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ARC411-R

# Reducing blast radius with cell-based architectures

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# Agenda

- Why cellular?
- Fundamental concepts:
  - Control plane vs. data plane
  - Cell properties; router properties
- AWS Well-Architected Framework
- Design tenets
- Customer use case
  - Architecture
  - Routing rules
- Key takeaways

# Cell-based architecture

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# Why cellular?

Contain the failures

Scale millions of TPS

Auto-healing

Pay for what you use

# What is a cell?

Fixed amount of resources


Well-defined function

No calling other cells

Will not expand

Diverse

# Fundamentals: Control plane and data plane

| Service | Control plane | Data plane |
|---|---|---|
| Amazon DynamoDB | DescribeTable API | Query API |
| Amazon EC2 | RunInstances API | A running EC2 instance |
| AWS Lambda | CreateFunction API | Invoke API |

- Control plane: administration of resources
- Data plane: usage of resources
- Separating control plane from data plane reduces blast radius

# Fundamentals: Service/system properties

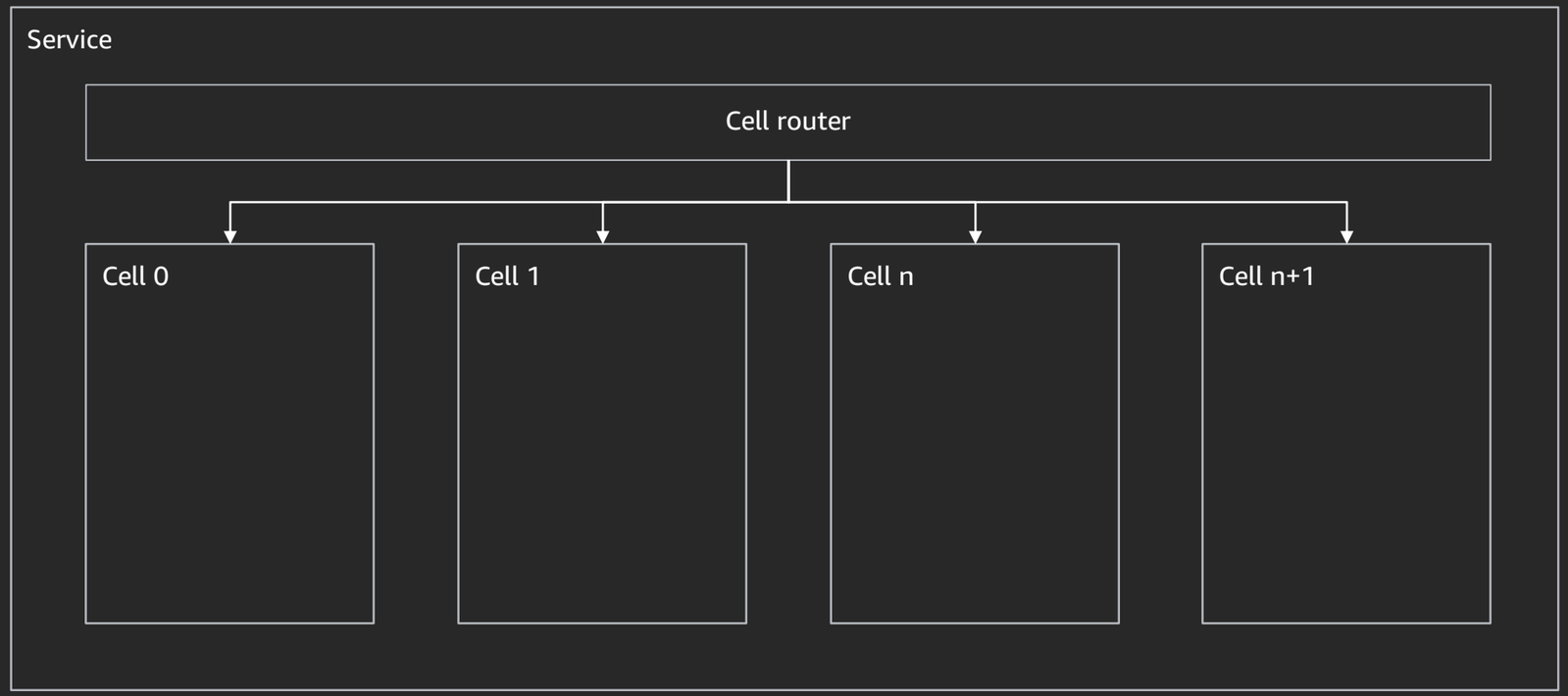
Workload isolation

Failure containment

Scale out versus scale up

Testability

Manageability



# Fundamentals: Small versus large cells

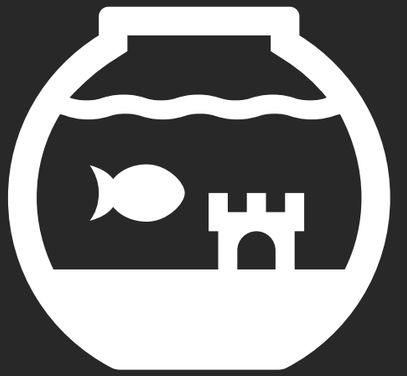
Smaller cells

- Reduced blast radius
- Easier to test
- Cells easier to operate

Larger cells

- Cost efficiency
- Reduced splits
- System easier to operate

versus



# Fundamentals: Router properties

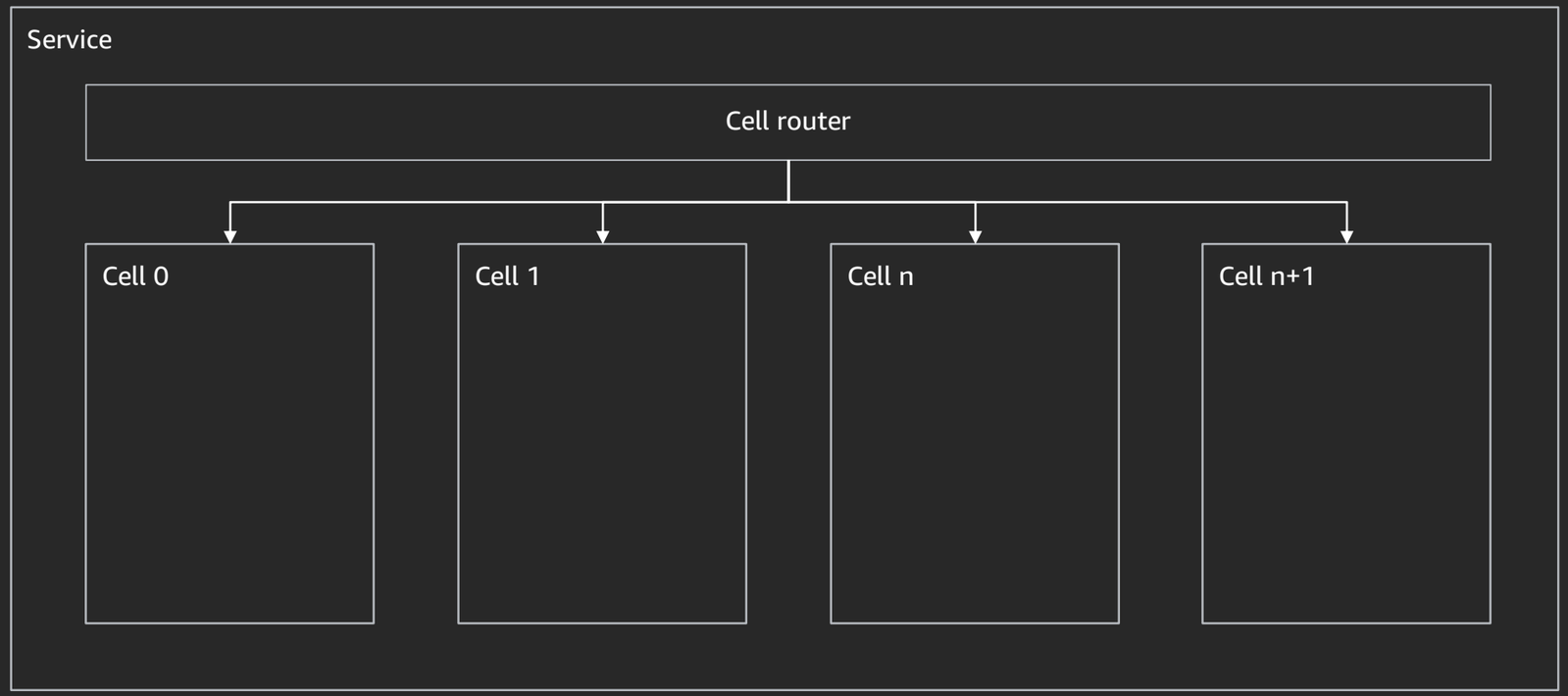
Routing policies

Stress testing

Battle hardening

Keep it simple!

“Thinnest possible layer”



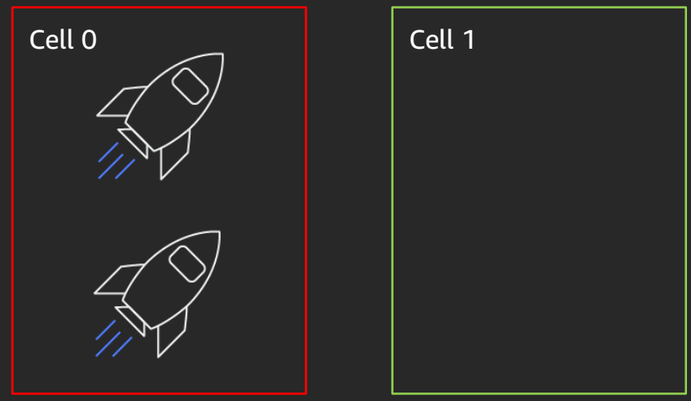
# Fundamentals: Cell State

Relocation of transactions

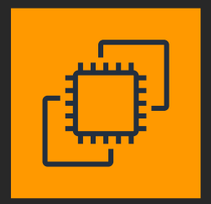
Driven by

- Heat management
- Size balancing
- Scale-out

Careful coordination between router and cells



# Zonal services versus serverless



Amazon Elastic Compute Cloud (Amazon EC2)

Amazon Elastic Block Store (Amazon EBS)

Amazon EMR

AWS CloudHSM

NAT gateway

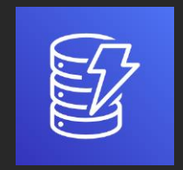
# Zonal services versus serverless

AWS Lambda

Amazon Elastic Kubernetes Service (Amazon EKS)

AWS Fargate

Amazon Aurora Serverless



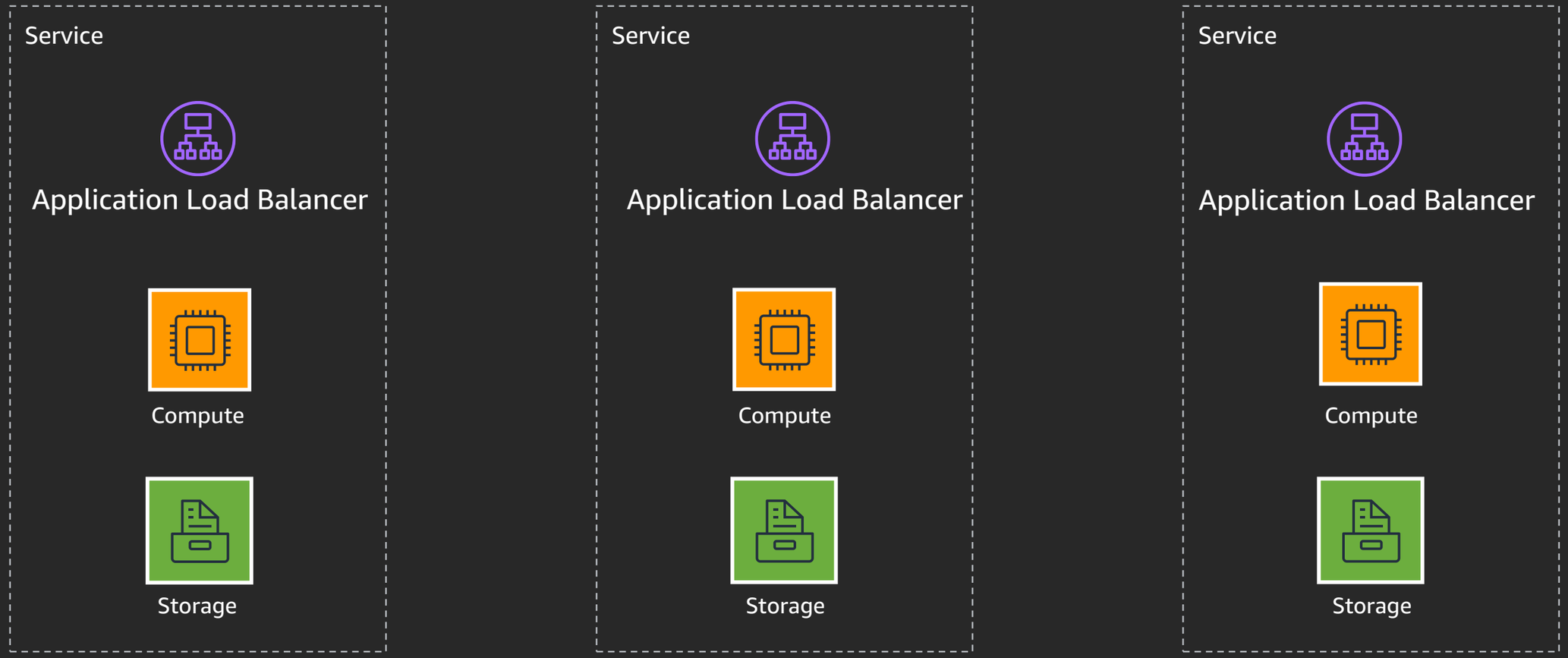
Amazon DynamoDB

Amazon Simple Storage Service (Amazon S3)

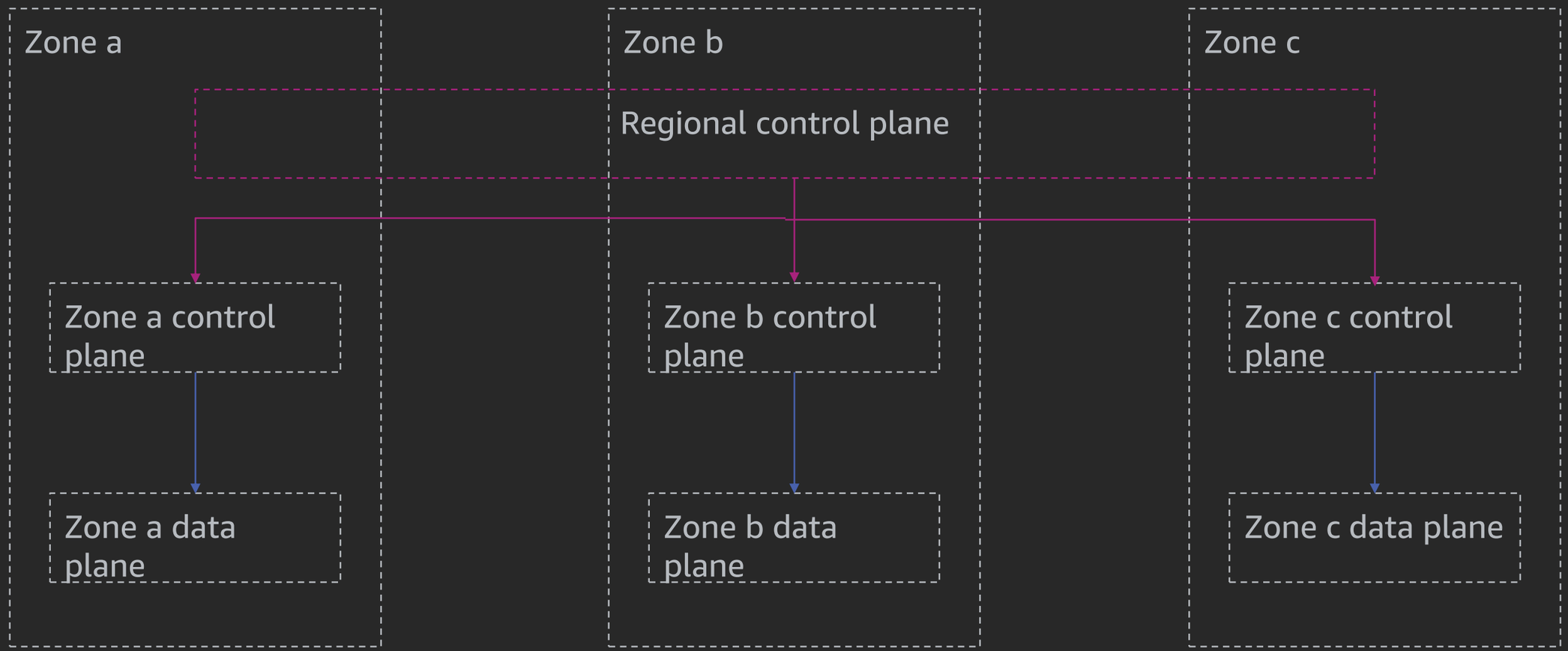
Elastic Load Balancing

Amazon Kinesis

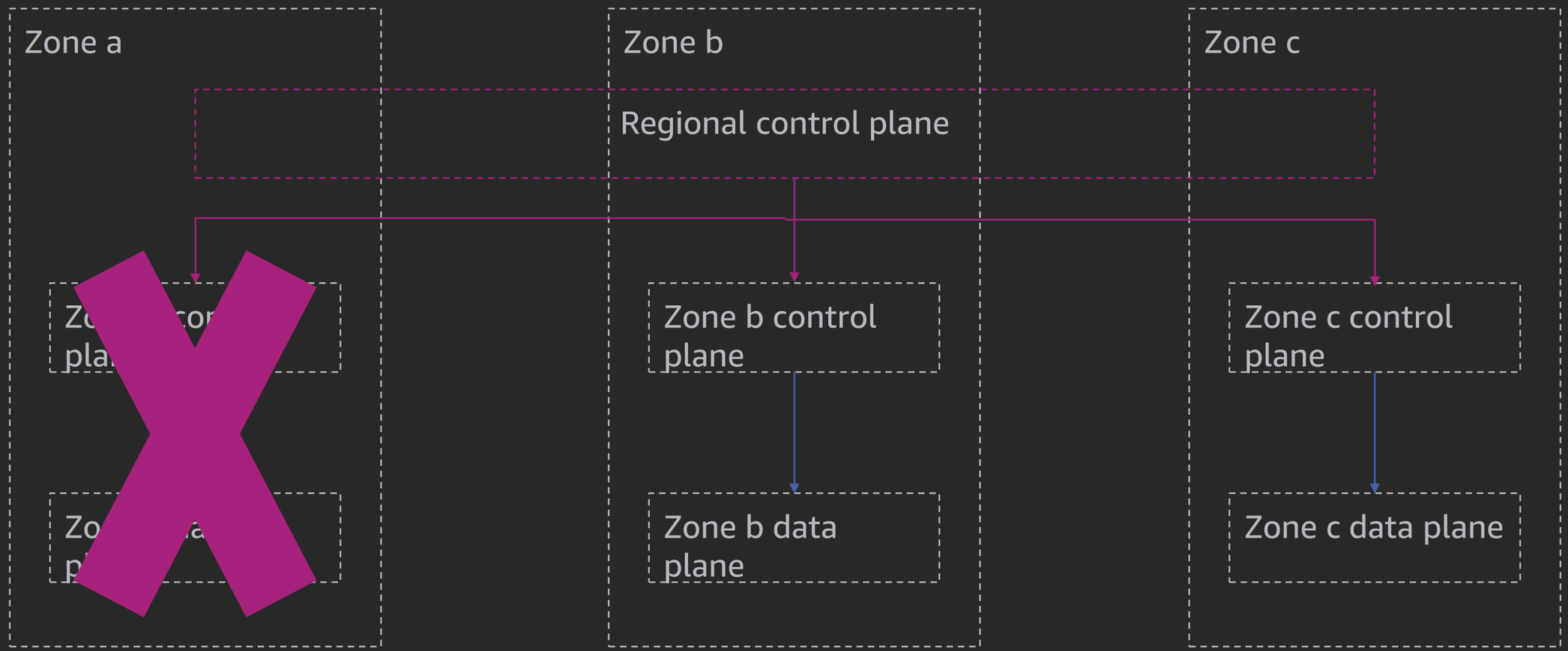
# Traditional service diagram



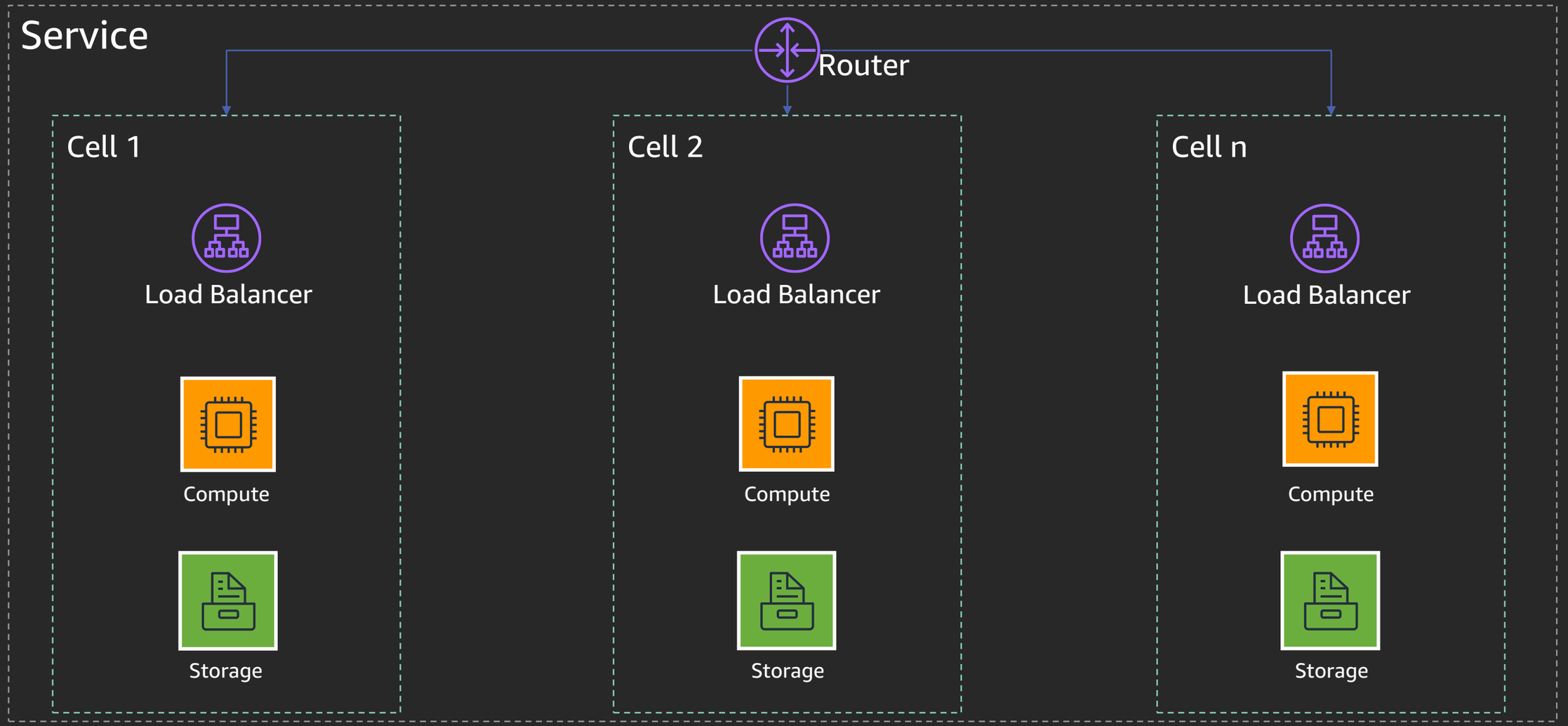
# Zone-based service diagram



# Availability Zone outage



# Cell-based service – AZ agnostic



# Well-Architected Framework

Operational excellence

Security

Reliability

Performance efficiency

Cost optimization

Review process

Consistent

Technology portfolio

# Customer use case

# Using the cellular principles

- Amazon.com, Information Security
- Conduit – AWS account management for internal services
- ASAP – Detect and remediate AWS infrastructure

# Security event data management system

Expanding platform scope to application logs

Real-time detection and remediation

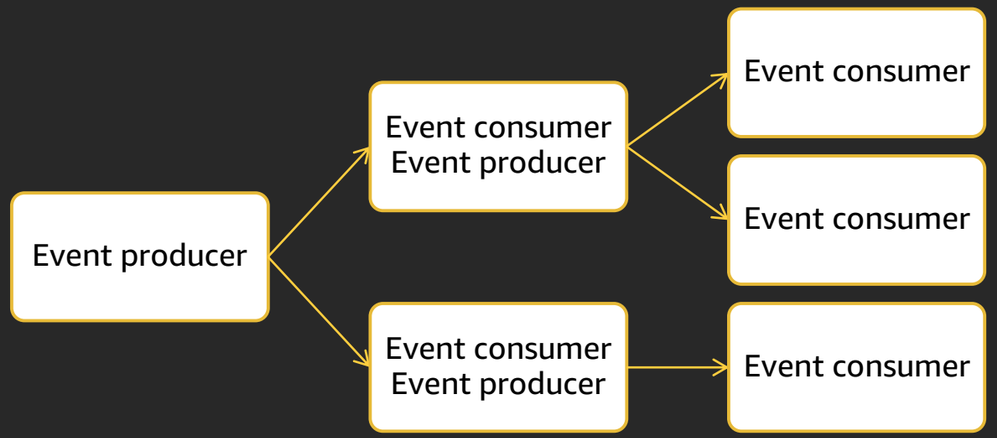
Faster security investigations

# Scale of data

- Growth of current AWS infrastructure
- Onboarding application logs for 75 new services by 2020
- 28 petabytes in 2019 to 90 petabytes in 2020

# Tenets

Minimize blast radius



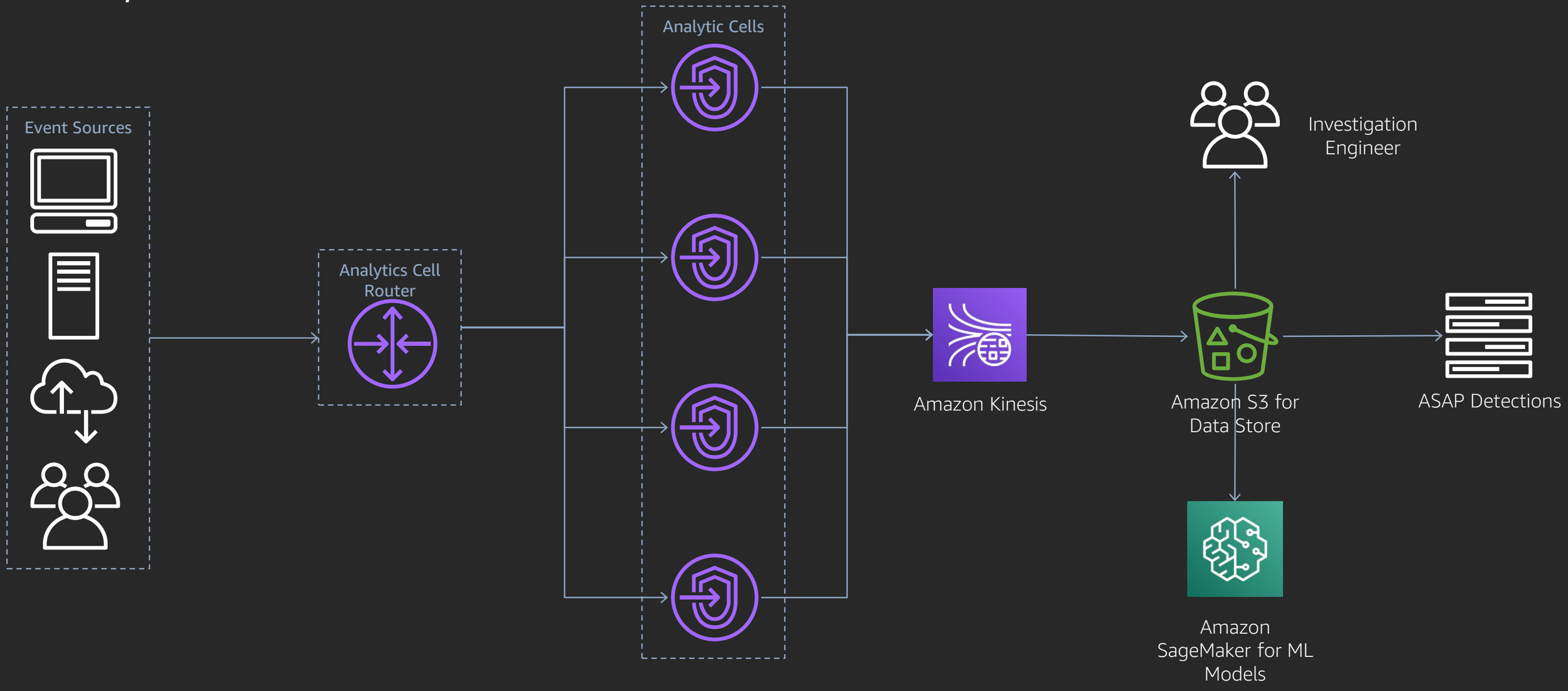

Event-driven architecture

# Tenets

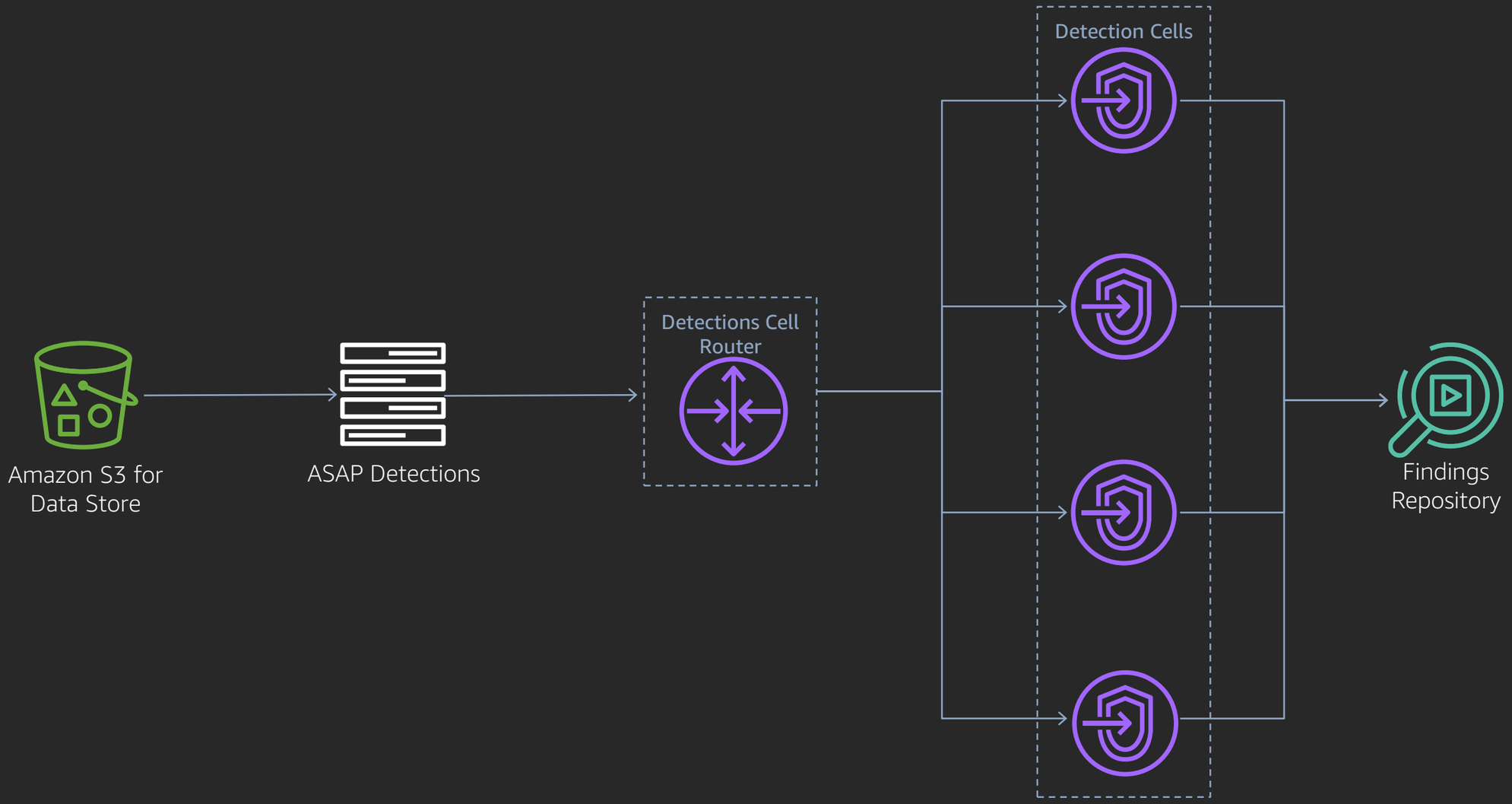
Serverless application

Infrastructure as code

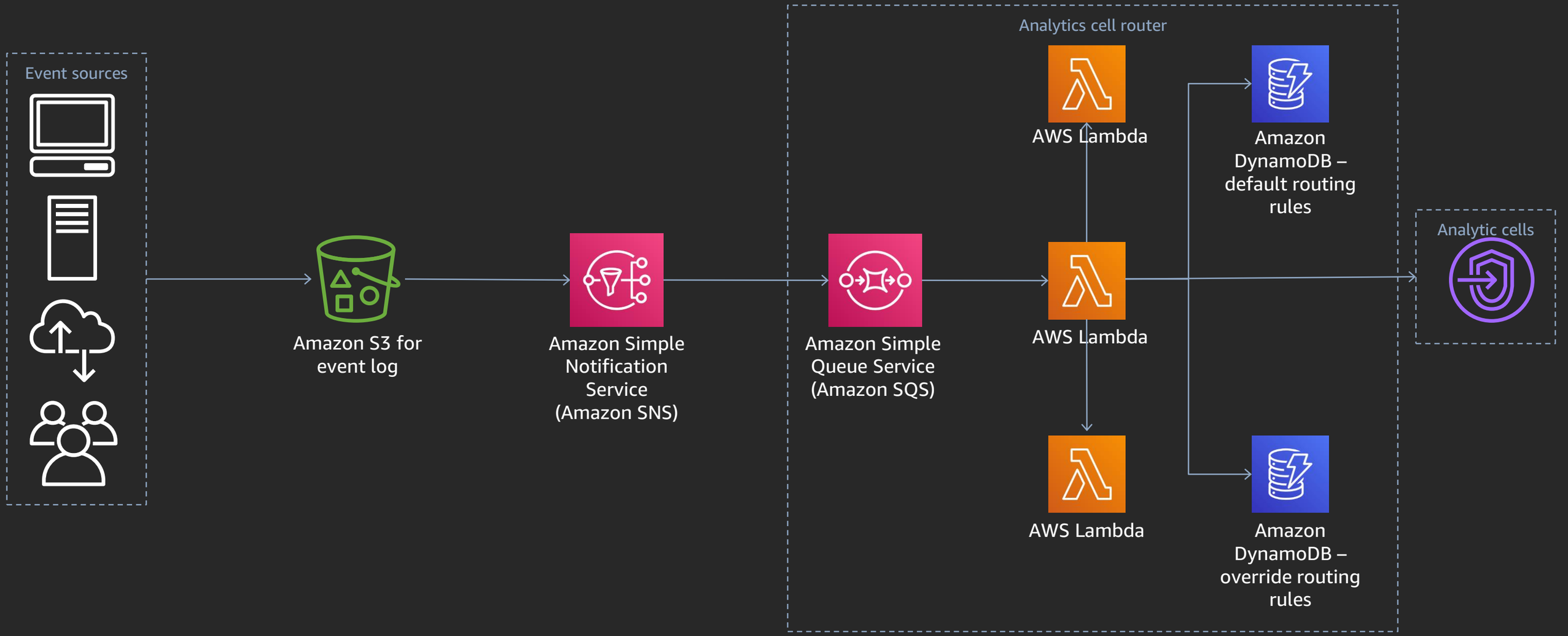
# 10,000-foot view



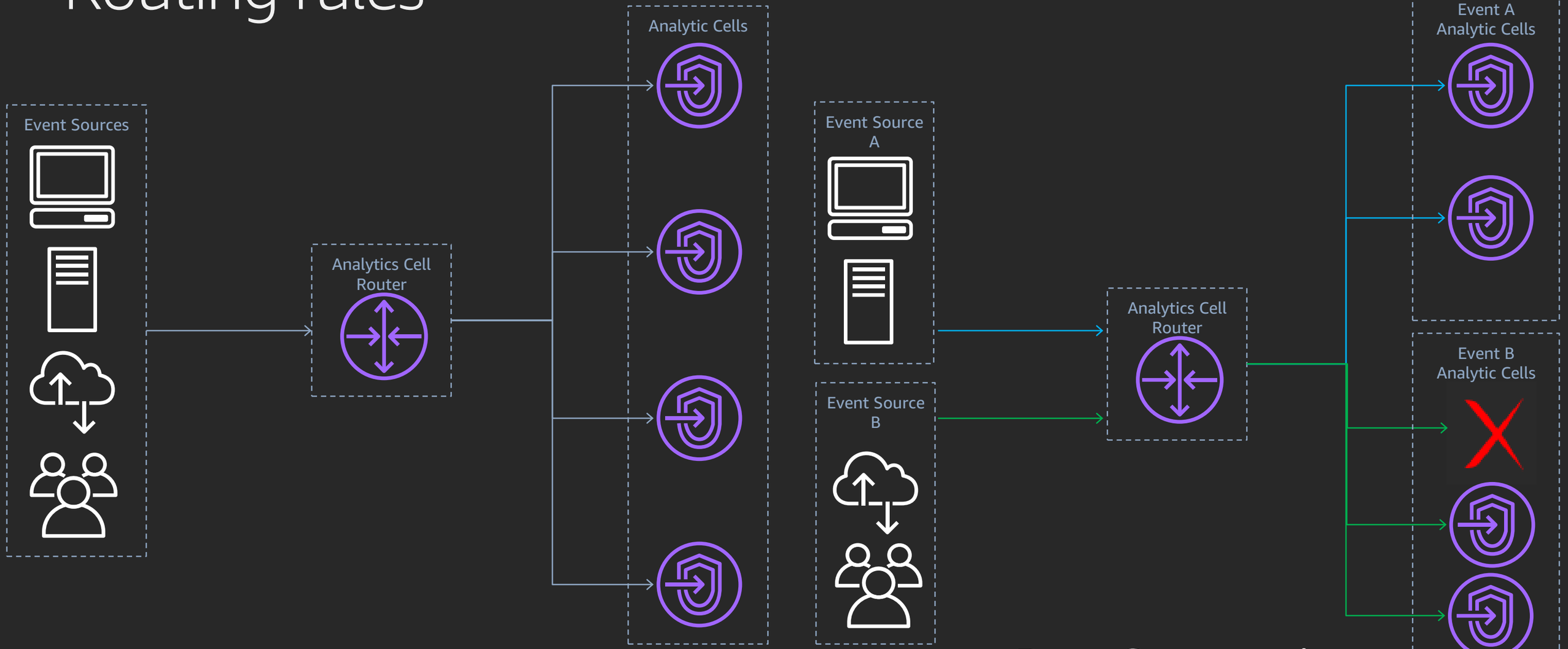
# Cellular design pattern



# Router architecture



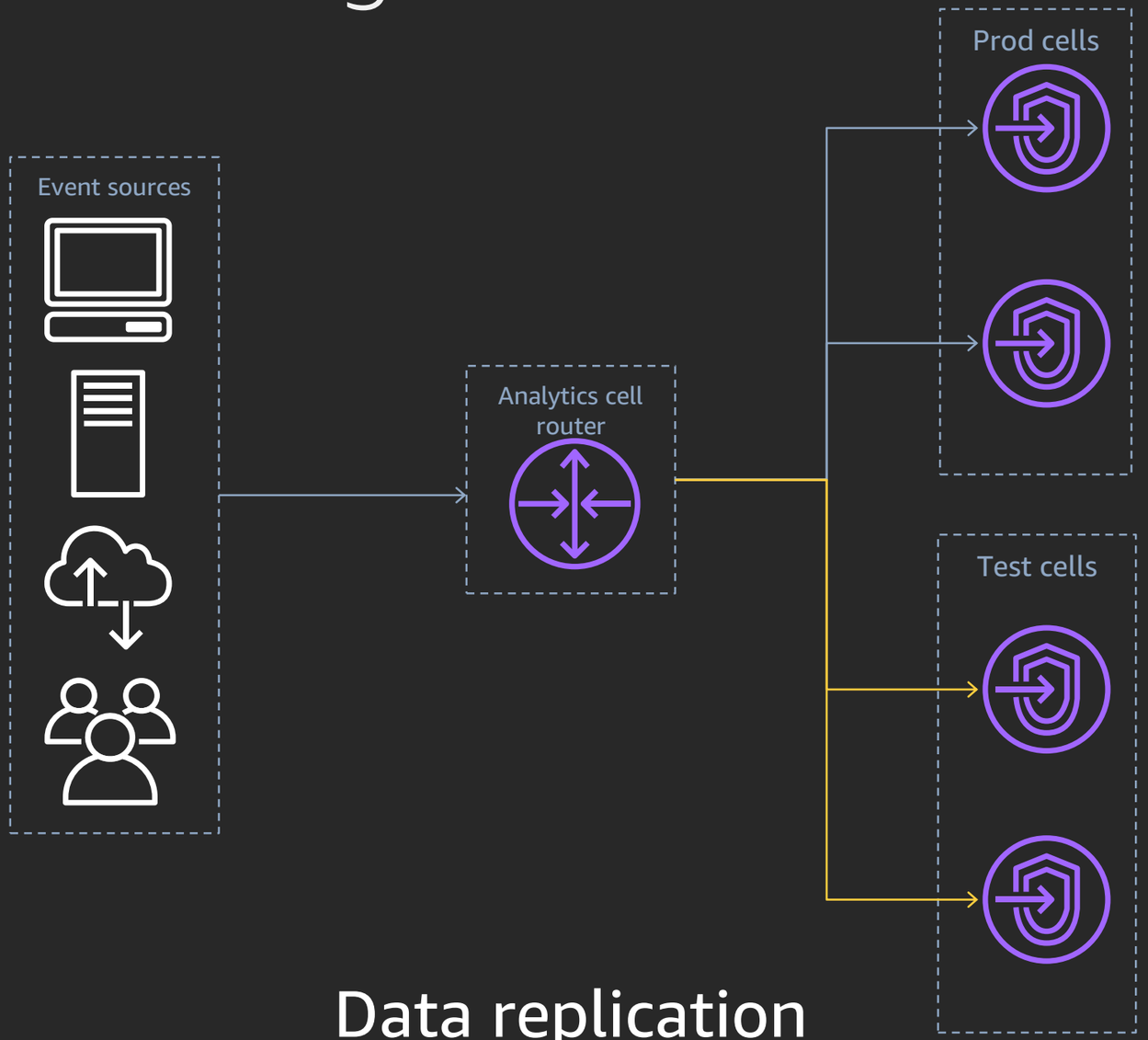
# Routing rules



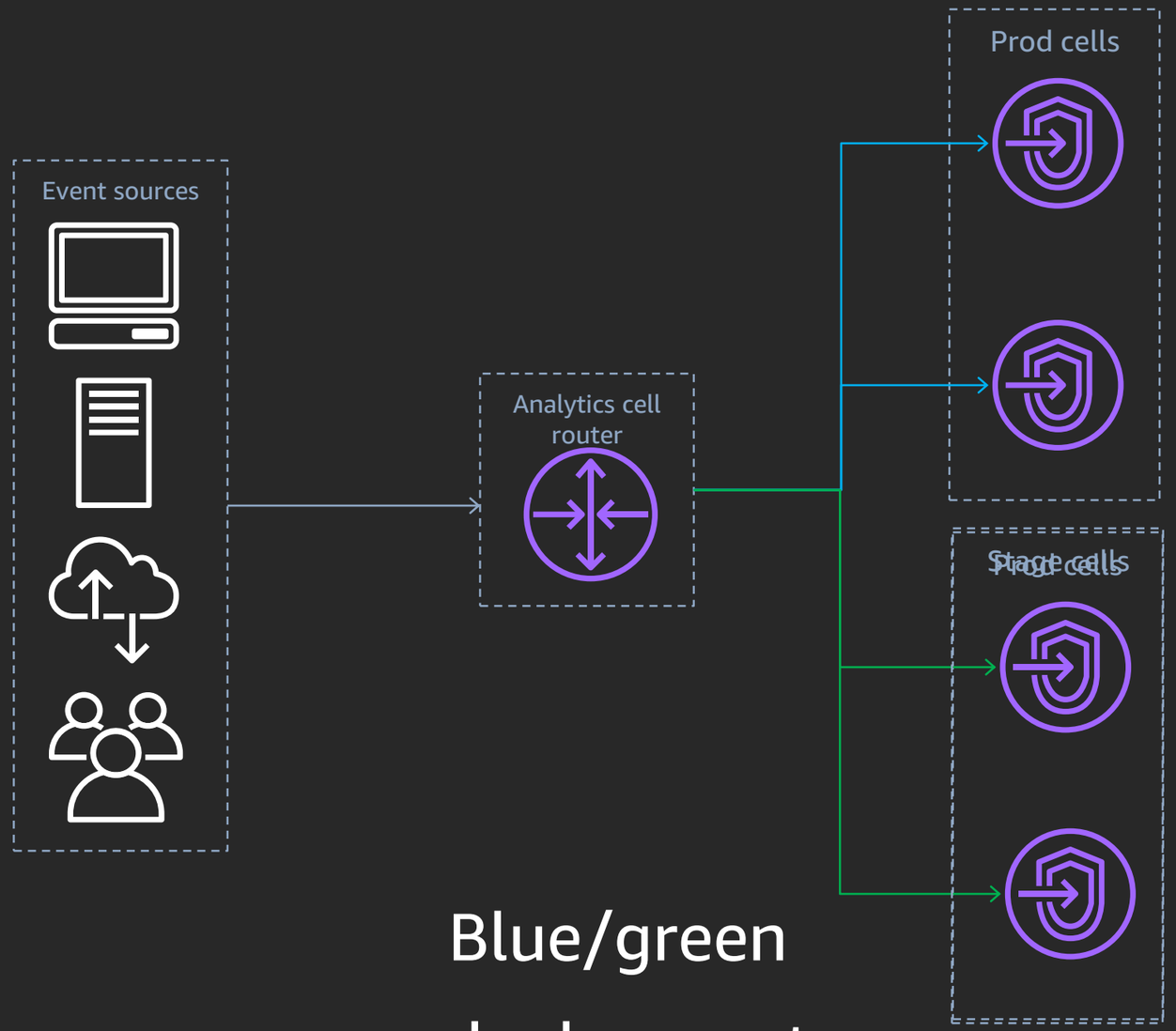

Load Balancing

Data Segregation with Load Balancing

# Routing rules




Data replication




Blue/green deployment

# Routing for SNS message

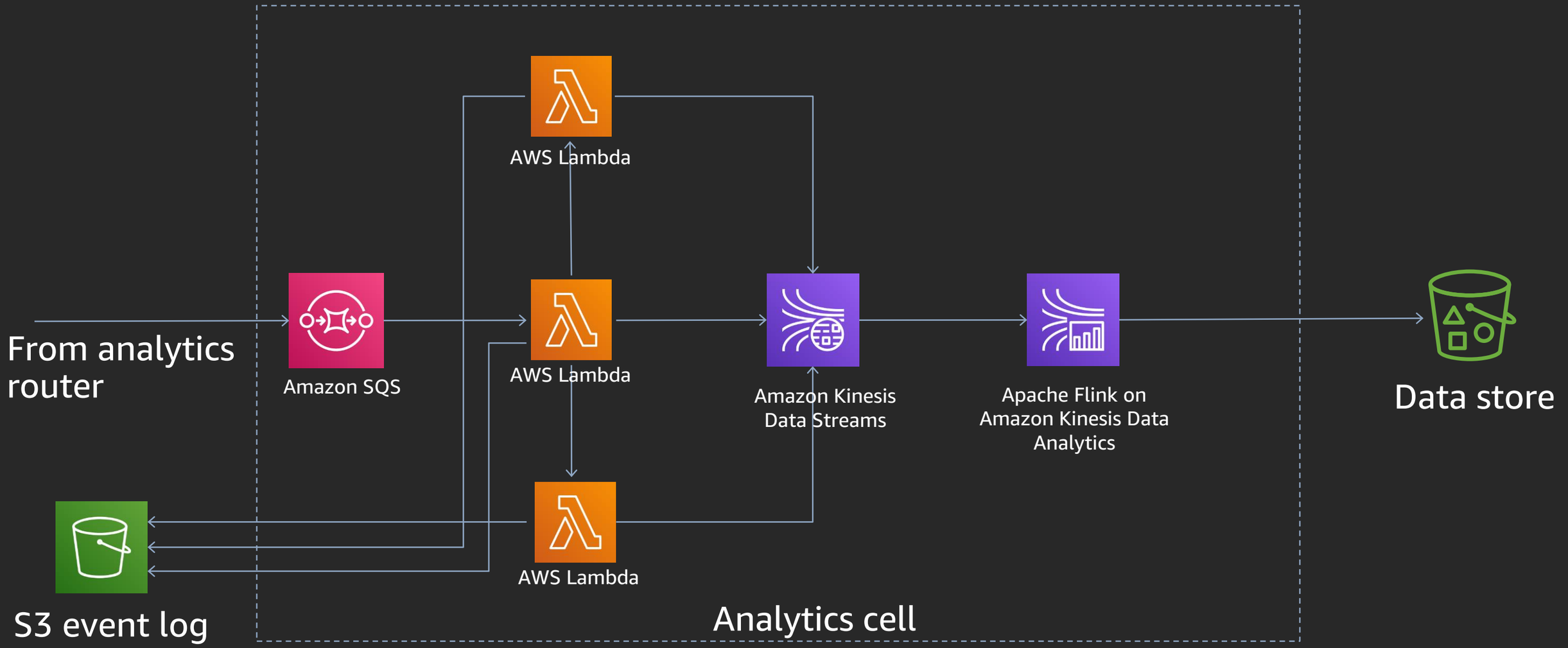

```
"Type"      : "Notification",
"MessageId" : "faf46c26-e7fb-5771-b6f4-38ec4b1bbc95",
"TopicArn"  : "arn:aws:sns:us-east-1:[redacted]:asap2-beta-us-east-1-log-events-topic",
"Subject"   : "Amazon S3 Notification",
"Message"   : "{\"Records\":[{\"eventVersion\":\"2.1\",\"eventSource\":\"aws:s3\",\"awsRegion\":\"us-east-1\",\"eventTime\":
      \"2019-09-15T21:20:36.132Z\",\"eventName\":\"ObjectCreated:CompleteMultipartUpload\",\"userIdentity\":{\"principalId\":
      \"AWS:AROA6L7TYIE5SPURYRA:asap2-beta-us-east-1-LogNormalizer\"},\"requestParameters\":{\"sourceIPAddress\":\"34.219.241.86\"},      \"responseElements
      \":{\"x-amz-request-id\":\"311A2040382E47BC\",\"x-amz-id-2\":\"j6TthhO+s2ZcptNRB5SM9Sw3b6napT1a3USBTAse2    +LT4LEsTpBcyEbZagQvkpdEXNvjaq06pvg=\"},
      \"s3\":{\"s3SchemaVersion\":\"1.0\",\"configurationId\":\"CloudtrailLogsCreateNotifications\",  \"bucket\":{\"name\":\"asap2-beta-us-east-1-log-
      events-bucket\",\"ownerIdentity\":{\"principalId\":\"A3AM8R2YBZLY\"},\"arn\":\"asap2-beta-      us-east-1-log-events-bucket\"},\"object\": {\"key\":
      \AndesService/application_log/AndesService/Prod/application.log/2019/09/15/19/application.log.2019-09-15-19.andes-prod-1b-841d3119.us-
      east-1.amazon.com.json.gz\",\"size\":11089,\"eTag\":\"017f62b142f21ad7fb9621749a329332\",\"sequencer\":\"005C50C1E6F538D4A3\"}}}]}",
      "Timestamp":  "2019-01-29T19:33:52.001Z",
```


Data segregation

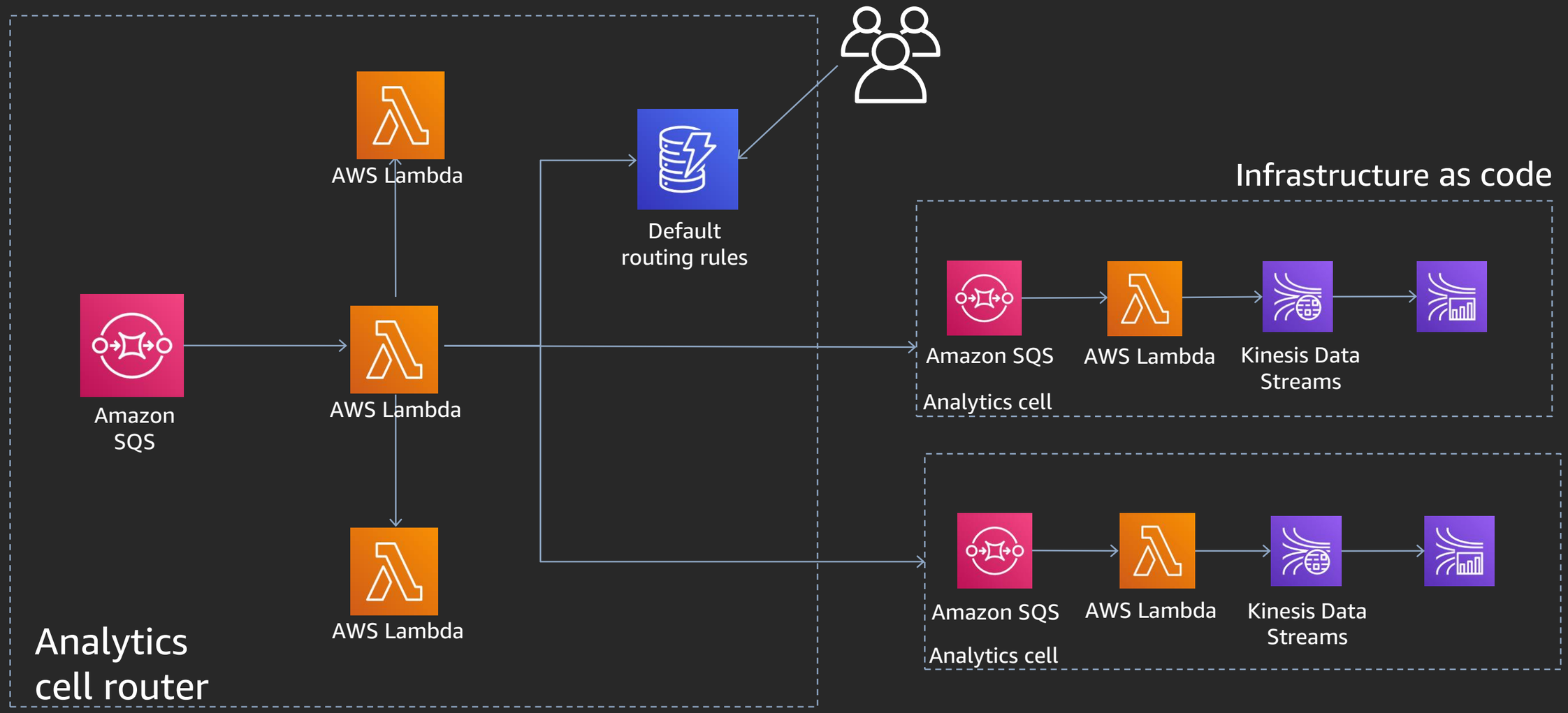

```
"Type" : "Notification",
"MessageId" : "faf46c26-e7fb-5b71-b6f4-38ec4b1bbc95",
"TopicArn" : "arn:aws:sns:us-east-1:[redacted]:Conduit-Cloudtrail-Log-Notification",
"Subject" : "Amazon S3 Notification",
"Message" : "{\"Records\":[{\"eventVersion\":\"2.1\",\"eventSource\":\"aws:s3\",\"awsRegion\":\"us-east-1\",\"eventTime\":\"2019-01-29T21:13:11.072Z\",\"eventName\":\"ObjectCreated:Put\",
           {\"principalId\":\"AWS:AROAI2LRE6HOGRN3IWEKI:regionalDeliverySession\"},\"requestParameters\":{\"sourceIPAddress\":\"34.219.241.86\"},\"responseElements\":
           {\"x-amz-request-id\":\"311A2040382E47BC\",\"x-amz-id-2\":\"j6TthhO+s2ZcptNRB5SM9Sw3b6napT1a3USBTAse2+LT4LEsTpBcyEbZagQvkpdEXNvjaq06pvg=\"},\"s3\":
           {\"s3SchemaVersion\":\"1.0\",\"configurationId\":\"CloudtrailLogsCreateNotifications\",\"bucket\":{\"name\":\"conduit-cloudtrail-logs\",\"ownerIdentity\":
           {\"principalId\":\"A3AM8R2VAYBZLY\"},\"arn\":\"arn:aws:s3:::conduit-cloudtrail-logs\"},\"object\": {\"key\":\"trail-logs/AWSLogs/549802330112/CloudTrail/us-west-2/2019/01/29/
```


Load balancing by AWS Account ID

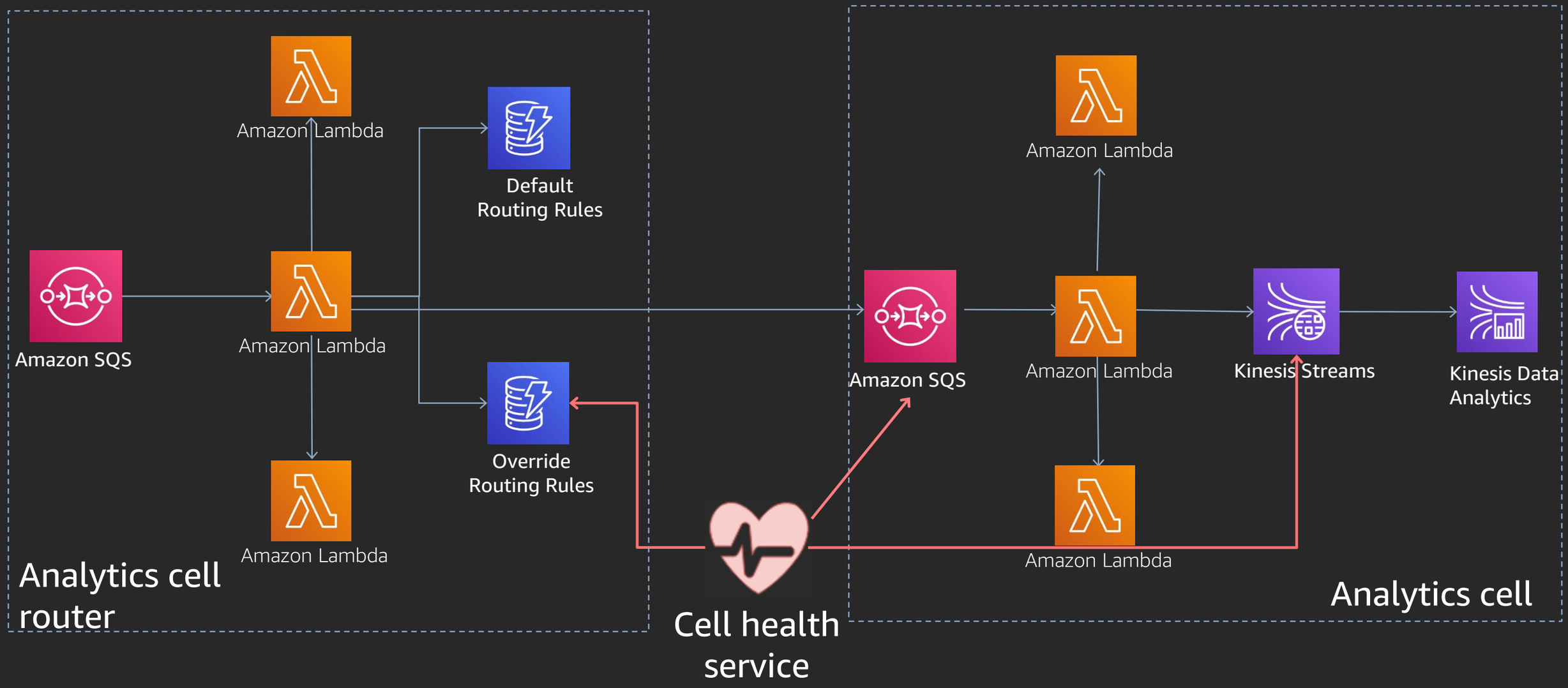
# Analytics cell



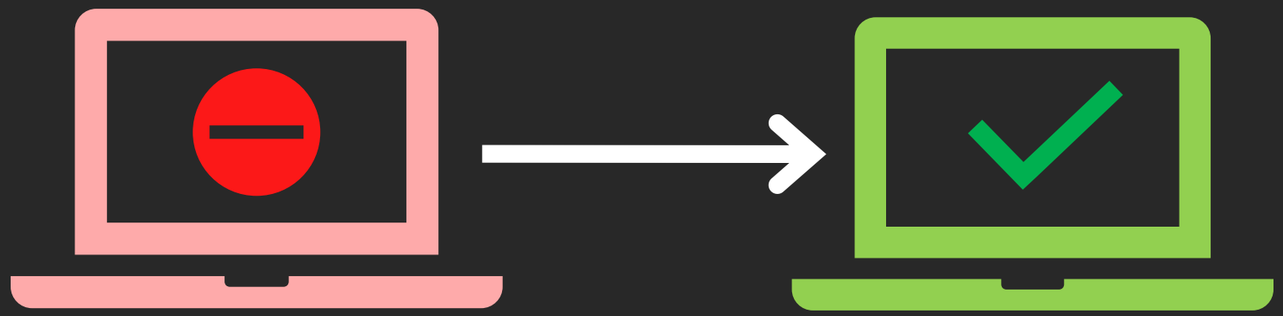
# Adding cells



# Cell health service

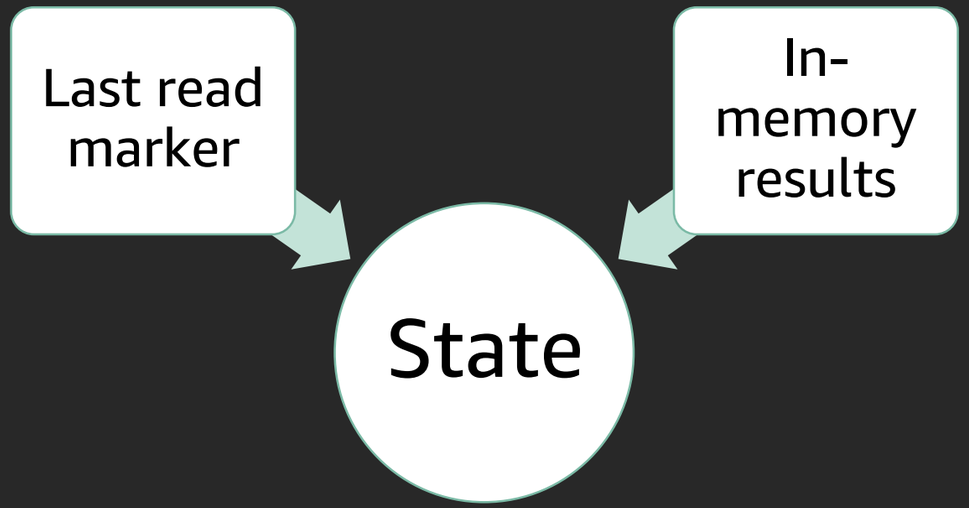


# Cell state

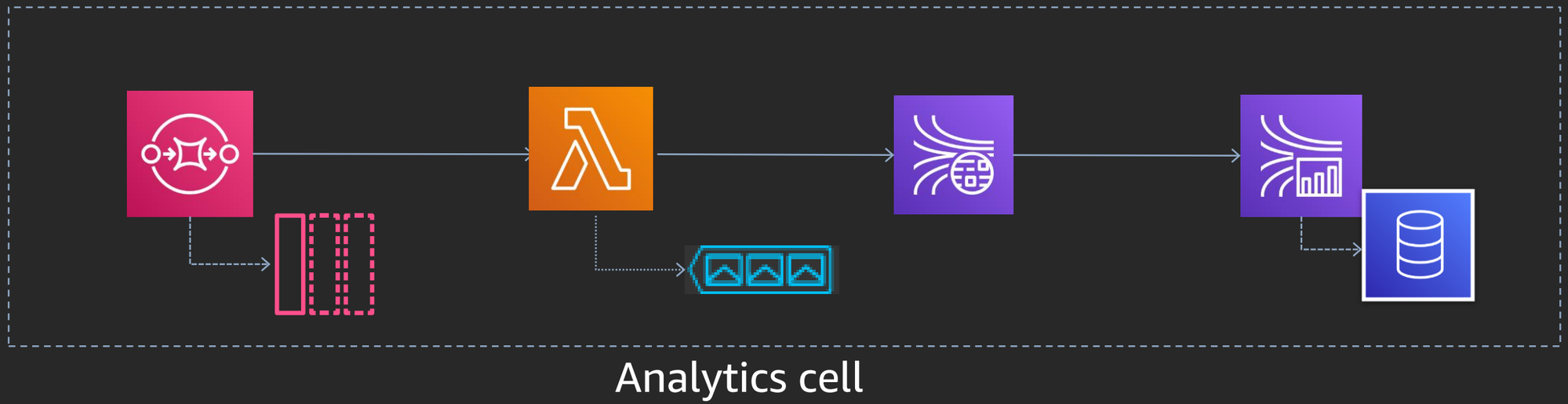


Why state?

What is state?



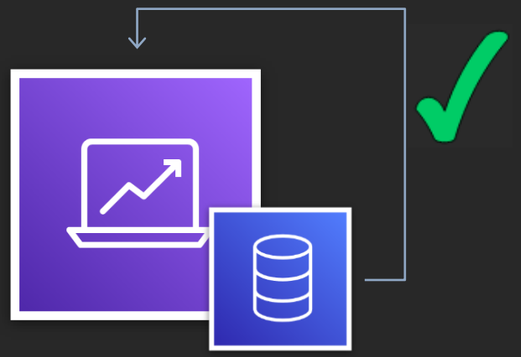
# State within analytics cell




- Amazon SQS
- Lambda failures – Dead-letter queue
- Apache Flink checkpoints and save points

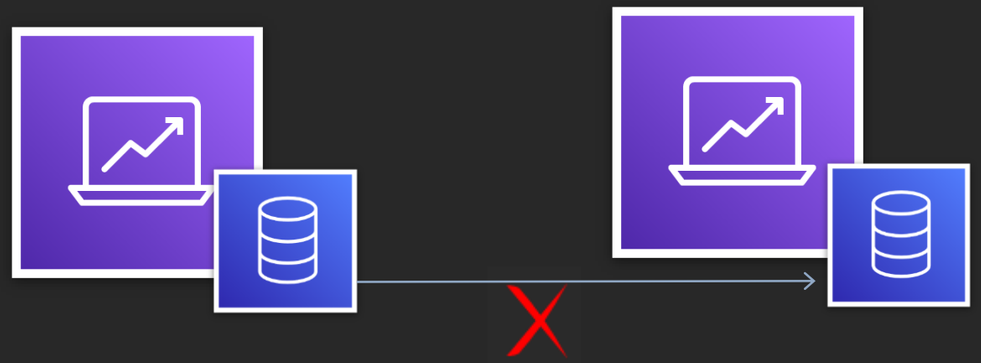
# What happens when a cell fails

## Recoverable failure



State maintained within a cell

## Unrecoverable failure



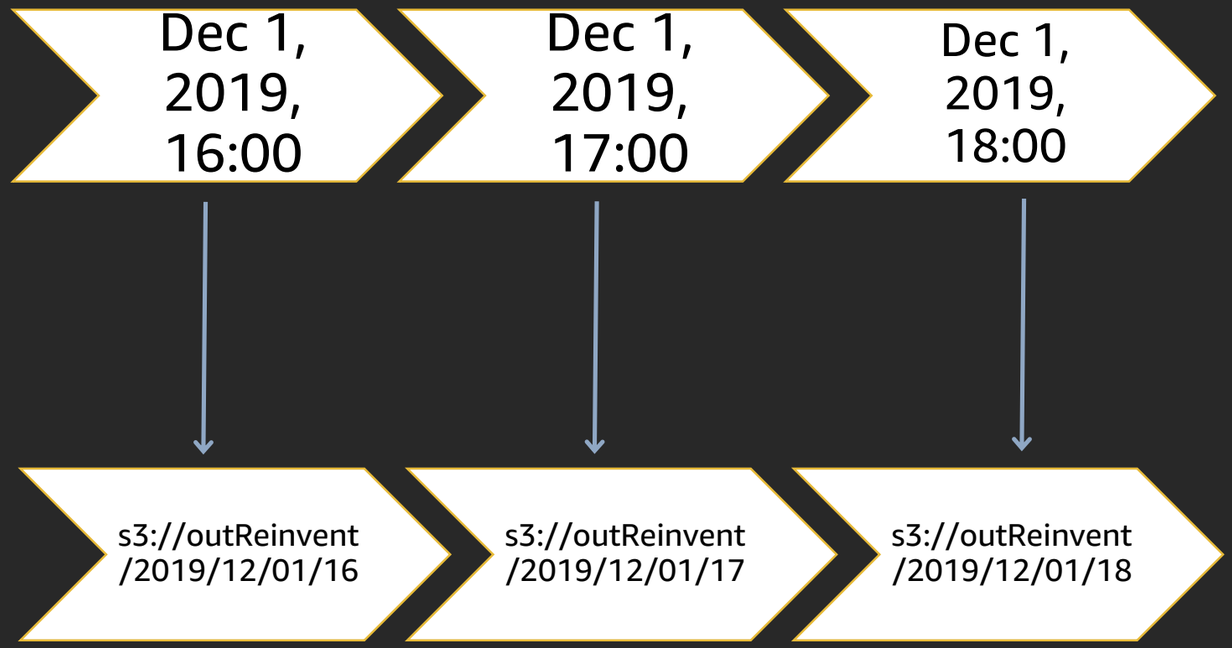
State never migrated across cells

# Unrecoverable failure

- Historical event cell
- Lambda to regenerate SNS notifications

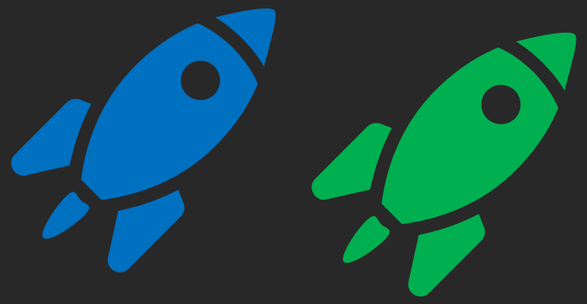
# Unrecoverable failure

- Backfill and restate historical results
- Event time partition on output data



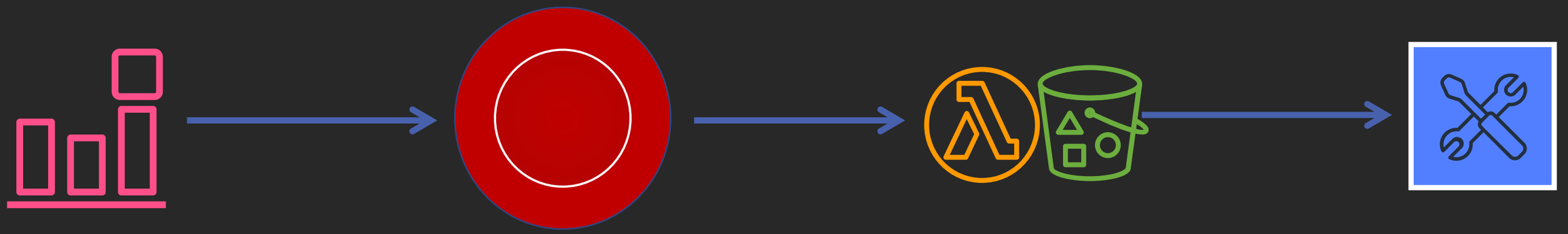
# More ways of reducing blast radius

Isolate noisy neighbors



Blue/green deployment

# Back to tenets



Event-driven architecture

Minimize failures

Serverless

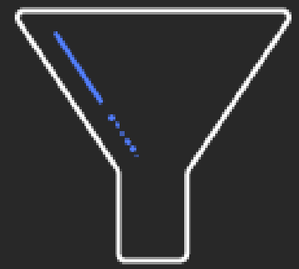
Infrastructure as code

# Key takeaways

vs.

Small vs. large cells

Design for failure



Thinnest possible layer

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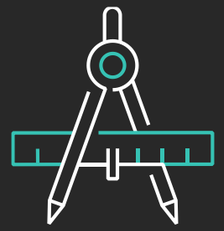

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