INNOVATE2018
ONLINE CONFERENCE
DEVELOPER EDITION

Data Design and Modeling for Microservices

John Streit, Sr Mgr Specialist Solution Architecture – Data & Analytics, EMEA | 2018

jostreit@amazon.com

@awscloud

#AWSInnovate

What to Expect from the Session

- Microservices at Amazon
  - Overview and Challenges
  - Key Elements and Benefits
  - Two Pizza Teams
- Data Architecture Challenges
  - Transactions and Rollbacks
  - Streams
  - Master Data Management
- Choosing a Data Store
- Aggregation

Microservices at Amazon

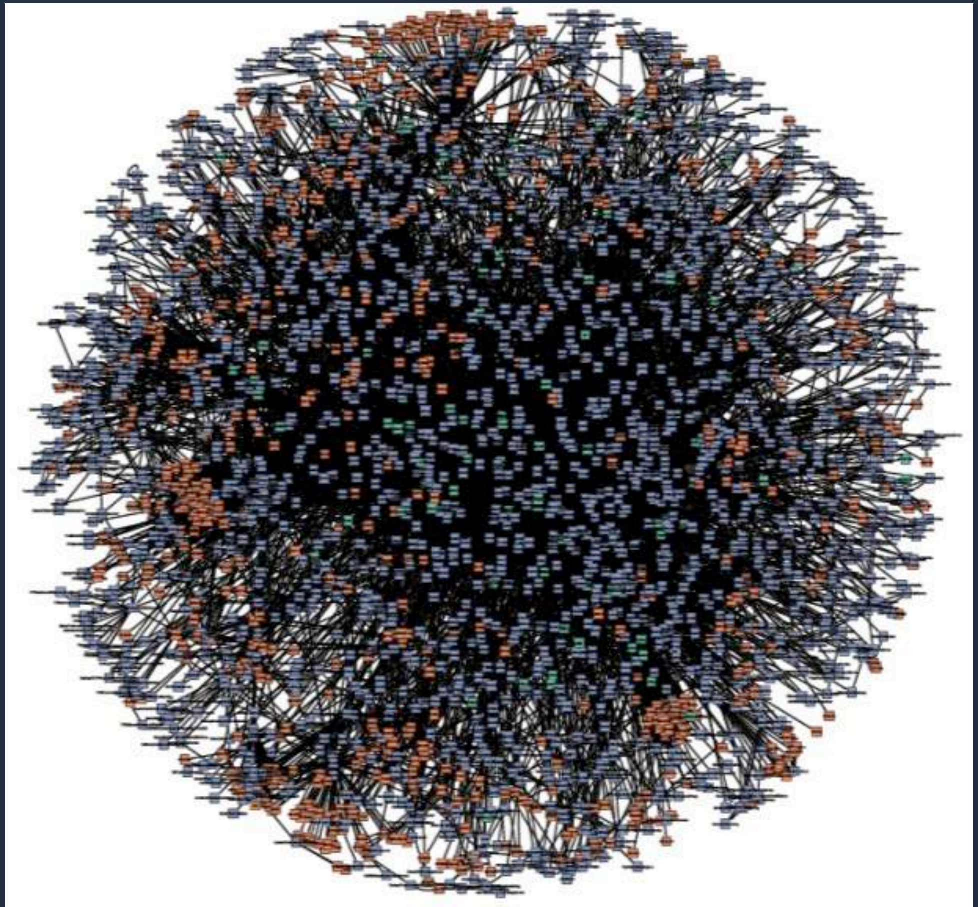
Service-Oriented Architecture (SOA)

Single-purpose

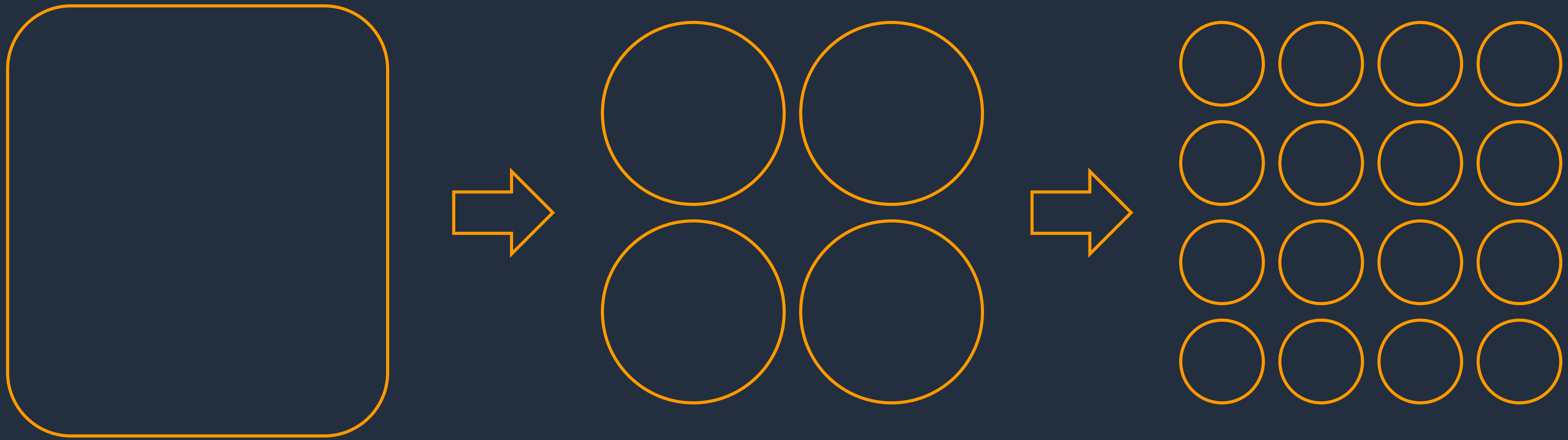
Connect only through APIs

Connect over HTTPS

“Microservices”



Monolithic vs. SOA vs. Microservices



Monolithic
Single Unit

SOA
Coarse-grained

Microservices
Fine-grained

Monolithic vs. SOA vs. Microservices

Microservices:

Many very small components

Business logic lives inside of single service domain

Simple wire protocols(HTTP with XML/JSON)

API driven with SDKs/Clients

SOA:

Fewer more sophisticated components

Business logic can live across domains

Enterprise Service Bus like layers between services

Middleware

Microservice Challenges

Distributed computing is hard

Transactions

- Multiple Databases across multiple services

Eventual Consistency

Lots of moving parts

Service discovery

Increase coordination

Increase message routing

Key Elements of Microservices…

Some core concepts are common to all services

- Service registration, discovery, wiring, administration
- State management
- Service metadata
- Service versioning
- Caching

Low Friction Deployment

Automated Management and Monitoring

Key Elements of Microservices…

Eliminates any long-term commitment to a technology stack

Polyglot ecosystem

Polyglot persistence

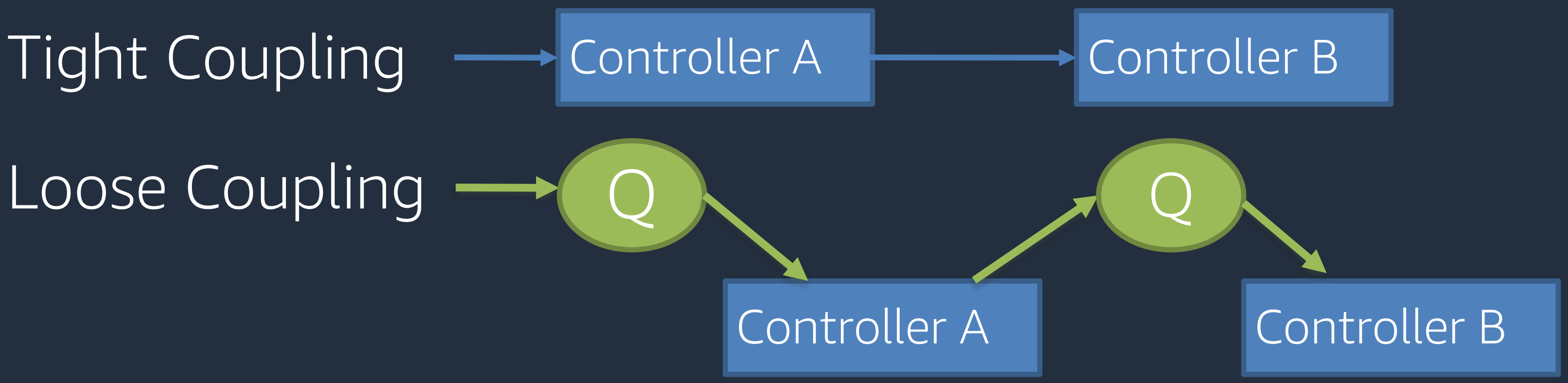
- Decompose Databases
- Database per microservice pattern

Allows easy use of Canary and Blue-Green deployments

Key Elements of Microservices…

Each microservice is:

- Elastic: scales up or down independently of other services
- Resilient: services provide fault isolation boundaries
- Composable: uniform APIs for each service
- Minimal: highly cohesive set of entities
- Complete: loosely coupled with other services



Microservices Benefits

Fast to develop

Rapid deployment

Parallel development & deployment

Closely integrated with DevOps

- Now "DevSecOps"

Improved scalability, availability & fault tolerance

More closely aligned to business domain

Principles of the Two Pizza Team

- Two-pizza teams
- Full ownership
- Full accountability
- Aligned incentives
- “DevOps”

How do Two Pizza Teams work?

We call them “Service teams”

Own the “primitives” they build:

- Product planning (roadmap)
- Development work
- Operational/Client support work

“You build it, you run it”

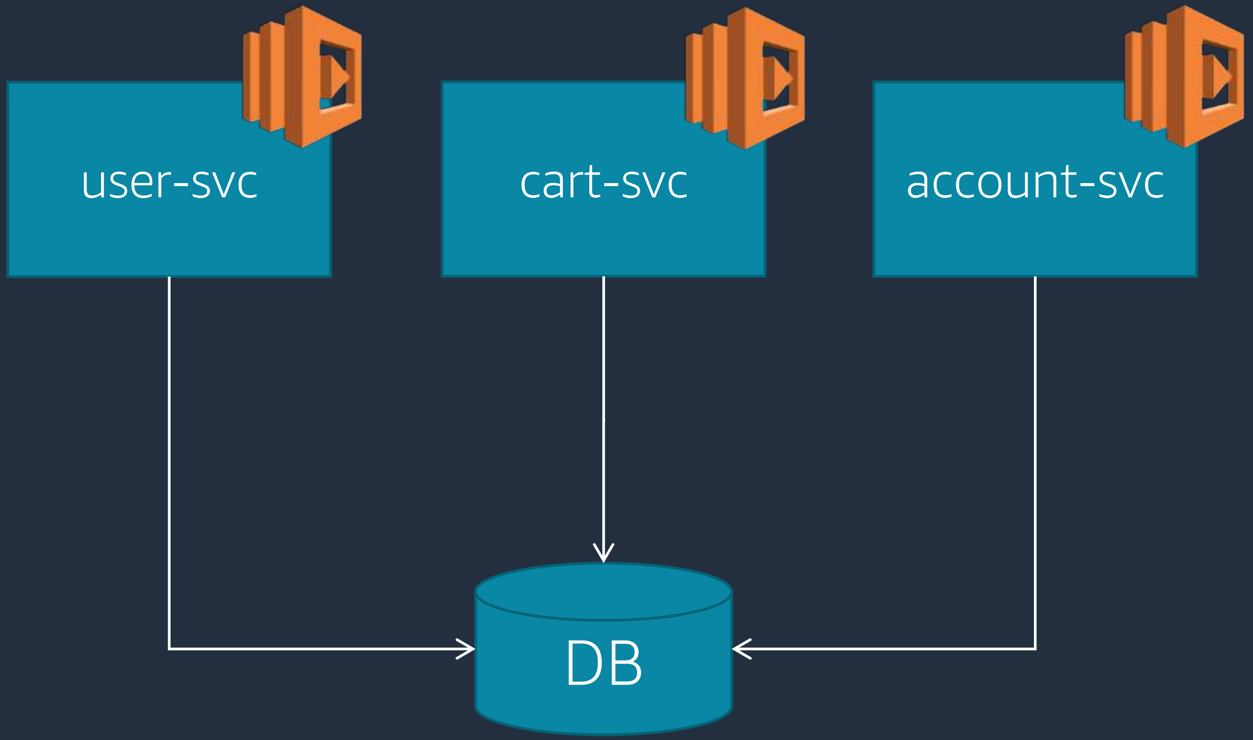
Part of a larger concentrated org (Amazon.com, AWS, Prime, etc)

Data Architecture Challenges

Challenge: Centralized Database

Applications often have a **monolithic** data store

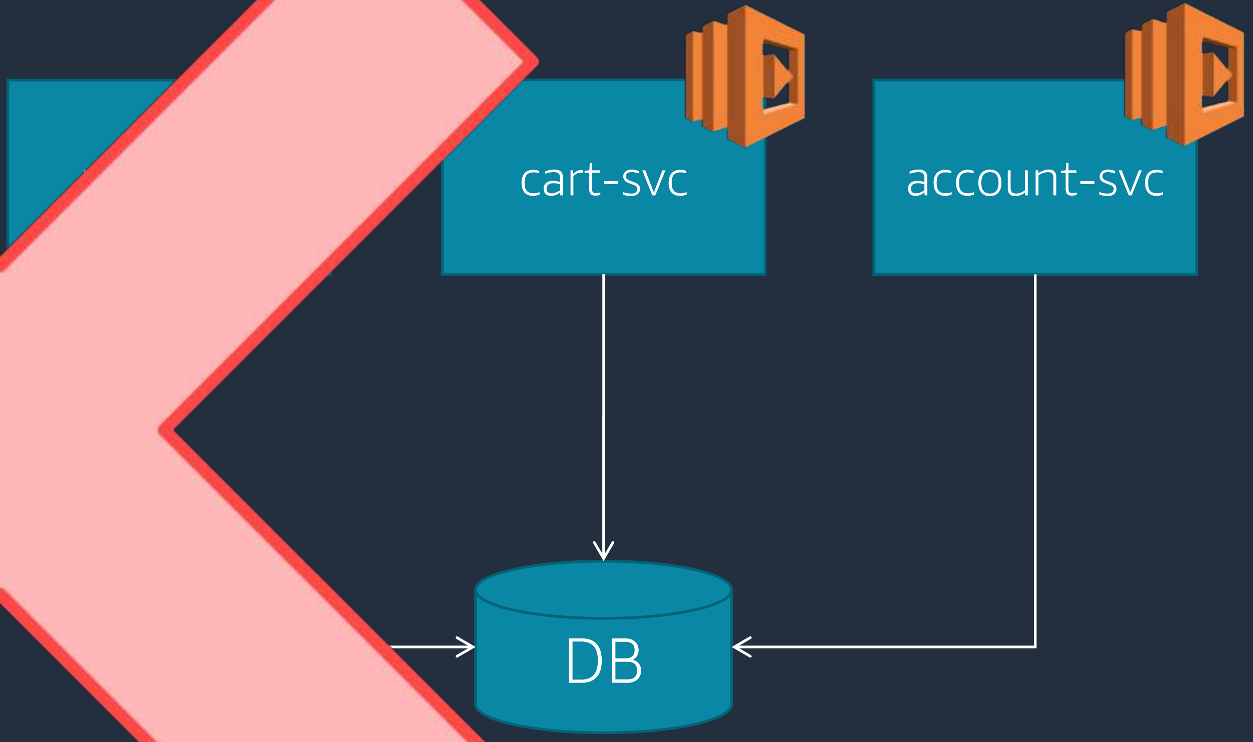
- Difficult to make schema changes
- Technology lock-in
- Vertical scaling
- Single point of failure



Centralized Database – Anti-pattern

Applications often
monolithic data stor

- Difficult to make schema changes
- Technology lock-in
- Vertical scaling
- Single point of failu



Decentralized Data Stores

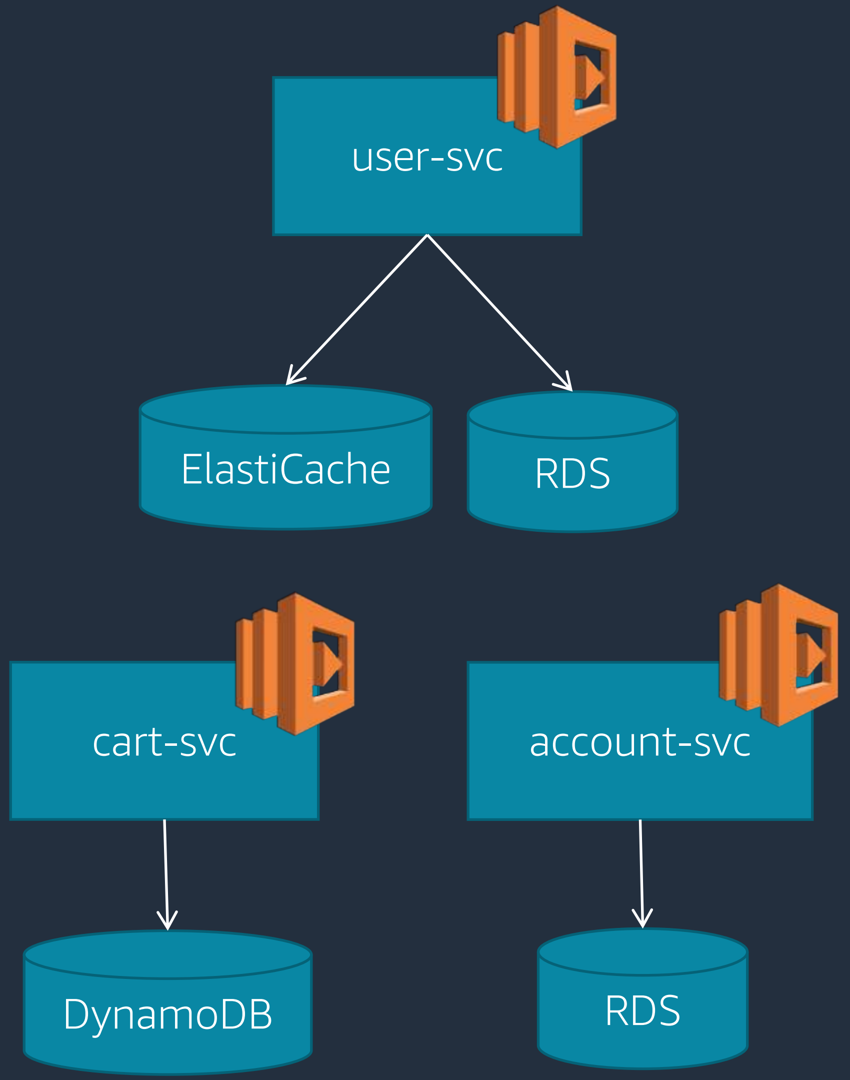
Polyglot Persistence

Each service chooses it's data store technology

Low impact schema changes

Independent scalability

Data is gated **through the service API**



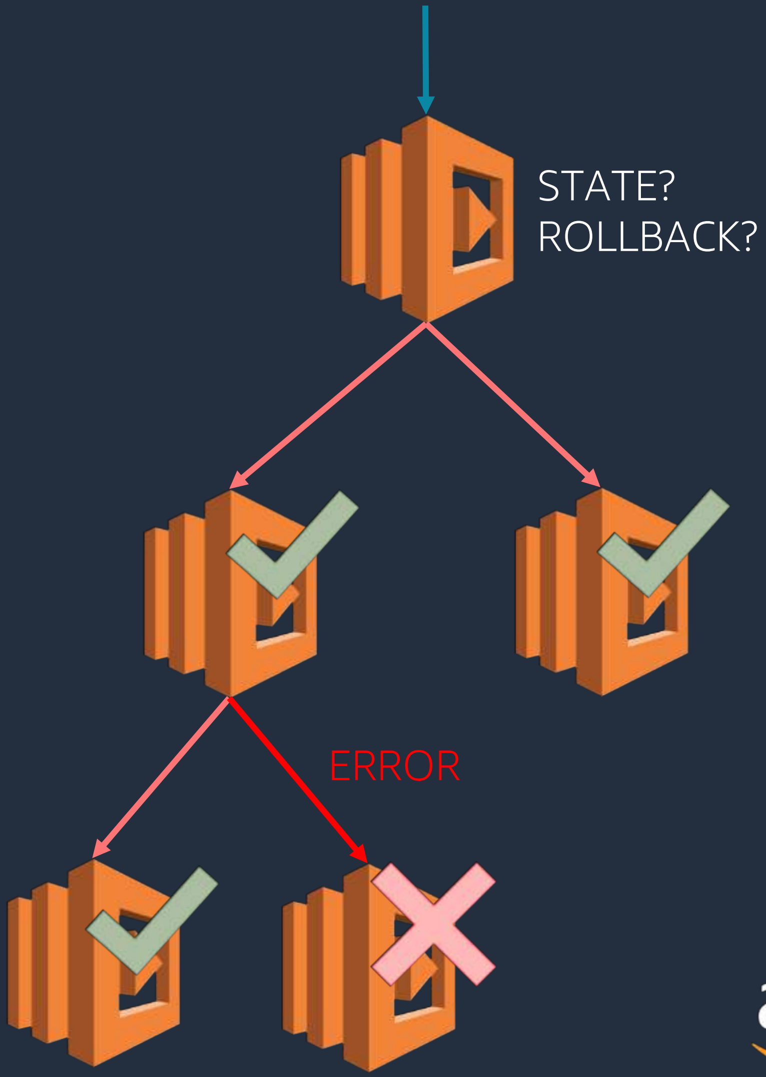
Challenge: Transactional Integrity

Polyglot persistence generally translates into **eventual consistency**

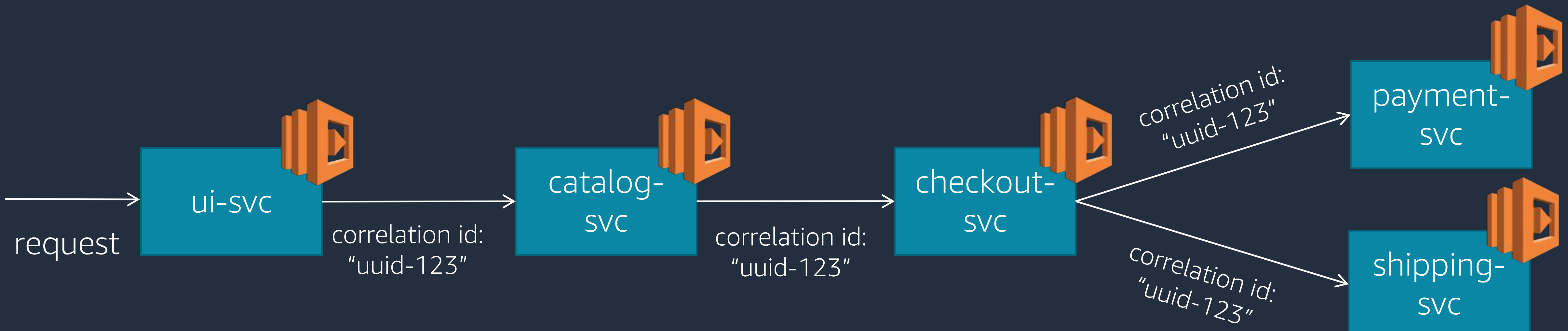
Asynchronous calls allow non-blocking, but returns need to be handled properly

How about **transactional integrity?**

- Event-sourcing – Capture changes as sequence of events
- Staged commit
- Rollback on failure



Best Practice: Use Correlation IDs


request
ui-svc
correlation id: "uuid-123"
catalog-svc
correlation id: "uuid-123"
checkout-svc
correlation id: "uuid-123"
payment-svc
correlation id: "uuid-123"
shipping-svc

```
09-02-2015 15:03:24 ui-svc INFO [uuid-123] ......
09-02-2015 15:03:25 catalog-svc INFO [uuid-123] ......
09-02-2015 15:03:26 checkout-svc ERROR [uuid-123] ......
09-02-2015 15:03:27 payment-svc INFO [uuid-123] ......
09-02-2015 15:03:27 shipping-svc INFO [uuid-123] ......
```

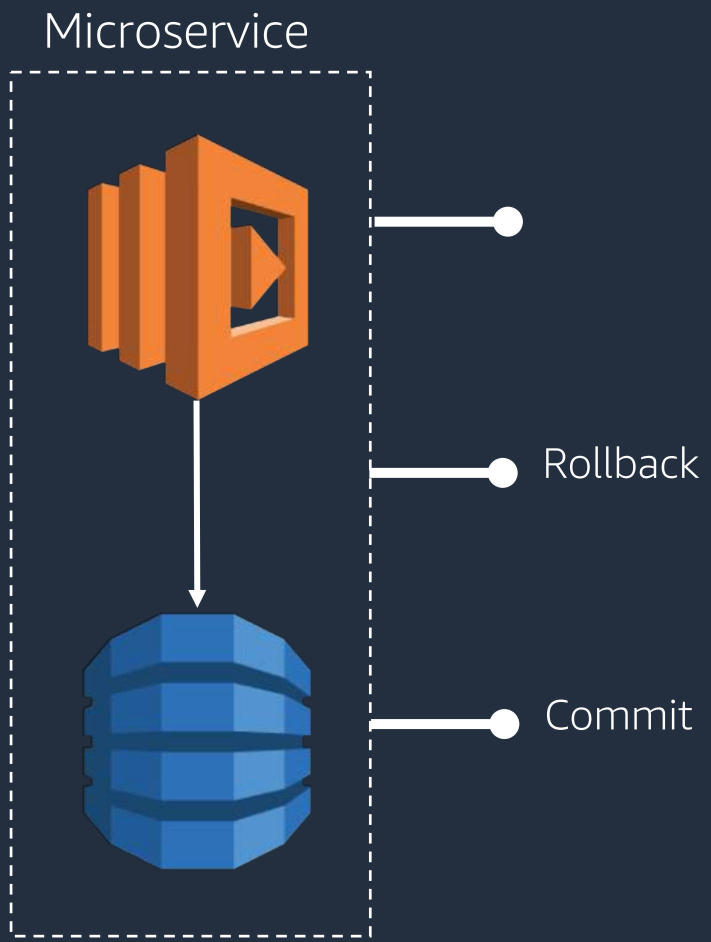
Best Practice: Microservice owns Rollback

Every microservice should expose it's own "rollback" method

This method could just **rollback** changes, or trigger **subsequent actions**

- Could send a notification

If you implement **staged commit,** also expose a commit function

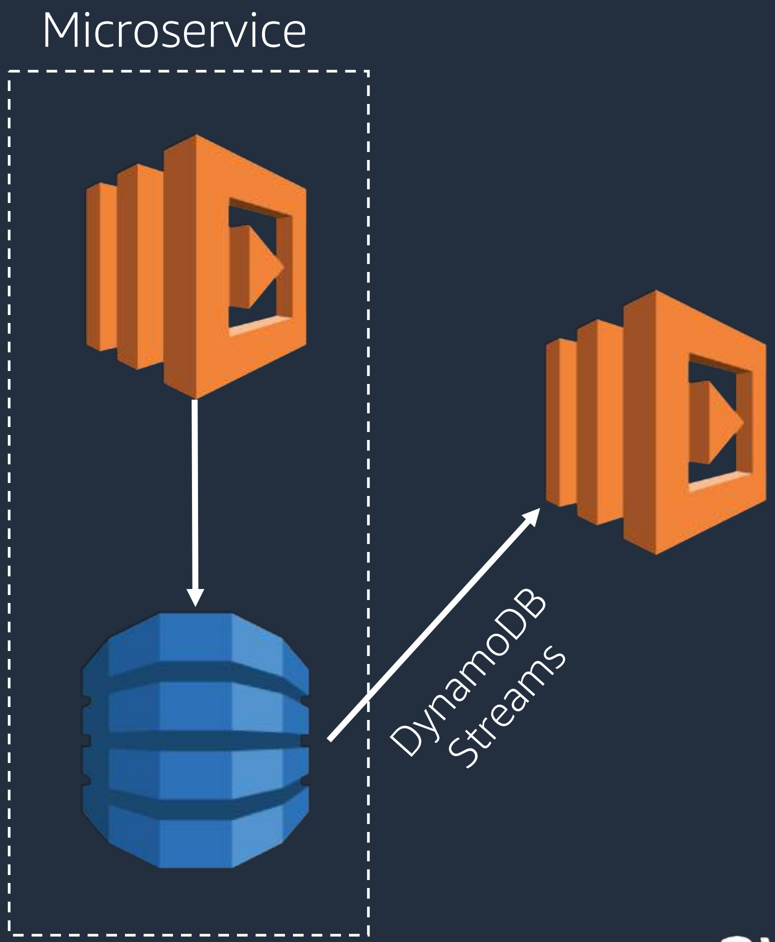


Event-Driven: DynamoDB Streams

If async, consider event-driven approach with **DynamoDB Streams**

Don’t need to manage function execution failure, DDB Streams **automatically retries** until successful

“Attach” yourself to the data of interest



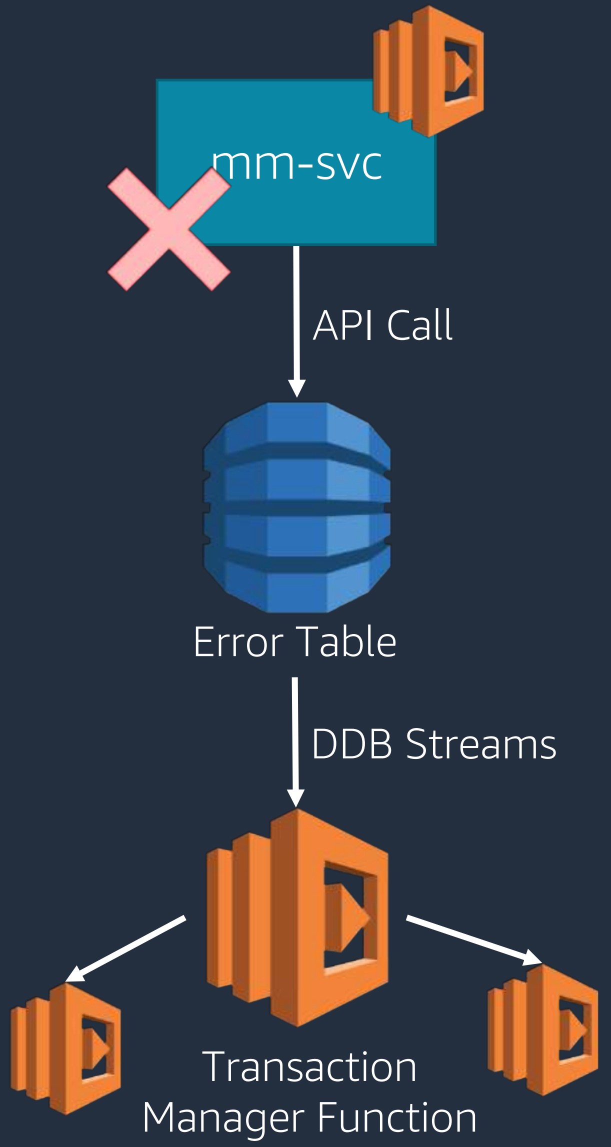
Challenge: Report Errors / Rollback

What if functions fail? (business logic failure, not code failure)

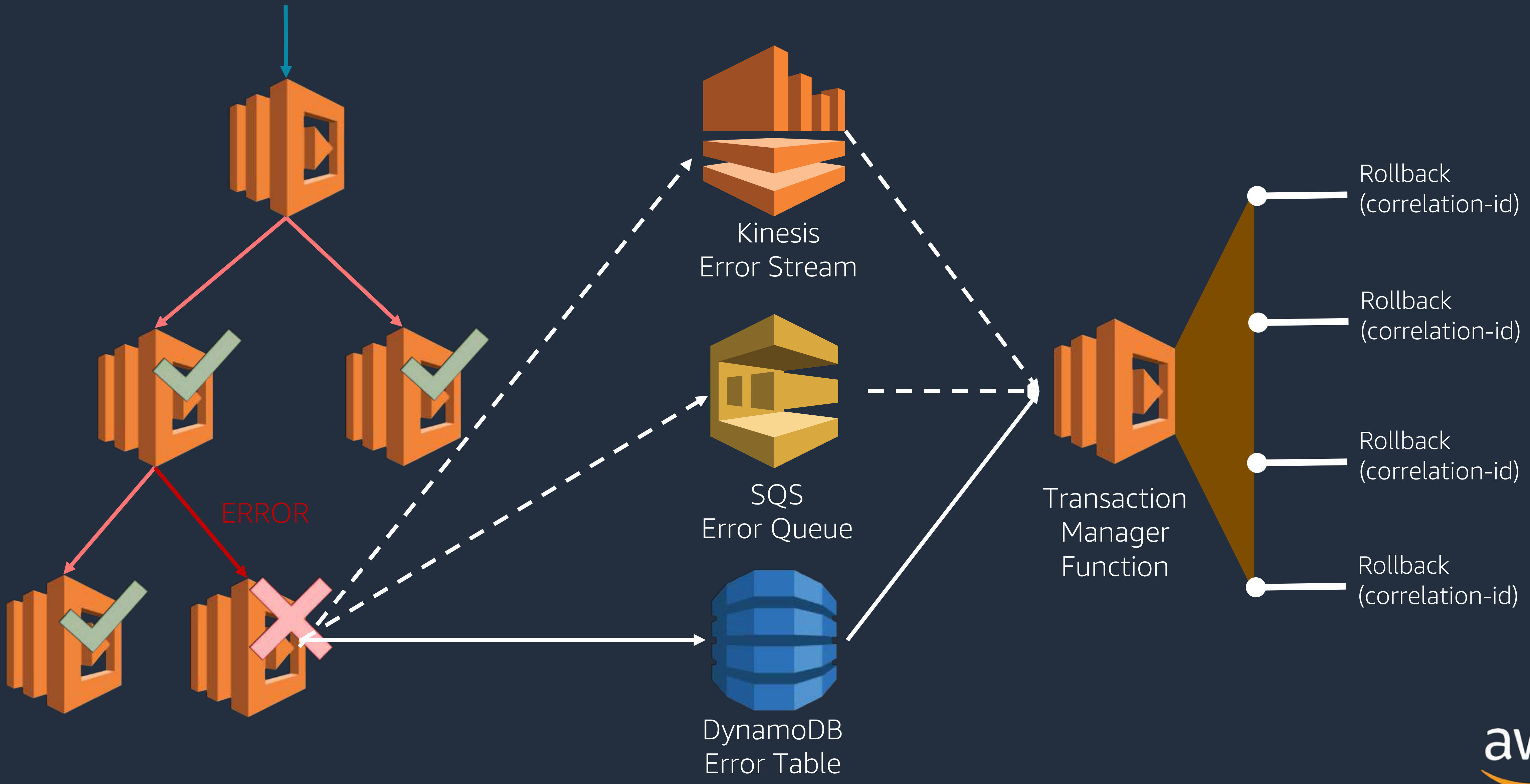
Create a **“Transaction Manager”** microservice that notifies all relevant microservices to rollback or take action

DynamoDB is the **trigger** for the clean-up function (could be SQS, Kinesis etc.)

Use **Correlation ID** to identify relations



Challenge: Report Errors / Rollback

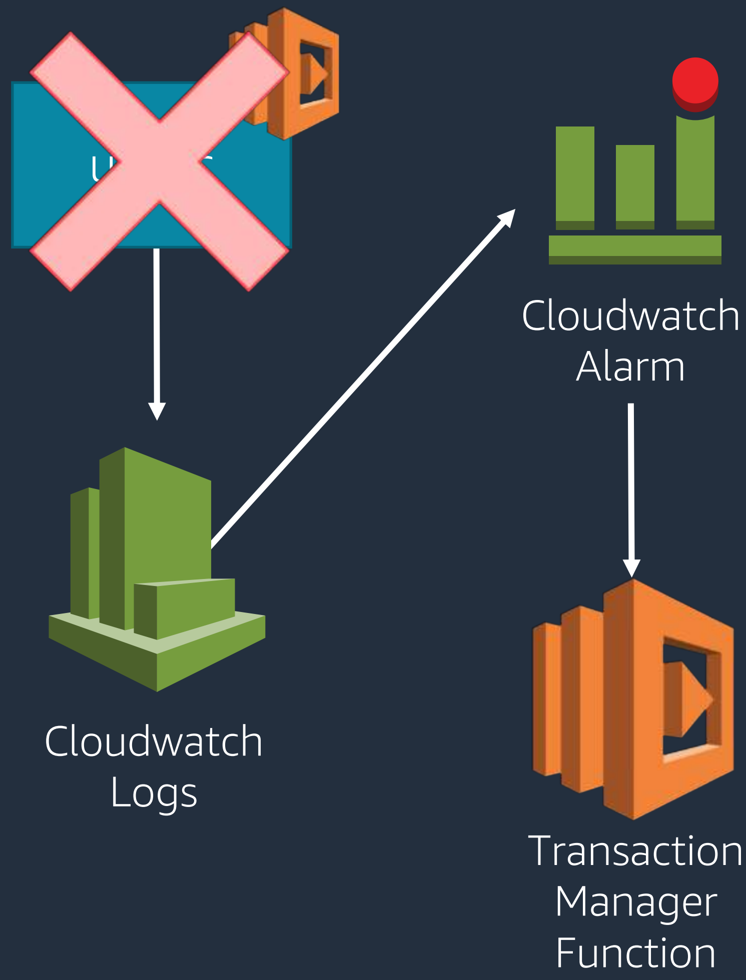


Challenge: Code Error

Lambda Execution Error because of **faulty code**

Leverage **Cloudwatch Logs** to process error message and call Transaction Manager

Set **Cloudwatch Logs Metric Filter** to look for Error/Exception and call Lambda Handler upon Alarm state

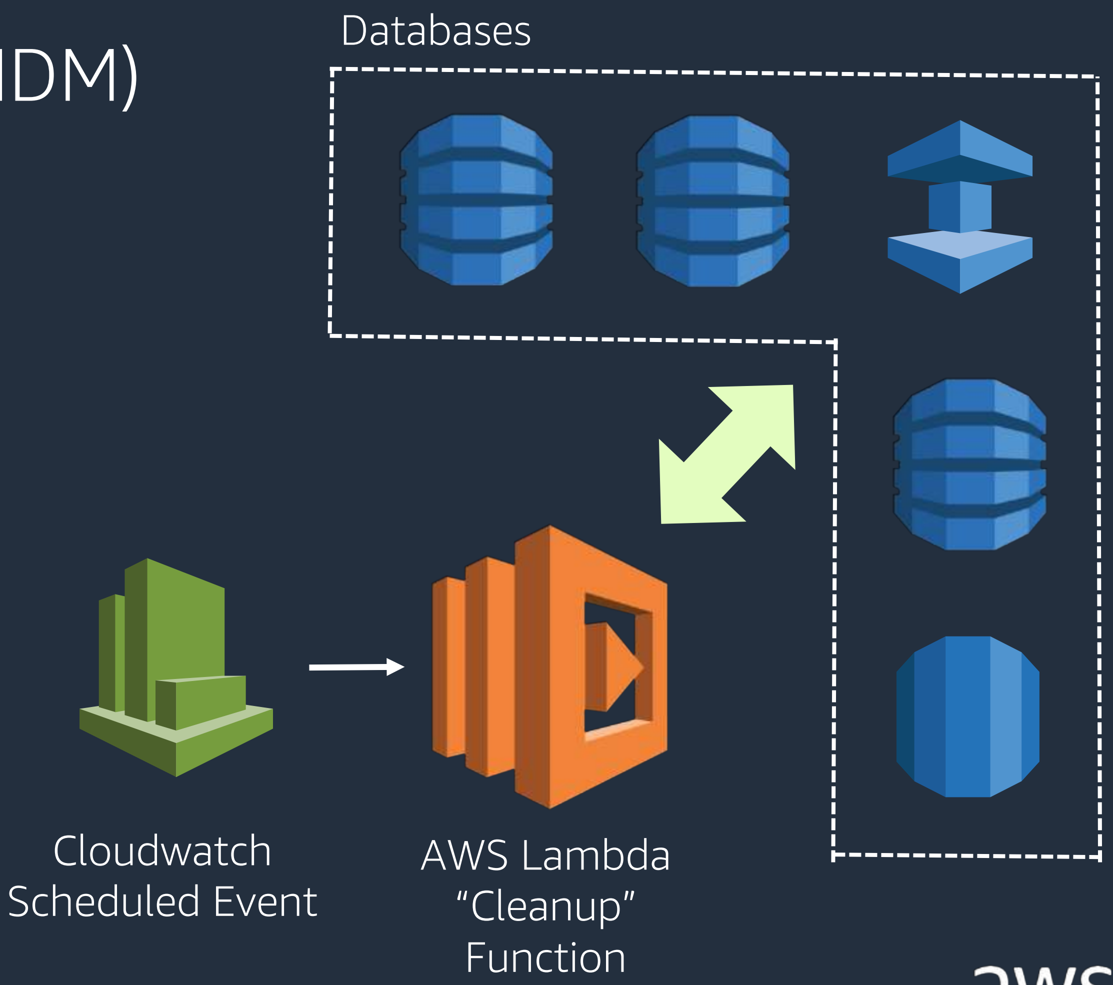


MDM – Keep Data Consistent

Perform **Master Data Management** (MDM) to keep data consistent

Create AWS Lambda function to **check consistencies** across microservices and "cleanup"

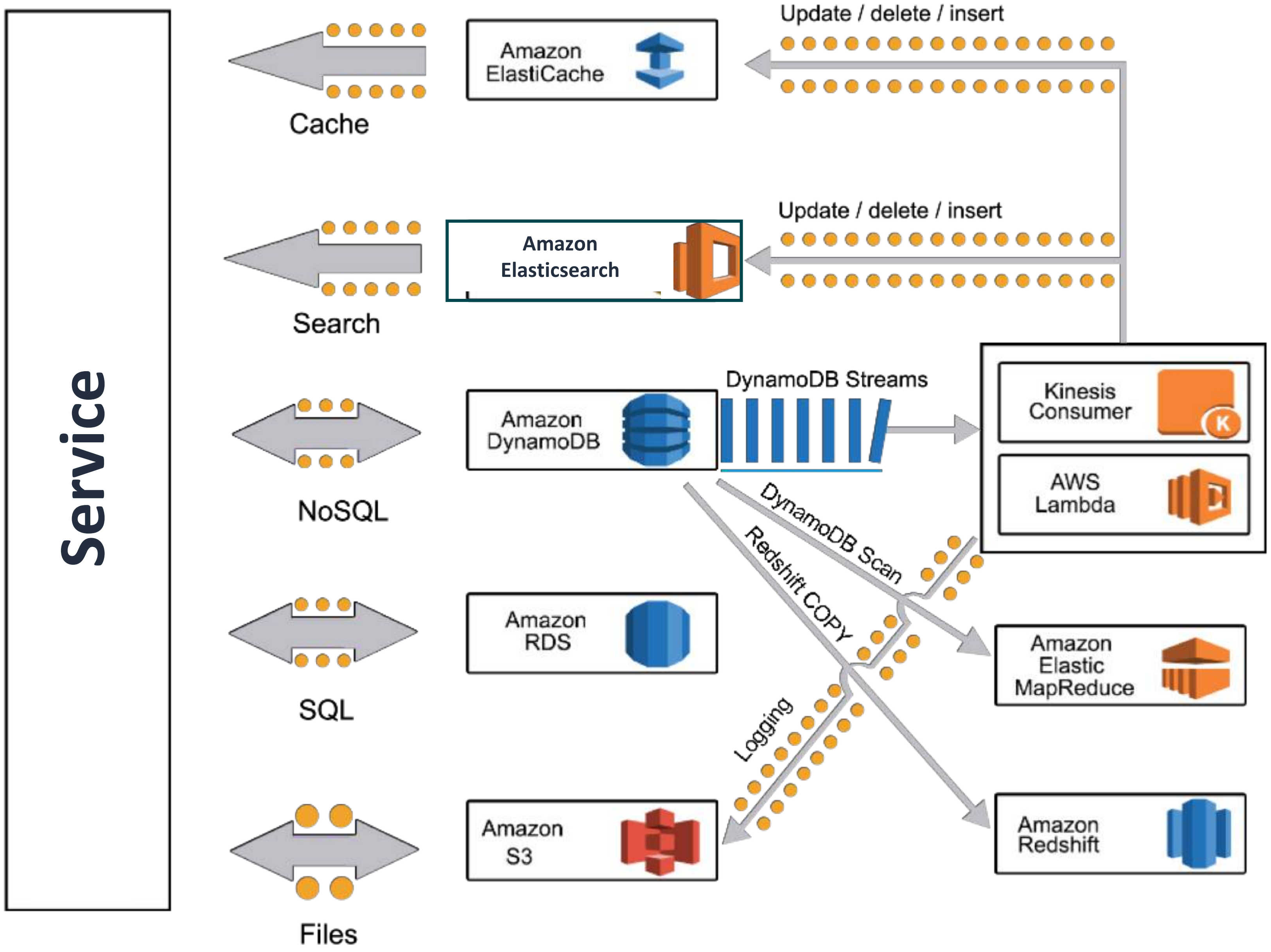
Create a **Cloudwatch Event** to schedule the function (e.g. hourly basis)



Choosing a Datastore

Storage & DB options in AWS

In-Memory	NoSQL	SQL	Graph	Object	Search	Streaming
Amazon ElastiCache	Amazon DynamoDB	Amazon RDS Amazon Redshift	Amazon Neptune	Amazon S3 Amazon Glacier	Amazon Elasticsearch Service	Amazon Kinesis


Service
Update / delete / insert
Amazon ElastiCache
Cache
Update / delete / insert
Amazon Elasticsearch
Search
DynamoDB Streams
Amazon DynamoDB
Kinesis Consumer
AWS Lambda
NoSQL
DynamoDB Scan
Redshift COPY
Amazon RDS
SQL
Amazon Elastic MapReduce
Logging
Amazon S3
Files
Amazon Redshift

Challenge: What Service to Use?

- Many problems can be solved with NoSQL, RDBMS or even in-memory cache technologies
- Non-functional requirements can help identify appropriate services
- **Solution:** Classify your organizations non-functional requirements and map them to service capabilities

Determine Your Non-Functional Requirements

This is only an example. Your company's classifications will be different

Requirement				
Latency	> 1s	200 ms -1s	20 ms – 200 ms	< 20 ms
Durability	99.99	99.999	99.9999	> 99.9999
Storage Scale	< 256 GB	256 GB – 1 TB	1 TB – 16 TB	> 16 TB
Availability	99	99.9	99.95	> 99.95
Data Class	Public	Important	Secret	Top Secret
Recoverability	12 – 24 hours	1 – 12 hours	5 mins – 1 hour	< 5 mins
Skills	None	Average	Good	Expert

There will be other requirements such as regulatory compliance.

Map Non-Functional Requirements to Services

The information below is not exact and does not represent SLAs

Service	Latency	Durability	Storage	Availability	Recoverability from AZ Failure (RPO, RTO)
RDS	< 100 ms	> 99.8 (EBS)	16 TB	99.95	0s and 90s (MAZ)
Aurora	< 100 ms	> 99.9	64 TB	> 99.95	0s and < 30s (MAZ)
Aurora + ElastiCache	< 1 ms	> 99.9	64 TB	> 99.95	0s and < 30s (MAZ)
DynamoDB	< 10 ms	> 99.9	No Limit	> 99.99	0s and 0s
DynamoDB / DAX	< 1 ms	> 99.9	No Limit	> 99.99	0s and 0s
ElastiCache Redis	< 1 ms	N/A	3.5 TiB	99.95	0s and < 30s (MAZ)
Elasticsearch	< 200 ms	> 99.9	150 TB	99.95	0s and < 30s (Zone Aware)
S3	< 500 ms	99.999999999	No Limit	99.99	0s and 0s

Finalizing Your Data Store Choices

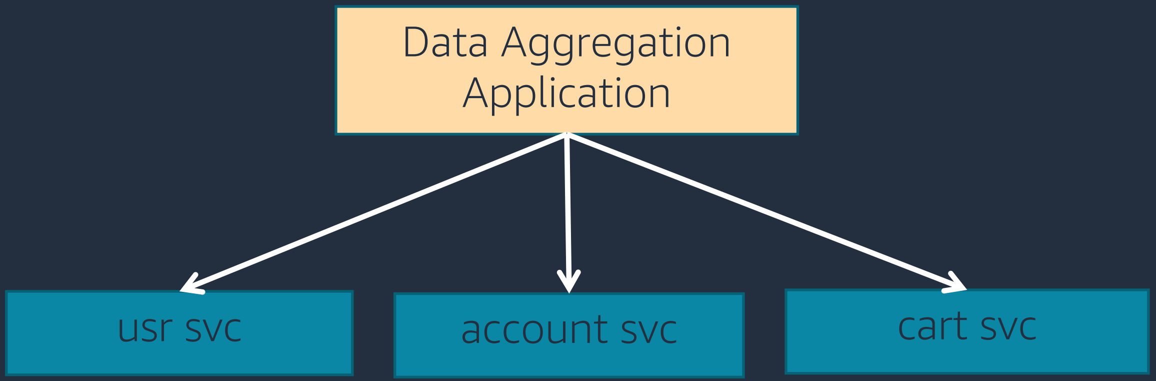
- After mapping your non-functional requirements to services you should have a short list to choose from
- Functional requirements such as geospatial data and query support will refine the list further
- You may institute standards to make data store selection simpler and also make it easier for people to move between teams, e.g Redis over Memcached and PostgreSQL over MySQL. These can still be overridden, but require justification to senior management

Challenge: Reporting and Analytics

- Data is now spread across a number of isolated polyglot data stores
- Consolidation and aggregation required
- **Solution:** Pull data from required microservices, push data to data aggregation service, use pub/sub. Don’t use a composite service (anti-pattern).

Aggregation

Pull model



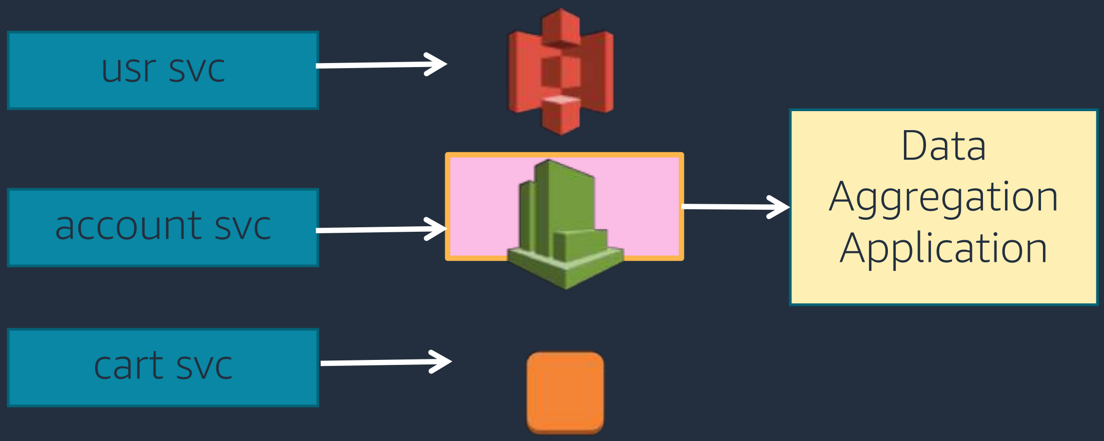
Data Aggregation Application

usr svc

account svc

cart svc

Push model



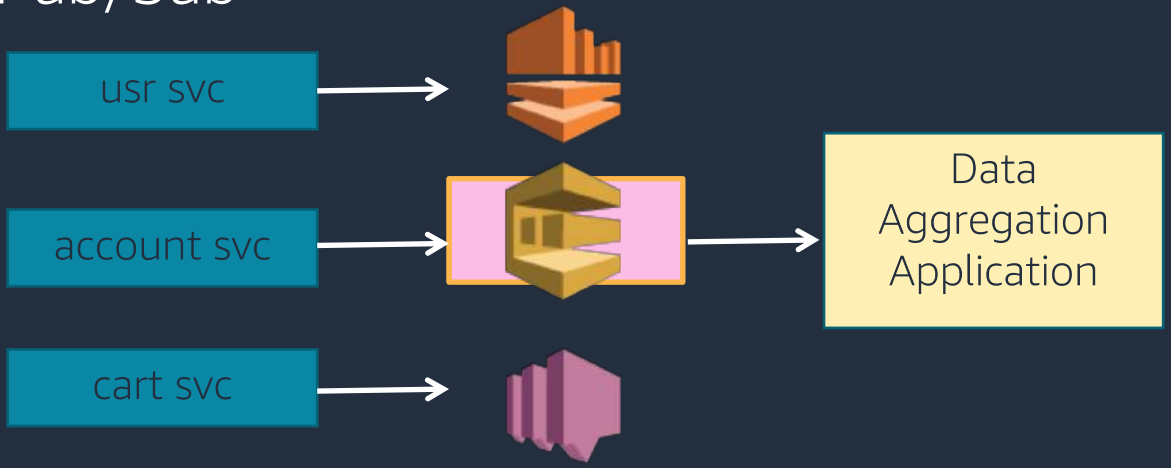
usr svc

account svc

cart svc

Data Aggregation Application

Pub/Sub



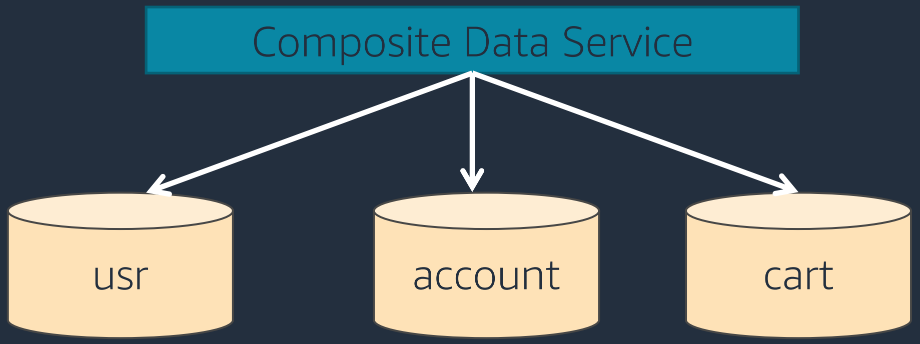
usr svc

account svc

cart svc

Data Aggregation Application

Composite



Composite Data Service

usr

account

cart

A Few Thoughts

- Use **Non-Functional Requirements** to help identify the right data store(s) for each microservice
- Use **polyglot persistence** to avoid bottlenecks, schema issues and allow independent scalability (and cache)
- Embrace **eventual consistency** and design fault-tolerant business processes which can recover
- Think ahead and plan your **analytics requirements** as part of the overall architecture

aws

INNOVATE 2018

ONLINE CONFERENCE

DEVELOPER EDITION

Thank you!

@awscloud

#AWSInnovate