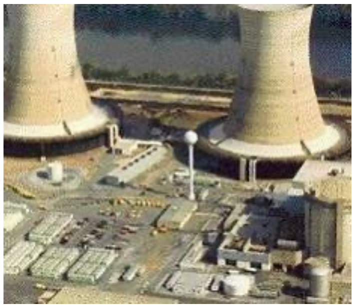
CLOUD COMPUTING

Ex: SalesForce.com

Software as a Service

Traditional Software

On-Demand Utility



Build Your Own

Plug In, Subscribe

Pay-per-Use

Software as a Service (SaaS)

- Application used as on demand service.
- Example: Google Apps

- Benefits to users
  - Reduce expenses
  - Ease of usage, access everywhere
- Benefits to providers
  - Easier to maintain
  - Control usage (no illegal copies)

42

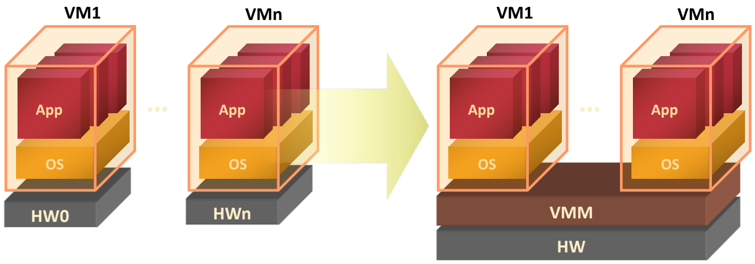
Cost of Distributed Servers

- Energy costs
  - Cooling costs
- Staffing costs
- Data silos and data synchronization

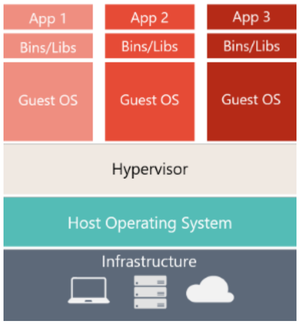
43

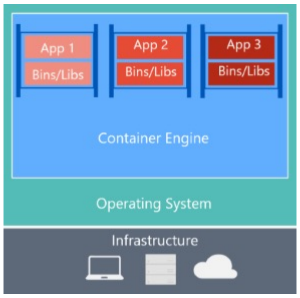
Hypervisor: Virtualize the Hardware

Server Consolidation

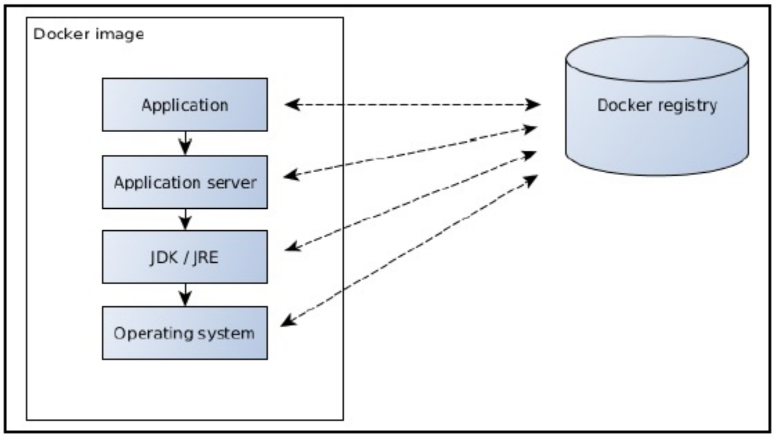


Container: Virtualize the OS





Containers



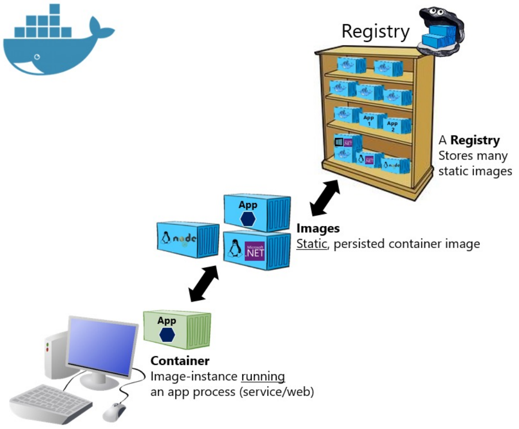
Containers

- Useful for Infrastructure as Code (IaC)

```
FROM jboss/wildfly:10.0.0.Final
COPY target/hello-cloud.war
    /opt/jboss/wildfly/standalone/deployments/
```

- Docker copy-on-write file system
  - Stateless applications

Basic taxonomy in Docker



A **Registry** Stores many static images

Images Static, persisted container image

Container Image-instance running an app process (service/web)

Hosted Docker Registry

Docker Trusted Registry on-prem.

On-premises ('n' private organizations)

Docker Hub Registry

Docker Trusted Registry on-cloud

Azure Container Registry

AWS Container Registry

Google Container Registry

Quay Registry

Other Cloud

Public Cloud (specific vendors)

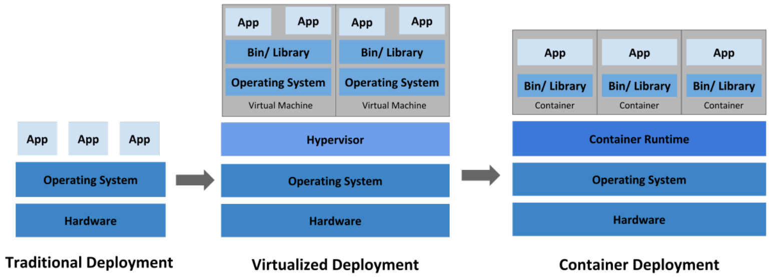
48

Docker Terminology

- Container image
- Dockerfile
- Container
- Volume
- (Container) Repository
- Registry (e.g. Docker Hub)
- Cluster
- Orchestrator

49

Containerized Deployment

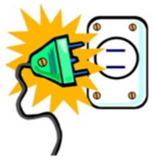


App App App
Operating System
Hardware
Traditional Deployment

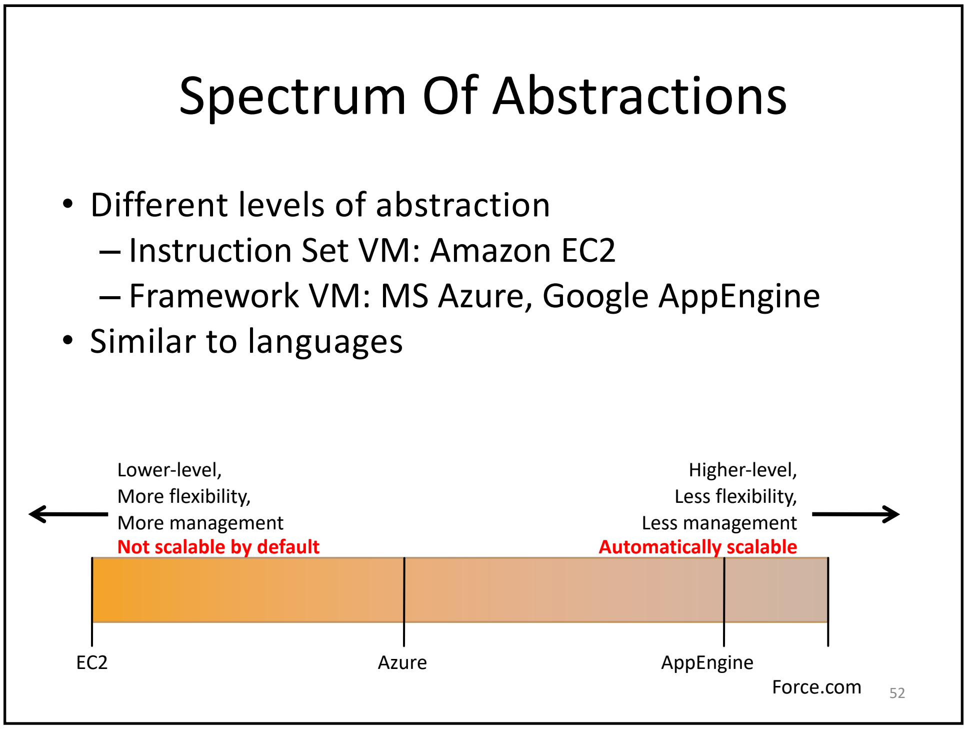
App App App App
Bin/ Library Bin/ Library
Operating System Operating System
Virtual Machine Virtual Machine
Hypervisor
Operating System
Hardware
Virtualized Deployment

App App App
Bin/ Library Bin/ Library Bin/ Library
Container Container Container
Container Runtime
Operating System
Hardware
Container Deployment

Utility Computing (UC)



- Computing resources on demand
  - Hardware as a service (HaaS)
  - Infrastructure as a service (IaaS)
  - Platform as a Service (PaaS)
- Examples of UC providers:
  - PaaS: Amazon S3, MS Azure …
  - IaaS: Amazon EC2 …
- Who will use UC?



Spectrum Of Abstractions

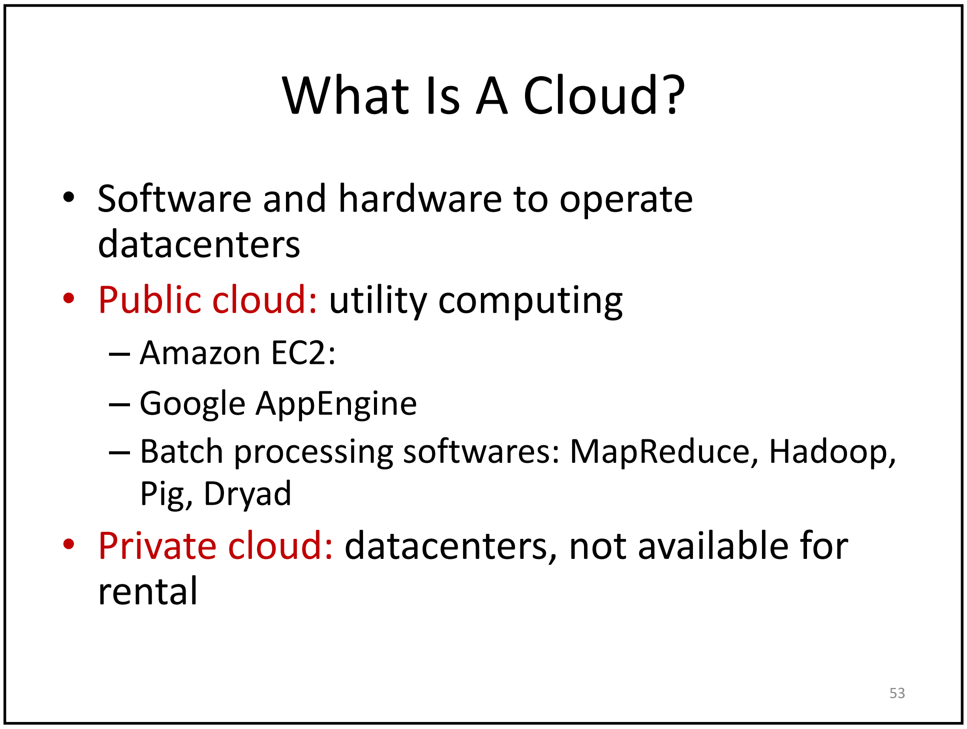
- Different levels of abstraction
  - Instruction Set VM: Amazon EC2
  - Framework VM: MS Azure, Google AppEngine
- Similar to languages

Lower-level,
More flexibility,
More management
Not scalable by default

Higher-level,
Less flexibility,
Less management
Automatically scalable

EC2
Azure
AppEngine
Force.com

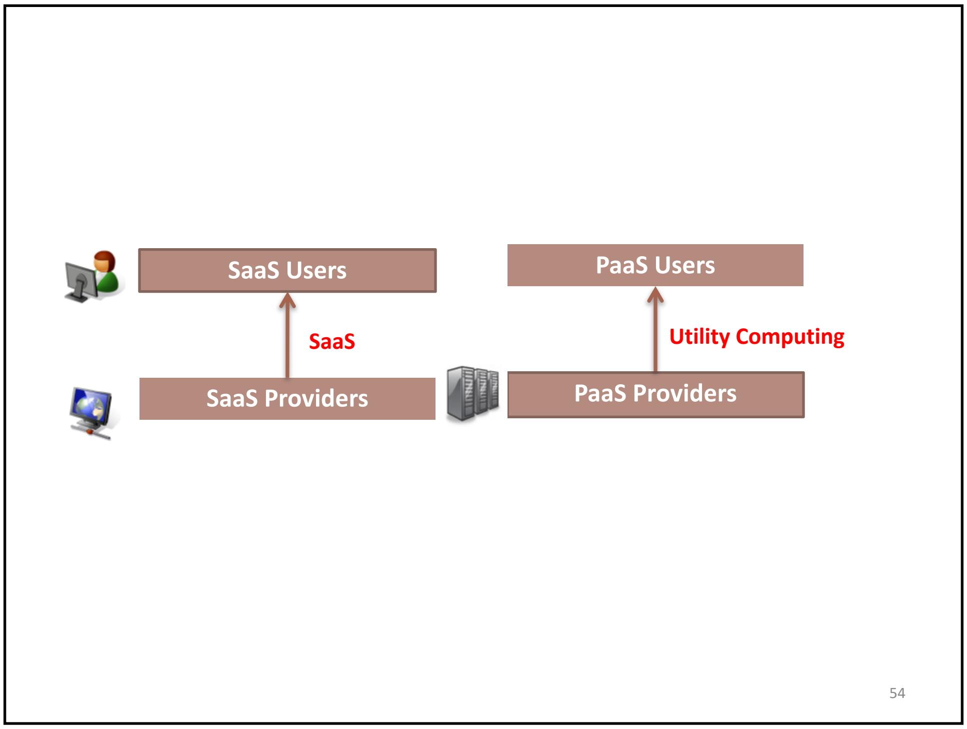
52



What Is A Cloud?

- Software and hardware to operate datacenters
- Public cloud: utility computing
  - Amazon EC2:
  - Google AppEngine
  - Batch processing softwares: MapReduce, Hadoop, Pig, Dryad
- Private cloud: datacenters, not available for rental

53



SaaS Users

SaaS

SaaS Providers

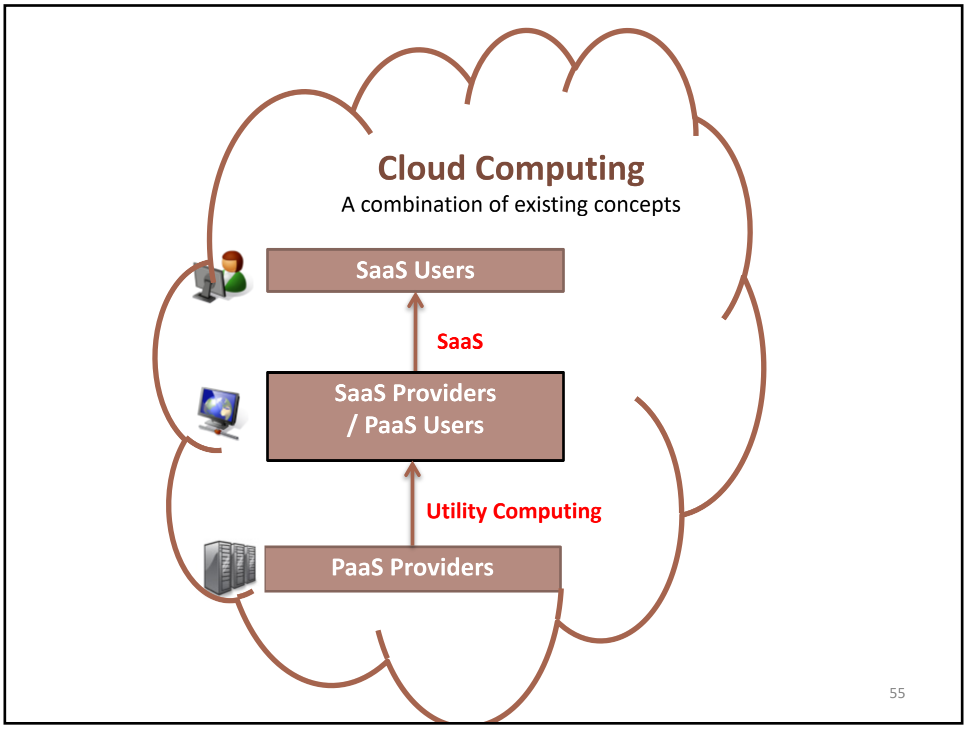
PaaS Users

Utility Computing

PaaS Providers

54

54



Cloud Computing

A combination of existing concepts

SaaS Users

SaaS

SaaS Providers / PaaS Users

Utility Computing

PaaS Providers

55

55

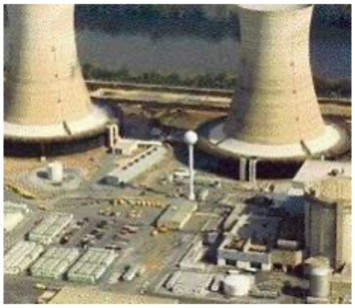
MICROSERVICES

56

Ex: SalesForce.com

Software as a Service

Traditional Software



Build Your Own

On-Demand Utility

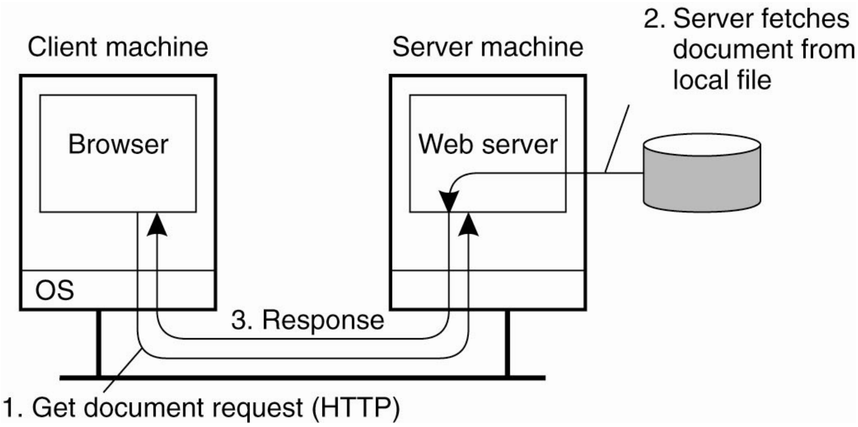
Plug In, Subscribe

Pay-per-Use

57

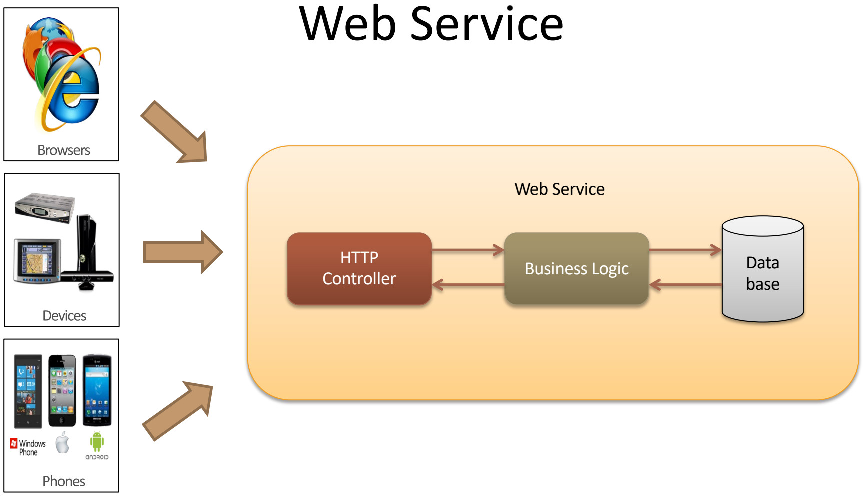
57

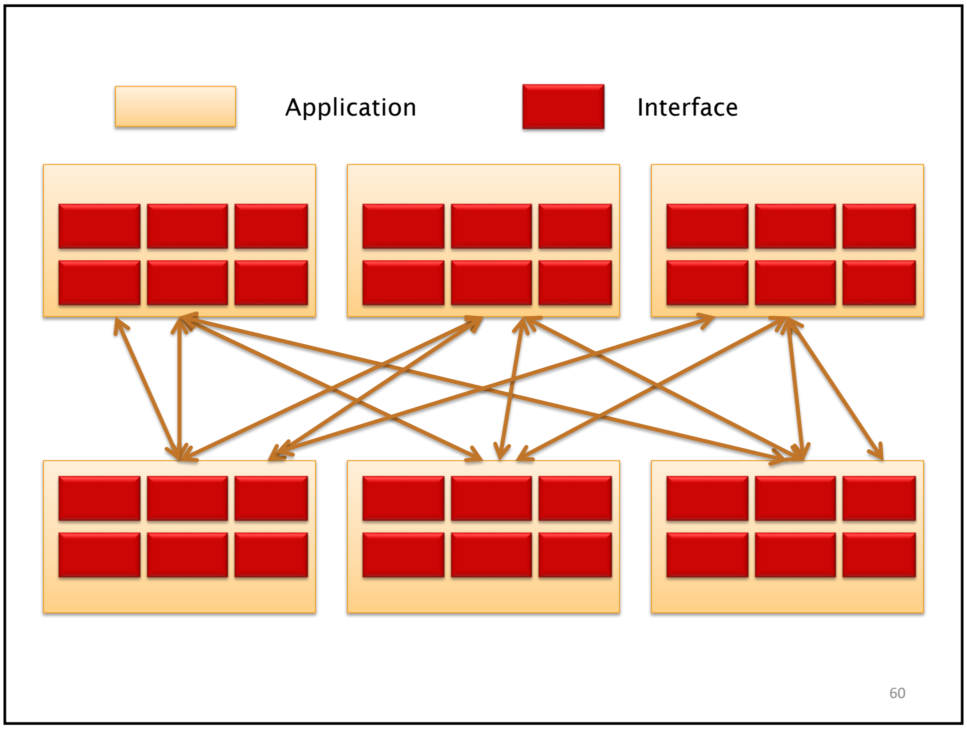
Web-Based Systems


2. Server fetches document from local file
Client machine
Server machine
Browser
Web server
OS
3. Response
1. Get document request (HTTP)

The overall organization of a traditional Web site.

Web Service





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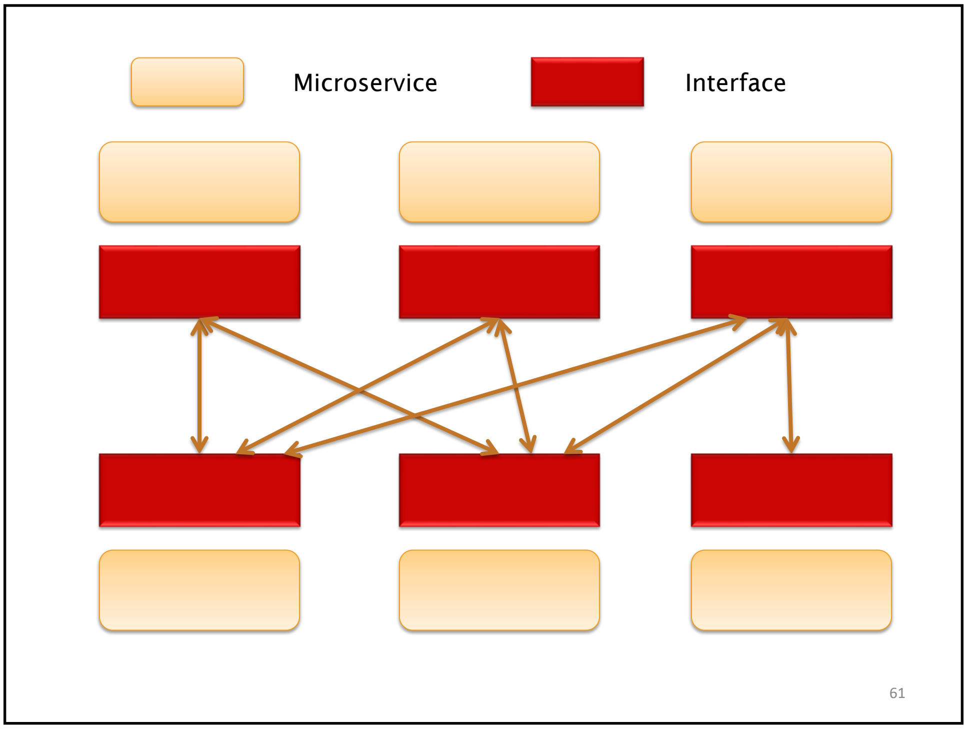

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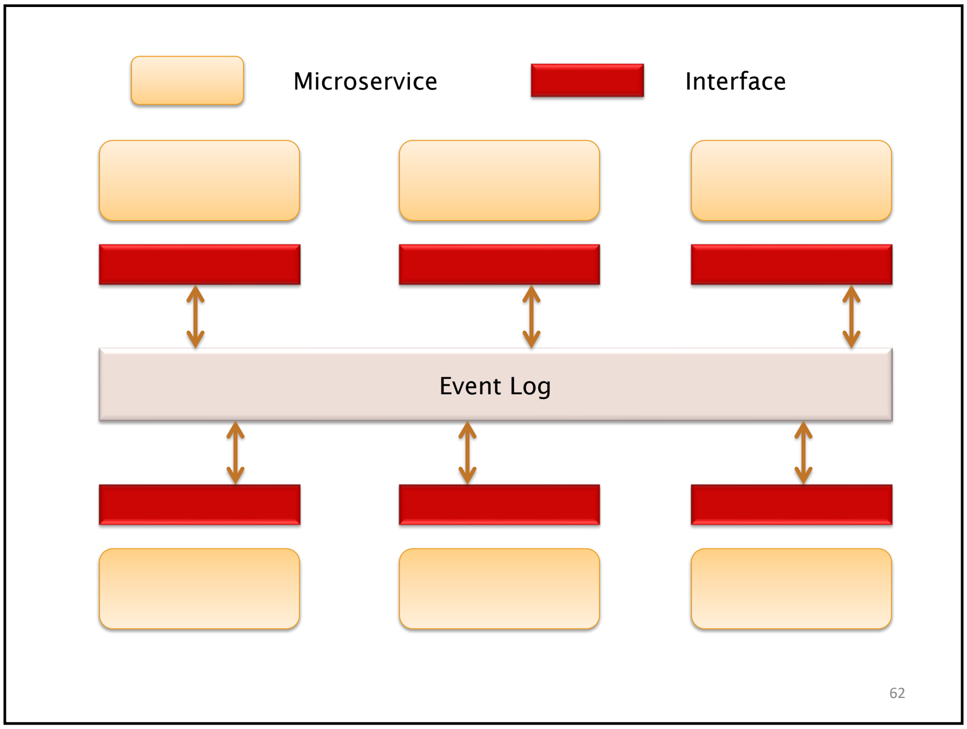
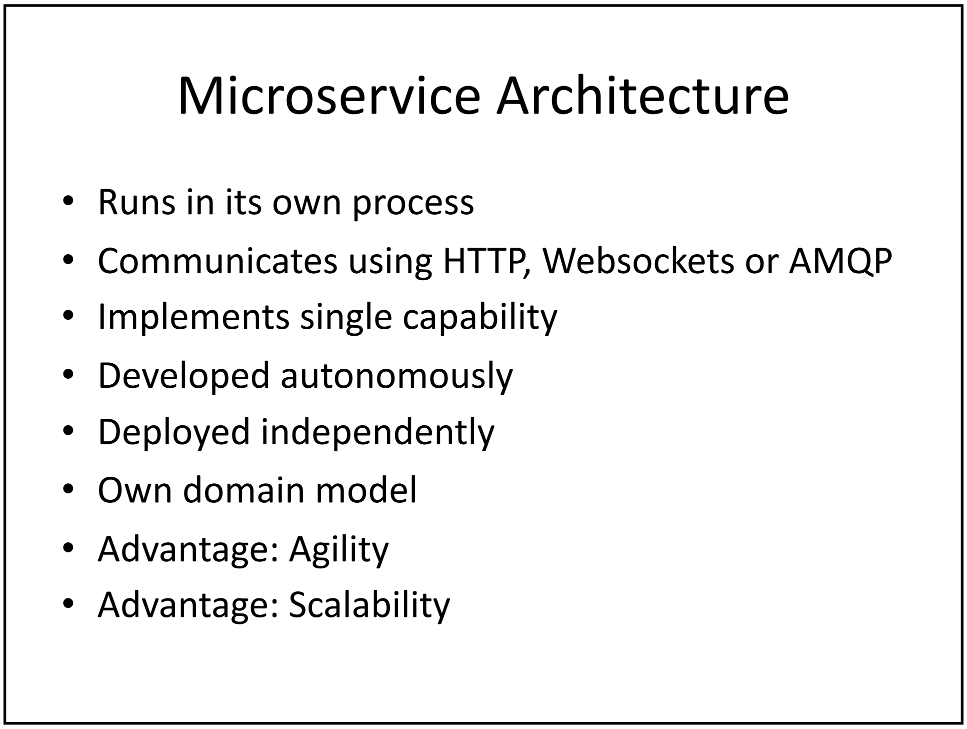


Microservice Interface

Event Log

62

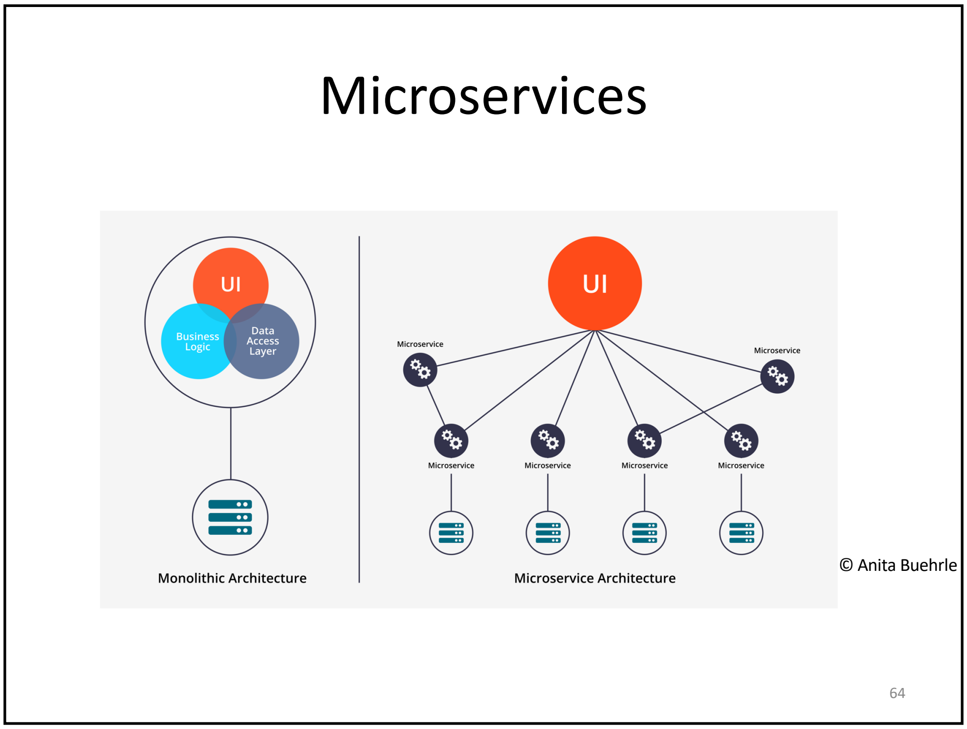
62



Microservice Architecture

- Runs in its own process
- Communicates using HTTP, Websockets or AMQP
- Implements single capability
- Developed autonomously
- Deployed independently
- Own domain model
- Advantage: Agility
- Advantage: Scalability

63



Microservices

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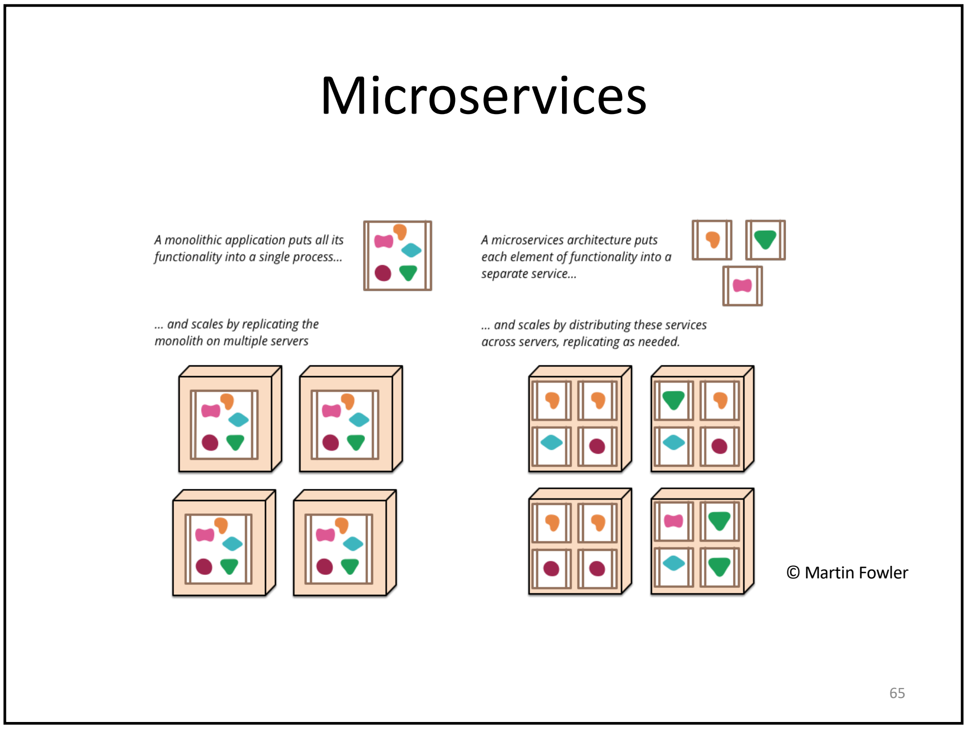
64

64



Microservices

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.

© Martin Fowler

65

65

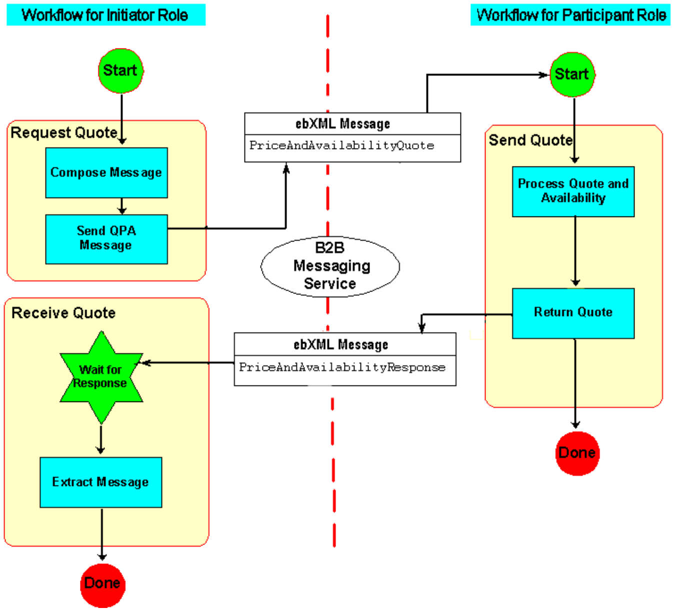
THIS COURSE

Software Architectures

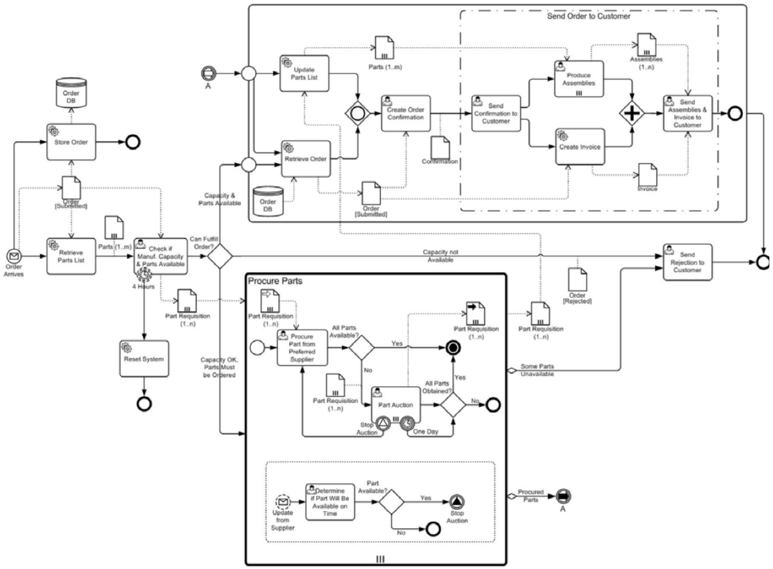
- Domain-driven
- Service-oriented
- Resource-oriented
- Event-driven
- CQRS and Cloud Native

Software Architectures

- Domain-driven
  - DDD, DSLs, ORM, …
- Service-oriented
  - Abstraction, reusability, autonomy, discoverability, …
- Resource-oriented
  - REST
- Event-driven
  - Message networks, CEP, …
- CQRS and Cloud Native
  - Orchestration frameworks, microservices



Process Modeling



70

70

Data Modeling

Domain

Model

Concept Animal*

Animal

age : int

Instance of

Instance of

Sher Kahn : Animal

age : int = 17

* Image © Heritage Park Zoological Sanctuary. http://www.heritageparkzoo.com

71

71