
AWS
re:Invent
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FSI310

NYSE: Protecting markets through real-time data processing

Joe Cho

Senior Technical Account Manager
AWS

Anand Pradhan

Senior Director, Head of Regulatory and NMS Technology
New York Stock Exchange

Vinil Bhandari

Director of Engineering
New York Stock Exchange

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Agenda

Trade surveillance

Intercontinental Exchange and the NYSE

Challenges of trade surveillance

Cloud migration journey

Optimization

Continuous evolution

Takeaways

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Trade surveillance

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Trade surveillance combats market abuse

- Market manipulation
- Distortion
- Rule violation
- Illegal trading practices
- Fraudulent activities
- Artificial pricing
- Misuse of information

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Intercontinental Exchange and NYSE

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Intercontinental Exchange (ICE)

- Integrated data and technology company that connects people to opportunity
- Global financial organization operating exchanges, clearing houses, data services, and mortgage technology



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New York Stock Exchange (NYSE)

- Equities exchanges: NYSE, ARCA, American, National, and Chicago
- Options exchanges: ARCA and Amex Options
- 12,000+ equities and ETFs traded
- 1.6+ million options series traded



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What is trade surveillance?



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Challenges of trade surveillance

Record ~0.5 trillion messages in a single day

< 20 usec consolidated market data latency

~35 usec order processing latency

~10TB of compressed binary real-time data per day

RegSCI resiliency requirement

~300 threat detection scenarios

~25 distinct data sources

Real-time audit trail data processing

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Migration goals

- Improve performance
- Build a scalable and resilient architecture
- Provide ease of data consumption
- Optimize infra footprint
- Support seamless failure and disaster recovery
- Reduce cost

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Migrating to AWS

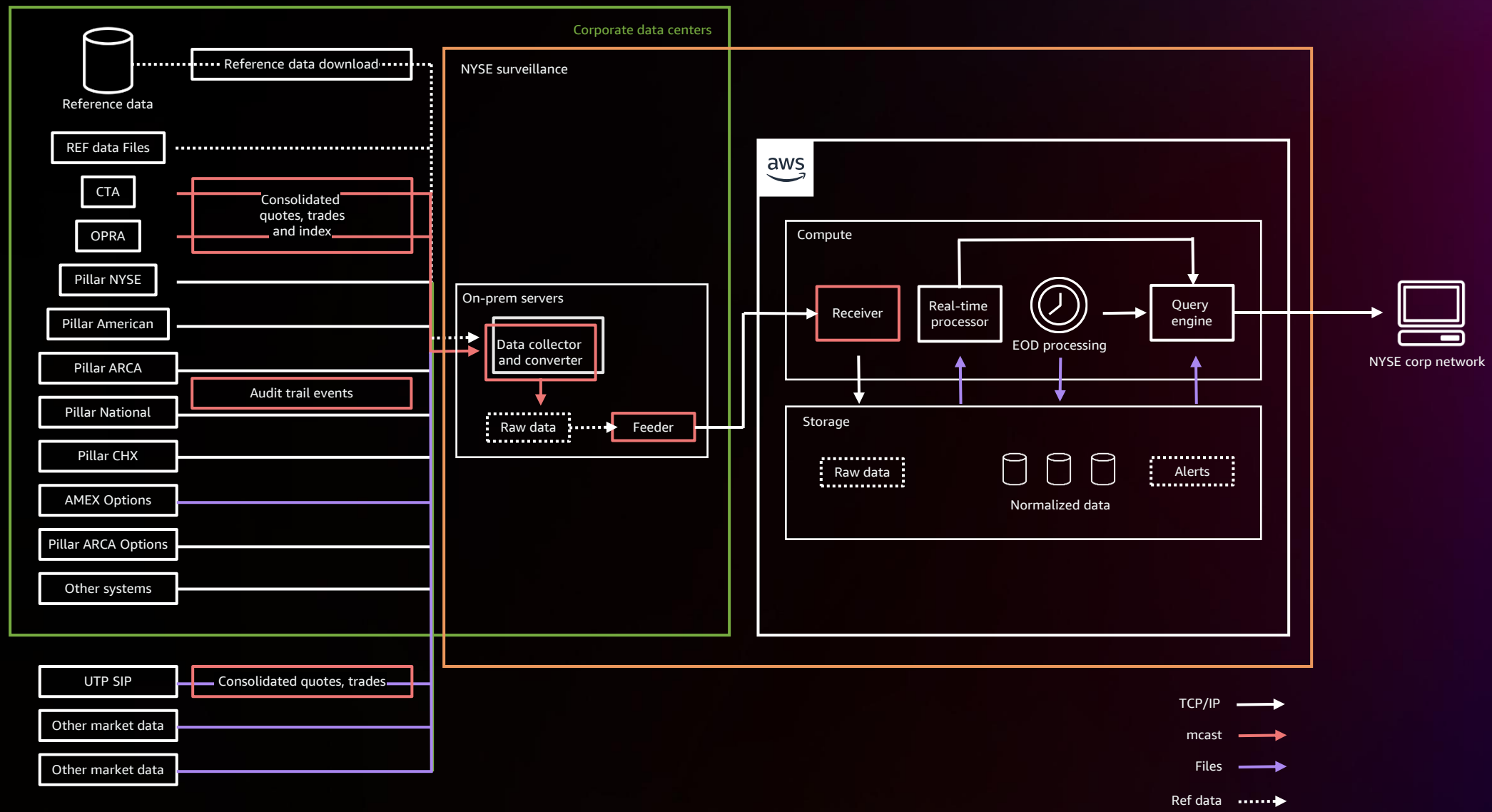
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Why AWS Cloud?

- Huge amount of infrequently accessed data
- Cushion to absorb higher geographic latency
- On-demand retro-runs on historical data
- Elastic demand based on number of parallel queries
- Huge-ingress bandwidth vs. low-egress bandwidth
- CapEx vs. OpEx
- Compliance and RegSCI coverage

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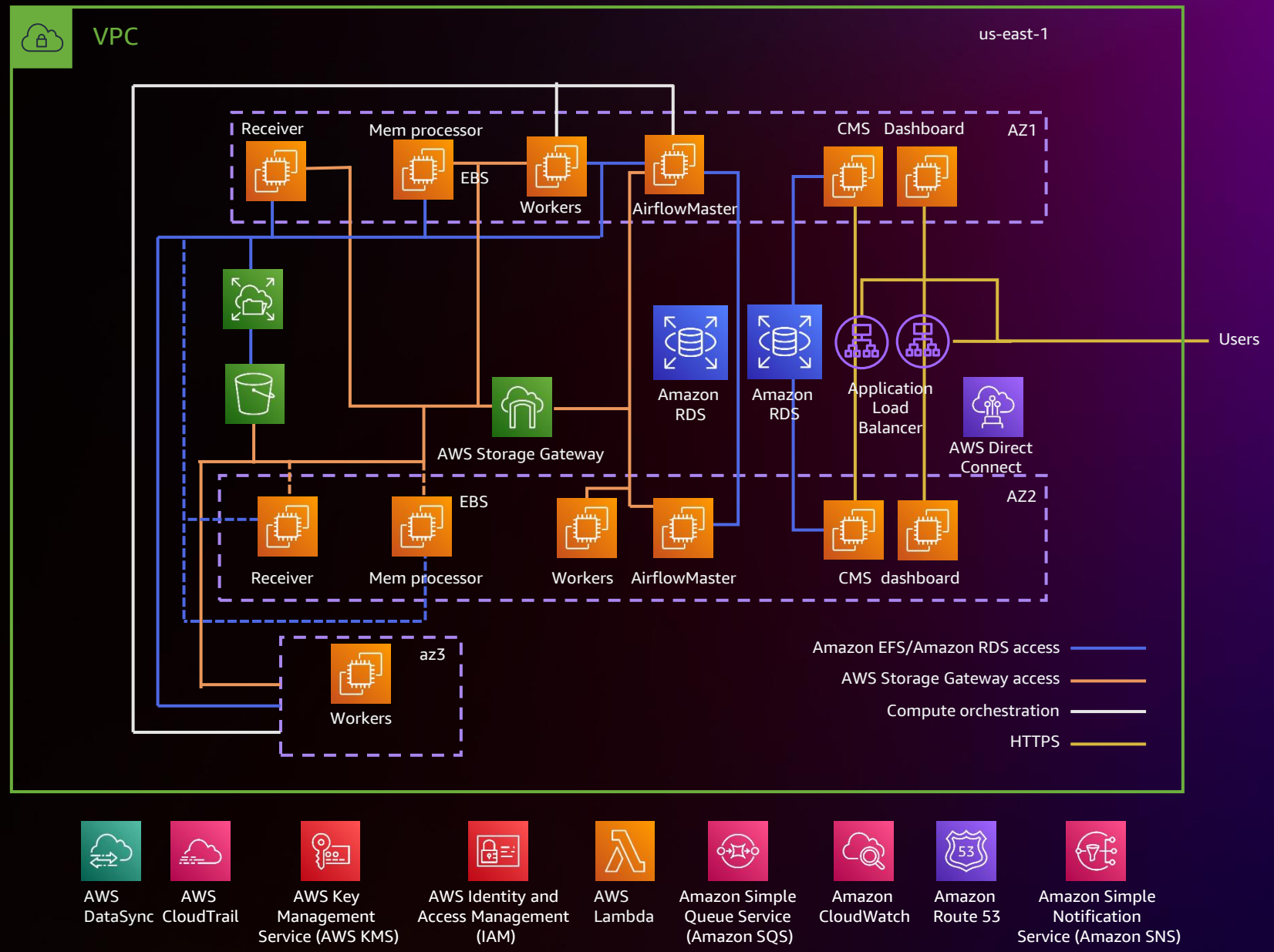
Business data flow



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Architecture

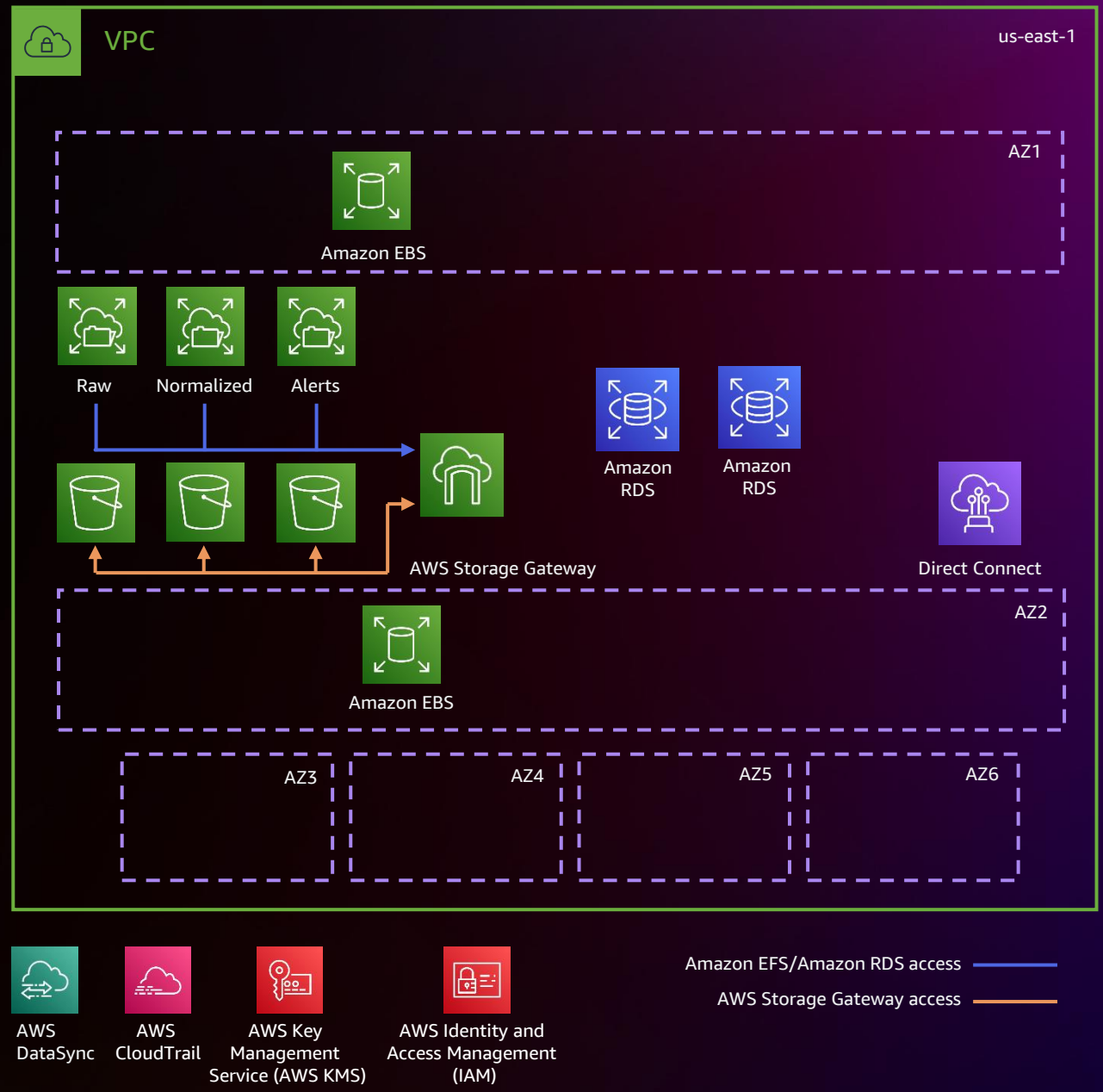
- ~40 AWS services
- End-to-end encryption
- Elastic storage, compute, and network
- Auto recovery
- AWS IAM RBACs
- Single-digit msec latency between on-prem and AWS
- IaC using AWS CDK/TF



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Storage

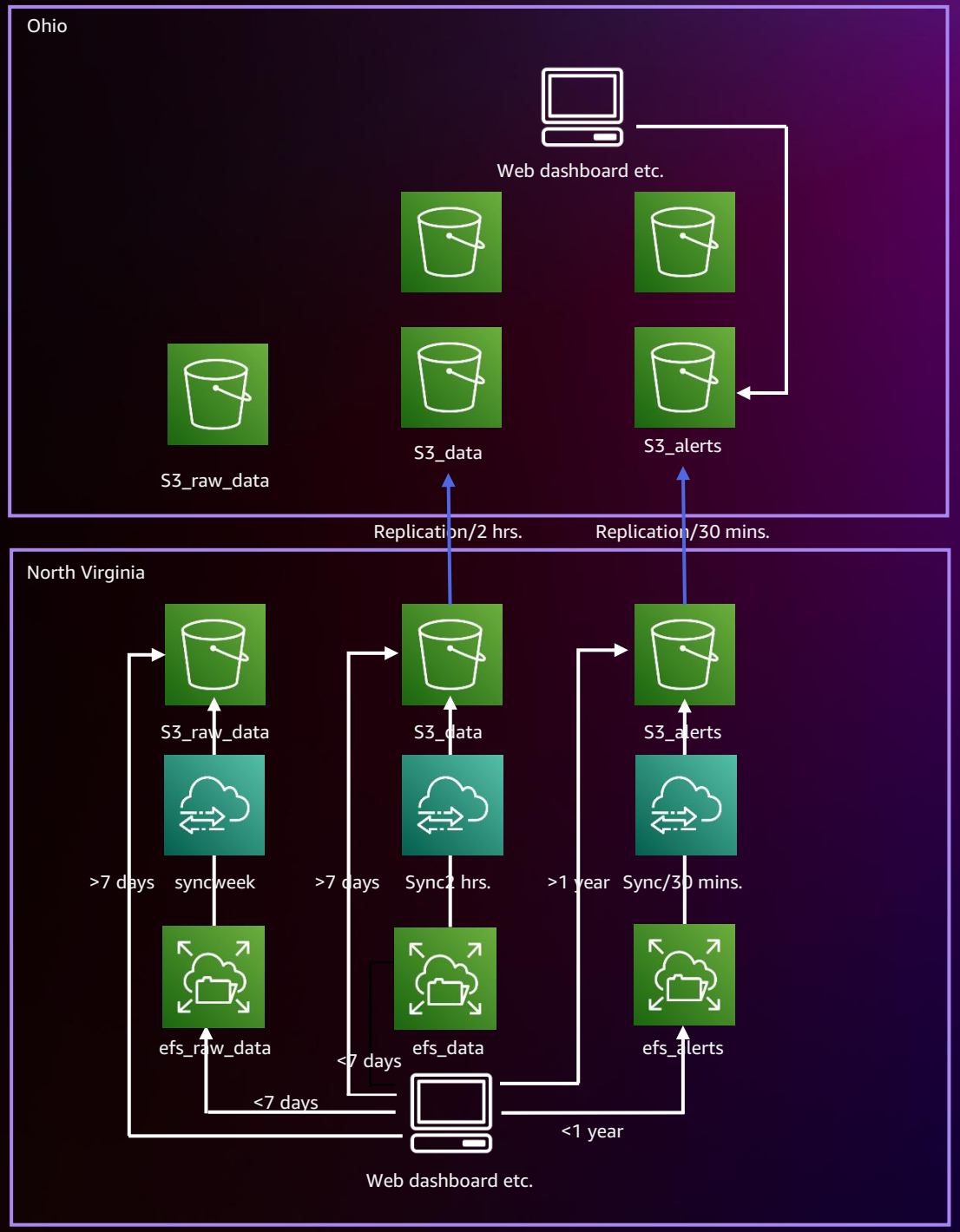
- All tiers of Amazon S3 and Amazon EFS
- Amazon EBS and Amazon RDS
- Encryption at rest
- 7+ petabytes
- 14 million objects



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Replication

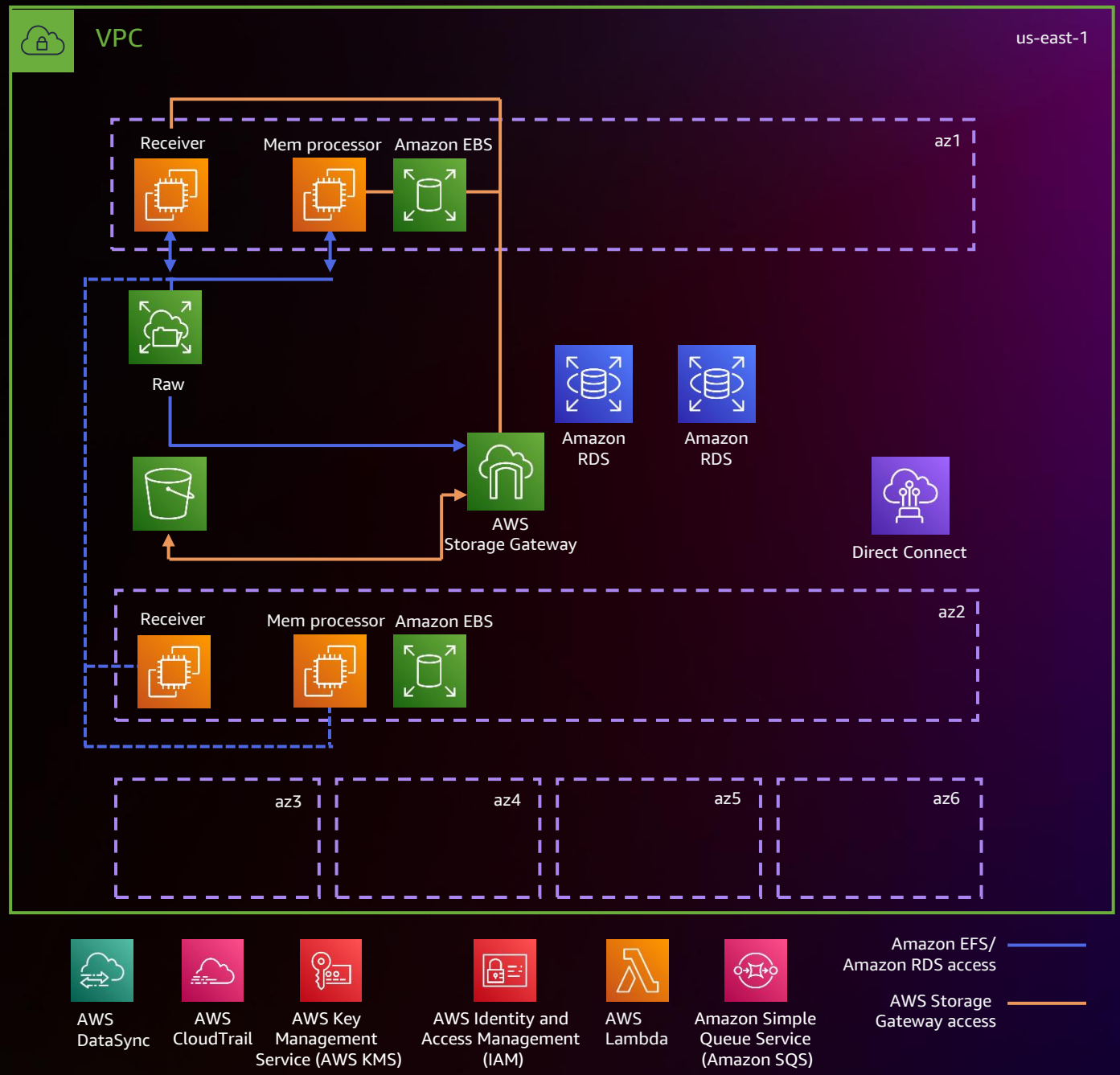
- AWS DataSync
- Amazon S3 Cross-Region Replication
- Amazon S3 lifecycle management



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Compute

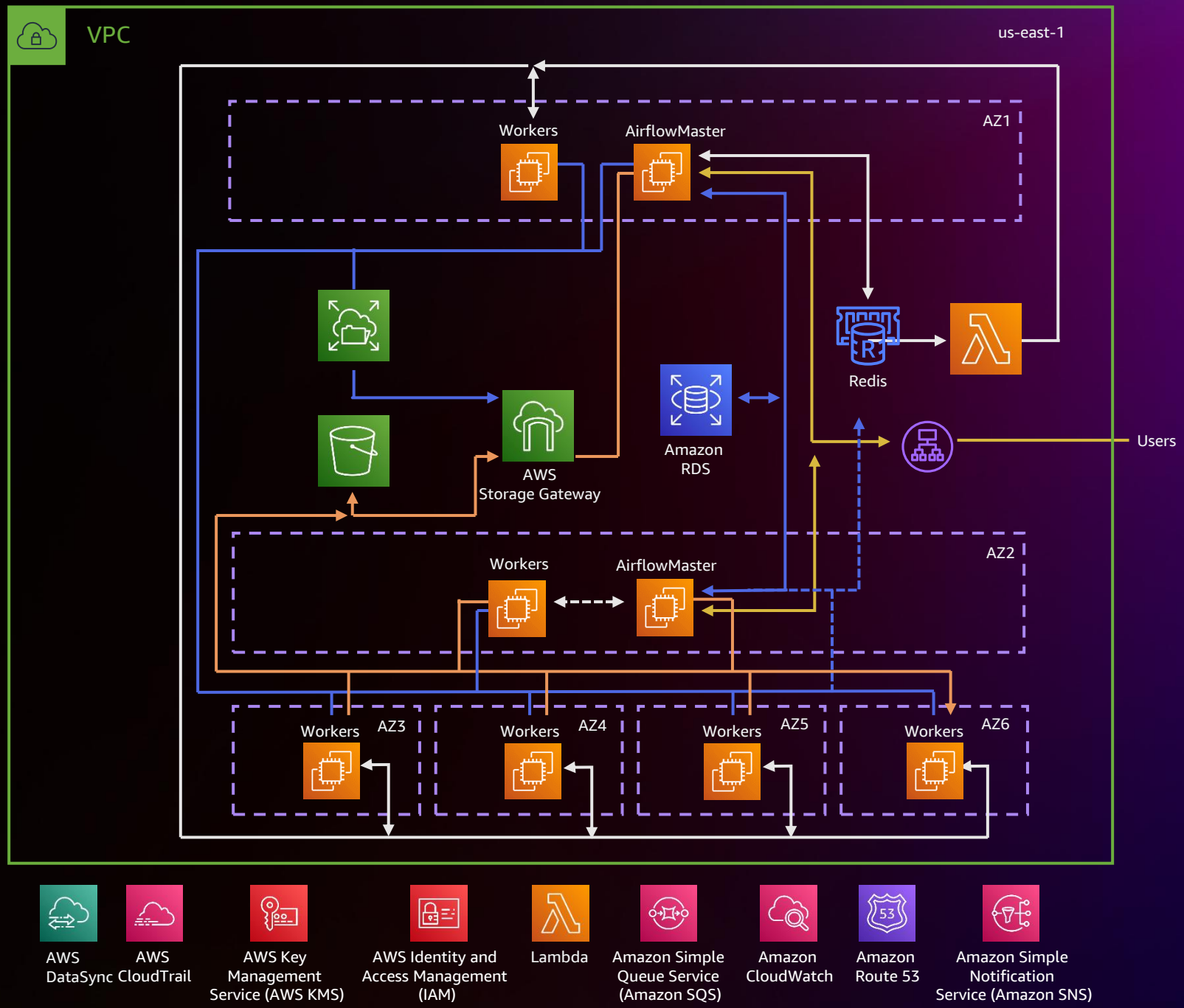
- 9 AZs in 2 regions
- ~500 billion records processed daily
- Multiple instance types
- Serverless



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Orchestration

- AWS CDK and Terraform
- Airflow
- Typical running state of 150-200 Amazon EC2 instances



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Right tool for the right job

Amazon S3 File Gateway

Store and access objects in Amazon S3 from file-based applications with local caching



Repository for machine generated data such as:

- Backups
- Archives
- Data lakes

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Agile architectural update

- AWS CDK and Terraform
- Moved from AWS Storage Gateway to Amazon EFS
- Instance optimizations – purpose built
- Expansion to more AZs



Amazon EFS



Amazon EC2
Auto Scaling



AWS Cloud
Development Kit

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Infrastructure as code

- Repeatability
- Testability
- Agility

```
import unittest
import pytest
import cdk.tests.omdutils.utils as util

#This class is using  fixtures actual_data and expected_data_class from conftest
@pytest.mark.usefixtures("actual_data")
@pytest.mark.usefixtures("expected_data_class")
class TestEC2CMSStack():
    #Unittest has many built in assertion function
    ut=unittest.TestCase()

    def test_basic_properties(self):
        instance_name=self.expected_data['instance_name']
        ami_actual = self.actual_data['Resources'][instance_name]['Properties']['ImageId']
        key_name_actual = self.actual_data['Resources'][instance_name]['Properties']['KeyName']
        encrypted_ebs_actual = self.actual_data['Resources'][instance_name]['Properties']['BlockDeviceMappings'][0]['Ebs']['Encrypted']
        self.ut.assertEqual(ami_actual, self.expected_data['ami'])
        self.ut.assertEqual(key_name_actual, self.expected_data['key_name'])
        self.ut.assertEqual(encrypted_ebs_actual, self.expected_data['encrypted_ebs'])

    def test_network_properties(self):
        instance_name = self.expected_data['instance_name']
        security_groups_actual = list(self.actual_data['Resources'][instance_name]['Properties']['SecurityGroupIds'])
        security_groups_actual = sorted(security_groups_actual, key = lambda i: i['Fn::ImportValue'])
        security_groups_expected = sorted(self.expected_data["security_groups"], key = lambda i: i['Fn::ImportValue'])

        subnet_id_actual = self.actual_data['Resources'][instance_name]['Properties']['SubnetId']
        availability_zone_actual = self.actual_data['Resources'][instance_name]['Properties']['AvailabilityZone']

        self.ut.assertListEqual(security_groups_actual, security_groups_expected)
        self.ut.assertEqual(subnet_id_actual, self.expected_data['subnet_id'])
        self.ut.assertEqual(availability_zone_actual, self.expected_data['availability_zone'])
```

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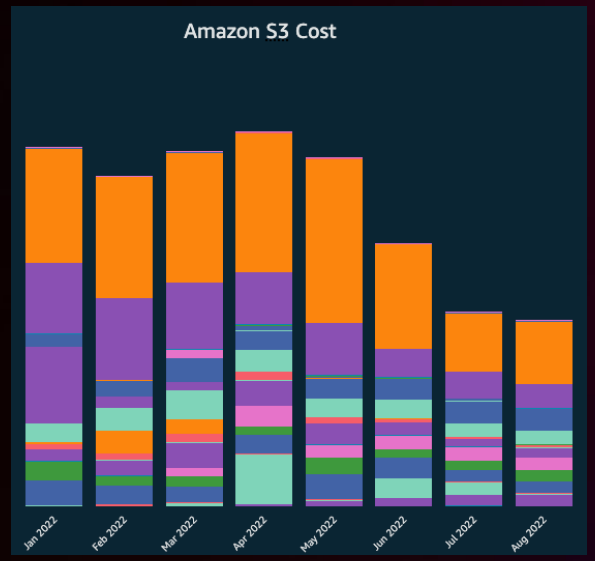
Optimizations

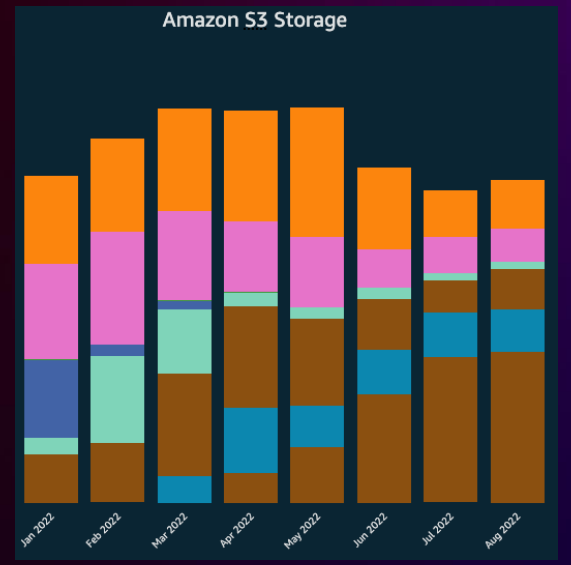
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Optimizations

- Cost reduction by 40%
- Amazon S3 versioning and lifecycle management
- Amazon EC2 Spot Instances
- Right sizing
- Bandwidth expansion between on-premises and AWS







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Continuous evolution

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Evolving further

- Looking further at optimizing Amazon EFS
- EFS lower latencies
- EFS Elastic Throughput
- EFS One Day Life Cycle
- Exploring other storage types, Amazon FSx Lustre, others



Amazon EFS



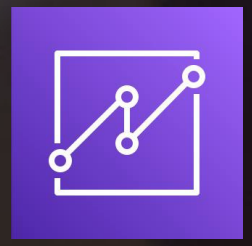
Amazon FSx for Lustre

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NYSE analytics

- Analytics with Amazon QuickSight
- QuickSight Asset Management
- AI/ML with Amazon SageMaker



Amazon QuickSight



Amazon SageMaker

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Takeaways

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Takeaways

- Enterprise-wide cultural shift, support from senior management
- Flexibility helps in innovation and optimization
- Technology compliance, security, and RegSCI process for cloud applications
- Upfront and ongoing effort to upskill staff

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“The world is indeed full of peril, and in it there are many dark places. But still, there is much that is fair. . . ”

Gandalf, *The Fellowship of the Ring*

J.R.R. Tolkien

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Thank you!

Joe Cho
/joe-cho

Anand Pradhan
/anandspradhan

Vinil Bhandari
/vinilbhandari



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