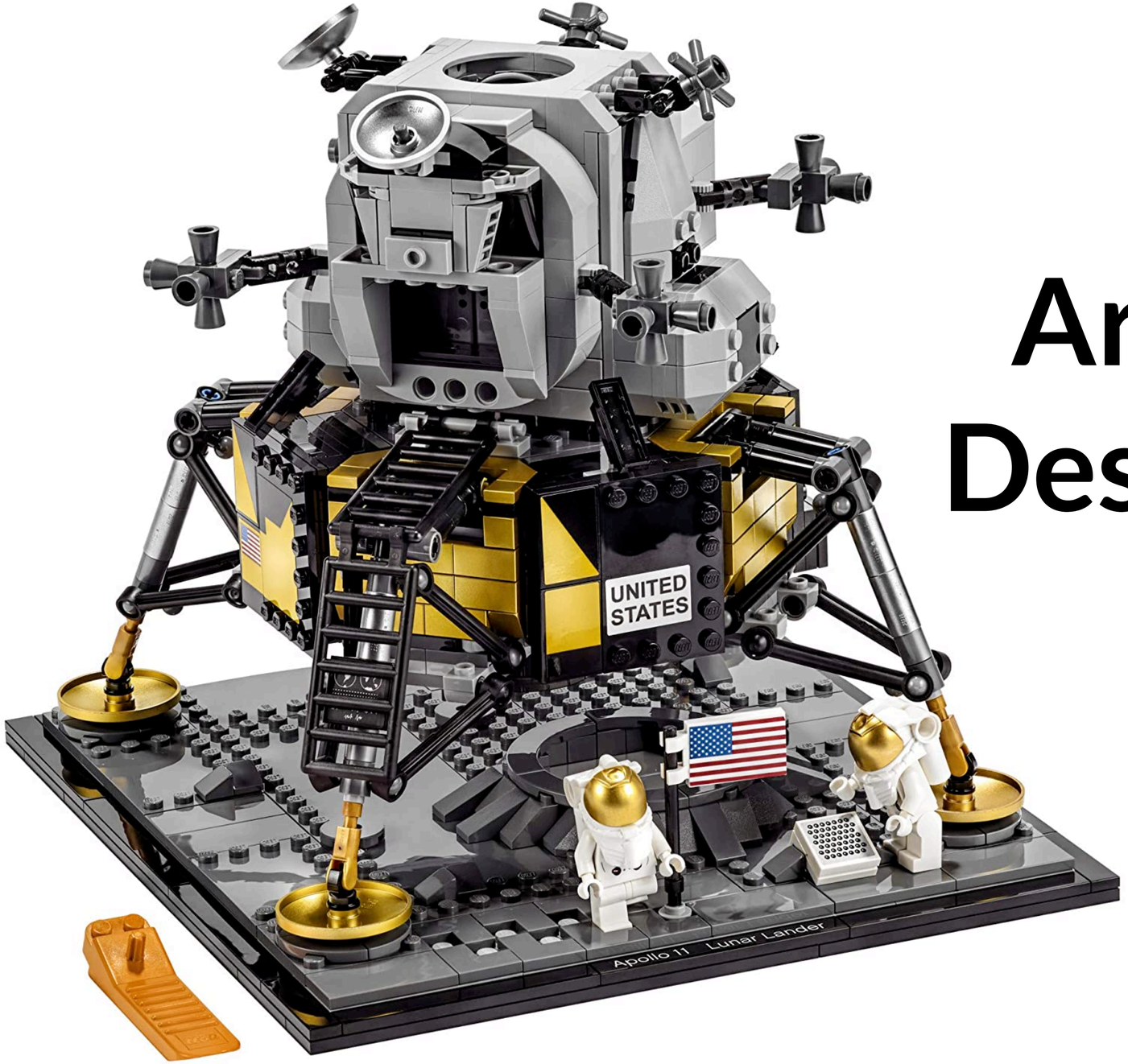
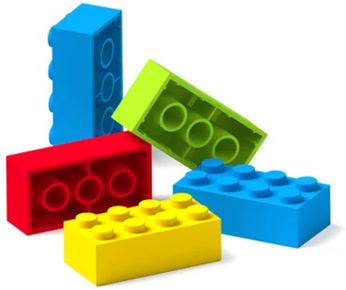


Architectural Design Patterns

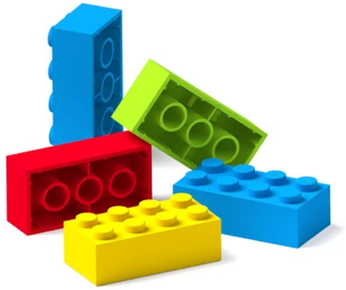
Daniel Hinojosa
@dhinojosa



Workshop Organization

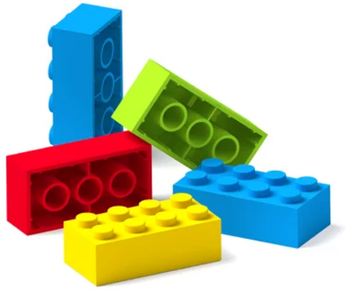
- Every Pattern will contain
  - The Problem
  - The Pattern
  - A Diagram or Animation of the Pattern
  - The Solution
  - The Tradeoffs

Hexagonal Architecture

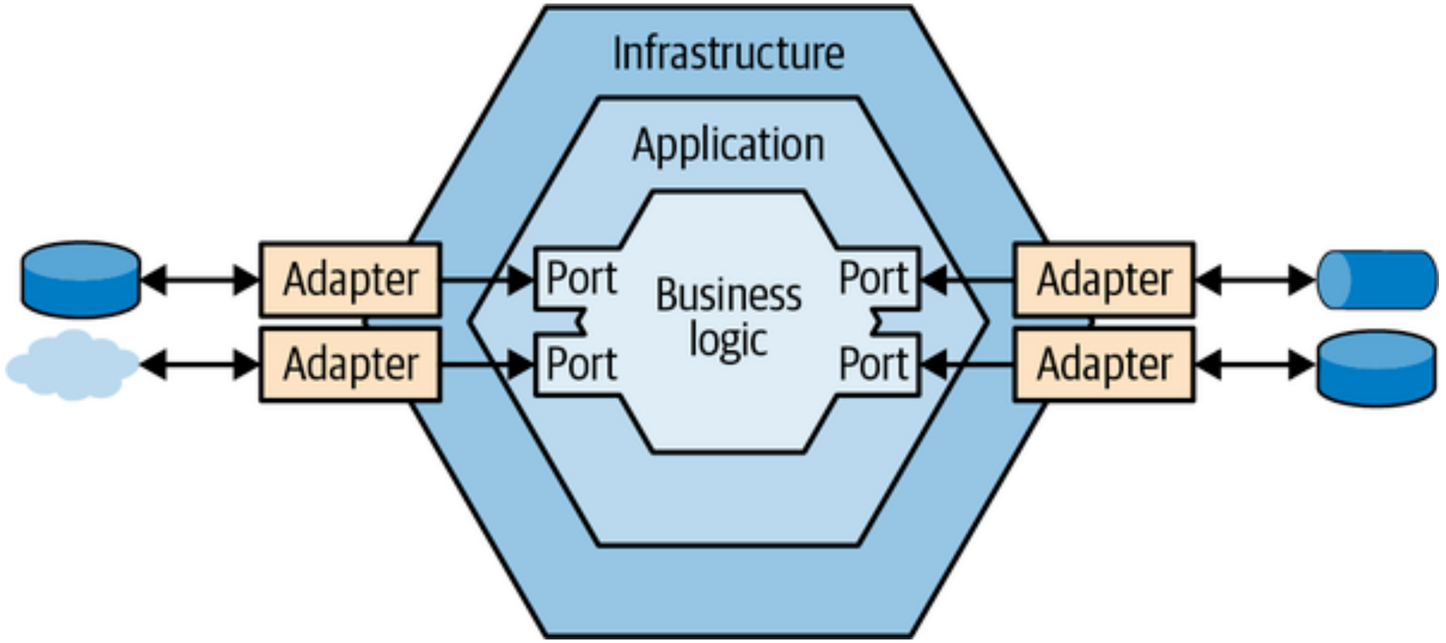


Hexagonal Architecture

- Ports and Adapters Architecture
- Decouple the system's business logic from its infrastructural components
- The infrastructure layer implements "adapters", which are concrete implementations
- Originally conceptualized by Alistair Cockburn
- Compliments Domain Driven Design, which we discuss next
- Separation of Concerns. Domain is encapsulated and interacts through the ports and adapters



Hexagonal Architecture



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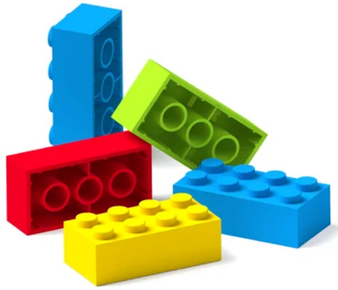
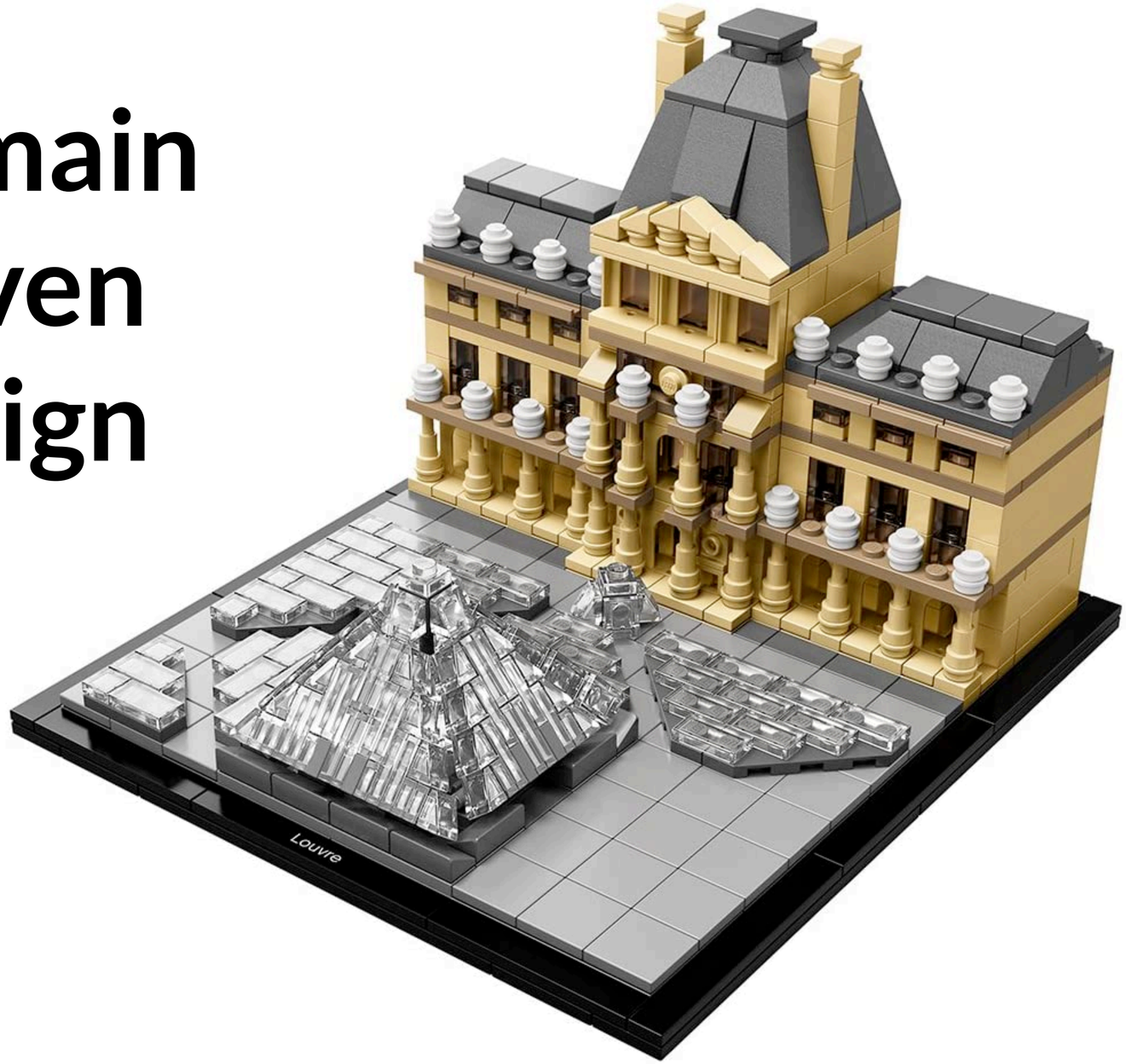
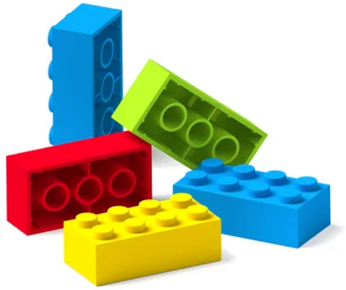


The Lab

- We will use ArchUnit
  - A Java library that will determine if packages, classes and code are in the right location
  - An essential library if you are intending to design applications according to a particular architecture, like the Hexagonal Architecture
  - We will be using Jitterted excellent Blackjack example notice how the application is divided cleanly

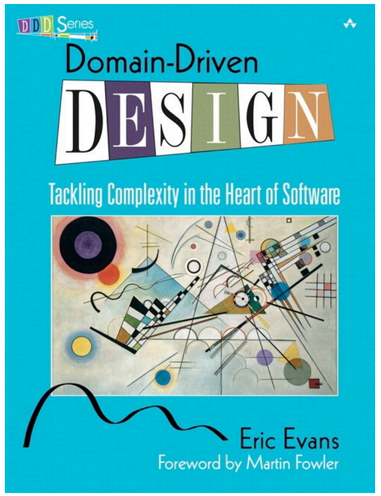
Domain Driven Design

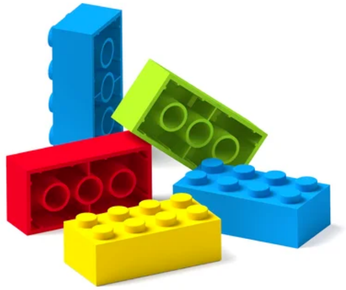




Domain Driven Design

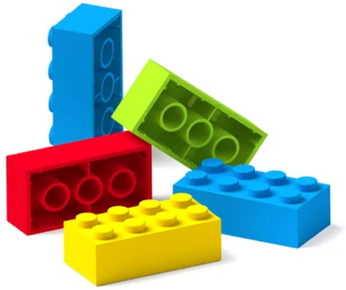
- Methodology focused about the important of the domain
- Build an *ubiquitous language* for domain
- Classifies Objects into Entities, Aggregates, Value Objects, Domain Events, and Service Objects
- One of the other important aspects to DDD is the notion of a bounded context





Ubiquitous Language

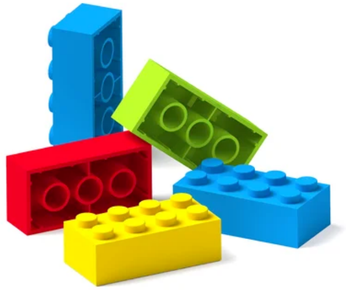
- Define the terms of your domain
- Language of your business
- Goals
  - Precise
  - Consistent
  - Unambiguous



Value Objects

- Object that can be identified by the composition of its values
- No explicit identification is required
- Changing the attributes of any of the fields yields a different object
- Value Objects can be used to counter the “Primitive Obsession” code smell
- Typically immutable

```
class Color {
   int red;
   int green;
   int blue;
}
```

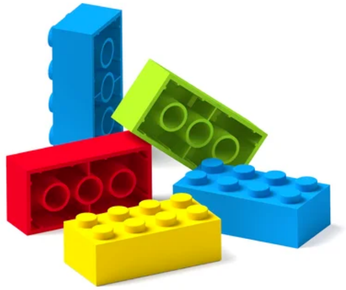


Entities

- Opposite of a value object and requires explicit identification
- Explicit identification is required
- For example, an Employee, just identified by an employee's first name and last name
- Entities are subject to change

```
class Employee {
   private Name name;
   //Constructors, equals, hashCode, etc.
}
```

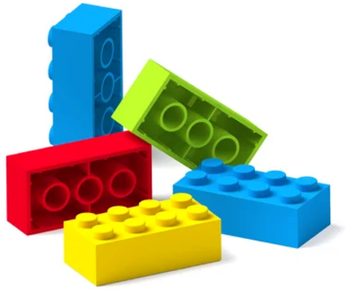
```
class Employee {
   private EmployeeId employeeId;
   private Name name;
   //Constructors, equals, hashCode, etc.
}
```



Aggregates

- An entity that manages a cluster of domain objects as a single unit
- Consider an `Order` to `OrderLineItem` relationship
- The root entity ensures the integrity of its parts
- Transactions should not cross aggregate boundaries
- They are domain objects(order, playlist), they are not collections, like List, Set, Map

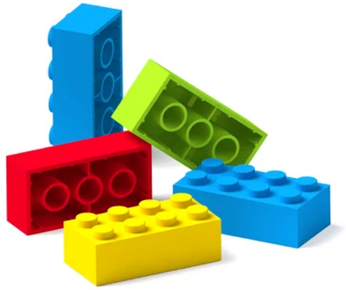
```
class Album {
   private Name name;
   private List<Track> tracks;

   public void addTrack(Track track) {
      this.tracks.add(track);
   }

   public List<Track> getTracks() {
      return Collections.copy(tracks)
   }
}
```



Domain Services

- Stateless object that implements the business logic
- It naturally doesn’t belong to any of the domain model’s aggregates or value objects

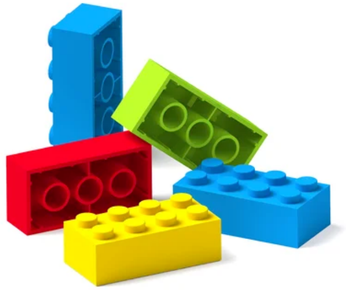
```
class OrderTax {
   //no state
   private void calculateTaxWithRate(Order
         order, TaxRate taxRate) {
       //...
   }
}
```



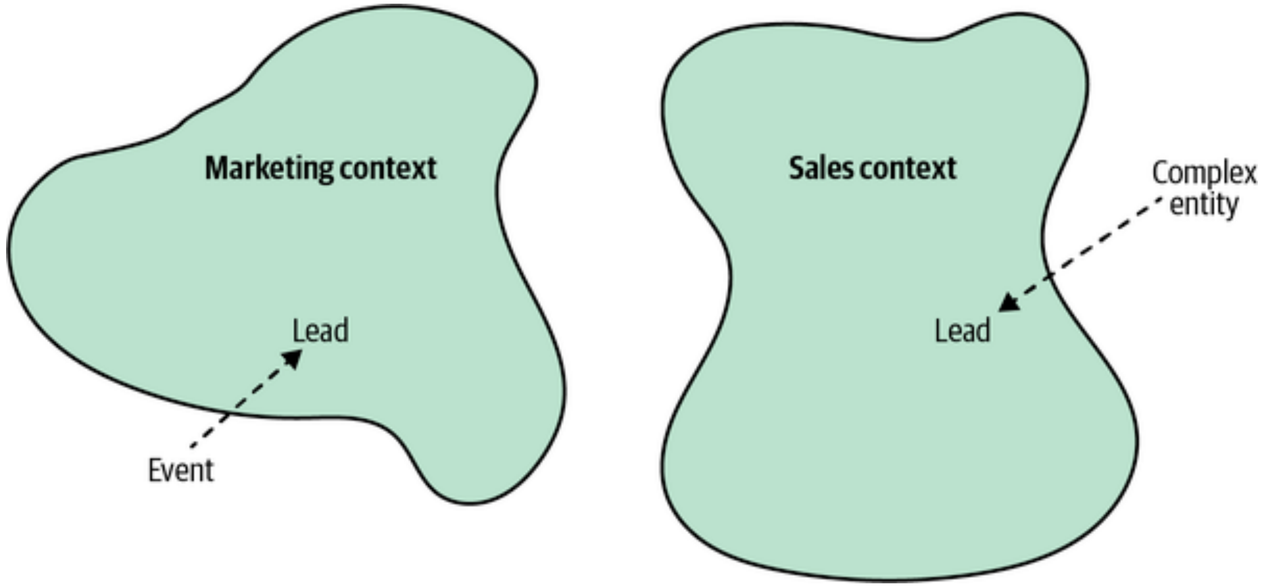
Application Services

- Makes use of Repositories (Storage Abstractions)
- Aggregate instances and then sent for transforming to a transformed object
- The transformed object will typically be routed to the UI

```
class OrderService {
   private OrderRepository;
   private void persistOrder(Order) {
       //...
   }
}
```



The Diagram



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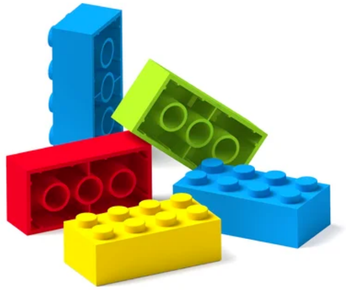
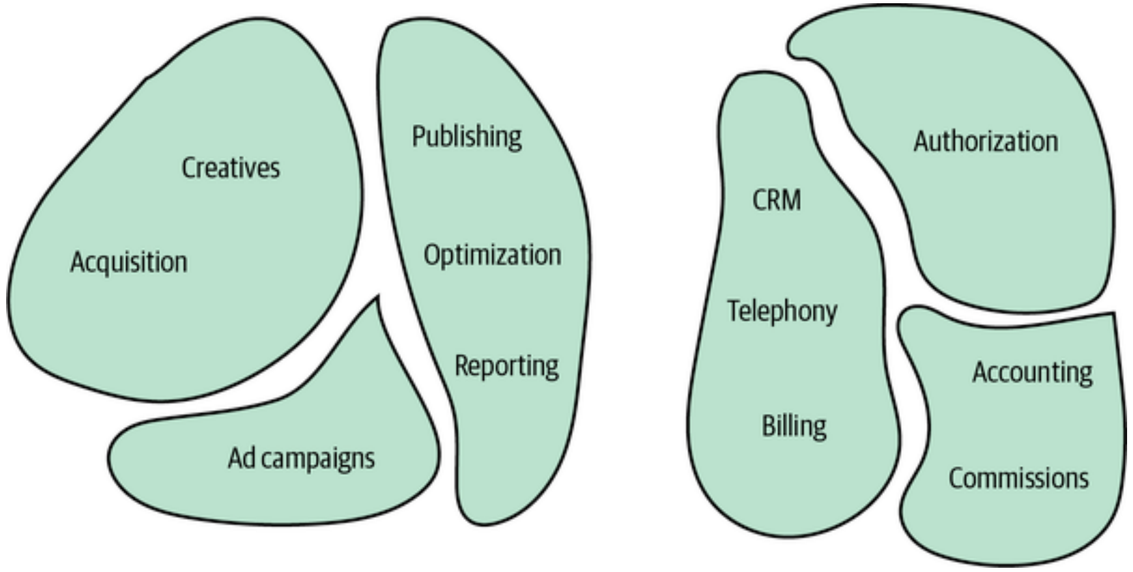


The Diagram



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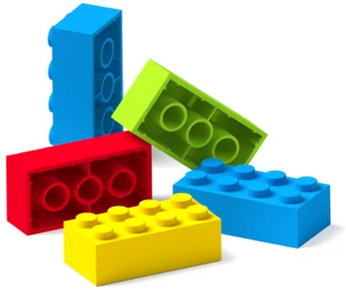
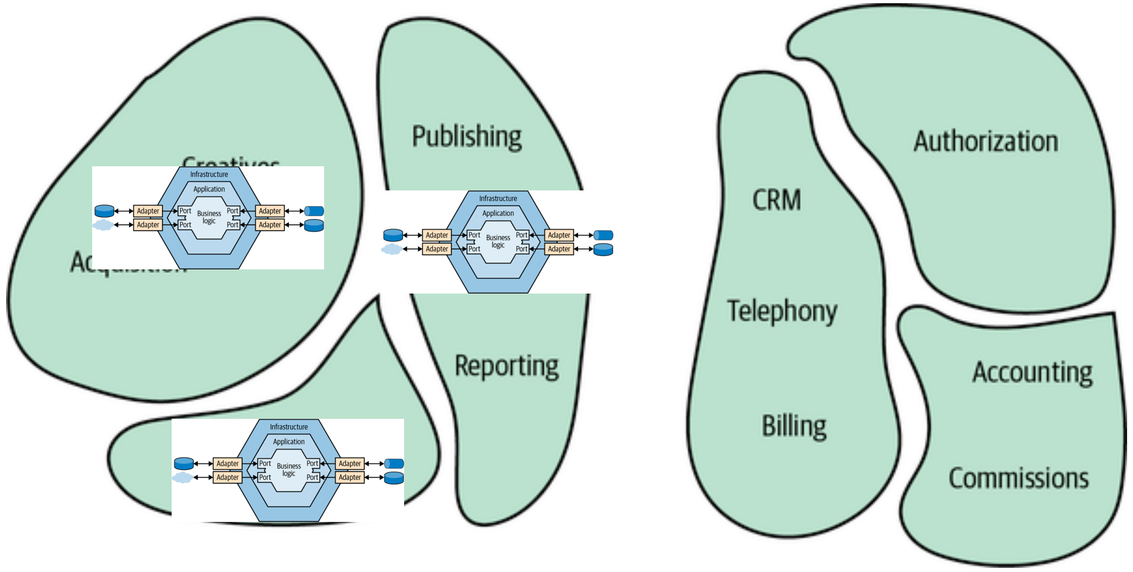
Contexts are neither big nor small, but useful



The Diagram



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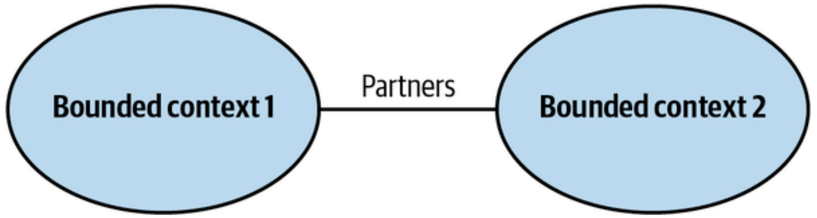
Contexts are neither big nor small, but useful

Bounded Context Interaction

Partnership

- One team can notify a second team about a change in the API, and the second team will cooperate and adapt—no drama or conflicts
- Two way coordination between contexts
- Both sides cooperate on integration, neither is interested in blocking the other



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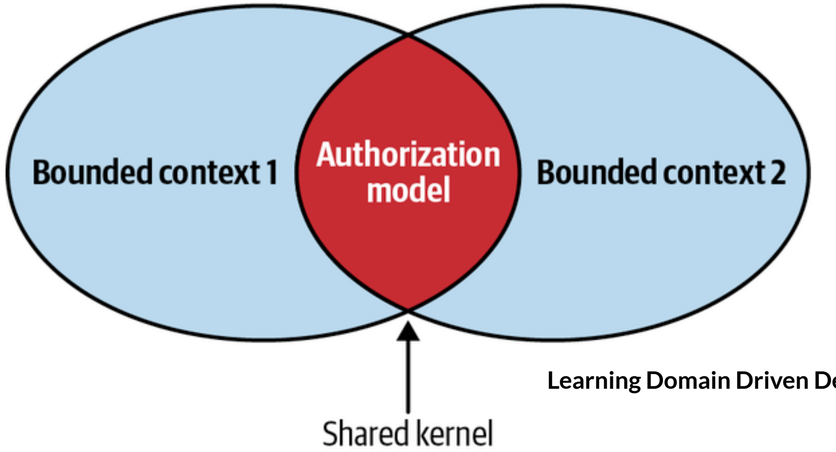
- Not a good fit for geographically distributed teams due to synchronization
- Good CI/CD is needed

Shared Kernel

- Cases when the same model of a subdomain, or a part of it, will be implemented in multiple bounded contexts.
- Shared model is designed according to the needs of all of the bounded contexts
- The model would have to be consistent across all contexts for others to use



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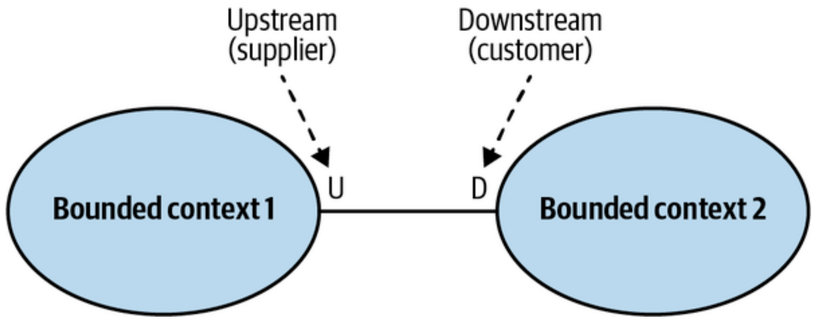
- After changing the shared kernel, integration tests would have to be invoked to ensure changes are not destructive

Customer-Supplier

- The supplier provides services to the customer
- Both the supplier and the customer can succeed independently
- But there is an imbalance of power, something has to give
- Either the Supplier dictates the terms, or the Customer does



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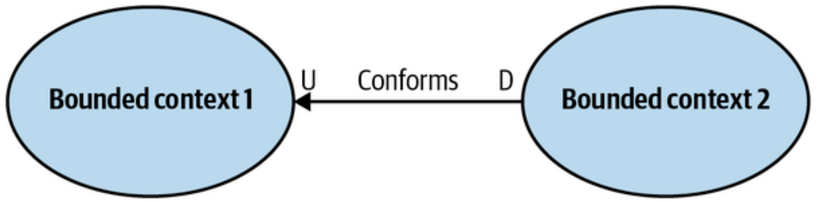
- This is where there are patterns between bounded contexts called conformist, anticorruption layer, and open-host patterns

Conformist

- Favor the upstream, the upstream doesn’t care about the customer’s needs
- Take it or leave it
- Often occurs with service providers where you have say about the terms or how they operate



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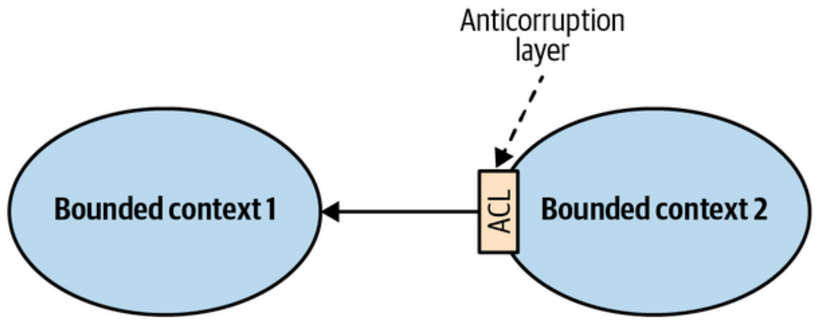
- Reasons include upstream may be an industry standard, a well-established model, or it is just good enough

Anti-Corruption Layer

- Favor the upstream, the upstream doesn’t care about the customer’s needs, same as *Conformist*
- Anticorruption Layer is a layer that will interpret the API changes from the supplier to it’s own model
- Works well if the upstream model is inefficient or inconvenient, or the upstream contract changes often



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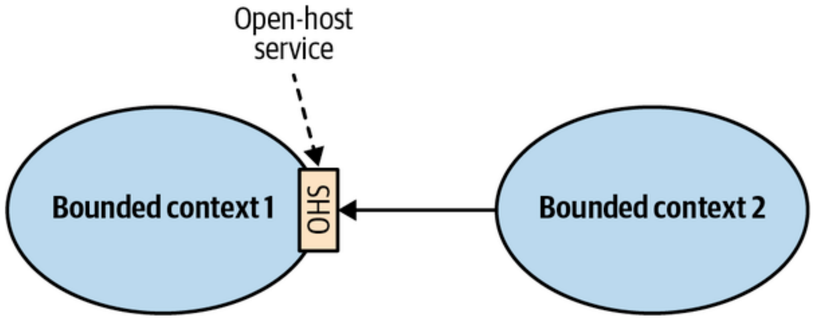
Open-Host Service

- The tables have turned! The power is with the customers
- It is now the supplier that has to adapt by providing multiple public interface customized for the customer
- This is done by decoupling the implementation from the public interface
- The supplier does not conform, but provides an adequate *published language*



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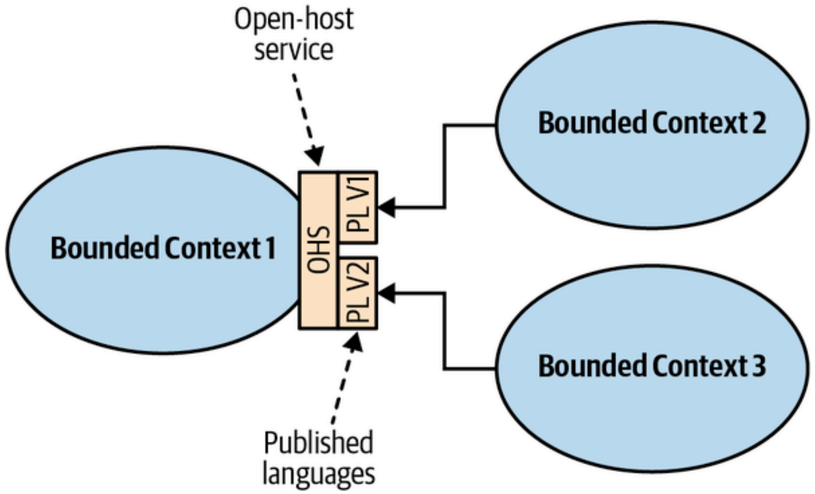

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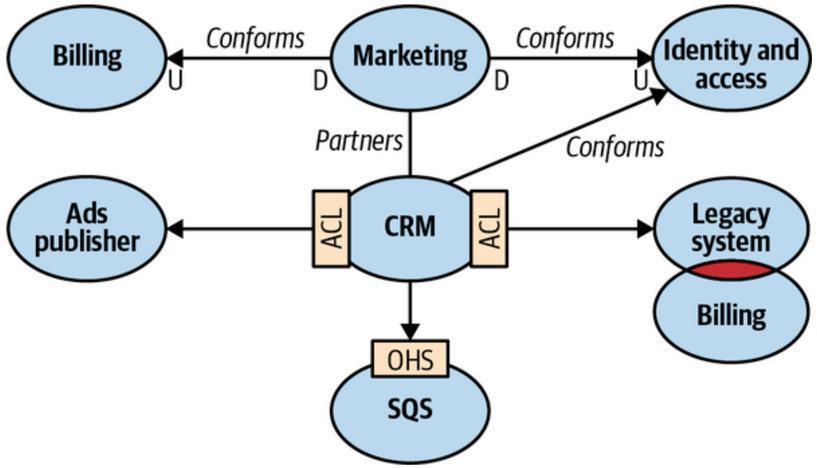
What does it mean?

- You have defined each of the bounded contexts, and each of the context have their own domain.
- Each context can interact with each other via interface if within the same application, or using a port to interact with it outside (see Hexagonal)
- Support either Microservice style, or monolith style.



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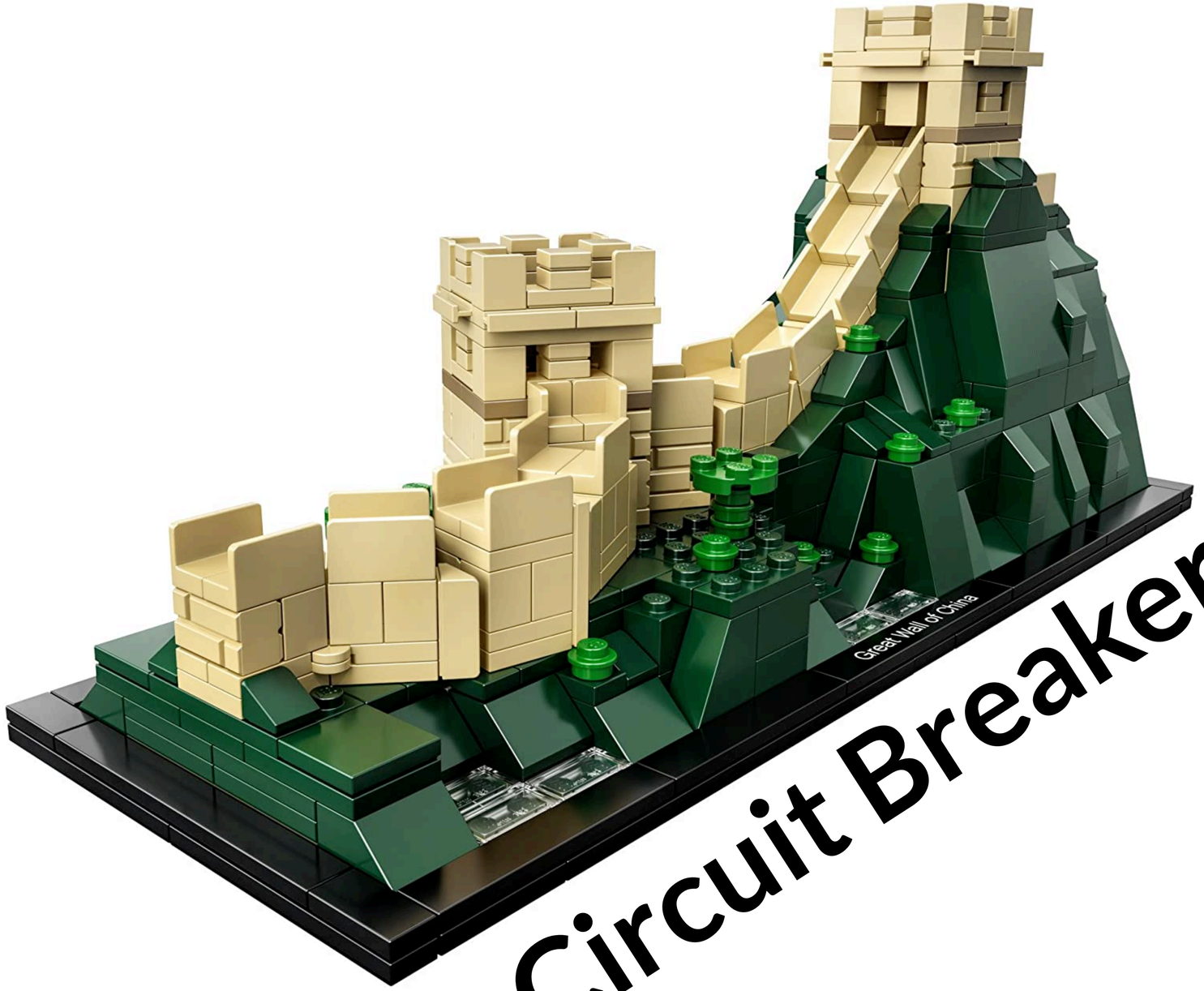
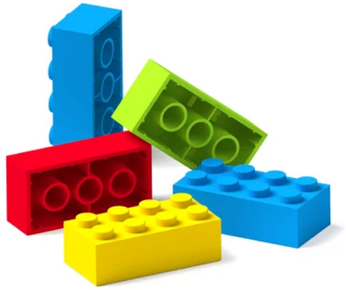
- Your domain architecture is defined and responsive to change

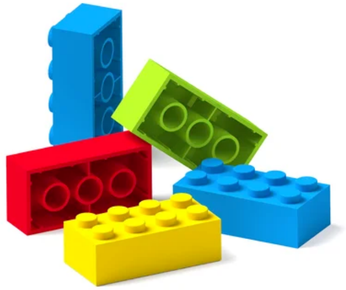


Circuit Breaker



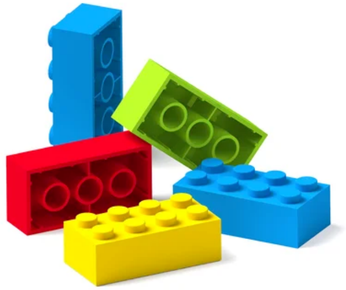
The Problem

- When a service synchronously requests from *a remote call* there is a big possibility of failure
- That remote call is that is a dependent may either be out or just taking too long
- Threads, since running synchronously will taken up
- One service’s failures or latency can cause a cascading failure



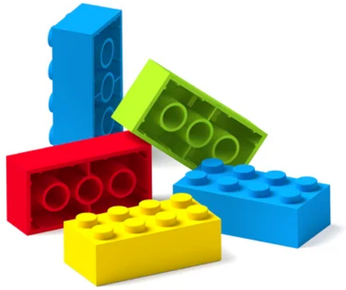
The Solution

- The client should invoke the remote service by proxy
- When the number of consecutive failures crosses a threshold, the circuit trips
- All attempts to invoke the remote service will ***fail*** immediately
- After the timeout expires, the circuit breaker will allows limited traffic to go through
- If it those test connections succeed, the circuit breaker resumes normal operation
- Otherwise, a new timeout is triggered



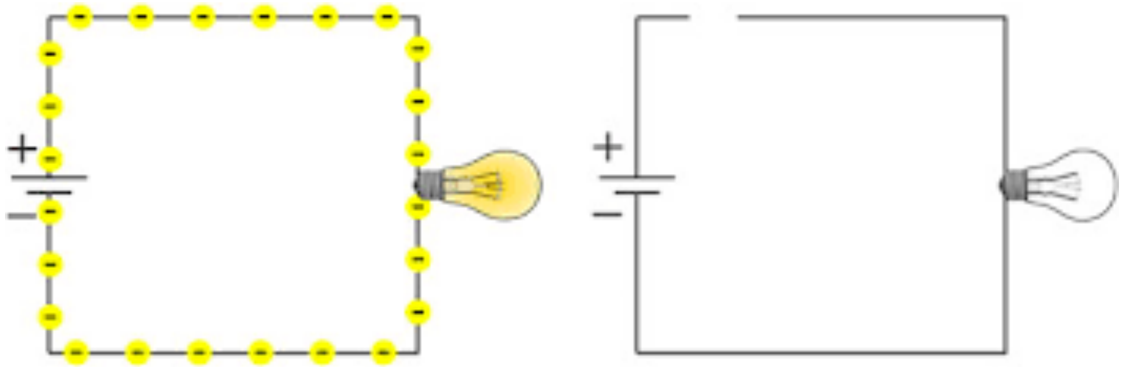
Closed Circuit Breaker

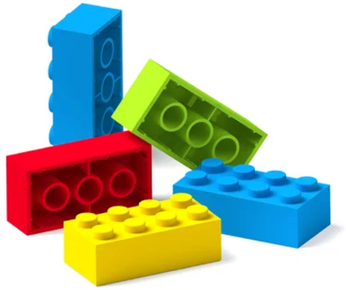
- The request from the application is routed to the operation. Proxy maintains a count of the number of recent failures
- If the call to the operation is unsuccessful the proxy increments this count
- If the number of recent failures exceeds a specified threshold within a given time period, the proxy is placed into the Open state.
- At this point the proxy starts a timeout timer, and when this timer expires the proxy is placed into the Half-Open state.
- The purpose of the timeout timer is to give the system time to fix the problem that caused the failure before allowing the application to try to perform the operation again.



Open Circuit Breaker

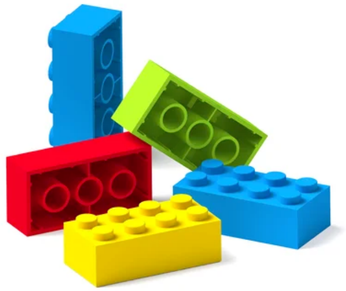
- The request from the application fails immediately and an exception is returned to the application
- Usually Open is a positive thing, but in this case it is not.



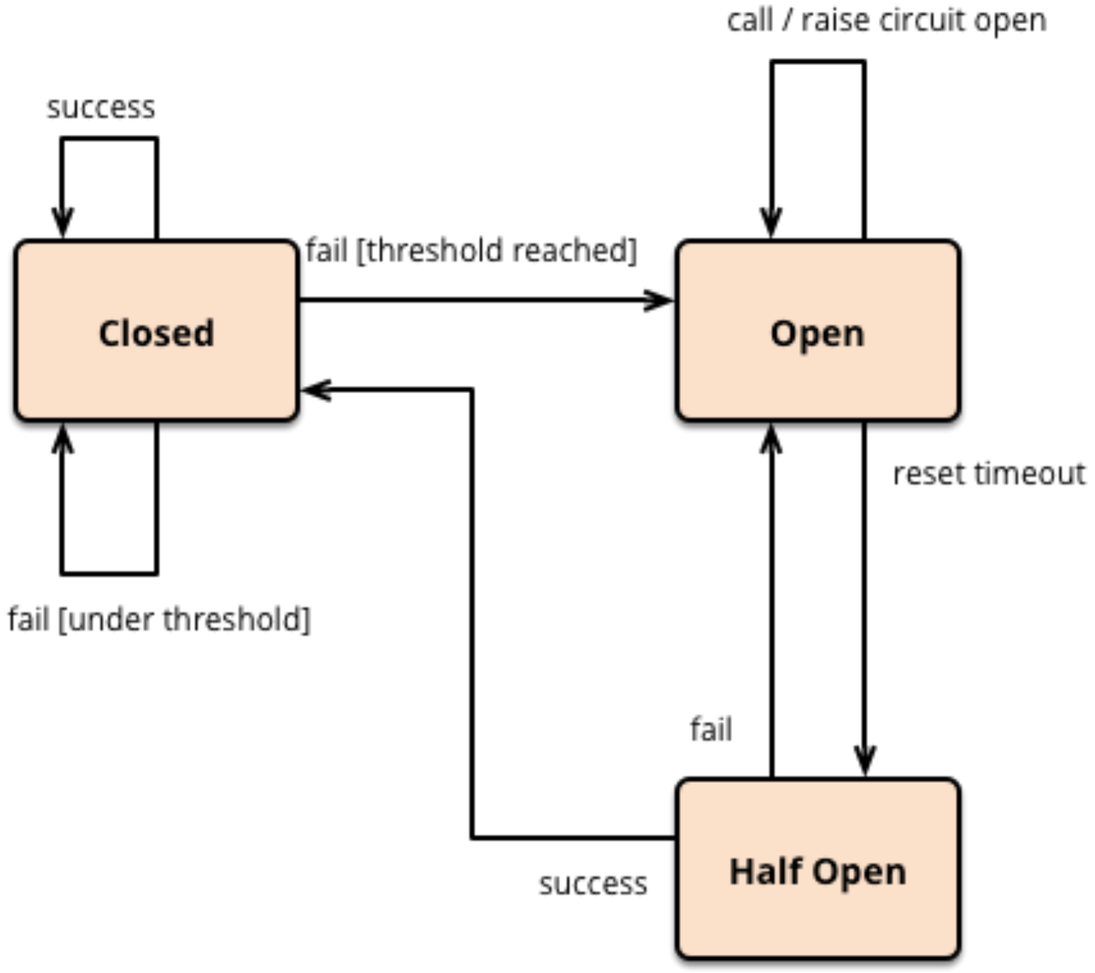


Half-Open Circuit Breaker

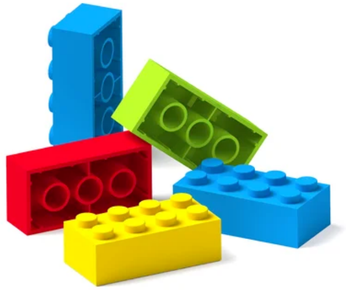
- A limited number of requests from the application are allowed to pass through and invoke the operation
- If these requests are successful, it's assumed that the fault that was previously causing the failure has been fixed and the circuit breaker switches to the **Closed** state
- If any request fails, the circuit breaker assumes that the fault is still present so it reverts back to the **Open** state and restarts the timeout timer to give the system a further period of time to recover from the failure



The Diagram

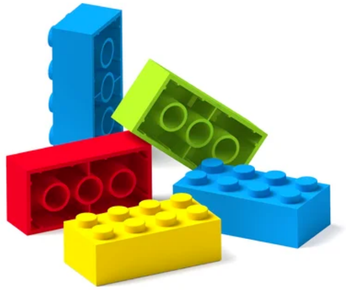


Source: https://martinfowler.com/bliki/CircuitBreaker.html



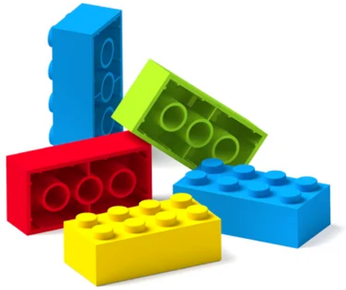
Notes on Circuit Breaker

- You must handle the exception thrown by the circuit breaker, or use Either types so that you can have the opportunity to degrade, or offer better exceptions
- Review the types of exceptions that are thrown, many are different. You may need to adjust your strategy based on the exception
- A circuit breaker can and should log all the requests for health monitoring



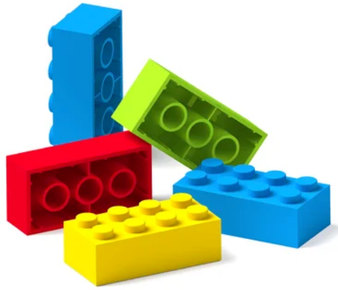
Notes on Circuit Breaker

- A circuit breaker can and should log all the requests for health monitoring
- If these requests are successful, it's assumed that the fault that was previously causing the failure has been fixed and the circuit breaker switches to the **Closed** state
- If any request fails, the circuit breaker assumes that the fault is still present so it reverts back to the **Open** state and restarts the timeout timer to give the system a further period of time to recover from the failure



The Tradeoffs

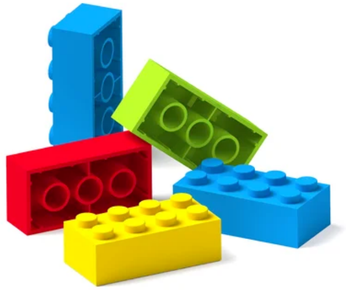
- Not used for private owned resources like an in-memory database
- This would not be a substitute for handling exceptions for internal programmatic functionality, this is an architectural pattern



The Lab

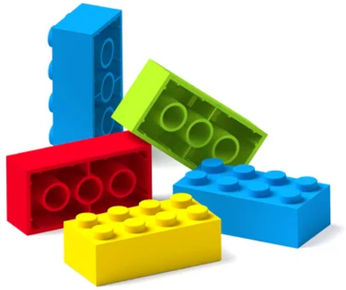
- We will use a library call Resilience4j
  - The heir apparent to Netflix' Hystrix used for performing retry, bulkhead, and short circuit, and more
  - https://resilience4j.readme.io/docs/

Retry



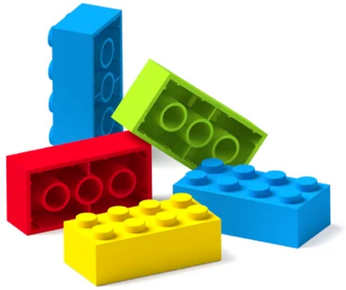
The Problem

- There can be transient faults when it comes to networking applications
  - Momentary loss of network
  - Unavailable Service
  - Service is busy
- Services may also throttle requests if the load is too high until resources start easing

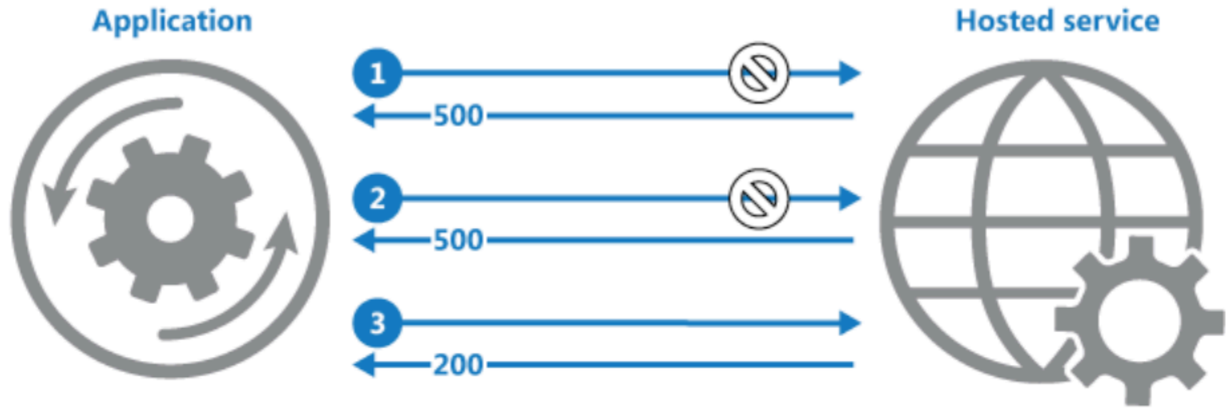


The Solution

- Handle the failures with the following:
  - **Cancel**. If the fault indicates that the failure isn't transient or is unlikely to be successful if repeated, the application should cancel the operation and report an exception. For example, an authentication failure caused by providing invalid credentials is not likely to succeed no matter how many times it's attempted.
  - **Retry.** If the specific fault reported is unusual or rare, it might have been caused by unusual circumstances such as a network packet becoming corrupted while it was being transmitted. In this case, the application could retry the failing request again immediately because the same failure is unlikely to be repeated and the request will probably be successful.
  - **Retry after delay.** If the fault is caused by one of the more commonplace connectivity or busy failures, the network or service might need a short period while the connectivity issues are corrected or the backlog of work is cleared. The application should wait for a suitable time before retrying the request.

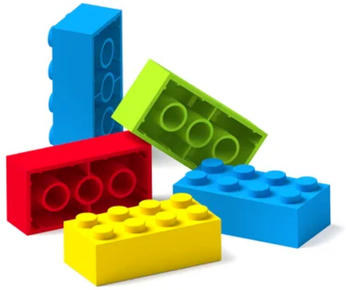


The Diagram



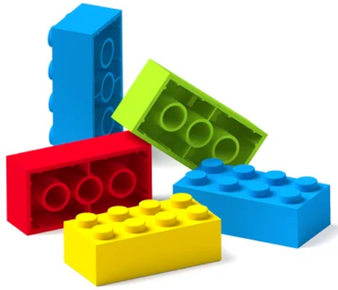
1: Application invokes operation on hosted service. The request fails, and the service host responds with HTTP response code 500 (internal server error).
2: Application waits for a short interval and tries again. The request still fails with HTTP response code 500.
3: Application waits for a longer interval and tries again. The request succeeds with HTTP response code 200 (OK).

Source: https://docs.microsoft.com/en-us/azure/architecture/patterns/retry



Retry Strategies

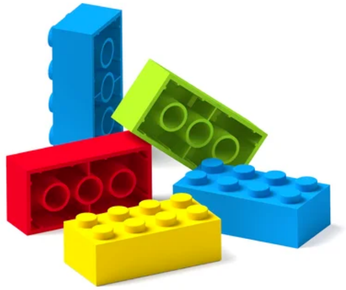
- Retries can be done using a backoff time period. This can be incremental or exponential
- Retries should log all the attempts for diagnosis
- Exponential Backoff is useful if the service is frequently busy
- Retries are very common with messaging systems, but this will often end in an *at least once* semantic



The Lab

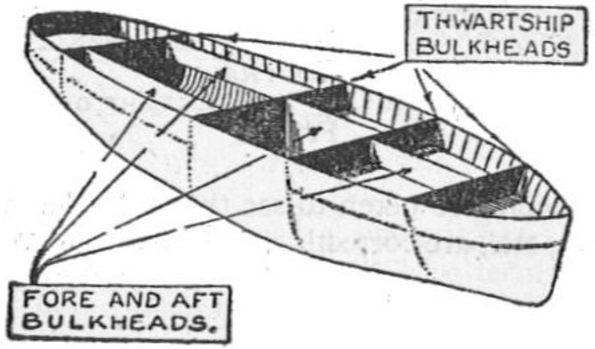
- Again we will turn our attention to Resilience4j
  - This time we will perform a retry pattern so as to ensure that we can retry transient failures
  - We should back off those transient failures after we are not receiving a timely response

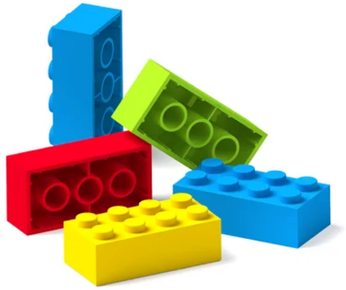
Bulkhead



The Problem

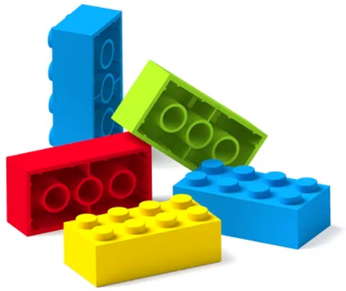
- Elements of an application are isolated into pools so that if one fails, the others will continue to function
- An application may constitute multiple services, with each service having one or more consumers
- Resources may become exhausted
- We will require that thread pools do not exceed a certain threshold



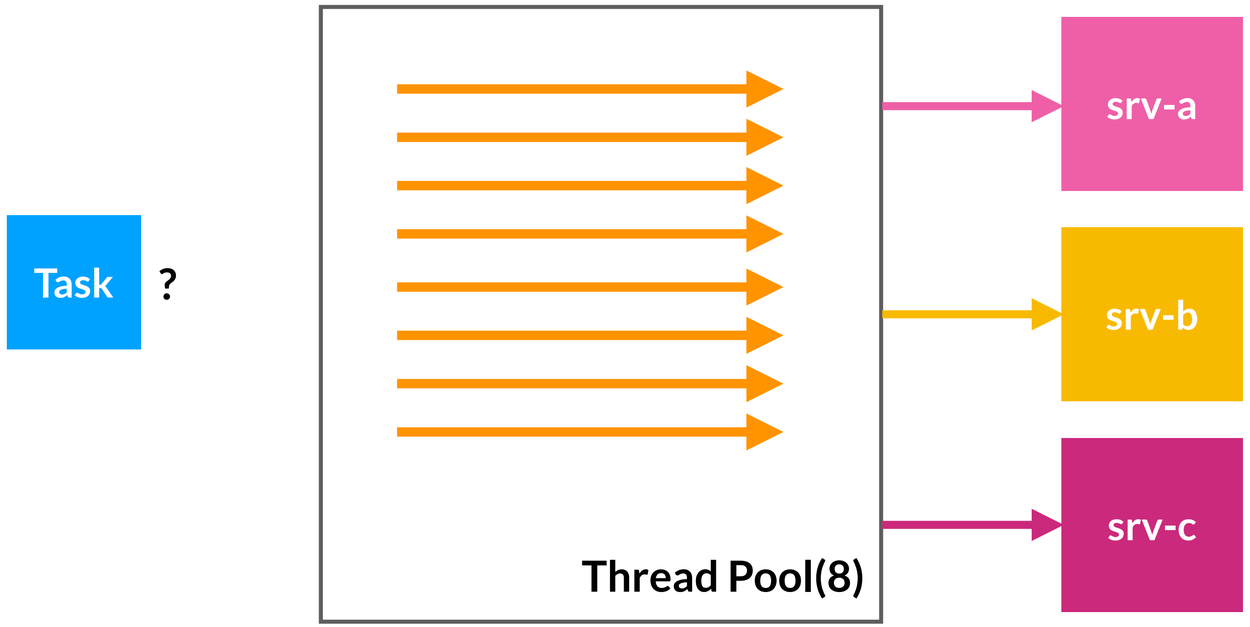


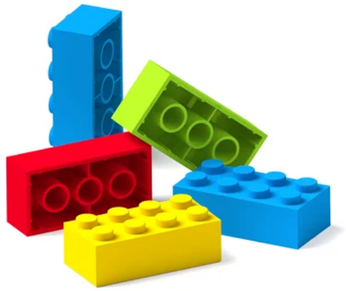
The Solution

- Partition Service instances into groups based on consumer load and availability requirements
- A consumer that calls multiple services may be assigned a connection pool for each service, and that connection pool can either have a task on a queue, or backed by another thread
- If a service begins to fail, it only affects the connection pool assigned for that service, allowing the consumer to continue using the other services

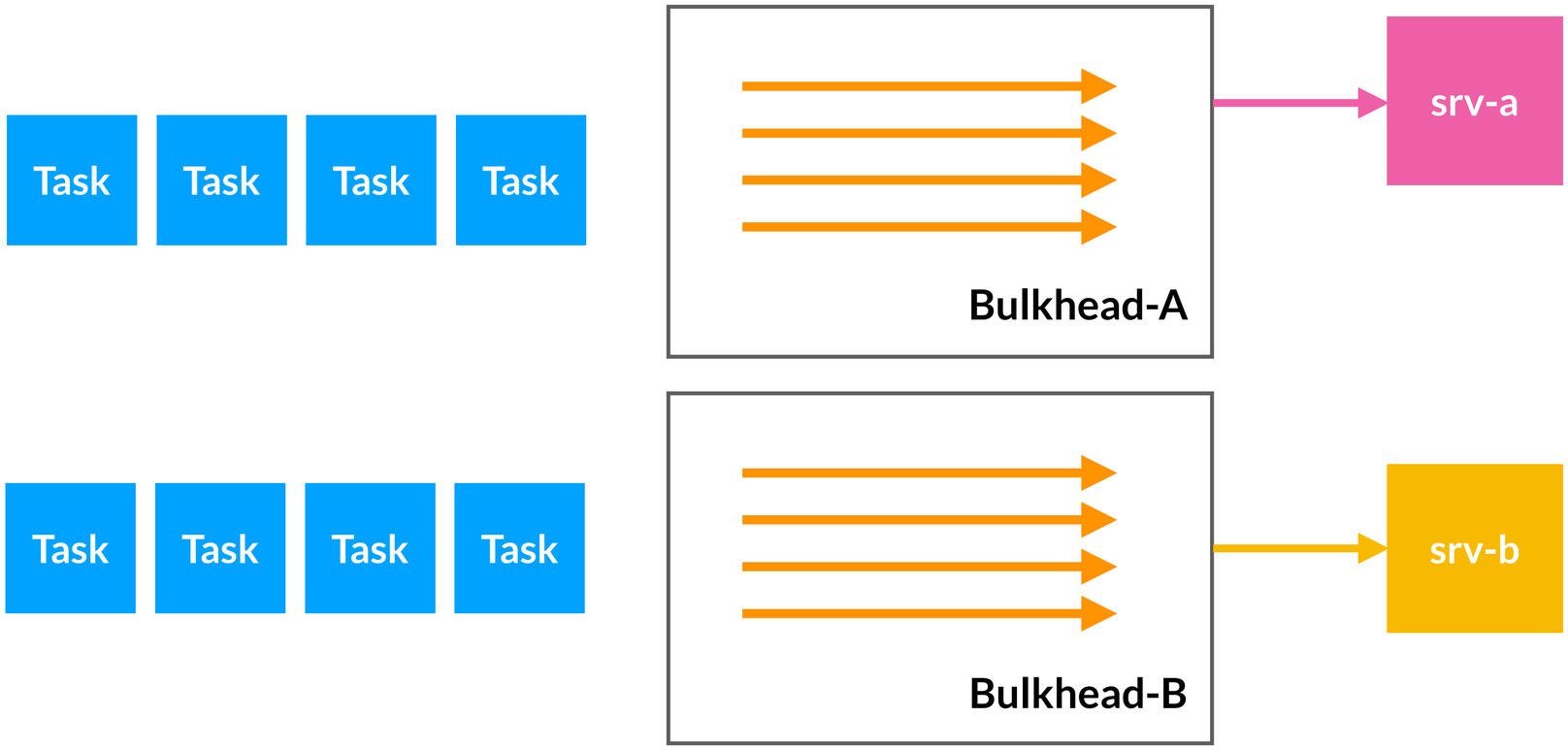


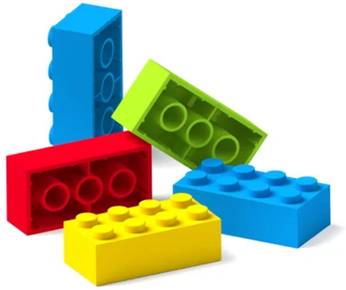
The Diagram





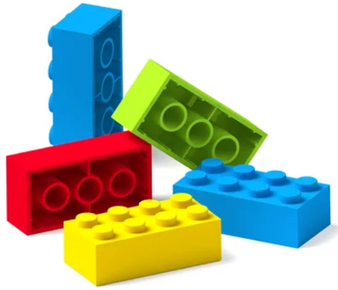
The Diagram


Task
Task
Task
Task
Task
Task
Task
Task
Bulkhead-A
Bulkhead-B
srv-a
srv-b



The Tradeoffs

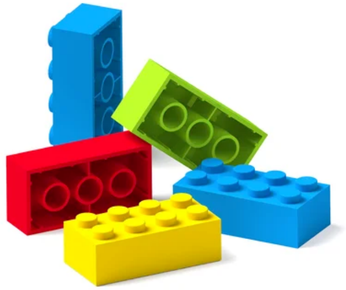
- Great for isolating resources used to consume a set of backend services, especially if the application can provide some level of functionality even when one of the services is not responding.
- Perfect for isolating critical consumers from standard consumers.
- It protects the application from cascading failures.
- It does add some complexity



The Lab

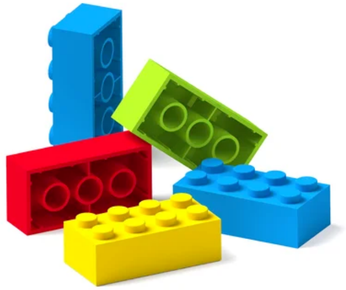
- Again we will turn our attention to Resilience4j
  - This time we will perform a bulkhead pattern so as to ensure that not all threads will be consumed for various purposes

Ambassador



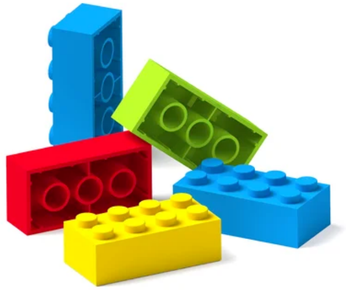
The Problem

- Applications require a multitude of services like
  - Circuit breaking
  - Monitoring
  - Metering
  - Datasource Connectivity and Proxying
- There are risks when it comes to application you are unfamiliar with.



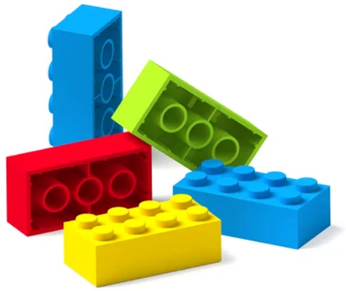
The Solution

- An Ambassador pattern is a proxy for your application to external services
- Deploy the proxy to the same environment, e.g. same pod
- The proxy can monitor performance metrics such as latency or resource usage, and this monitoring happens in the same host environment as the application
- You can make updates to the ambassador with affecting the legacy application
- This can be typically done as a sidecar in the same pod

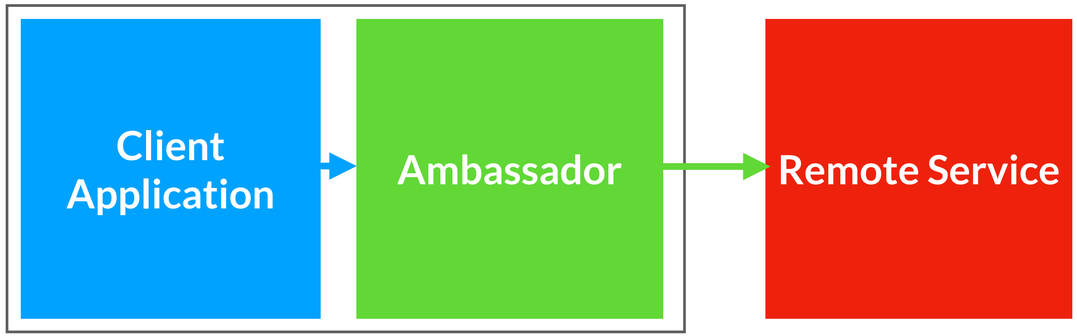


The Tradeoffs

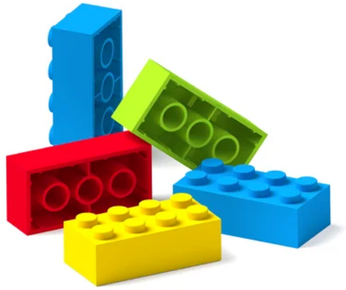
- There is minimal latency overhead
- The solution is better off to be integrated to the application itself
- When client connectivity features are consumed by a single language, a better option might be a client library that is distributed to the development teams as a package



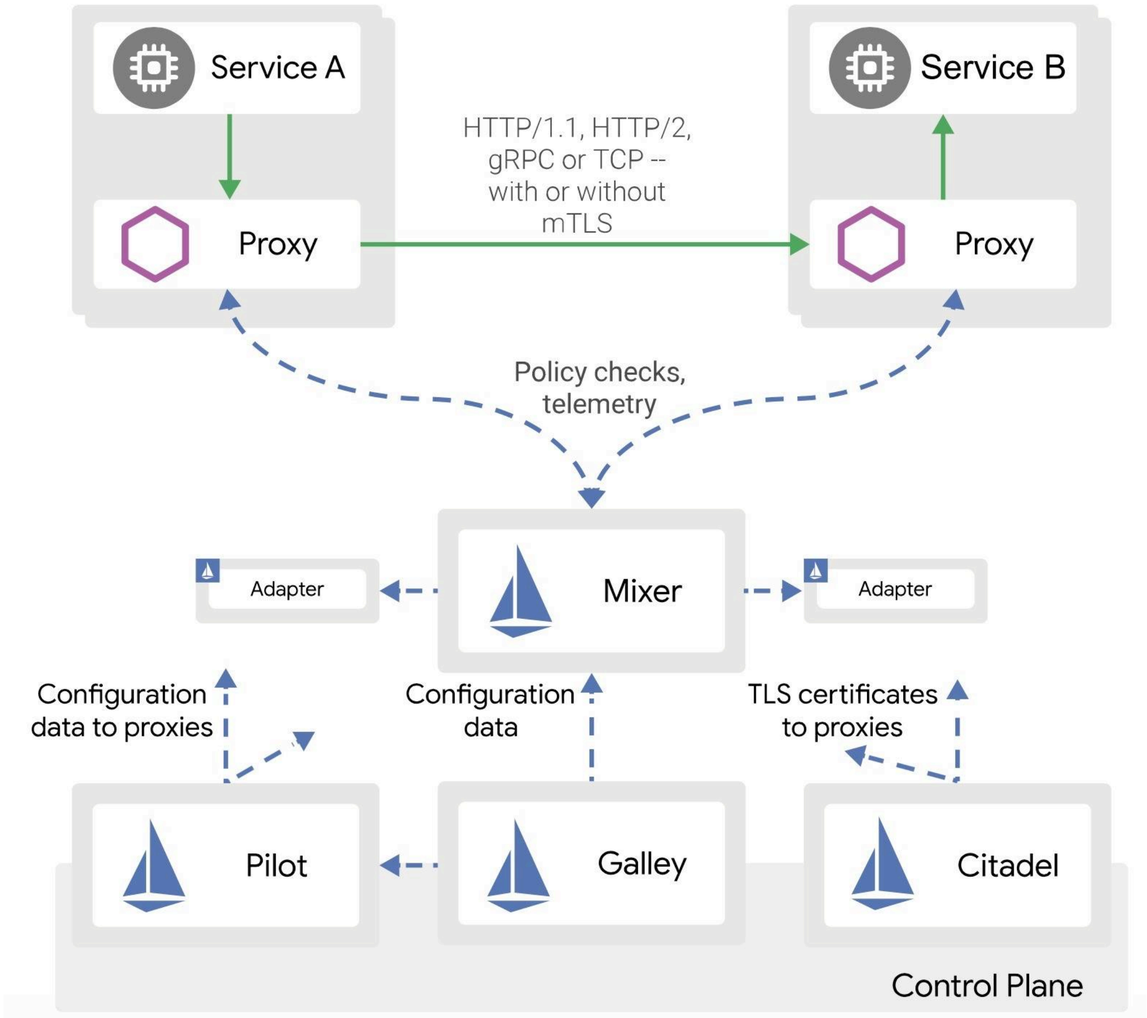
The Diagram



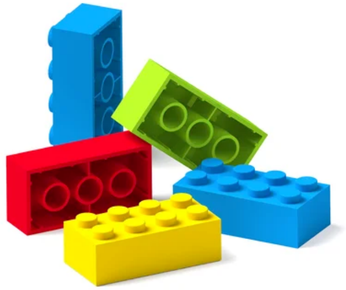
The ambassador will be intercept traffic and provide services for caching, security, circuit breaking, and more



The Diagram

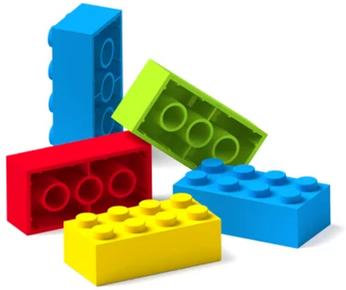

Service A
Service B
HTTP/1.1, HTTP/2,
gRPC or TCP --
with or without
mTLS
Proxy
Proxy
Policy checks,
telemetry
Adapter
Mixer
Adapter
Configuration
data to proxies
Configuration
data
TLS certificates
to proxies
Pilot
Galley
Citadel
Control Plane

Event Sourcing



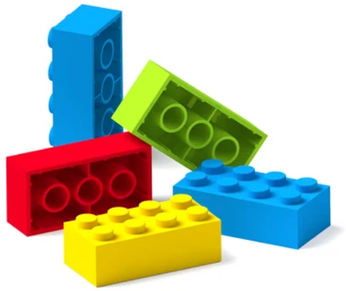
The Problem

- Typical CRUD Database have issues
  - It is a change log where information get overridden, and not all data is like that
  - Slowdown of performance, when writing to a typical datastore there can be contention and lack of scalability
  - Unless there is an implementation of auditing much of this data is lost
- Event Sourcing compliments CQRS (to be covered soon)



The Solution

- Events are recorded in an append only store
- Events are described with discrete events like:
  - `AddedItemToCart`
  - `RemoveItemFromCart`
  - `ClearCart`
- Therefore it can be used to materialize view, prepare the data for the purposes of being *efficiently* read by a UI or business analytics for consumption



The Diagram

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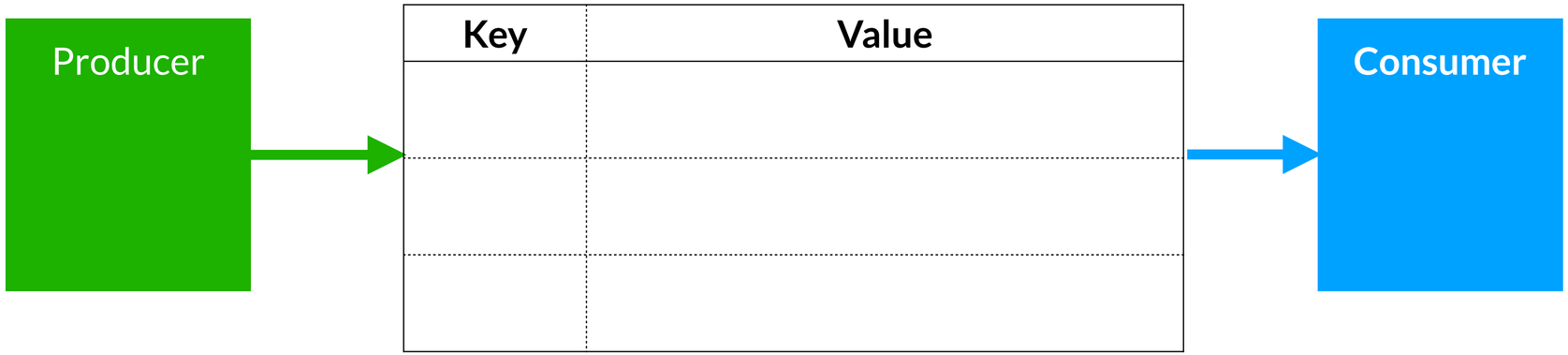


```
3002
```

```
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 “item_id”: “2001”
 “quantity”: 3}
```

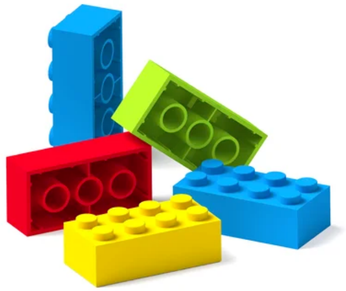

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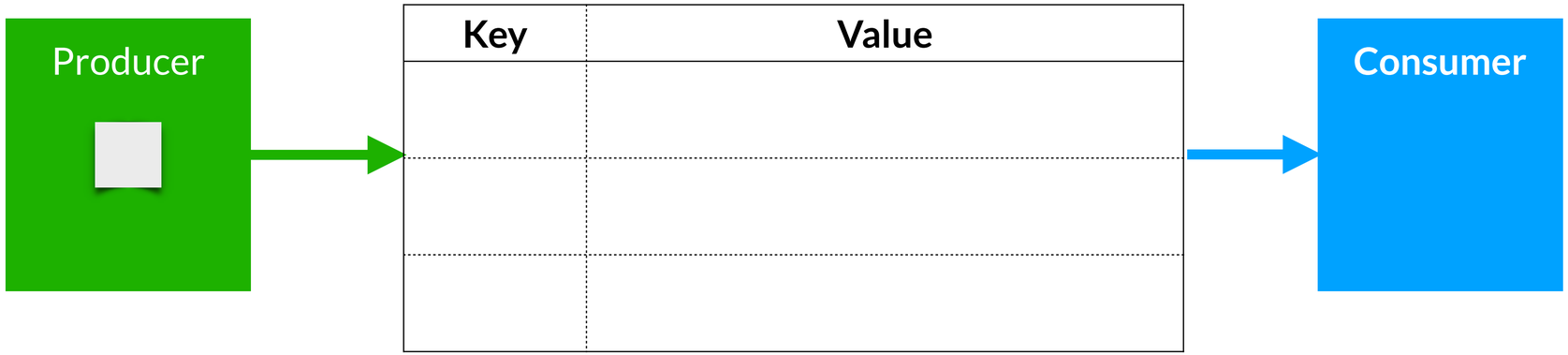

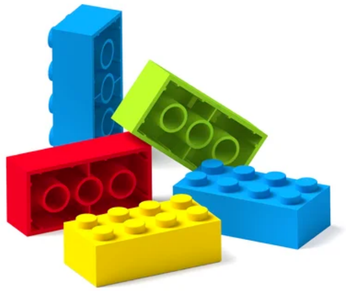

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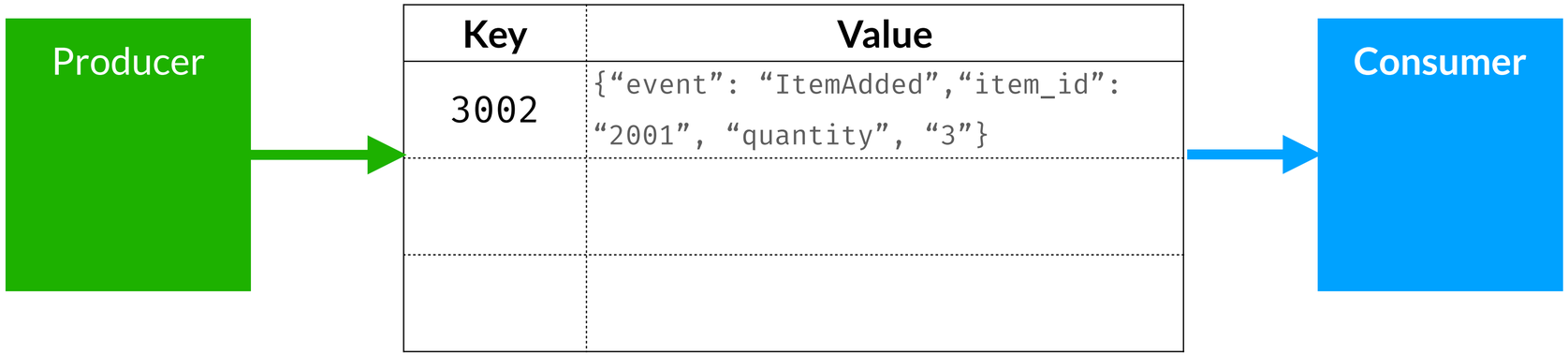

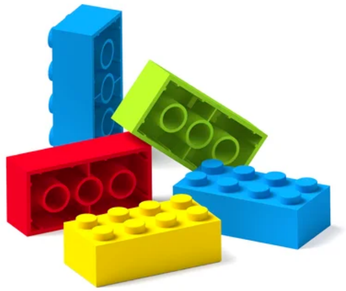

The Diagram

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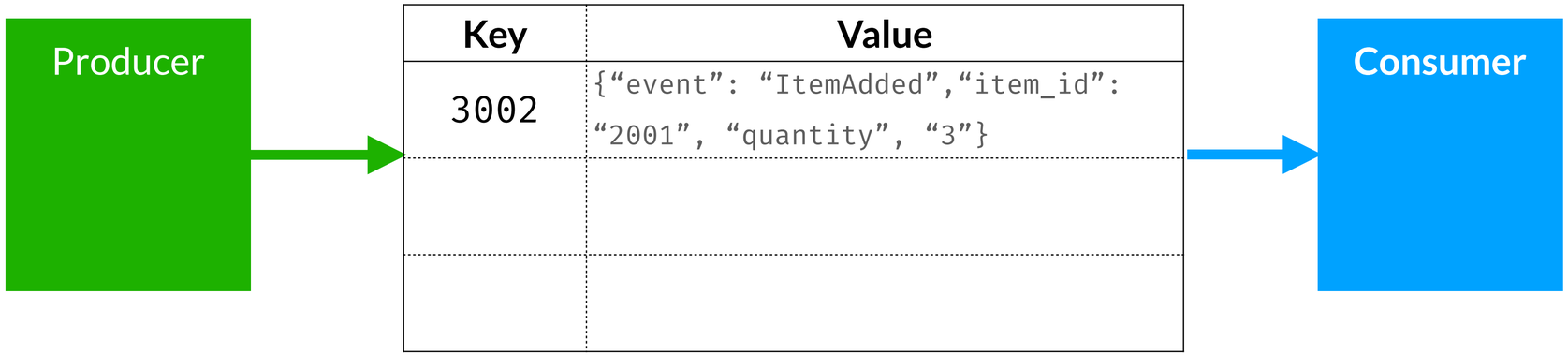


```
3043
```

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 “quantity”: 2}
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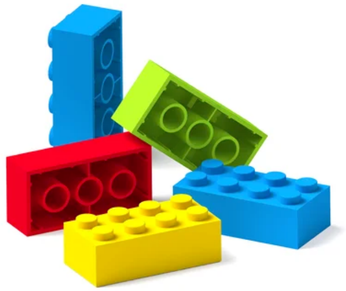

The Diagram

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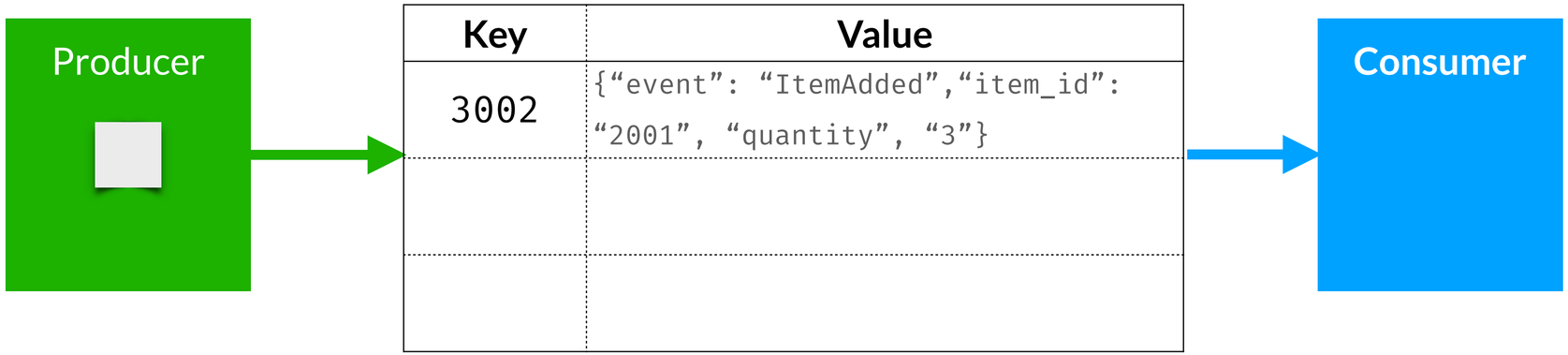

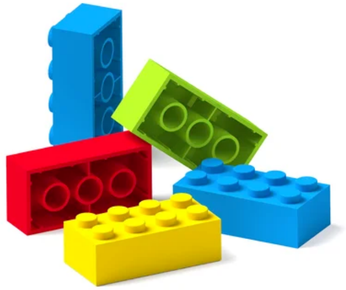

The Diagram

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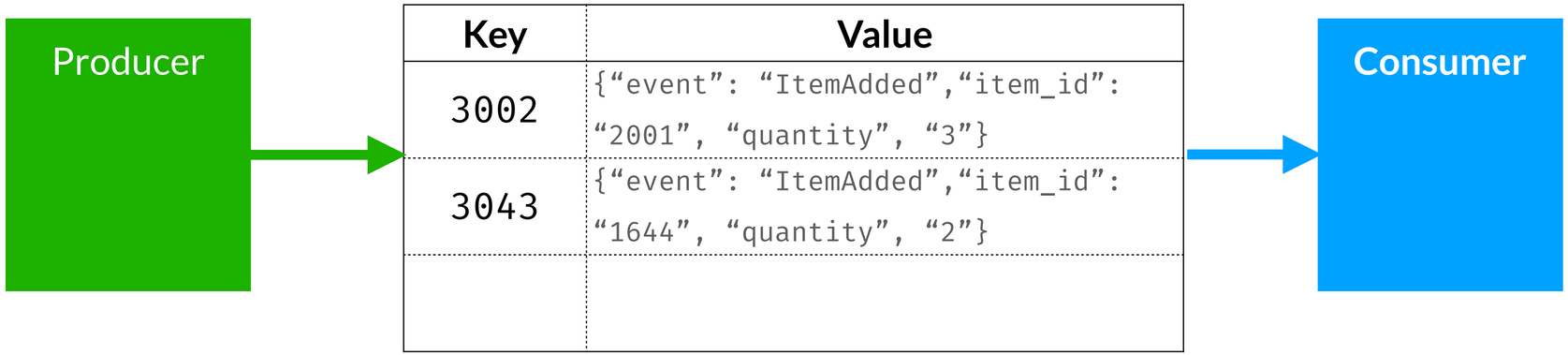

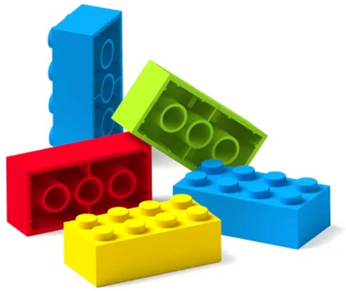

The Diagram

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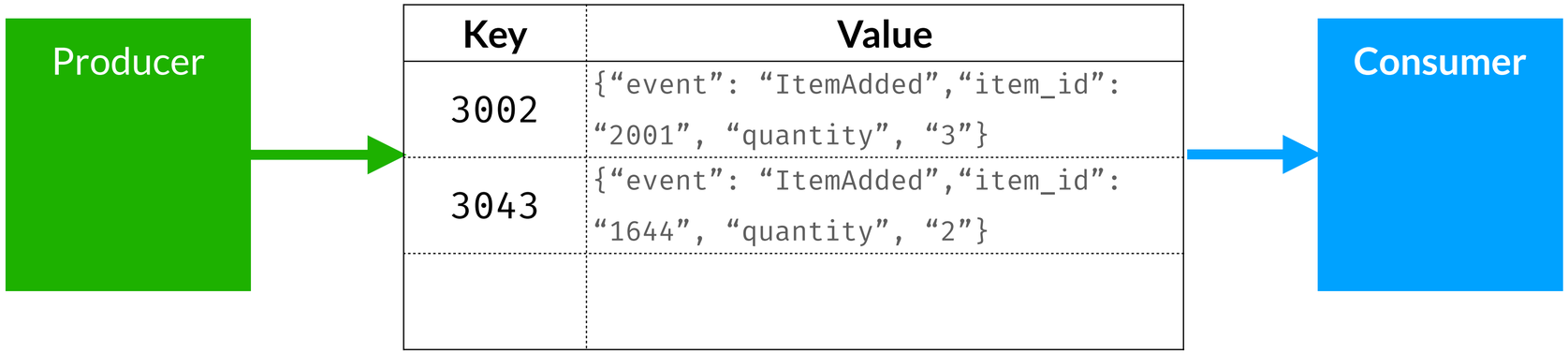
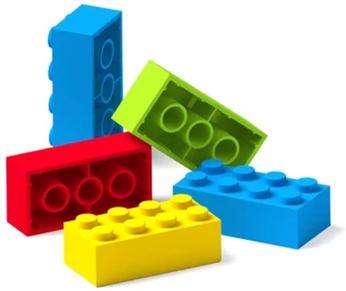


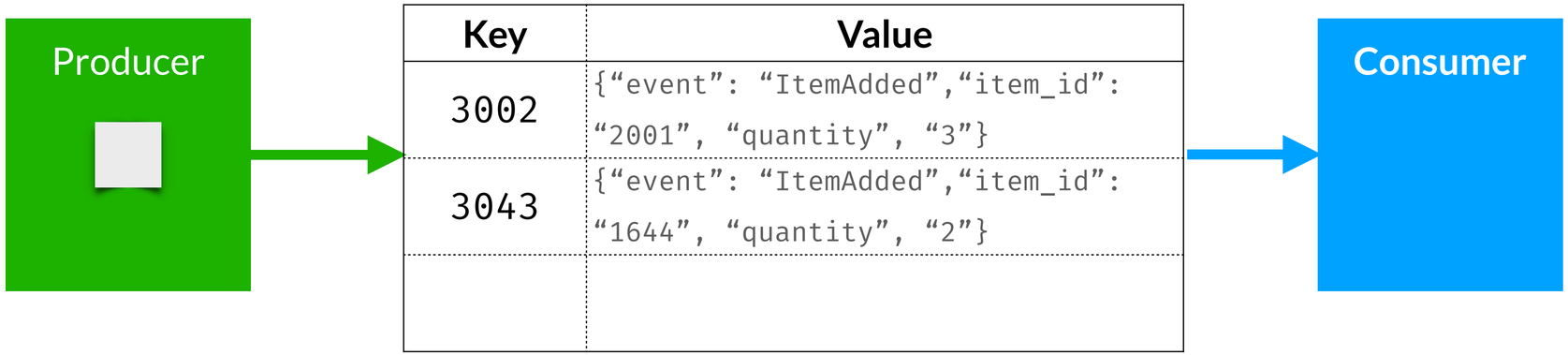

```
3002
```

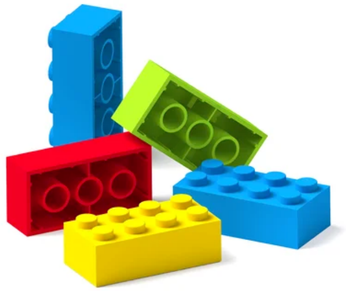
```
{“event”: “ItemAdded”,
 “item_id”: “2001”
 “quantity”: 1}
```



The Diagram

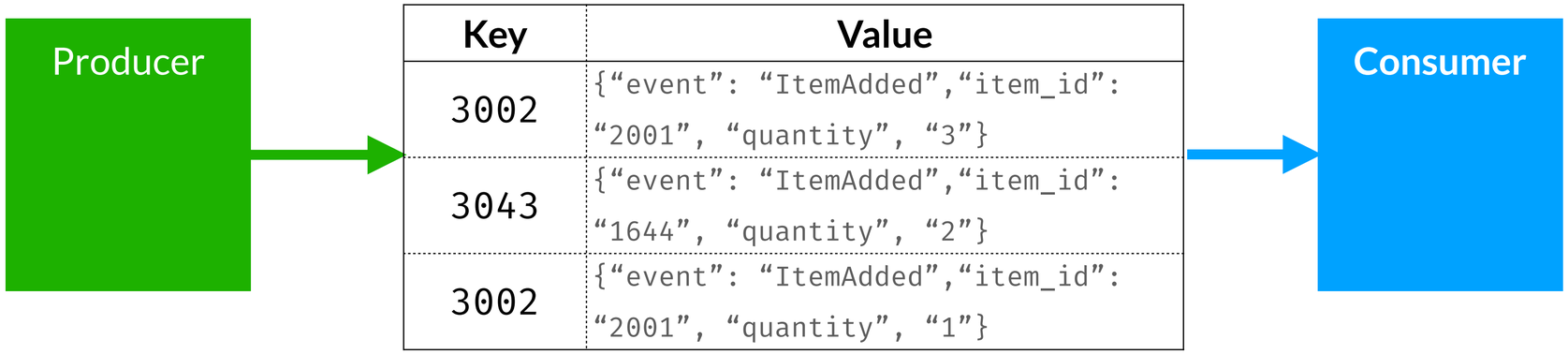
Append-Only & Immutable

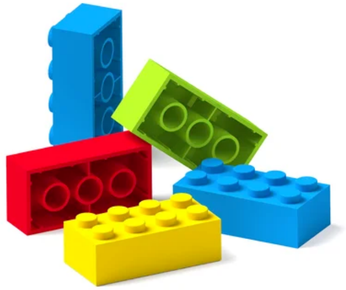




The Diagram

Append-Only & Immutable

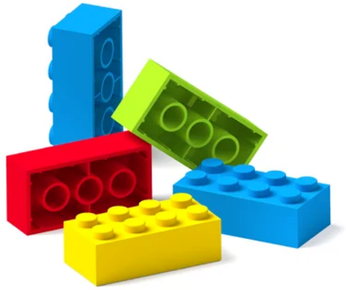




The Tradeoffs

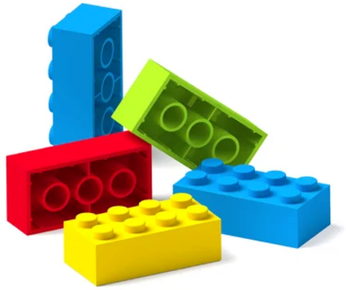
- **Eventually Consistent -** The data that is available to be read will soon be there, but will not be there immediately
- Immediately real-time consistency is not available. It’s very close though.
- If you do not require audit trails, history, and roll backs, it might be overkill
- If you do not expect a lot of conflicts, this too will be overkill

Competing Consumers



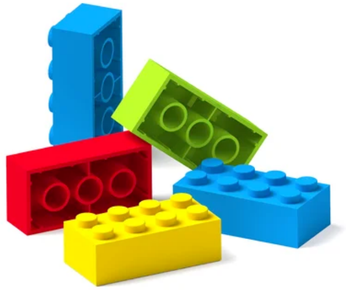
The Context

- We require constant processing of a number of requests
- Pass them through a messaging system to another service (a consumer service) that handles them asynchronously
- Using a single instance for consuming can be daunting
- Messaging might be overwhelmed
- Workloads need to be balanced across multiple consumers

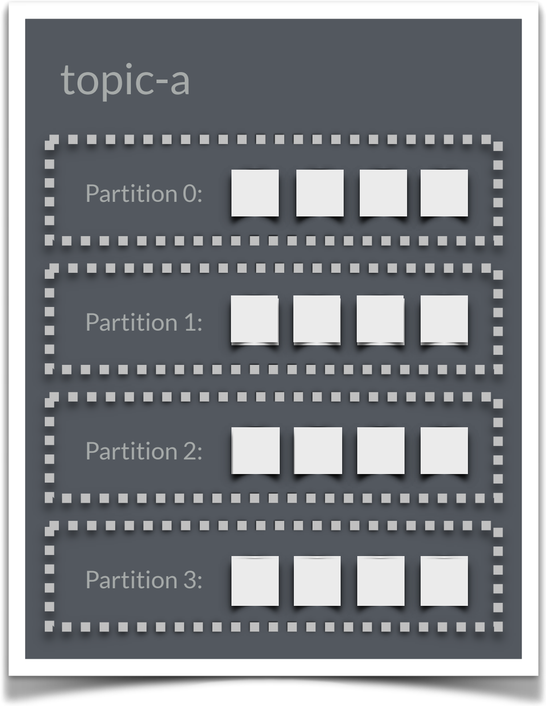


The Solution

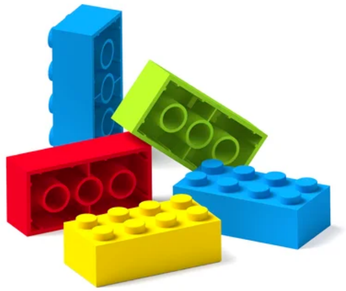
- Use a message queue or pub/sub to send messages over to the consumer
- Each consumer can process the message in a way that doesn’t interfere with other consumers
- Consumers become fault tolerant
- Improves reliability, delivered at least once
- By using offsets any consumer that takes on messages that the others haven’t then the consumer can process those same messages



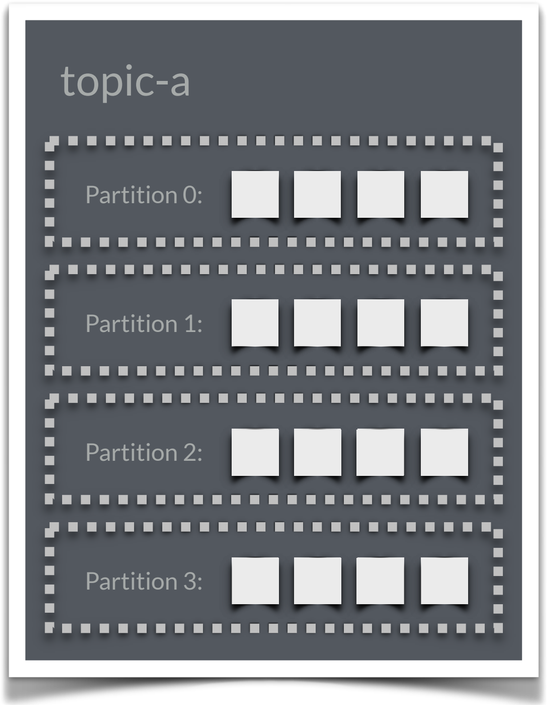
The Diagram


topic-a
Partition 0:
Partition 1:
Partition 2:
Partition 3:

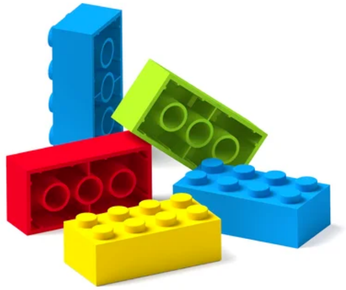

consumer-1



The Diagram

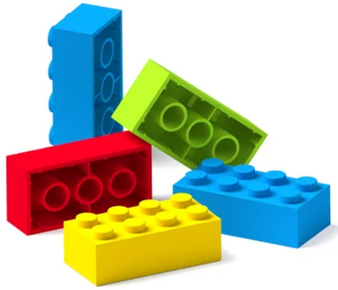

topic-a
Partition 0:
Partition 1:
Partition 2:
Partition 3:


consumer-1
consumer-2
consumer-3
consumer-4



The Tradeoffs

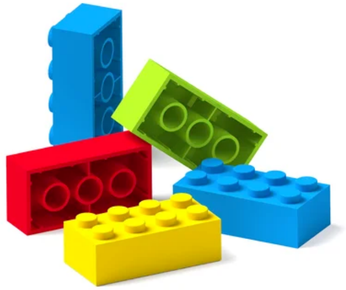
- It may not be easy to separate the application workload into discrete tasks
- There's a high degree of dependence between tasks
- Tasks must be performed synchronously, and the application logic must wait for a task to complete before continuing
- Tasks must be performed in a specific sequence



The Lab

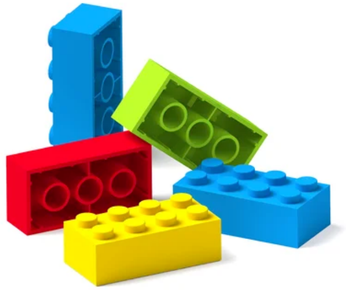
- Let’s take a look at Kafka Consumers which happen to adhere to this design pattern

Claim Check



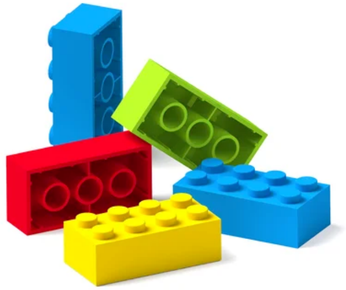
The Context

- Many messaging application can’t accept really large payloads
- Send a claim check to the messaging platform and store that payload to an external service.
- This will prevent the messaging service from being overwhelmed or being slowed down
- Less expensive overall, since storage is cheaper than messaging

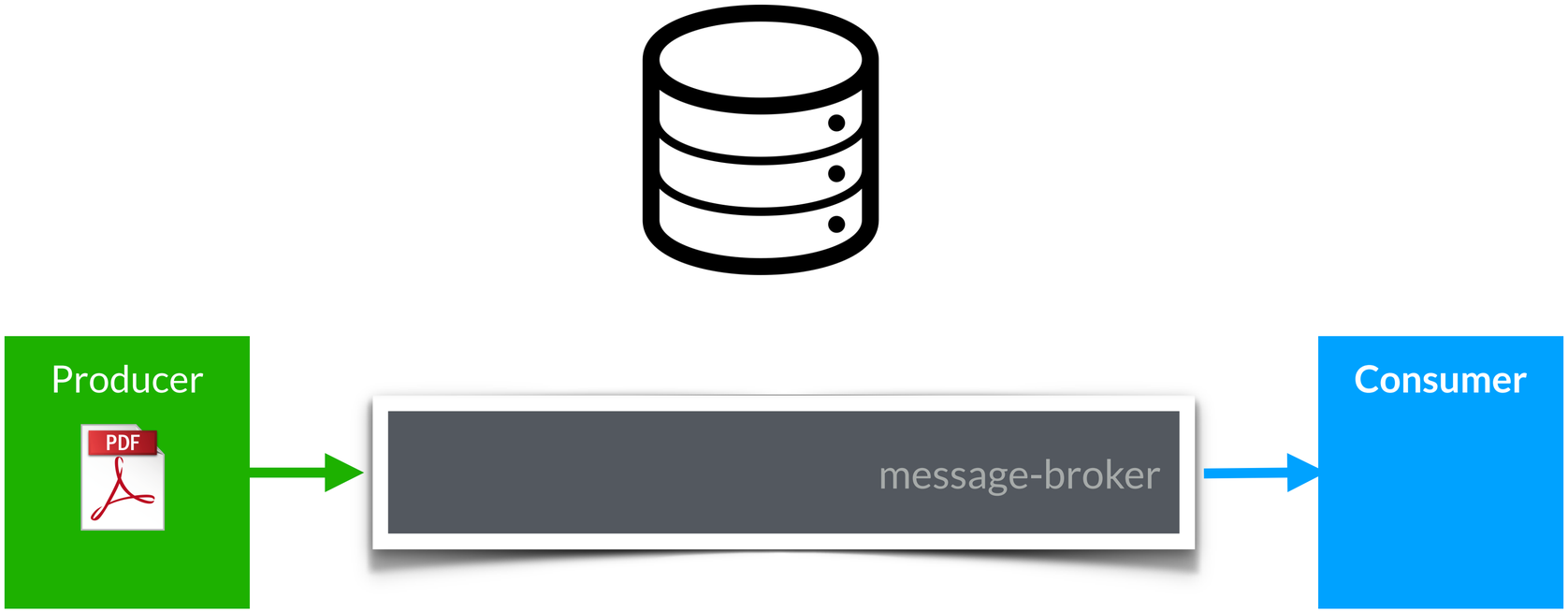


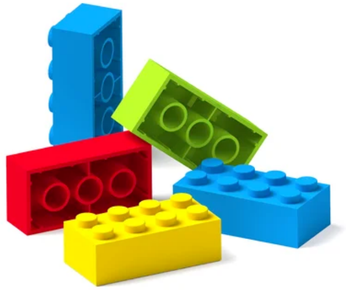
The Solution

- Store the entire message payload into an external service, like a datastore
- Get a reference, like a integer identifier to stored payload
- Attach and send the reference to the message broker *inside of the message*
- The consumer of the message will use the identifier to retrieve the large payload

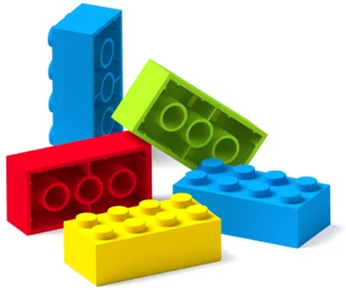


The Diagram

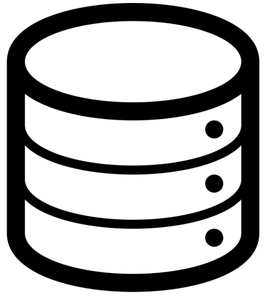


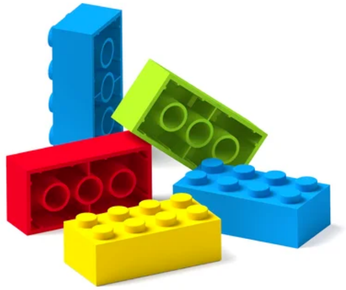


The Diagram

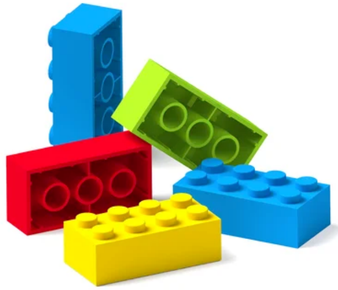


The Diagram





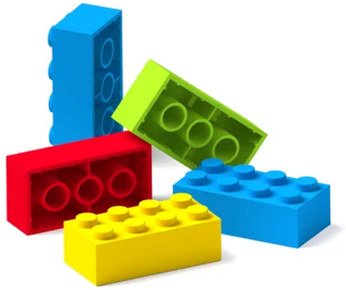
The Diagram



The Lab

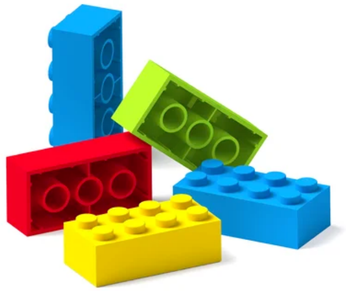
- Next we will use Kafka and Schema Registry to implement the following behaviors
  - Loading a Schema on a Datastore called schema registry
  - Seeing that the consumer gets the same data

Materialized View

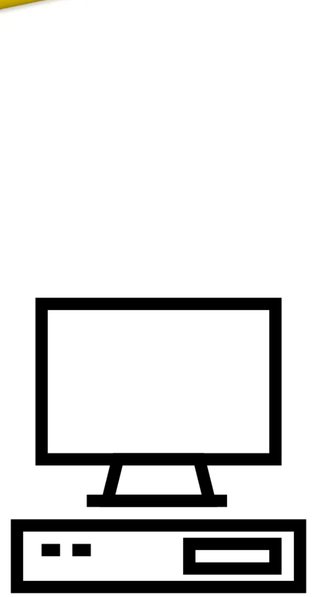


The Problem

- Currently much of the data revolves on how it is stored, not how it is read
- Data when read needs to transformed and prepared
- Each entity typically has too much information for it to be queryable and usable
  - For example, one data entry in a document style database can have other aggregates that are not absolutely necessary
- Data may also need to be joined, cleansed, or engineered for a particular purpose, like machine learning



The Diagram



Orders

Id	State	Customer
1	NY	Carlos
2	AZ	Ann
3	CA	Pritha
4	CA	Antoni
5	AZ	Amani
6	NY	Widelene

Products

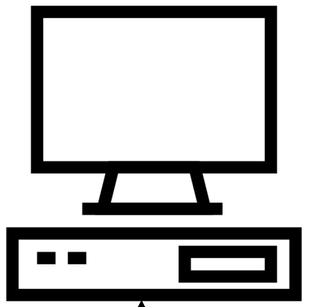
ID	Name	Cost
1	Dr. Magestic's Tonic	40
2	Dragonfeel Pillows	200
3	Sumatra Fresh	430
4	Mars Rover	212
5	Ennui Engine	190
6	Pittsburgh Passion	410

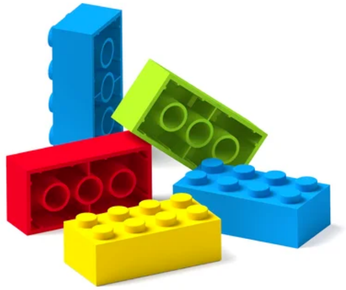
Order Items

ID	Order ID	Quantity	Product ID
1	1	23	1
2	1	2	2
3	2	4	4
4	2	5	6
5	2	60	5
6	3	10	4

ID	State	Qty	Total
1	NY	30	4000
2	AZ	75	3500
3	CA	123	12322
4	NJ	80	3892
5	TX	3	1200
6	PA	90	3304

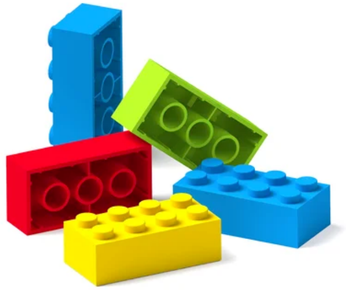
Materialized Report





The Solution

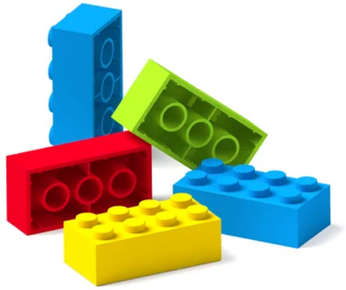
- Create a different perspective of the data that you need
- This can be implemented by the datastore itself
  - Oracle
  - PostgreSQL
- Can be performed by Stream Processing Frameworks
  - Kafka
  - Spark
  - Flink



The Tradeoffs

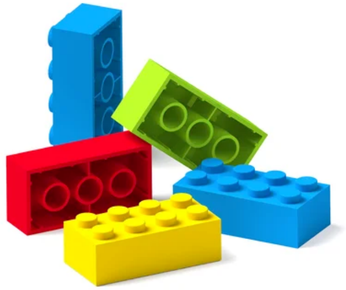
- If your source is already simple and easy to query, there is no need
- If immediate consistency is required, then query direct

CQRS



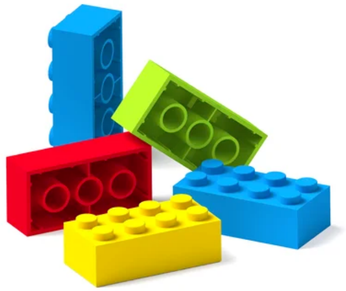
CQRS

- **Command and Query Responsibility Segregation**
- Separating reads and updates for a databases
- Benefits include better performance, scalability, and security
- Better evolution over time
- Prevents Merge Conflicts



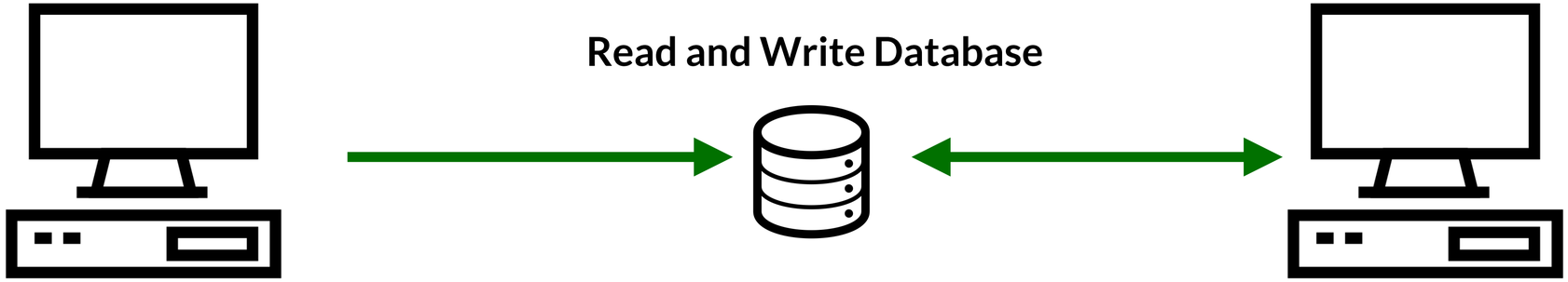
How do you connect the databases?

- **Command and Query Responsibility Segregation**
- Separating reads and updates for a databases
- Benefits include better performance, scalability, and security
- Better evolution over time
- Prevents Merge Conflicts (Remember from Event Sourcing)

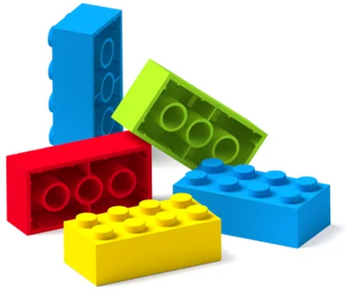


The Diagram

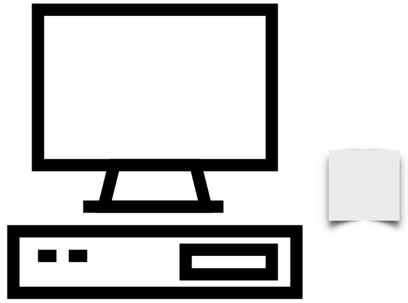
What if we need to query...
`SELECT state, count(*) from orders group by state`, over and over?



State	Amount	Customer
NY	4000	Carlos
AZ	300	Ann
CA	1000	Pritha
CA	340	Antoni
AZ	2133	Amani



The Diagram

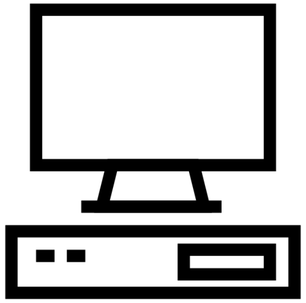


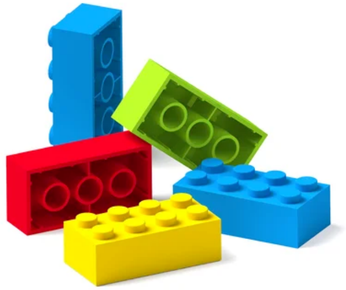
Read Database

State	Amount	Customer
NY	4000	Carlos
AZ	300	Ann
CA	1000	Pritha
CA	340	Antoni
AZ	2133	Amani

Write Database

State	Total
NY	4000
AZ	2433
CA	1340





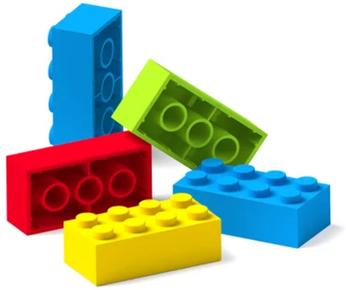
The Diagram

Read Database

State	Amount	Customer
NY	4000	Carlos
AZ	300	Ann
CA	1000	Pritha
CA	340	Antoni
AZ	2133	Amani
NY	900	Widelene

Write Database

State	Total
NY	4000
AZ	2433
CA	1340



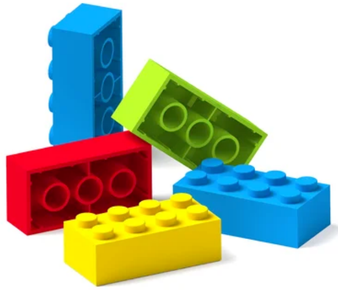
The Diagram

Read Database

State	Amount	Customer
NY	4000	Carlos
AZ	300	Ann
CA	1000	Pritha
CA	340	Antoni
AZ	2133	Amani
NY	900	Widelene

Write Database

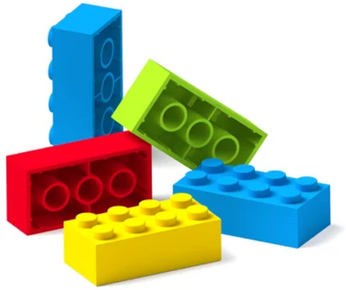
State	Total
NY	4900
AZ	2433
CA	1340



The Lab

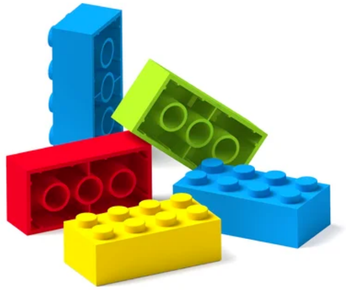
- Next we will use Kafka to implement the following behaviors
  - Event Sourcing
  - Materialized Views
  - CQRS (Command Query Responsibility Segregation)

Strangler Fig



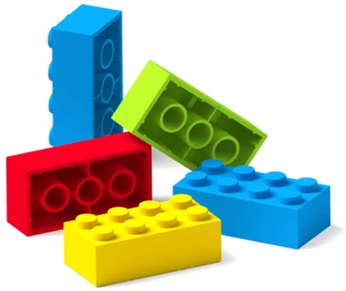
The Context

- Services can become obsolete.
- New features over time can make things difficult to manage
- Need responsible and gradual migration to the new system
- Clients would need to be update to the new location
- Once moved, the old system can be responsibly removed



The Solution

- Create a façade called the *Strangler Facade* which will intercept requests that is going into a legacy system.
- The façade routes the requests to either the legacy or new services
- Existing features can be migrated to the new system gradually and consumers use the same interface



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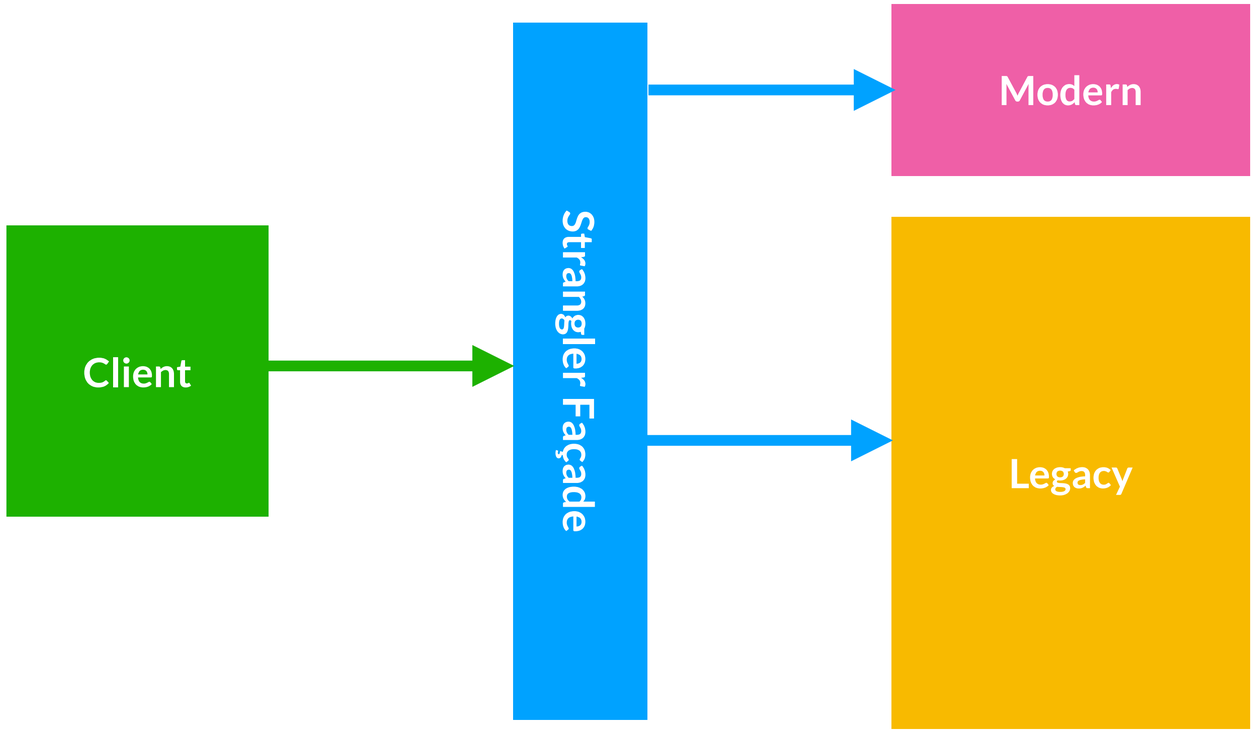
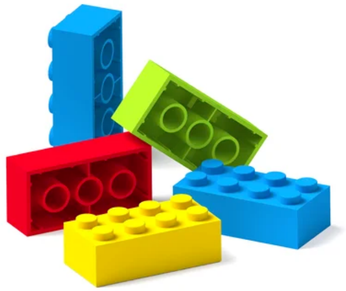
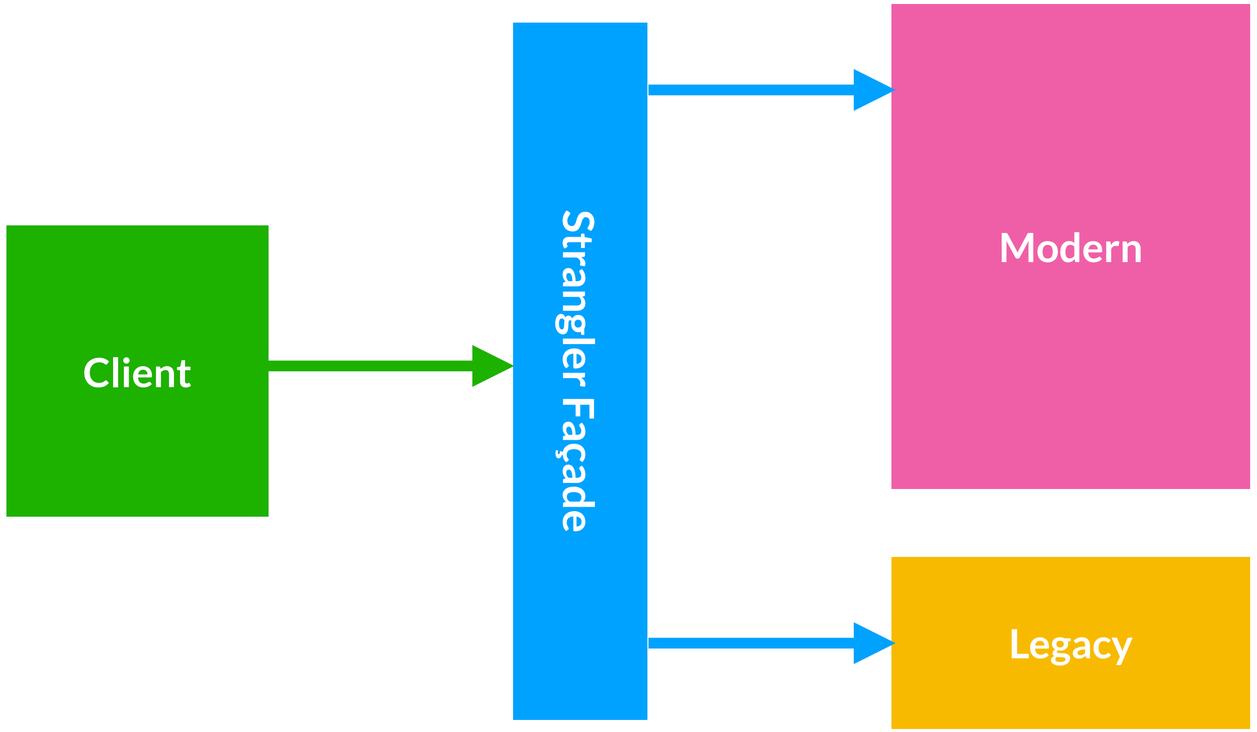
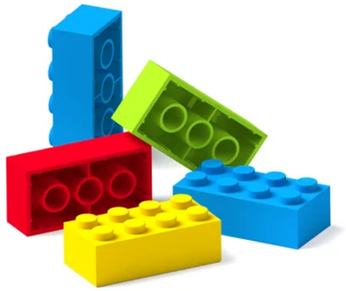




The Diagram





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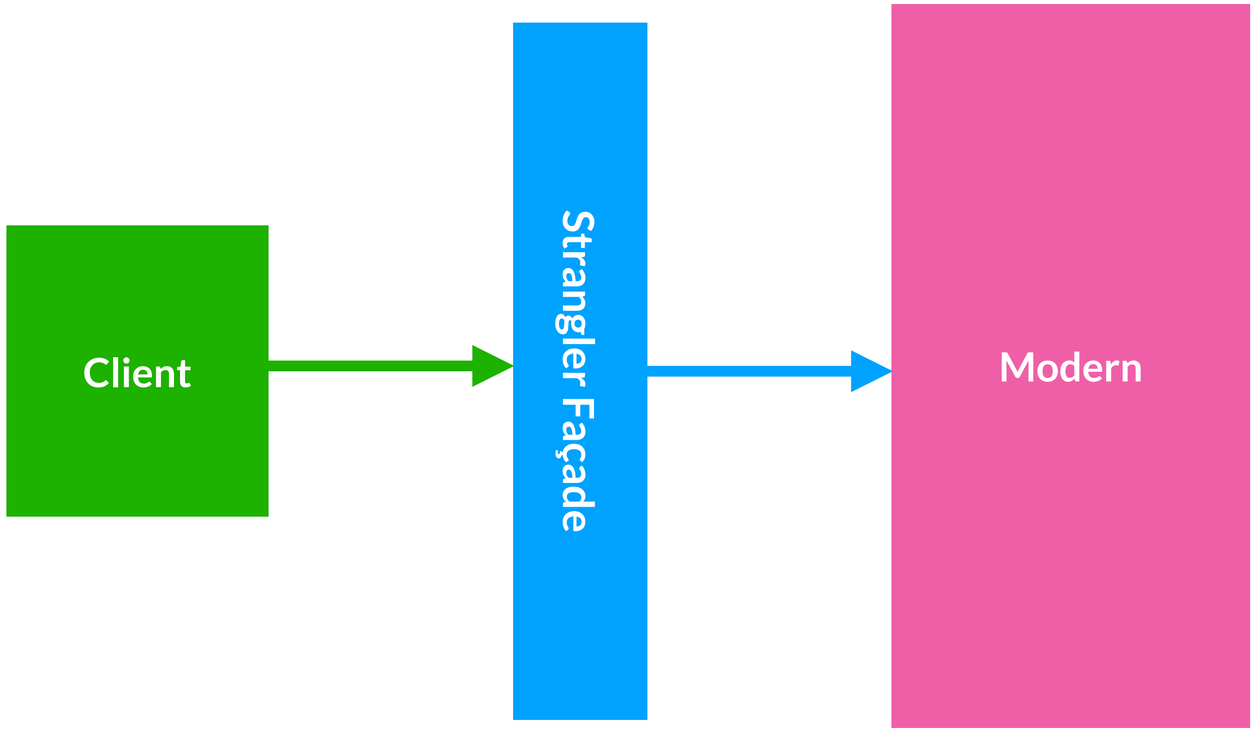
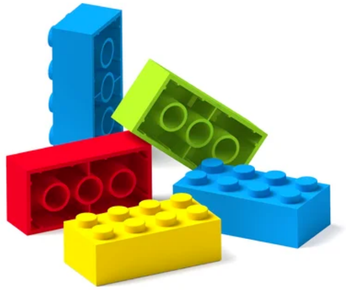
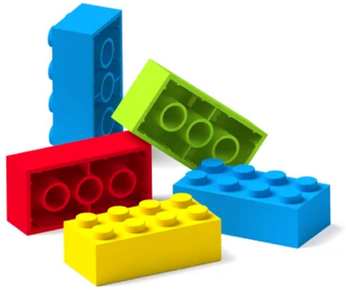




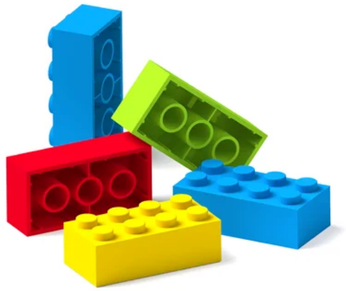
The Tradeoffs

- Ensure that the façade doesn’t become a bottleneck
- Ensure that the façade keeps up with the migration
- After the migration the façade would go away or kept

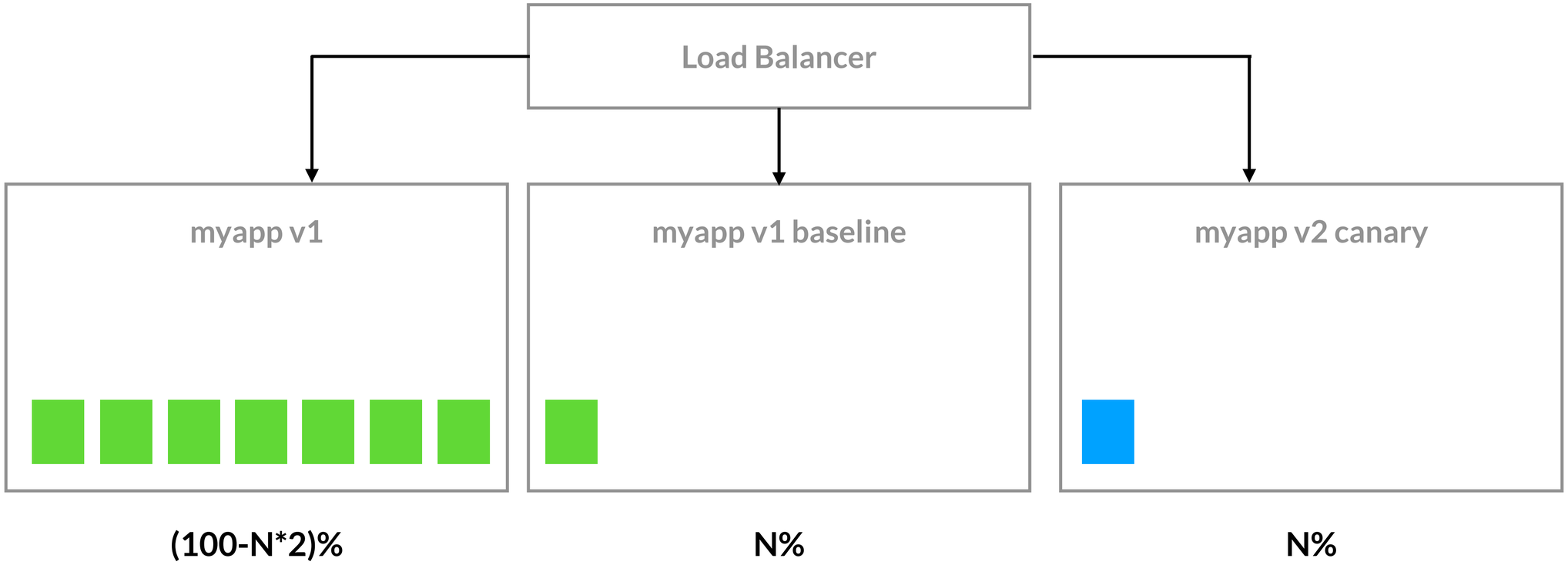


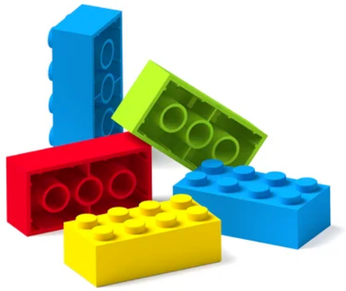
Canary Deployments

- An Different view of the Strangler Fig
- Deployment Strategy - Popularly used by Netflix
- Should be a part of CI/CD
- Rolling out releases to a subset of users or servers and measure the response typically using metrics packages like Prometheus
- No Downtime
- If the subset is fails, doesn’t perform well, or doesn’t meet standards, rollback to the previous

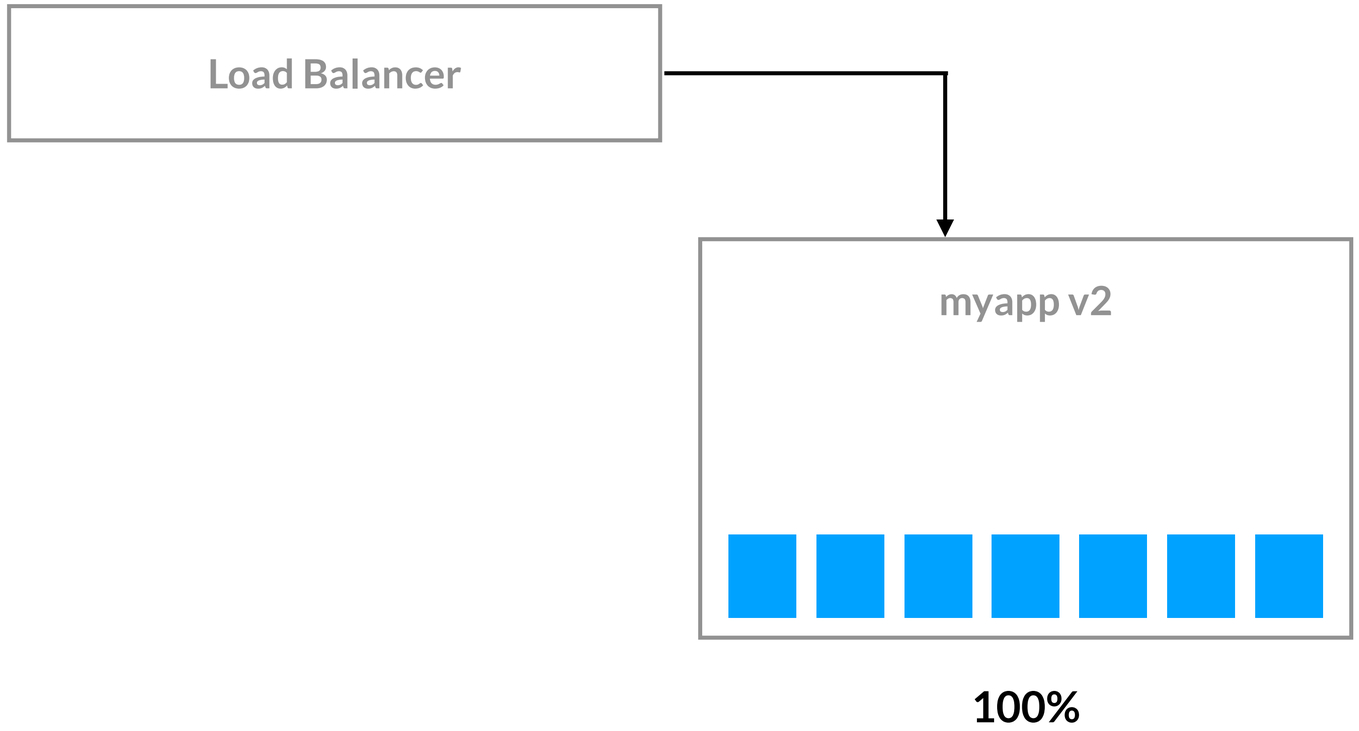


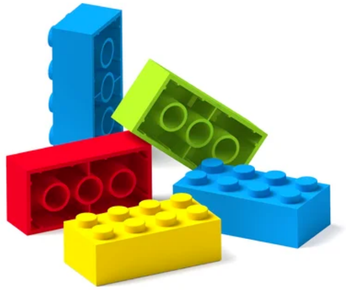
Canary Deployments





Canary Deployments

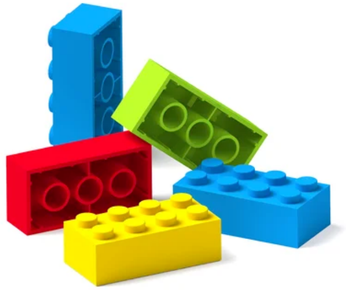




How to do with Kubernetes

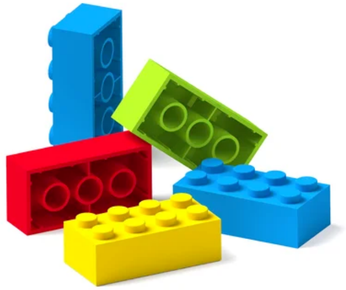
- Use Label Selectors on the Service and appropriate sizing
- Use a Deployment object of the workload
- For consistency with common Deployment object, update the version of the original deployment object if continuing with the rollout

Gatekeeper



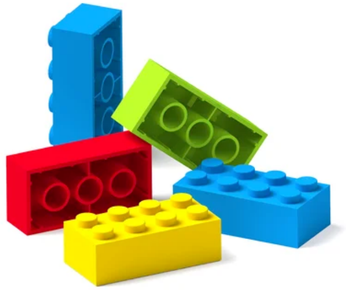
The Context

- Services may have potentially sensitive information
- If a hacker is able to get into the hosting environment, they can have access to a gamut of information like credentials, storage keys and datastores.



The Solution

- Create a façade that will be entry point of all requests
- The Gateway facade will be in charge of:
  - Accepting Requests
  - Sanitizing the Requests
  - Validating the Requests
  - Mutating the Requests



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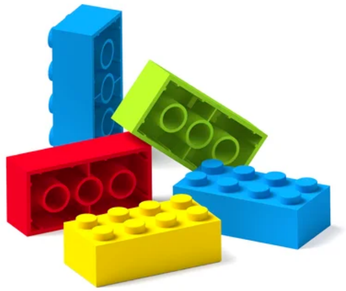
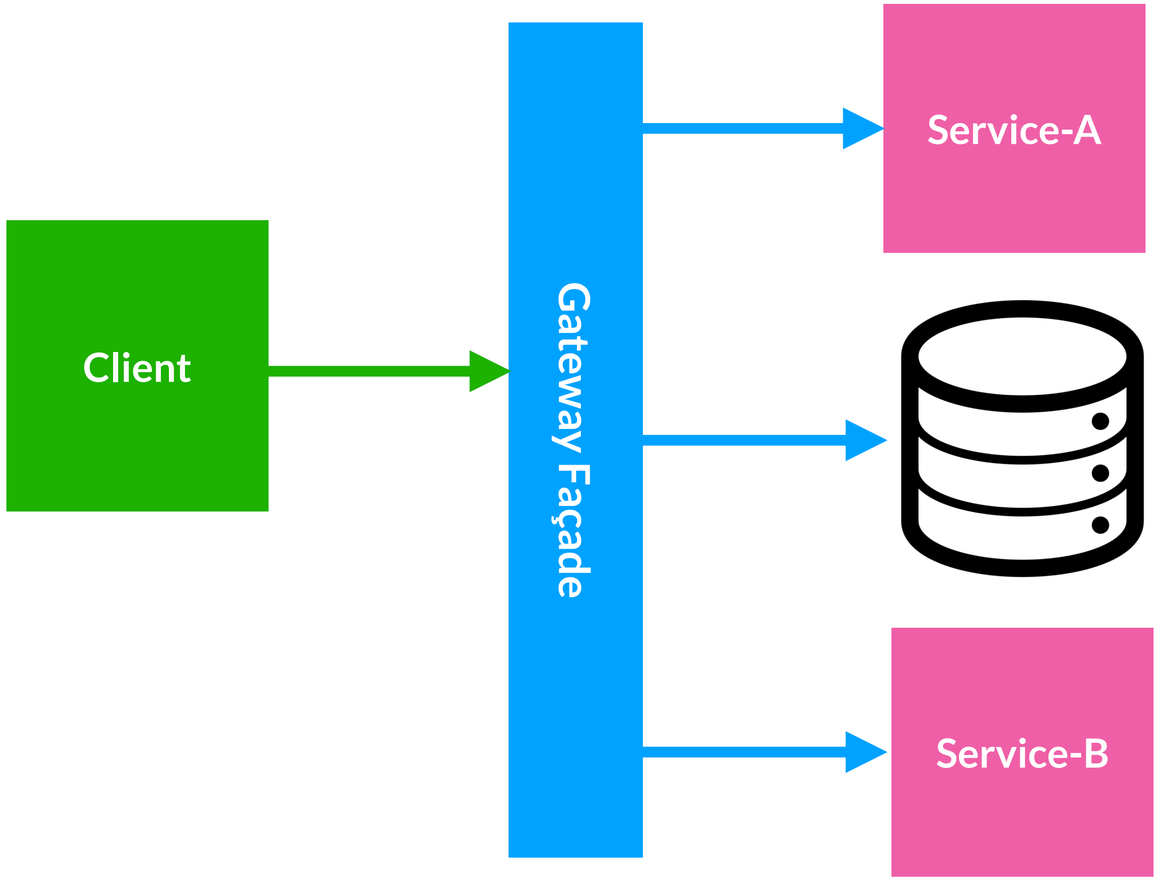
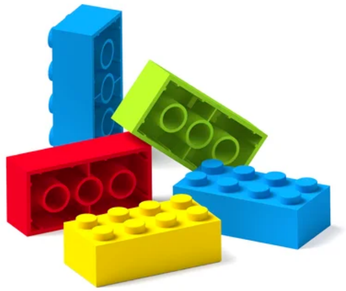
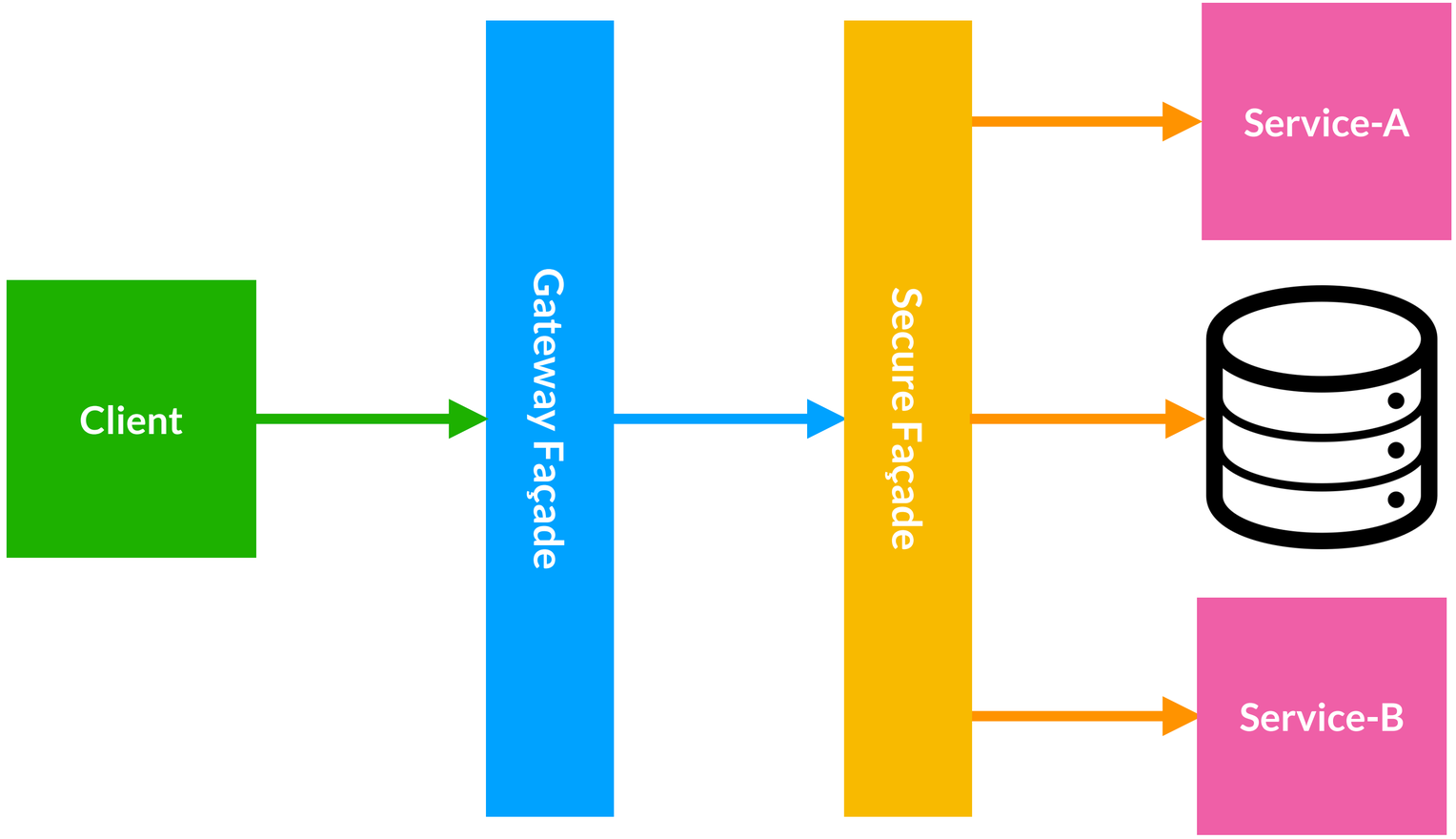


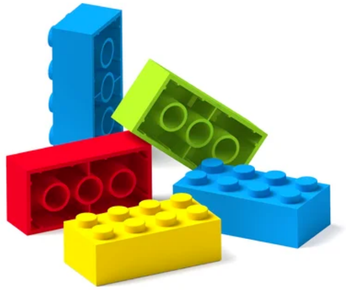
The Diagram





The Diagram





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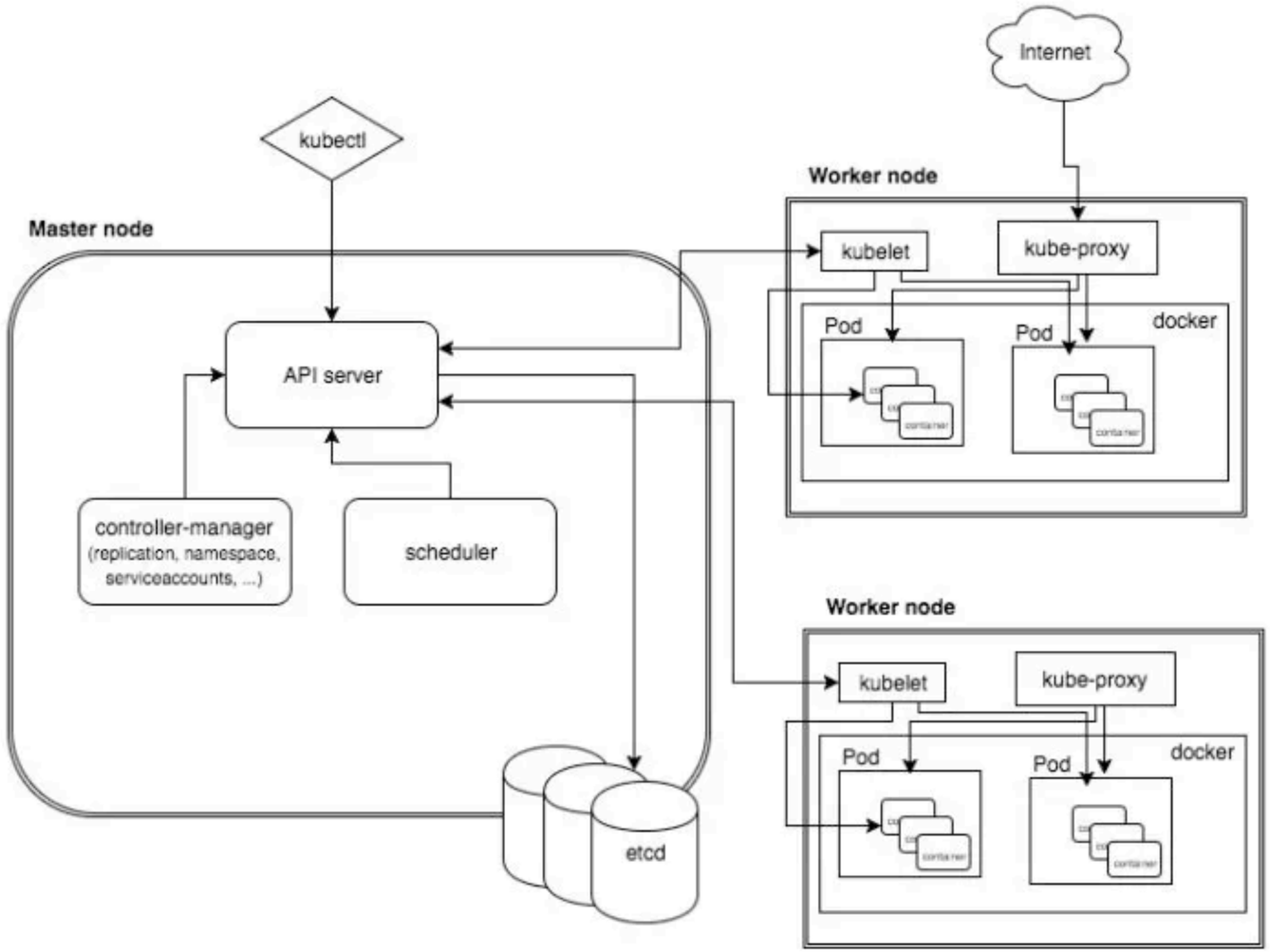
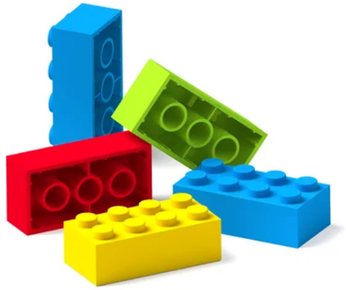
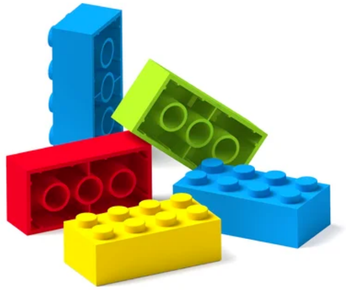

Internet
kubectl
Worker node
Master node
kubelet
kube-proxy
Pod
Pod
docker
API server
controller-manager
(replication, namespace,
serviceaccounts, ...)
scheduler
Worker node
kubelet
kube-proxy
Pod
Pod
docker
etcd

Saga



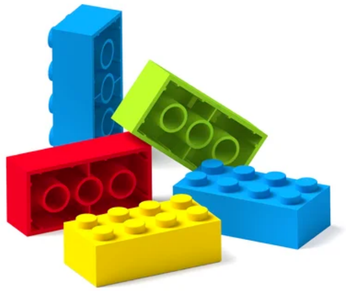
The Context

- We require distributed transactions across through events
- A transaction is a single unit of logic or work, sometimes made up of multiple operations.
- Within a transaction, an event is a state change that occurs to an entity, and a command encapsulates all information needed to perform an action or trigger a later event.
- Transactions must be atomic, consistent, isolated, and durable (ACID). Transactions within a single service are ACID, but cross-service data consistency requires a cross-service transaction management strategy.

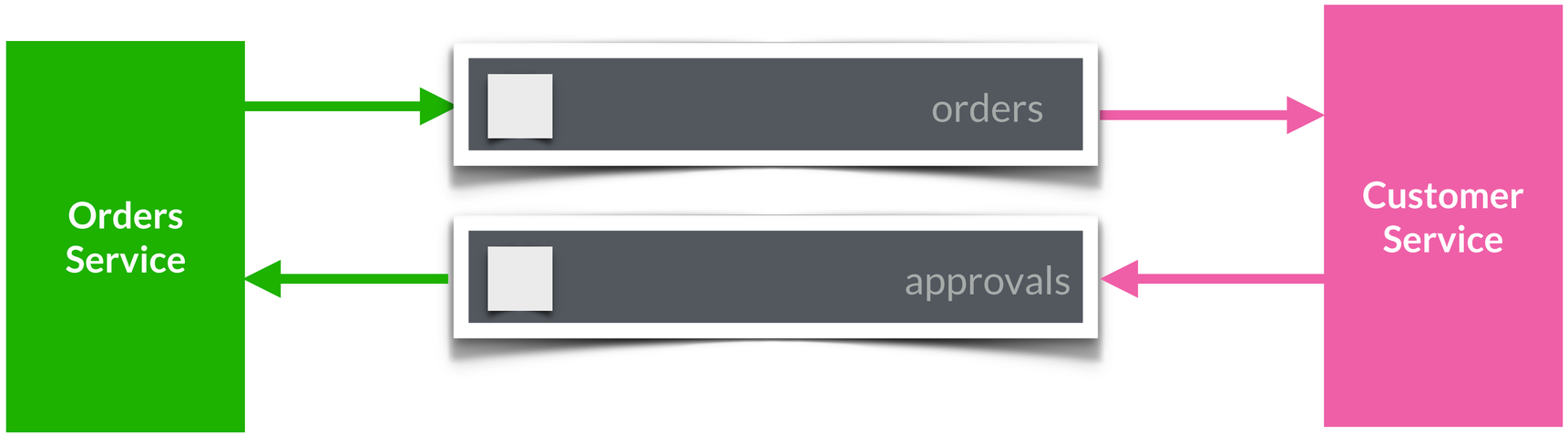


ACID Transactions

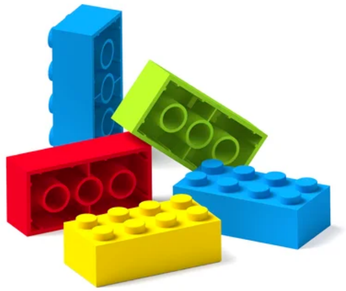
- **Atomicity** is an indivisible and irreducible set of operations that must all occur or none occur.
- **Consistency** means the transaction brings the data only from one valid state to another valid state.
- **Isolation** guarantees that concurrent transactions produce the same data state that sequentially executed transactions would have produced.
- **Durability** ensures that committed transactions remain committed even in case of system failure or power outage.



The Diagram

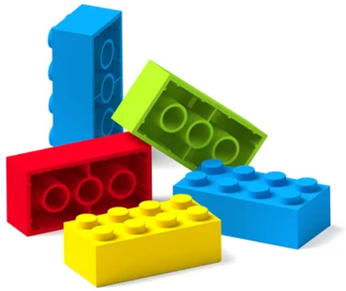


Choreography based pattern

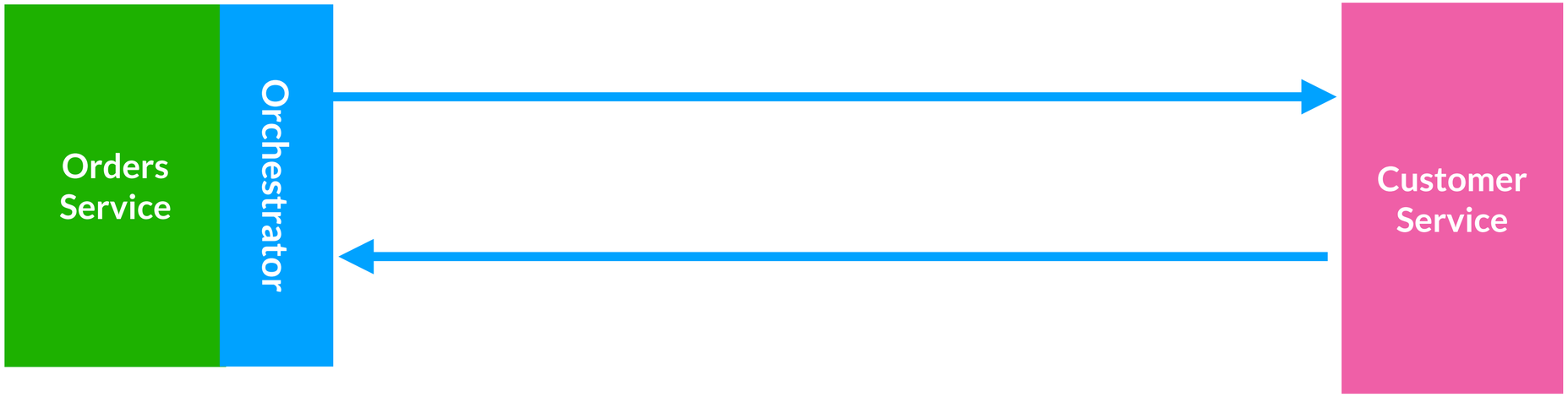


The Diagram

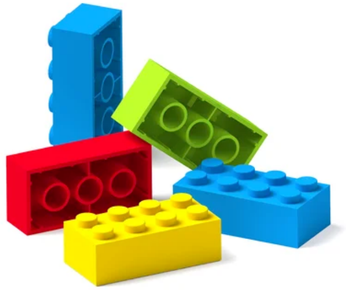
Orchestrator based pattern where state of the transaction is owned by a service



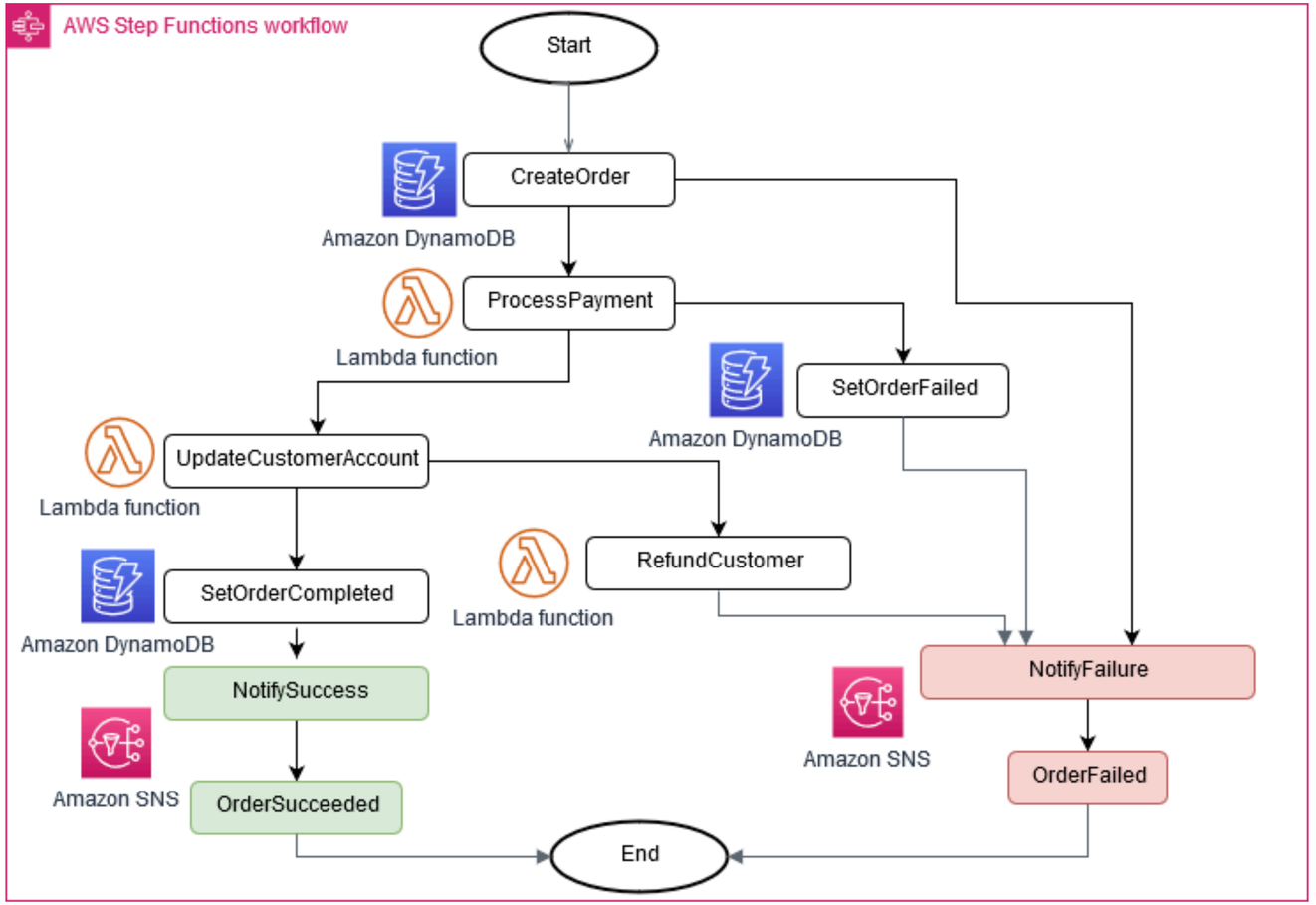
The Diagram



The point-to-point is performed by the orchestrator and aggregation is also done by the orchestrator



The Diagram



https://docs.aws.amazon.com/prescriptive-guidance/latest/modernization-data-persistence/saga-pattern.html

Thank You

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