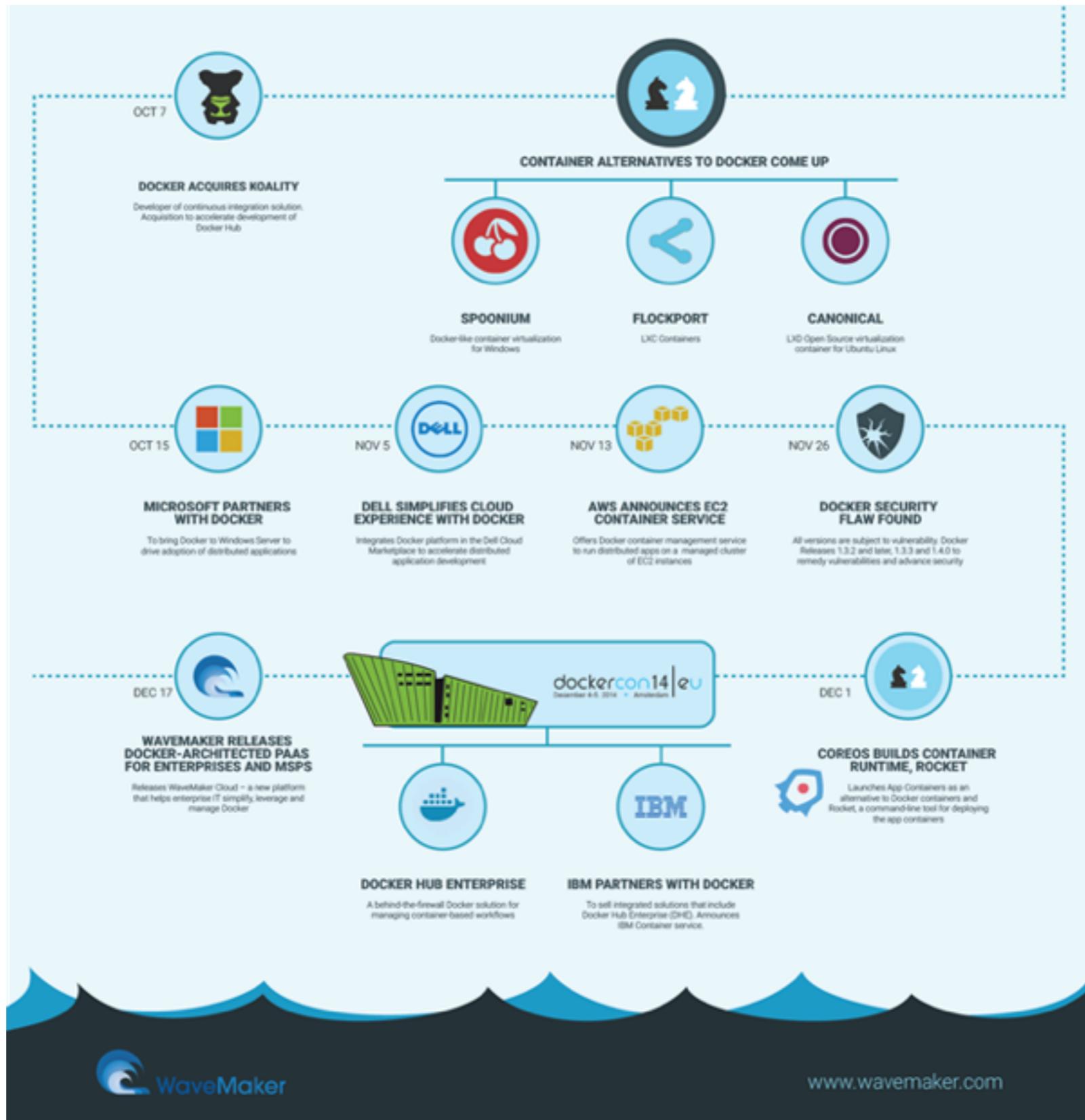
VMMATE TEAMS
WITH DOCKER

Partners with Docker to help enterprises run
and manage container-based apps



SEP 16
DOCKER RAISES
\$40 MILLION FUNDING

Series C round of funding led by
Sequoia, with a 3x increase in round size





docker



Docker Project: 2014 Year in Review

102.5 Million

Docker Container Downloads

DEC

↑ 18.8K%
GROWTH

66.3 Million

NOV

32 Million

OCT

46.8 Million

SEP

8.5 Million

AUG

18.8 Million

JUL

2.7 Million

JUN

4.3 Million

MAY

of Docker Container
Downloads

542,552

JAN

1.2 Million

FEB

1.5 Million

MAR

1.7 Million

APR

2.7 Million

MAY

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JUN

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SEP

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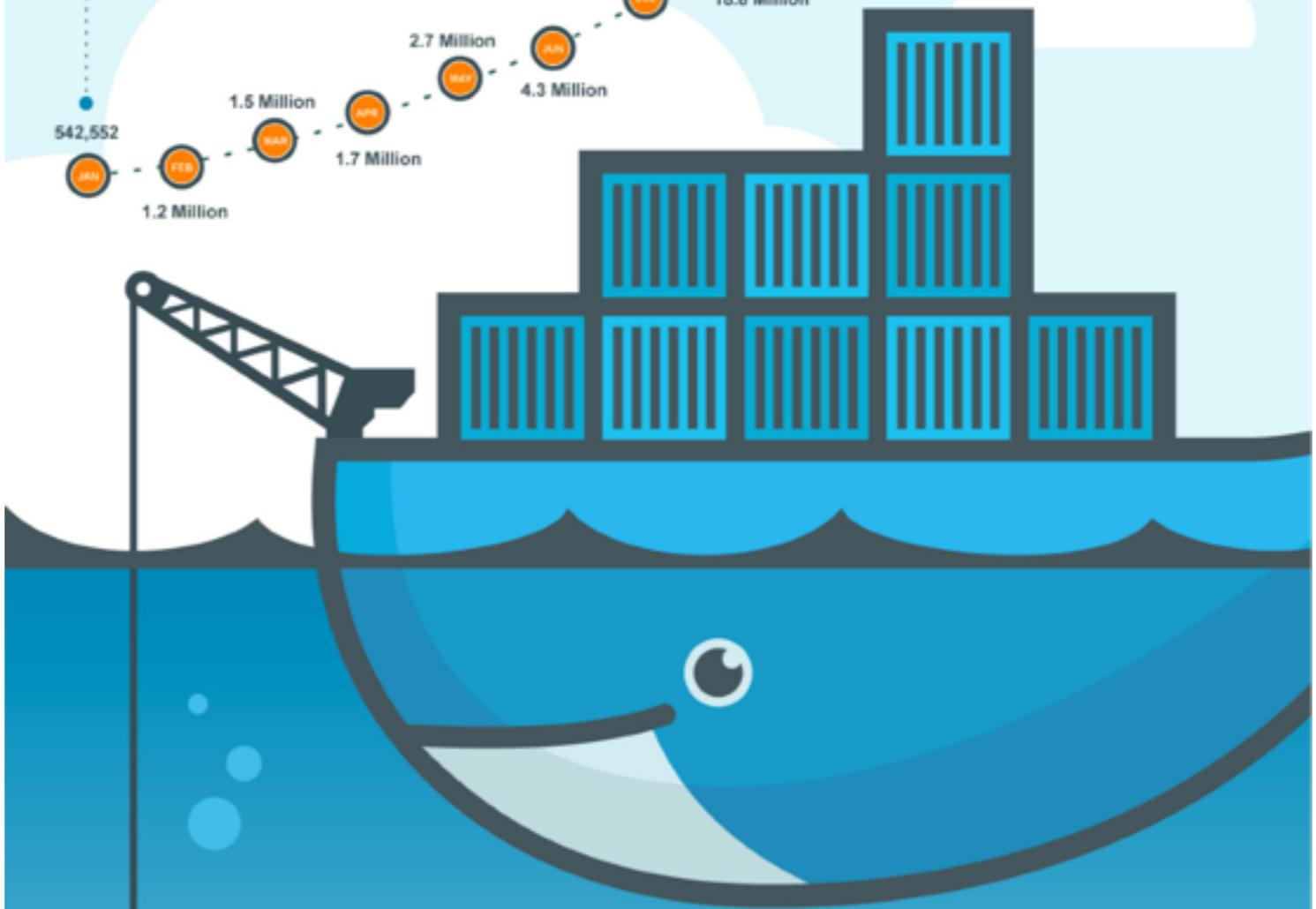
OCT

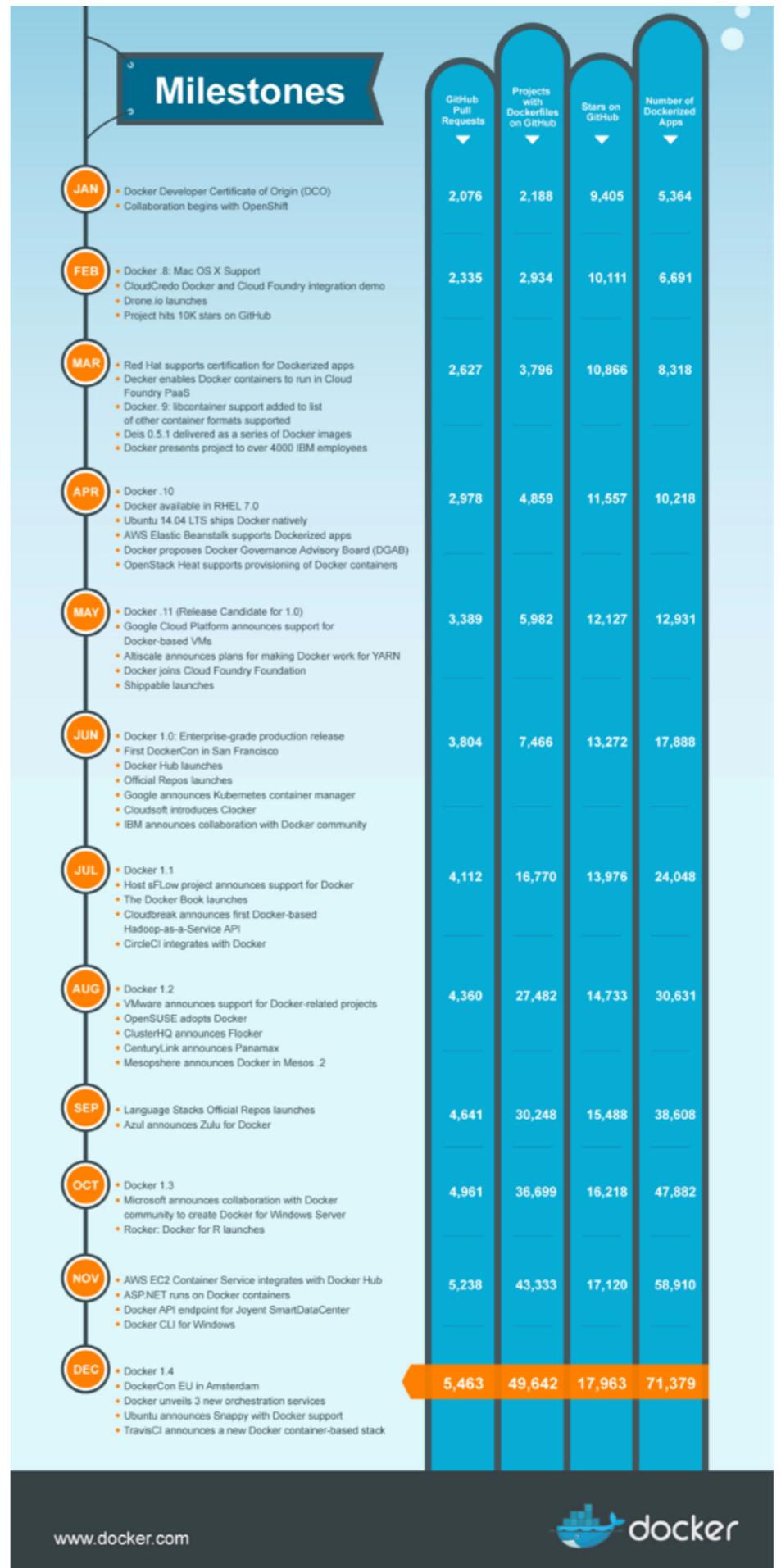
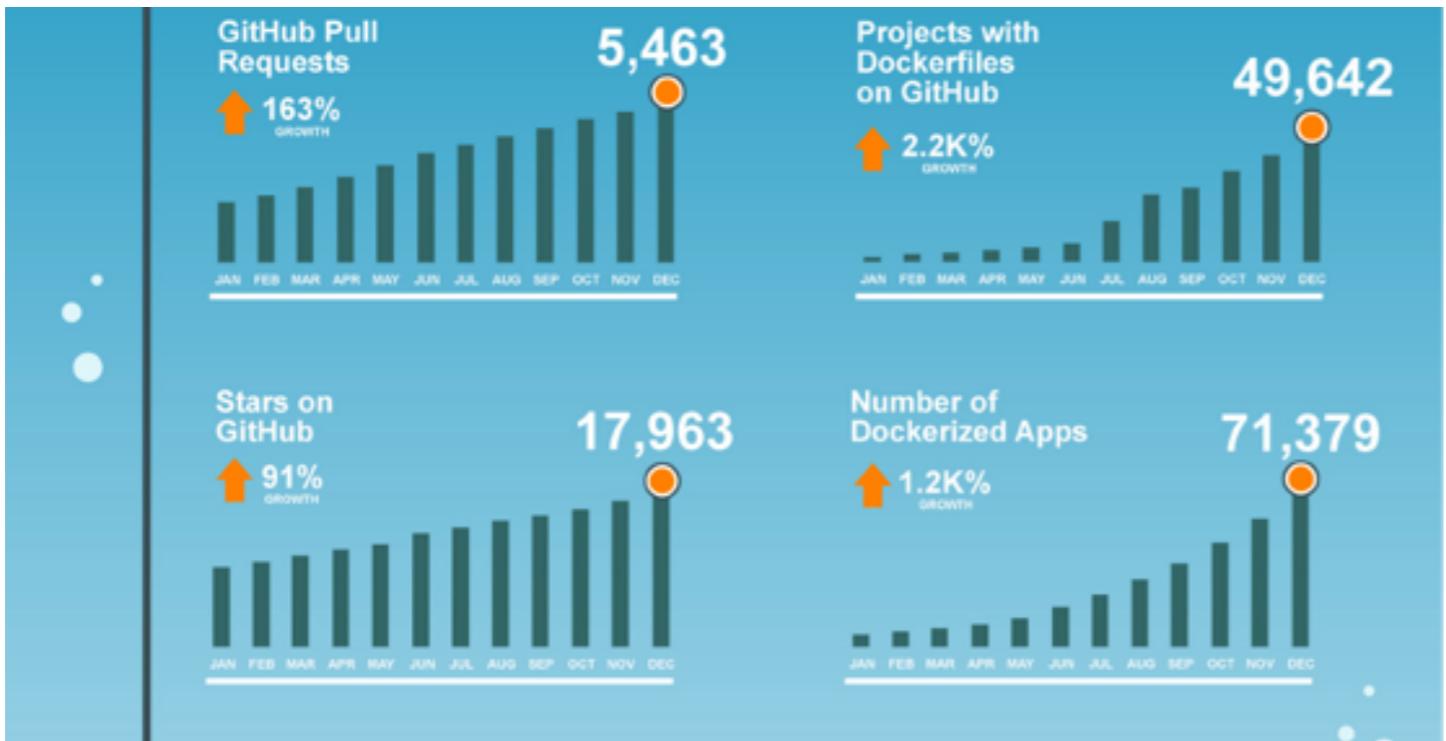
66.3 Million

NOV

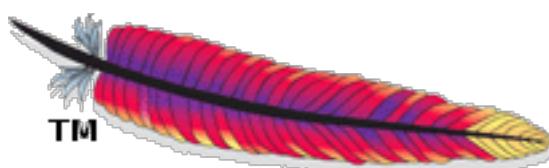
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DEC





Application Operating Environment



Kubernetes



Kubernetes



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Kubernetes



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- Provide declarative primitives for the “desired state”

Kubernetes



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Kubernetes



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 - Re-scheduling
 - Replicating

Key Concepts



Key Concepts



- **Pods:** Smallest deployable unit that can be created, scheduled, managed (logical collection of containers)

Key Concepts



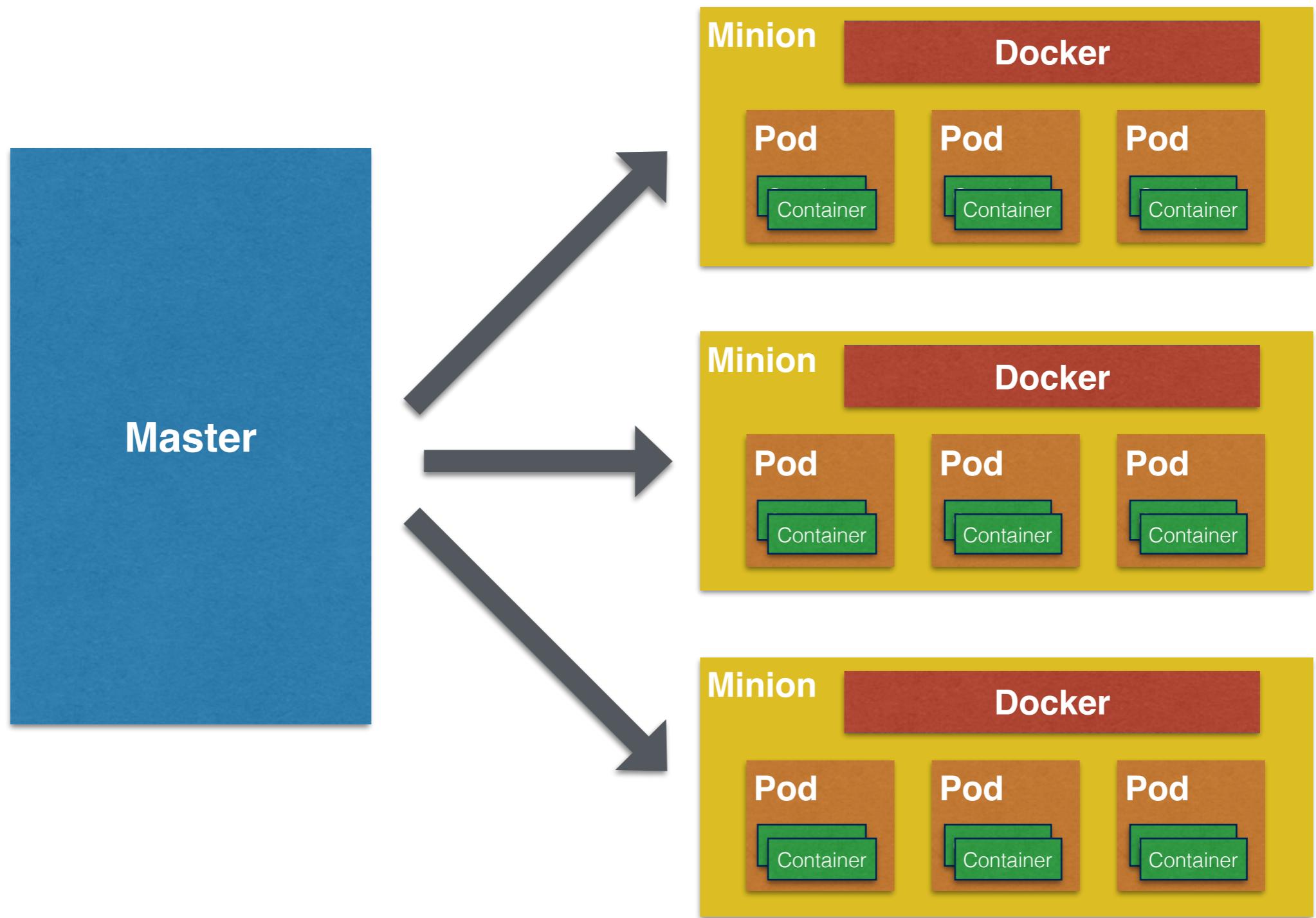
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Key Concepts



- **Pods:** Smallest deployable unit that can be created, scheduled, managed (logical collection of containers)
- **Master:** Central point that provides unified view of cluster, control one or more minions
- **Minion:** Run tasks from master

Kubernetes



kubectl

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- `kubectl get pods or minions`
- `kubectl create -f <filename>`
- `kubectl update or delete`
- `kubectl resize --replicas=3 replicationcontrollers <name>`

```
{  
    "id": "mysql",  
    "kind": "Pod",  
    "apiVersion": "v1beta1",  
    "desiredState": {  
        "manifest": {  
            "version": "v1beta1",  
            "id": "mysql",  
            "containers": [ {  
                "name": "mysql",  
                "image": "mysql",  
                "cpu": 100,  
                "ports": [ {  
                    "containerPort": 3306,  
                    "hostPort": 3306  
                } ]  
            } ]  
        }  
    },  
    "labels": {  
        "name": "mysql"  
    }  
}
```

```
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        } ]
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    }
  }
}

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    },
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    }
  }
}
```

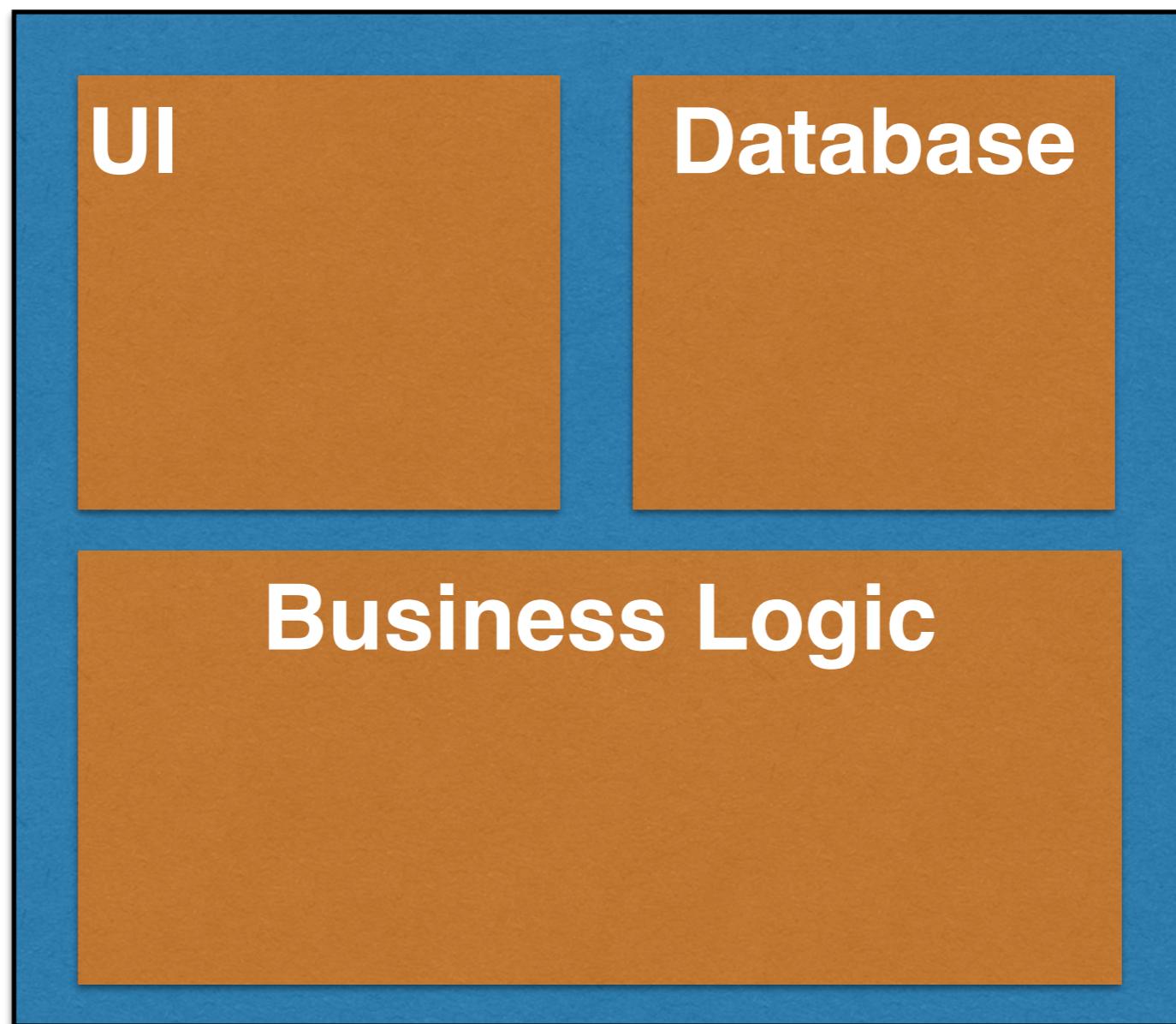
Microservices

*building applications as **suites of services**. As well as the fact that services are **independently deployable and scalable**, each service also provides a **firm module boundary**, even allowing for different services to be written in **different programming languages**. They can also be **managed by different teams***

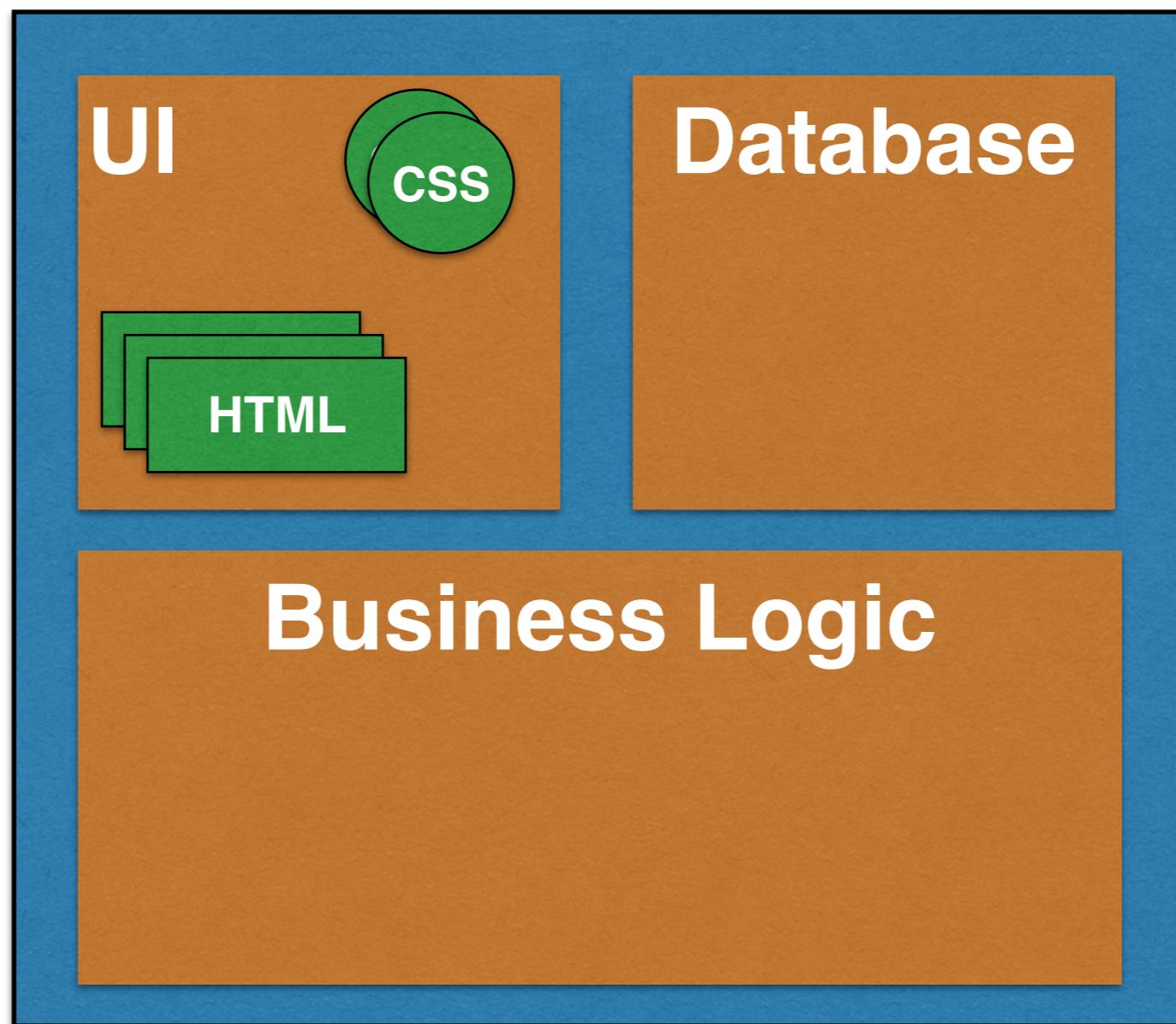
Is it SOA?

- SOA for hipsters?
- Fine-grained SOA?
- Focus on ESBs in SOA?
- SOA done right?

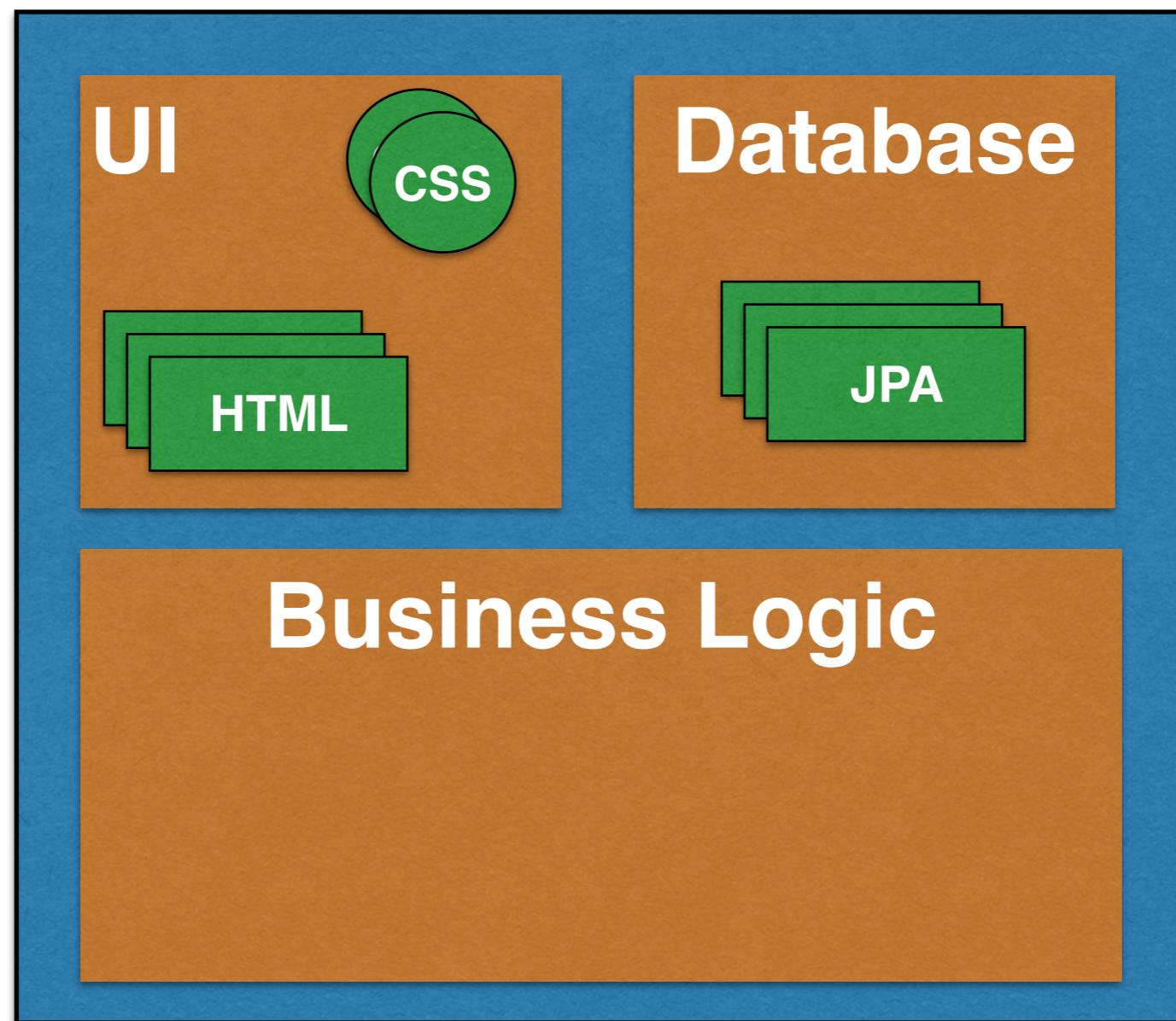
Monolith Application



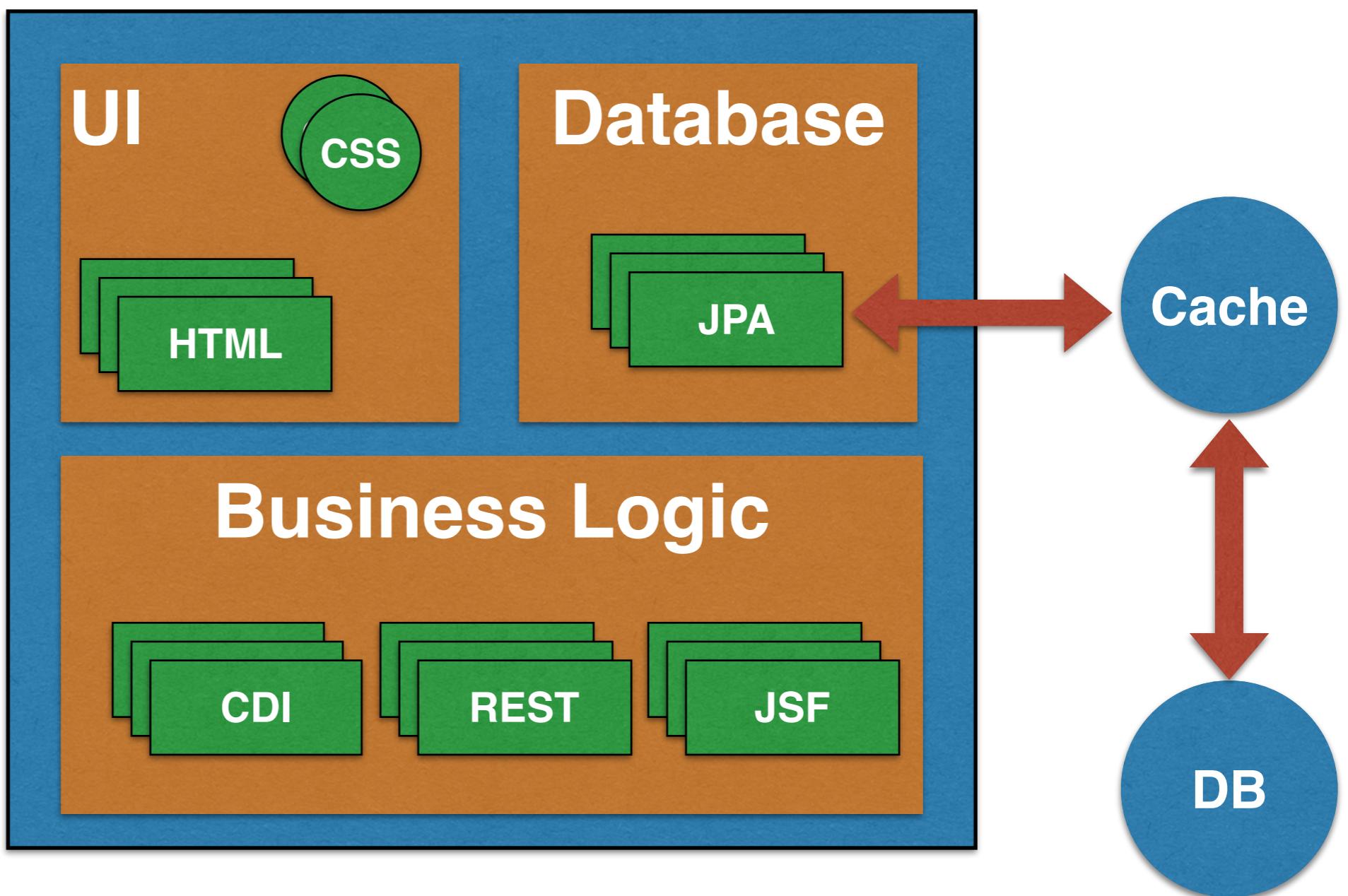
Monolith Application



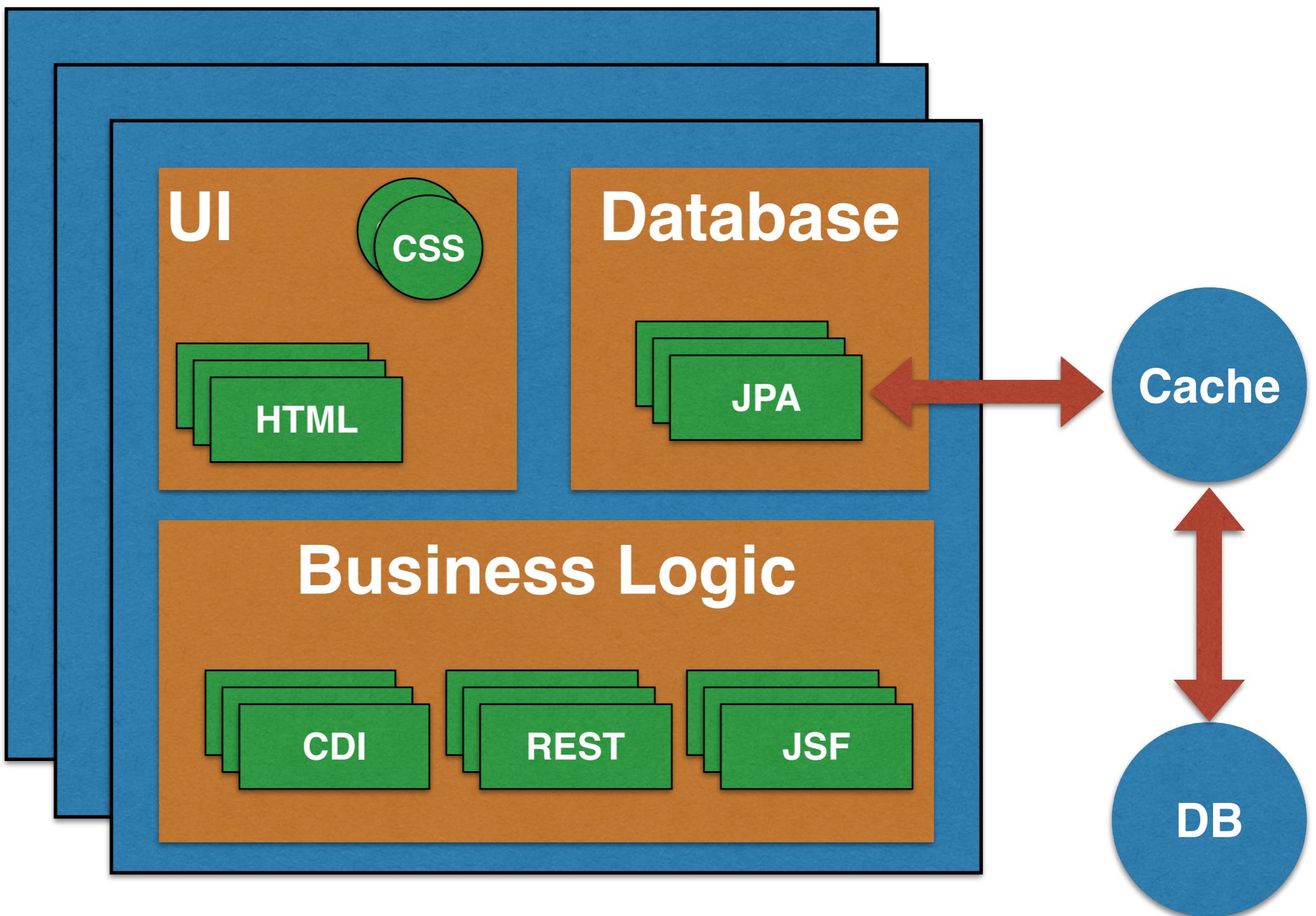
Monolith Application



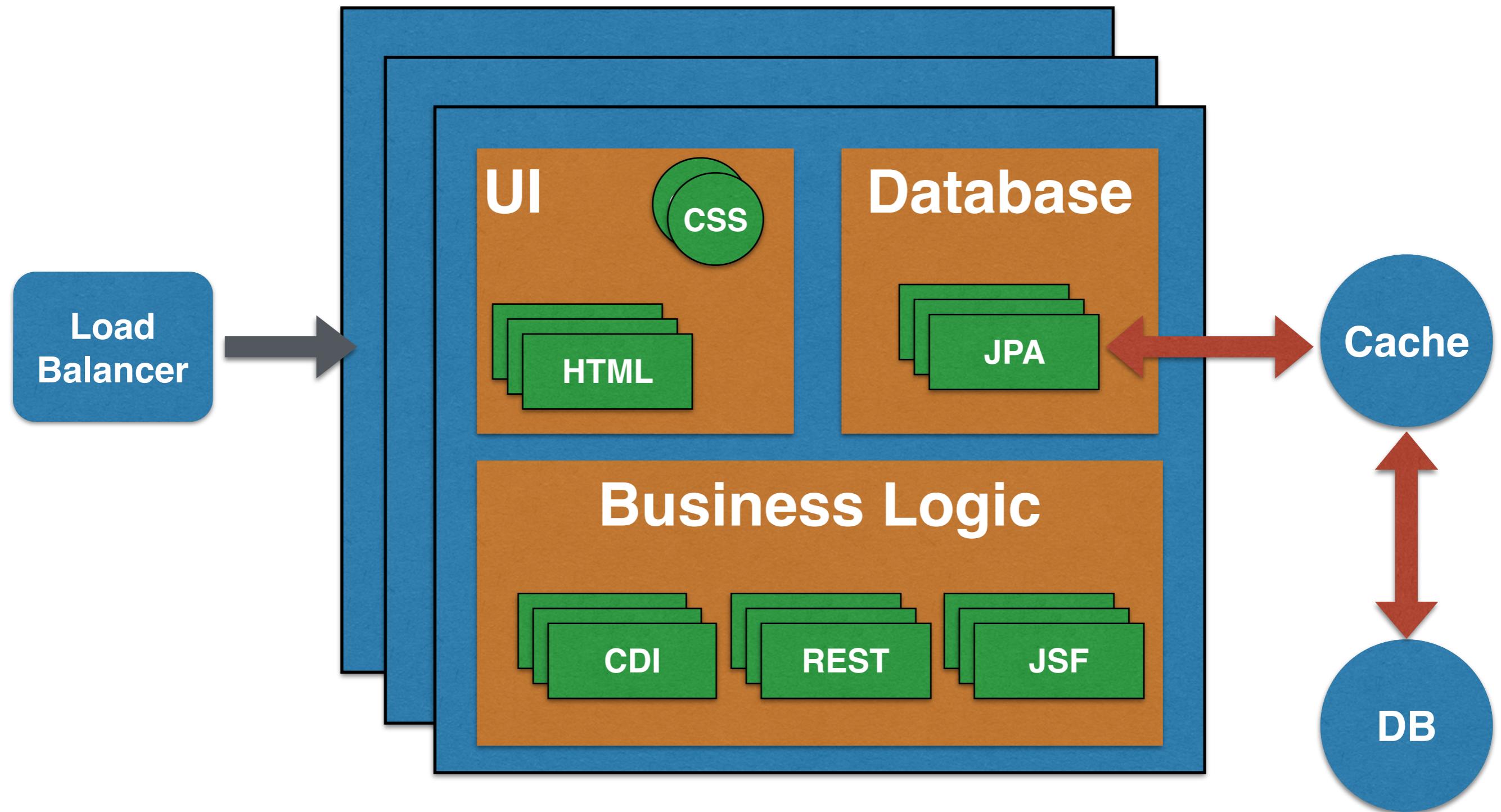
Monolith Application



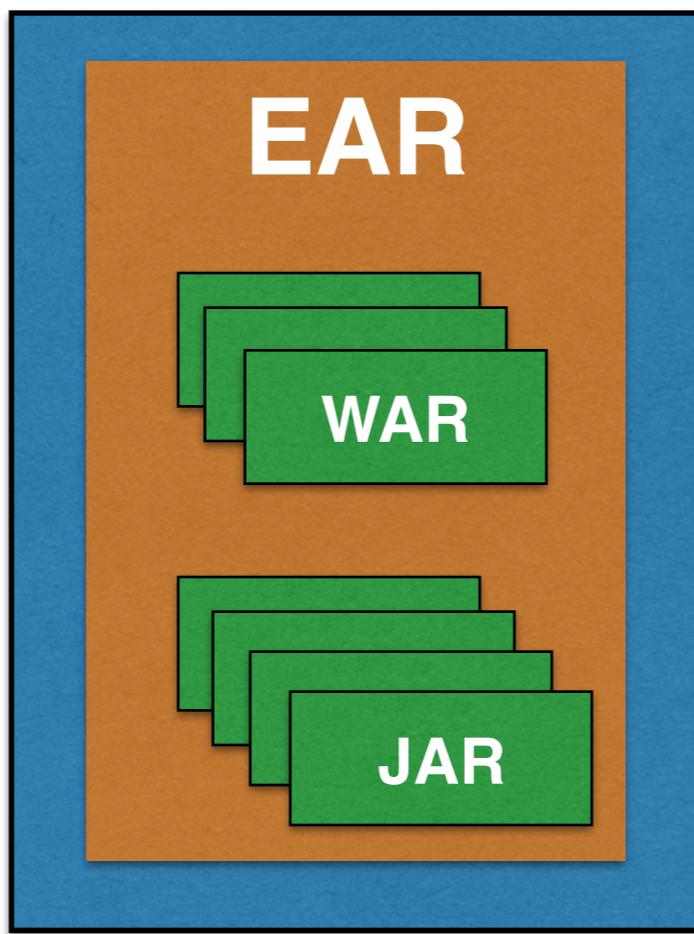
Monolith Application



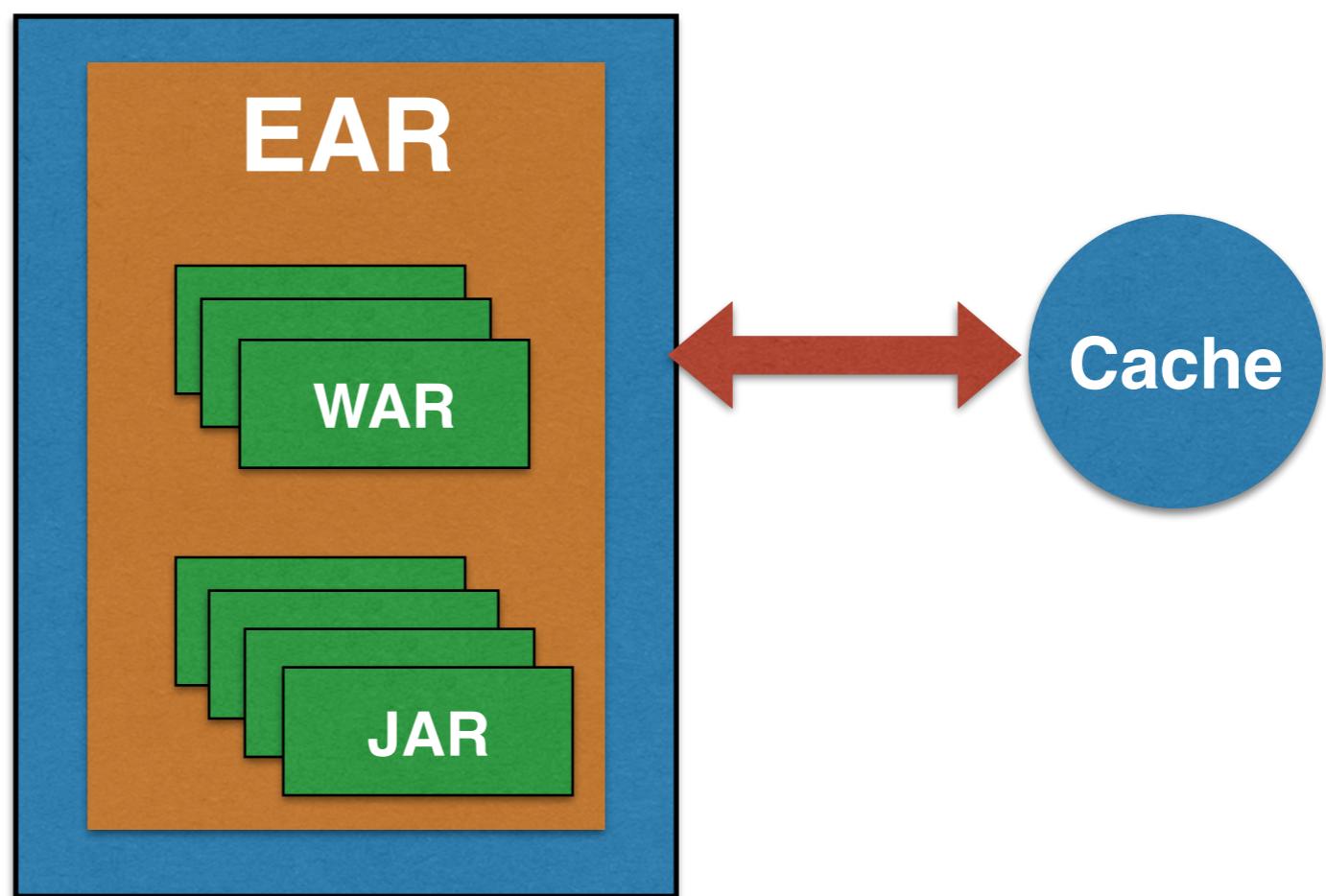
Monolith Application



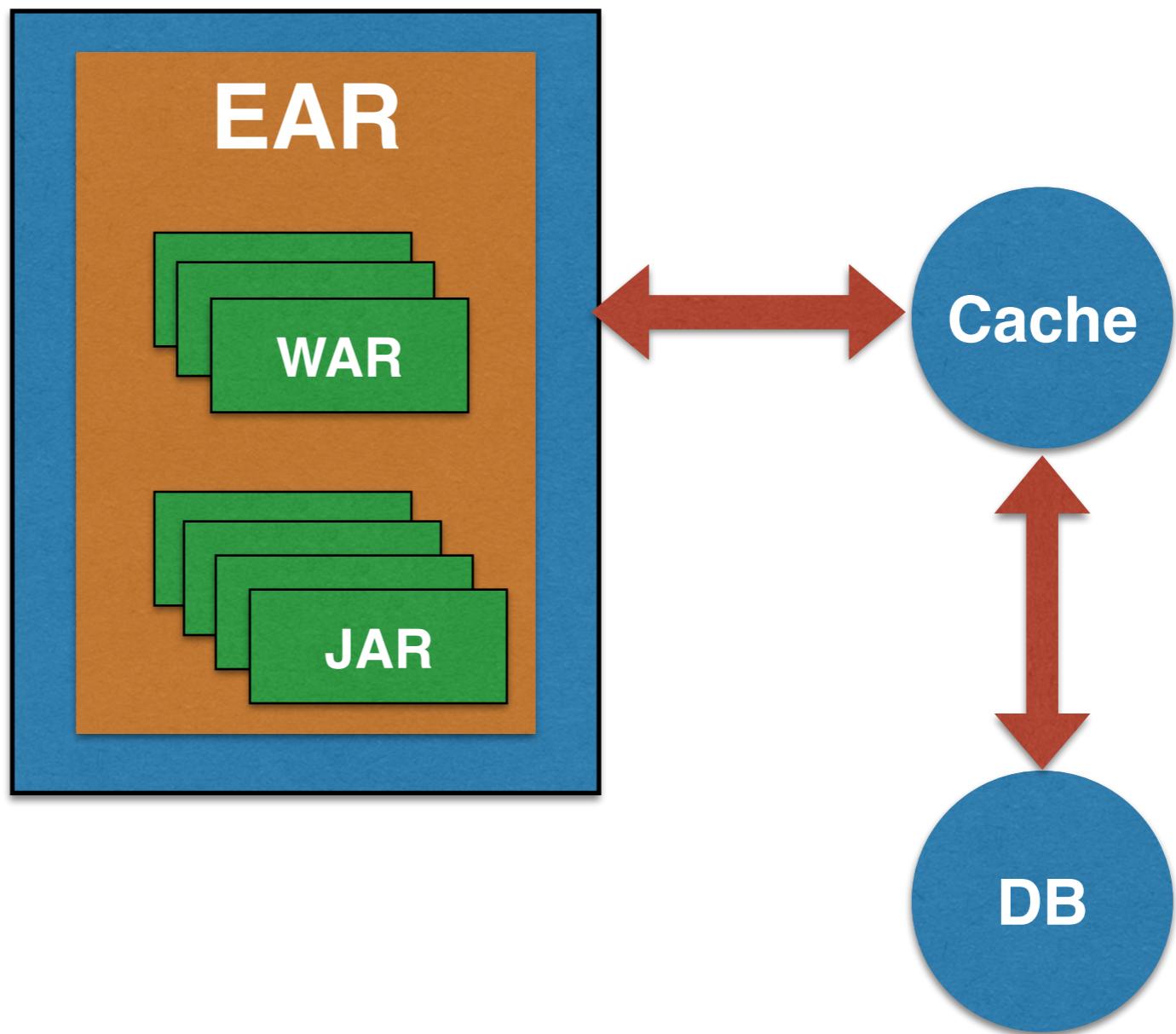
Before Microservices



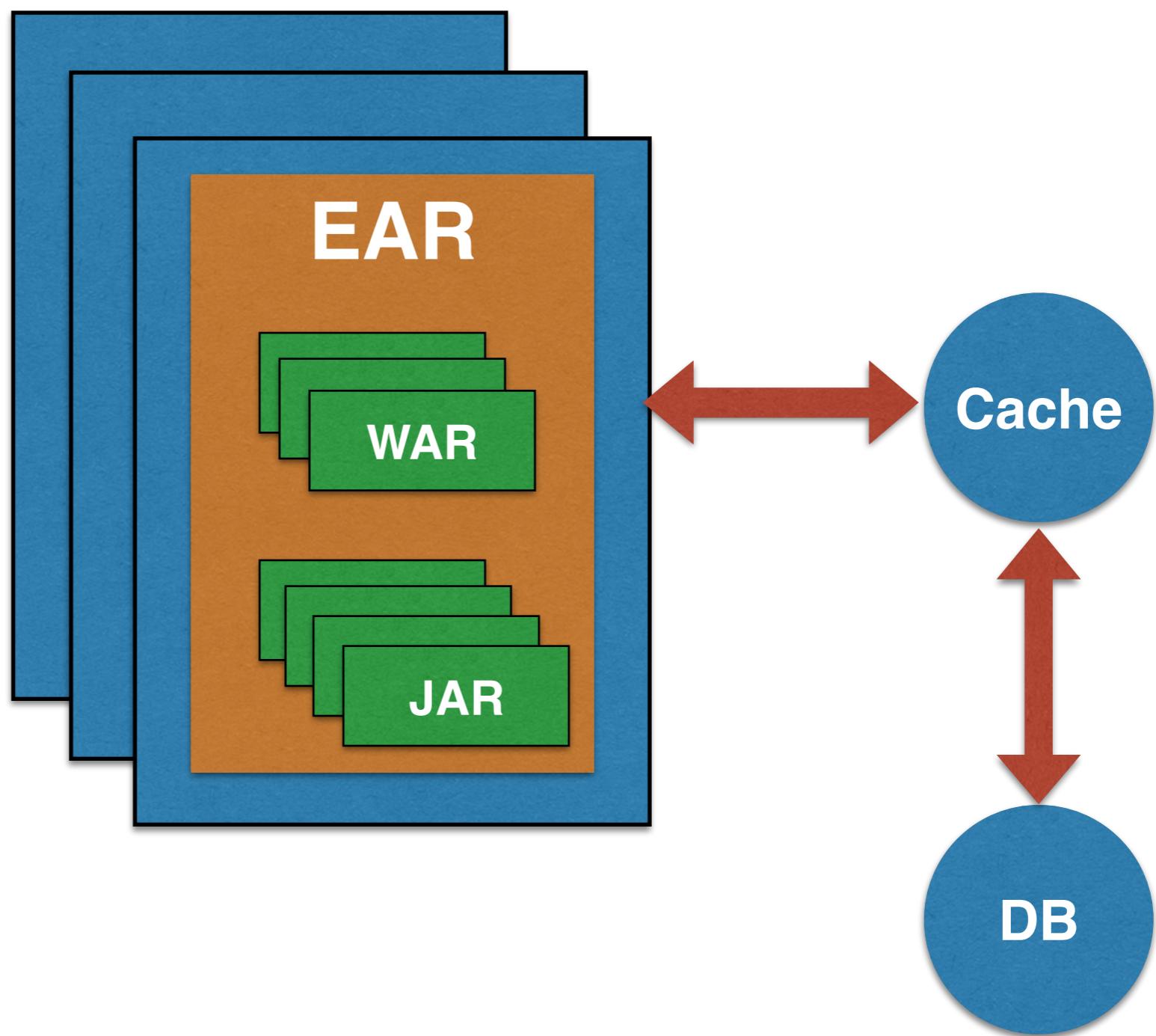
Before Microservices



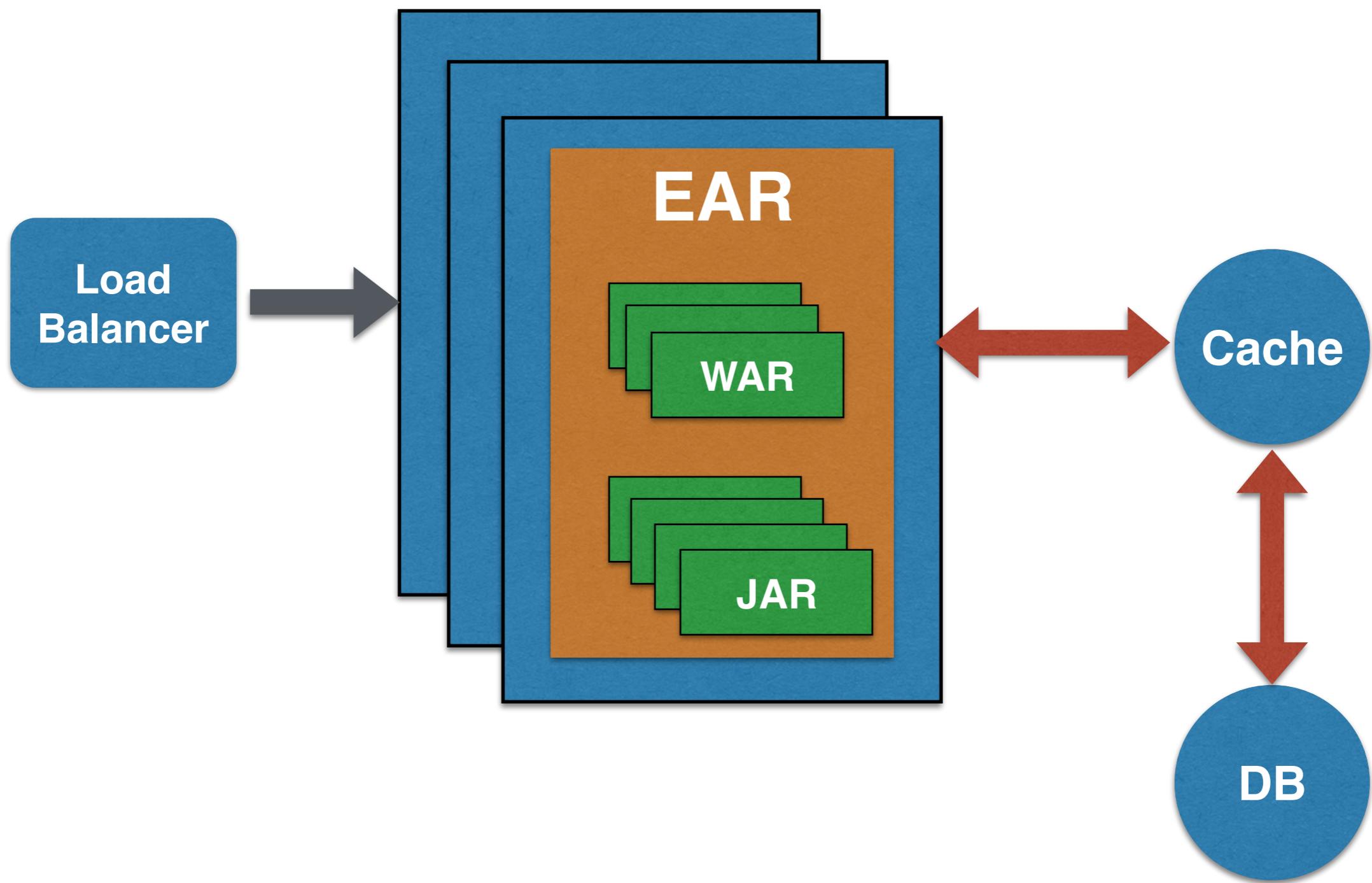
Before Microservices



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- Easy to test (all required services are up)

Disadvantages of Monolith Application

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- Difficult to develop and maintain

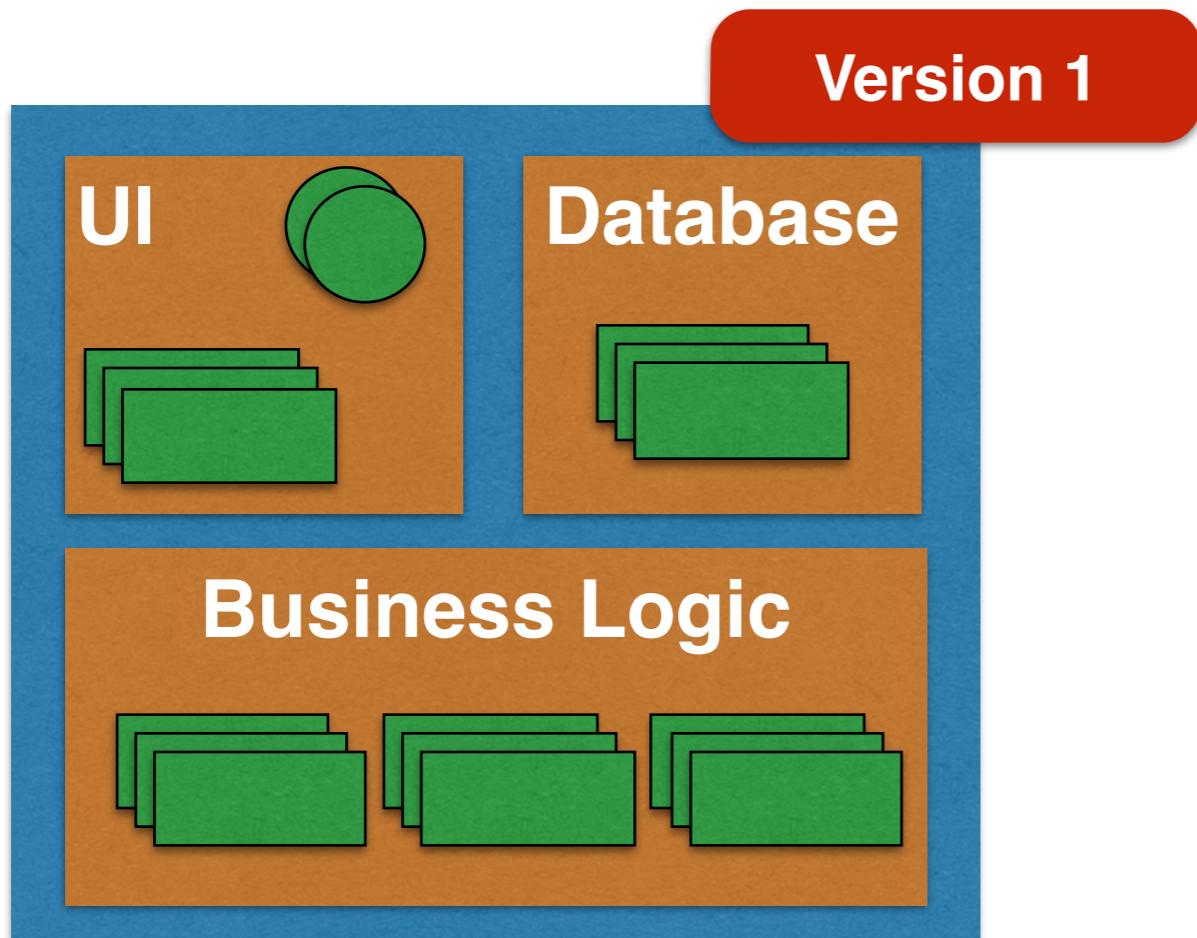
Disadvantages of Monolith Application

- Difficult to develop and maintain
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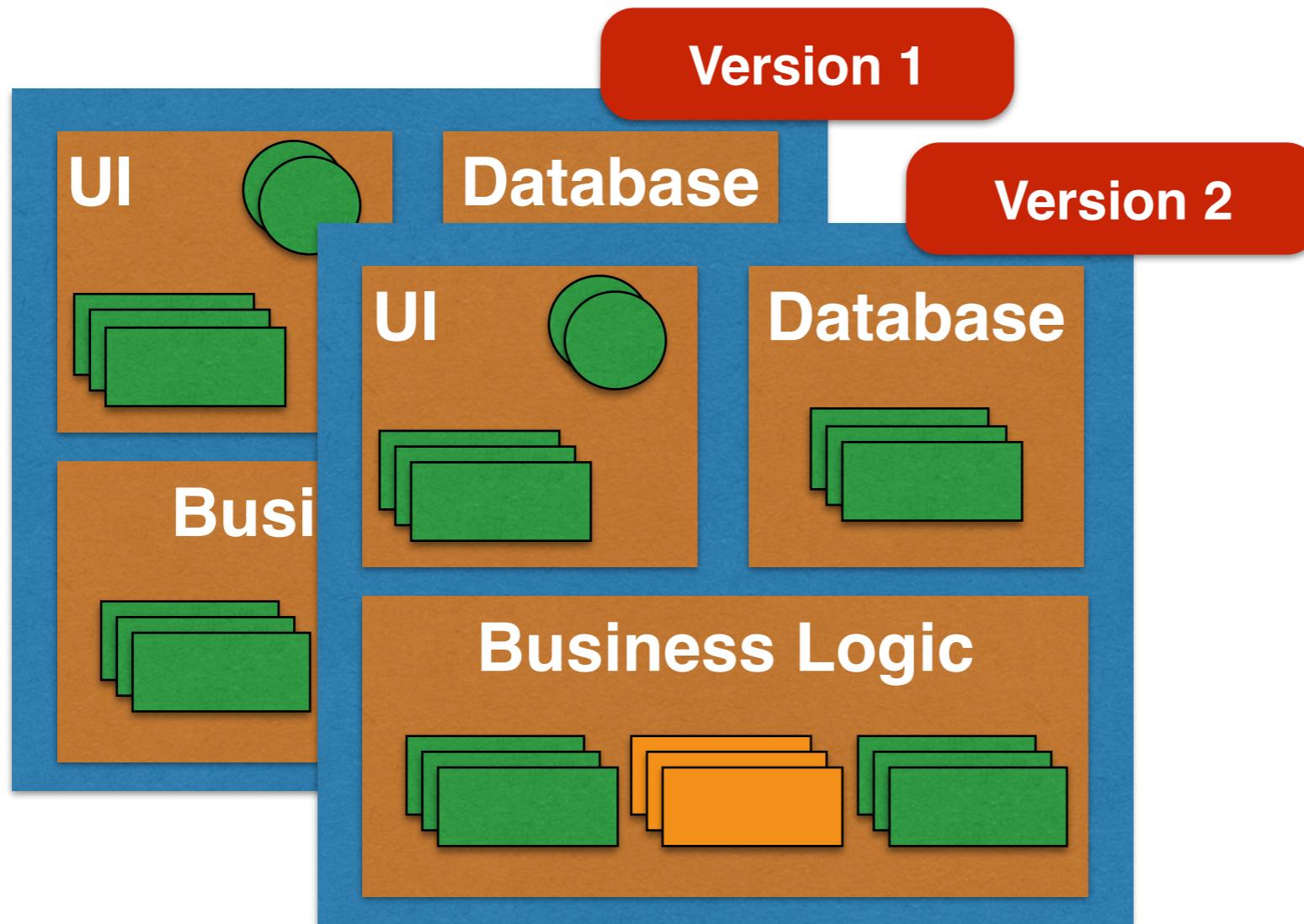
Disadvantages of Monolith Application

- Difficult to develop and maintain
- Obstacle to frequent deployments
- Makes it difficult to try out new technologies/
framework

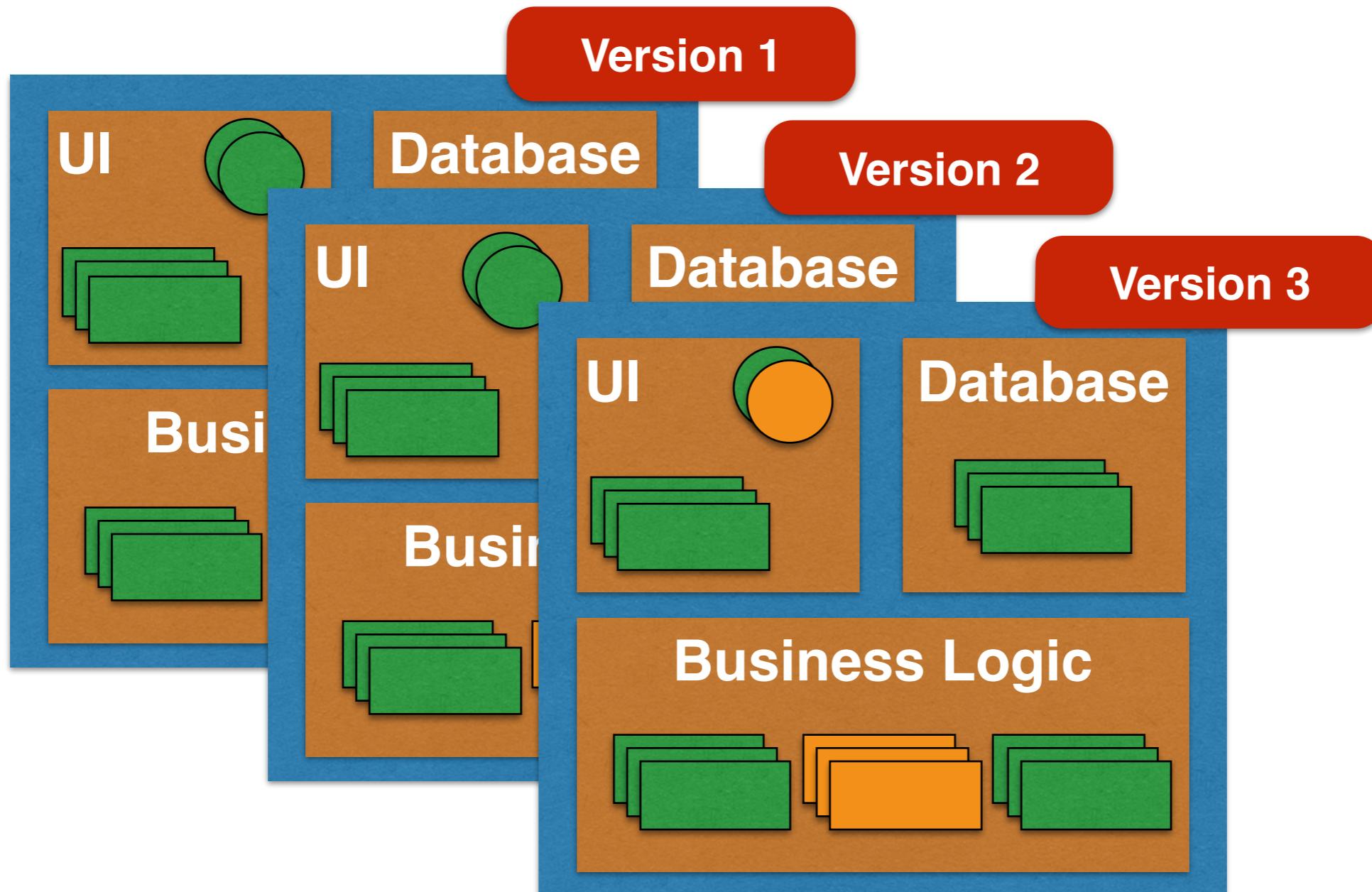
Monolith Application



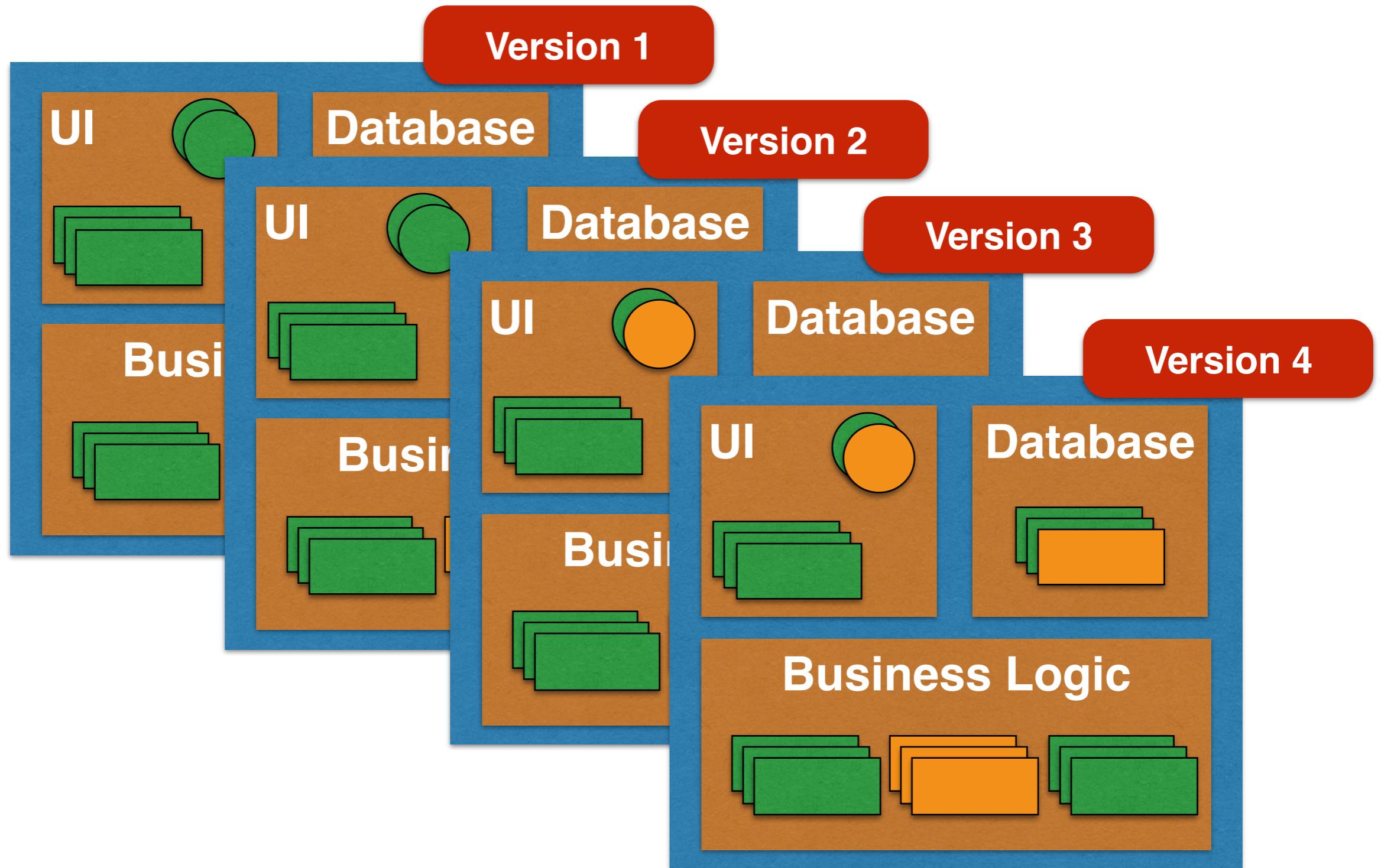
Monolith Application



Monolith Application



Monolith Application



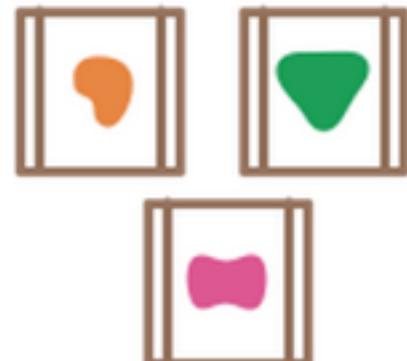
A monolithic application puts all its functionality into a single process...



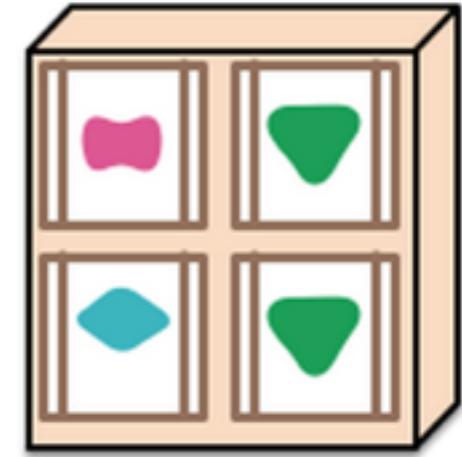
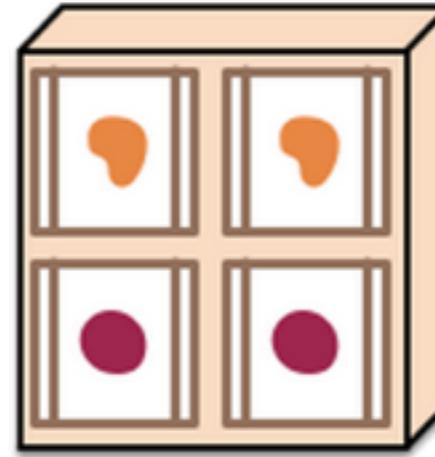
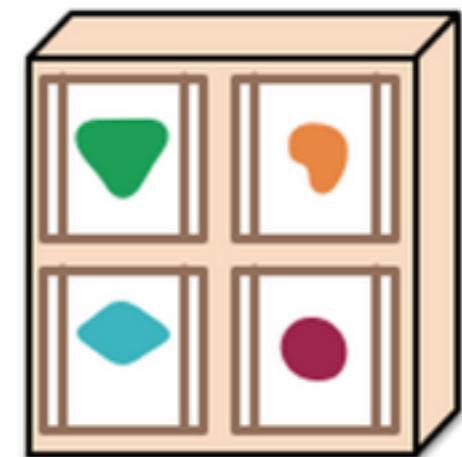
... and scales by replicating the monolith on multiple servers



A microservices architecture puts each element of functionality into a separate service...



... and scales by distributing these services across servers, replicating as needed.



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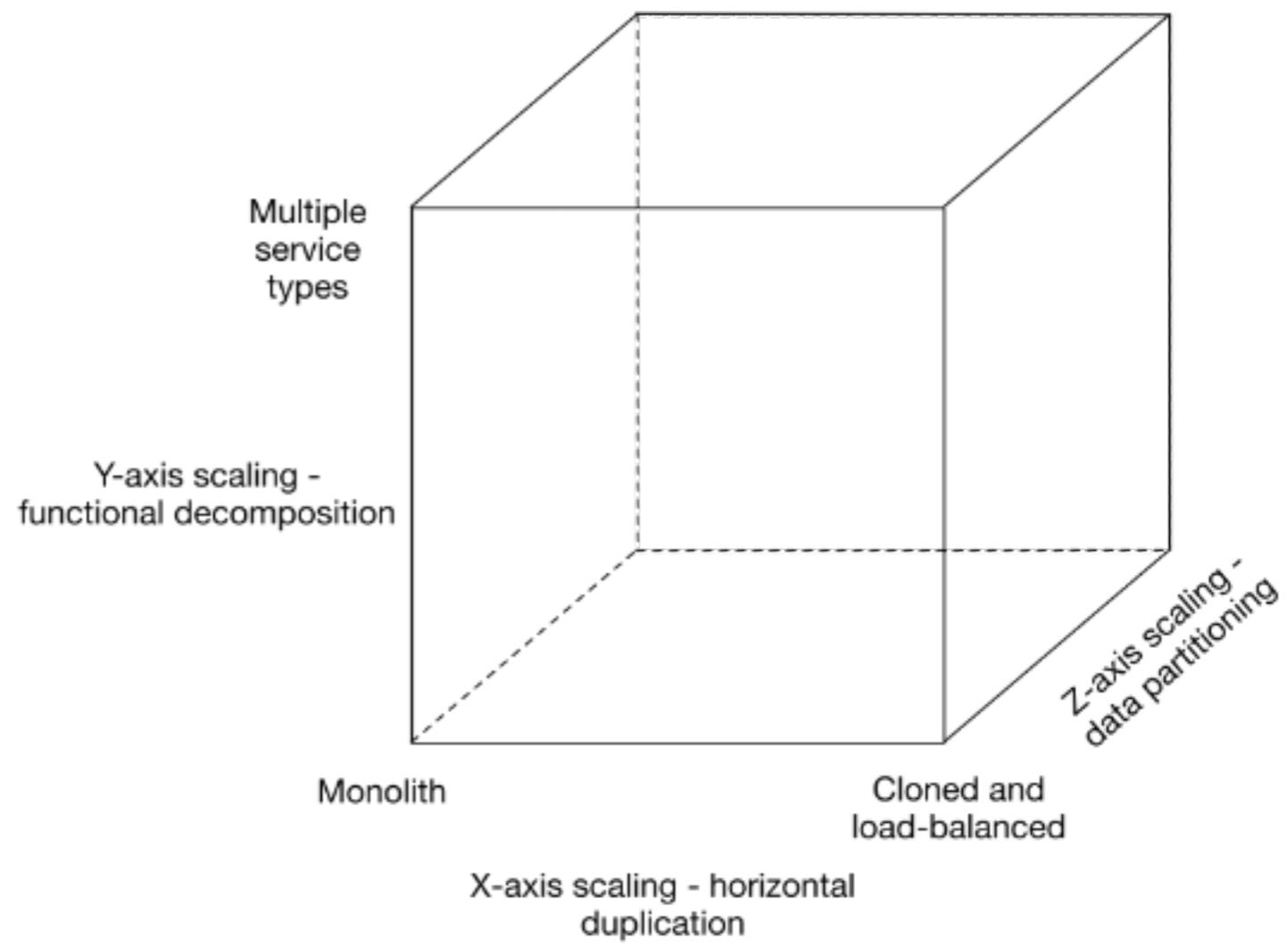
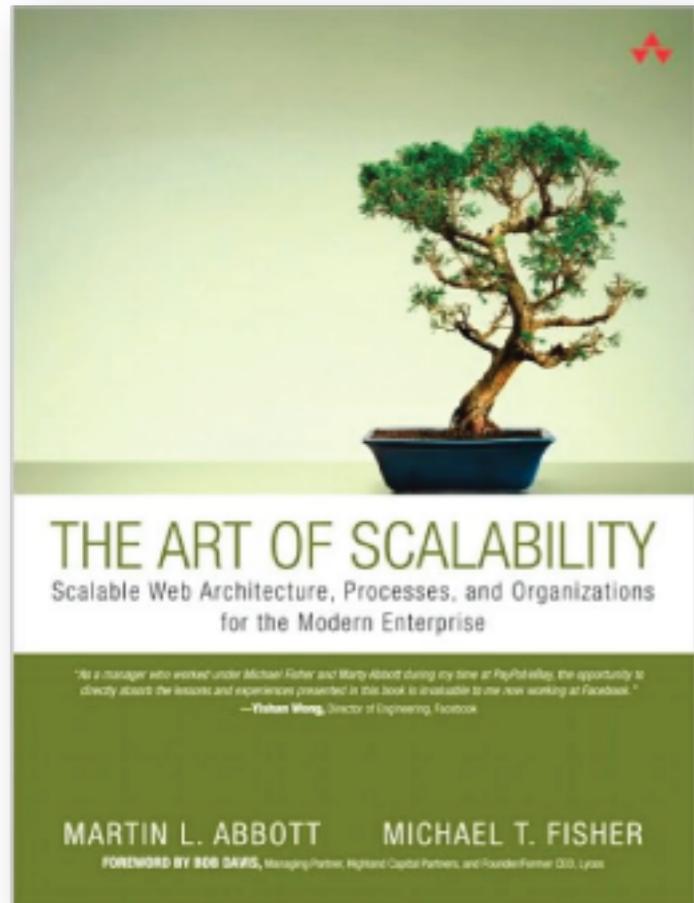
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Decompose applications into microservices



Strategies for decomposing

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- Verb or usecase - e.g. Checkout UI

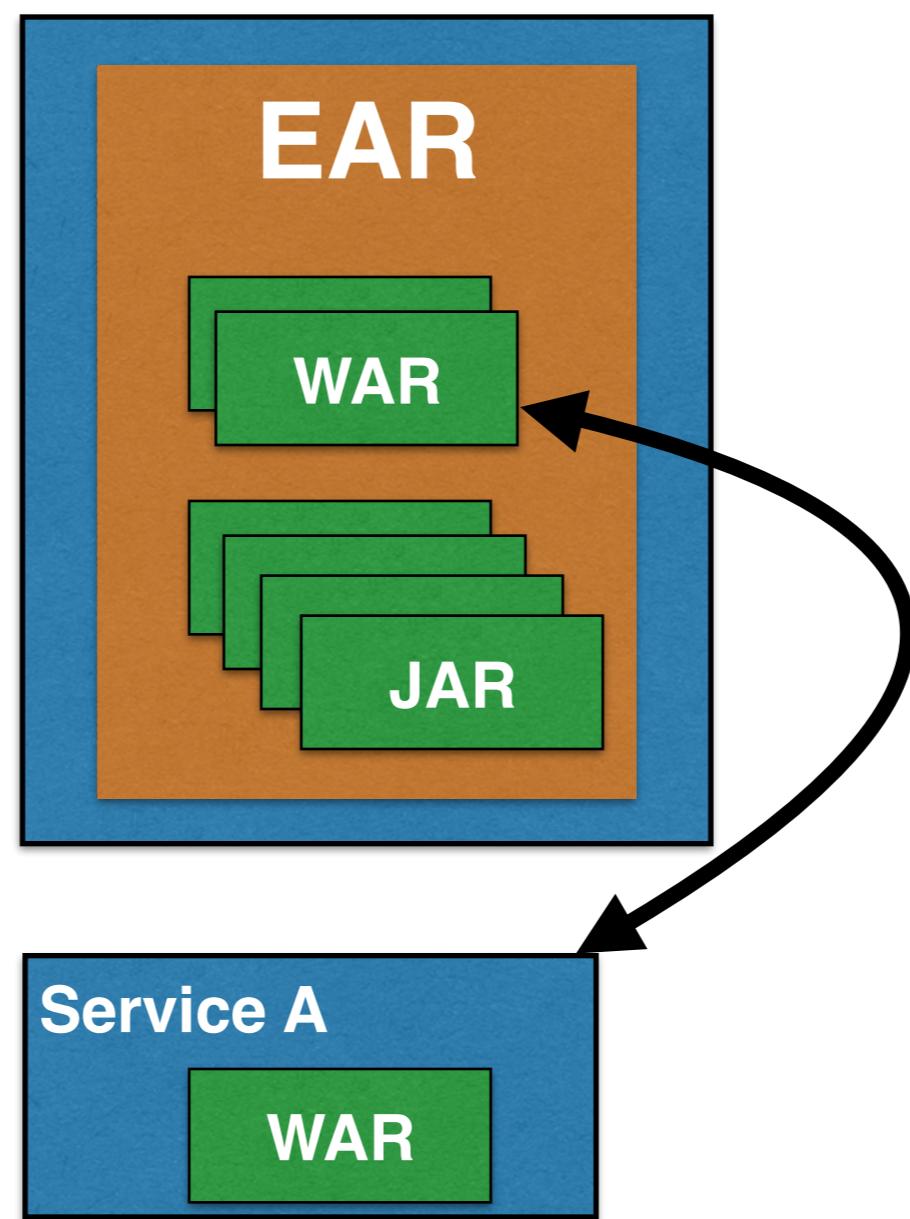
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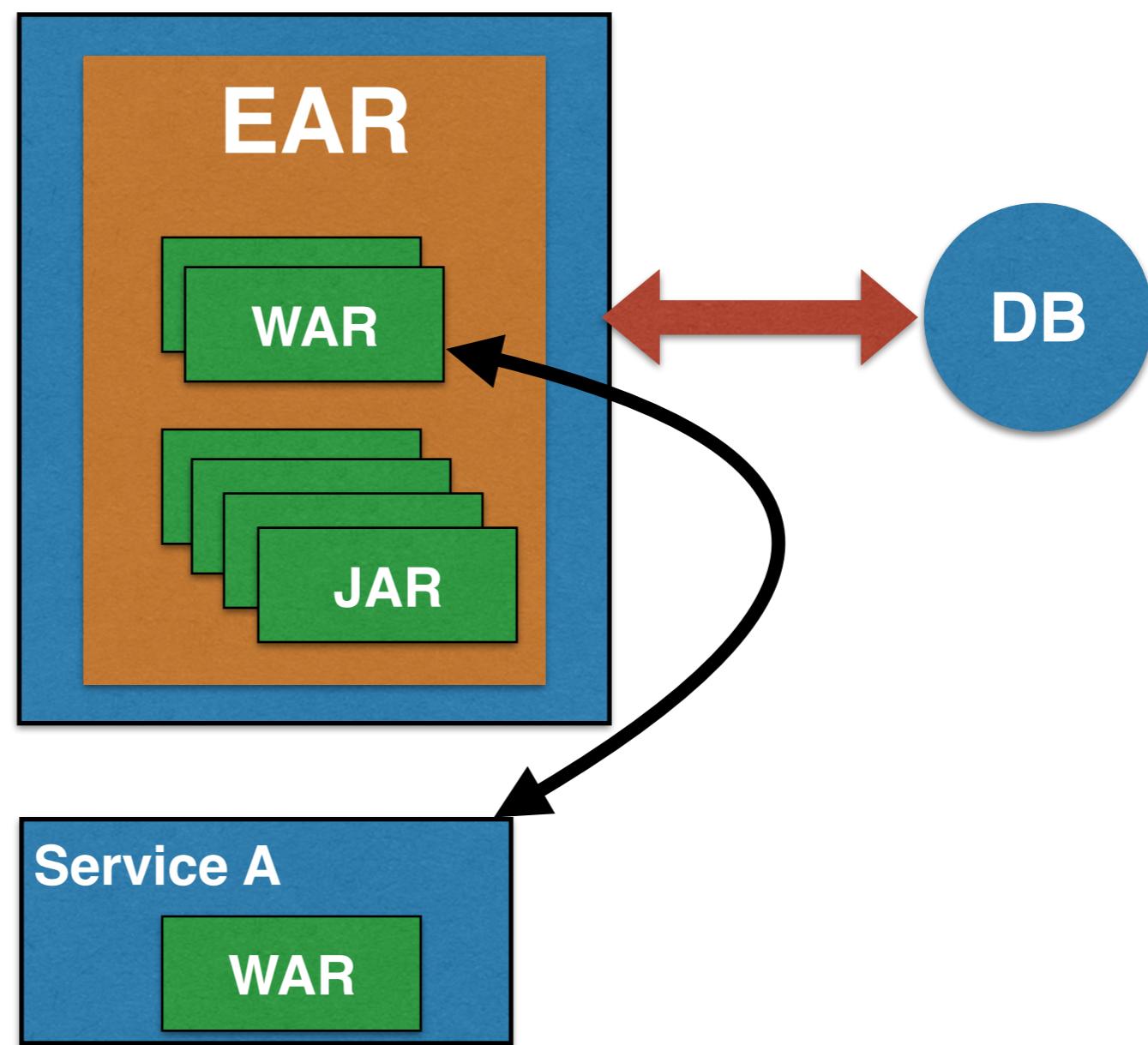
Strategies for decomposing

- Verb or usecase - e.g. Checkout UI
- Noun - e.g. Catalog product service
- Single Responsible Principle - e.g. Unix utilities

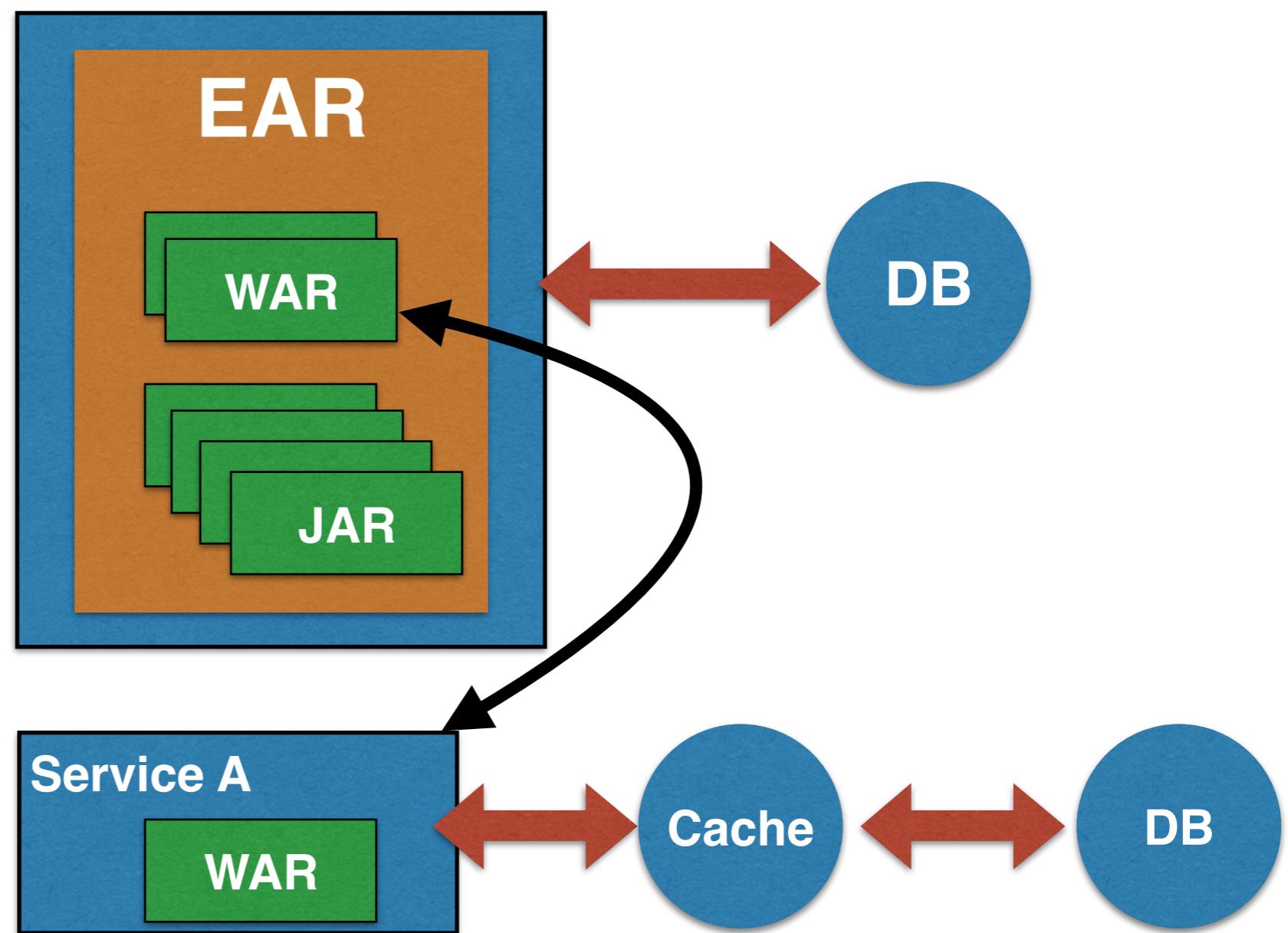
Towards Microservices



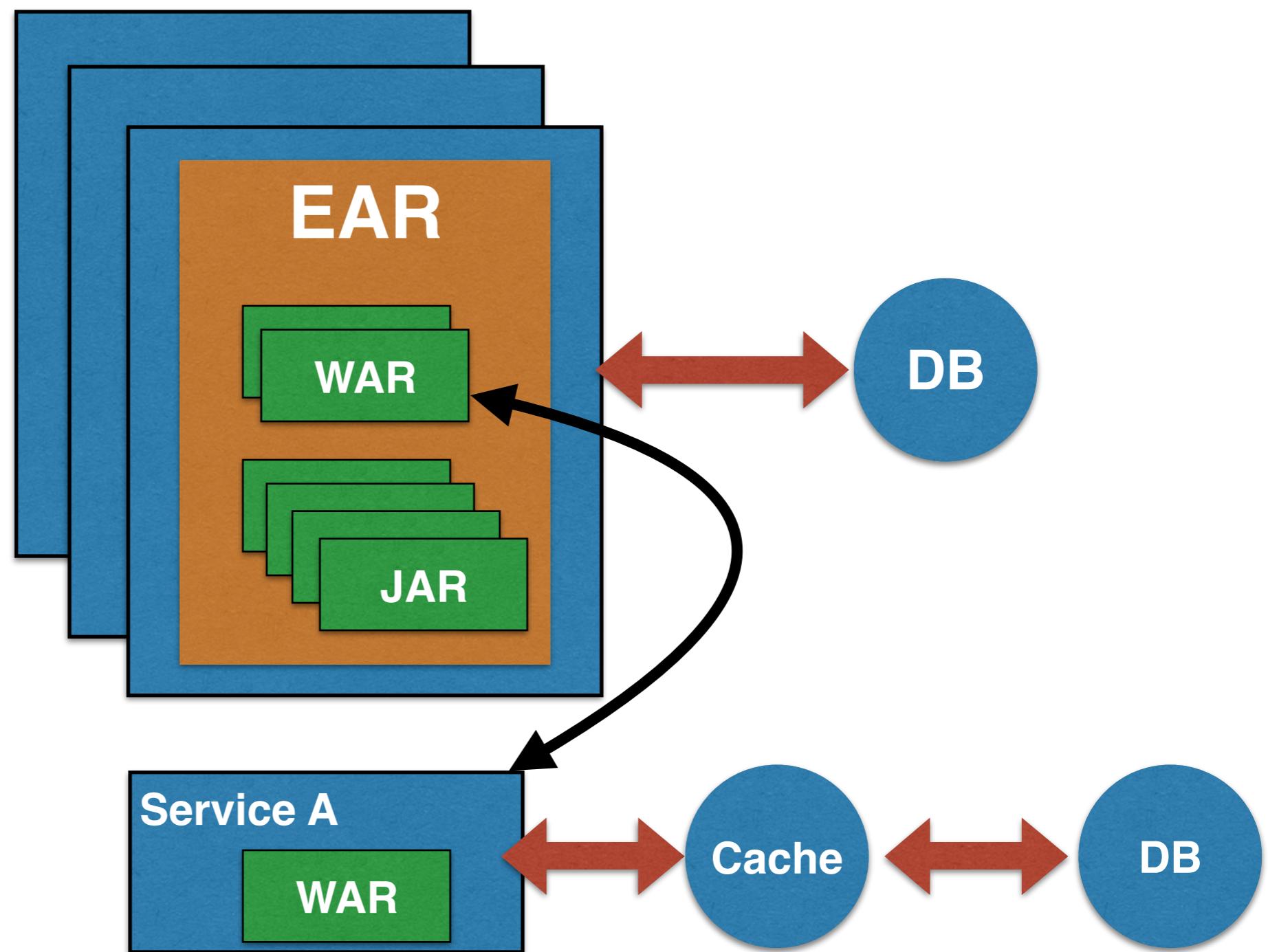
Towards Microservices



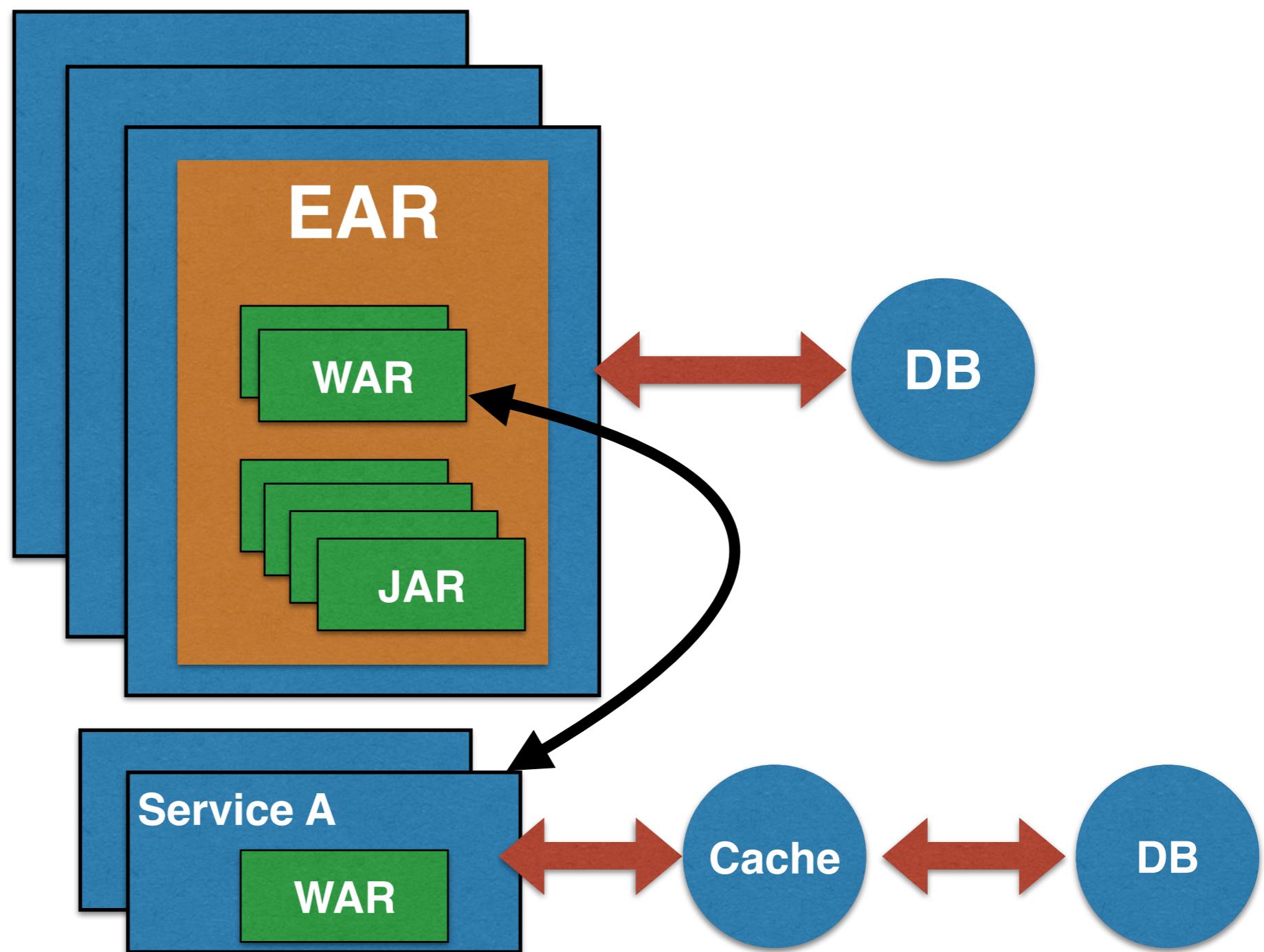
Towards Microservices



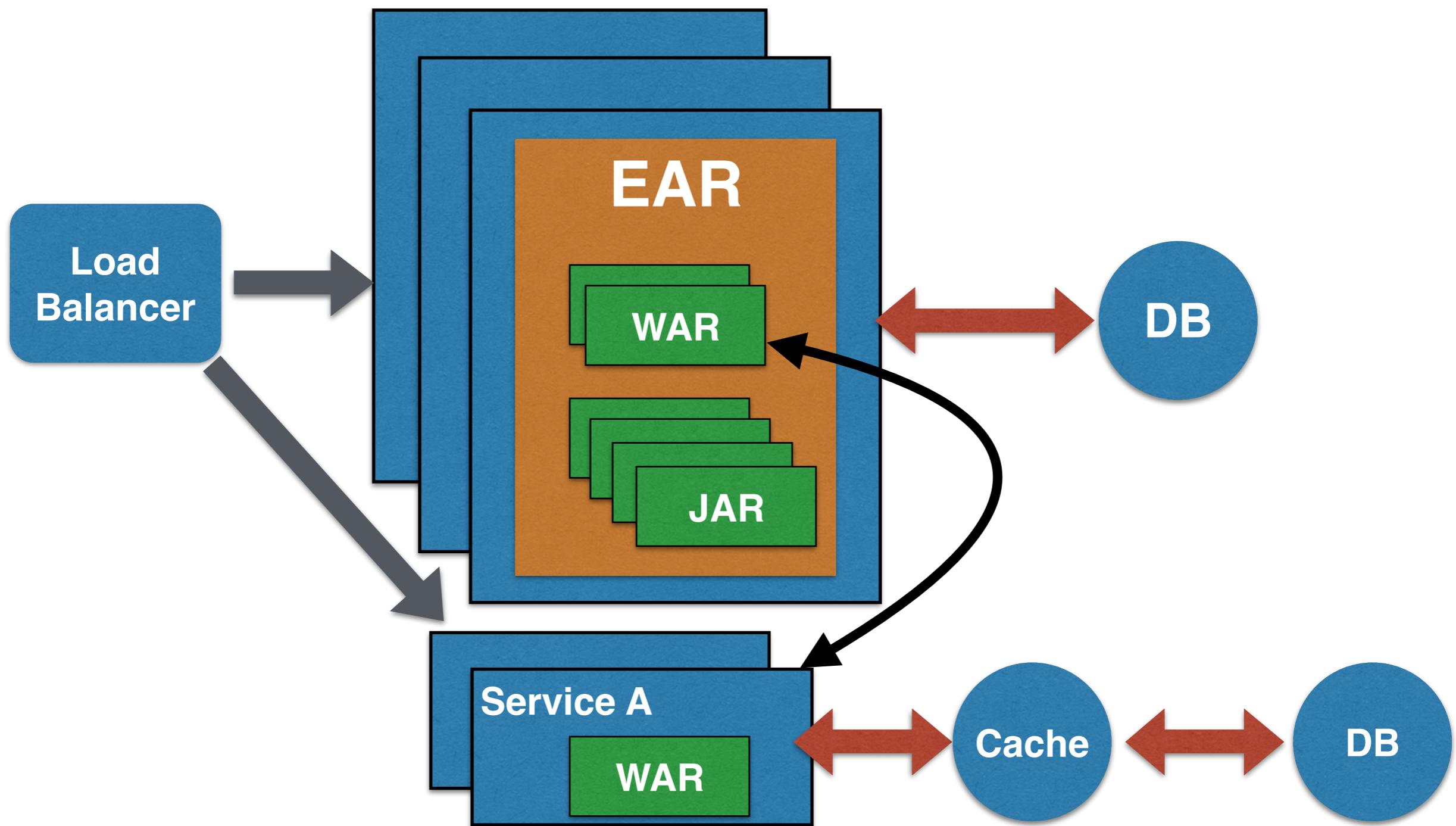
Towards Microservices



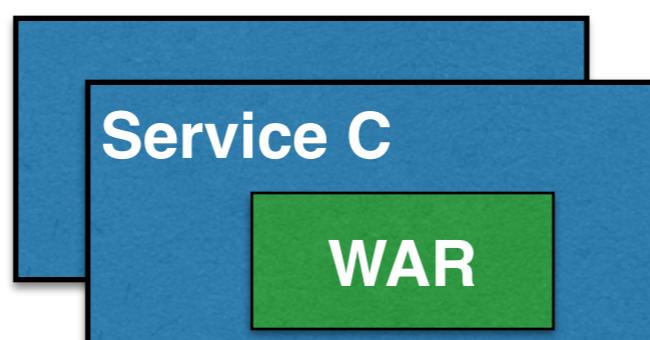
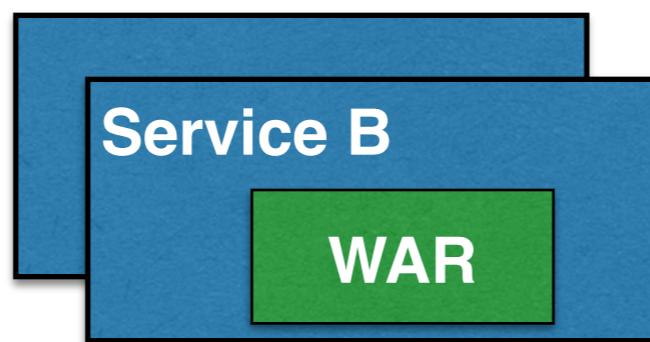
Towards Microservices



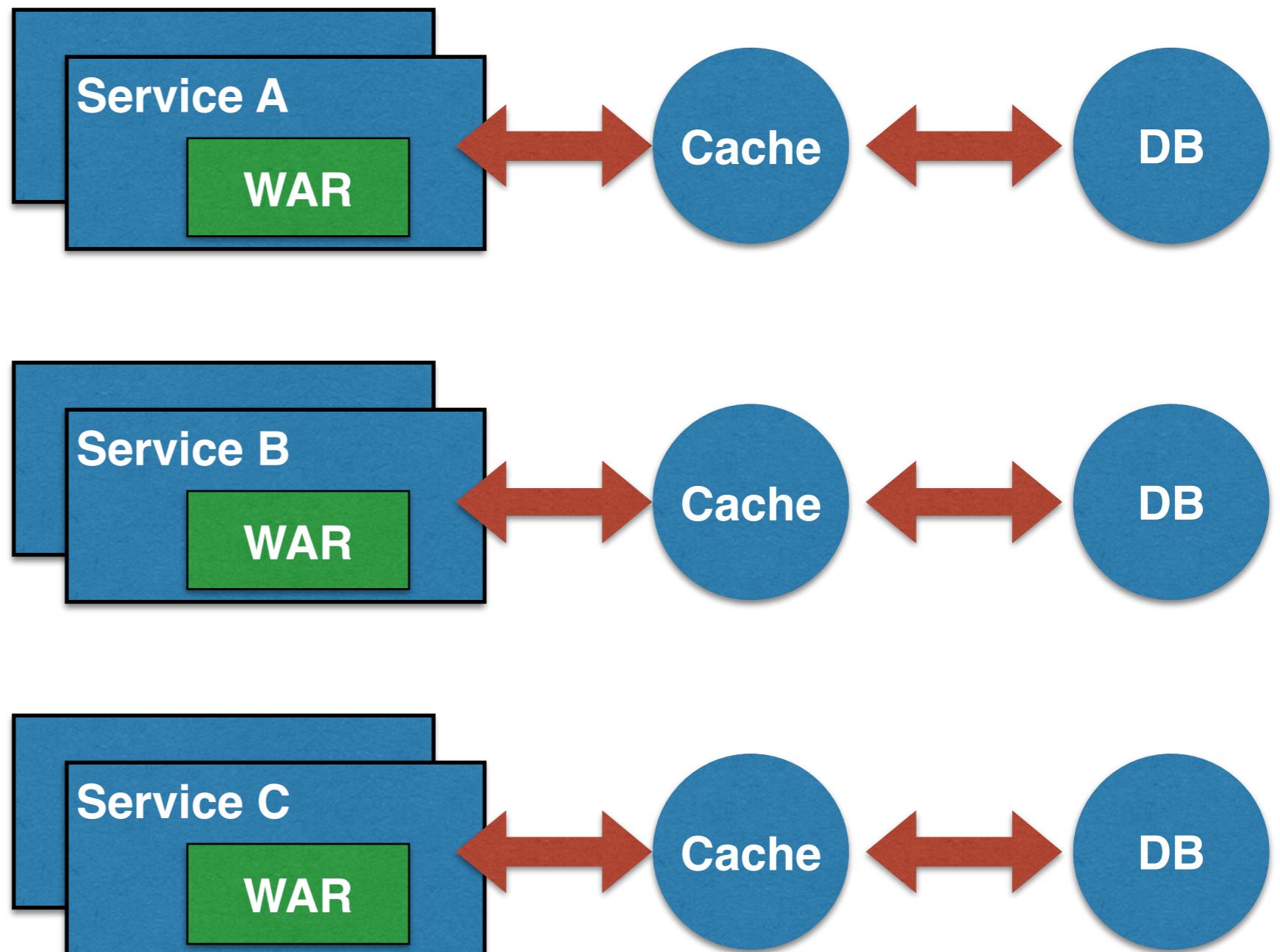
Towards Microservices



Aggregator Pattern #1

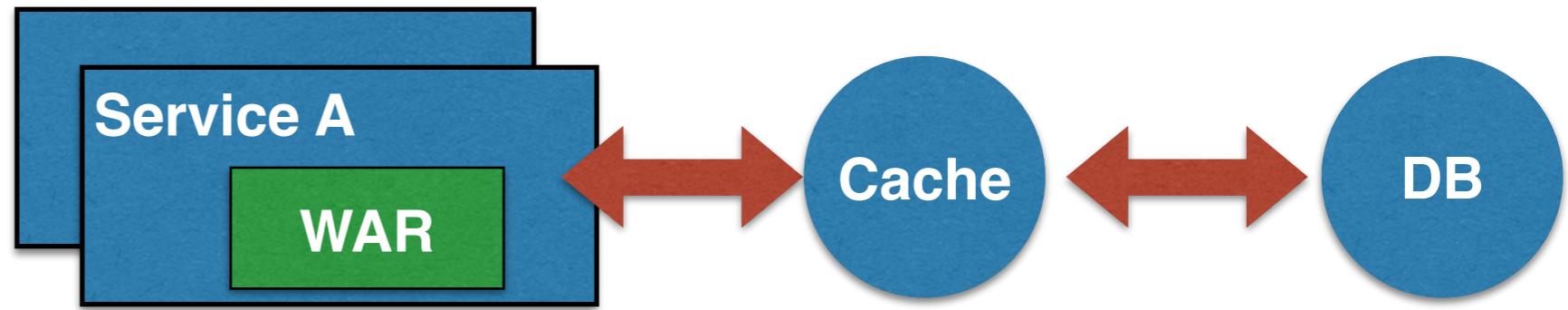


Aggregator Pattern #1

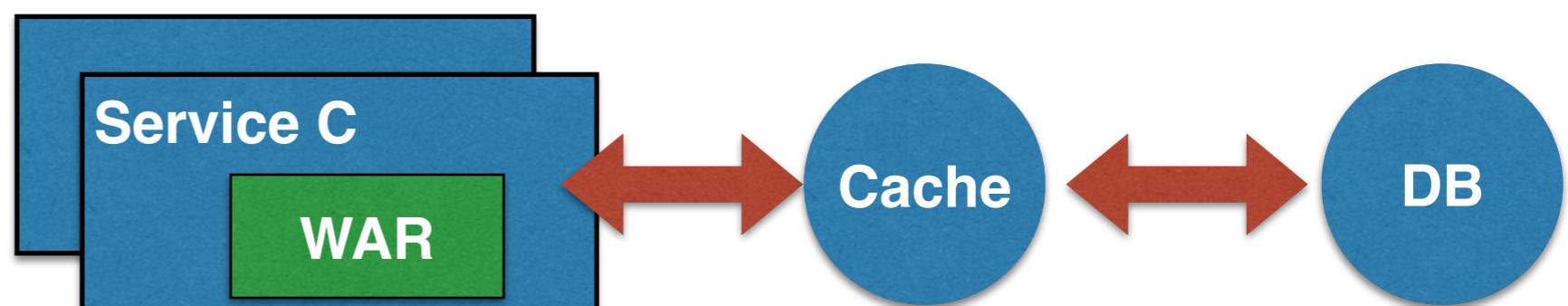
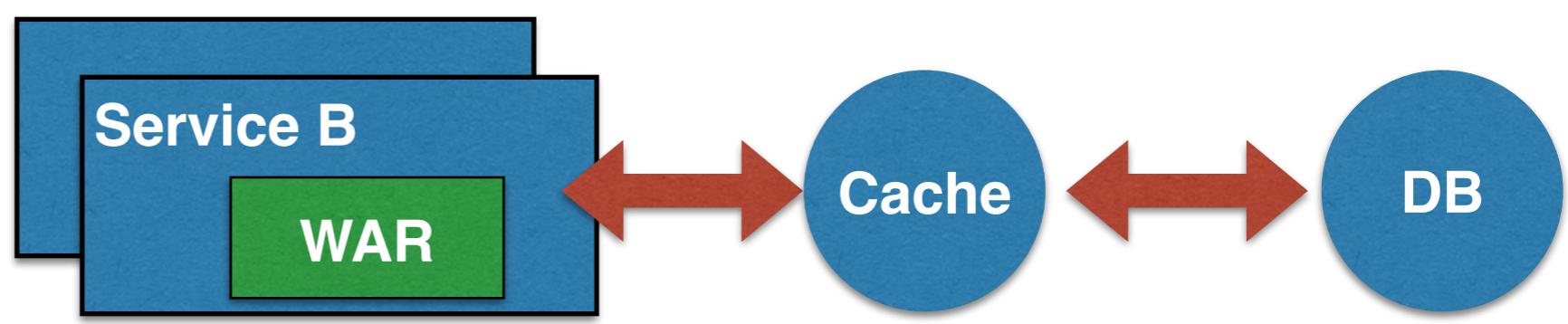


Aggregator Pattern #1

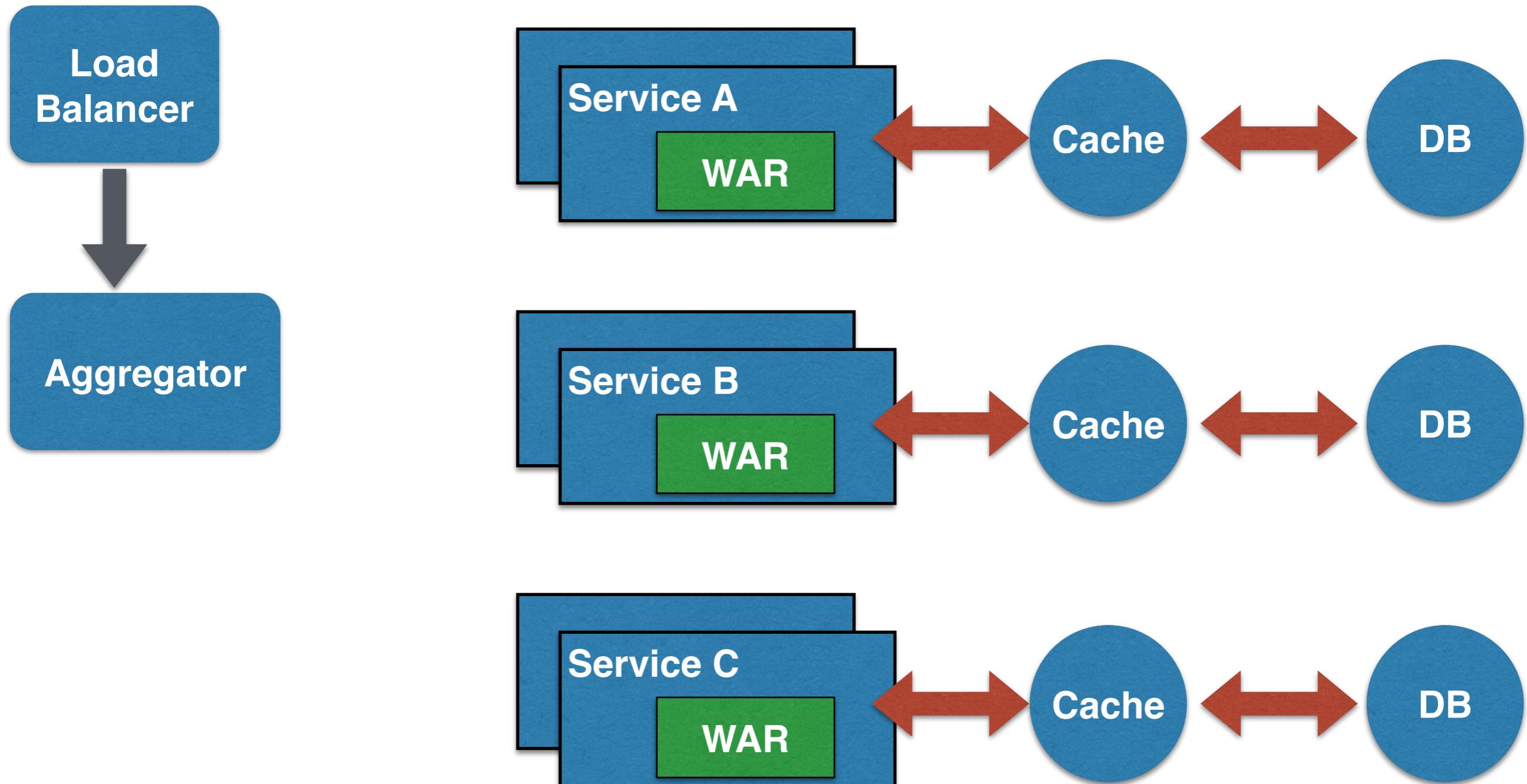
Load
Balancer



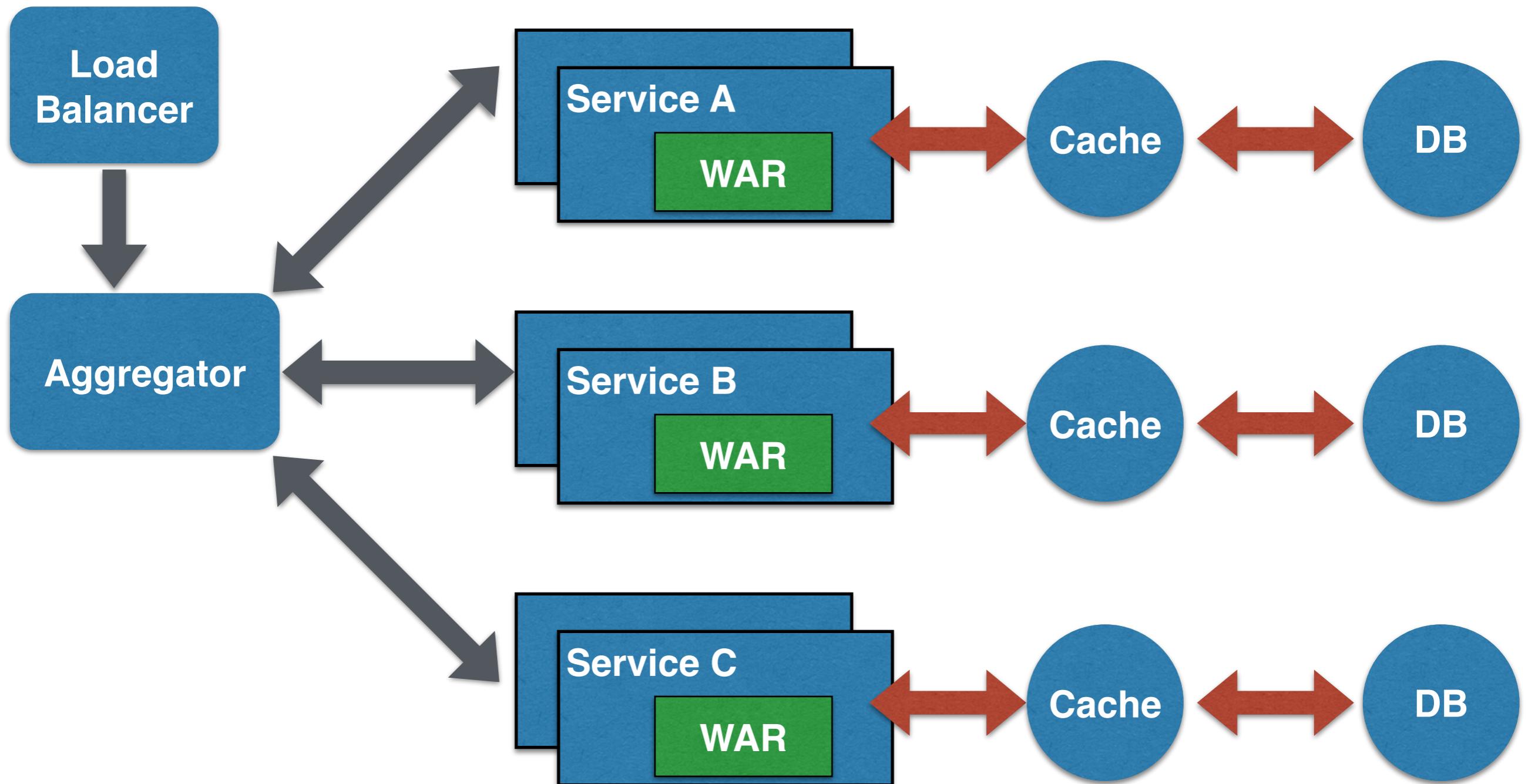
Aggregator



Aggregator Pattern #1

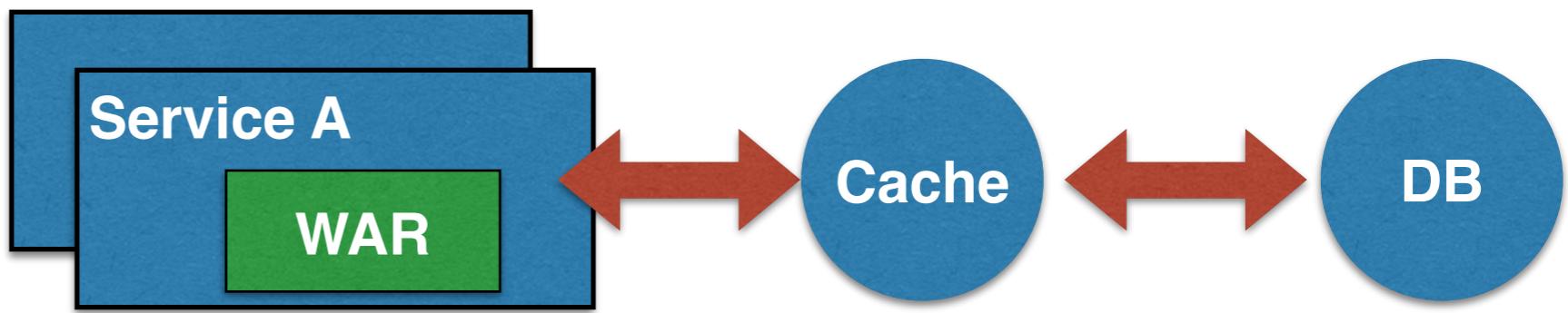


Aggregator Pattern #1

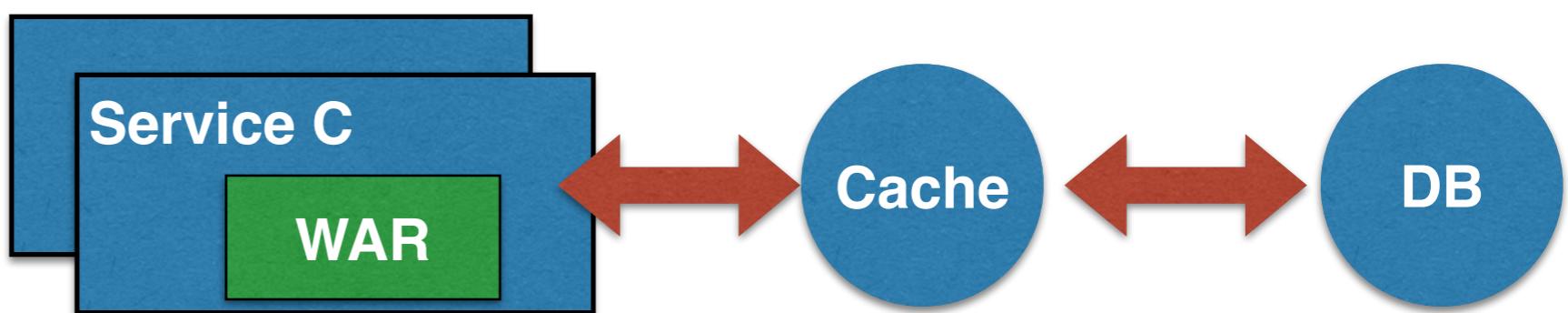
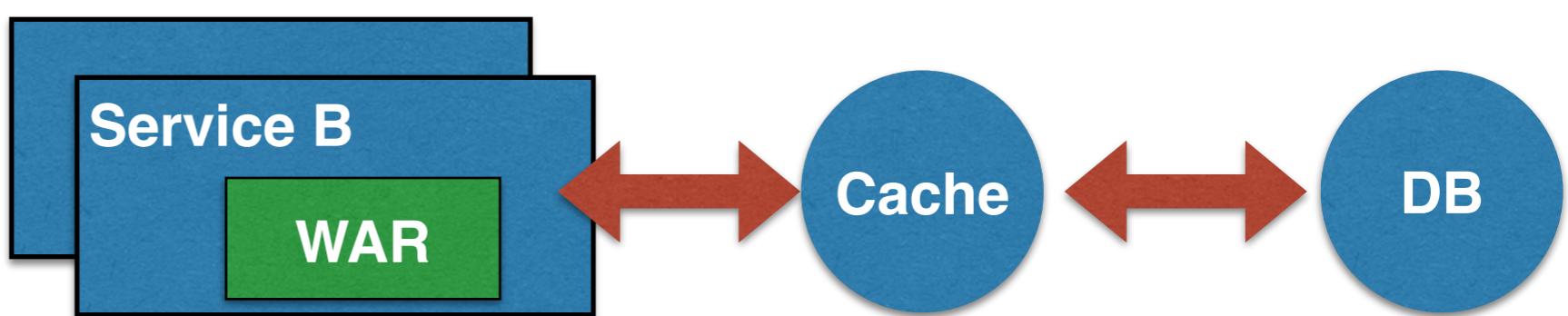


Proxy Pattern #1.5

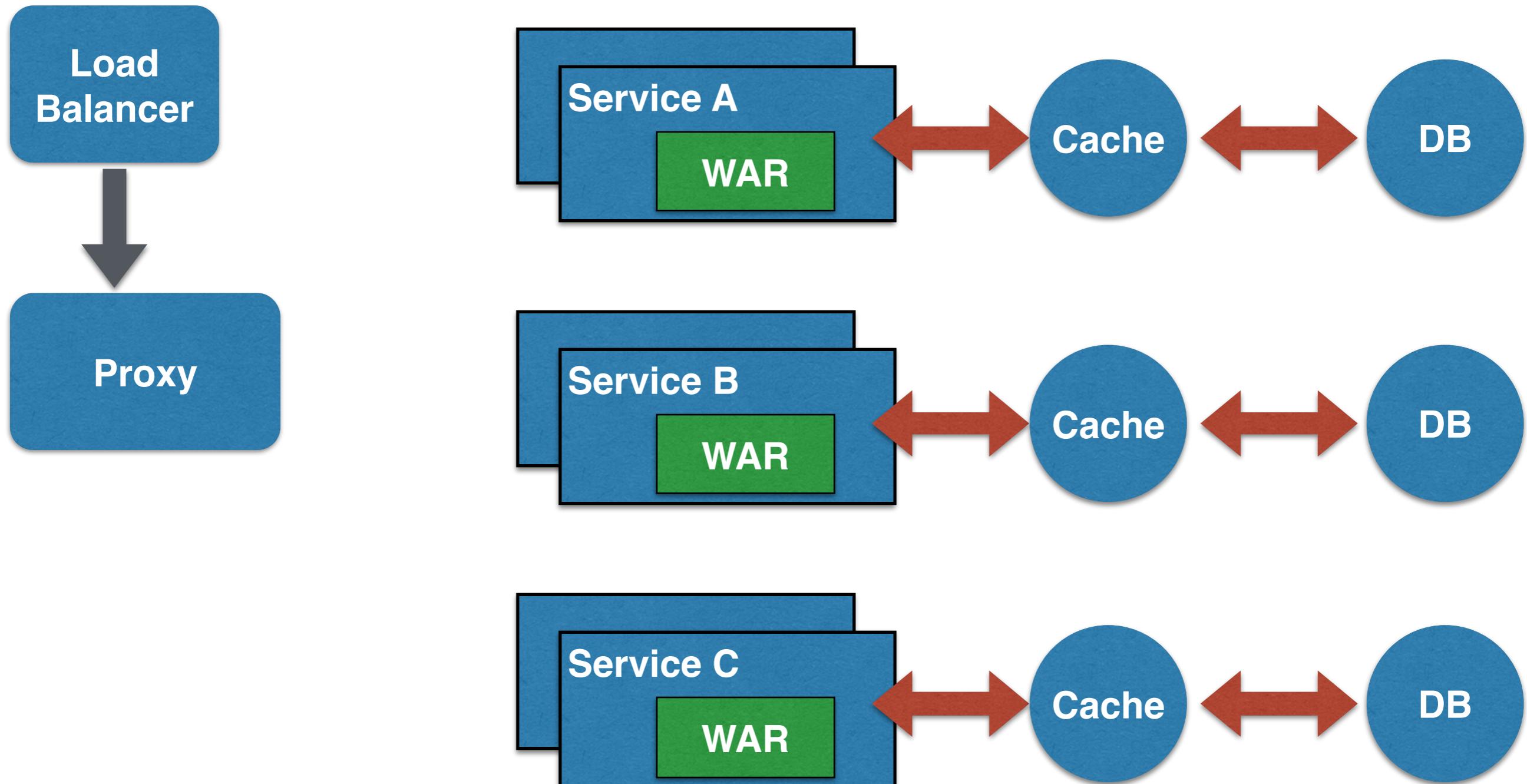
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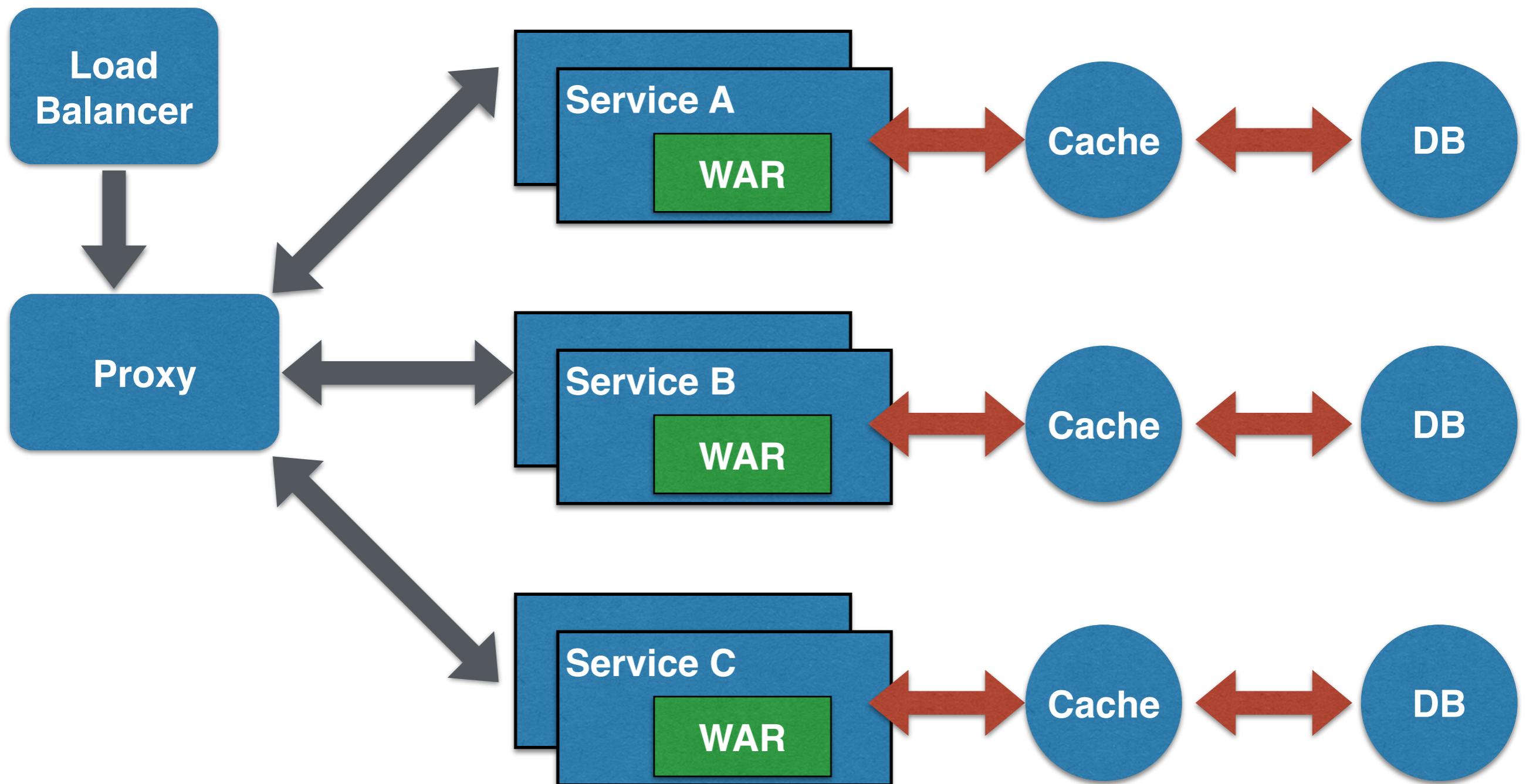
Proxy



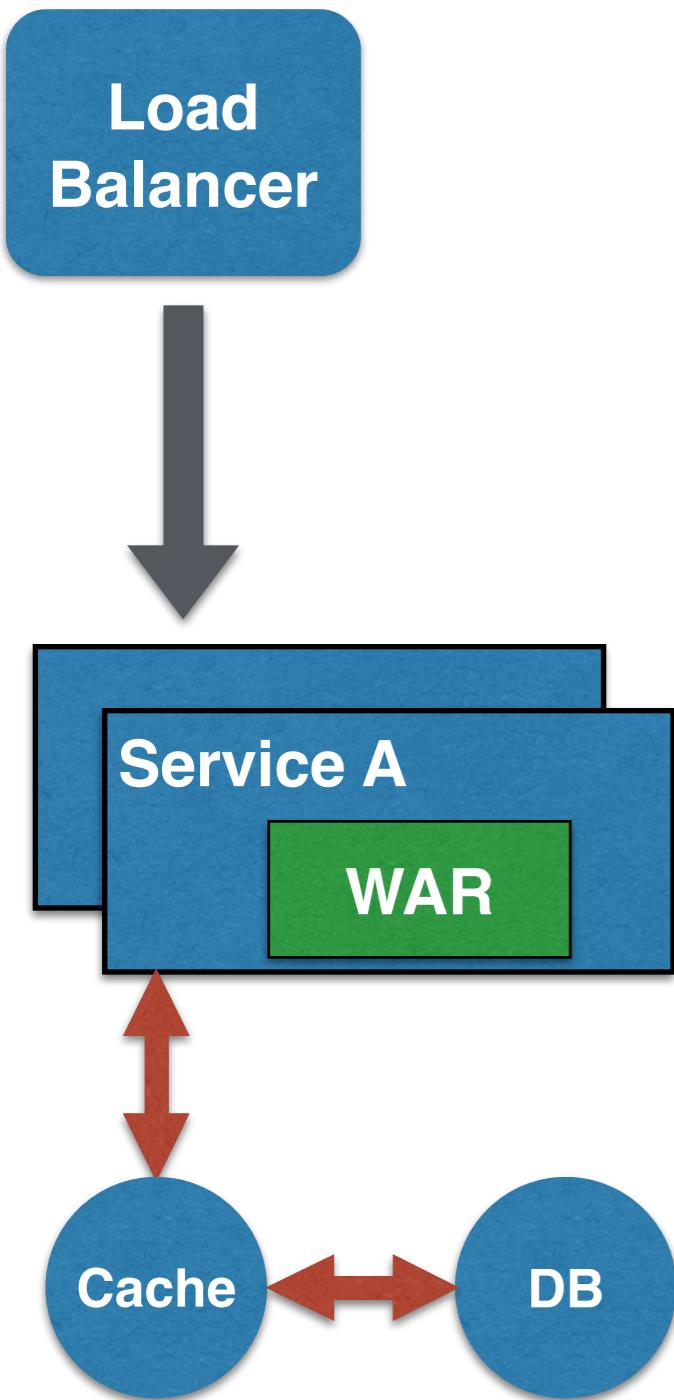
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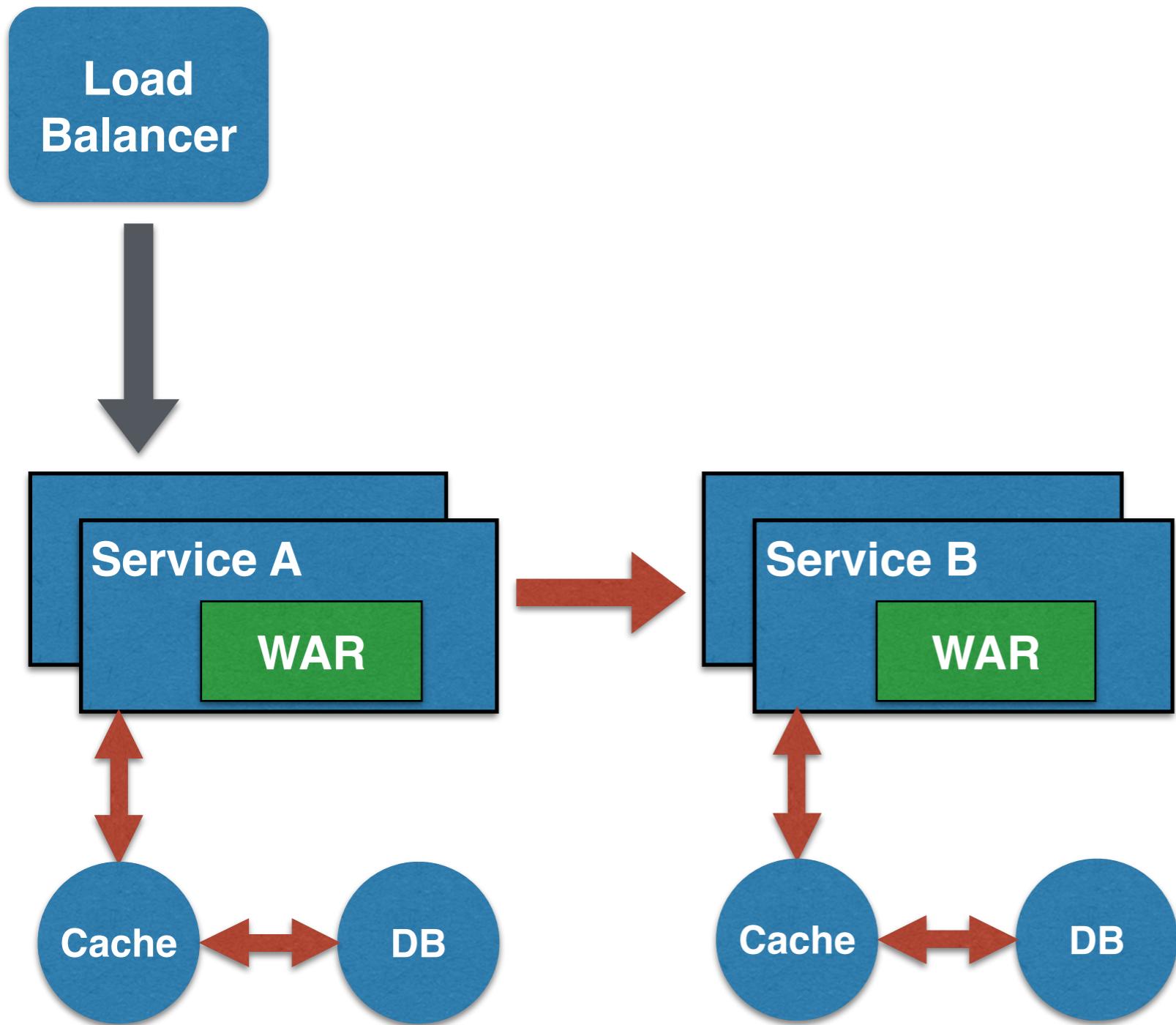
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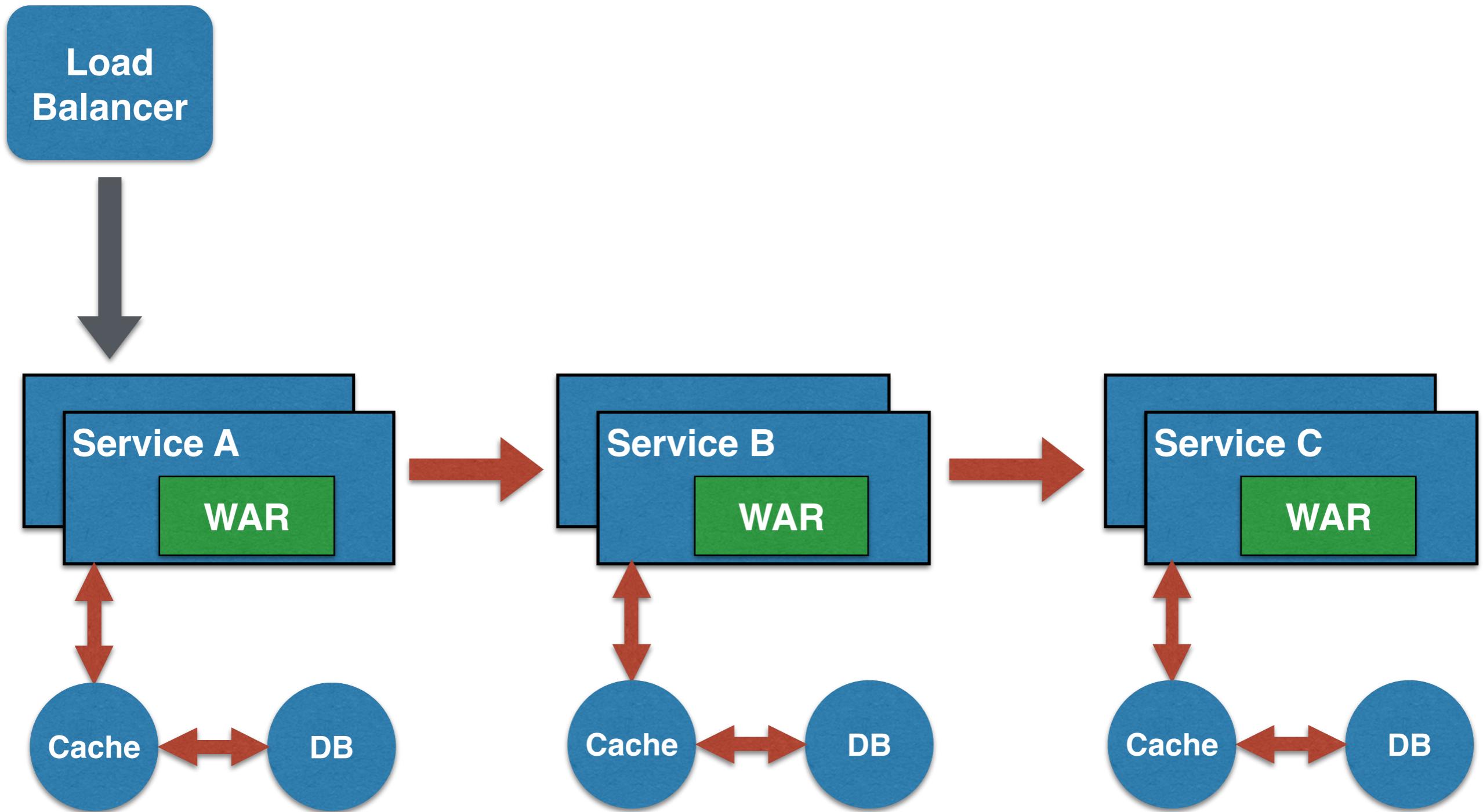
Chained Pattern #2



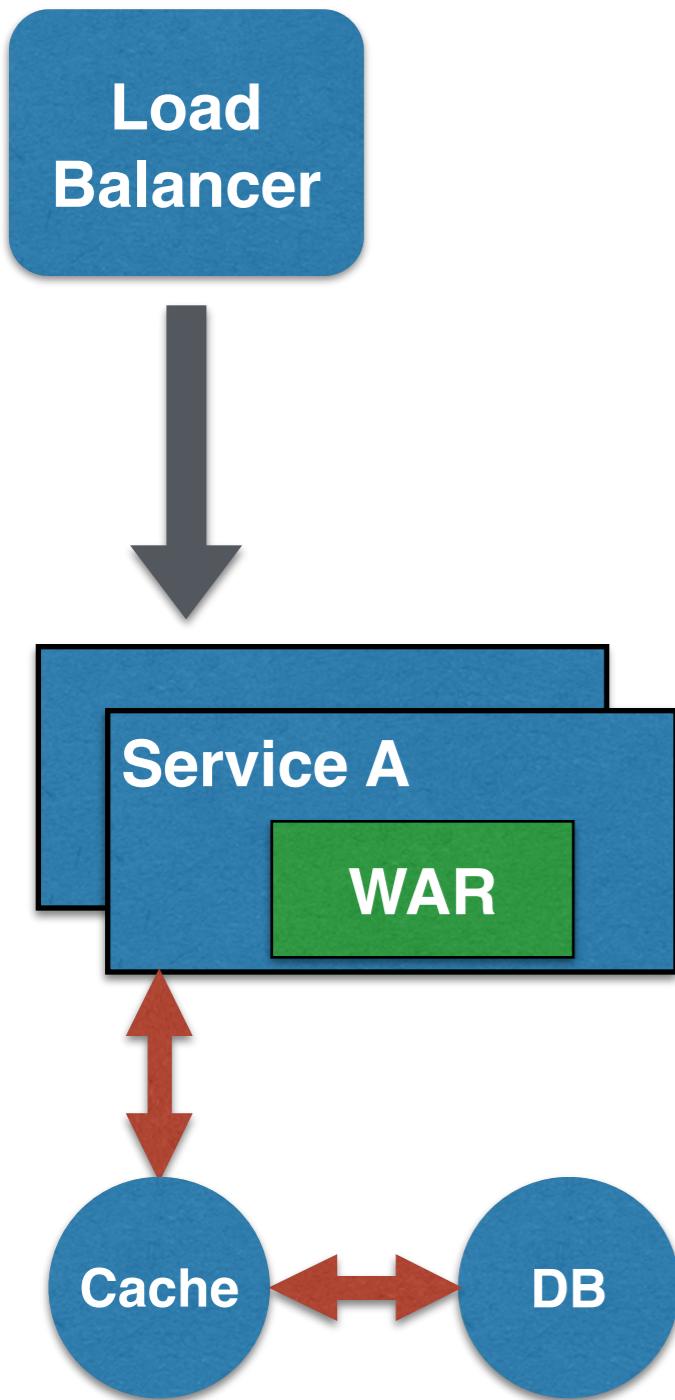
Chained Pattern #2



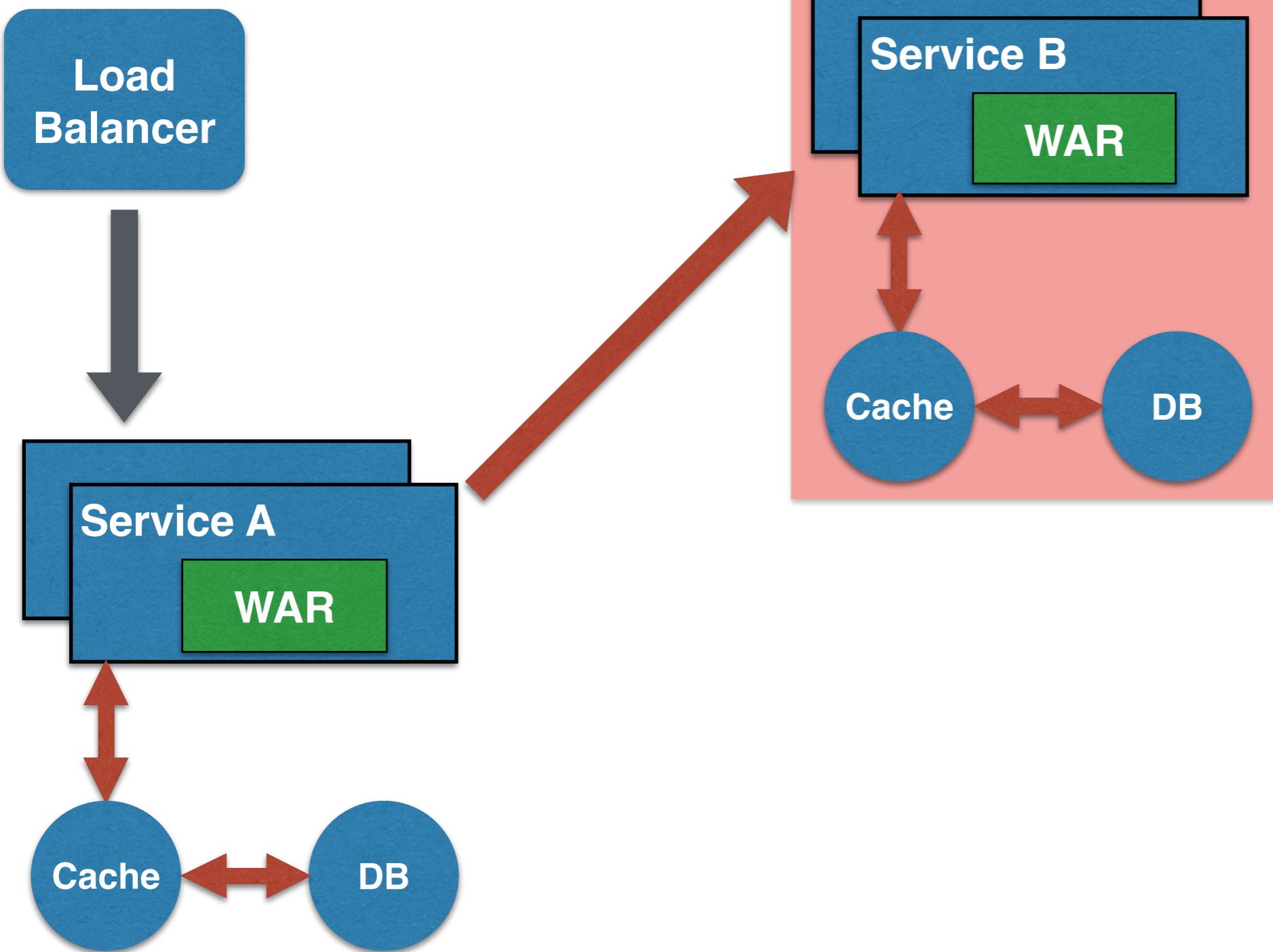
Chained Pattern #2



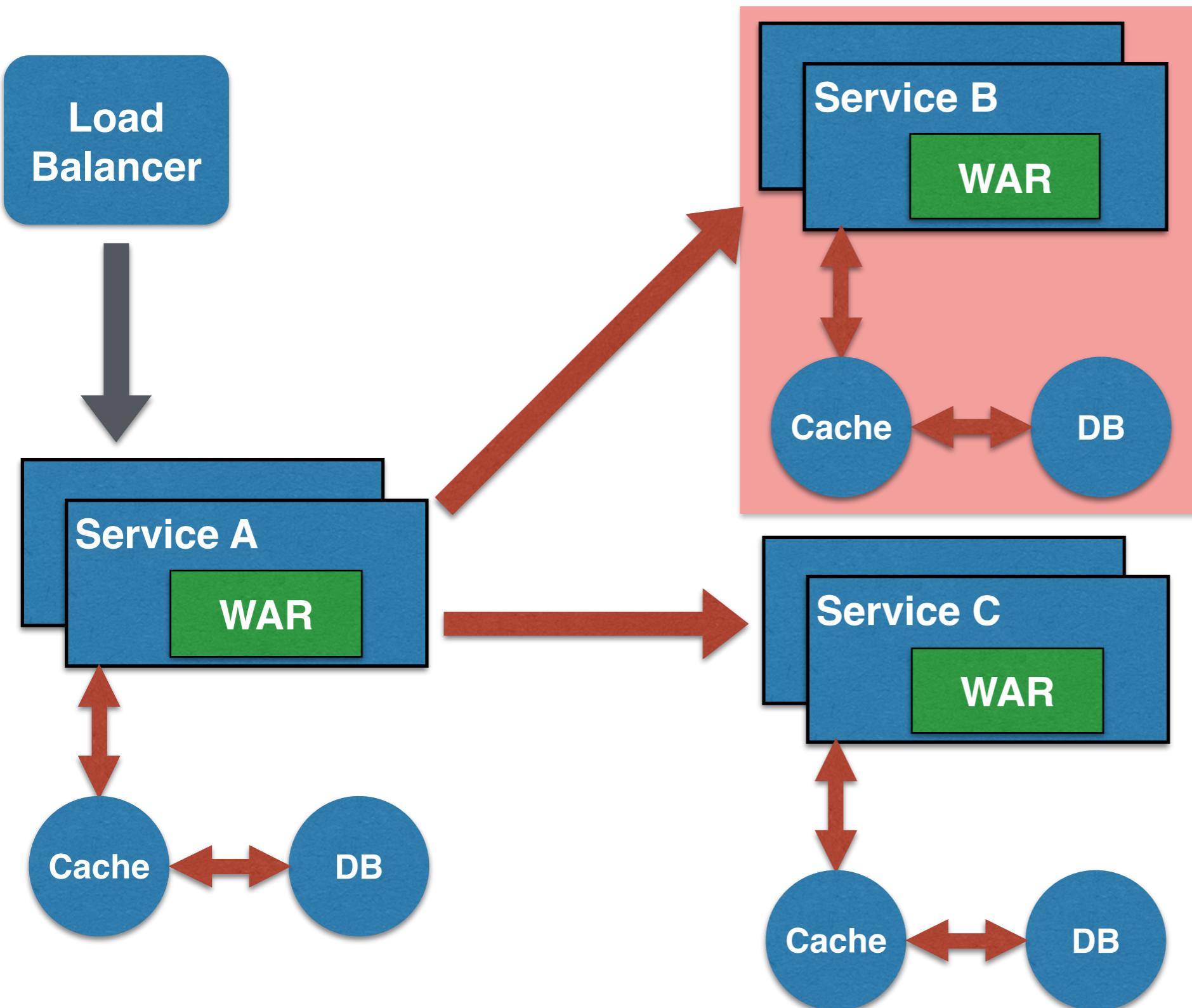
Branch Pattern #3



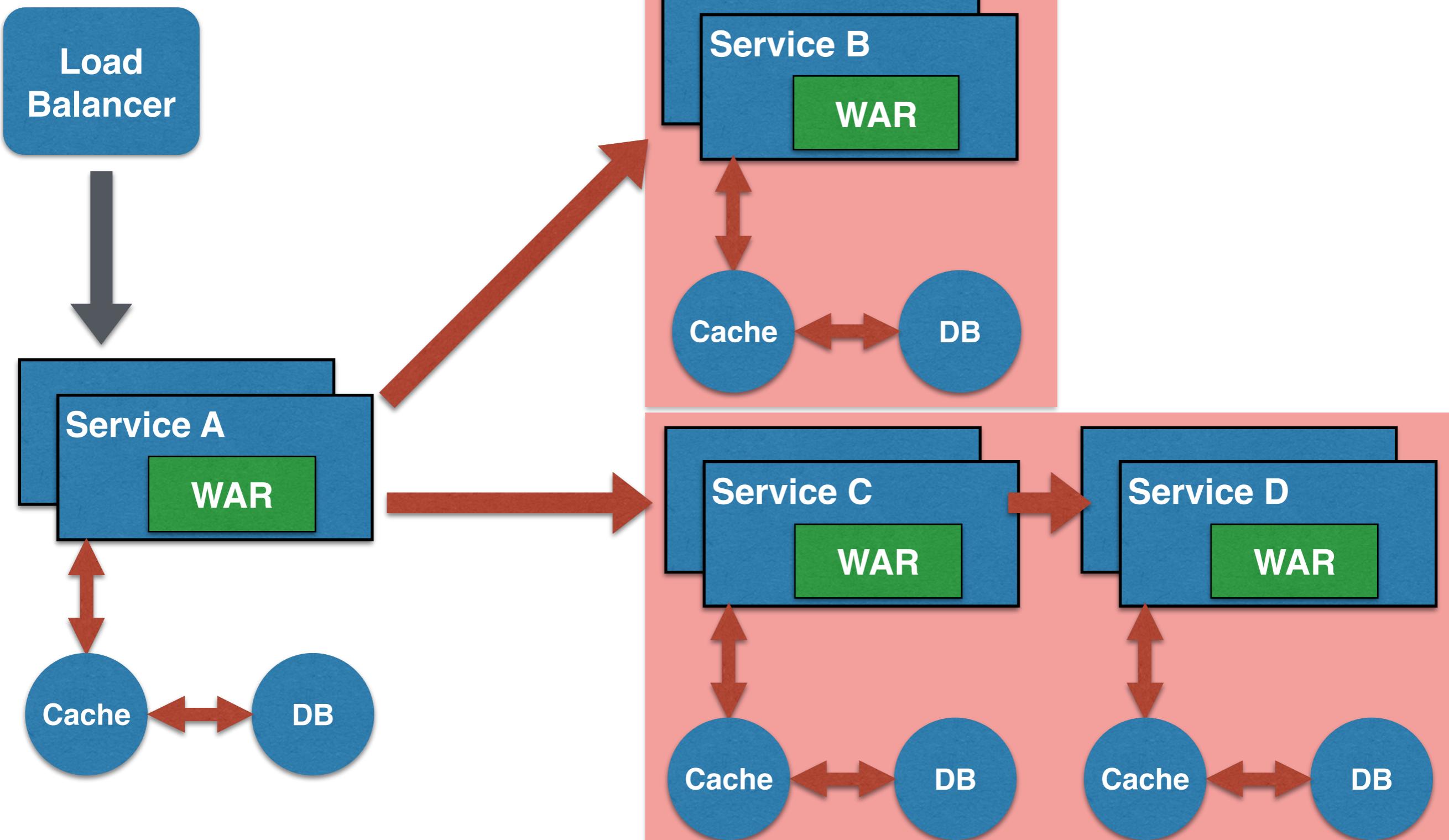
Branch Pattern #3



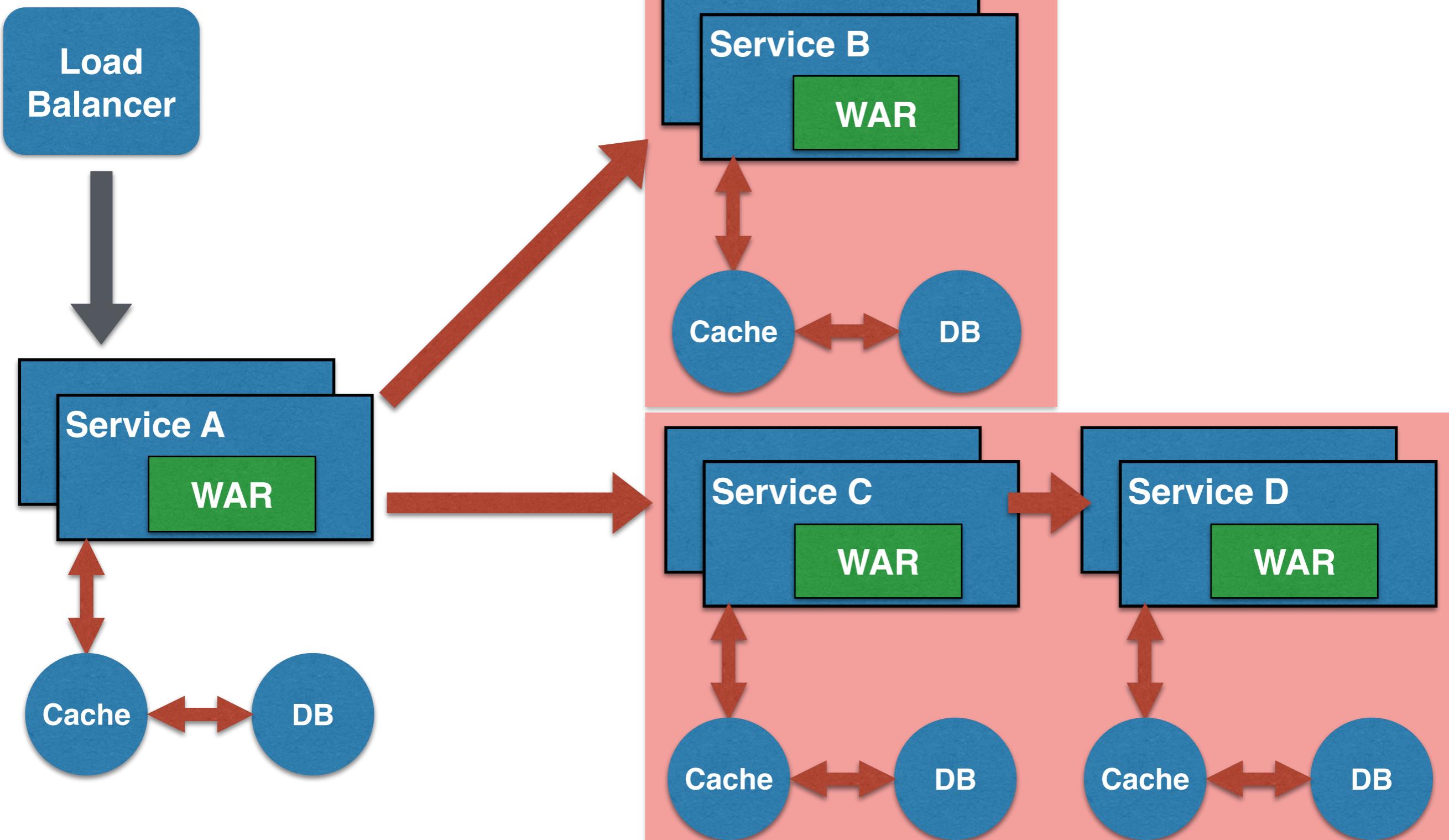
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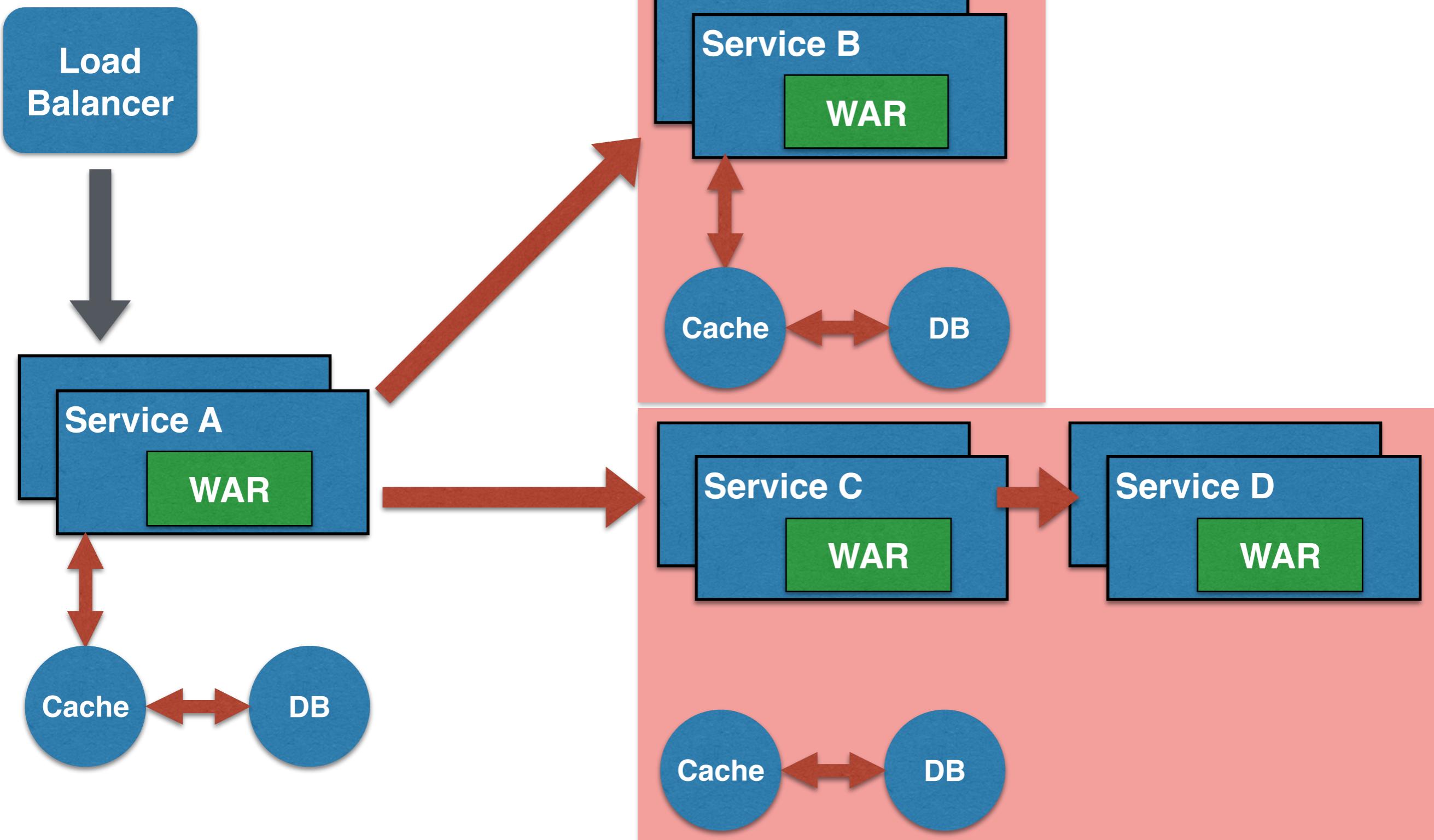
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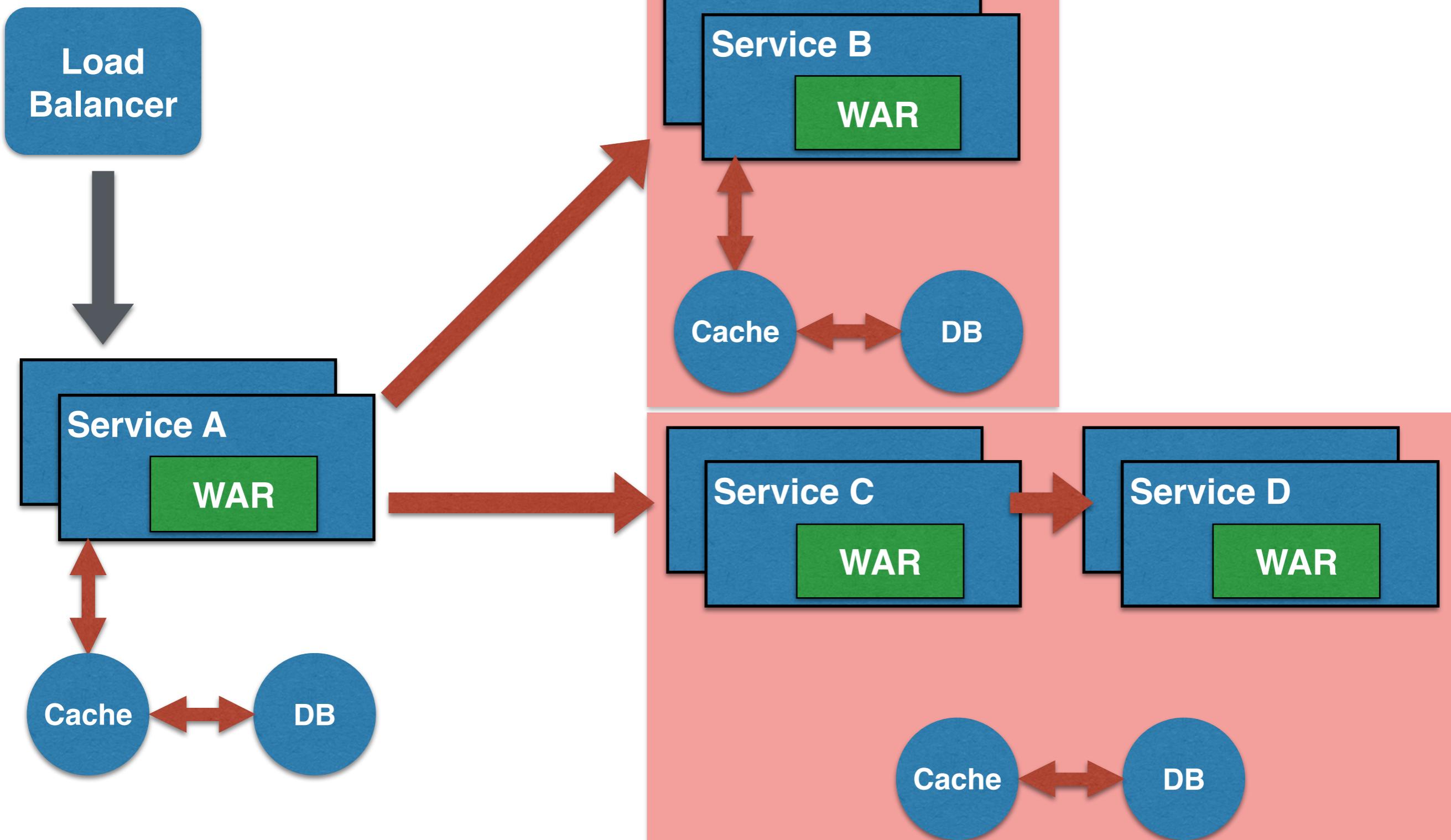
Shared Resources #4



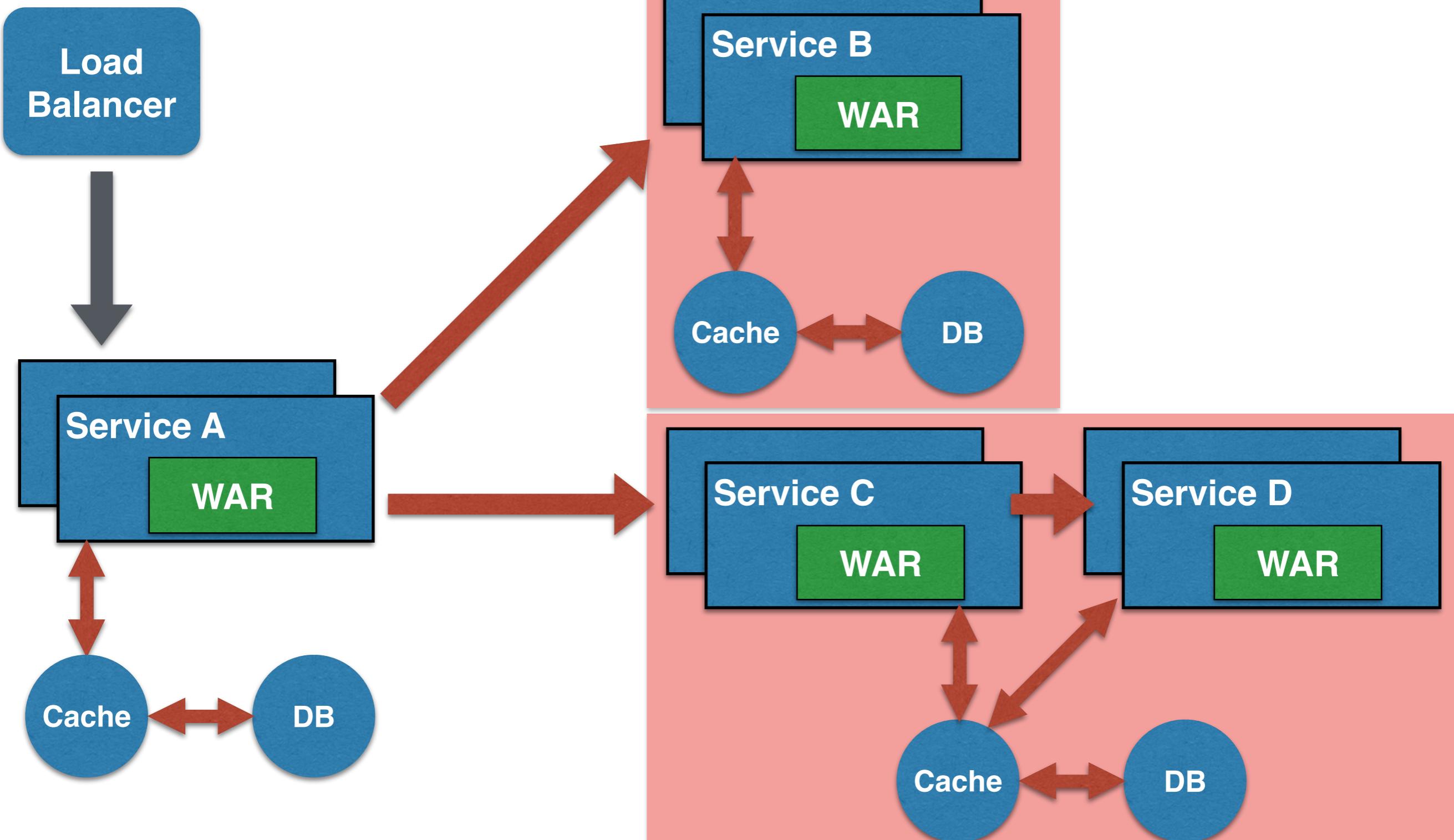
Shared Resources #4



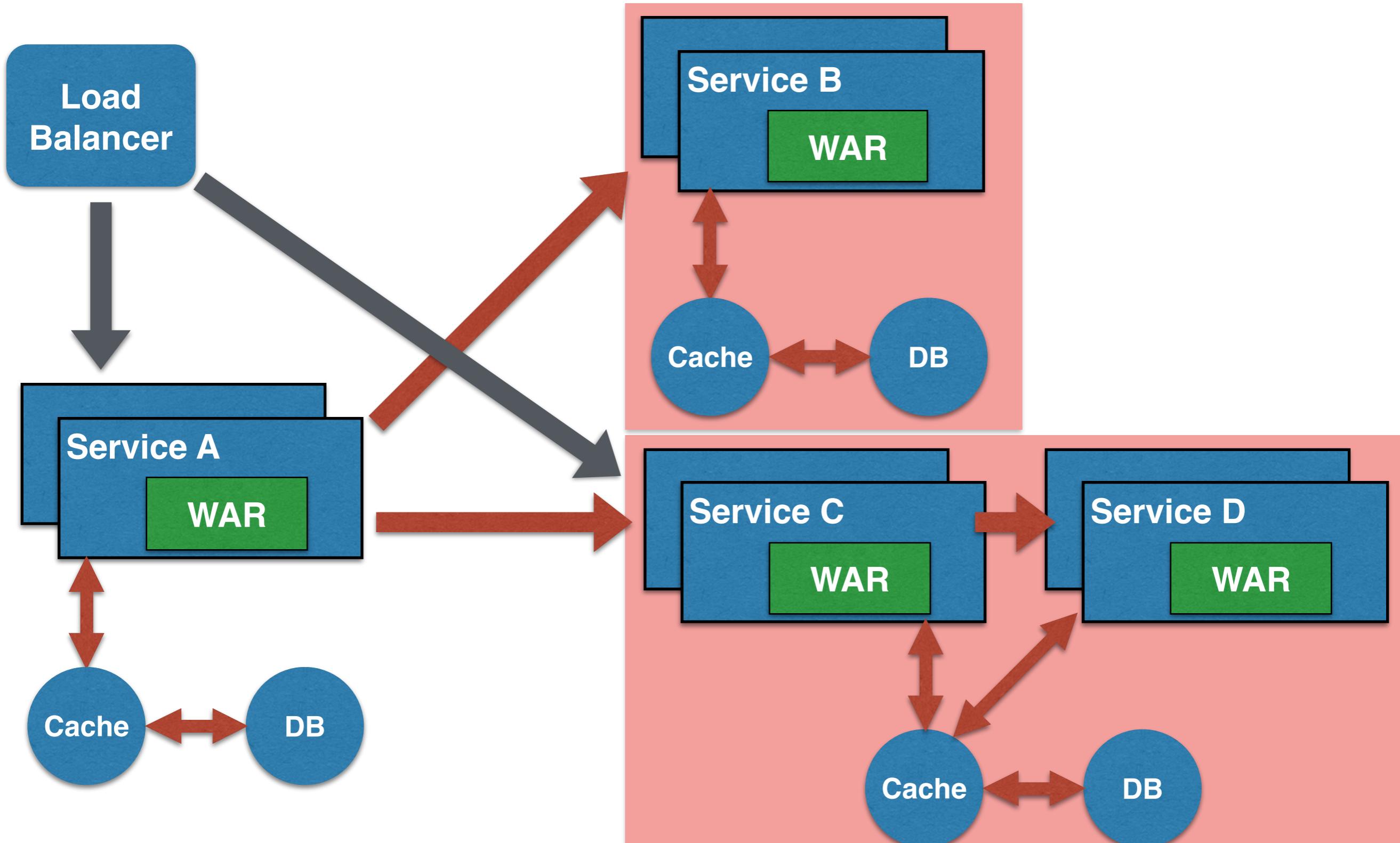
Shared Resources #4



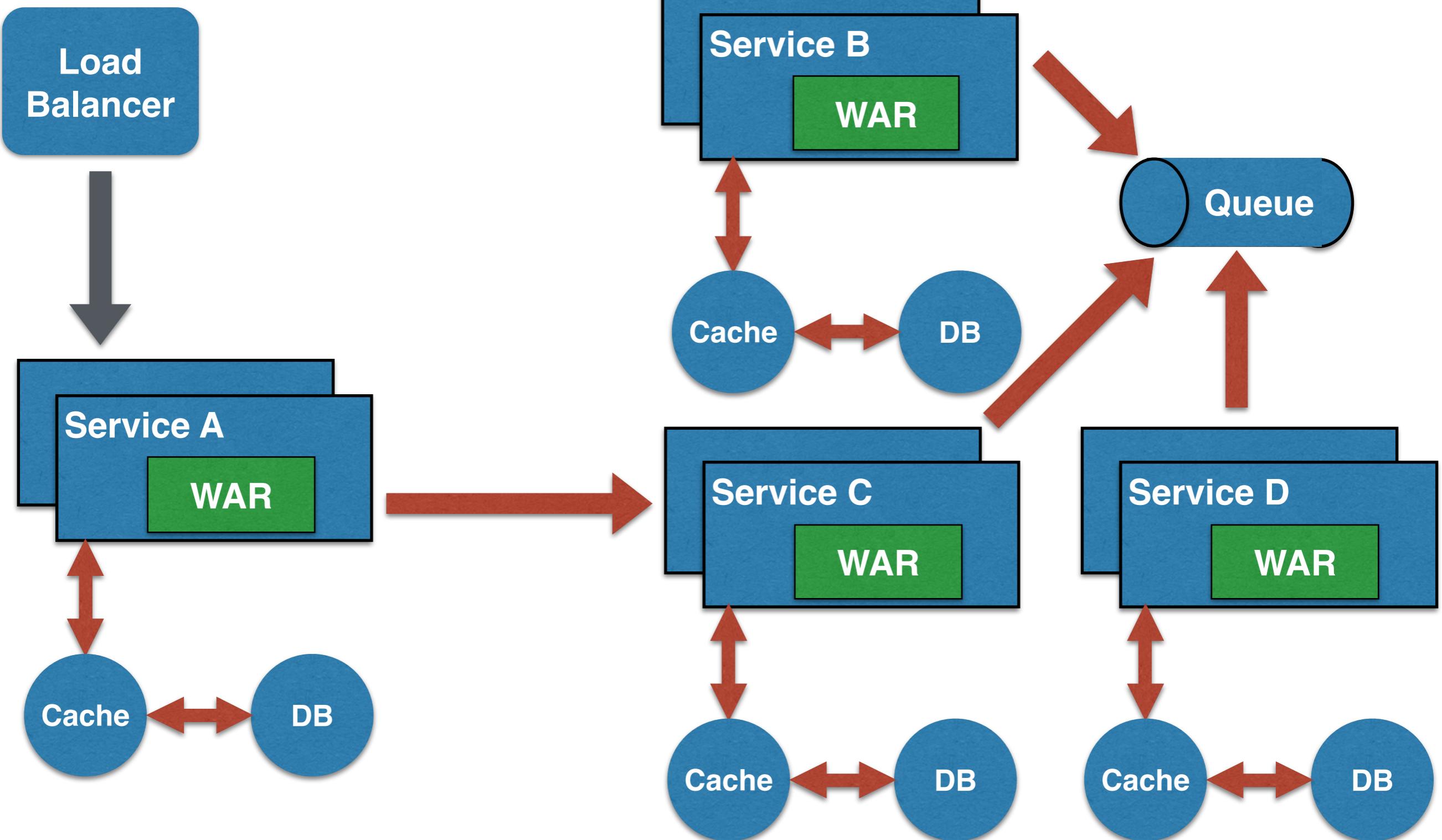
Shared Resources #4



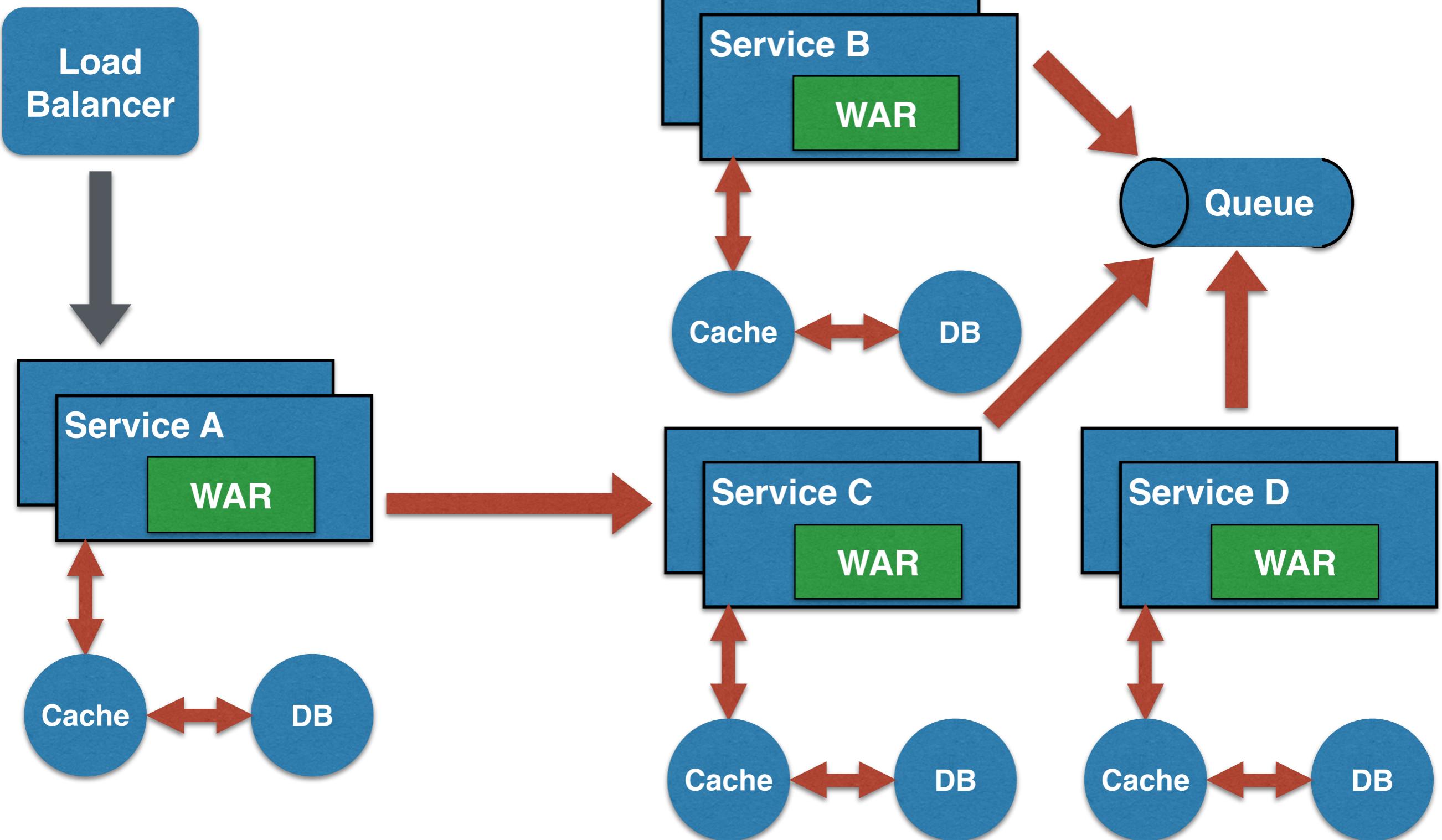
Shared Resources #4



Message Queues #5



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- Freedom of choice of technology, tools, frameworks

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- Rollout plan to coordinate deployments
- Slower ROI, to begin with

References

- github.com/arun-gupta/docker-tutorial
- martinfowler.com/articles/microservices.html
- www.infoq.com/articles/microservices-intro

Refactor your applications using Container and Microservices



Arun Gupta, @arungupta
Red Hat