What Are Microservices?

Understanding the Microservices architectural style and its impact

Module Outline

- **Defining Microservices**
- ✓ Microservices Explanation
  - Understanding the Monolith
  - Understanding Microservices
- Practical Considerations

What Are Microservices

- Presently a lot of hype!
- Best described as:
  - An architectural style
  - An alternative to more traditional 'monolithic' applications
  - Decomposition of single system into a suite of small services, each running as independent processes and intercommunicating via open protocols
    - With all the benefits / risks this implies.

Definitions from the Experts

- Developing a single application as a suite of small services, each running in its own process and communicating with lightweight mechanisms, often an HTTP resource API.
  - Martin Fowler

- Fine-grained SOA
  - Adrian Cockcroft - Netflix

Microservices – Working Definition:

- Composing a single application using a suite of small services
  - (rather than a single, monolithic application)
- … each running as independent processes
  - (not merely modules / components within a single executable)
- … intercommunicating via open protocols
  - (Like HTTP/REST, or messaging)
- Separately written, deployed, scaled and maintained
  - (potentially in different languages)
- Services encapsulate business capability
  - (rather than language constructs (classes, packages) as primary way to encapsulate.
- Services are independently replaceable and upgradable

Microservices are not:

- The same as SOA
  - SOA is about integrating various enterprise applications. Microservices are mainly about decomposing single applications
- A silver bullet
  - The microservices approach involves drawbacks and risks
- New! You may be using microservices now and not know it!

Current Trends

- Twitter moved from Ruby/Rails monolith to Microservices.
- Facebook moved from PHP monolith to Microservices
- Netflix moved from Java monolith to Microservices

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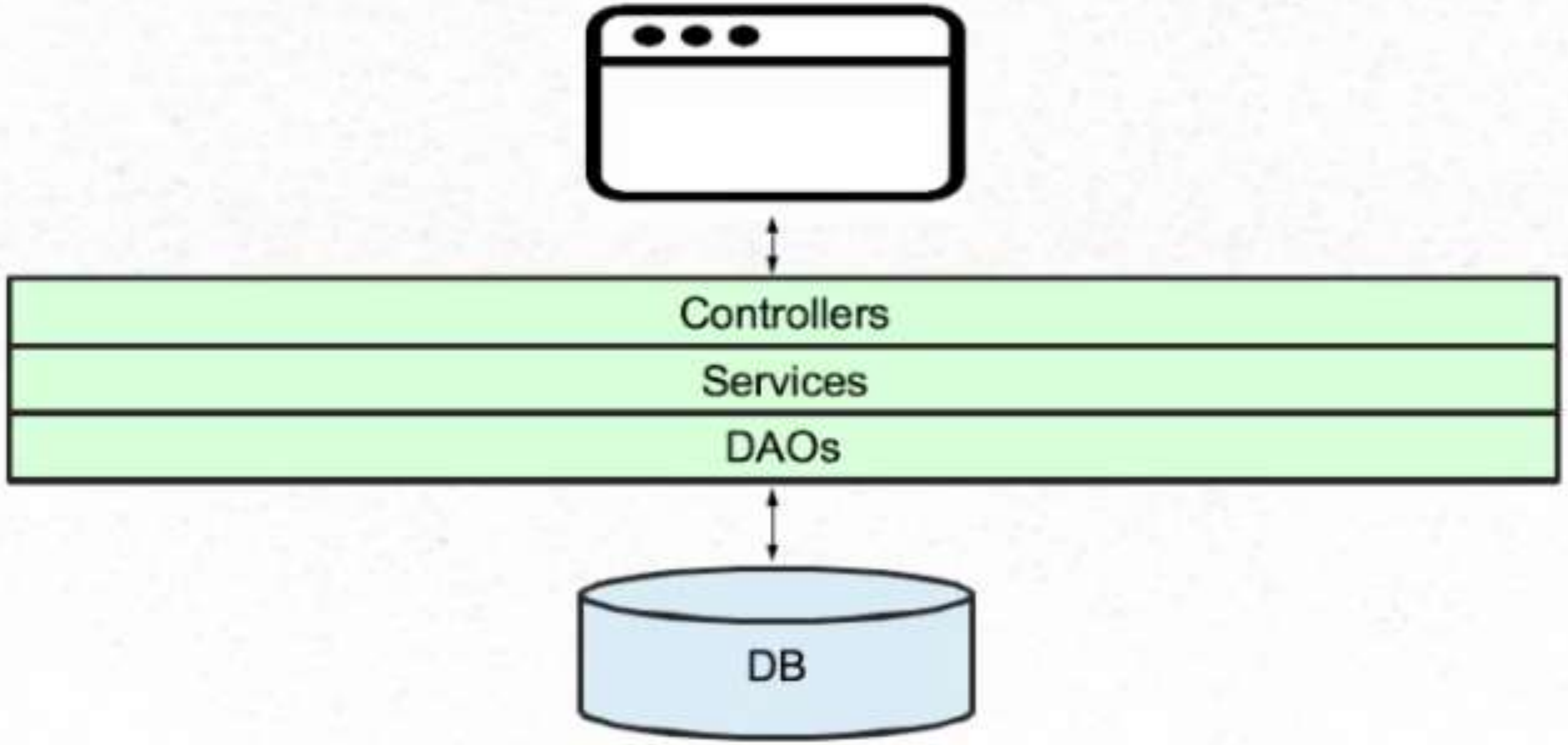
Microservices Example

- Consider a monolithic shopping cart application:
  - Web / mobile interfaces
  - Functions for:
    - Searching for products
    - Product catalog
    - Inventory management
    - Shopping cart
    - Checkout
    - Fufillment
- How would this look with microservices?

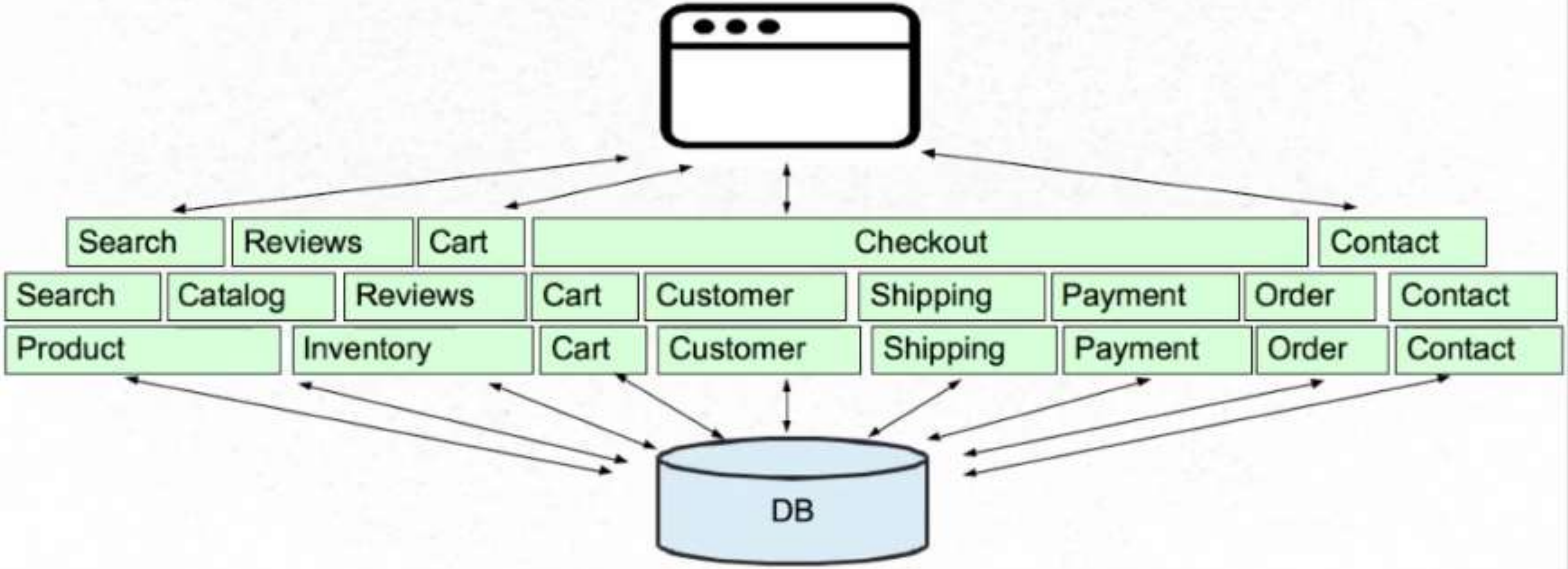
Monolithic Application Example

- Monolithic shopping cart application:



Monolithic Application Example

- Understanding the Monolithic Architecture



Monolithic Application Example

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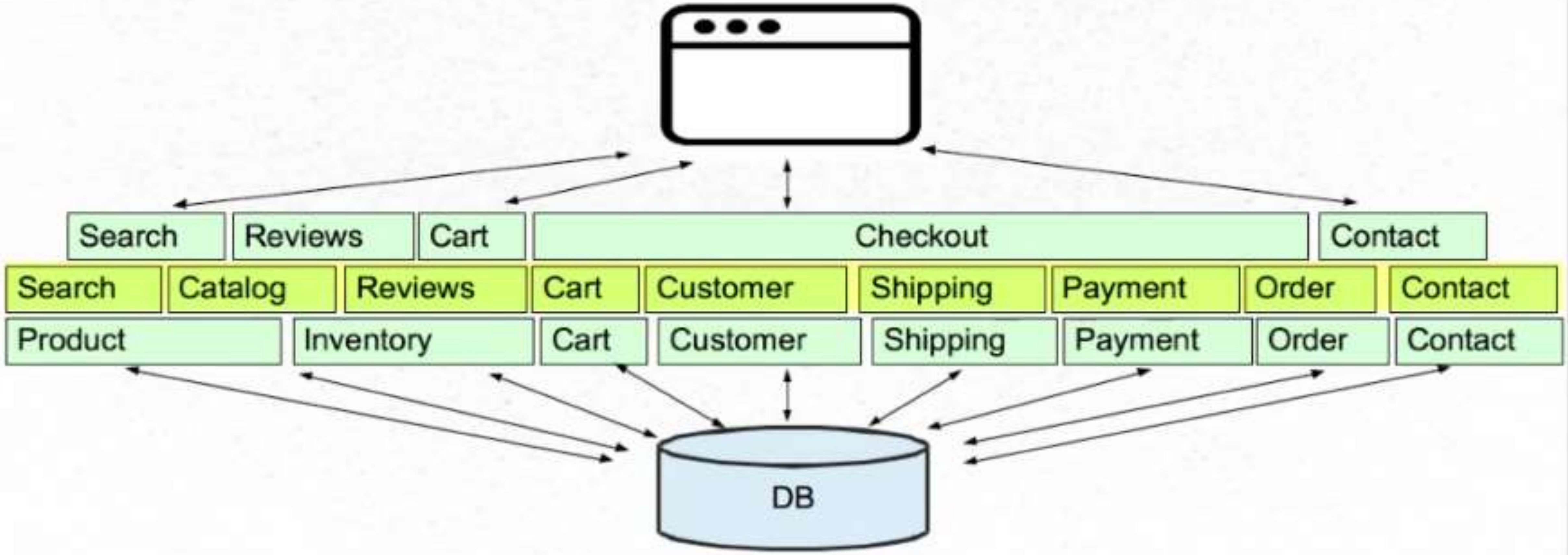
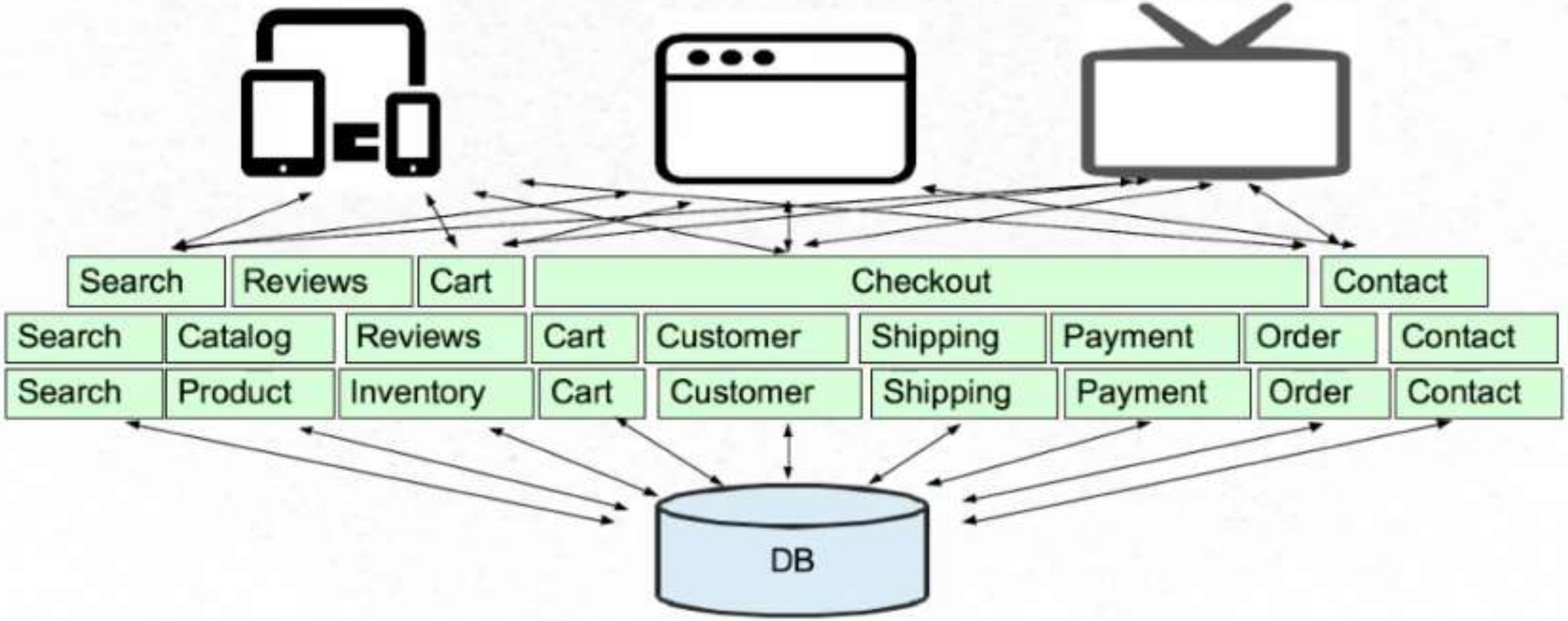


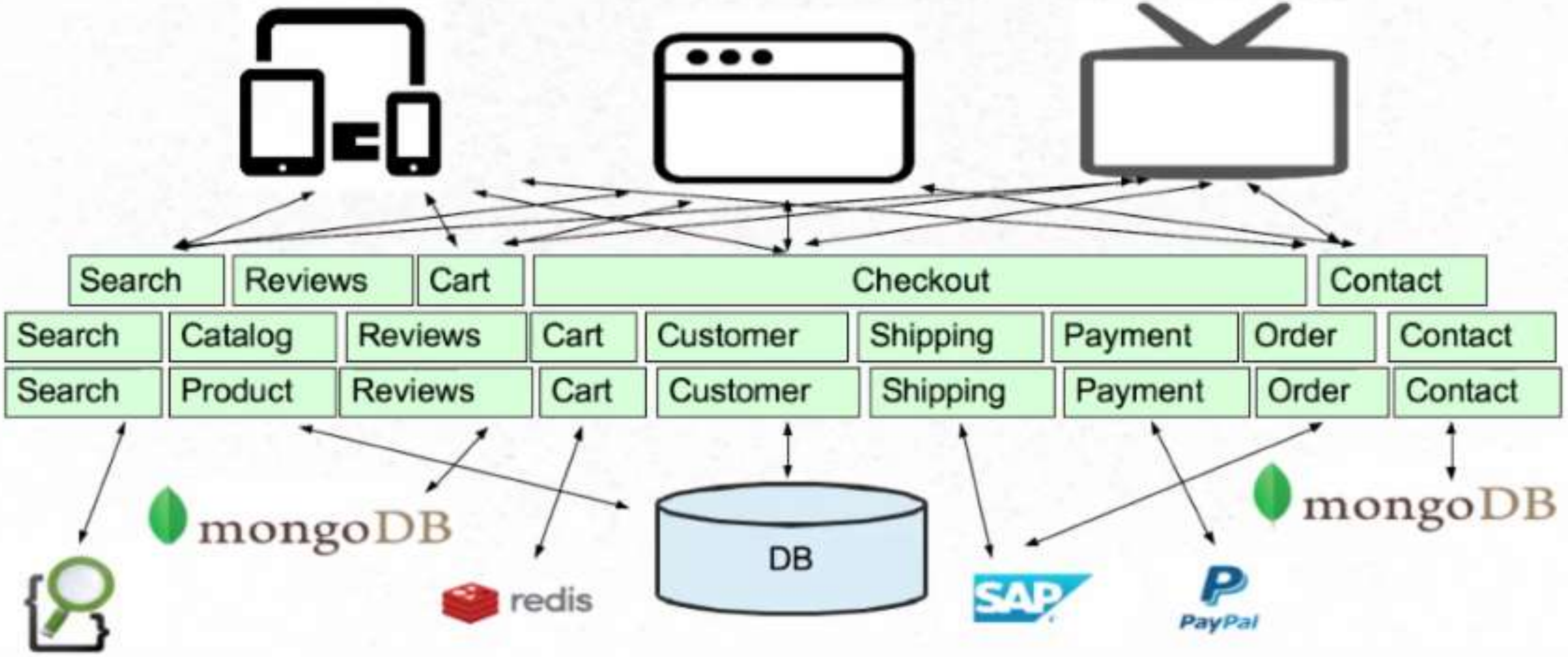
Monolithic Challenges

- New types of client applications



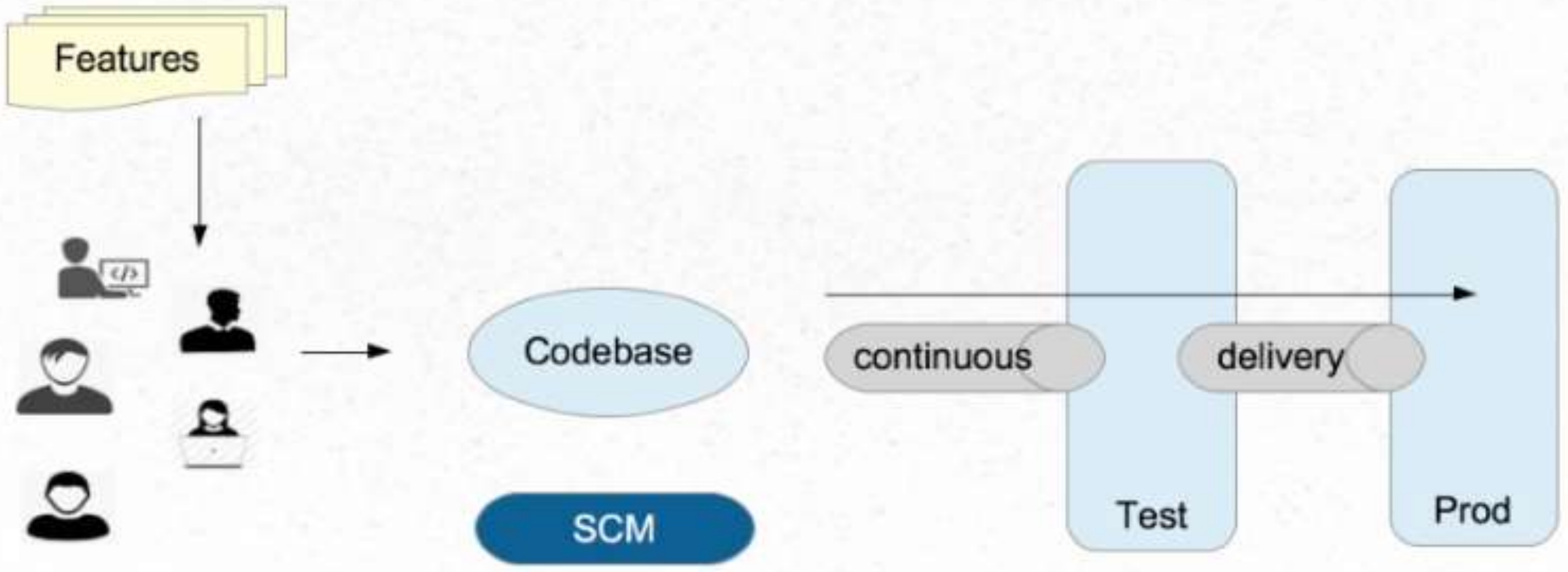
Monolithic Challenges

- New types of persistence / services



Monolithic Challenges

- Single Codebase, Deployment, Versioning, Team Size



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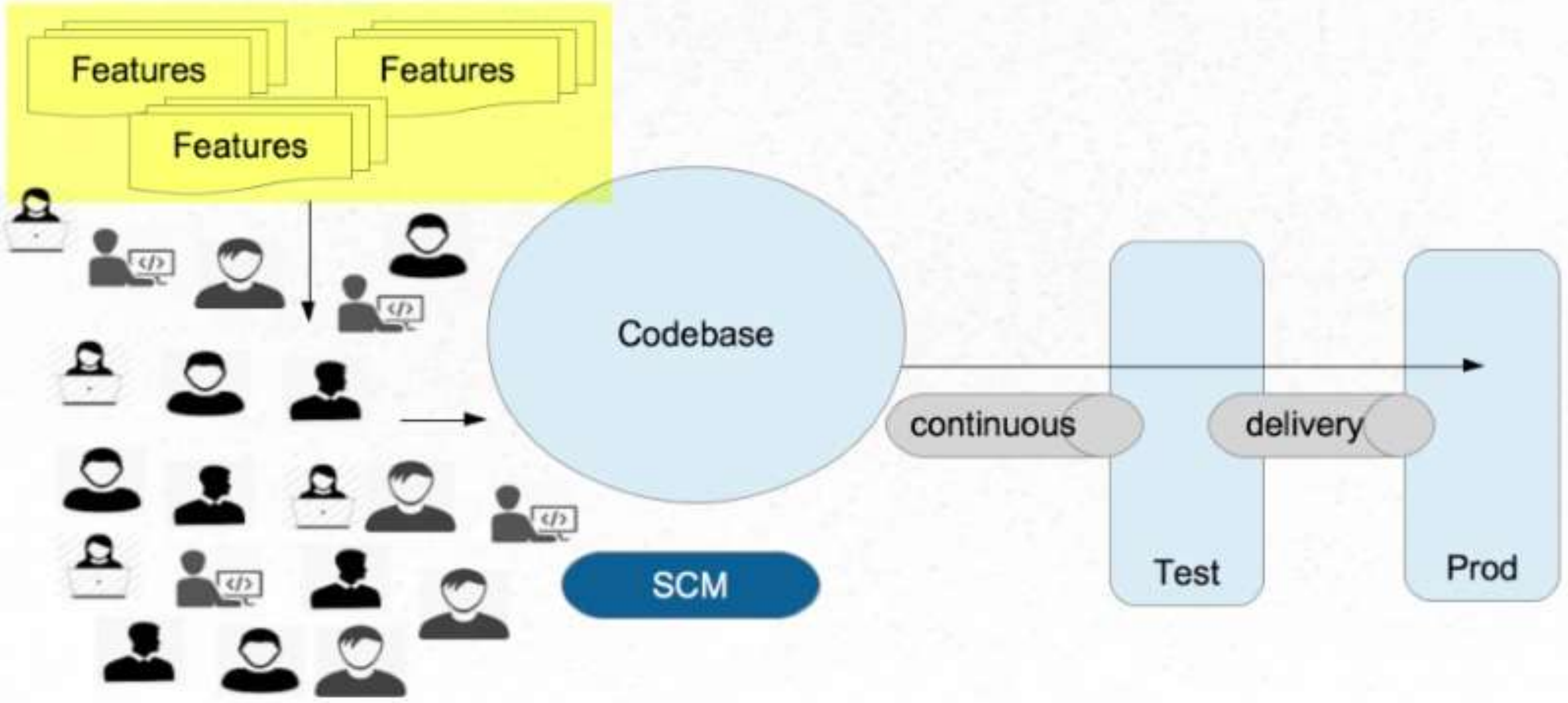
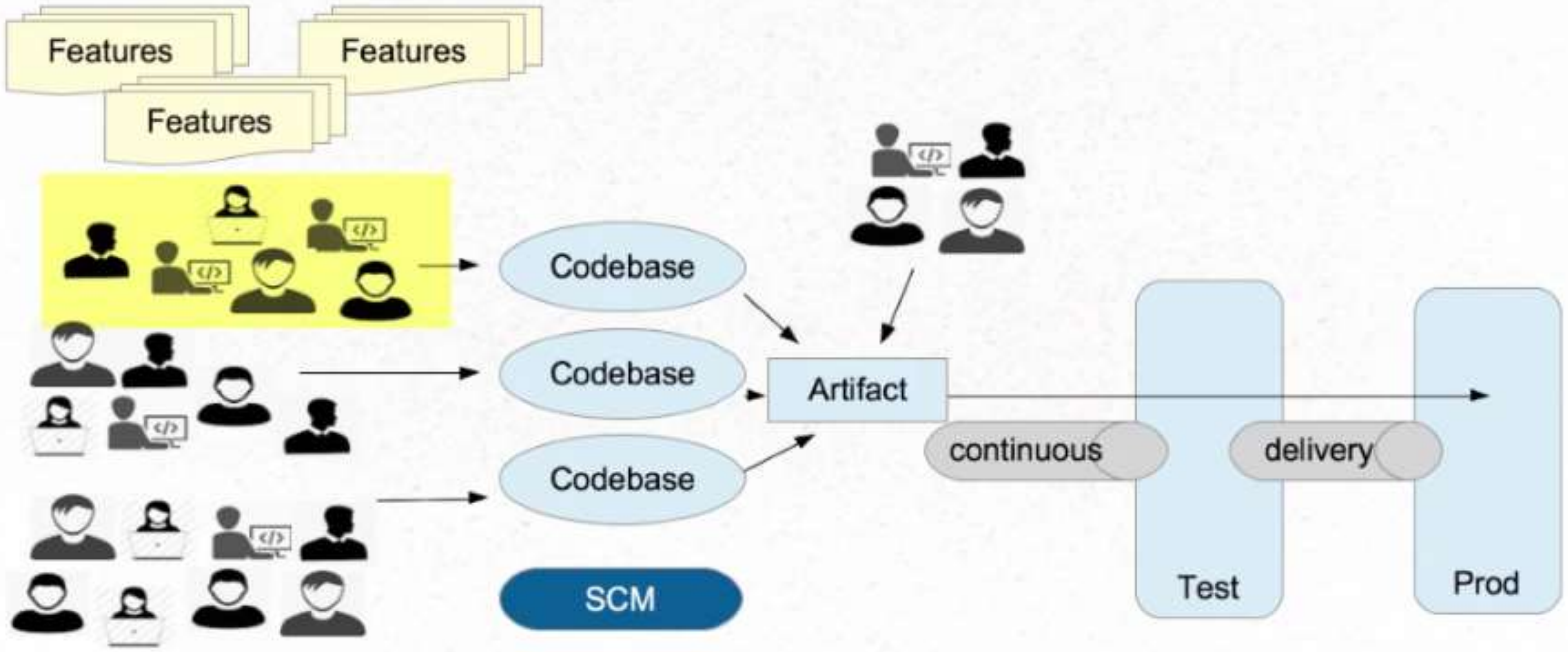


Monolithic Challenges

- Using Teams / Language Constructs



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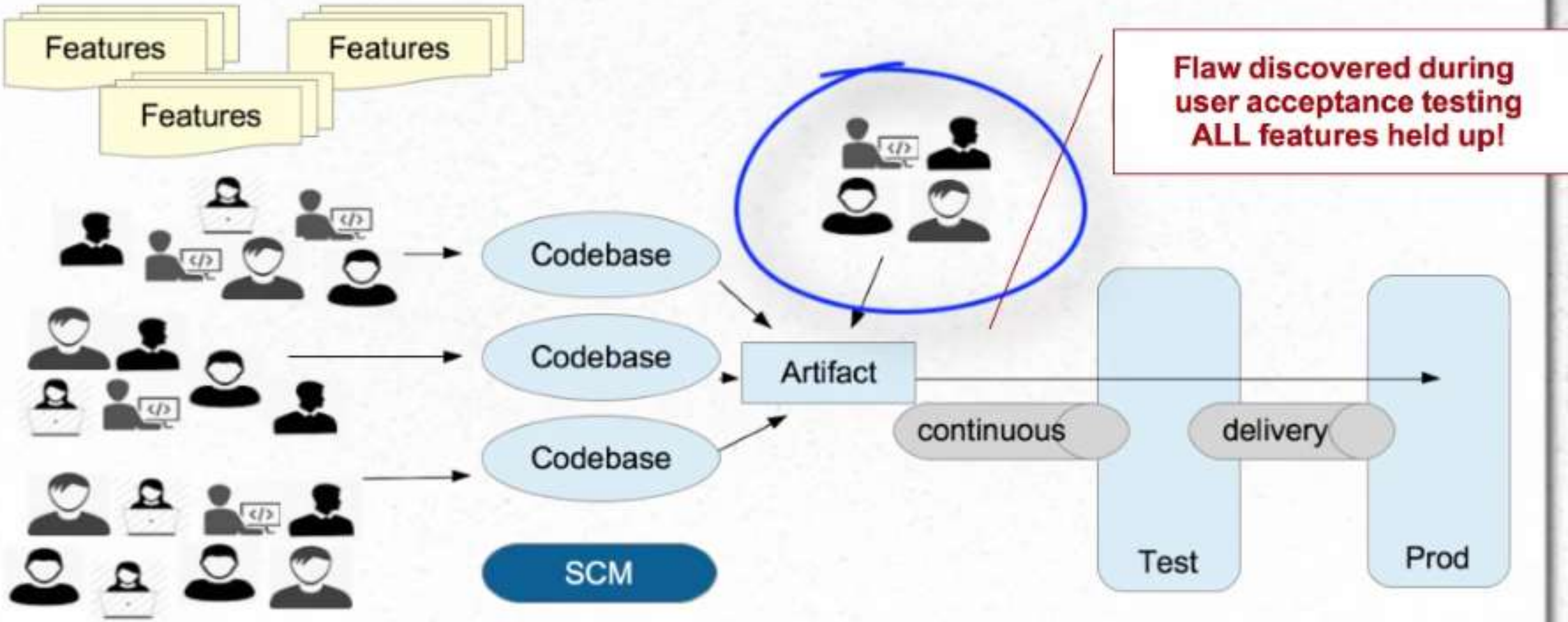


Understanding the monolithic implementation

- Single application executable
  - Easy to comprehend, but not to digest.
  - Must be written in a single language.
- Modularity based on Program Language
  - Using the constructs available in that language (packages, classes, functions, namespaces, frameworks)
  - Various storage / service technologies used
    - RDBMS, Messaging, eMail, etc.

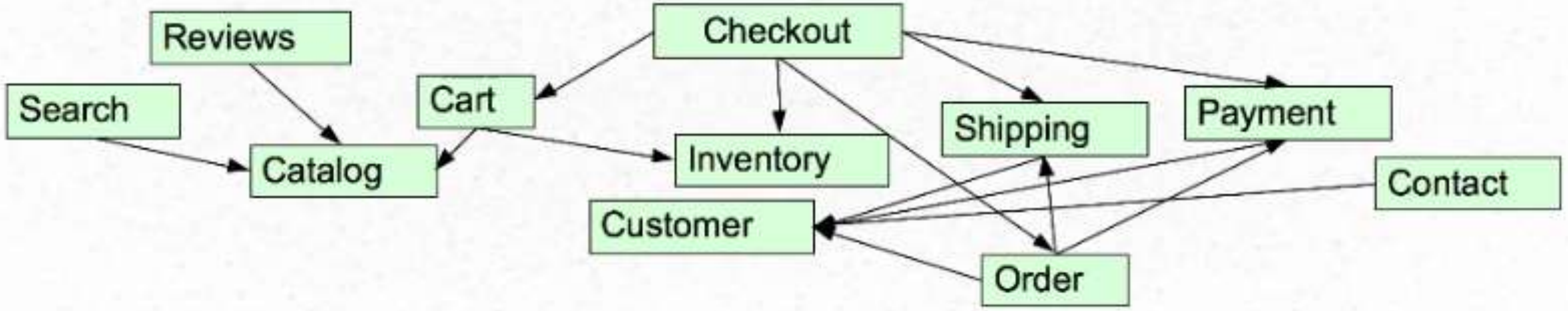
Monolithic Advantages

- Easy to comprehend (but not digest)
- Easy to test as a single unit (up to a size limit)
- Easy to deploy as a single unit.
- Easy to manage (up to a size limit)
- Easy to manage changes (up to a point)
- Easy to scale (when care is taken)
- Complexity managed by language constructs.

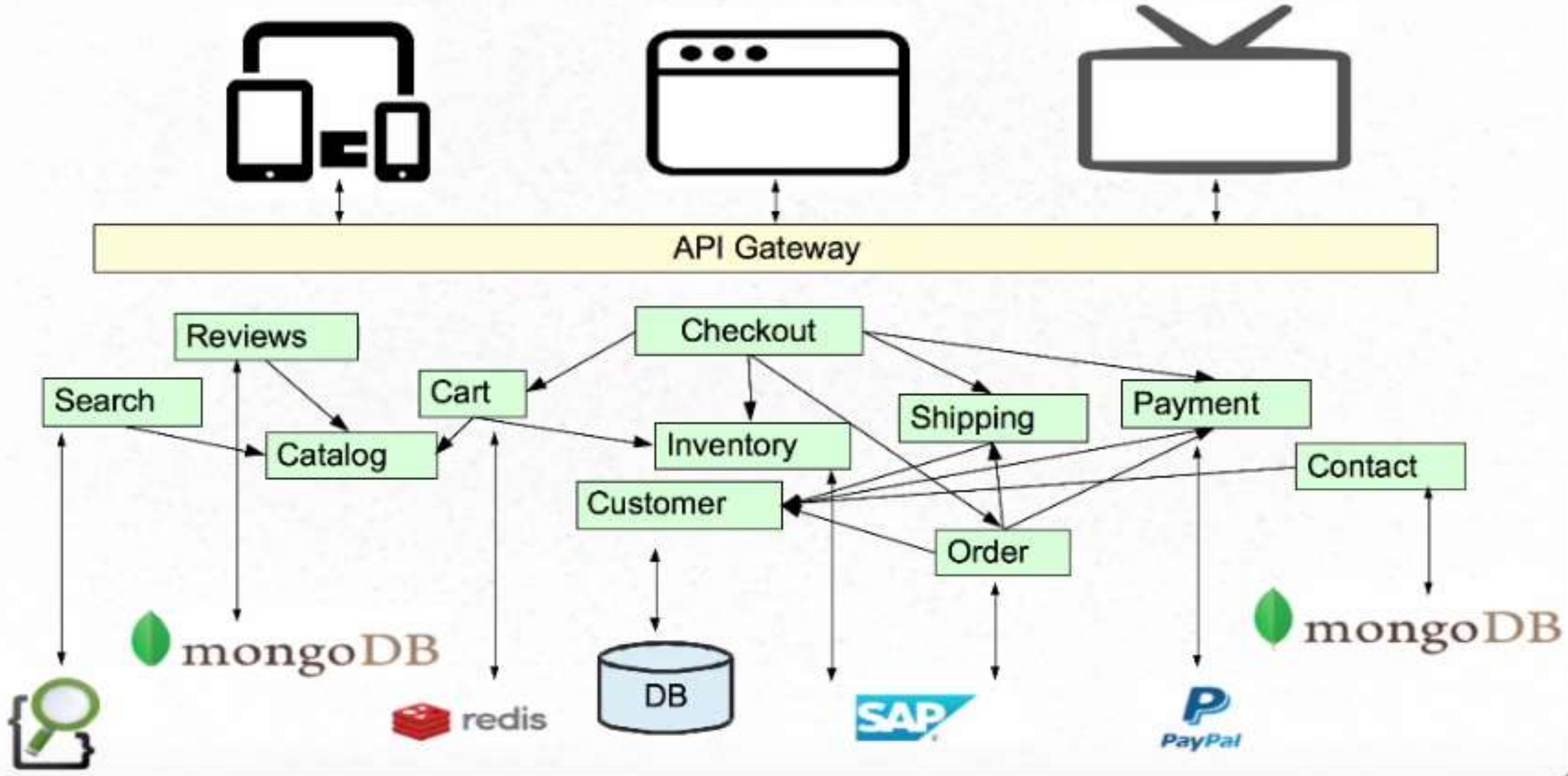
Monolithic Drawbacks

- Language / Framework Lock
  - Entire app written with single technology stack. Cannot experiment / take advantage of emerging technologies
- Digestion
  - Single developer cannot digest a large codebase
  - Single team cannot manage a single large application
    - Amazon's "2 Pizza" rule
- Deployment as single unit
  - Cannot independently deploy single change to single component.
  - Changes are "held-hostage" by other changes

Enter Microservices architecture

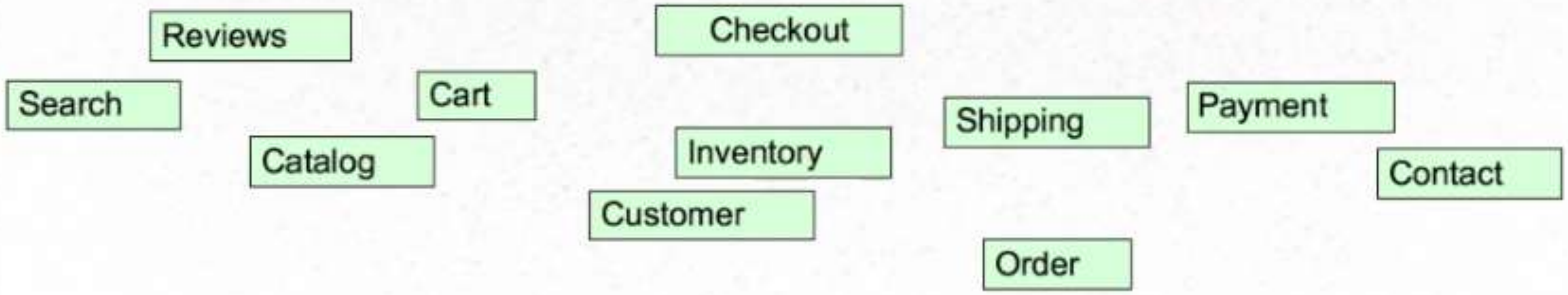


Enter Microservices architecture



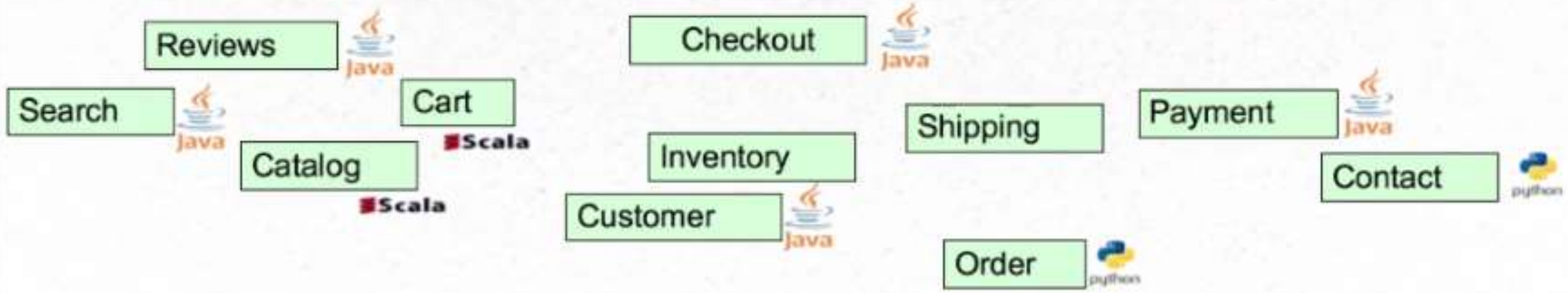
Componentization via Services

- NOT language constructs.
- Where services are small, independently deployable applications
- Forces the design of clear interfaces
- Changes scoped to their affected service



Microservices:
Composed using suite of small services

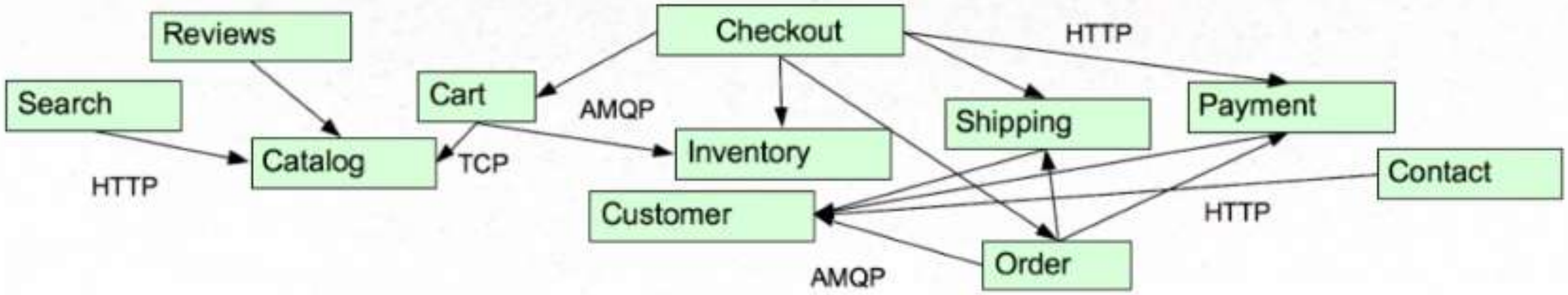
- Services are small, independently deployable applications
  - Not a single codebase
  - Not (necessarily) a single language / framework
  - Modularization not based on language / framework constructs



Microservices

Communication based on lightweight protocols

- HTTP, TCP, UDP, Messaging, etc.
  - Payloads: JSON, BSON, XML, Protocol Buffers, etc.
- Forces the design of clear interfaces
- Netflix's Cloud Native Architecture – Communicate via APIs
  - NOT Common Database



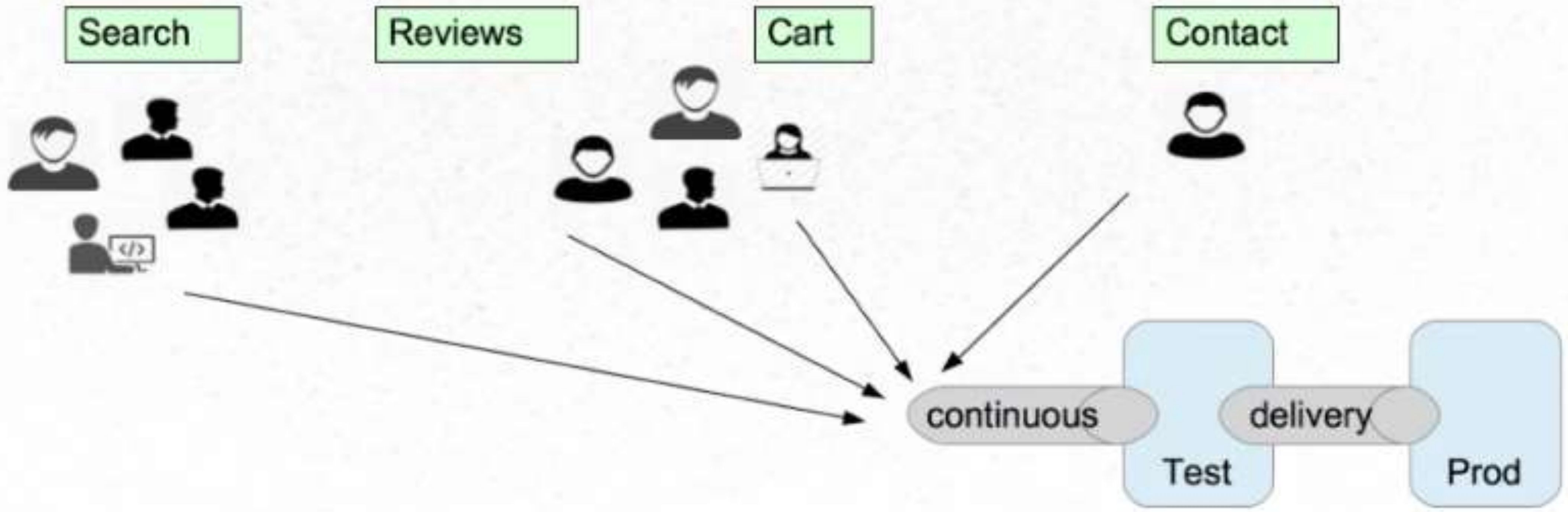
Microservices:
Services encapsulate business capabilities

- Not based on technology stack
- Vertical slices by business function (i.e. cart, catalog, checkout)
- ...Though technology chunk also practical (email service)
- Suitable for cross-functional teams

Search	Reviews	Cart	Contact
PUT /search	GET /review/123	POST /cart	GET /post/123
	POST /review	GET /cart/123	POST /post
		POST /cart/123/item	
		DELETE /cart/123	
		PUT /cart/123/item/1	
		DELETE /cart/123/item/1	

Microservices:
Services easily managed

- Easy to comprehend, alter, test, version, deploy, manage, overhaul, replace
  - By small, cross-functional teams (or even individuals)



Polyglot Persistence

- Freedom to use the best technology for the job
  - Don't assume single RDBMS is always best
  - Very controversial! Many DBAs will not like this!
    - No pan-enterprise data model!
    - No transactions!

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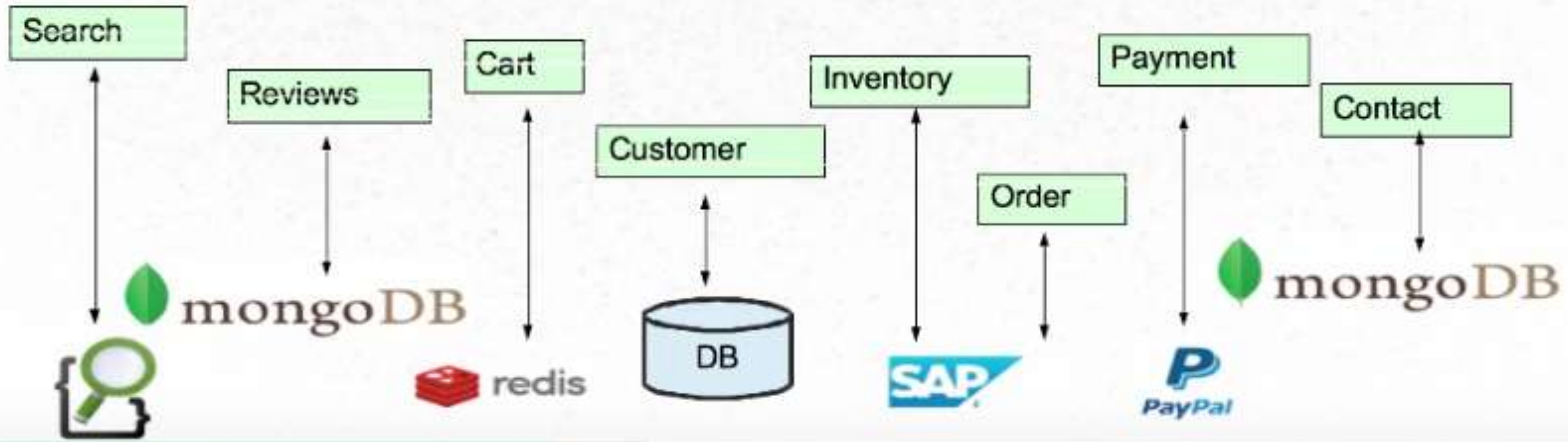


Microservice Advantages

- Easy to digest each service (difficult to comprehend whole)
- VERY easy to test, deploy, manage, version, and scale single services
- Change cycle decoupled
- Easier to scale staff
- No Language / Framework lock.

Challenges with Microservices

- Complexity has moved out of the application, but into the operations layer
  - Fallacies of Distributed Computing
- Services may be unavailable
  - Never needed to worry about this in a monolith!
  - Design for failure, circuit breakers
    - "Everything fails all the time" - Werner Vogels, CTO Amazon
  - Much more monitoring needed
- Remote calls more expensive than in-process calls

Challenges with Microservices (continued)

- Transactions: Must rely on eventual consistency over ACID
- Features span multiple services
- Change management becomes a different challenge
  - Need to consider the interaction of services
  - Dependency management / versions
- Refactoring Module Boundaries

Fallacies of Distributed Computing

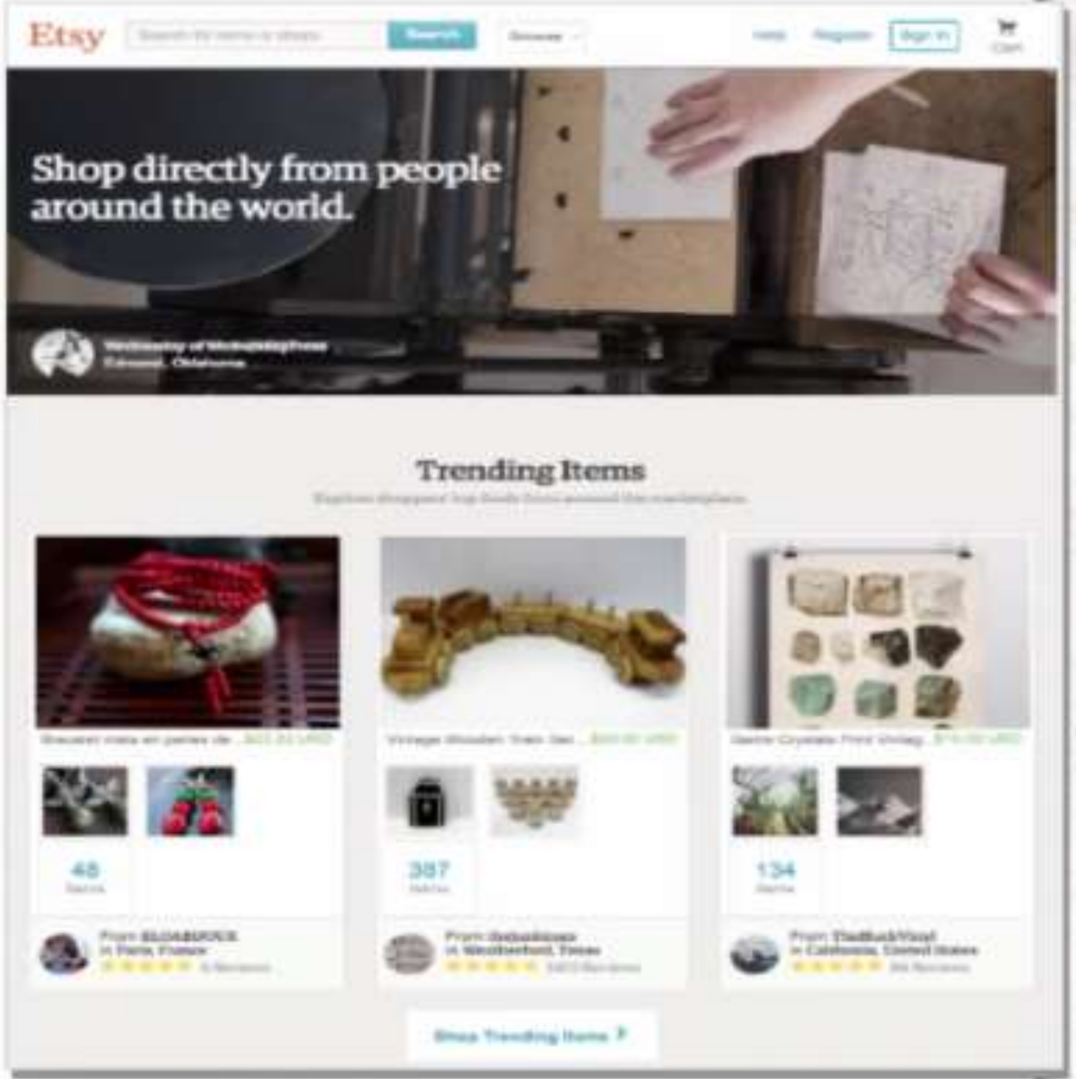
- The network is reliable.
- Latency is zero.
- Bandwidth is infinite.
- The network is secure.
- Topology doesn't change.
- There is one administrator.
- Transport cost is zero.
- The network is homogeneous.

How Micro is Micro?

- Size is not the compelling factor
  - Small enough for an individual developer to digest
  - Small enough to be built and managed by small team
    - Amazon's two pizza rule
  - Documentation small enough to read and understand
    - Social Security Act of 1935 – 63 pages
    - Affordable Care Act of 2010 – 906 pages
  - Dozens of secrets, not hundreds.
  - Predictable. Easy to experiment with

Are Monoliths Always Bad?

- Consider etsy.com
  - As of February 2013: 1.49 billion page views, 4,215,169 items sold, $94.7 million of goods sold, 22+ million members
  - 150 developers deploy single WAR 60 times a day
  - Practices: CI; push button deployment; good monitoring; developers deploy to the site on the first day; VMs per developer; GitHub; Chef; IRC to control releases; dashboards; no source control branches.



Summary

- Microservices are an architectural style
  - Decomposition of single system into independent running, intercommunicating services
  - Alternative to Monolithic applications
- Microservices have advantages and disadvantages
  - As do monoliths