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DevOps-Continuous Development

Microservice Architecture

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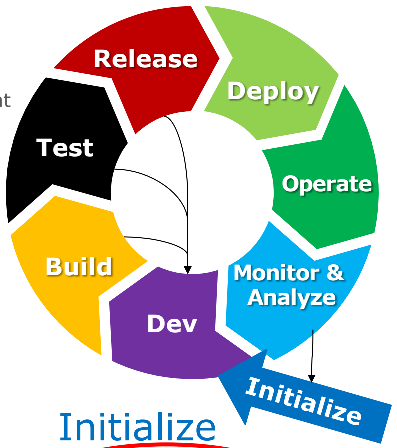
DEVOPS PROCESSES

Release
Approve for deployment

Test
Automate tests as much as possible

Build
Create an executable artifact

Dev
Perform normal development activities



Deploy
Move into production environment

Operate
Execute system and gather measurements about its operation

Monitor & Analyze
Display measurements taken during operation & analyze the data

Initialize
Select architecture to support other activities
Create scripts for other activities

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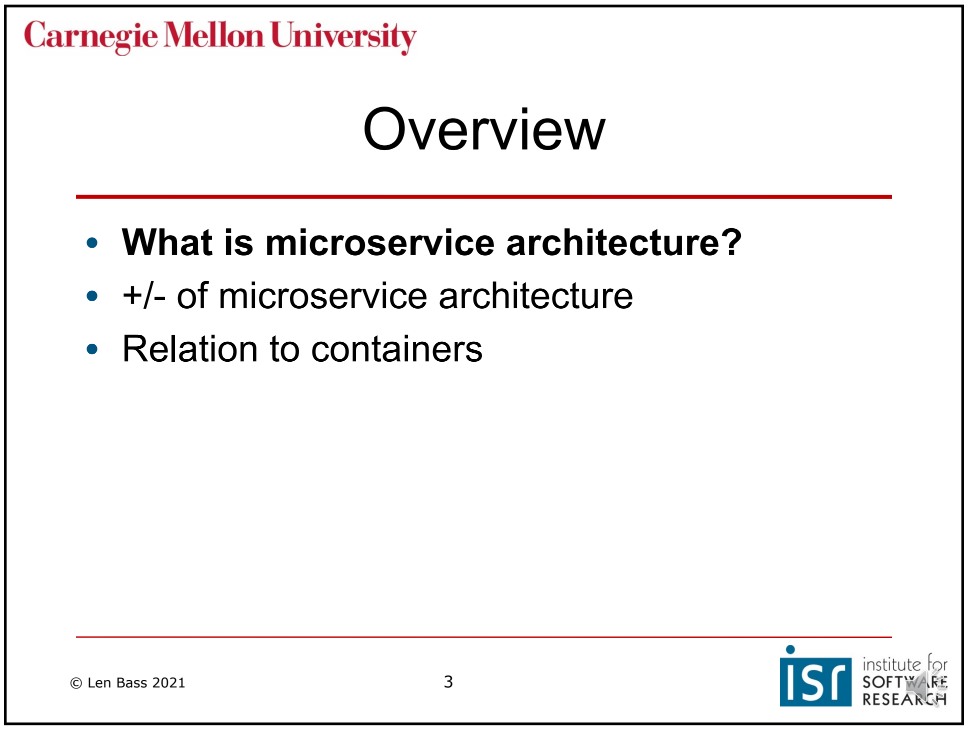
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Overview

- **What is microservice architecture?**
- +/- of microservice architecture
- Relation to containers

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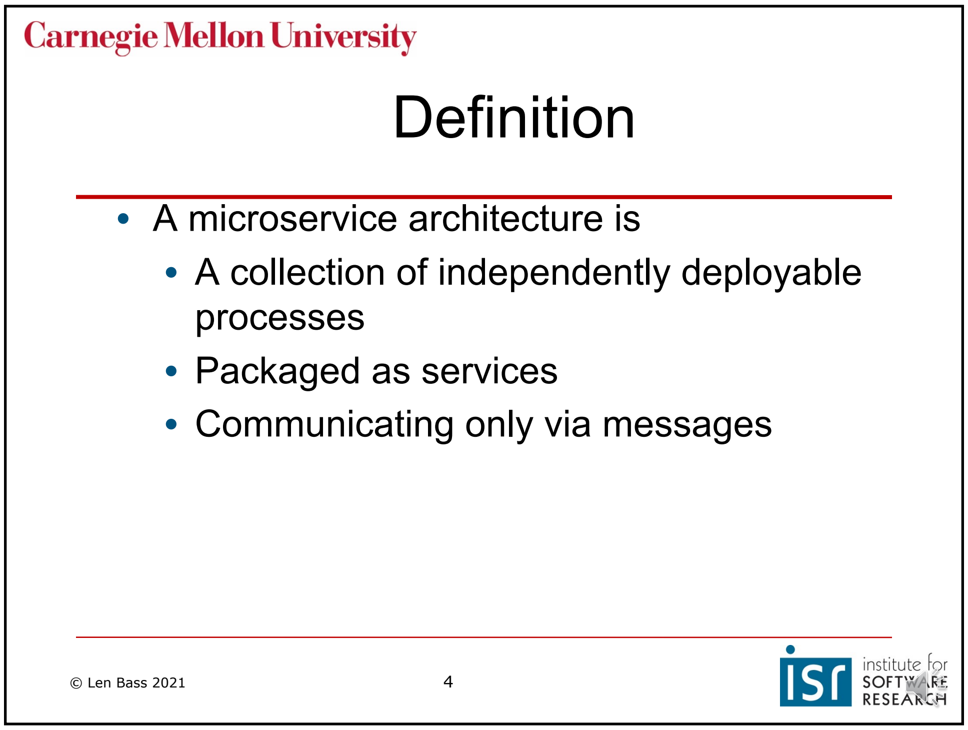
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Definition

- A microservice architecture is
  - A collection of independently deployable processes
  - Packaged as services
  - Communicating only via messages

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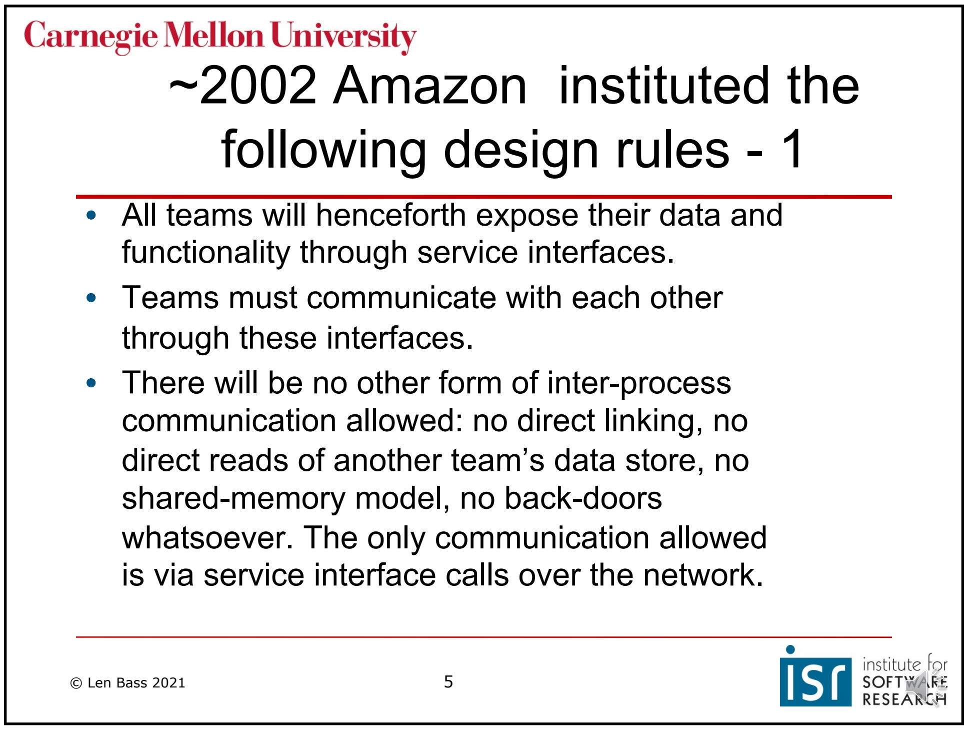

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~2002 Amazon instituted the following design rules - 1

- All teams will henceforth expose their data and functionality through service interfaces.
- Teams must communicate with each other through these interfaces.
- There will be no other form of inter-process communication allowed: no direct linking, no direct reads of another team's data store, no shared-memory model, no back-doors whatsoever. The only communication allowed is via service interface calls over the network.

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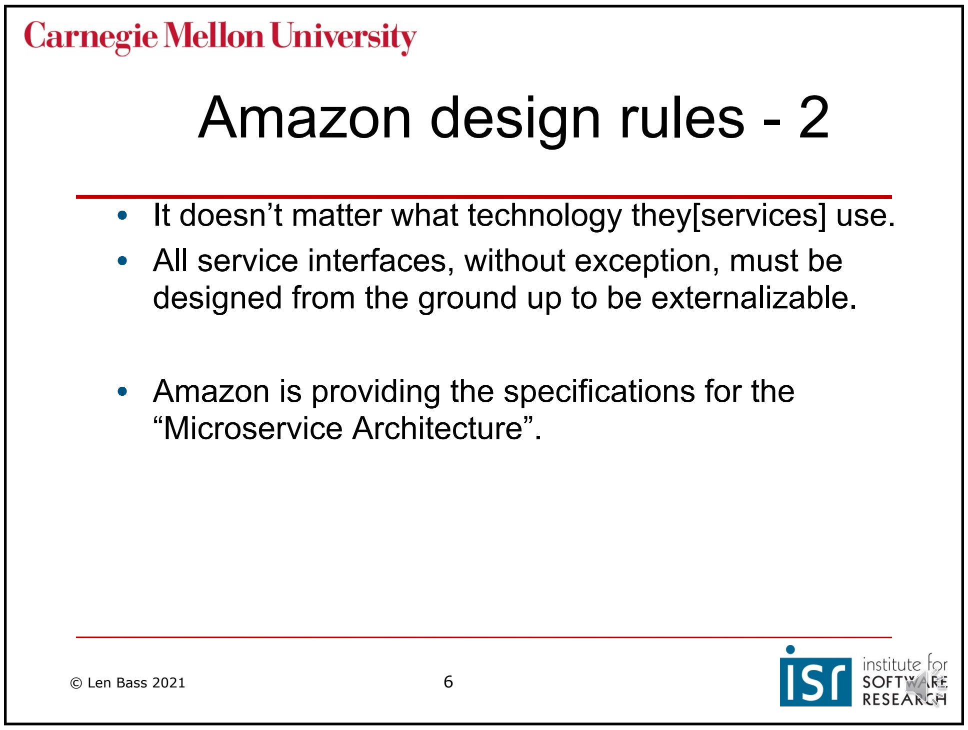

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Amazon design rules - 2

- It doesn't matter what technology they[services] use.
- All service interfaces, without exception, must be designed from the ground up to be externalizable.
- Amazon is providing the specifications for the "Microservice Architecture".

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In Addition

- Amazon has a “two pizza” rule.
- No team should be larger than can be fed with two pizzas (~7 members).
- Each (micro) service is the responsibility of one team
- This means that microservices are small and intra team bandwidth is high
- Large systems are made up of many microservices.
- There may be as many as 140 in a typical Amazon page.

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Services can have multiple instances

- The elasticity of the cloud will adjust the number of instances of each service to reflect the workload.
- Requests are routed through a load balancer for each service
- This leads to
  - Lots of load balancers
  - Overhead for each request.

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Digression into Service Oriented Architecture (SOA)

- The definition of microservice architecture sounds a lot like SOA.
- What is the difference?
- Amazon did not use the term “microservice architecture” when they introduced their rules. They said “this is SOA done right”

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SOA characteristics

- Services in an SOA are typically stand alone applications.
- SOA has:
  - Enterprise service bus
  - Elaborate protocols for sending messages to services (WS*)
  - Each service may be under the control of different organization
  - Brokers
  - Etc

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Enterprise Service Bus (ESB)

- The primary duties of an ESB are:
  - Route, monitor, and control messages between services
  - Control deployment and versioning of services
  - Provide commodity services like event handling, data transformation and mapping, message and event queuing and sequencing, security or exception handling, protocol conversion and enforcing proper quality of communication service.

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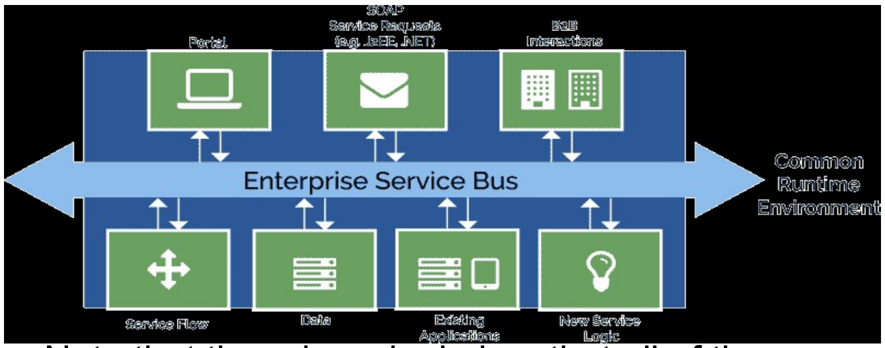
ESB



Note that there is a single bus that all of the services interact with. Hub and spoke model

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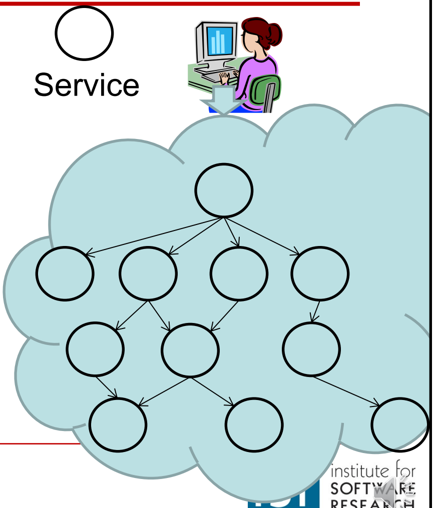
Micro service architecture

- Applications are collections of microservices
- Each user request is satisfied by some sequence of services.
- Most services are not externally available.
- Each service communicates with other services through service interfaces.
- Service depth may
  - Shallow (large fan out)
  - Deep (small fan out, more dependent services)



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Microservice architecture supports DevOps processes

- Reduces need for coordination
- Reduces pipeline errors
- Supports continuous deployment

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How does microservice architecture reduce requirements for coordination among teams?

- Architectural decisions can be made
  - incrementally as system evolves or
  - Initially when the system is defined..
- Microservice architecture makes most of the architectural decisions.
- Consequently they only need to be made once for a system, not once per release.

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Seven Decision Categories

- Architectures can be categorized by means of seven categories
  1. Allocation of functionality
  2. Coordination model
  3. Data model
  4. Management of resources
  5. Mapping among architectural elements
  6. Binding time decisions
  7. Technology choices

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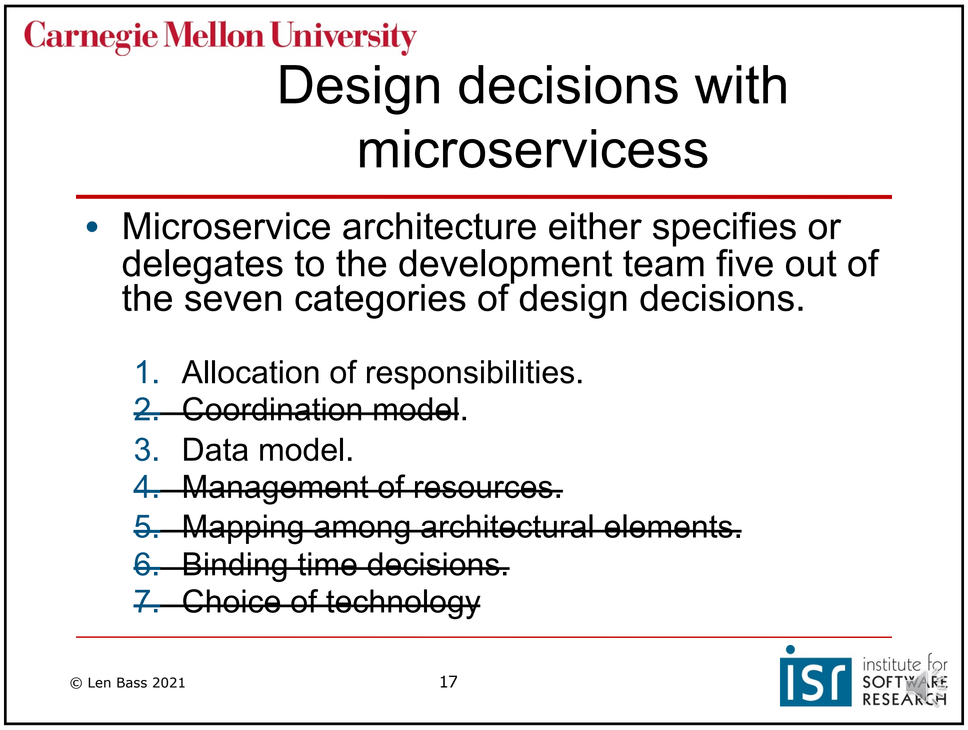

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Design decisions with microservicess

- Microservice architecture either specifies or delegates to the development team five out of the seven categories of design decisions.

1. Allocation of responsibilities.
2. ~~Coordination model~~.
3. Data model.
4. ~~Management of resources.~~
5. ~~Mapping among architectural elements.~~
6. ~~Binding time decisions.~~
7. ~~Choice of technology~~

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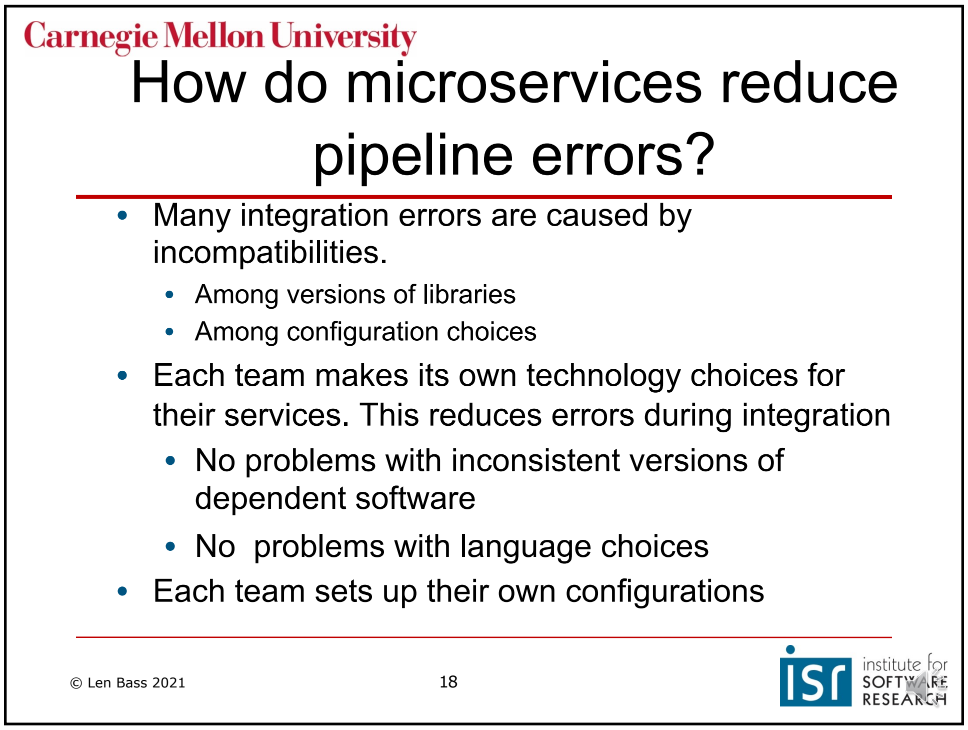

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How do microservices reduce pipeline errors?

- Many integration errors are caused by incompatibilities.
  - Among versions of libraries
  - Among configuration choices
- Each team makes its own technology choices for their services. This reduces errors during integration
  - No problems with inconsistent versions of dependent software
  - No problems with language choices
- Each team sets up their own configurations

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How do microservices support continuous deployment?

- Each team can deploy their service when it is ready without consultation with other teams.
  - Since services are small, this can happen frequently
  - New feature implementation in one service can be deployed without waiting for that feature to be implemented in other services.
  - Requires architectural support – discussed in lecture on deployment

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Overview

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- +/- of microservice architecture
- Relation to containers

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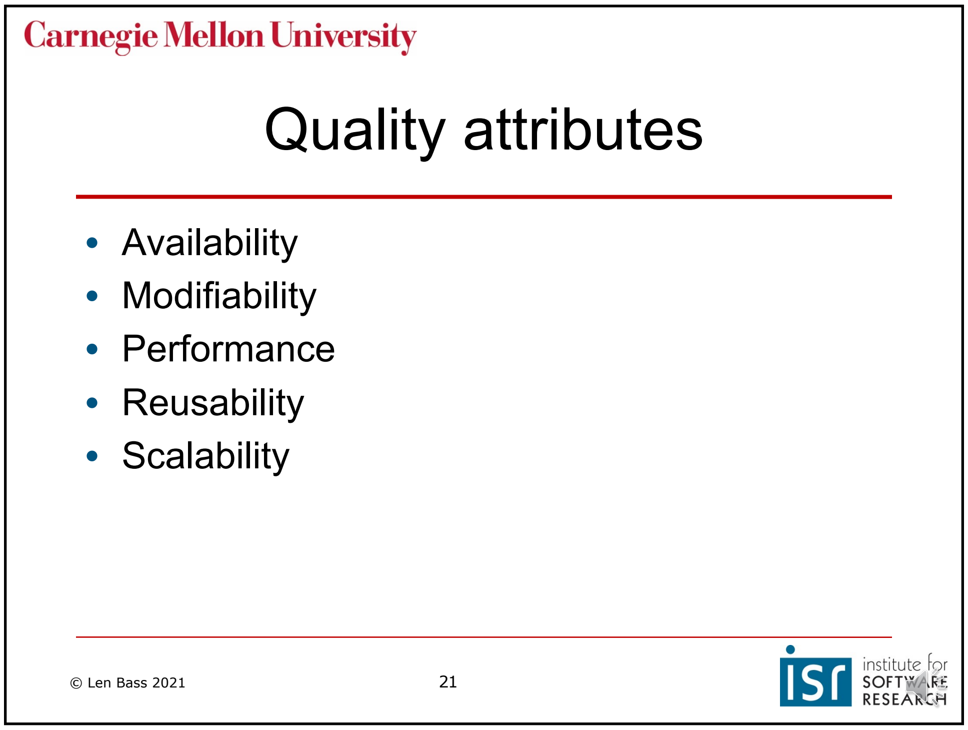
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Quality attributes

- Availability
- Modifiability
- Performance
- Reusability
- Scalability

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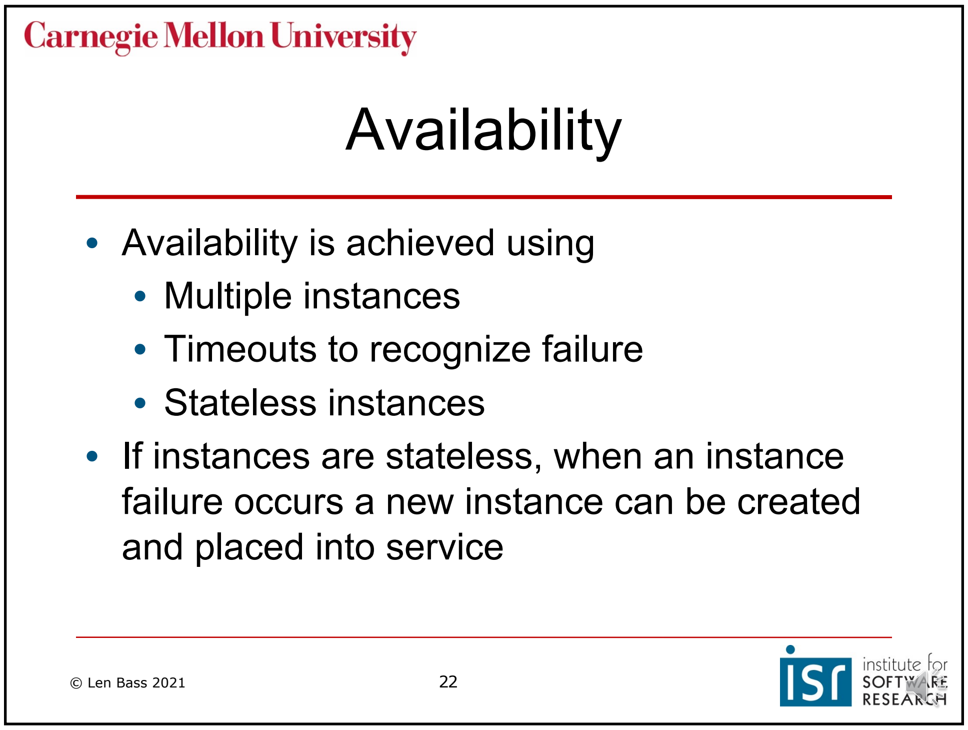
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Availability

- Availability is achieved using
  - Multiple instances
  - Timeouts to recognize failure
  - Stateless instances
- If instances are stateless, when an instance failure occurs a new instance can be created and placed into service

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Modifiability

- Modifiability depends on the design of the various microservices.
- Low coupling and high cohesion are design principles to achieve modifiability.
- Also, a catalog of microservices must be maintained since there will be many microservices and developers must be able to understand how functionality is distributed among them.

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Performance

- Microservices are based on message passing.
- Network communication takes time.
- Important to measure and monitor microservices to determine where time is spent so that performance objectives can be met.
- Pods are means for improving performance

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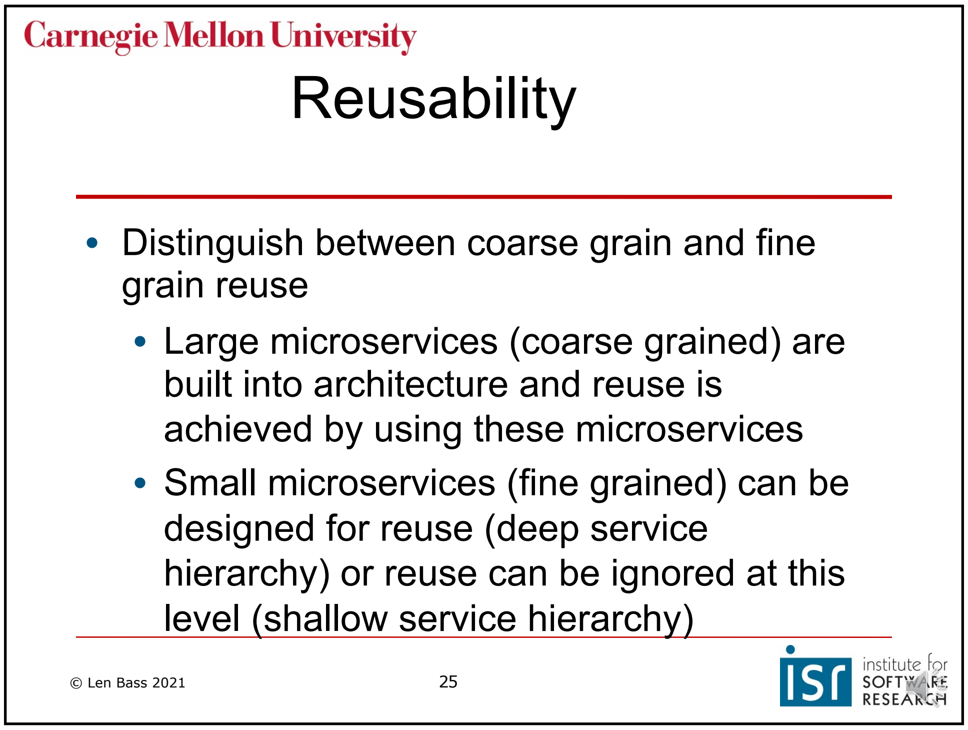
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Reusability

- Distinguish between coarse grain and fine grain reuse
  - Large microservices (coarse grained) are built into architecture and reuse is achieved by using these microservices
  - Small microservices (fine grained) can be designed for reuse (deep service hierarchy) or reuse can be ignored at this level (shallow service hierarchy)

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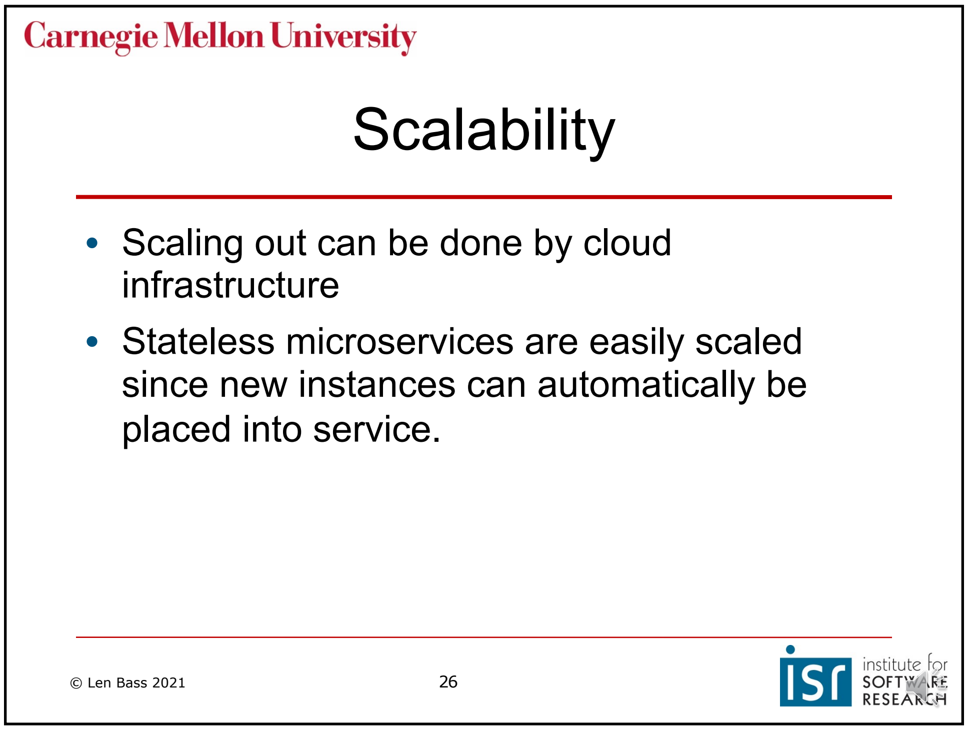
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Scalability

- Scaling out can be done by cloud infrastructure
- Stateless microservices are easily scaled since new instances can automatically be placed into service.

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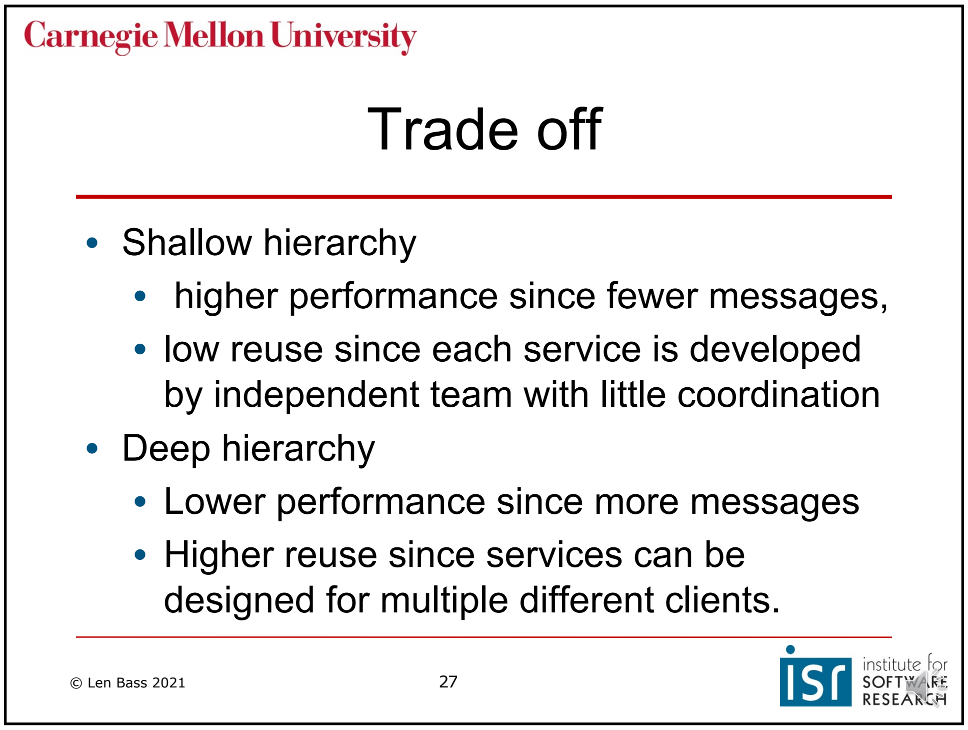
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Trade off

- Shallow hierarchy
  - higher performance since fewer messages,
  - low reuse since each service is developed by independent team with little coordination
- Deep hierarchy
  - Lower performance since more messages
  - Higher reuse since services can be designed for multiple different clients.

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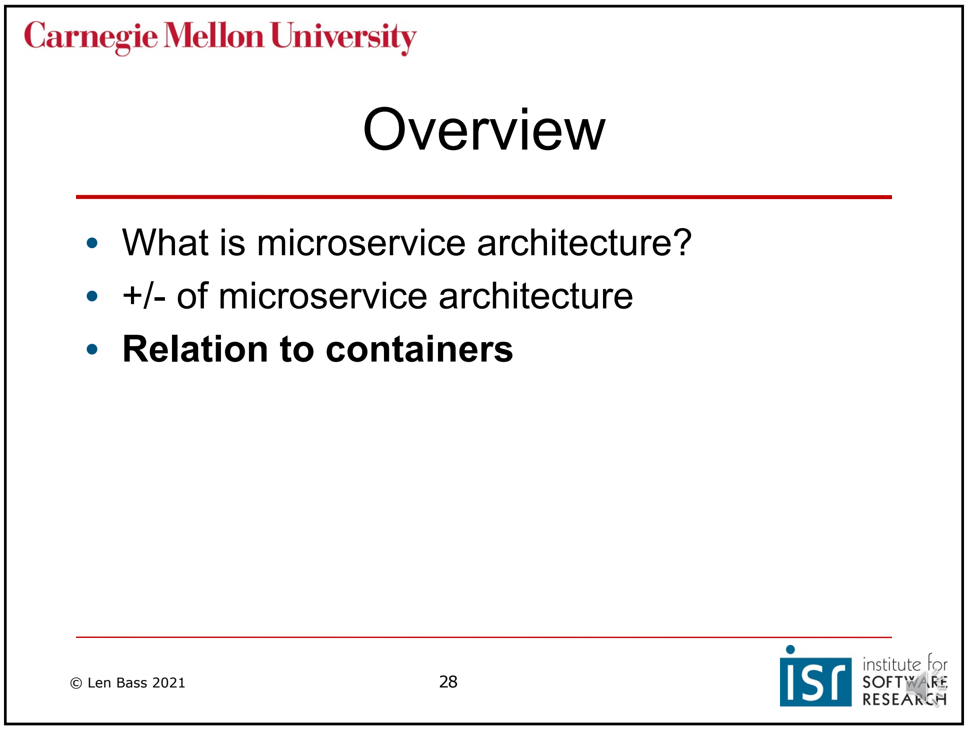
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Overview

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- **Relation to containers**

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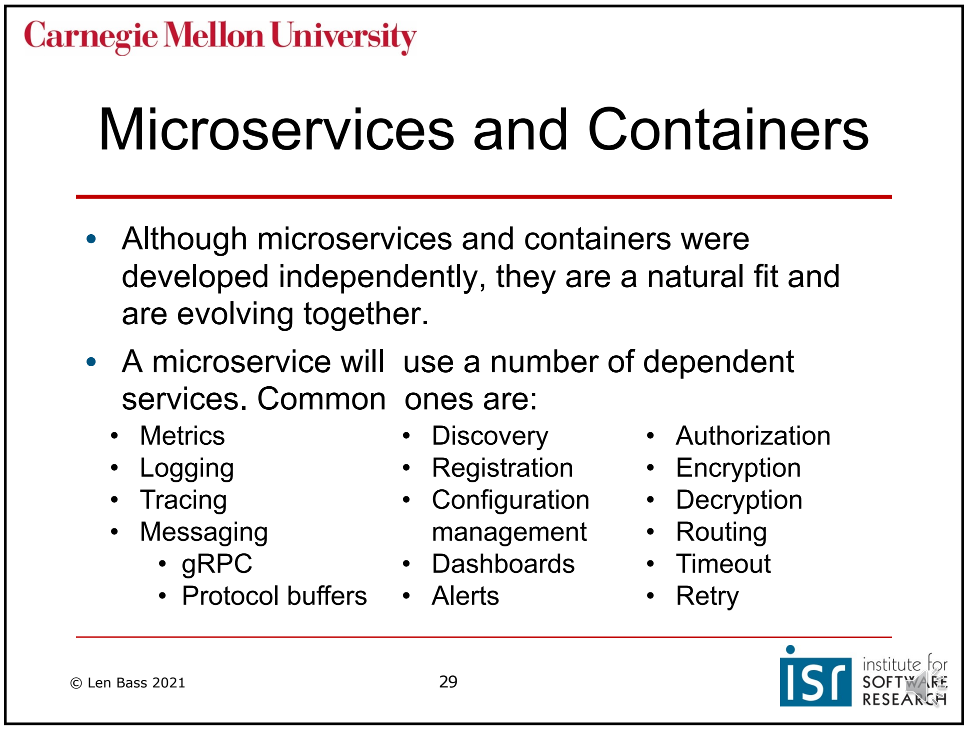

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Microservices and Containers

- Although microservices and containers were developed independently, they are a natural fit and are evolving together.
- A microservice will use a number of dependent services. Common ones are:
  - Metrics
  - Logging
  - Tracing
  - Messaging
    - gRPC
    - Protocol buffers
  - Discovery
  - Registration
  - Configuration management
  - Dashboards
  - Alerts
  - Authorization
  - Encryption
  - Decryption
  - Routing
  - Timeout
  - Retry

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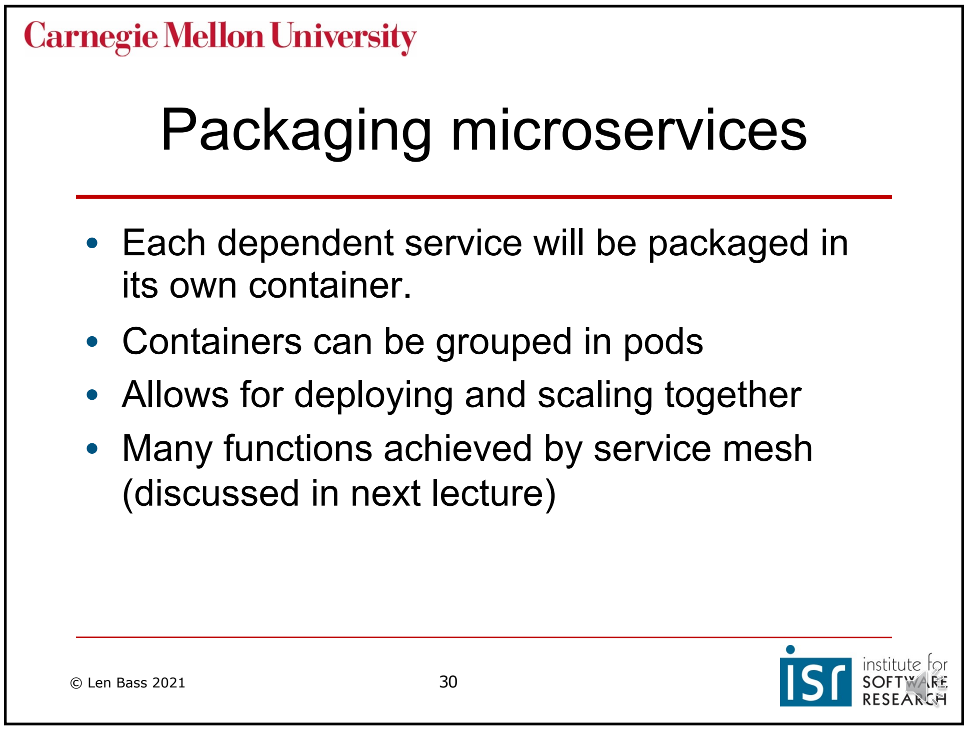

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Packaging microservices

- Each dependent service will be packaged in its own container.
- Containers can be grouped in pods
- Allows for deploying and scaling together
- Many functions achieved by service mesh (discussed in next lecture)

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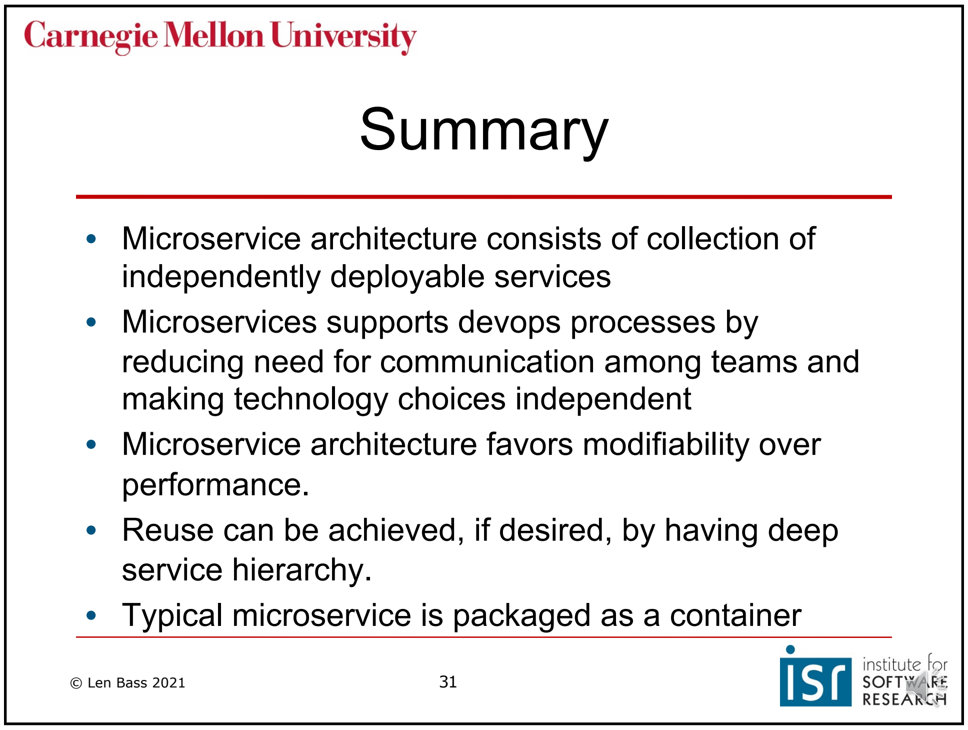
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Summary

- Microservice architecture consists of collection of independently deployable services
- Microservices supports devops processes by reducing need for communication among teams and making technology choices independent
- Microservice architecture favors modifiability over performance.
- Reuse can be achieved, if desired, by having deep service hierarchy.
- Typical microservice is packaged as a container

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