AWS re:Invent

MFG202

Building on AWS: The architecture of the Siemens MindSphere platform

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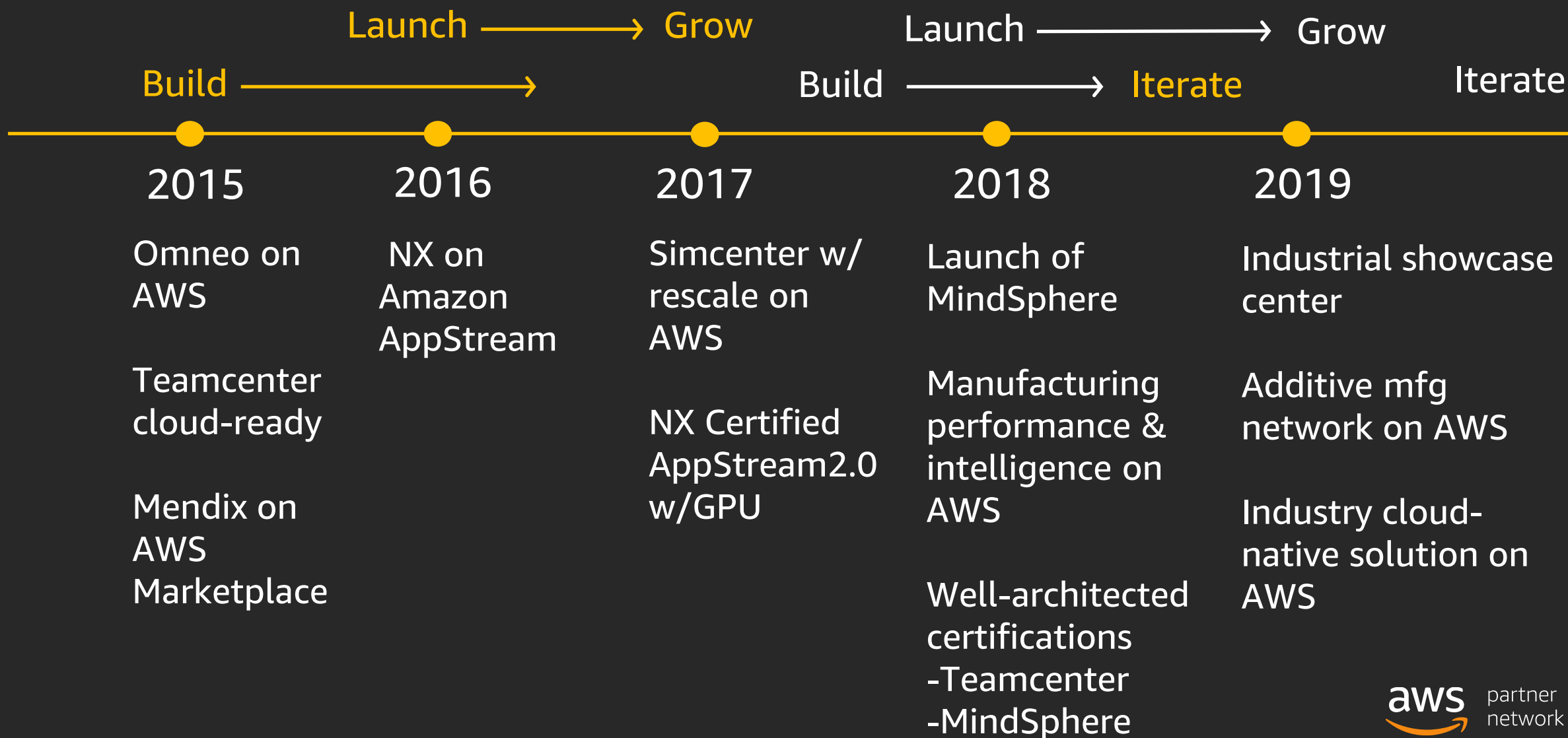Amazon Web Services

aws
re:Invent

aws

Siemens

The world leader in industrial automation
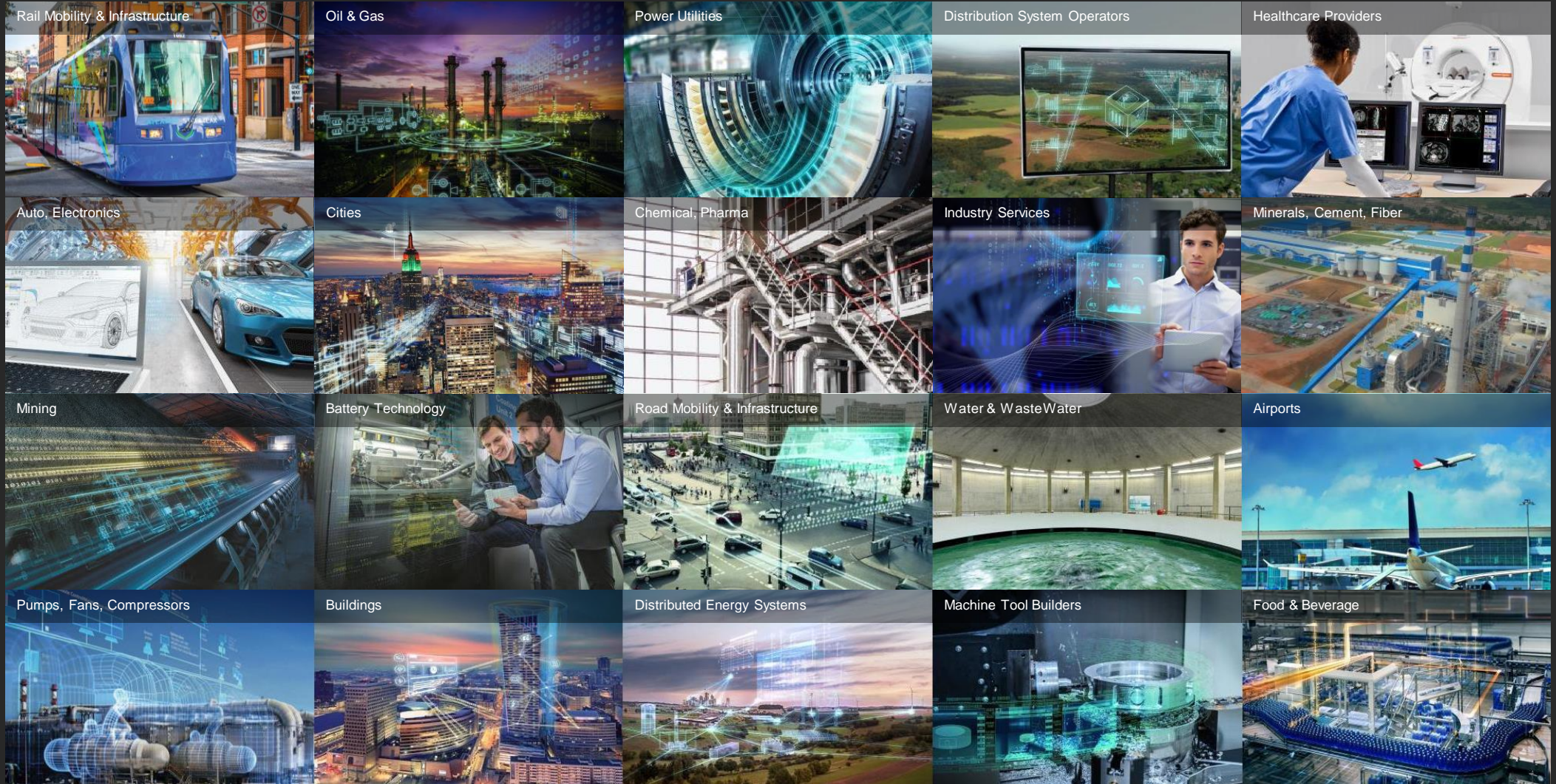
Customers move from ideas to implementation easier, faster, more securely, and at a lower cost with AWS

Most functionality

Largest community of customers and partners

Most secure

Most proven operational expertise

Fastest pace of innovation

aws

Siemens DISW and AWS Cloud journey

Build ⟶   Launch ⟶ Grow   Launch ⟶ Grow

Build ⟶ Iterate   Iterate

| 2015	2016	2017	2018	2019
Omneo on AWS	NX on Amazon AppStream	Simcenter w/ rescale on AWS	Launch of MindSphere	Industrial showcase center
Teamcenter cloud-ready		NX Certified AppStream2.0 w/GPU	Manufacturing performance & intelligence on AWS	Additive mfg network on AWS
Mendix on AWS Marketplace			Well-architected certifications -Teamcenter -MindSphere	Industry cloud-native solution on AWS

aws partner network

AWS Industrial Software Competency

- Partners who have demonstrated technical expertise through rigorous technical validation and proven customer success

- Siemens MindSphere and Teamcenter were both recognized for gaining Industrial Competency status

- Siemens is the only company to receive competency status for two solutions

Converging IT & OT to maximize value
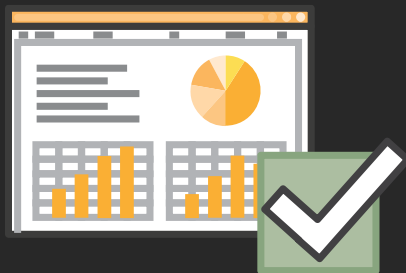
Accelerate decision making

Operations transparency

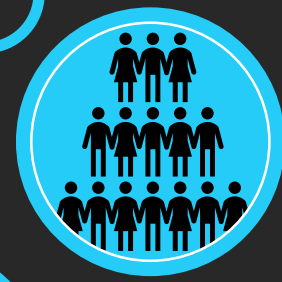**Rapid applications bring new products**

Optimize products

aws partner network

What is MindSphere?

Applications

MindSphere applications provide asset transparency and analytical insights into machines, plants, fleets, and systems
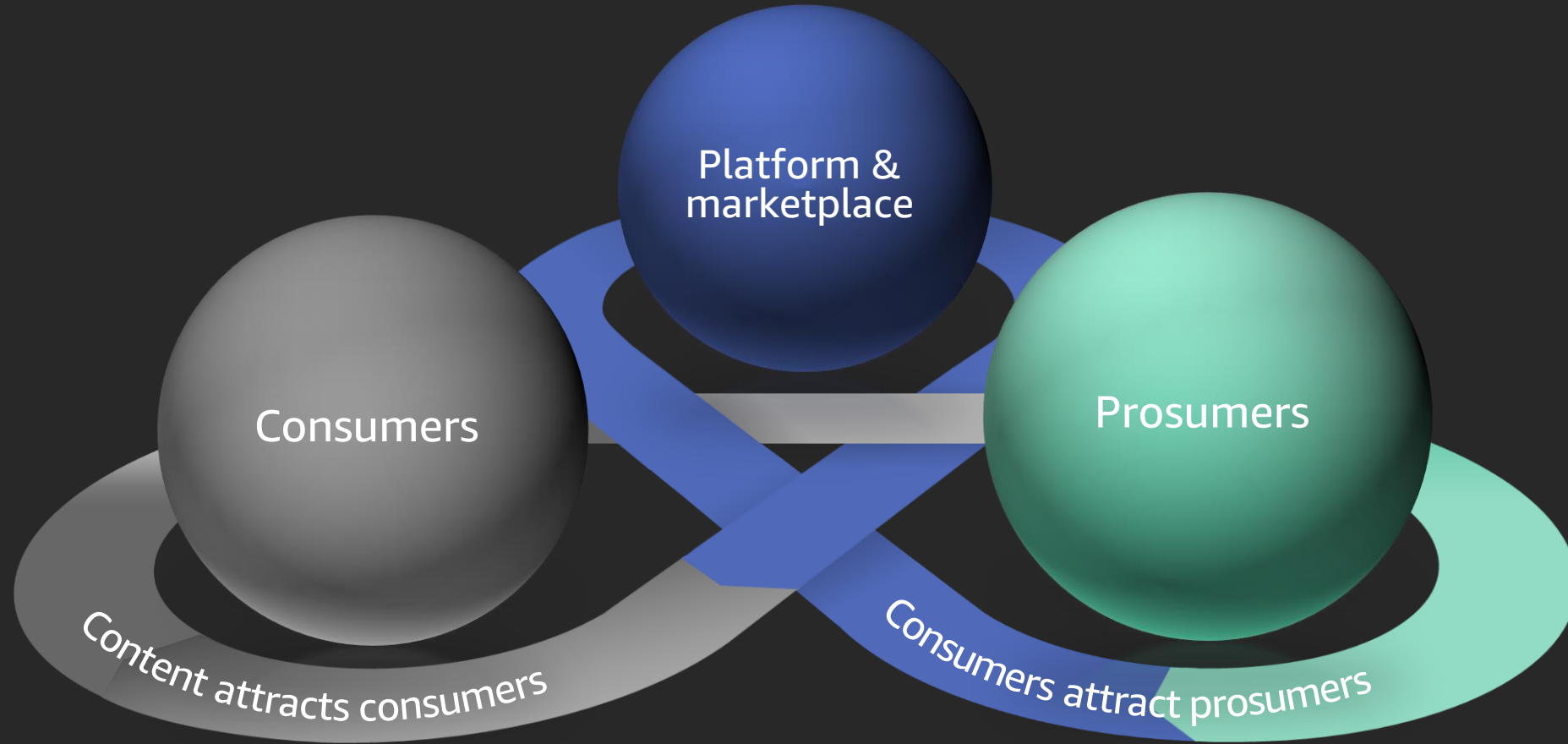
Open PaaS

MindSphere, the open PaaS, gives you scalable, global IoT connectivity and application development with native cloud accessibility

Connectivity

MindConnect connects products, plants, systems, machines, enterprise applications, and legacy DB via a secured plug-and-play collection of products and equipment

MindSphere

mx

Industrial ecosystem

MindSphere ecosystem: Customers, partners, developers

MindSphere world

Growing worldwide

Recently added
Japan, Korea, Taiwan

Global partner ecosystem

Over 475 and growing

Mendix ecosystem

>90,000 developers

100,000+ applications making an impact already on the Mendix platform
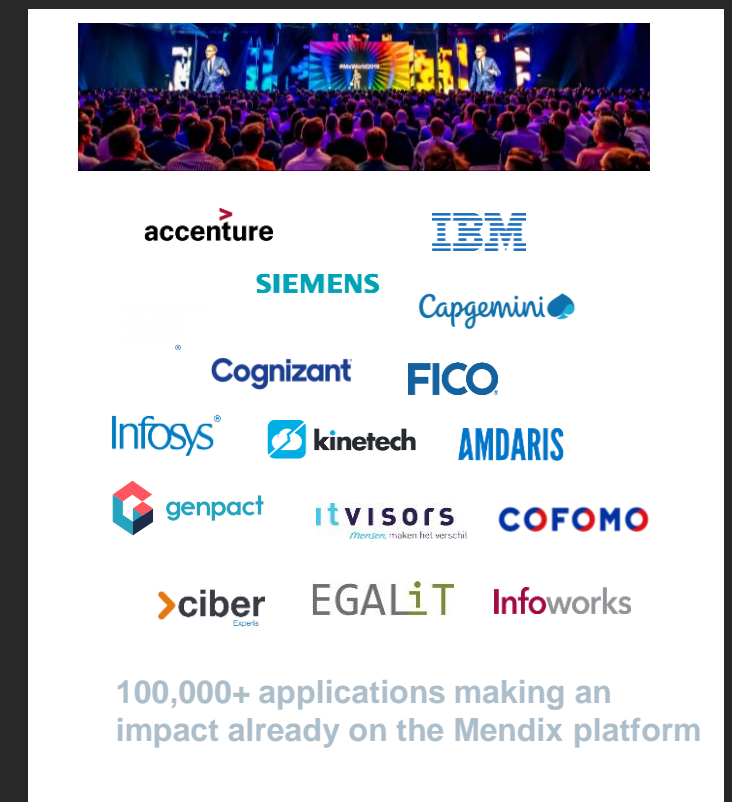
Know your differentiators

Comprehensive services

EoU & OOTB functionality

Integrated closed-loop digital twin

Global Siemens customer footprint

Partners speak to MindSphere as the integration layer

Leading industrial domain knowledge

Reduced complexity aggregated services
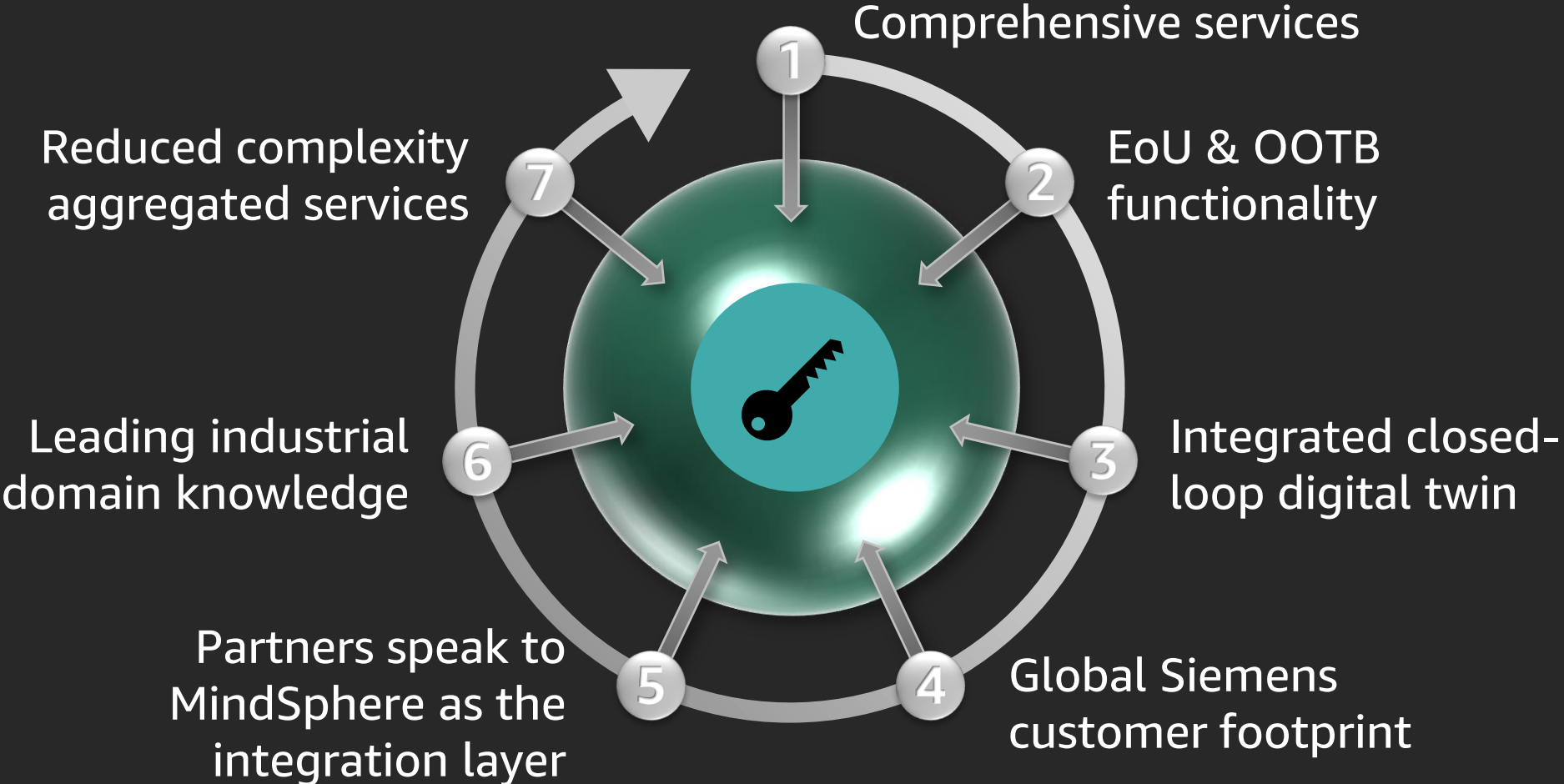
Approach: Cloud-optimized

"We don't want to manage anything we don't have to manage."

- Consensus of MindSphere architecture team

"We want to ride AWS's innovation curve, not fight it."

- David Mitchell, VP MindSphere Products

Managed services

Fully managed
Automatic data replication to 3 AZs
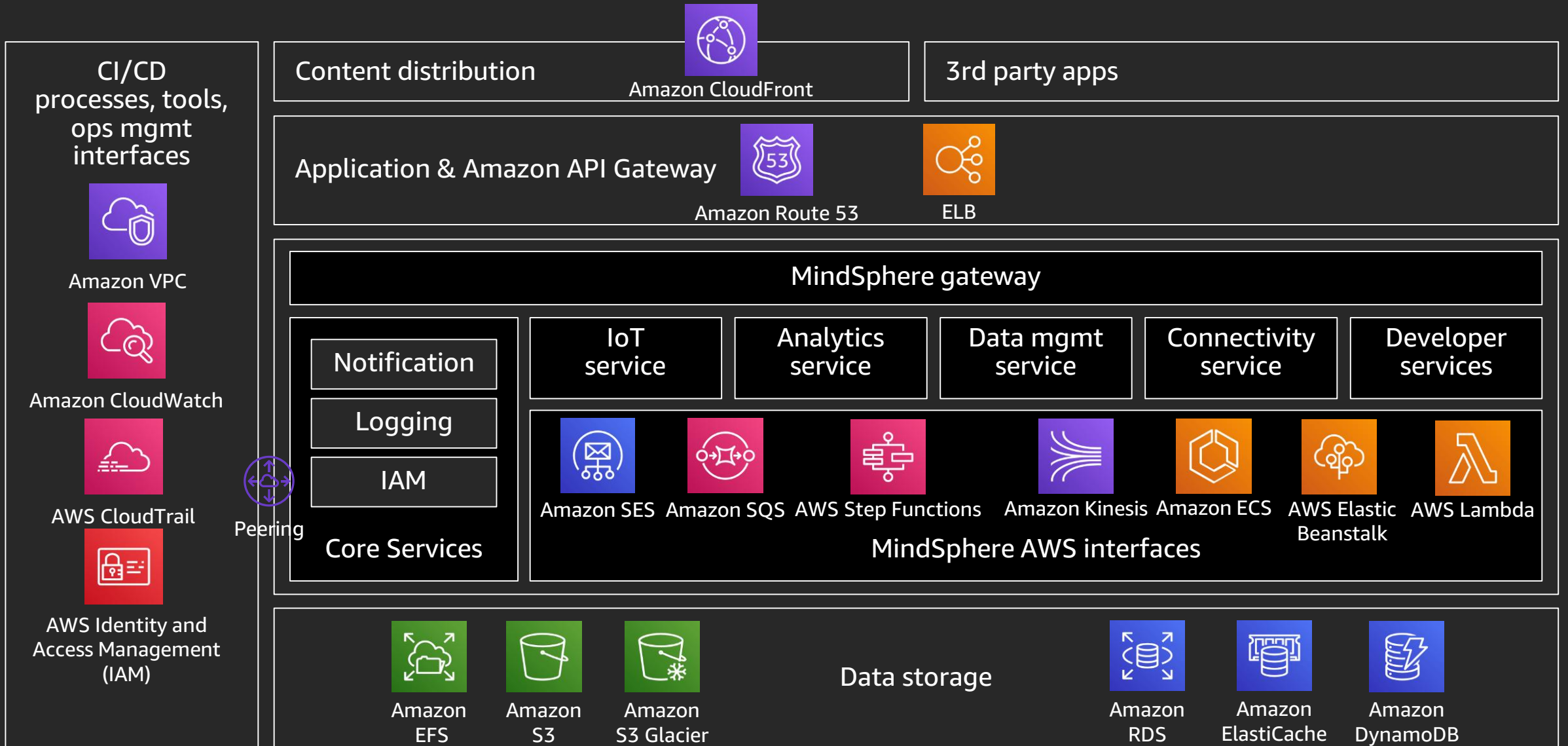Easy split/merge shards

Self-managed
Monitor & scale
Manage backups

Apache Kafka

Amazon Kinesis

MindSphere on AWS overview

CI/CD processes, tools, ops mgmt interfaces

Amazon VPC

Amazon CloudWatch

AWS CloudTrail

AWS Identity and Access Management (IAM)

Peering

Content distribution

Amazon CloudFront

3rd party apps

Application & Amazon API Gateway

Amazon Route 53

ELB

MindSphere gateway

Notification	IoT service	Analytics service	Data mgmt service	Connectivity service	Developer services
Logging					
IAM					

Core Services

Amazon SES   Amazon SQS   AWS Step Functions   Amazon Kinesis   Amazon ECS   AWS Elastic Beanstalk   AWS Lambda

MindSphere AWS interfaces

Data storage

Amazon EFS

Amazon S3

Amazon S3 Glacier

Amazon RDS

Amazon ElastiCache

Amazon DynamoDB

Services in use in 2018

AWS Elastic Beanstalk

Amazon ECS

Amazon CloudFront

Amazon DynamoDB

Amazon EBS

Amazon EC2

Amazon Kinesis

AWS Lambda

Amazon RDS

Amazon SES

Amazon SNS

Amazon SQS

AWS Step Functions

Application Load Balancer

Amazon API Gateway

Amazon S3

Amazon ElastiCache

Amazon EMR

Amazon VPC

AWS WAF

Amazon CloudWatch

AWS CloudTrail

AWS Direct Connect

AWS KMS

Amazon Registrar
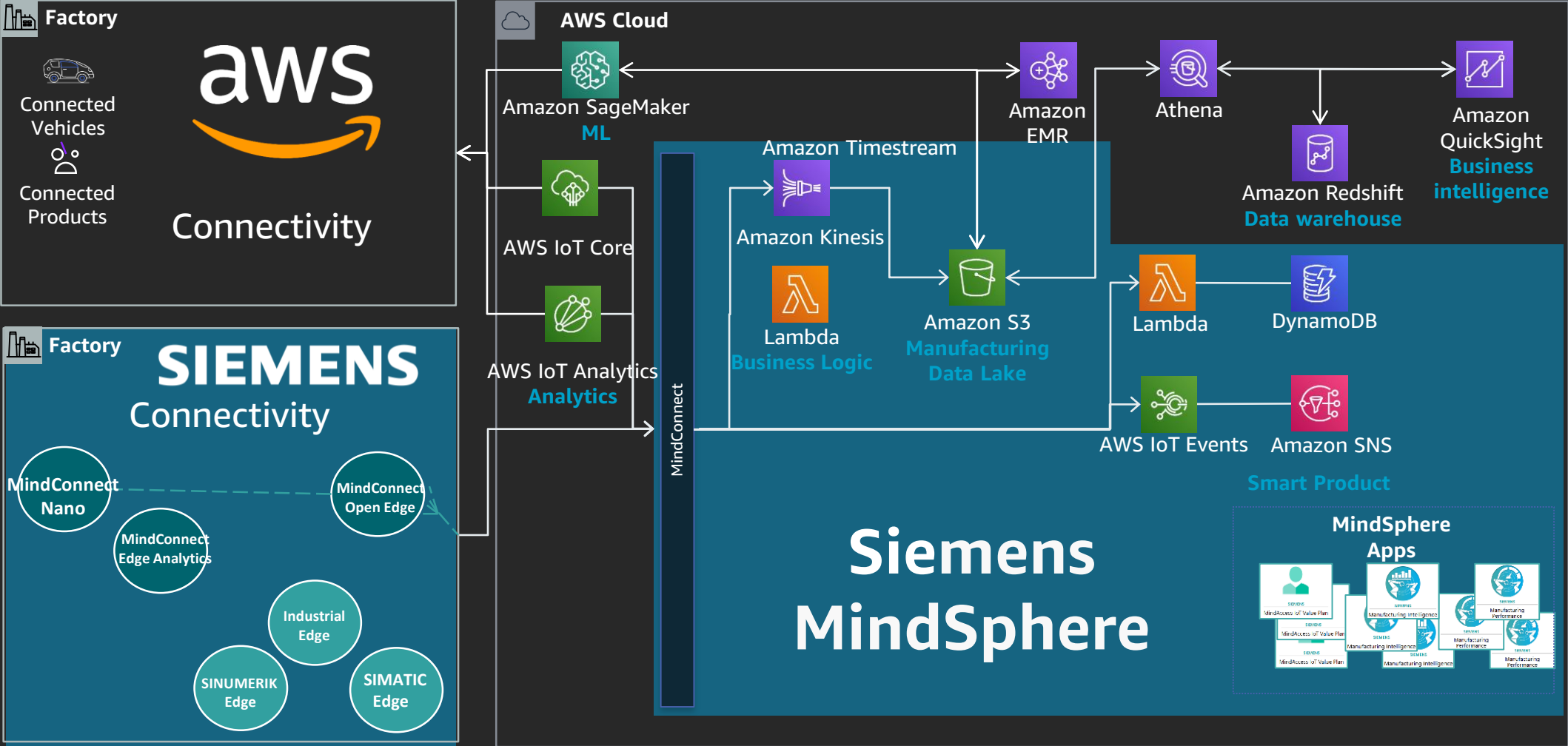
Amazon Route 53

AWS Secrets Manager

Amazon Shield

Amazon Shield Advanced

Services in use now

Amazon ECR	AWS Elastic Beanstalk	AWS Budgets
Amazon ECS	Amazon EFS	Amazon CloudWatch
Amazon Kinesis Data Firehose	Amazon WorkSpaces	AWS CloudTrail
Amazon CloudFront	Application Load Balancer	AWS Config
Amazon DynamoDB	Amazon API Gateway	Amazon DMS
Amazon EBS	Amazon S3	AWS Direct Connect
Amazon EC2	Amazon Athena	Amazon GuardDuty
Amazon EKS	AWS Batch	AWS KMS
Amazon Kinesis	Amazon DocumentDB	Amazon Registrar
AWS Lambda	Amazon ElastiCache	Amazon Route 53
Amazon Neptune	Amazon ES	AWS Secrets Manager
Amazon RDS	Amazon EMR	Amazon Shield
Amazon SES	AWS Glue	Amazon Shield Advanced
Amazon SNS	Amazon VPC	AWS Systems Manager
Amazon SQS	AWS WAF	AWS Trusted Advisor
AWS Step Functions		AWS X-Ray

MindSphere + AWS accelerates solutions

Design patterns

aws

Design patterns: Containerized microservices

AWS Cloud

Availability Zone 1

VPC

Optimistic task scheduler

Task 1   Task 2   Task 1

ECS cluster with Auto Scaling group

Availability Zone 2

Optimistic task scheduler

Task 1   Task 2   Task 1

Primary RDS

Replication

Standby RDS

Amazon S3

BR/DR lifecycle

Amazon S3 Glacier
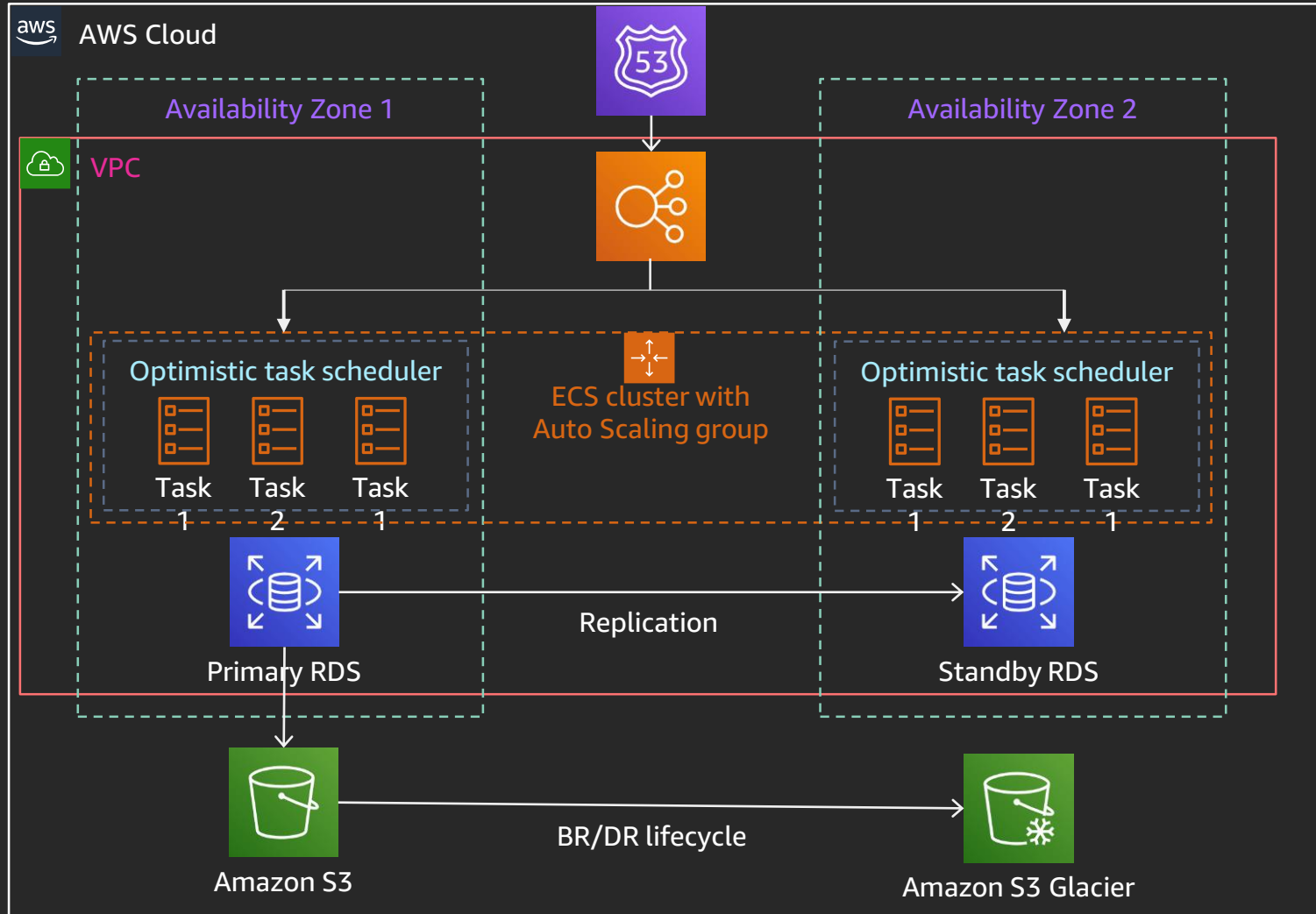
1	Resilient
2	Auto Scaling
3	Secure
4	Durable

Design patterns: Serverless
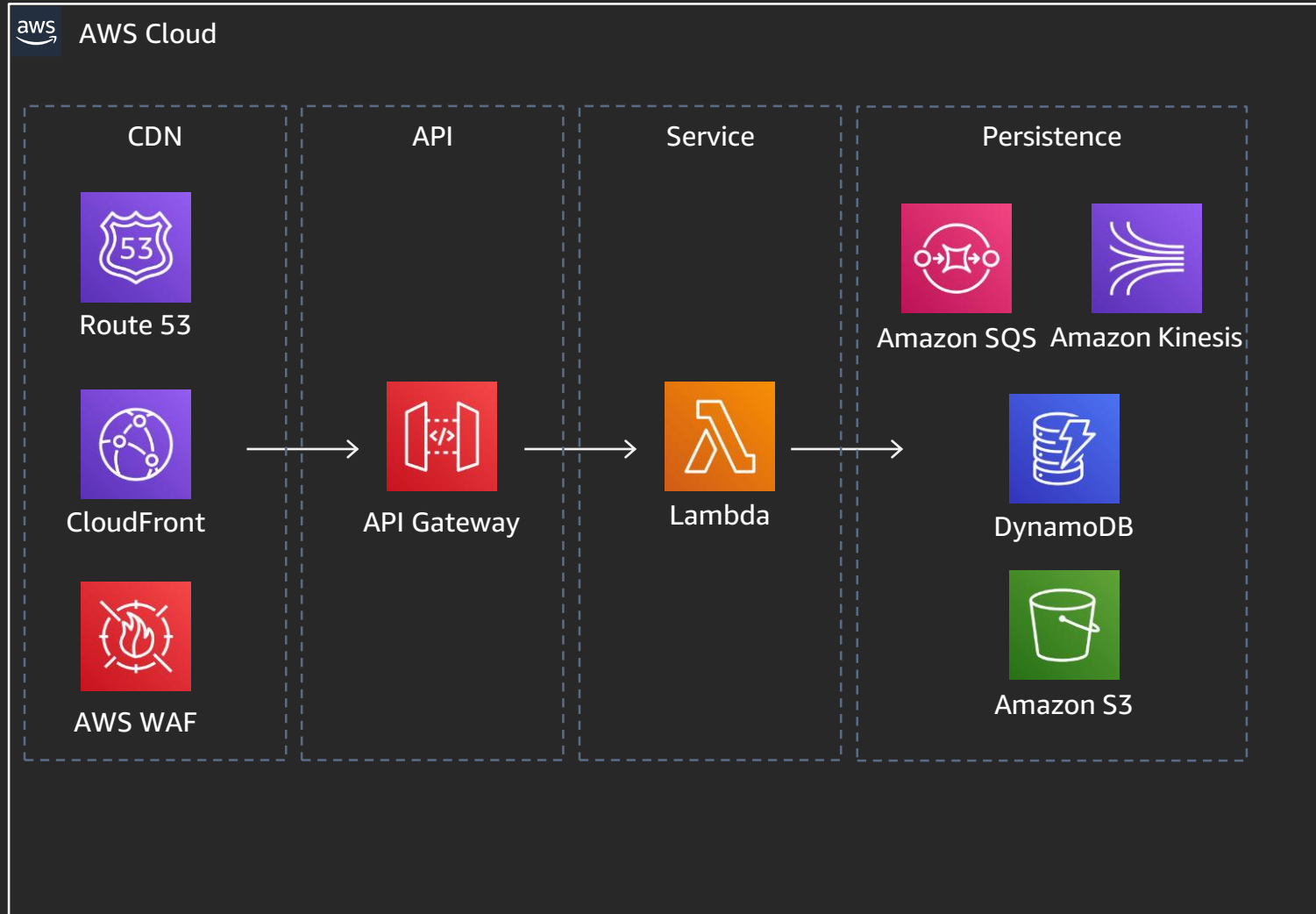
Evolution of architectures resulting in increased productivity

Serverless

Containerization

Cloud computing

Virtualization

Physical machine
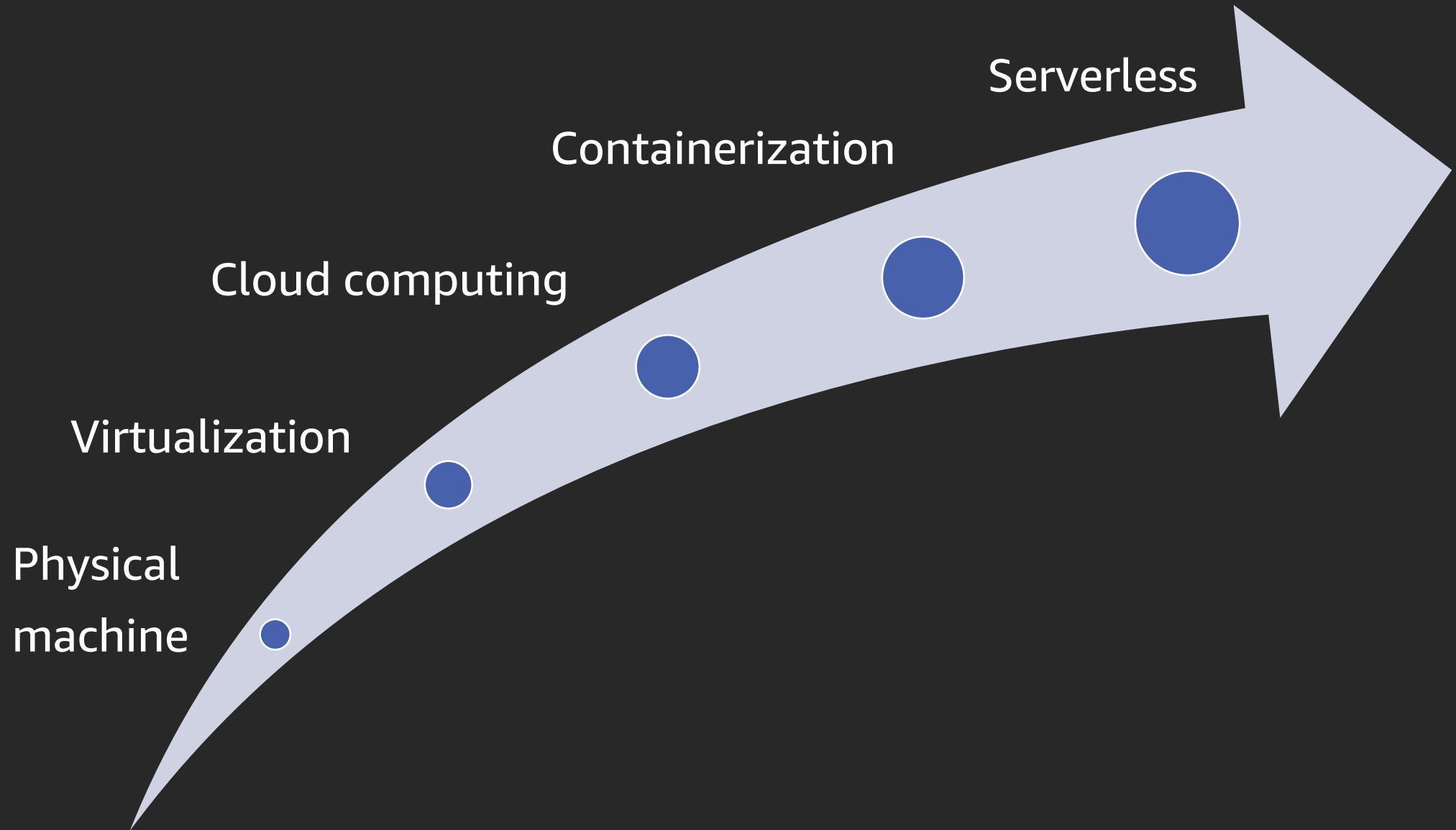
Data lake versus data swamp

Challenges running @ scale

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Unpredictable workloads

AWS Cloud

Amazon Kinesis → Indexer → Amazon ES

Amazon Kinesis → Writer → DynamoDB

Amazon Kinesis → Aggregator → Amazon S3
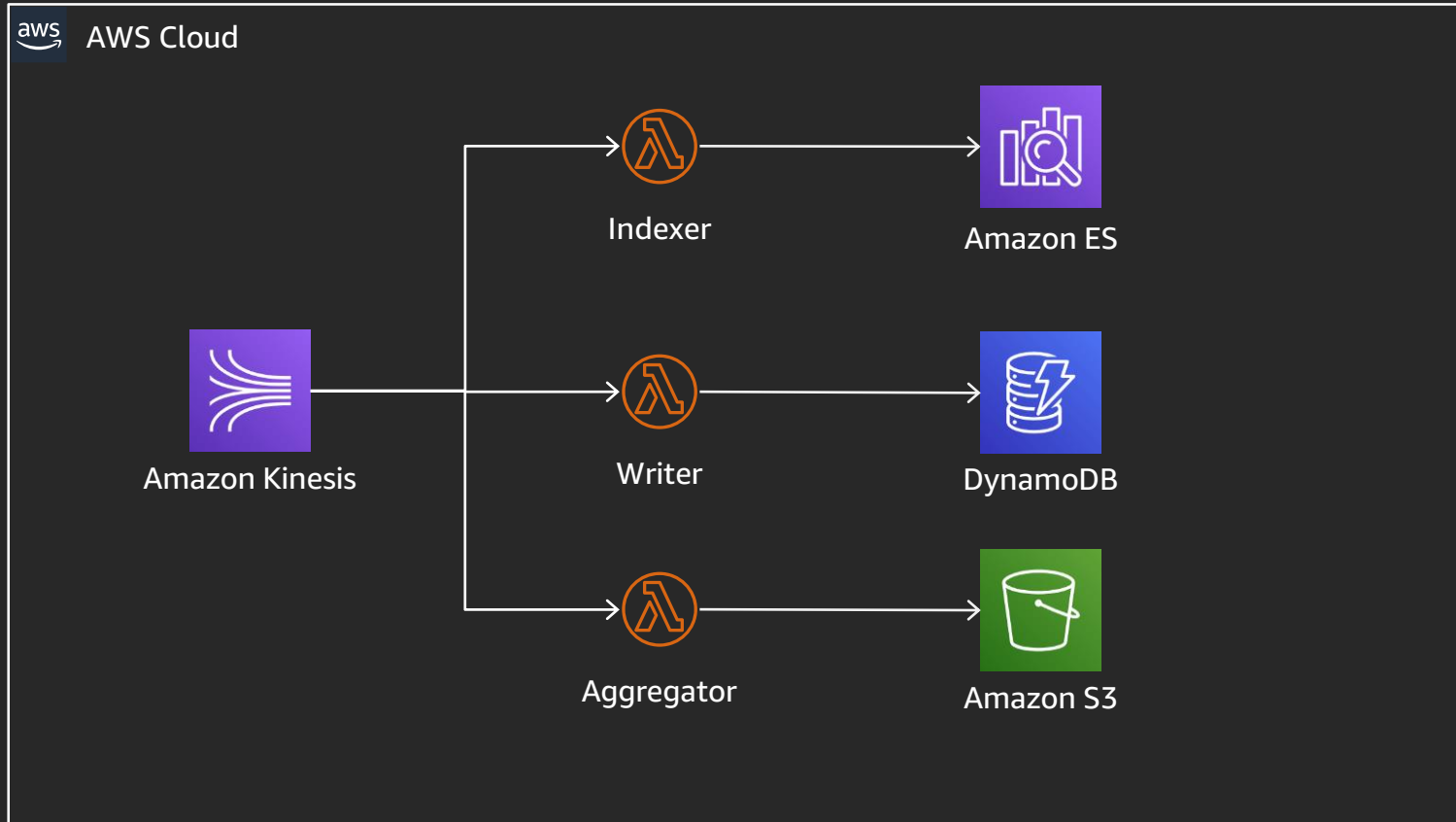
1	Over-provisioning high cost
2	Buffer for peak workloads
3	Separate real time from historical
4	Separate mixed workloads

… the real world is never what you expect

Separate real-time from non-real-time data

Split mixed workloads

AWS Cloud

Data ingest

High-throughput or dedicated
Kinesis → DynamoDB High WCU

Medium workloads
Kinesis → DynamoDB Med WCU

Low-cost low-throughput
Kinesis → DynamoDB Low WCU
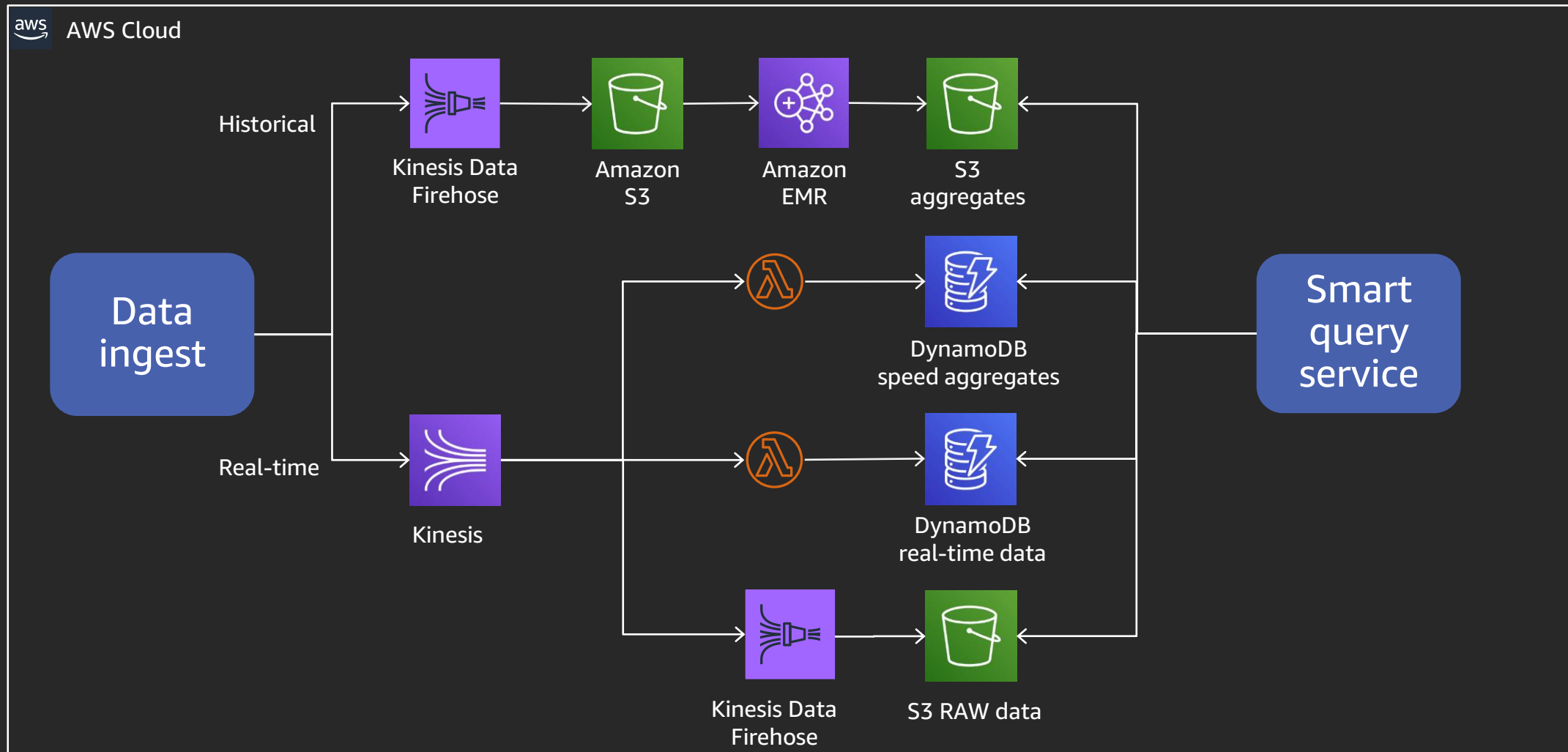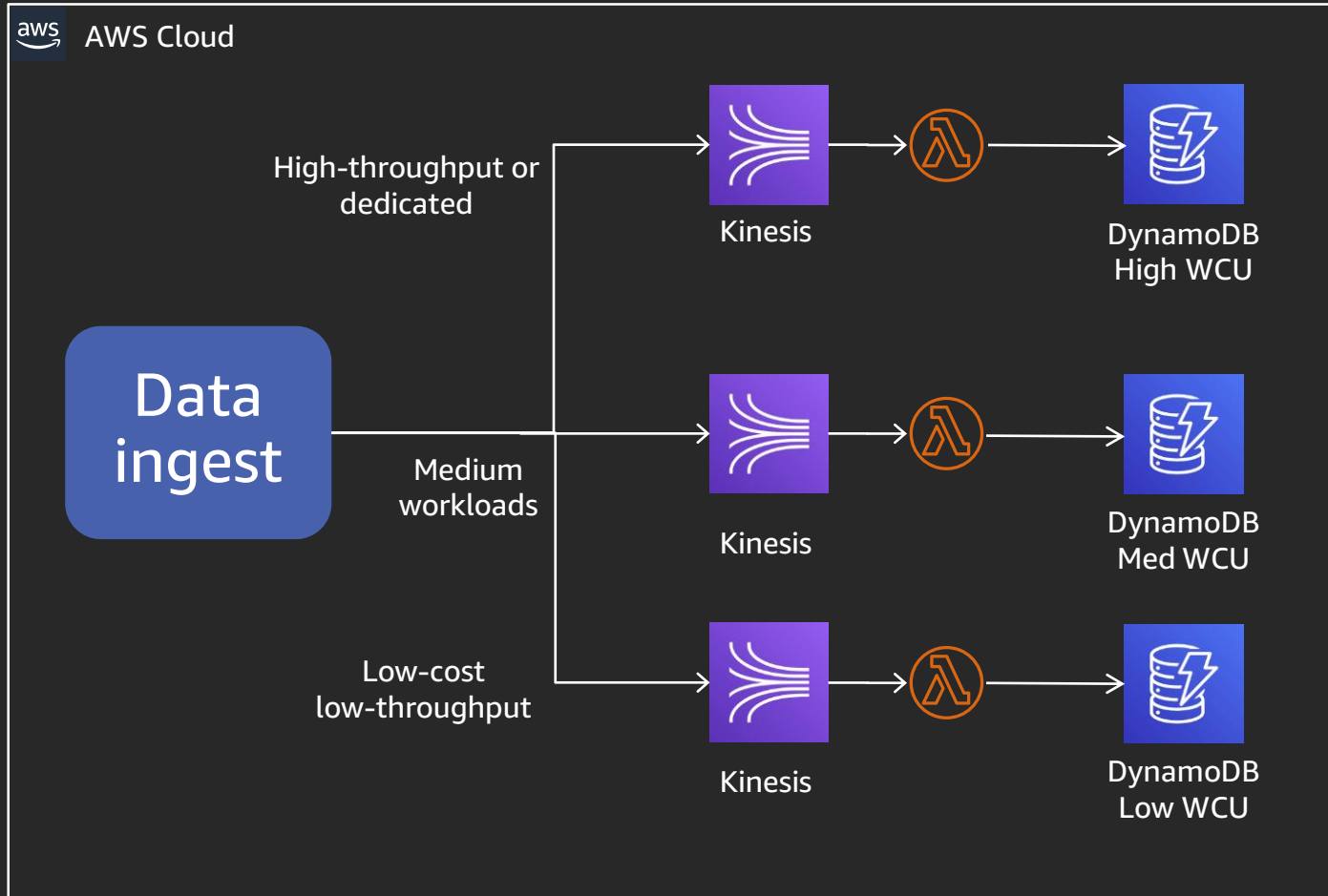
Not all devices are the same

Over-provisioning for worst case is expensive

Key learnings for scalability

- Understand service limits & design with them in mind

- Scaling takes time

- The real world will not be what you expect

- Monitor access patterns—learn & adapt

- Serverless makes it all easier—but still has limits

Cost optimization

Managing costs: Understanding cost factors

- Use cost calculators

- Storage costs

- WCU & RCU

- Reading costs

- Provisioned vs on-demand

Indexed Data Storage:

Dataset Size: `0` `GB ▼`

On-demand Capacity *:

Item Size (All attributes): `1` KB

Read Consistency: ◉ Strongly Consistent ○ Eventually Consistent

Total number of items read per month: `0` in millions

Number of transactional items read per month (subset of above): `0` in millions

Number of items read with eventual consistency: `0` in millions

Number of items read with strong consistency: `0` in millions

Number of items written per month: `0` in millions

Number of transactional items written per month (subset of above): `0` in millions

Provisioned Capacity *:

Item Size (All attributes): `1` KB

Read Consistency: ◉ Strongly Consistent ○ Eventually Consistent

Total number of items read per second: `0` Reads/Second

Number of transactional items read per second (subset of above): `0` Reads/Second

Number of items read with eventual consistency: `0` Reads/Second

Number of items read with strong consistency: `0` Reads/Second

Number of items written per second: `0` Writes/Second

Number of transactional items written per second (subset of above): `0` Writes/Second

DynamoDB Streams:

Read Request Units: `0` `Units/Month ▼`

Data Transfer (optional):

Data Transfer Out of Region: `0` `GB/Month ▼`

Data Transfer In: `0` `GB/Month ▼`

General practices for cost optimization

- Automate everything
- Turn it off!
- Low-cost development environments
- Rightsize your instances
- Manage caches
- Polling on Amazon SQS vs. push on Amazon SNS
- Plan infrastructure based on usage patterns
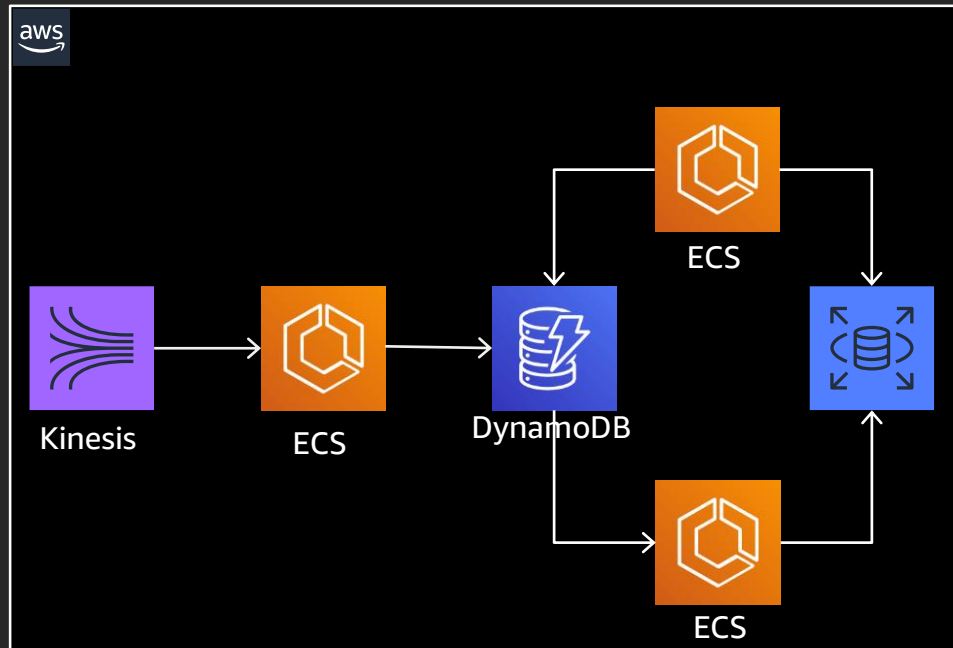- Use the billing console & Trusted Advisor

Cost optimize with serverless

Stream Kinesis
ECS reader to **DynamoDB**
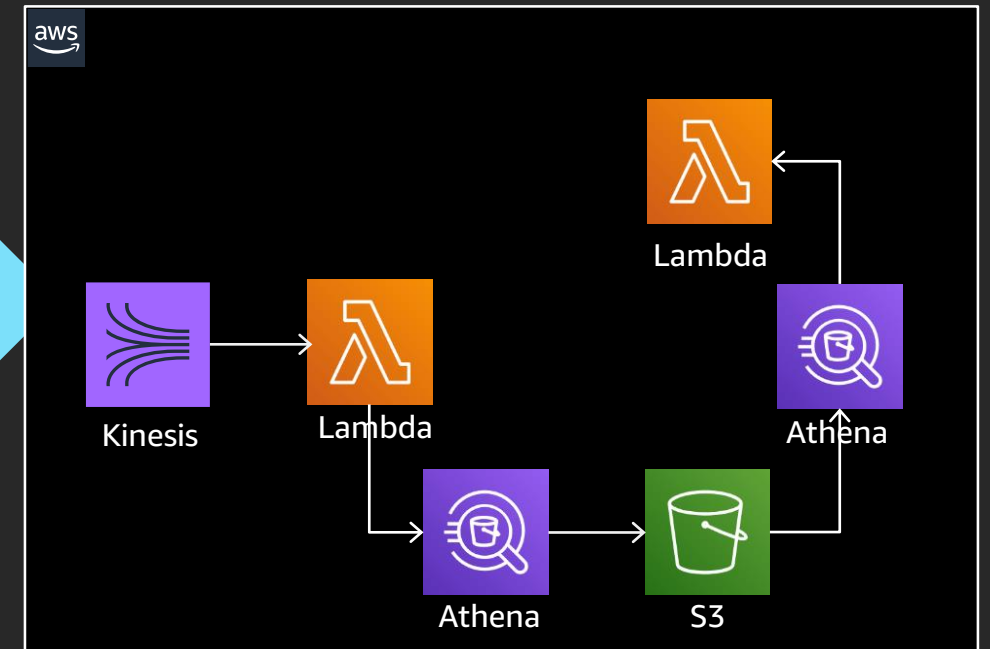Aggregator to **Amazon RDS**
Query **DynamoDB** & **Amazon RDS**

Stream Kinesis
Lambda reader to **Amazon S3**
Athena aggregator
Query **Athena** on **Amazon S3**

"You have to understand that the system you're building now is not the system you will be running in 6 months or 2 years."

Werner Vogels

CTO, Amazon.com

Delivery & operations

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Microservices—independent delivery
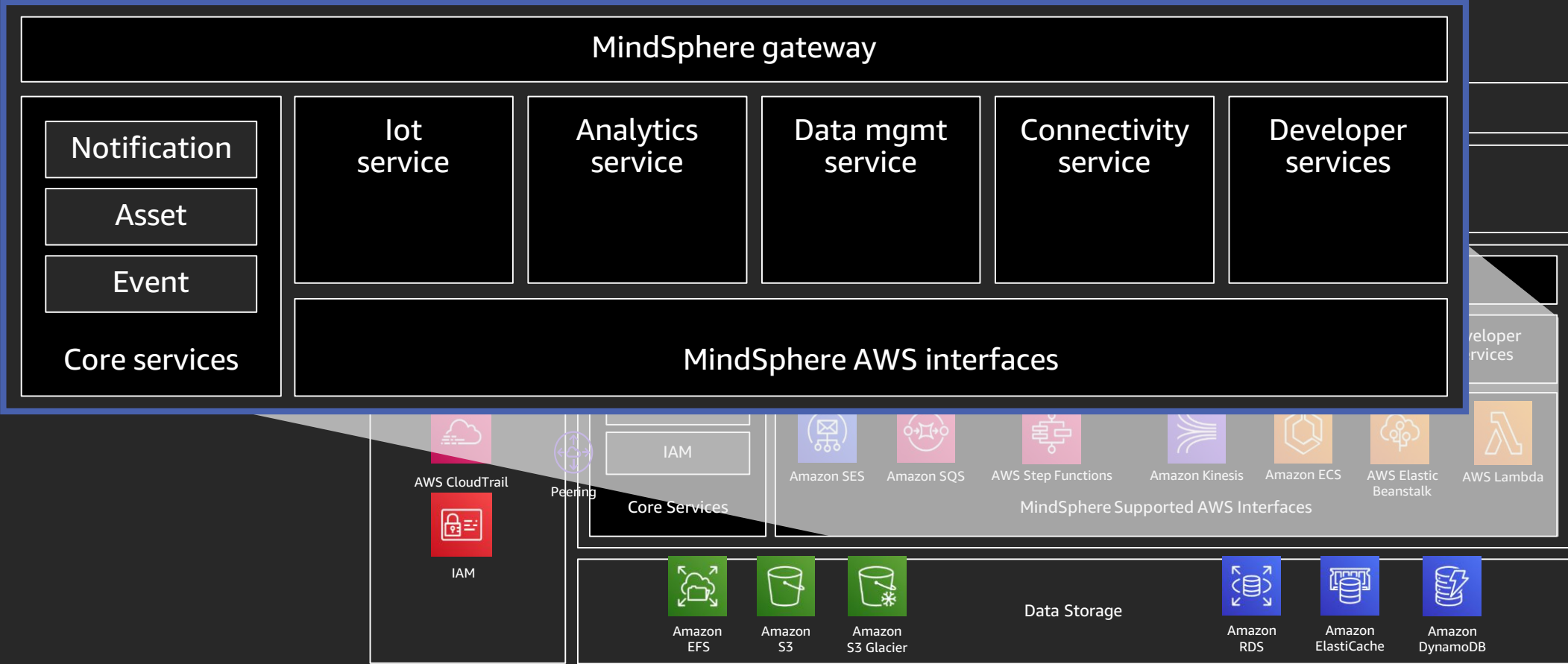
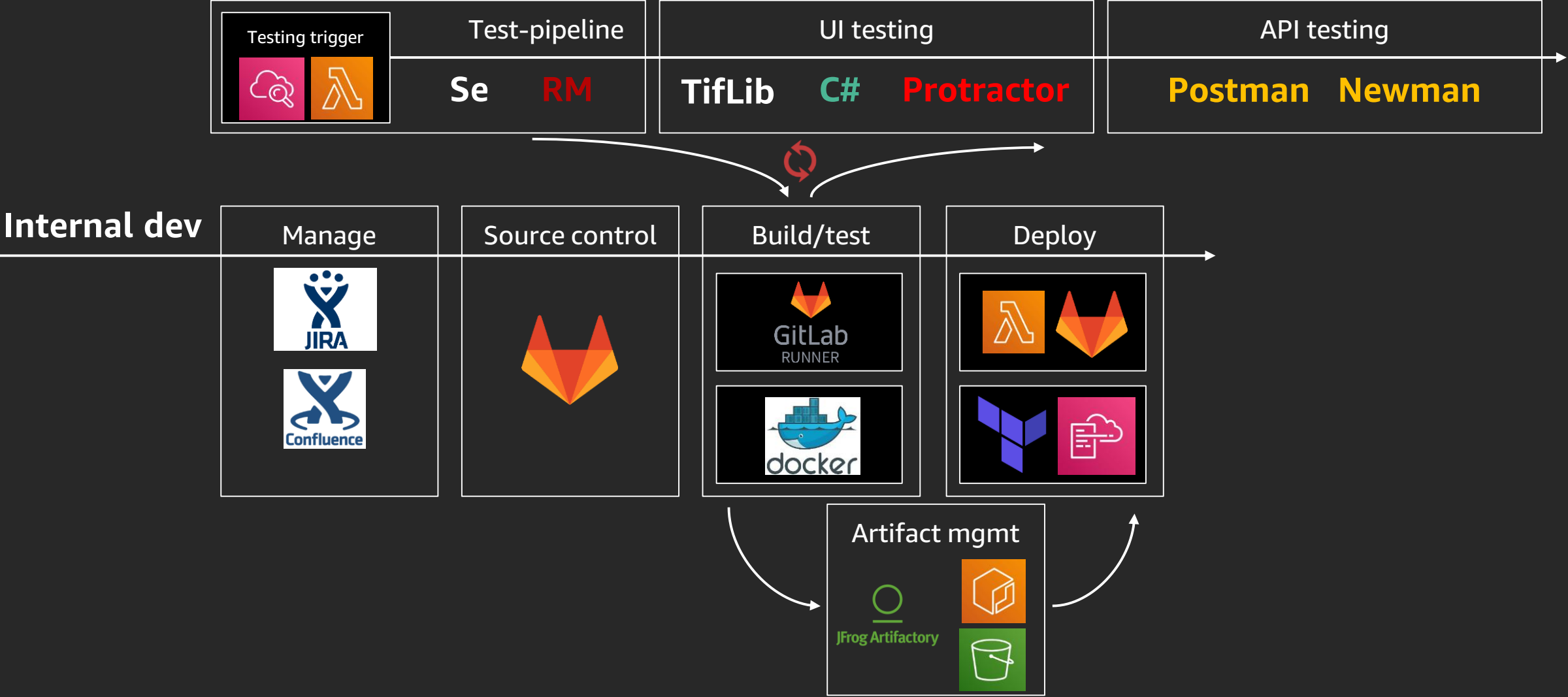# Operational readiness

Security

Quality of service:
availability & operations
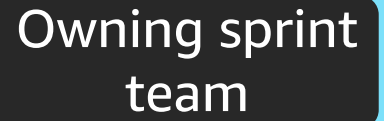
Quality concerns:
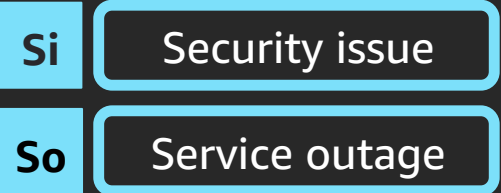DoD, E2E & defect culture

Deployment

Speed & reproducibility

Continuous monitoring

Customer support team

Incident

Ir

report

| **Si** | Security issue |
| **So** | Service outage |

→ JIRA

Amazon CloudWatch   Grafana   Guard Duty

Lambda

System generated

| **Si** | Security issue |
| **So** | Service outage |

→ pagerduty →

Central OPS
Production support

Owning sprint team

555

DevOps
Sprint teams
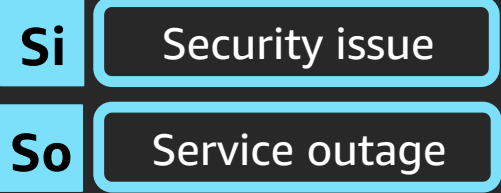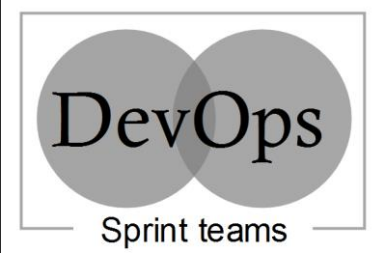
Key takeaways

✓ **Align your architecture & strategy**

✓ **Security, reliability & scalability**

✓ **Plan for change**

✓ **Monitor, analyze & improve**

✓ **Practice & experiment**

Thank you!

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