# AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

STG202

# Simplify your file-based workloads with Amazon FSx


Edward Naim
General Manager, Amazon FSx
AWS

Andy Crudge
Principal Product Manager
AWS

Norm Nadeau
VP of Site Reliability
Pearson


© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Agenda

- Introduction to Amazon FSx
- Moving or extending existing apps and storage to the cloud
- Building new data-intensive workloads
- Fully automated management and robust security with Amazon FSx
- Pearson’s migration to Amazon FSx for NetApp ONTAP

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

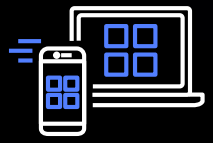
# Why are customers moving to AWS?



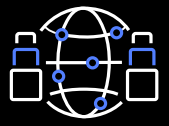
Elasticity



Functionality



Agility



Global infrastructure



Cost-optimized



**Better ROI**



**Faster time to results**

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Why do customers use file storage?

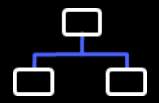
File storage provides . . .



Simple experience



Shared access



High performance



Rich data capabilities

File storage is commonly used with **existing applications**…

…and to support **net-new workloads**

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# No one-size-fits-all storage solution

Each file system offers customers a unique combination of:



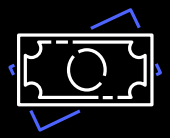
Feature sets



Performance characteristics



Data management capabilities



Cost profiles

Migrating existing workloads to a different storage solution often requires **re-architecting, re-certifying, and re-training**

Customers building new workloads are looking for a **storage solution that's optimized** for their workload

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# FSx = File Systemx

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# What does *x* represent?



**Your choice for your workload**

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# What do we mean by *your choice*?



Launch, run, and scale . . .



feature-rich, high-performance, cost-effective, and fully managed storage . . .

Amazon FSx for NetApp ONTAP

Amazon FSx for OpenZFS

Amazon FSx for Windows File Server

Amazon FSx for Lustre

powered by **your choice** of the world's most popular file systems

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# What are some example *workloads*?



Corporate IT applications



Database applications



Home directories



Software build environments



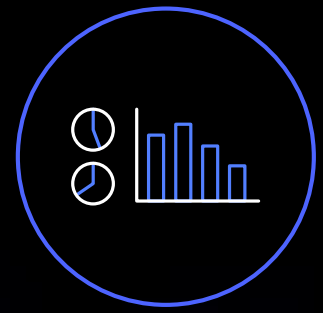
High performance computing



Machine learning



Media rendering and transcoding



Big data analytics

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Amazon FSx has changed the game for file storage in the cloud



## Move or extend existing apps and storage to the cloud

1. What you have is what you get
2. Broadest set of cost-management capabilities
3. Data access from virtually anywhere



## Build new data-intensive workloads

1. Bleeding-edge performance
2. Continual improvement of price-perf
3. Easy experimentation at scale

\+ Fully automated management and robust security

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

JOHN HOLLAND

John Holland Group actively migrated more than **90 key applications** to FSx for Windows File Server **within 48 hours**

"Amazon FSx for Windows File Server **hasn't missed a beat**. The speed, the stability, and the ability to tune throughput speed and availability to our environment are quite positive for us."

**Kier Morrison**
GM of IT Operations

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.




BlackThorn Therapeutics uses Amazon FSx for Lustre to **process magnetic imaging (MRI) data**.

"FSx for Lustre has enabled us to create a **high-performance MRI data processing pipeline**. Data processing time for our ML-based workflows was **cut down to minutes compared to days and weeks**."

**Oscar Rodriguez**
Senior Director, Innovation & Technology

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Amazon FSx has changed the game for file storage in the cloud



## Move or extend existing apps and storage to the cloud

1. What you have is what you get
2. Broadest set of cost-management capabilities
3. Data access from virtually anywhere



## Build new data-intensive workloads

1. Bleeding-edge performance
2. Continual improvement of price-perf
3. Easy experimentation at scale

\+ Fully automated management and robust security

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Amazon FSx has changed the game for file storage in the cloud



## Move or extend existing apps and storage to the cloud

1. What you have is what you get
2. Broadest set of cost-management capabilities
3. Data access from virtually anywhere



## Build new data-intensive workloads

1. Bleeding-edge performance
2. Continual improvement of price-perf
3. Easy experimentation at scale

\+ Fully automated management and robust security

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 1 Amazon FSx is designed to provide 100% compatibility

Amazon FSx provides complete, fully managed deployments of . . .




NetApp ONTAP




OpenZFS




Windows Server




Lustre

with the **familiar features and APIs** customers use on-premises

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 1 What you have is what you get
## > Move or extend easily and quickly



File systems with familiar capabilities and APIs

- Feature set
- Performance profile
- Data management capabilities




© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 2 Broadest set of cost management capabilities
## > Reduce total cost of ownership



Fully elastic capacity storage and backups

Data compression, deduplication, and compaction

Automatic hot/cold tiering of data

Storage quotas

Dynamic scaling of performance

✓ Fine-tune TCO for your application needs

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 2 Cost-effective ONTAP storage in the cloud

## Storage tiers

SSD storage
- Sub-ms latencies
- Optimized for active data

Capacity pool storage
- Fully elastic (automatically grows/shrinks)
- Cost-optimized for infrequently accessed data



~20% of data





ONTAP's **built-in, automatic data tiering**
- Optimized for file workloads
- Intelligent and bidirectional



~80% of data



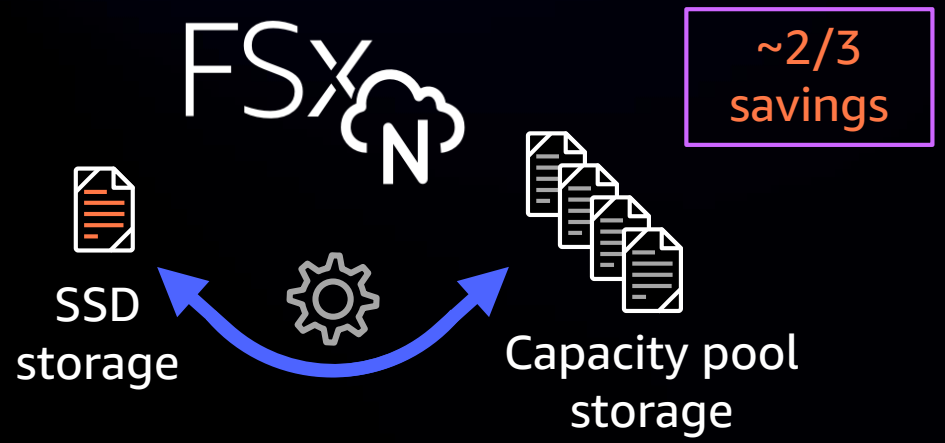
SSD performance for a fraction of the cost

aws

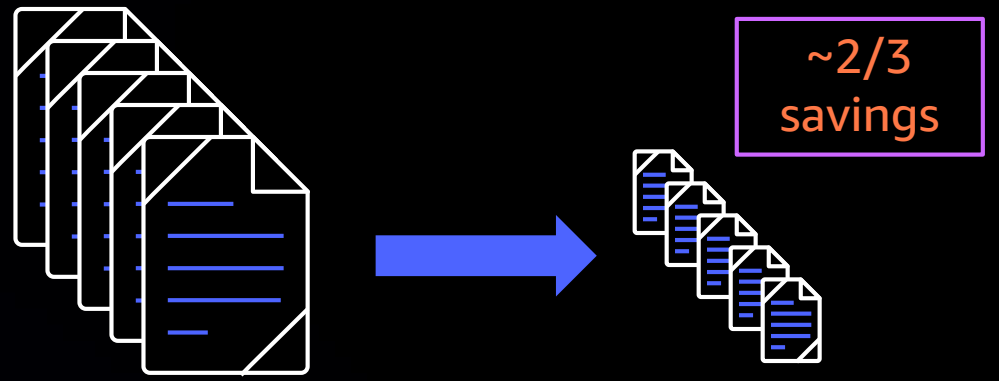
© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 2 Cost-effective ONTAP storage in the cloud

## Intelligent data tiering




## Data compression & deduplication




For a typical data set:

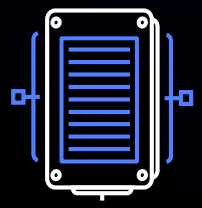
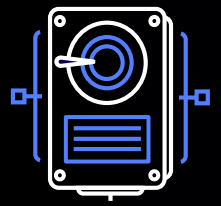
88% cost savings

$0.030/GB-mo storage cost

Note: Based on FSx for ONTAP pricing in US East (N. Virginia)

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 2 Cost-effective Windows storage in the cloud

| | Single-AZ (per GB-month) | Multi-AZ (per GB-month) |
|---|---|---|
|  SSD | 6.5 cents | 11.5 cents |
|  HDD | 0.65 cents | 1.25 cents |

Typical savings from deduplication and compression for general file shares is ~50%

Note: Based on FSx for Windows File Server pricing in US East (N. Virginia)

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 2 Lustre storage options optimized for price-performance

| Storage type | Baseline throughput per TiB | Price per GB/s-hour |
|---|---|---|
| HDD Persistent | 12 MB/s | $2.85 |
| | 40 MB/s | $2.85 |
| NEW SSD Persistent | 125 MB/s | $1.59 |
| | 250 MB/s | $1.15 |
| | 500 MB/s | $0.93 |
| | 1000 MB/s | $0.82 |

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 3 FSx file systems enable data access from virtually anywhere: ONTAP example

## Operating system

Microsoft Windows

Linux

macOS

## Protocol

NFS (versions 3, 4, 4.1, 4.2)

SMB (versions 2.x, 3.x)

iSCSI

## Compute instance


Amazon EC2


Amazon WorkSpaces

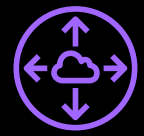

Amazon ECS


Amazon AppStream 2.0


Amazon EKS


VMware Cloud

## Networking and caching

In-VPC access, VPC peering, and AWS Transit Gateway


AWS Direct Connect


AWS VPN

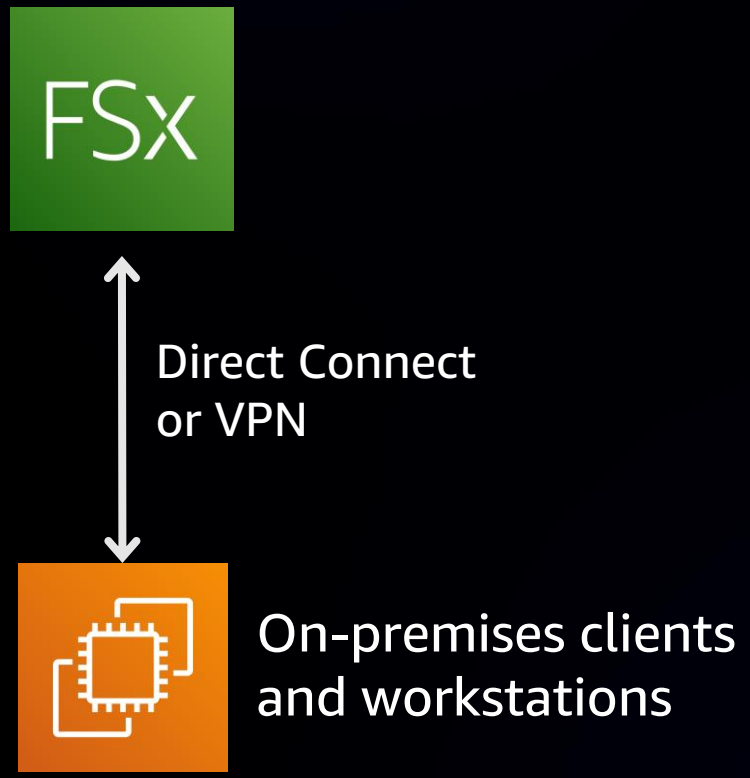

NetApp Global File Cache

aws

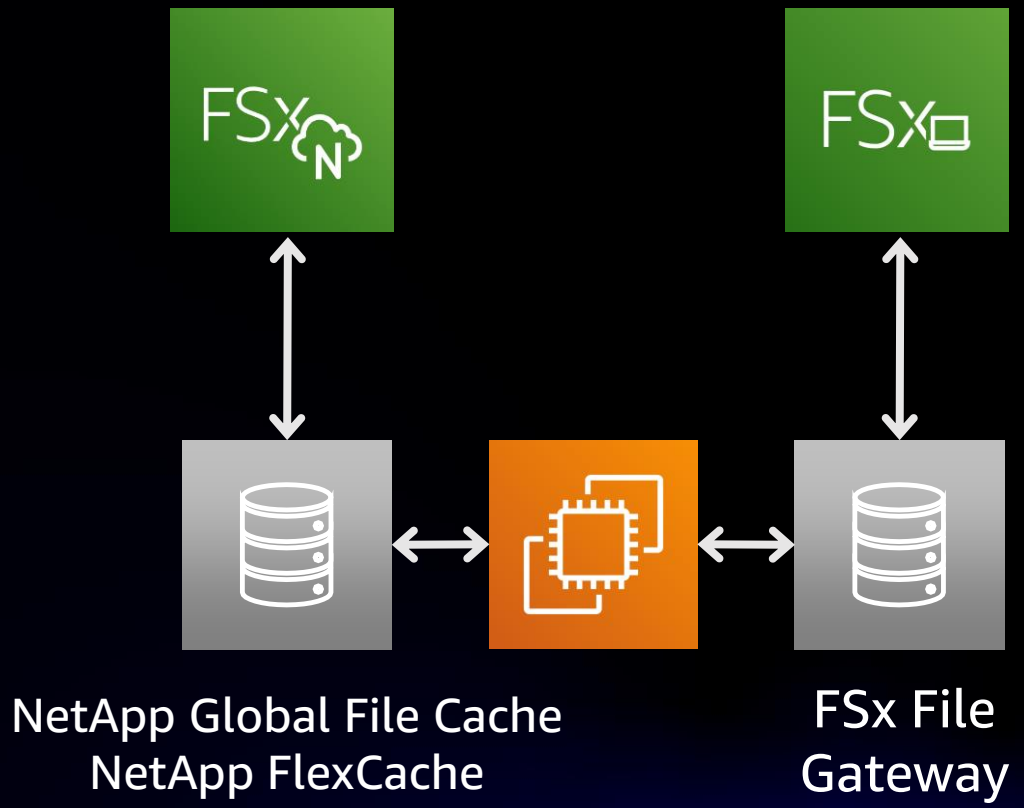
© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 3 Fast access to your data from on premises

## Direct access from on premises



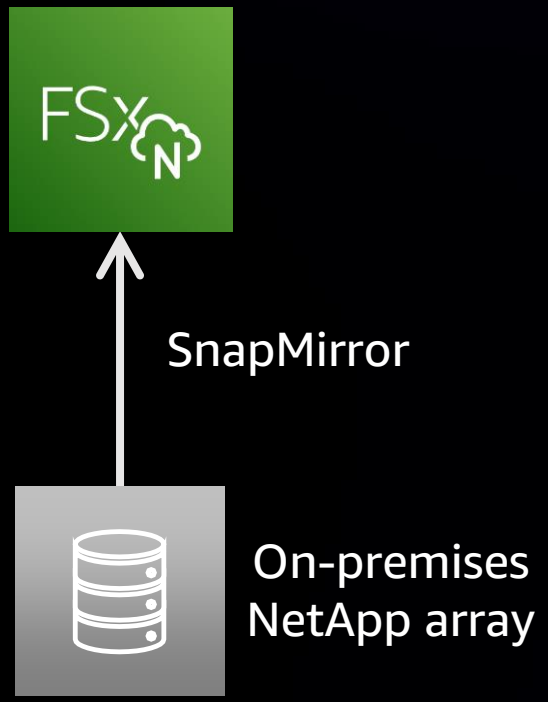

## With on-premises caching



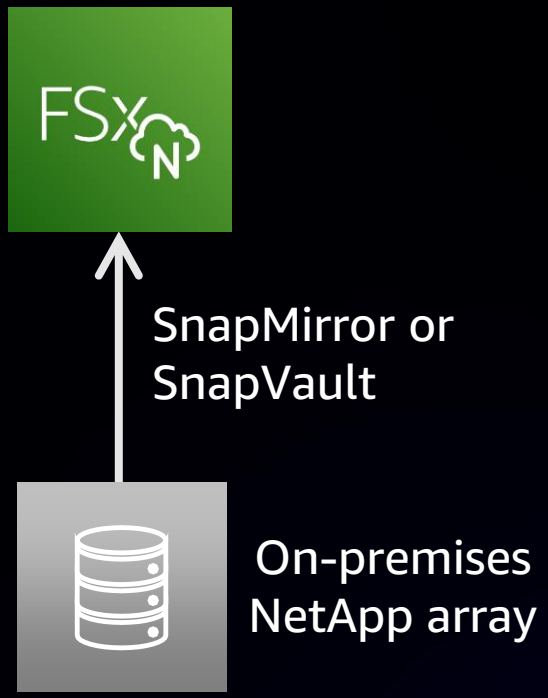

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 3 Easily extend ONTAP to the cloud

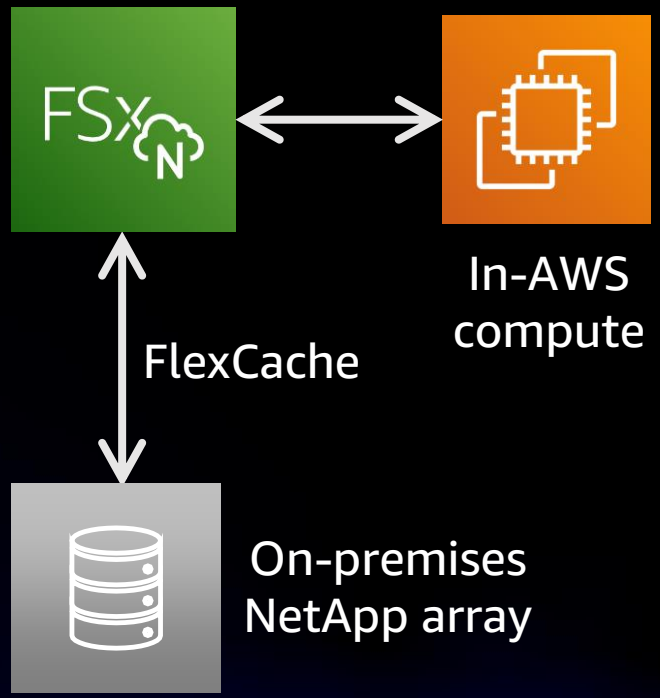
## Migration




## Disaster recovery




## Cloud bursting




© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Amazon FSx has changed the game for file storage in the cloud



## Move or extend existing apps and storage to the cloud

1. What you have is what you get
2. Broadest set of cost-management capabilities
3. Data access from virtually anywhere



## Build new data-intensive workloads

1. Bleeding-edge performance
2. Continual improvement of price-perf
3. Easy experimentation at scale

\+ Fully automated management and robust security

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Amazon FSx has changed the game for file storage in the cloud



## Move or extend existing apps and storage to the cloud

1. What you have is what you get
2. Broadest set of cost-management capabilities
3. Data access from virtually anywhere



## Build new data-intensive workloads

1. Bleeding-edge performance
2. Continual improvement of price-perf
3. Easy experimentation at scale

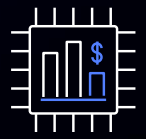
\+ Fully automated management and robust security

aws

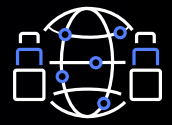
© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 1 Bleeding-edge performance

## > Run your highly demanding high-perf applications



**Built on latest AWS tech**
for higher performance and lower TCO



**Massive parallel access**
From up to hundreds of thousands of cores



**Highest scale/virtually unlimited scale**
Up to multi-TB/s throughput
Up to millions of IOPS



**Lowest latencies/ultra-low latencies**
As low as a few hundred microseconds

✓ Run your highly demanding, latency-sensitive, throughput-heavy or IOPS-intensive applications

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 1 Choice of scale-up and scale-out file systems



| | Scale-up | Scale-out |
|---|---|---|
| File systems | NetApp ONTAP<br>OpenZFS<br>Windows File Server | Lustre |
| Benefit | Ultra-low latencies | Virtually unlimited throughput |

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 2 Continual improvement of price-perf

## > Save costs for the same performance



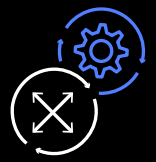
Pick storage media and replication level



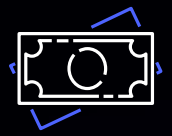
Automatic tiering to lower-cost storage



Data compression and deduplication



Provision and scale perf independently from storage



Low price for throughput



No request costs for SSD/HDD storage

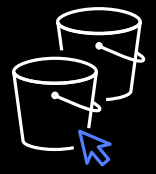
✓ Run performance-intensive workloads at optimal costs

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# 3 Easy experimentation at scale
## > Do more with your data and innovate more quickly



Snapshots to store and recover previous versions of files



Instant data cloning to spawn test/dev versions of dataset




Amazon S3 linking to process S3 datasets with high-perf file system

✓ More easily build and run data-intensive apps at scale
✓ Enable rapid experimentation and faster innovation

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Amazon FSx has changed the game for file storage in the cloud



## Move or extend existing apps and storage to the cloud

1. What you have is what you get
2. Broadest set of cost-management capabilities
3. Data access from virtually anywhere



## Build new data-intensive workloads

1. Bleeding-edge performance
2. Continual improvement of price-perf
3. Easy experimentation at scale

\+ Fully automated management and robust security

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Amazon FSx has changed the game for file storage in the cloud



## Move or extend existing apps and storage to the cloud

1. What you have is what you get
2. Broadest set of cost-management capabilities
3. Data access from virtually anywhere



## Build new data-intensive workloads

1. Bleeding-edge performance
2. Continual improvement of price-perf
3. Easy experimentation at scale

\+ Fully automated management and robust security

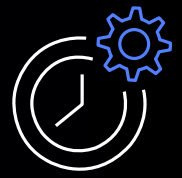
aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Fully automated management
## > Increase business agility



Launch and scale file storage in minutes



Automatic replication and failover



Automatic backups and maintenance



Automatic encryption in transit and at rest

✓ Focus more on your application
✓ Respond quickly to changing business needs

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Robust security

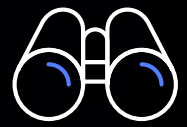
## > Increase security and achieve compliance



Data encrypted at rest and in transit



Integration with your organization's Active Directory



Antivirus protection



File access auditing



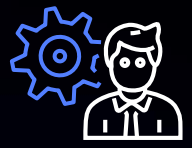
Admin API access control and monitoring

AWS Identity and Access Management (IAM), AWS CloudTrail



Network traffic access control

VPC security groups



File-level permissions

POSIX, NFS ACLs, Windows ACLs



Industry-standard compliance eligibility

PCI-DSS, ISO, SOC, IRAP, GDPR, HIPAA

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Pearson – Who are we?




**Hundreds of millions of learners**



**Nearly 200 countries**

Pearson

**Pearson is a global provider of educational content, assessment, and digital services to learners and enterprises**

**Optimized costs**

**Increased scalability**

**Increased agility**

**Improved innovation**

**Since 2012, Pearson has been using AWS**

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# TEP – The Enabling Program



- Started in 2016
- The Enabling Program (TEP) is a key strategic project
- Simplify and standardize Pearson's systems, policies and processes across Finance, Operations, and HR
- Enabling Pearson to do things in a more globally consistent way to be more efficient
- Consists of many backend systems that create one ERP system for Pearson

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Why FSx for ONTAP – Pearson



Bleeding-edge performance

- Application jobs run 3x faster
- 10x faster cloning and refresh speed
- RPO/RTO down from hours to minutes

Broadest set of cost management capabilities

- Reduced storage capacity by 46%

Fully automated management

- Initial testing to production in under 2 months
- Managed service – support staff had no previous NetApp expertise

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# What's next – Pearson

- DR for NetApp estate in data centers
- Media server content for higher education
- Code repositories



© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

# Thank you!

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.