Architectural Skills

CSSE6400

Richard Thomas

May 30, 2022

Quote

> Architecture is the stuff you can't Google.
>
> – Mark Richards [1]

Quote

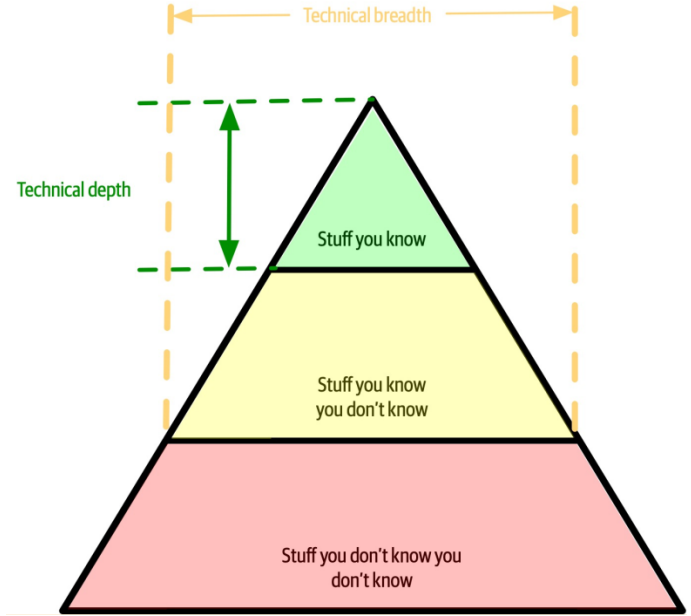
There are no right or wrong answers in architecture—only trade-offs.

– Neal Ford [1]

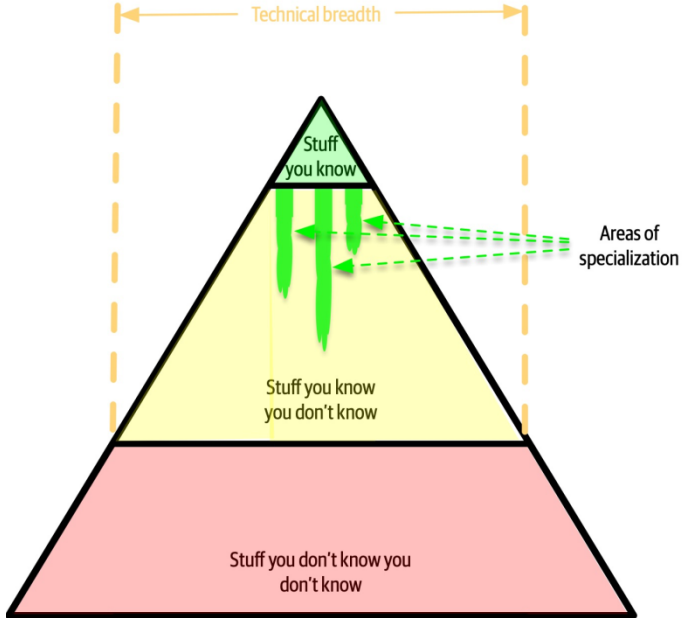
Architectural Design

Architects use knowledge and experience to analyse trade-offs to design architectures appropriate to the system context.

Developers – Technical Depth [1]



Architects – Technical Breadth [1]



- Architects need greater technical breadth than depth.
- Breadth allows better consideration of trade-offs.
- Avoid trying to become an expert across many areas – you'll fail.
- Don't stop learning – increase your breadth – don't let your knowledge become stale.

Question

What are the benefits of a monolith architecture?

Question

What are the benefits of a monolith architecture?

Answer

- Simple deployment

Question

What are the benefits of a monolith architecture?

Answer

- Simple deployment
- Simple communication between modules

Question

What are the benefits of a monolith architecture?

Answer

- Simple deployment
- Simple communication between modules
- Simple system testing & debugging

Question

Why do monoliths have a bad name?

Question

Why do monoliths have a bad name?

Answer

- Many legacy system nightmares were monoliths

Question

Why do monoliths have a bad name?

Answer

- Many legacy system nightmares were monoliths
- Easy to defeat modularity

Question

Why do monoliths have a bad name?

Answer

- Many legacy system nightmares were monoliths
- Easy to defeat modularity
- Cannot scale components of system

Question

Why do monoliths have a bad name?

Answer

- Many legacy system nightmares were monoliths
- Easy to defeat modularity
- Cannot scale components of system
- Monolith databases scale poorly

Question

What can be done if a monolith architecture is no longer suitable?

Question

What can be done if a monolith architecture is no longer suitable?

Answer

- Greenfields replacement

Question

What can be done if a monolith architecture is no longer suitable?

Answer

- Greenfields replacement
- Migrate to another architecture

- Replacement: Can choose any suitable architecture. Risky, as you're developing a new system and maintaining existing.
- Migration: Adaptive maintenance, changing architecture slowly. Some limitation on choice of architecture, but most sophisticated architecture can be used.

Question

How do I migrate a monolith to a new architecture?

Question

How do I migrate a monolith to a new architecture?

Answer

Decompose the monolith into services.

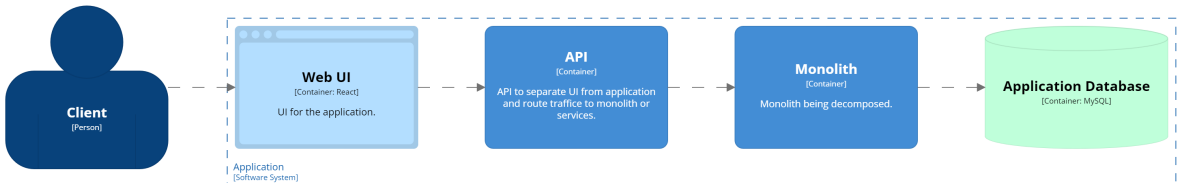
Implies a service-based or microservices architecture.

Strangler Fig Pattern

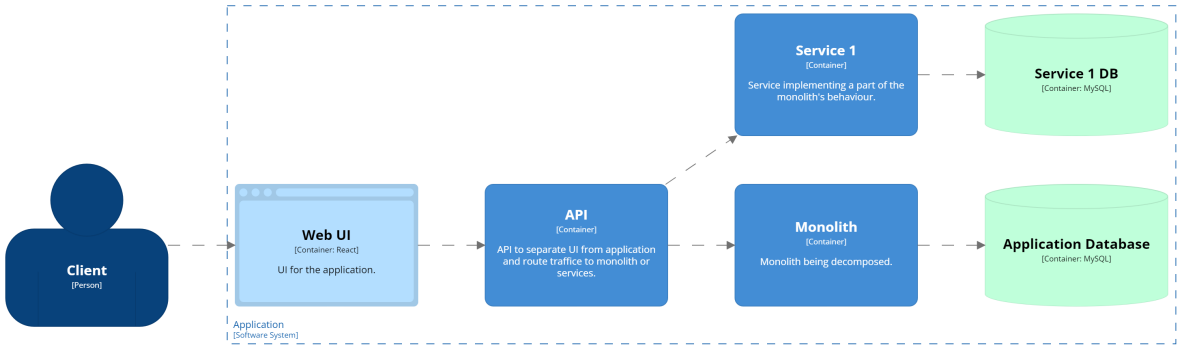
- Develop API for application's UI
- Proxy intercepts API calls
  - Proxy directs calls to application or new services
- Implement a service
  - Redirect calls to service
- Progressively replace monolith
- Shadow & Blue-Green Deployment

- May already have an API if the UI is a web or mobile app.
- Initially deploy proxy and new interface into production, with only existing monolith. Test it works as expected.
- Use shadow deployment to test service with application, before making available to end users.

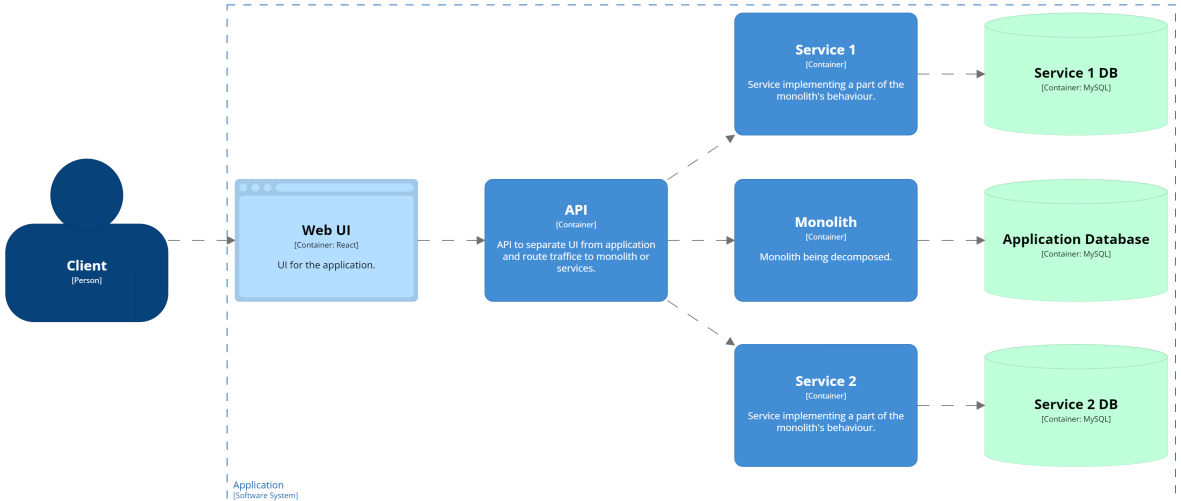
Monolith Deployment



Monolith Decompose: Step 1



Monolith Decompose: Step 2



Decomposition Process

- Identify bounded-contexts
- Simple first service
  - e.g. Authentication
- Minimise dependency from services to monolith
  - Monolith may use services

- Use first service (or first few) to validate approach and deployment infrastructure.
- Minimise changes required in monolith.

- Reduce coupling between bounded-contexts
  - e.g. Customer account management
    - Profile, Wish List, Payment Preferences – separate services
- Decouple vertically
  - Service delivers entire bounded-context
    - Data is decoupled from monolith

- Account management may be tightly coupled in monolith. Separate each aspect (context), one at a time.
- Do not focus only on UI or internal components, service needs to implement all parts of the business process.
- Data management needs to be decentralised.

Decomposition Process

- Focus on pain points
  - Bottlenecks
  - Frequently changing behaviour
- Rewrite, don't reuse
  - Redesign for new infrastructure
  - Reuse complex logic
    - e.g. Discounts based on customer loyalty and behaviour, bundle offers, …

- Extract services that deliver highest value.
- What contexts may need to scale more than others?
- What contexts change more frequently and benefit from separate deployment?
- Services deliver capabilities provided by monolith.
- Most often it is better to rewrite the capability to take advantage of new infrastructure.
- Only reuse code that has complex logic that will be difficult to duplicate and test fully.

- Refactor monolith
  - Use service to deliver application functionality
    - Monolith may need to invoke service
  - Remove service logic from monolith

- Atomic replacement of monolith behaviour by service's behaviour.
- Don't deploy production code with service behaviour left in monolith. Leads to a maintenance nightmare determining where behaviour is used, or it may be used in both the monolith and service.

Stepwise Decomposition

Replace application functionality one service at a time.

Definition 1. Macroservice

Separate service, but may span more than one domain or share a database with the monolith or other services.

- Similar scalability and deployment issues to a monolith, but grouped by clusters of macroservices if they share a database.
- Interim step to build microservices.

Definition 2. Nanoservice

Service that depends on other services and cannot be deployed independently – its context is too small.

- Anti-pattern where services are too fine grained and need to be coupled to deliver business processes.
- Some use the term “nanoservice” to refer to independently deployable functions, similar to serverless architecture.

Definition 3. Conway's Law

Organisations design systems whose structure is inevitably a copy of the organisation's communication structure [2] [3].

- First citation is original article.
- Second citation is one of several about MIT and Harvard research into the phenomenon, calling it the "mirroring hypothesis".
- Elaborate on this point and Coplien's research into organisational sociology.

Conway's Law Consequences

- Business Process Management
- Microservices to reflect organisation structure
- Teams formed around services

- BPM: Redesign organisation structure to reflect system you want.
- Microservices: Design system to reflect your organisation.
- Elaborate on benefits of both approaches.
- Comment on benefits of small focussed teams.

Conway's Law Consequences

Team insularity – more loyal to team than organisation.

- Amazon example from week 11, negotiation difficulties with other teams.
- Need to ensure inter-team cooperation.
- Possibly move people between teams.
- Cloud platforms, and microservices, also support this and with larger teams.
- Intra-team communication becomes more difficult with large teams.

- Cross-cutting concerns
  - e.g. Security
- Organisation structure should align with market structure
- Physical location of teams

- Cross-cutting concerns span services, and consequently teams.
- Can't have a "security" service. It has to be part of every service.
- Teams solely based around Conway's law and services may not deliver some cross-cutting concerns.
- Cooperation, documentation and audits may be necessary.
- Market structure may complement team structure to place teams closer to their end users.
- Global development and outsourcing mean different teams are likely to be in different locations.
- Requires additional overhead and documentation for cooperation between teams.

Evidenced-Based Software Engineering

Don’t follow fads, seek evidence for good practice.

Elaborate on finding reliable sources of information and confirming facts yourself.

Let's hear from an expert

1 / 47

---

https://youtu.be/HrVtA-ue-x0

References

[1] Mark Richards and Neal Ford.
Fundamentals of Software Architecture: An Engineering Approach.
O'Reilly Media, Inc., January 2020.

[2] Melvin E. Conway.
How do committees invent?
Datamation, April 1968.

[3] Alan MacCormack, Carliss Baldwin, and John Rusnak.
Exploring the duality between product and organizational architectures: A test of the "mirroring" hypothesis.
Research Policy, 41(8):1309–1324, 2012.