Microservices

.NET CORE

The Microservice architectural style is an approach to developing a single application as a suite of small services. Each service runs in its own process and usually communicates with HTTP resource API.

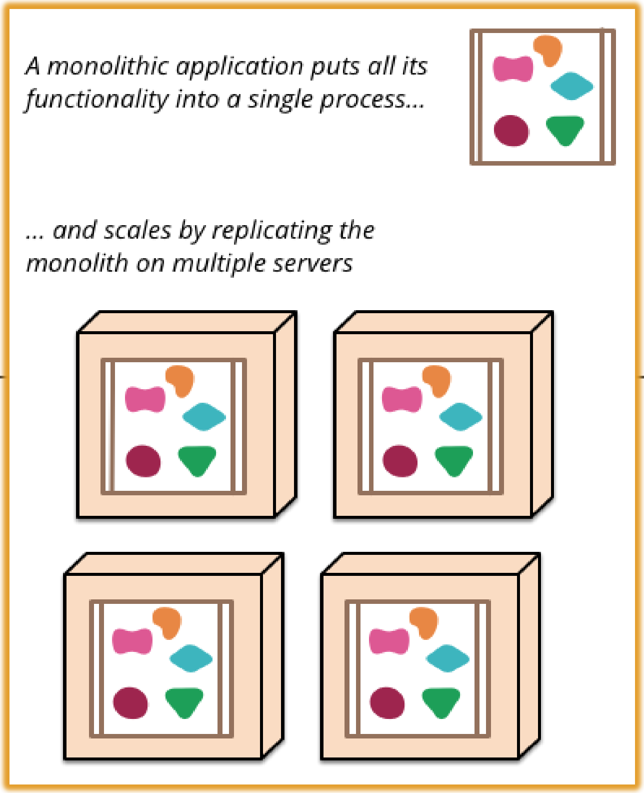
HTTPS://MARTINFOWLER.COM/MICROSERVICES/

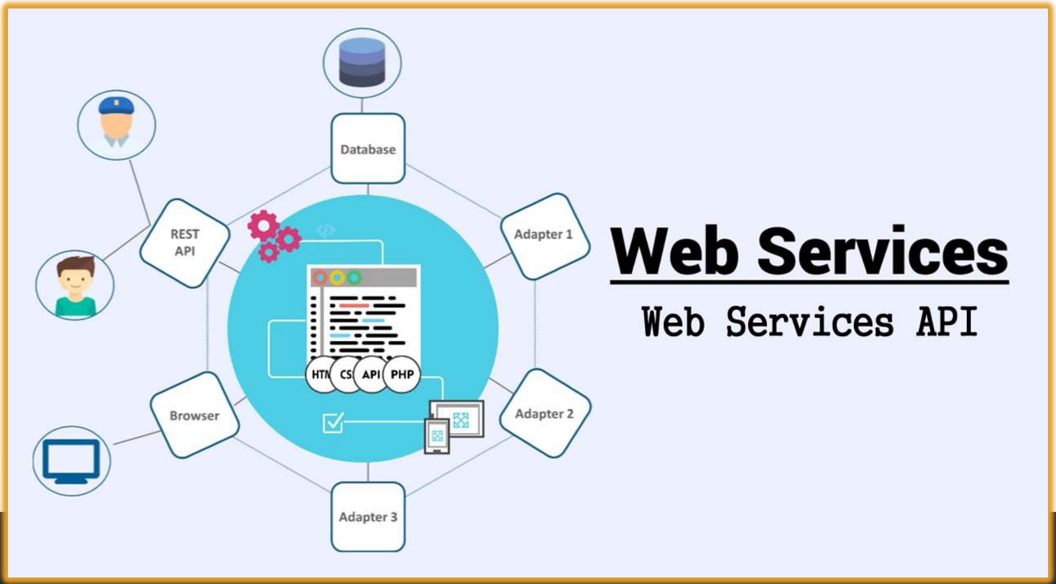
Web Services Applications Review

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

Applications are often built as a “monolith”.
All the code (except DB and UI) is compiled together and deployed together.
What’s the problem with this approach?

- One small change forces you to rebuild and redeploy the whole application as a new version.
- It’s hard to keep the code well organized with strong abstractions.
- If one part of the app is a bottleneck the whole app is affected.

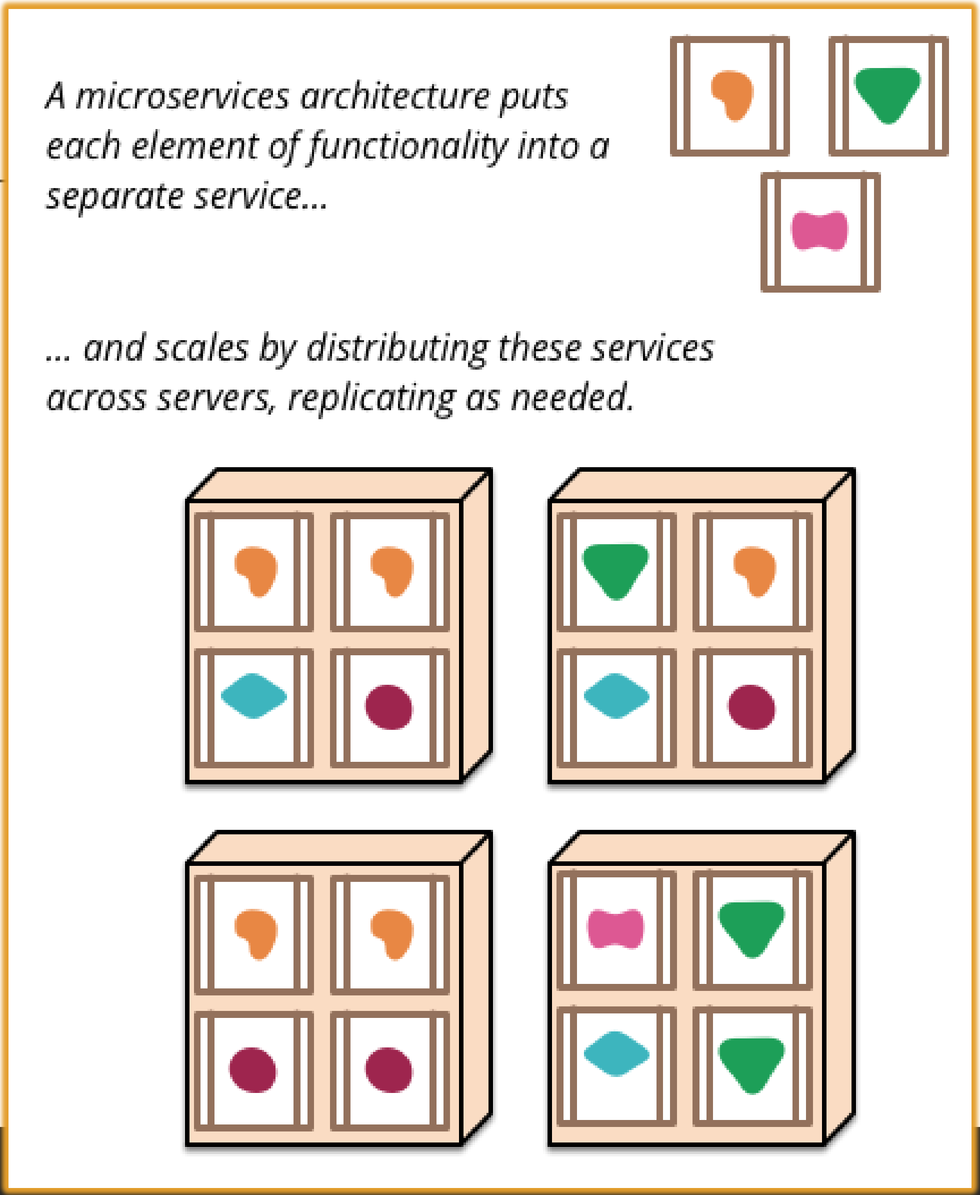

A monolithic application puts all its functionality into a single process...
... and scales by replicating the monolith on multiple servers



Microservices Architecture (MSA) – Overview

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

The ***Microservice architectural style*** means developing a single application as a suite of smaller services. ***MSA's*** are built around business needs and each service (component) is independently deployable by fully automated deployment machinery. There is vary little centralized management of the services and they are loosely coupled so they may be written in different programming languages with different data storage technologies.

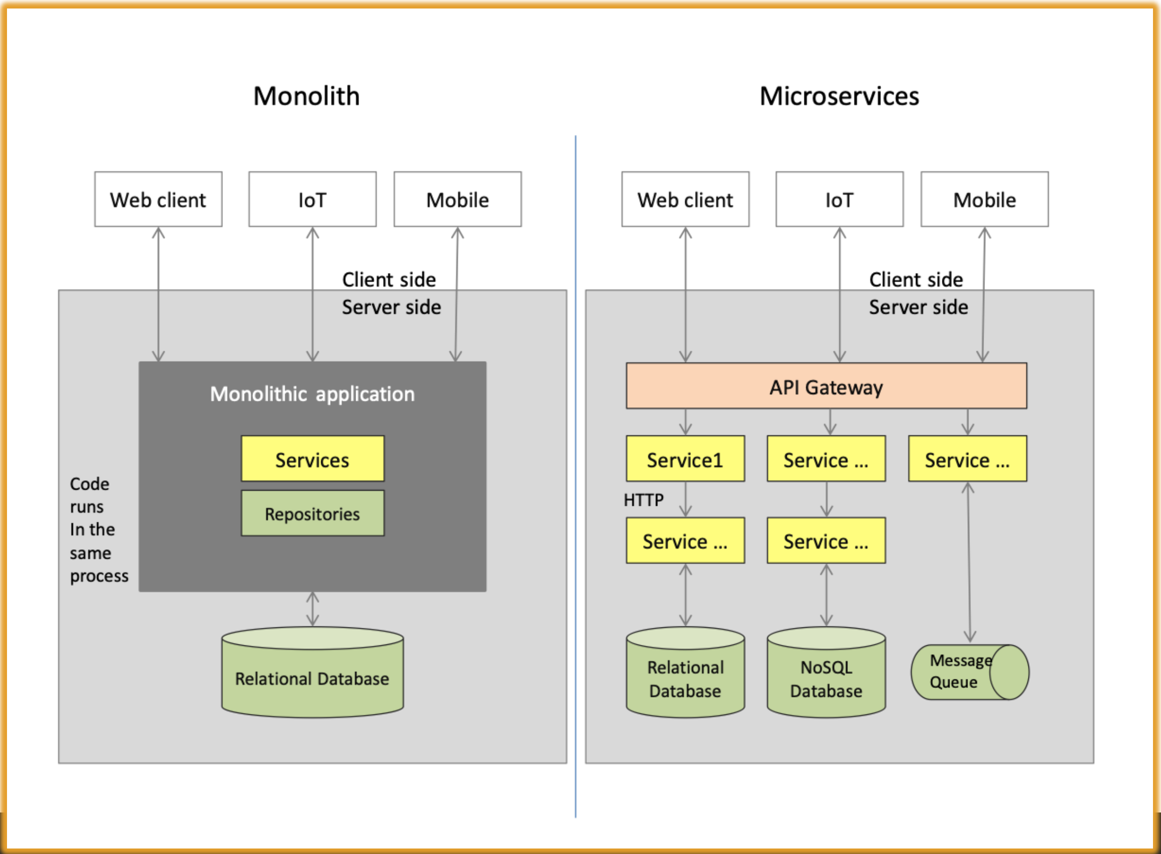

A microservices architecture puts each element of functionality into a separate service...
... and scales by distributing these services across servers, replicating as needed.

Microservices Architecture (MSA) – Overview

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

The basic characteristics of Microservices Architecture are:

- Application divided into components (services).
- Avoids Conway's Law.
- Products, not projects
  - Developers are responsible for the service for its entire lifetime.
- Smart endpoints and dumb pipes
  - Use HTTP to receive requests and respond, staying as decoupled as possible.
  - Use a lightweight message bus that acts as a message router only and don't do much more than provide a reliable asynchronous fabric
- CI/CD

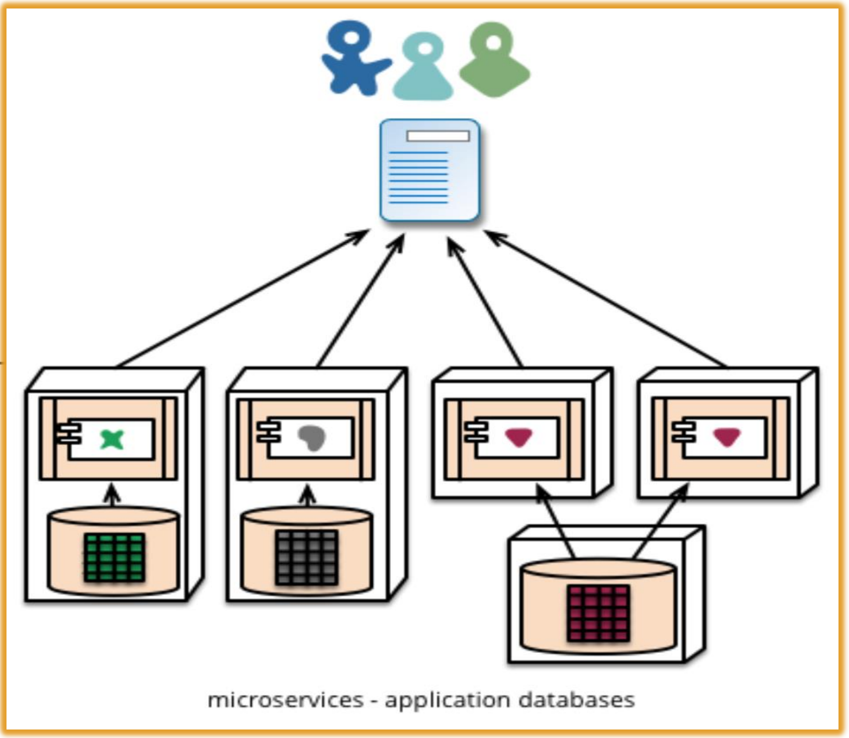


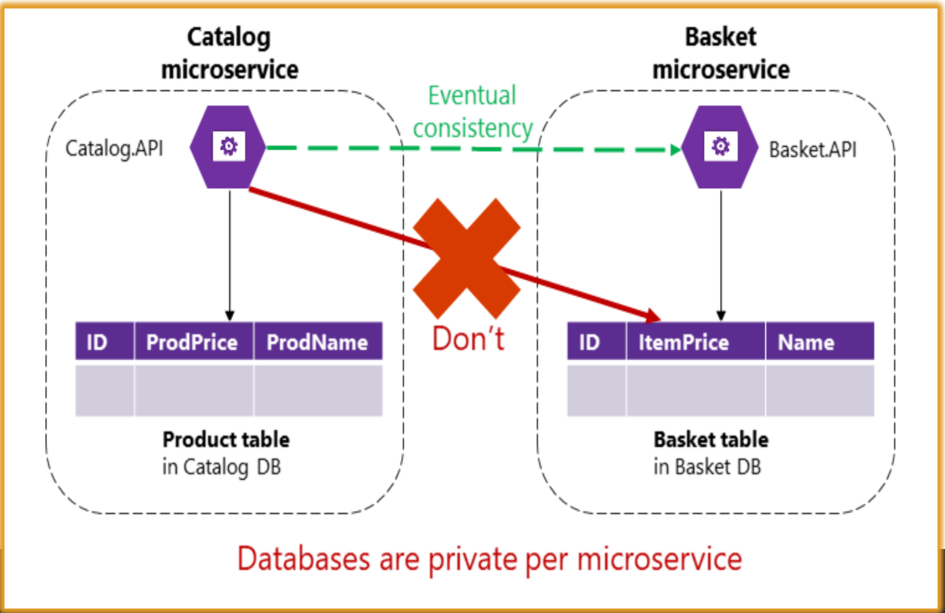
MSA Components – Overview

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

The basic characteristics of Microservices Components (services) are:

- Each service implements one business capability.
- Services are developed, deployed, and scaled independently.
- Services control their own logic.
- Services manage/persist their own data
- Each services is replaceable and upgradable.
- Services communicate with ***RPC's***



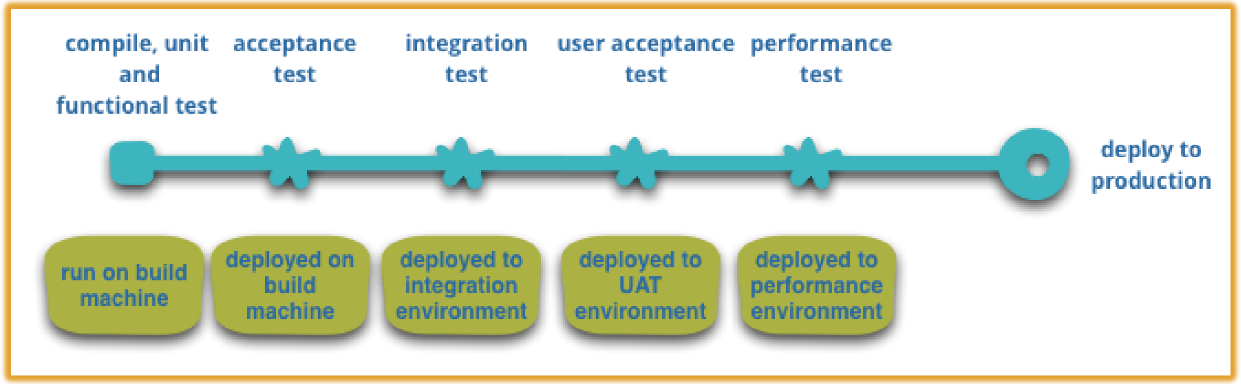


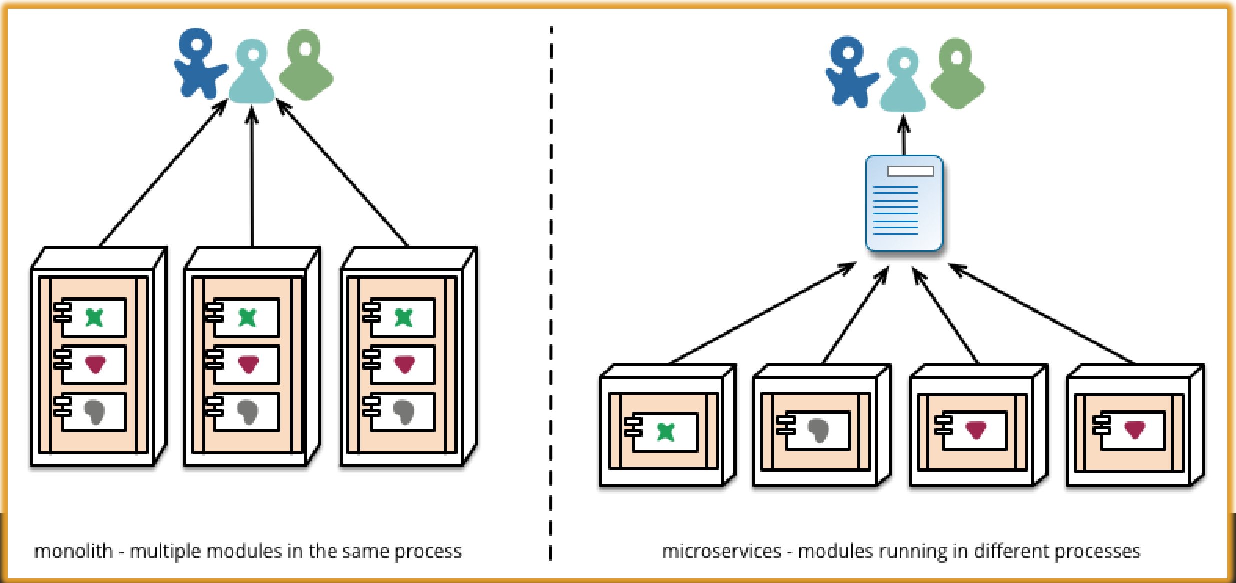
MSA and CI/CD

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

The evolution of “the cloud” has reduced the operational complexity of building, deploying and operating microservices. Teams using CI/CD make extensive use of infrastructure automation techniques.

As long as deployment is “boring” there isn't much difference between monoliths and microservices. Although the operational landscape for each can be very different.


compile, unit and functional test
acceptance test
integration test
user acceptance test
performance test
deploy to production
run on build machine
deployed on build machine
deployed to integration environment
deployed to UAT environment
deployed to performance environment


monolith - multiple modules in the same process
microservices - modules running in different processes

Pros of MSA

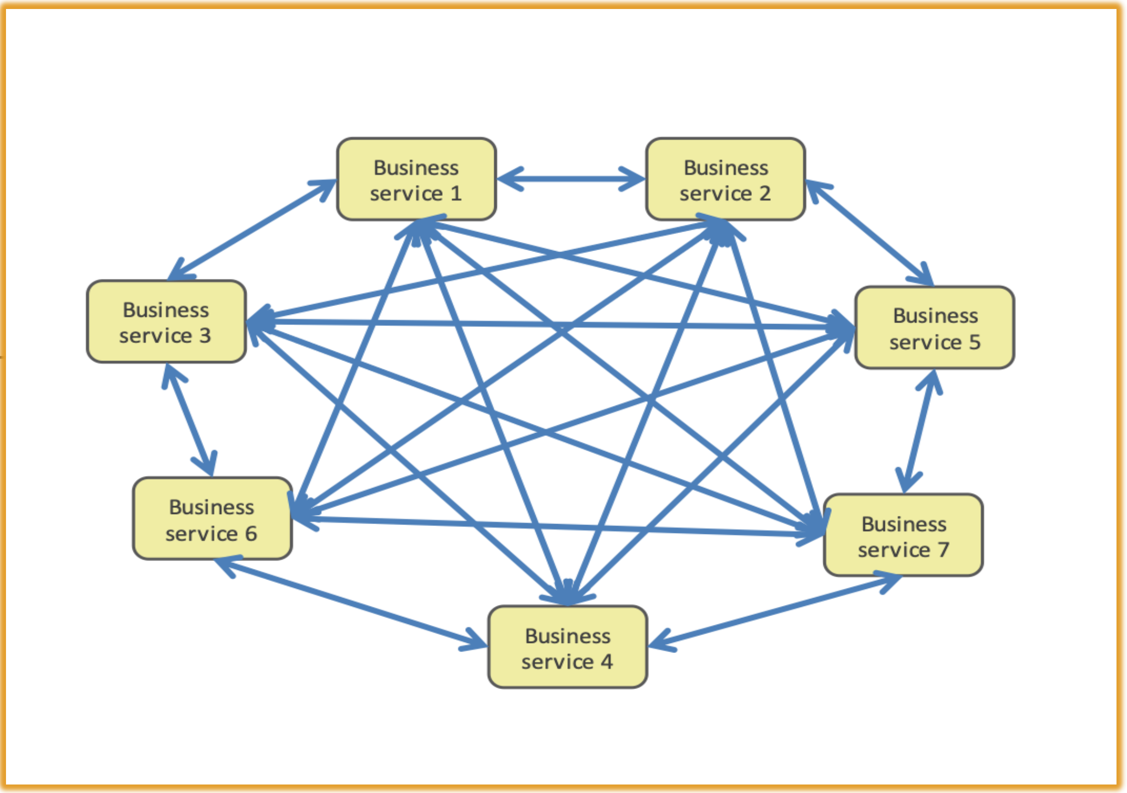
https://developer.ibm.com/technologies/microservices/articles/challenges-and-benefits-of-the-microservice-architectural-style-part-1/

- Long-term flexibility when new technologies are developed.
- Higher ROI and better TCO (Total Cost of Ownership) with faster, cheaper development using simpler, cheaper hardware.
- Easier fault isolation and bug fixing leads to higher resiliency.
- Loose coupling is enforced by the architecture
- Time-to-market: Smaller, easier-to-understand services help to quickly get new features live.
- Easily scalable with increasing load requirements. Just add another server!
- Implement individual services in most appropriate technology

Cons of MSA

https://developer.ibm.com/technologies/microservices/articles/challenges-and-benefits-of-the-microservice-architectural-style-part-1/

- If the service relies on a relational DB, they may be difficult to scale and complex to manage. ACID transactions increase overhead.
- There are many more moving parts that can break so there must be more error handling and resiliency built into the system.



•Different technologies used for each service can lead to difficulties:

•when team members transition from one team to another.

•when maintaining a very diverse technology group, more personnel are needed.

•High dependency between varying services can lead to a “microservices death star”. Many services needing to be altered for certain adjustments made to one service.

•A complex and changing communication system between services can be hard to understand. IP addresses and ports can get out of sync when updating.

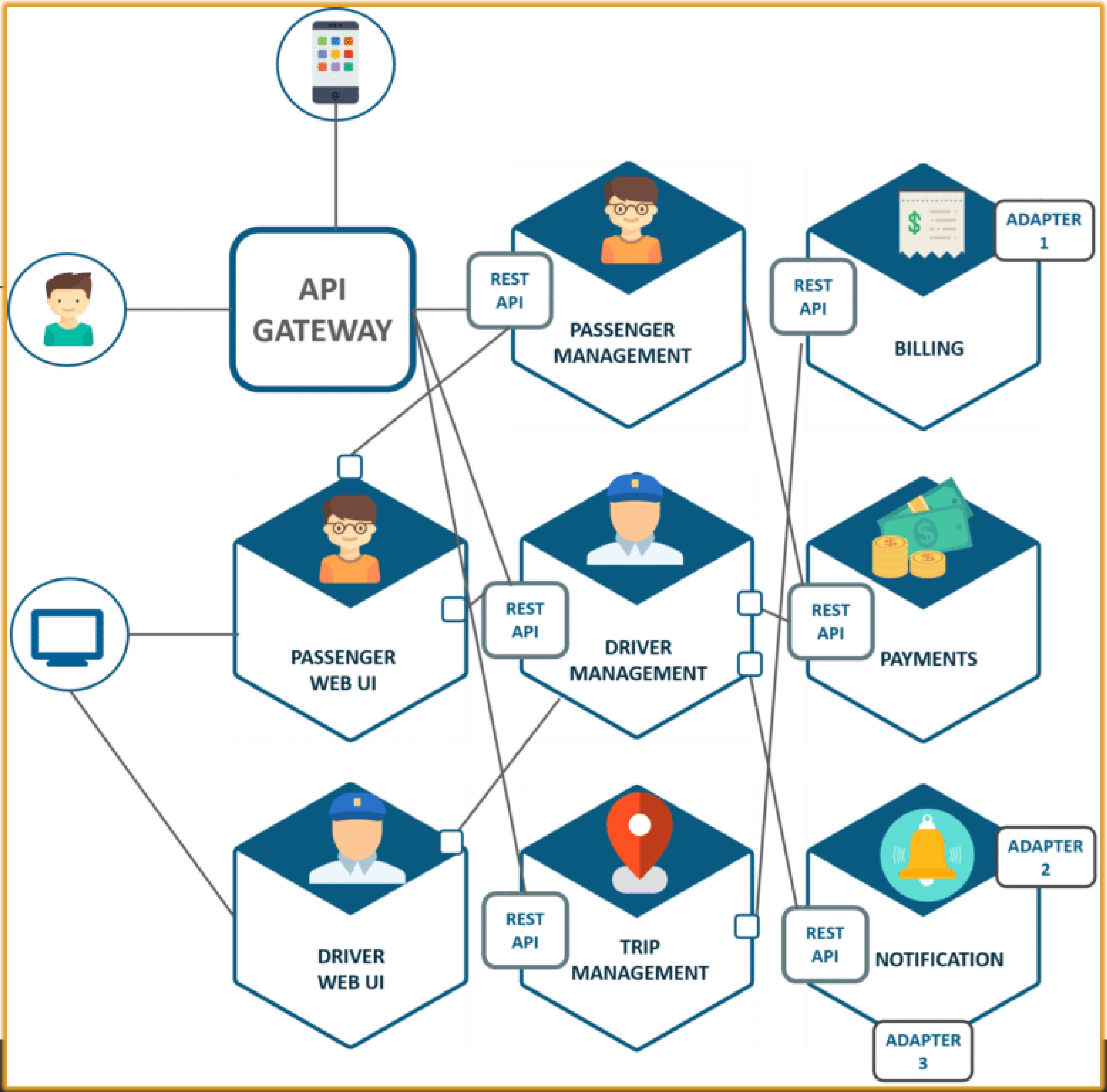
•Harder to implement integration testing when each team only deals with their own microservice.

MSA Example and Requirements

https://martinfowler.com/bliki/MicroservicePrerequisites.html

You must have certain capabilities in place before starting a MDA application.

- Quick server creation – you must be able to automate provisioning to respond quickly to outages or fluctuating demand.
- Accurate Monitoring – detect problems quickly to be able to respond appropriately to arising problems.
- Fast deployment – preferably use a fully automated deployment pipeline to rapidly respond to developing needs.
- Employ Product-centered teams that develop and maintain the same product for the lifetime of the product.



When is MSA Appropriate?

https://martinfowler.com/bliki/MicroservicePremium.html

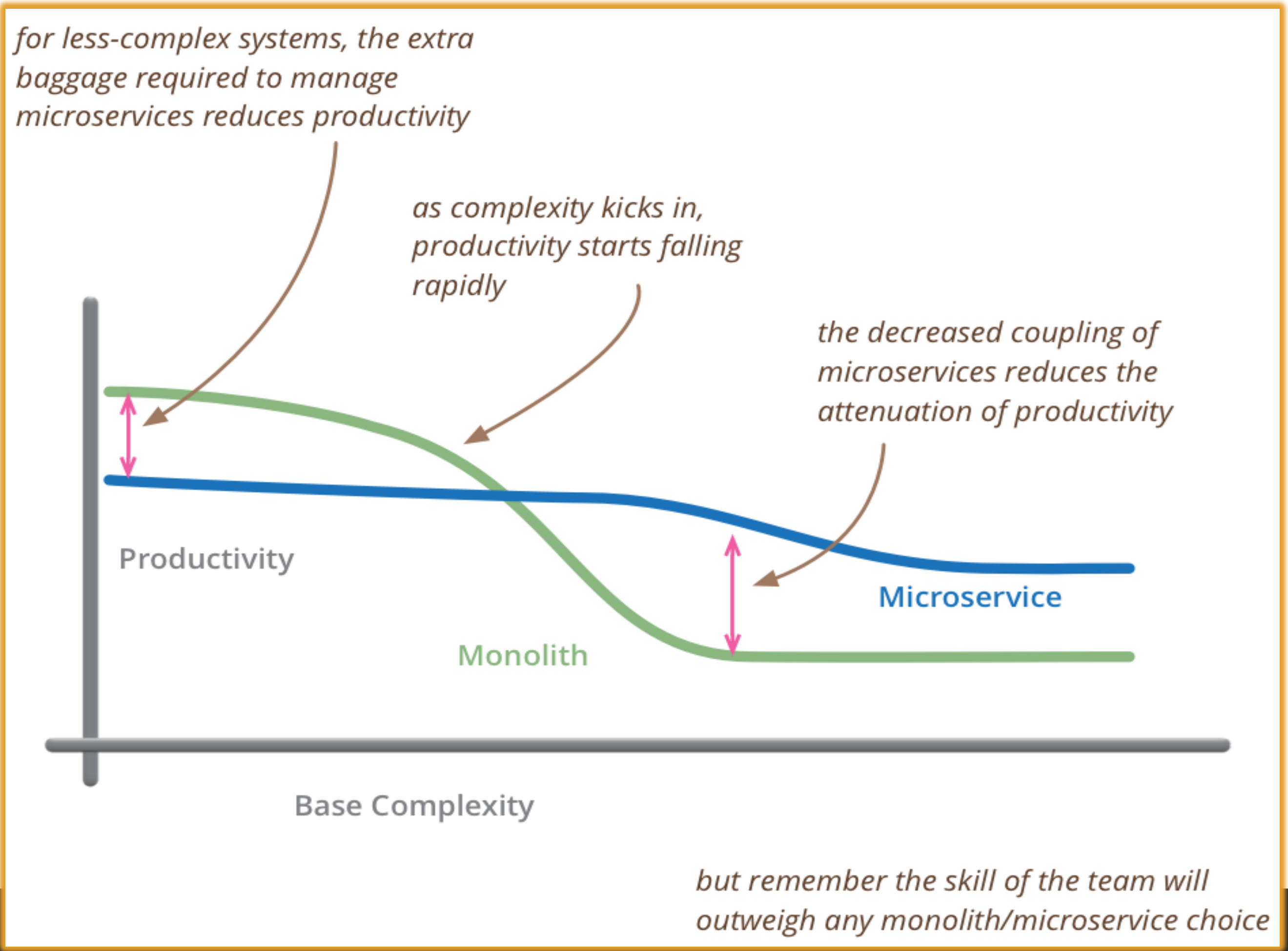
The decision of whether or not to use microservices depends on the complexity of the system you're contemplating.

The MSA approach introduces its own set of complexities, like:

- automated deployment and monitoring,
- dealing with failure,
- eventual consistency

The primary guideline would be:

don't even consider microservices unless you have a system that's too complex to manage as a monolith.



MSA and Containerization

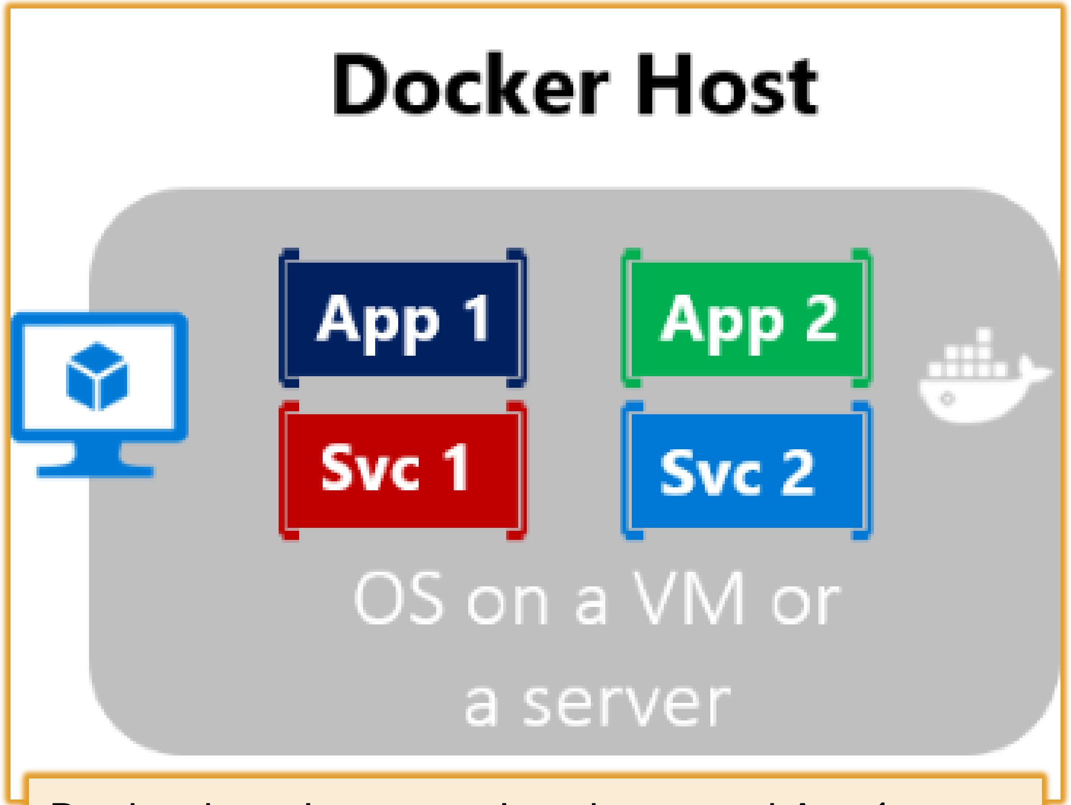
https://docs.microsoft.com/en-us/dotnet/architecture/microservices/container-docker-introduction/

Containerization is when an application (or service), its dependencies, and its configuration are packaged together as a container image. The containerized application can be tested as a unit and deployed as a container image instance to the host operating system (OS).

Software containers act as a standard unit of software deployment that can contain different code and dependencies.

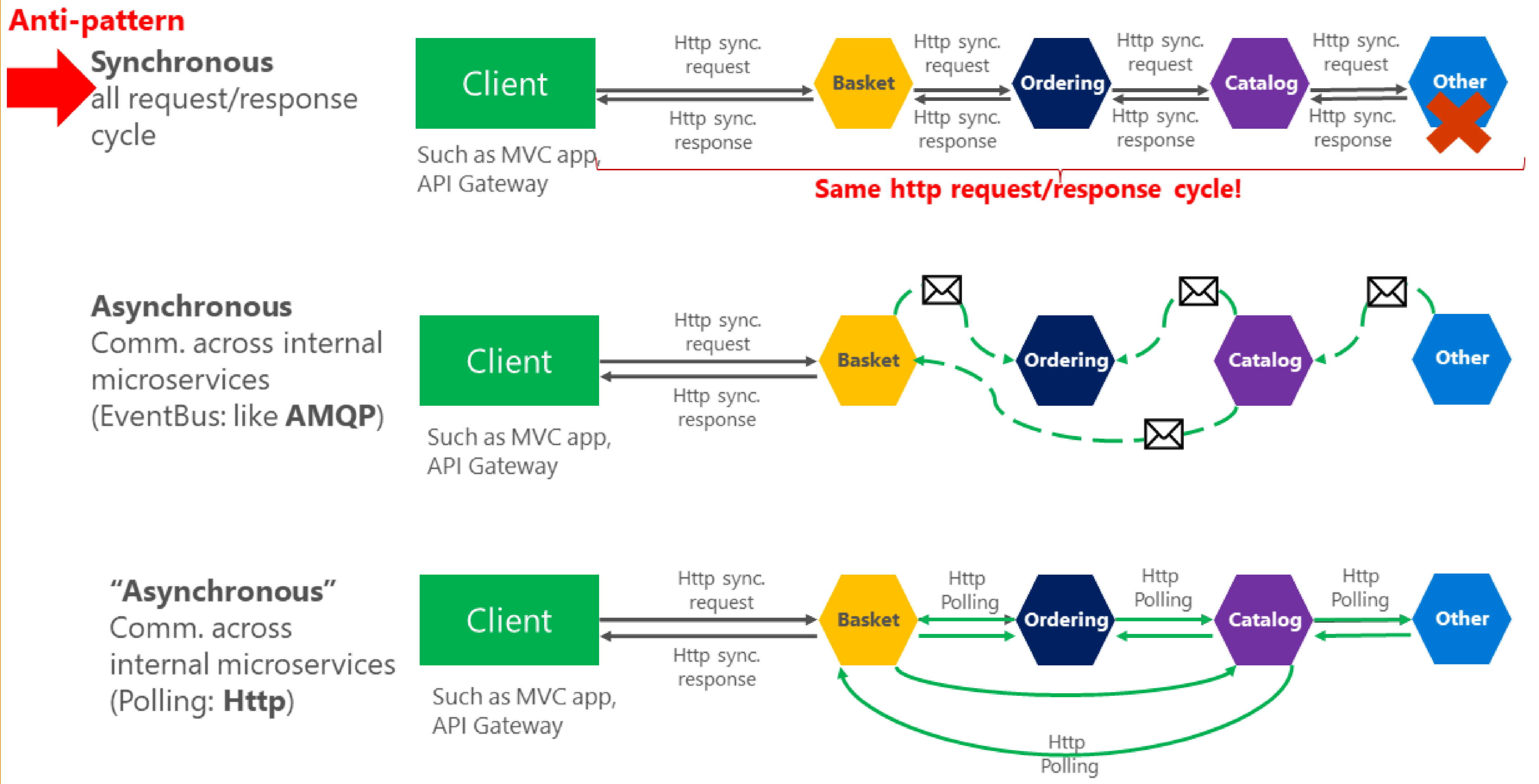
Each container can run a whole web application or a service.

Containers offer the benefits of isolation, portability, agility, scalability, and control. The most important benefit is the environment's isolation provided between Dev and Ops.



Docker host is a container host, and App1, App2, Svc 1, and Svc 2 are containerized applications or services.

Synchronous vs. async communication across microservices

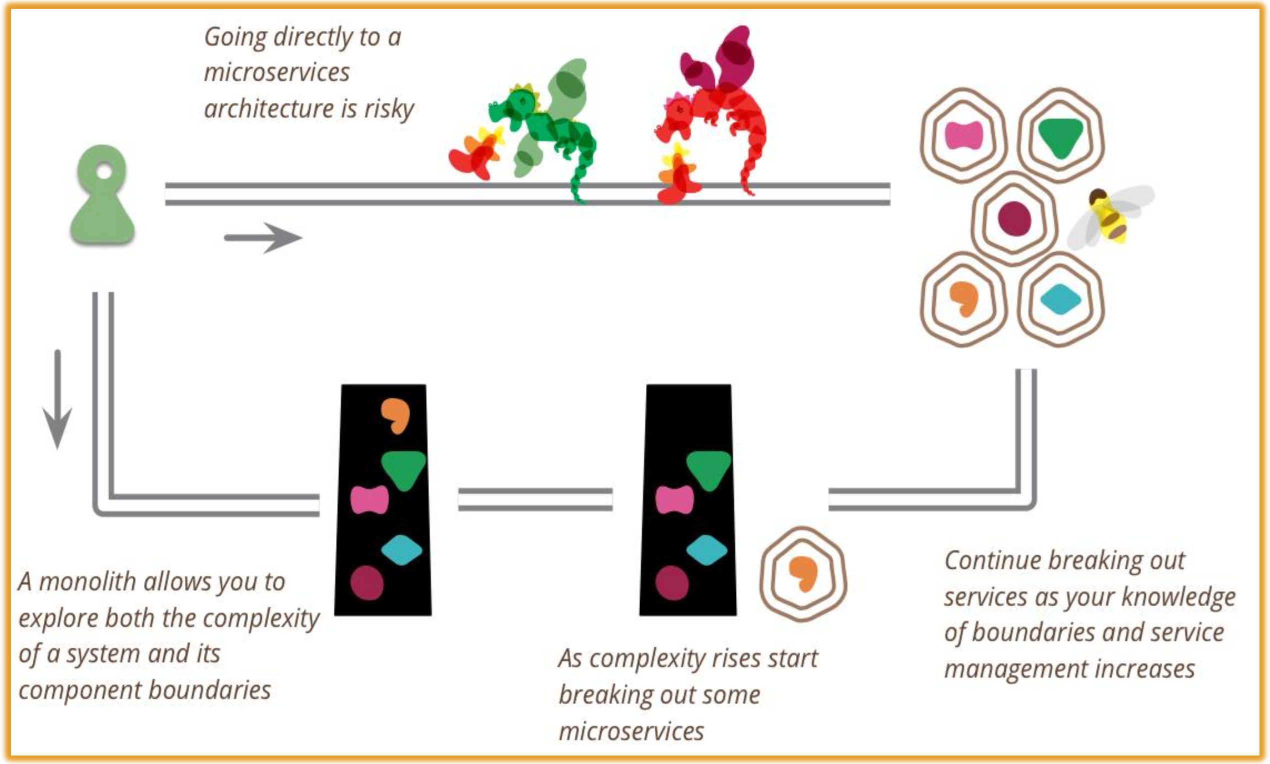


Monolith + MSA?

Some say, start with a monolith and evolve it to MSA if and when needed

Pros:

- That's what most MSA success stories did
- Do we *really* know where to draw all the service boundaries before we have an MVP?

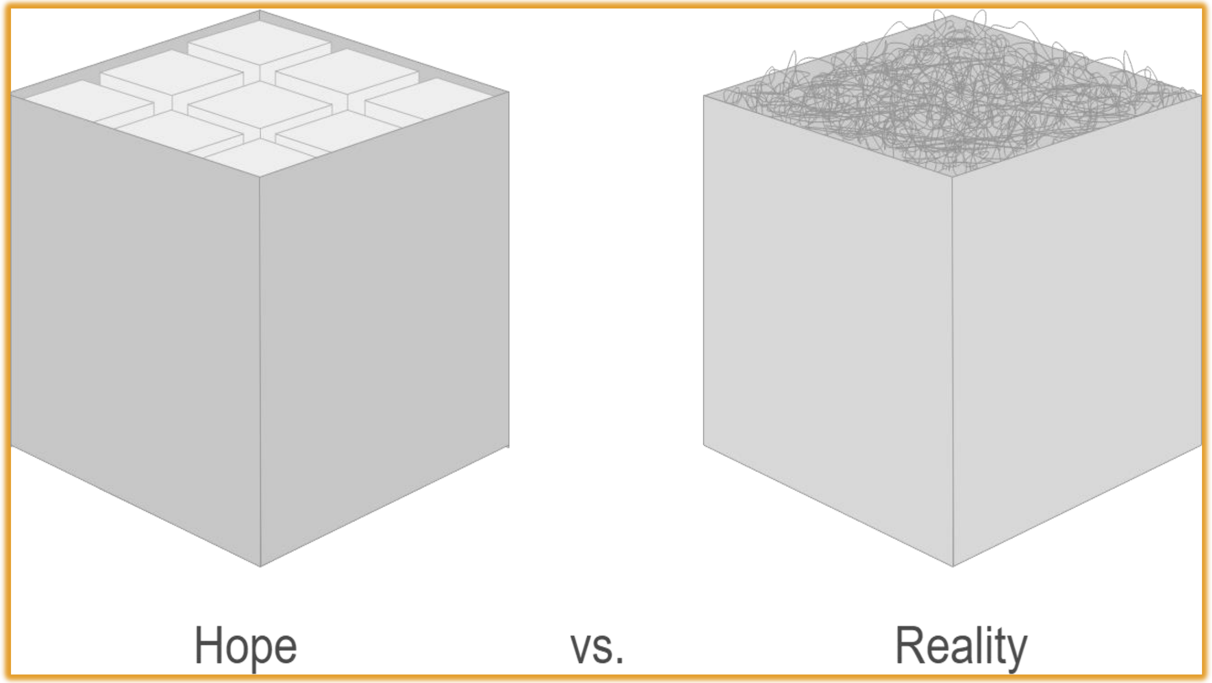


Going directly to a microservices architecture is risky
A monolith allows you to explore both the complexity of a system and its component boundaries
As complexity rises start breaking out some microservices
Continue breaking out services as your knowledge of boundaries and service management increases

Convert a Monolith to MSA?

Cons:

- The monolith’s parts will inevitably be more tightly coupled to each other
- Good module separation in a monolith might not be the same as good service boundaries



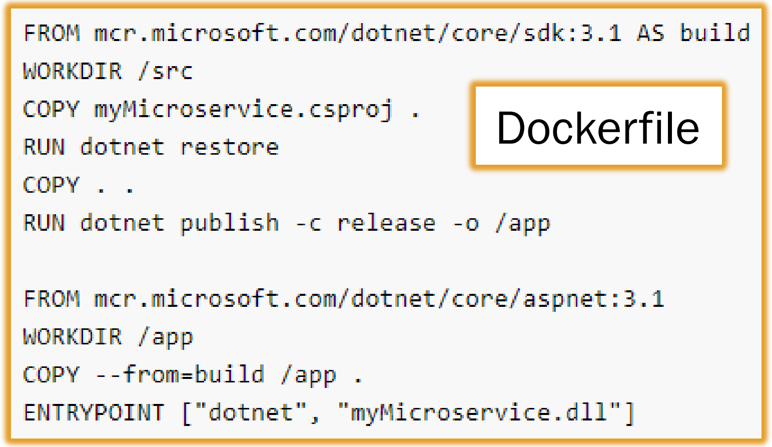
Review – Things that go well with MSA

- Agile
- DevOps, CI/CD
- Containers/Docker
- Orchestration/Kubernetes
- Automated testing
- REST

Microservices Tutorial

https://dotnet.microsoft.com/learn/aspnet/microservice-tutorial/intro
https://dotnet.microsoft.com/learn/aspnet/microservice-tutorial/create

1. Create a new api with dotnet new webapi -o myMicroservice --no-https. This creates the template WeatherForecast API.
2. Move into the new directory with cd myMicroservice.
3. Run it with dotnet run.
4. Make sure you have Docker with docker –version. Download Docker here.
5. Create a ***Dockerfile*** with vim dockerfile. No suffix needed.
6. Add the text to the right to the Dockerfile.
7. Build the Docker Image with ‘docker build -t mymicroservice .’. The image is named mymicroservice.
8. Check that the image is created with docker images.
9. Run the service in the container with ‘docker run -it --rm -p 3000:80 --name mymicroservicecontainer mymicroservice’.
10. Verify that the container is running with docker ps.
11. Access the running app at http://localhost:3000/WeatherForecast.



Dockerfile

```
FROM mcr.microsoft.com/dotnet/core/sdk:3.1 AS build
WORKDIR /src
COPY myMicroservice.csproj .
RUN dotnet restore
COPY . .
RUN dotnet publish -c release -o /app

FROM mcr.microsoft.com/dotnet/core/aspnet:3.1
WORKDIR /app
COPY --from=build /app .
ENTRYPOINT ["dotnet", "myMicroservice.dll"]
```