Managed services Lustre on AWS
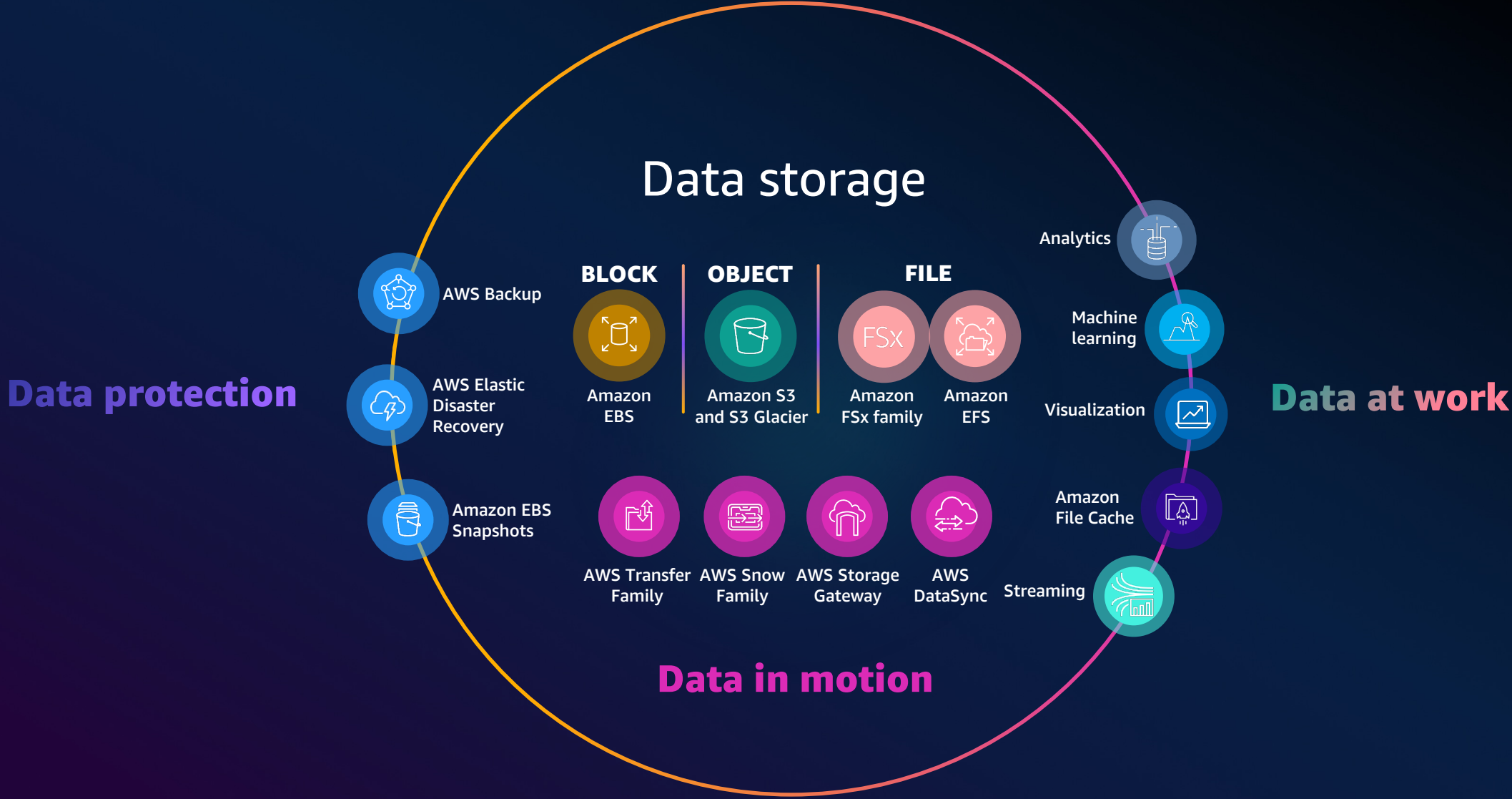
Meriem Belhadj
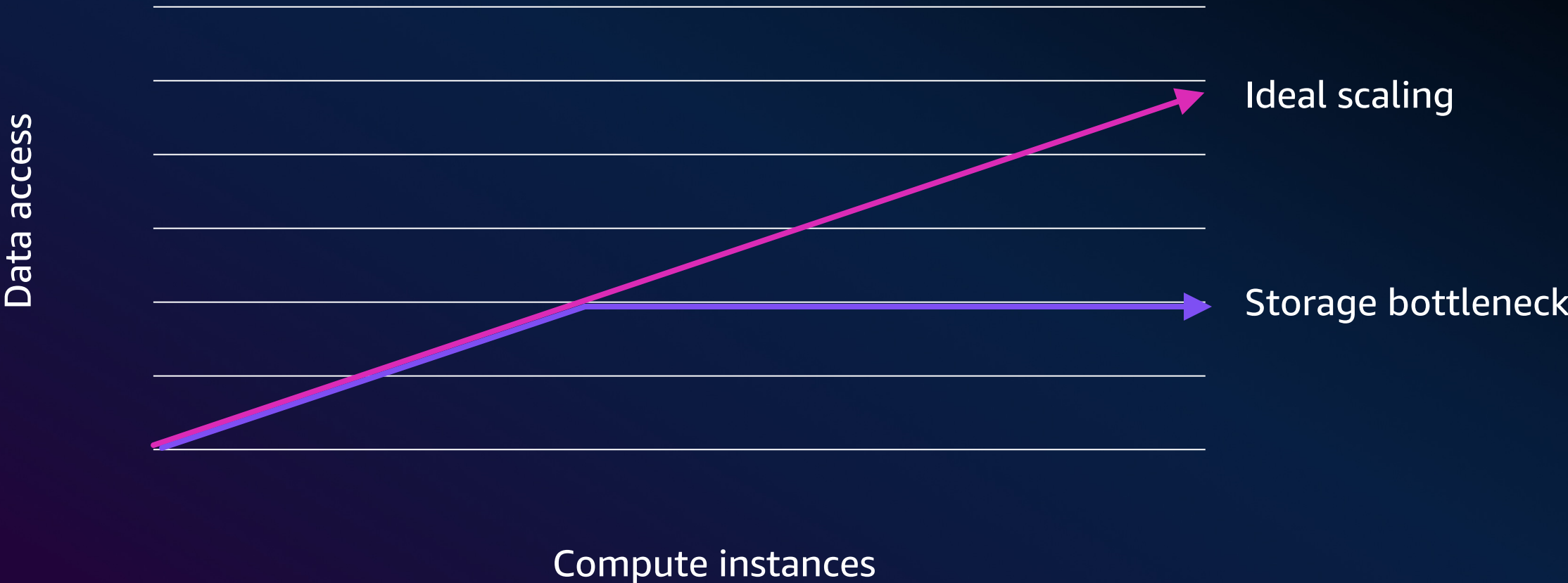
Sr. Storage Specialist Solutions Architect
Amazon Web Services

AWS cloud storage portfolio

Data storage

Data protection

- AWS Backup
- AWS Elastic Disaster Recovery
- Amazon EBS Snapshots

BLOCK — Amazon EBS

OBJECT — Amazon S3 and S3 Glacier

FILE — Amazon FSx family, Amazon EFS

Data in motion

- AWS Transfer Family
- AWS Snow Family
- AWS Storage Gateway
- AWS DataSync

Data at work

- Analytics
- Machine learning
- Visualization
- Amazon File Cache
- Streaming

Reduce time to results by running compute-heavy workloads on AWS

Finite capacity on-premises

Virtually unlimited capacity on cloud

Fixed data center capacity limit

Scalable compute requires scalable data access

Data access

Ideal scaling

Storage bottleneck

Compute instances

FSx for Lustre: Designed for the most compute-intensive workloads

By industry

Financial services

Life sciences

Media and entertainment

Automotive

Semiconductor

Oil and gas

By application area

Big data analytics

Machine learning

High-performance computing

Amazon FSx for Lustre
The power of Lustre, fully-managed

Tested and operated at an unprecedented scale

Automatic infrastructure monitoring and replacement

Unified support experience

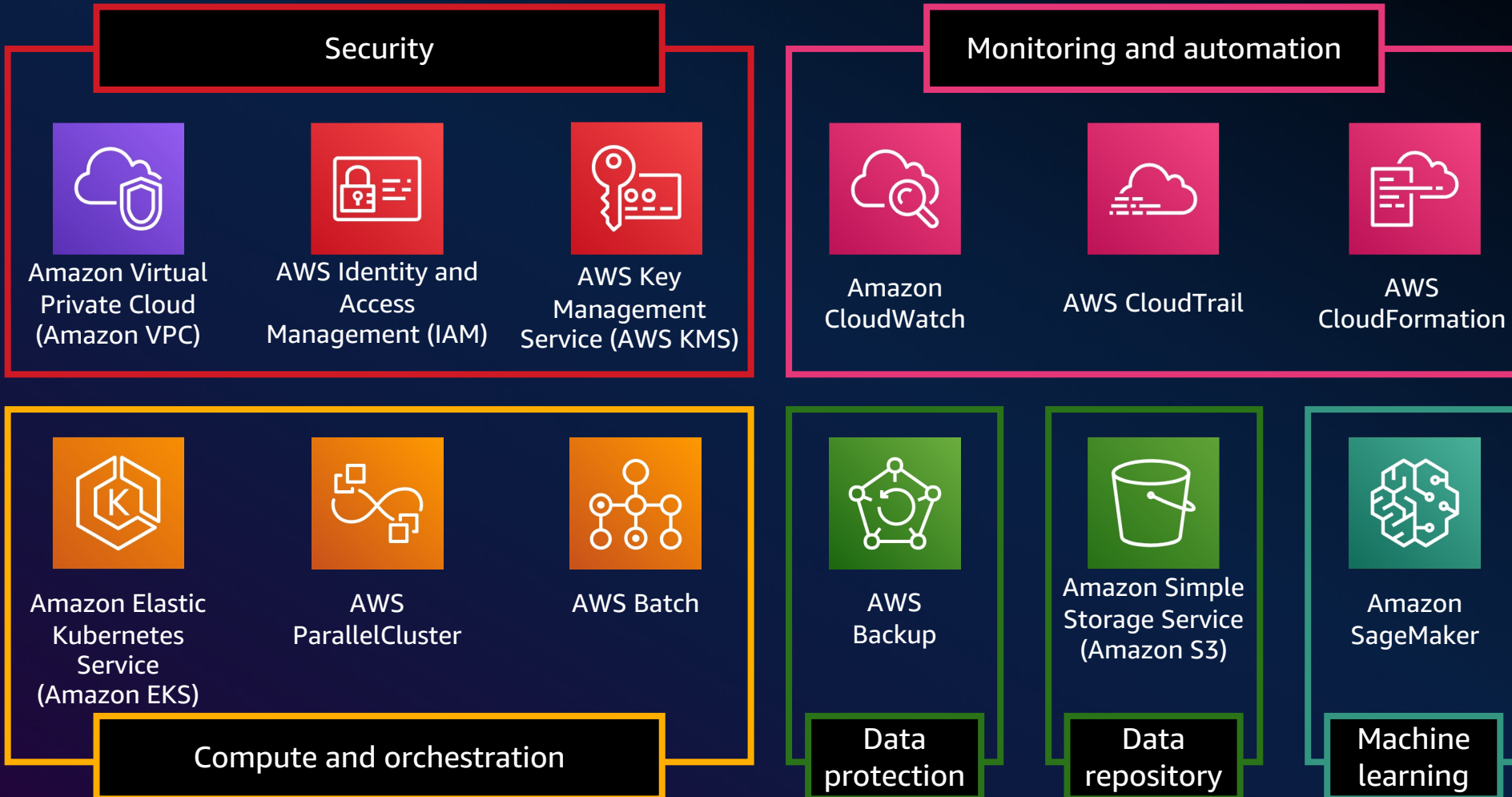Designed and tuned to optimize AWS resources

Automatic and secure backups
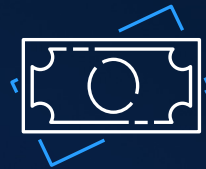
API for infrastructure as code

...and natively integrated into AWS

Security

Amazon Virtual Private Cloud (Amazon VPC)

AWS Identity and Access Management (IAM)

AWS Key Management Service (AWS KMS)

Monitoring and automation

Amazon CloudWatch

AWS CloudTrail

AWS CloudFormation

Compute and orchestration

Amazon Elastic Kubernetes Service (Amazon EKS)

AWS ParallelCluster

AWS Batch

AWS Backup

Data protection

Amazon Simple Storage Service (Amazon S3)

Data repository

Amazon SageMaker

Machine learning

What FSx for Lustre brings to your workloads

Highly scalable
throughput
capacity

Storage options
optimized for
price performance

Integrate data lakes
through a fast file
interface

What FSx for Lustre brings to your workloads

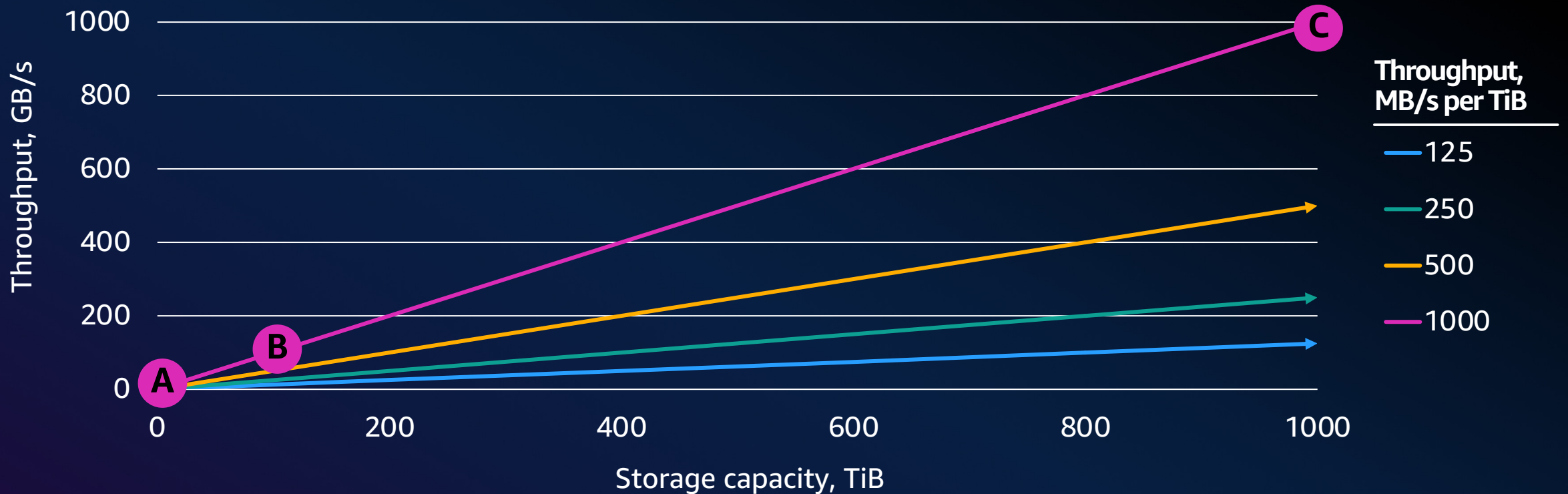**Highly scalable**
throughput
capacity

100s of GB/s
of throughput

Millions
of IOPS

Network bandwidth on Amazon EC2 instances is growing

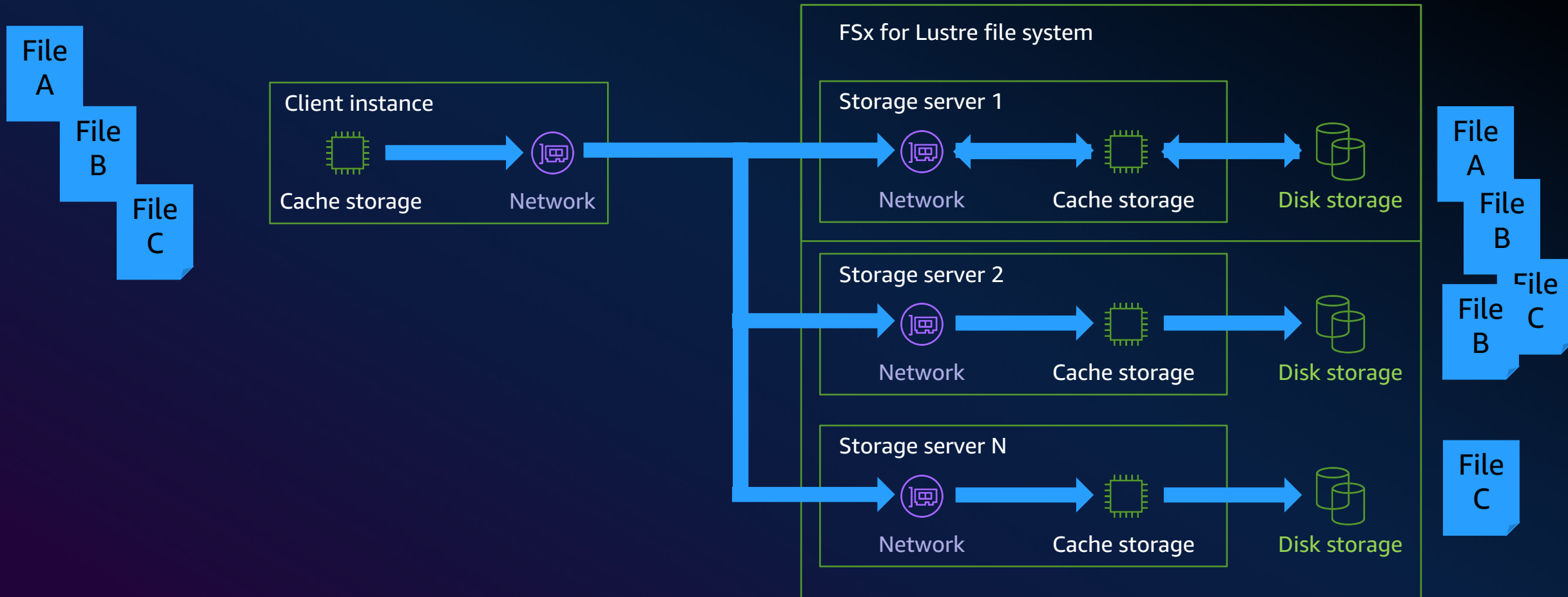Amazon Elastic Compute Cloud (Amazon EC2) instance bandwidth, Gbps

C6g	C6gn	G5	P4d/DL1	Trn1n	P5
25	100	100	400	1,600	3,200

Compute-optimized instances

Accelerated computing instances

Lustre performance scales with storage capacity

	Storage capacity	Baseline throughput	IOPS	Latencies
A	10 TiB	10 GB/s	Tens of thousands	
B	100 TiB	100 GB/s	Hundreds of thousands	Sub-millisecond
C	1,000 TiB	1,000 GB/s	Millions	

FSx for Lustre storage scaling and rebalancing

FSx for Lustre file IO

Lustre file IO

1 GB file

Disk storage

>1 GB file
Disk storage   Disk storage   Disk storage   Disk storage   Disk storage
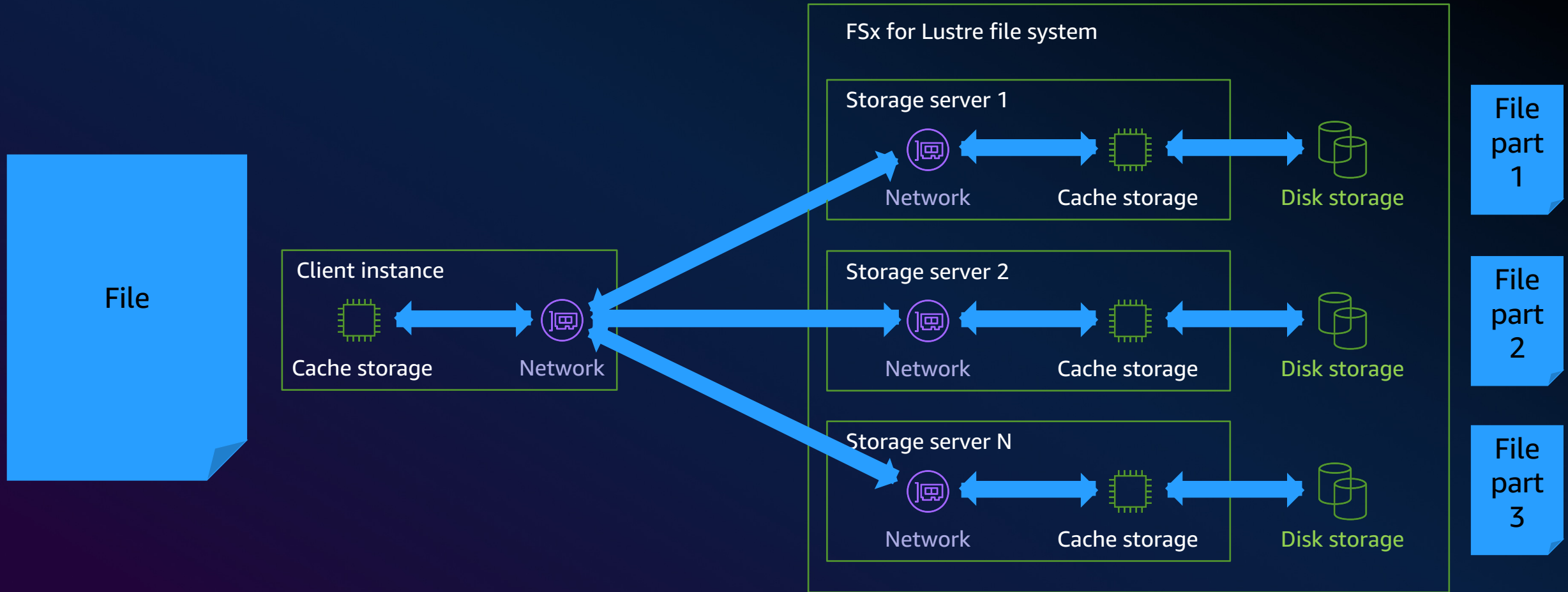
1 TB file
Disk storage   Disk storage   Disk storage   Disk storage   Disk storage   • • •   Disk storage

Shell augments their on-premises compute capacity by bursting to the cloud with Amazon EC2 clusters and Amazon FSx for Lustre.

This solution gives Shell the capability to quickly scale up and down, and only purchase additional compute capacity when needed. With FSx for Lustre, Shell's GPU capacity is fully utilized.

Learn More
Amazon FSx for Lustre

What FSx for Lustre brings to your workloads

Highly scalable
throughput
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through a fast file
interface

Storage optimized for price performance

HDD-based persistent storage

SSD-based persistent storage
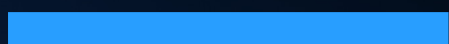
HDD-based persistent storage with an SSD cache

SSD-based scratch storage

Storage optimized for price performance

Storage type	Throughput per TiB	Price per unit of storage $ per GB-month	
HDD persistent	12 MB/s	$0.025	
	40 MB/s	$0.083	
SSD persistent	125 MB/s	$0.145	
	250 MB/s	$0.210	
	500 MB/s	$0.340	
	1,000 MB/s	$0.600	

Storage optimized for price performance

Storage type	Throughput per TiB	Price per unit of storage $ per GB-month		Price per unit of throughput, $ per MB/s-month	
HDD persistent	12 MB/s	$0.025	▎	$2.08	████████████
	40 MB/s	$0.083	▊	$2.08	████████████
SSD persistent	125 MB/s	$0.145	█▌	$1.16	███████
	250 MB/s	$0.210	██	$0.84	█████
	500 MB/s	$0.340	███	$0.68	████
	1,000 MB/s	$0.600	█████	$0.60	███

GA 2023

Amazon FSx for Lustre

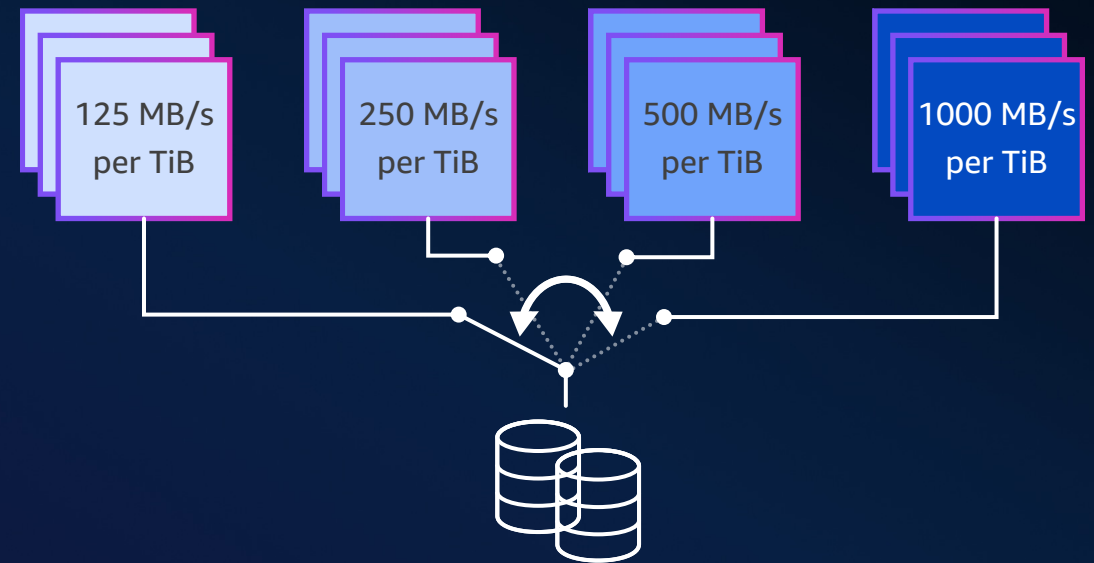## THROUGHPUT SCALING ON-DEMAND

INCREASED AGILITY

- Scale your file system's throughput tier up or down without scaling storage capacity
- Easily accommodate the performance needs of growing compute clusters
- Manage periodic increases in data access in a cost-effective manner
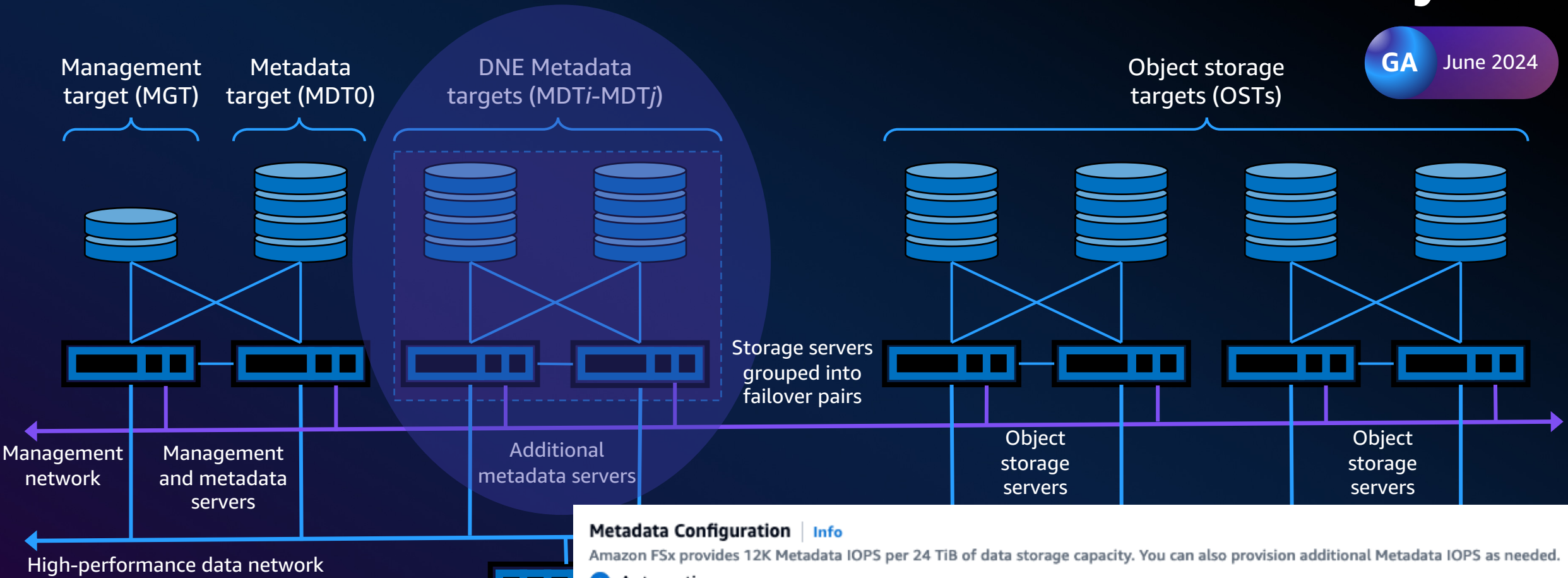
STORAGE SERVERS

125 MB/s per TiB

250 MB/s per TiB

500 MB/s per TiB

1000 MB/s per TiB

STORAGE TARGETS (DISKS)

New feature increases maximum metadata IOPS by 15x

Management target (MGT)

Metadata target (MDT0)

DNE Metadata targets (MDTi-MDTj)

Object storage targets (OSTs)

GA June 2024

Storage servers grouped into failover pairs

Management network

Management and metadata servers

Additional metadata servers

Object storage servers

Object storage servers

High-performance data network

Metadata Configuration | **Info**

Amazon FSx provides 12K Metadata IOPS per 24 TiB of data storage capacity. You can also provision additional Metadata IOPS as needed.

○ **Automatic**
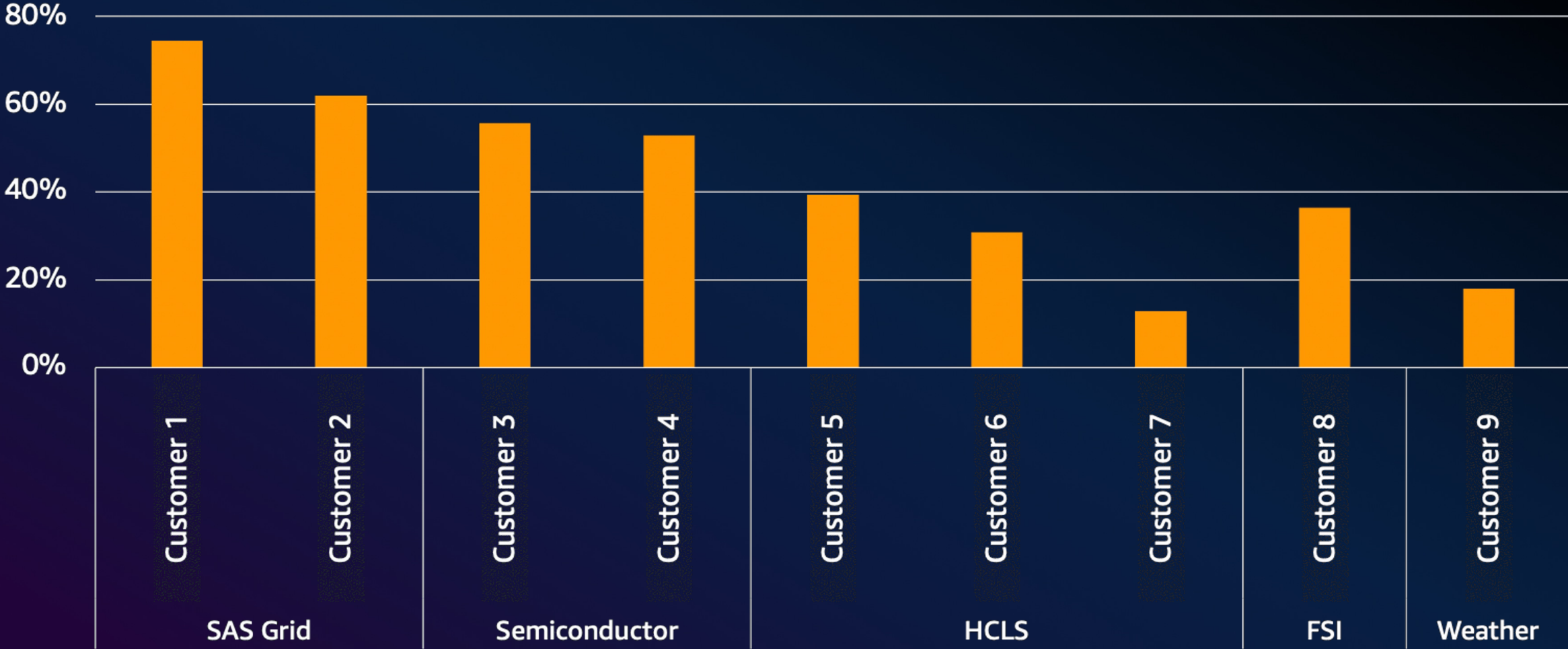12000 IOPS

● **User-provisioned**

Metadata IOPS

12000 ⌄ **IOPS**

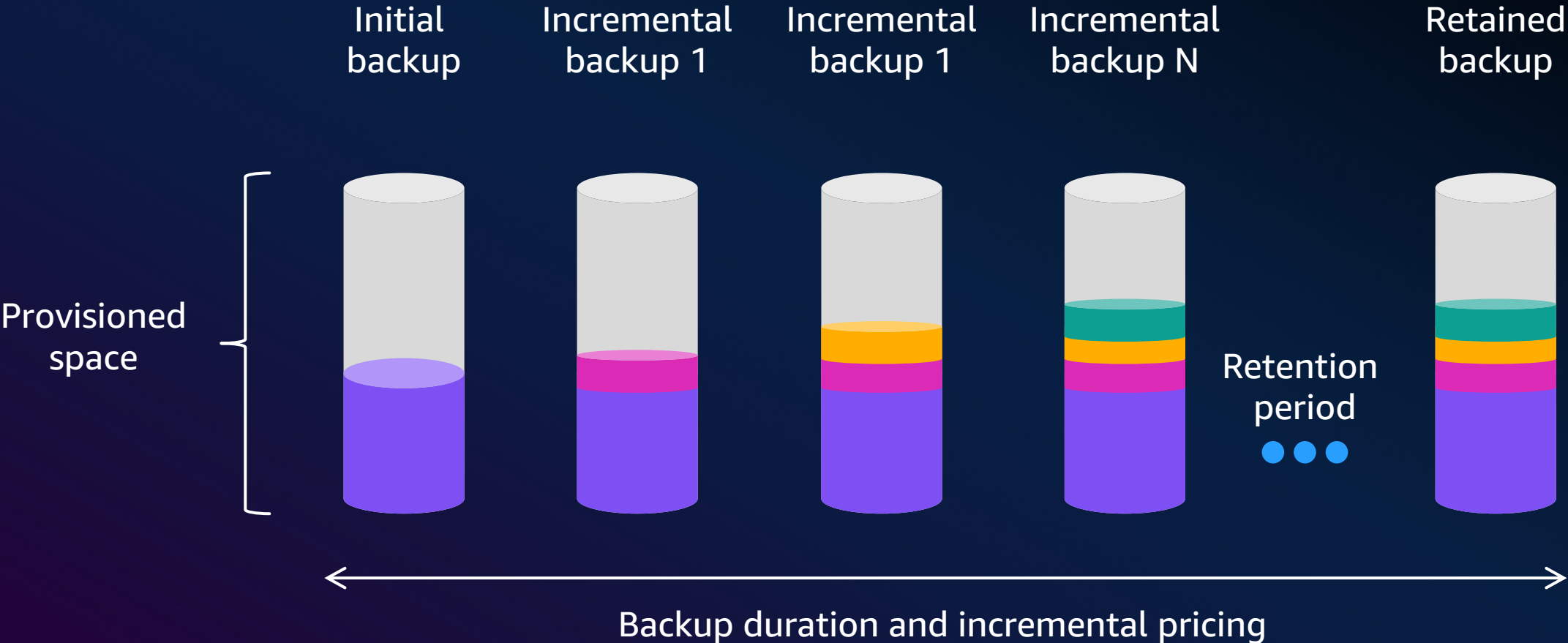Supported sizes: 1,500, 3,000, 6,000 or increments of 12,000; Maximum 192,000 IOPS.

https://docs.aws.amazon.com/fsx/latest/LustreGuide/managing-metadata-performance.html

Data compression: Sample compression rates

Efficient backup storage

Provisioned space

Initial backup

Incremental backup 1

Incremental backup 1

Incremental backup N

Retention period

•••

Retained backup

Backup duration and incremental pricing

NETFLIX

Netflix accelerates large-scale ML training using Amazon FSx for Lustre to scale up and keep the data pipeline loaded

FSx for Lustre performance enables Netflix to saturate GPUs and to virtually eliminate GPU idle time

3–4x improvement using pre-compute and FSx for Lustre. ML model **training time reduced from a week to 1–2 days.**

Learn More
Amazon FSx for Lustre

What FSx for Lustre brings to your workloads

Highly scalable throughput capacity

Storage options optimized for price performance

Integrate data lakes through a fast file interface

How FSx for Lustre enables HPC/ML with your data lake

Integrate your data lake with your ML/HPC compute through a fast file interface

Data lake

Amazon S3 ←→ FSx for Lustre ←→ Amazon EC2

AWS modern data architecture for machine learning (ML)

Pre-train

Fine-tune

Retrieval Augmented Generation (RAG)

Data sources

IOT/DEVICES

APP/LOGS

THIRD-PARTY DATA

Amazon S3

Amazon SageMaker

DIY/custom-built FMs

Amazon Bedrock

Amazon EC2

Amazon FSx for Lustre

PEOPLE

APPS

DEVICES

Live or batch predictions (inference), model deployment, hosting & monitoring

aws

Reducing training time with FSx for Lustre

Amazon SageMaker: Patient classification using liver dataset

■ Dataset download   ■ Model training

Training time

-67%   -83%

S3
(each run)

S3+FSx for Lustre
(1st run)

S3+FSx for Lustre
(2nd -> Nth run)

Lazy-loaded
data

Cached data

*Amazon internal testing
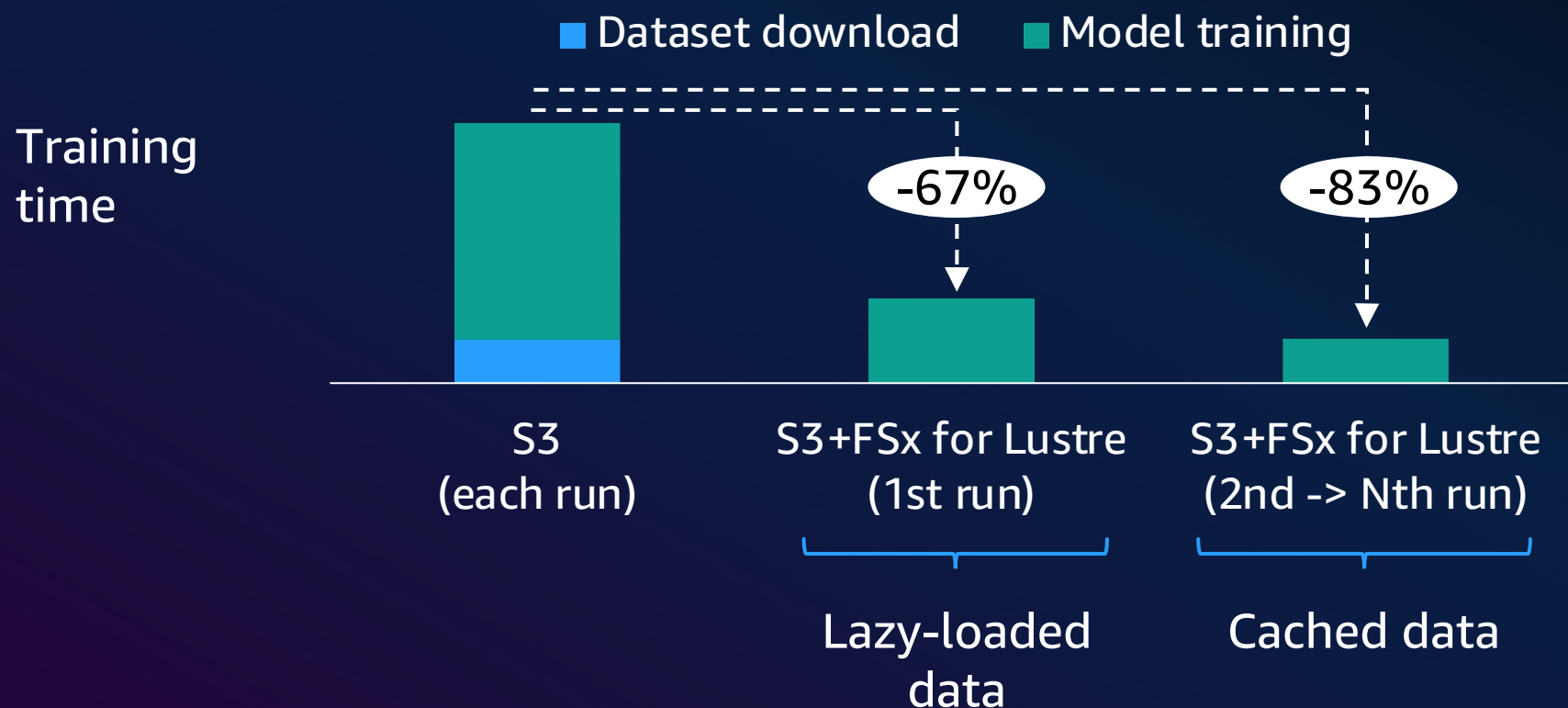
Toyota Research Institute chooses FSx for Lustre to reduce object recognition ML training times

"We needed a parallel file system for our ML training data sets and chose Amazon FSx for Lustre … The **integration with AWS services, including S3**, also made it the preferred option for our high performance file storage."

David Fluck, Software Engineer
Toyota Research Institute

Learn More
Amazon FSx for Lustre

Thank you!

Meriem Belhadj

mebelhad@amazon.fr

Cloud Storage
on AWS