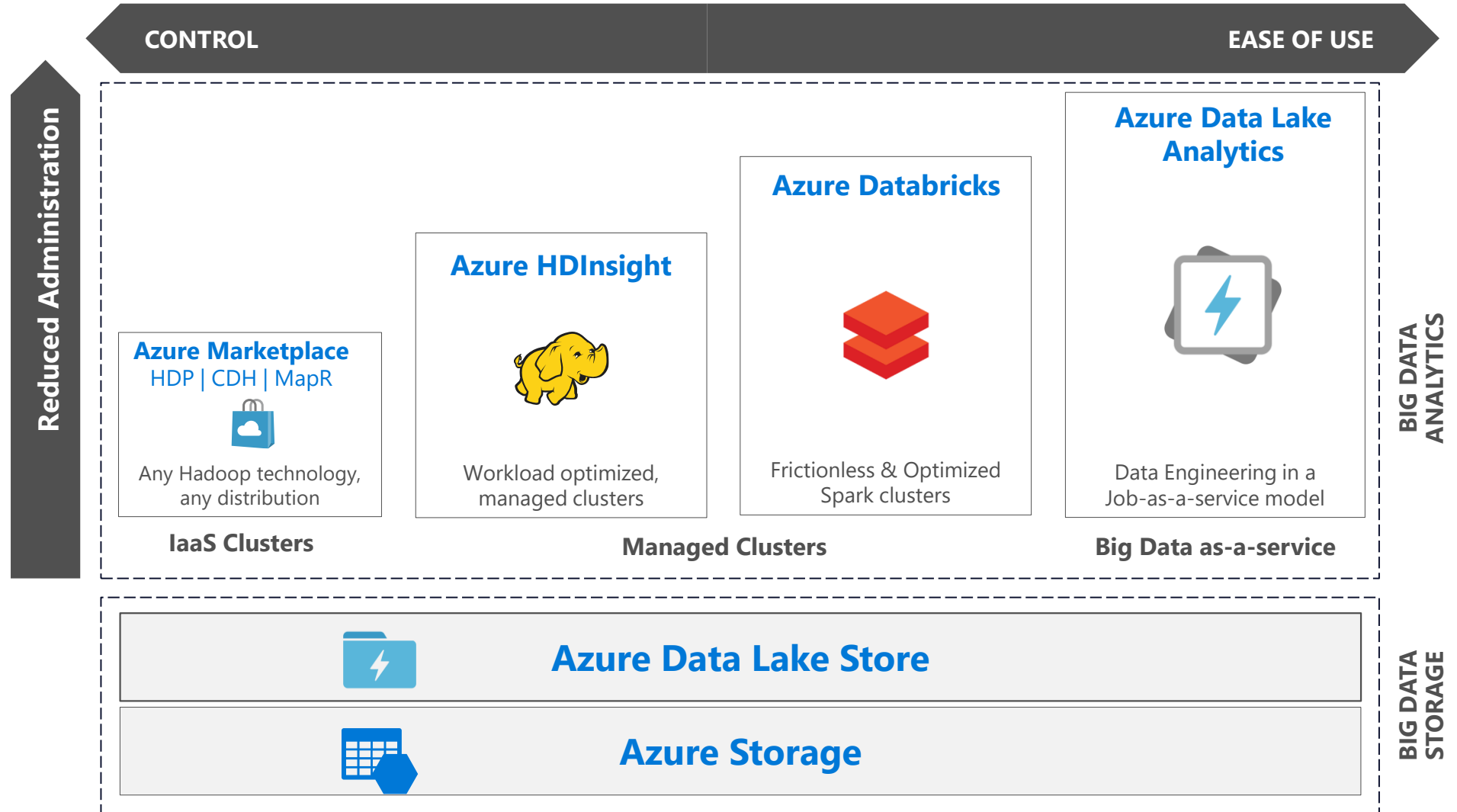


Big Data Storage



Azure Big Data Solutions



Big data thinking: All data has value

- ⚡ All data has potential value
- ⚡ Data hoarding
- ⚡ No defined schema—stored in native format
- ⚡ Schema is imposed and transformations are done at query time (*schema-on-read*).
- ⚡ Apps and users interpret the data as they see fit



Big Data Storage Options

Capability	ADLS	Azure Blob
Geographic Availability	East US 2, Central US, North Europe	All Data Centers
HDFS	Yes (Web HDFS)	No
Scale	No Limit on Bandwidth or Storage size	Limits -5PB Storage -50Gbps Bandwidth
File Folder level ACL's	Yes	No
Role Based Access	Yes	No
Encryption	Yes	Yes
Geo- Replication	No	Yes [LRS, GRS, RA-GRS]
Cost [1PB]	\$40K	HOT \$20K COOL \$16K
GA Date	Nov 16 th 2016	Feb 1 st 2010

What to pick?

- HDInsight works with both storage types
- Possible Combinations
 - ADLS Only
 - WASB Only
 - ADLS+WASB both attached to a cluster

Ultimately it boils down to

- Geographic Feasibility
- Azure Data Lake Analytics
- Existing Data
- File Folder level ACL's

Object storage for every use case

Azure Blob



Hot

Frequently accessed data



Cool

Less frequently accessed data



Archive

Rarely accessed data



PER TB
PER MONTH

\$18.40

\$10.00

\$2.00



PER 10K WRITE
OPERATIONS

\$0.05

\$0.10

\$0.10



RETRIEVAL
TIMES

Immediate

Immediate

Hours

USE CASES

Cloud native
application data
storage

Repository for
server backups

Medical records
archiving

Blob Level Tiering

Introducing Blob-Level Tiering

Individual blobs can move between tiers
All tiers co-exist in the same storage account

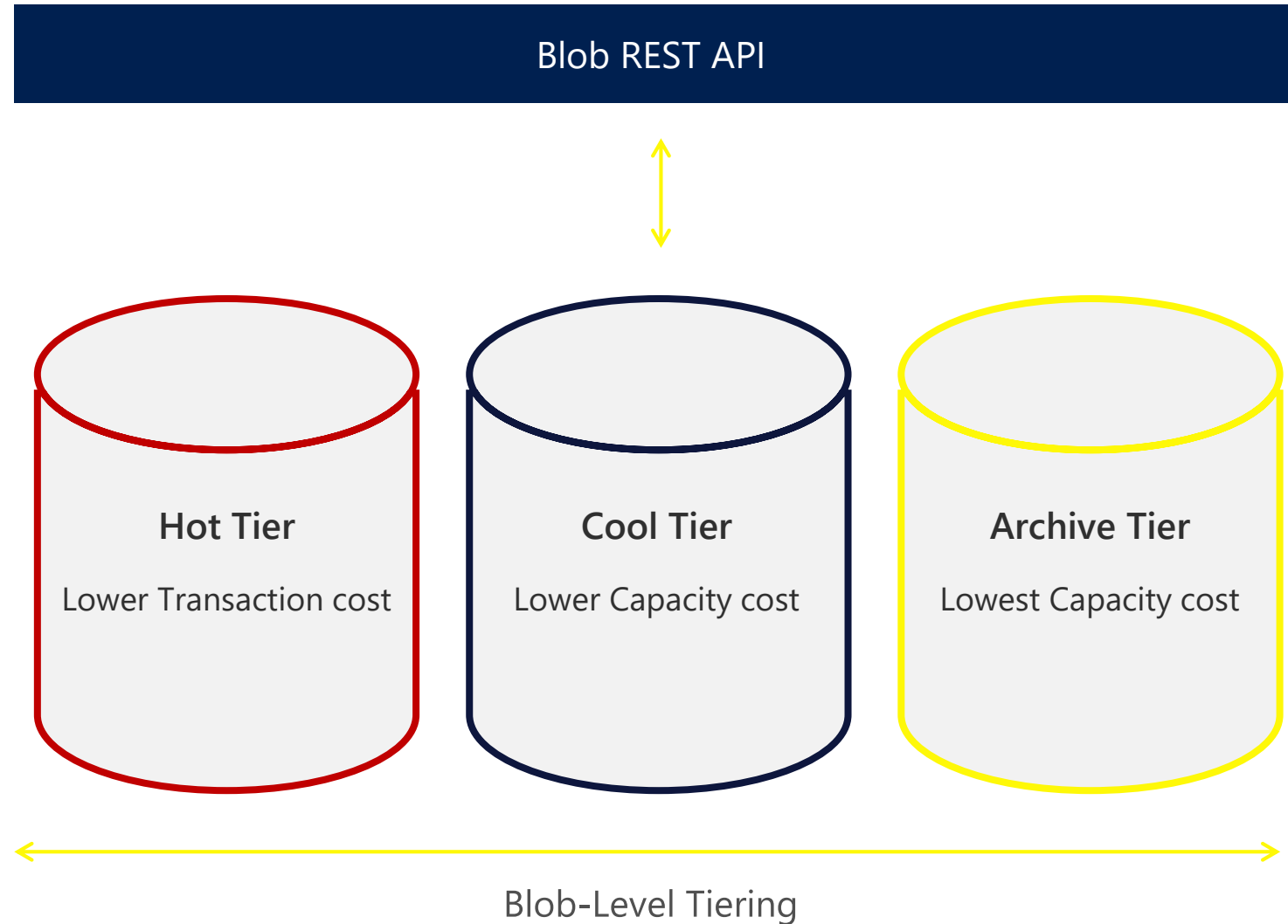
New API to set blob tier: *SetBlobTier*

Acknowledged immediately from service

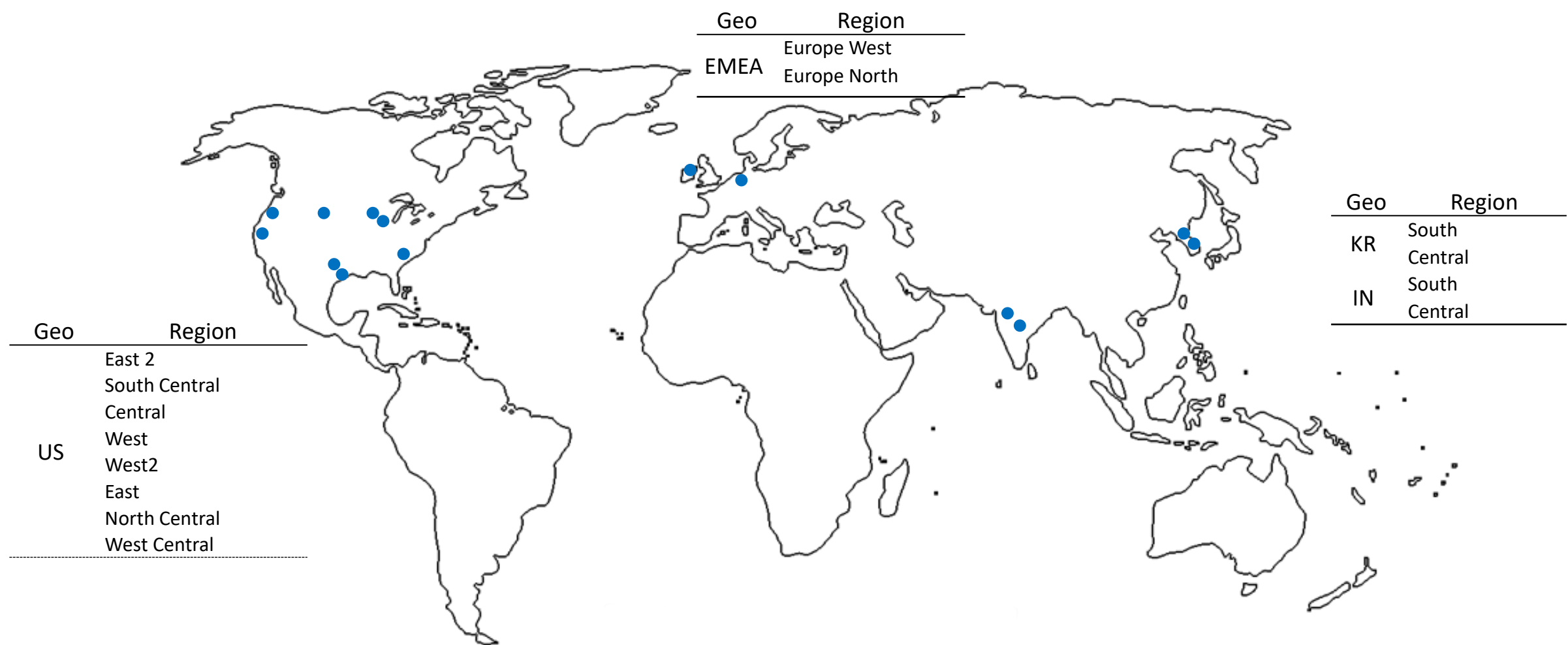
Get APIs (*GetBlobProperties* and *ListBlobs*) return current tier and archive status

New headers "x-ms-access-tier" and "x-ms-archive-status"

Future: Automated Lifecycle Management

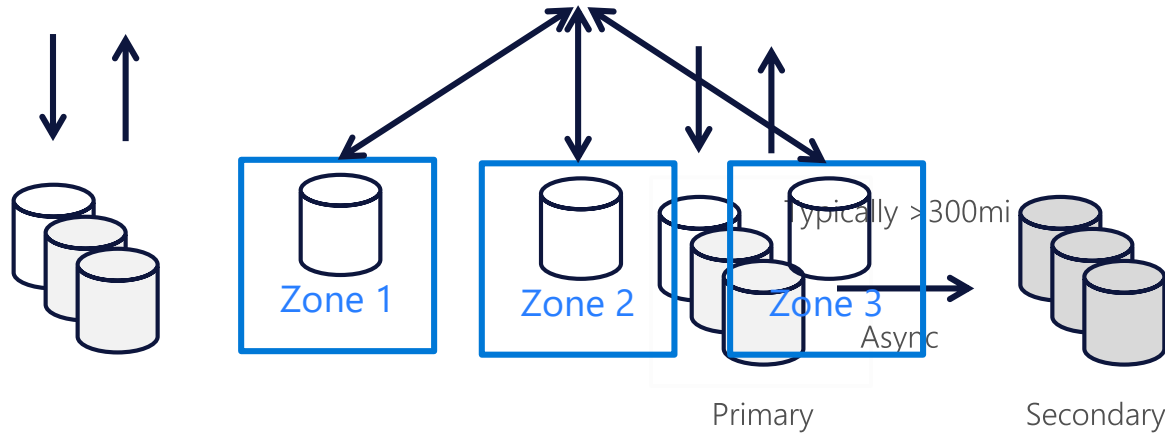


Archive Regional Availability @ GA



Blob-Level tiering will be available in all regions

Azure Storage Durability



LRS

3 replicas, 1 region

Protect against disk, node, rack failures

Write is ack'd when all replicas are committed

Superior to dual-parity RAID

ZRS V2

3 replicas **across 3 Zones**

Protect against disk, node, rack and **zone** failures

Synchronous writes to all 3 zones

Private preview now

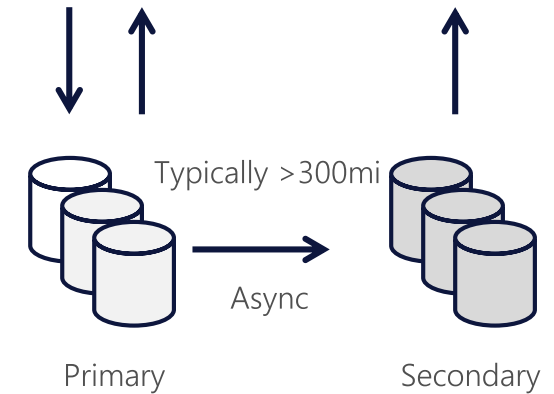
GA – End of Q1/Early Q2 in 4 regions

GRS

6 replicas, 2 regions (3/region)

Protects against major regional disasters

Asynchronous to secondary



RA-GRS

GRS + Read access to secondary

Separate secondary endpoint

RPO delay to secondary can be queried

Azure Storage Security & Compliance

Encryption at Rest

Always on with MS keys
Customer supplied keys – GA in Q1 CY18

Firewalls and Virtual Networks

Restrict access from public internet – GA 02/18

AAD, OAuth and RBAC

AAD creds for Auth instead of Shared key/SAS
Full RBAC at container level
Preview H1 CY18; GA – H2 CY18

WORM

SEC 17a-4(f) compliant
Across all Storage tiers
Preview – Late Q1/Early Q2 CY18,
GA H1 CY18

Access policy

containerexp

Save

Retention policy

Policy type

Time based retention

Time base retention

Legal hold

Time based retention

Time base retention

Legal hold

Set retention period for

7

days

OK


Cancel

Access policy

containerexp

Save

Complete retention policy lock



Completing the retention lock process is irreversible.

Ensure the retention lock is configured as desired.

[Learn more](#)

Confirm Blob lock

Type 'yes' for confirmation

OK

Cancel

	READ	WRITE	DELETE
	✓		
	✓		
	✓	✓	✓
	✓	✓	
	✓	✓	✓
	✓	✓	✓

account ⓘ

k

<

Blob Storage

Scale & Performance

Per Blob

Single Block Blob max size increased 25x to 5TB

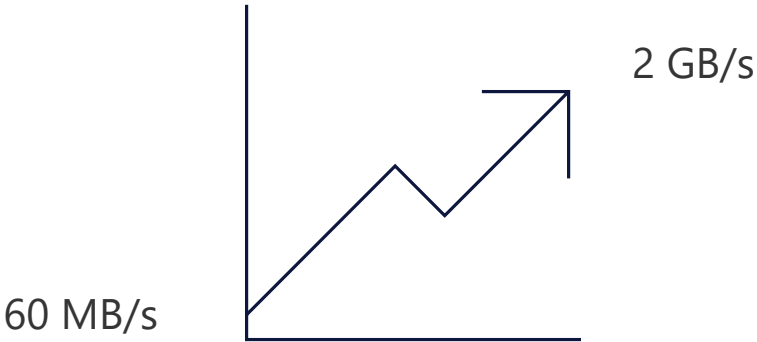
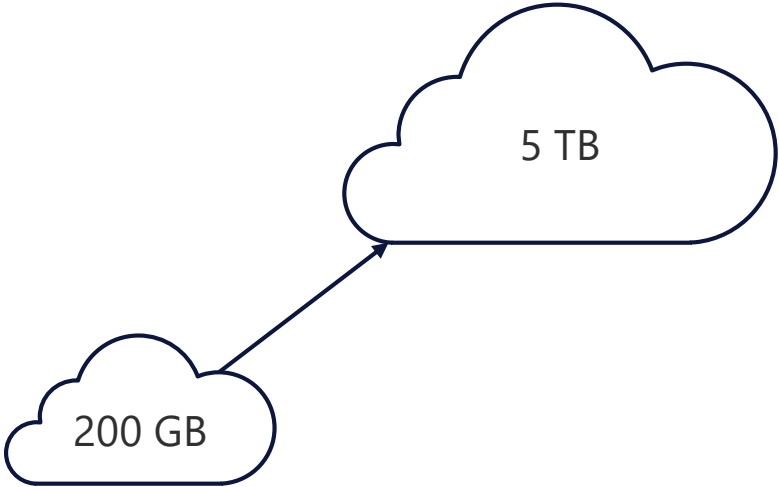
Read throughput increase up to 2GB/s

Write throughput improvements by ~3x

More improvements in H1 CY18 to write throughput

50% improvement in read latency for small blobs

Per Storage Account



Per Account Limits	Through 08/17	Current	H1 CY18
Capacity	500 TB	5PB	20 PB
TPS	20K tps	50K tps	100K tps
Throughput	20/30 Gbps	50 Gbps	100 Gbps

Blob Storage Manageability

Access from unified Azure Monitor APIs

Setup charts and alerts

Archive analytics data

Stream analytics data to Event Hub, OMS, etc.

Access from Azure Portal, REST, SDK, Powershell, CLI

GA: CY18

Soft Delete

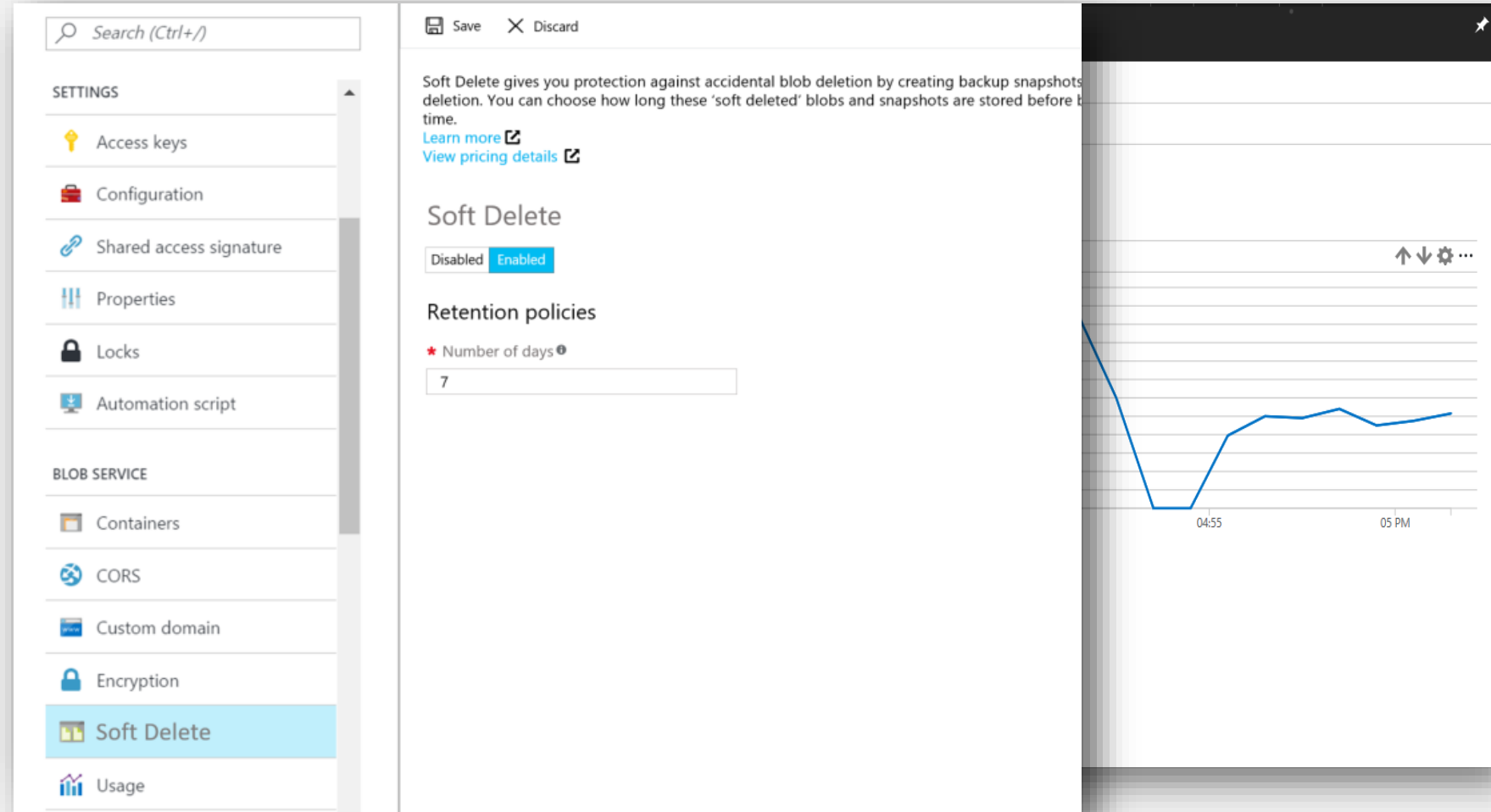
Recovery from accidental deletions

Configurable number of days to retain (max: 365)

Can be turned off

Blob level

DeleteBlob call results in an entry



Blob Storage Open

Linux FUSE Adapter

Mount a container and use regular filesystem commands

Serves HPC and big data workloads on Linux

Mount container for reads on many nodes (no write sync)

Parallel uploads/downloads for fast access to large blobs

Local read cache to improve subsequent access times

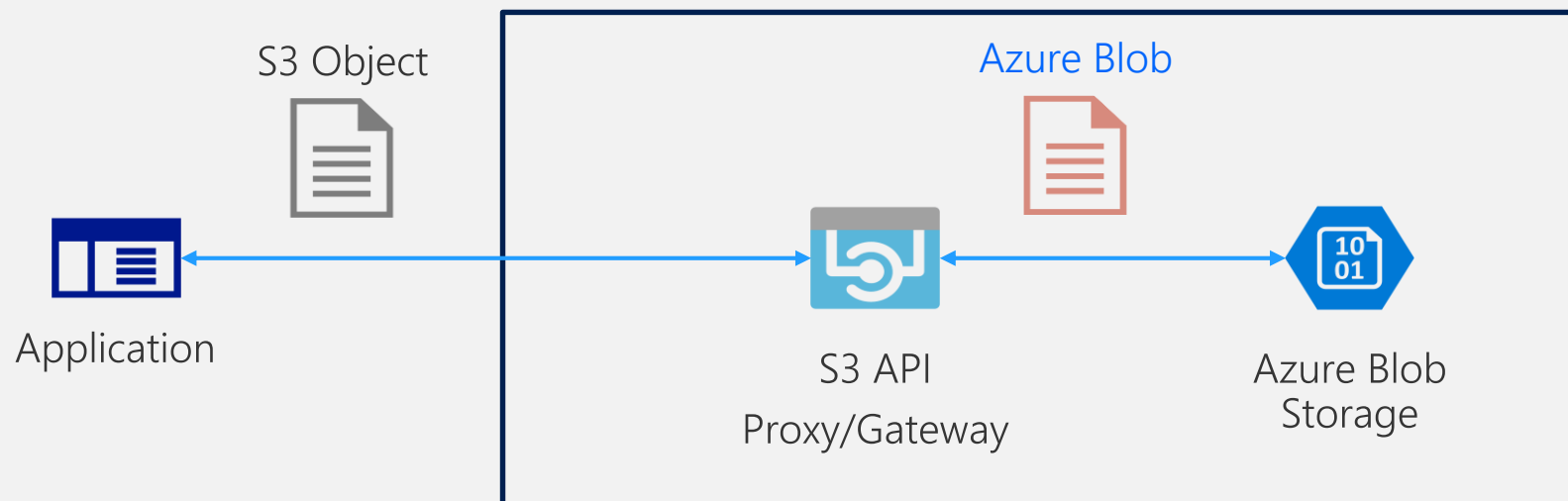
Partner support for S3

Variety of data, deployment and cost models

Blob data is non-opaque

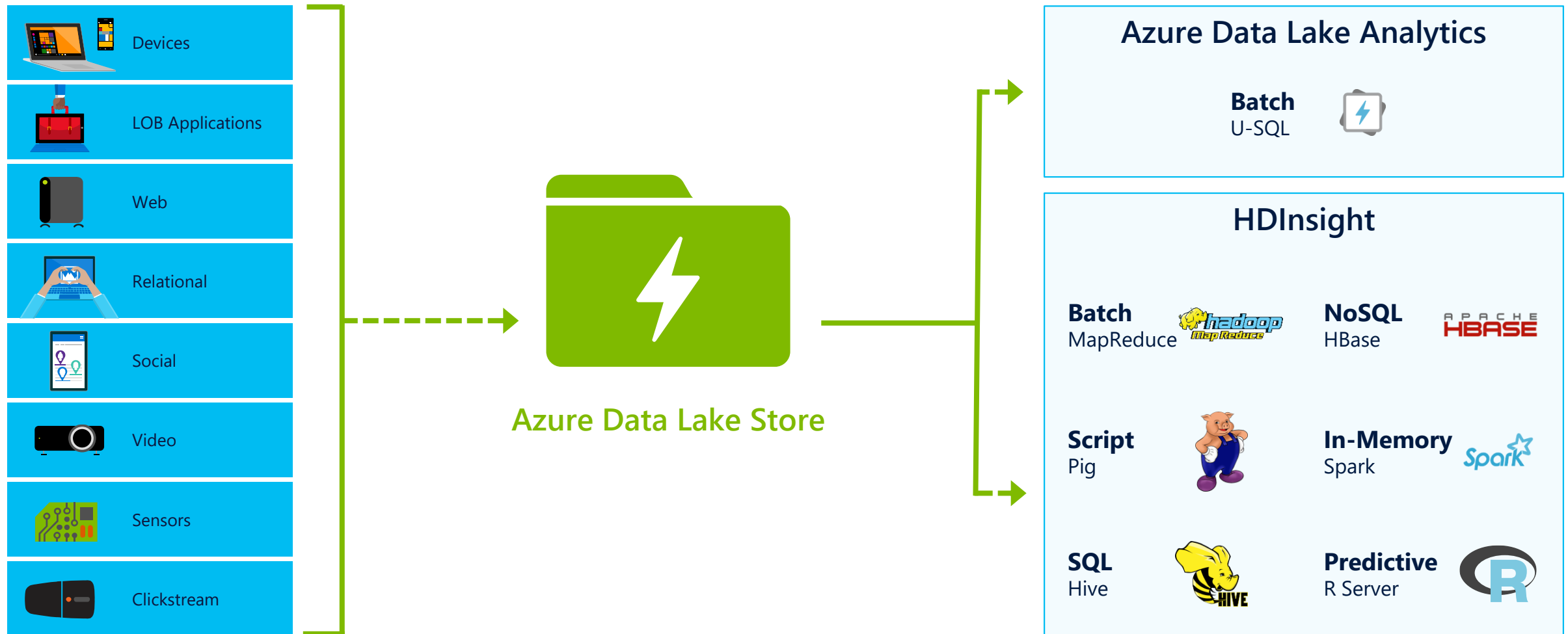
Use objects with Blob API including other Azure services

```
sshuser@fusedemo:~$  
sshuser@fusedemo:~$  
sshuser@fusedemo:~$  
sshuser@fusedemo:~$
```



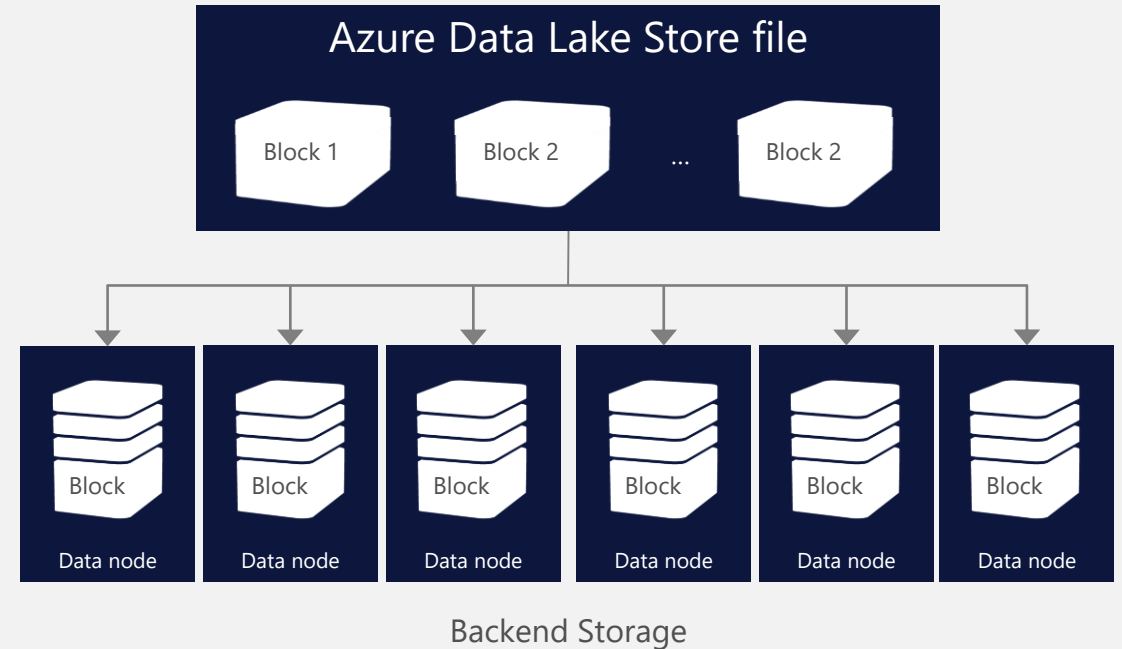
Azure Data Lake Store

A highly scalable, distributed, parallel file system in the cloud specifically designed to work with a variety of big data analytics workloads



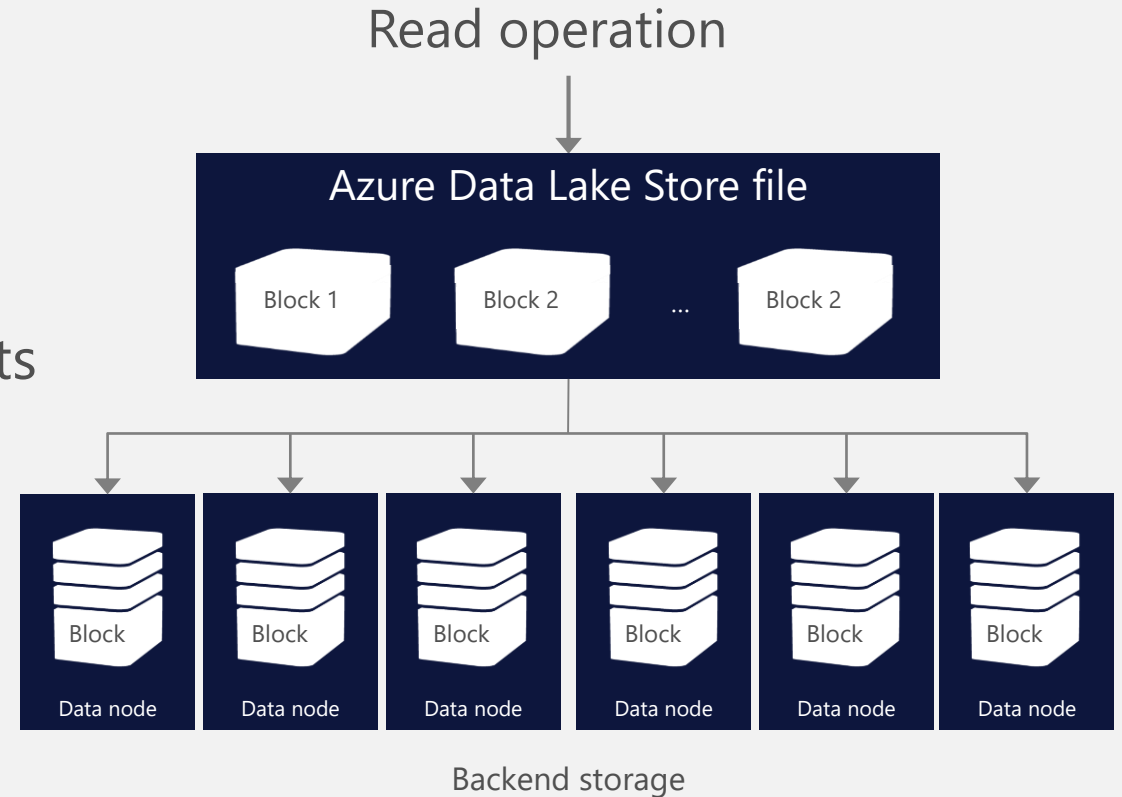
ADL Store Unlimited Scale – How it works

- ⚡ Each file in ADL Store is sliced into blocks
- ⚡ Blocks are distributed across multiple data nodes in the backend storage system
- ⚡ With sufficient number of backend storage data nodes, files of any size can be stored
- ⚡ Backend storage runs in the Azure cloud which has virtually unlimited resources
- ⚡ Metadata is stored about each file
No limit to metadata either.



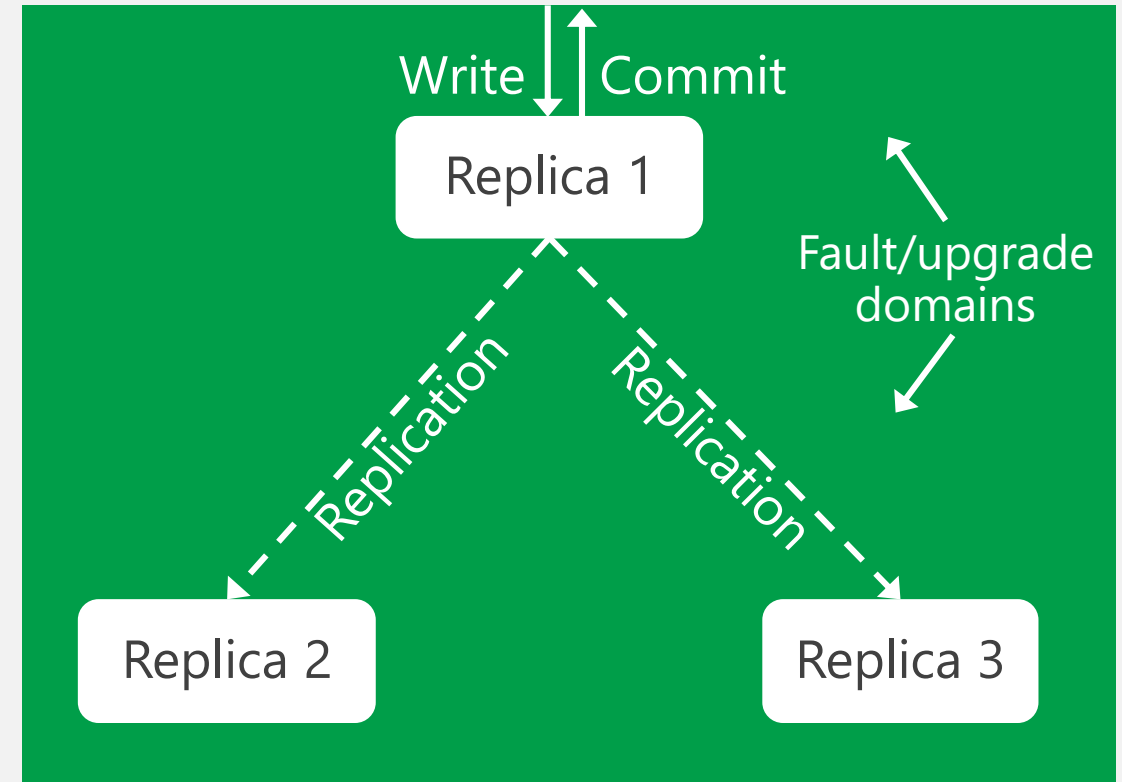
ADL Store offers massive throughput

- ⚡ Through read parallelism ADL Store provides massive throughput
- ⚡ Each read operation on a ADL Store file results in multiple read operations executed in parallel against the backend storage data nodes



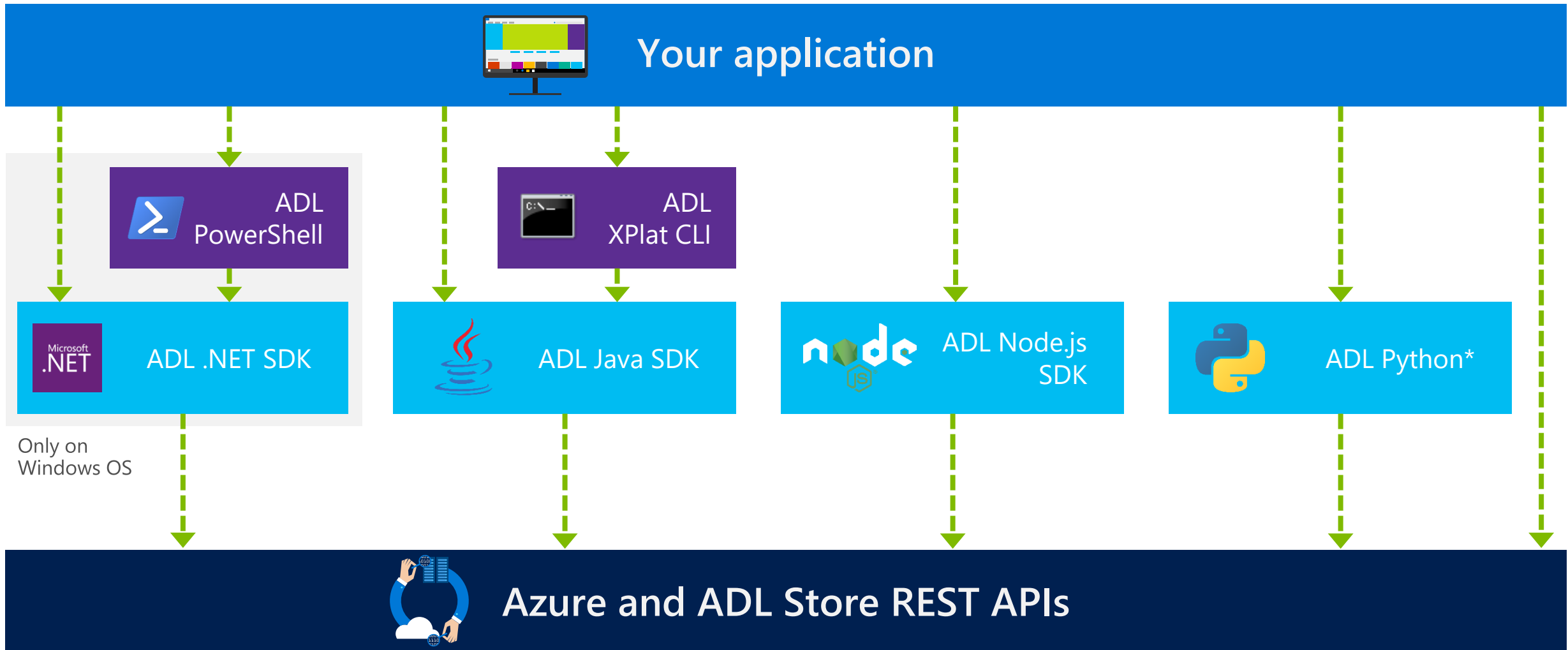
ADL Store: high availability and reliability

- ⚡ Azure maintains 3 replicas of each data object per region across three fault and upgrade domains
- ⚡ Each create or append operation on a replica is replicated to other two
- ⚡ Writes are committed to application only after all replicas are successfully updated
- ⚡ Read operations can go against any replica



Data is never lost or unavailable even under failures

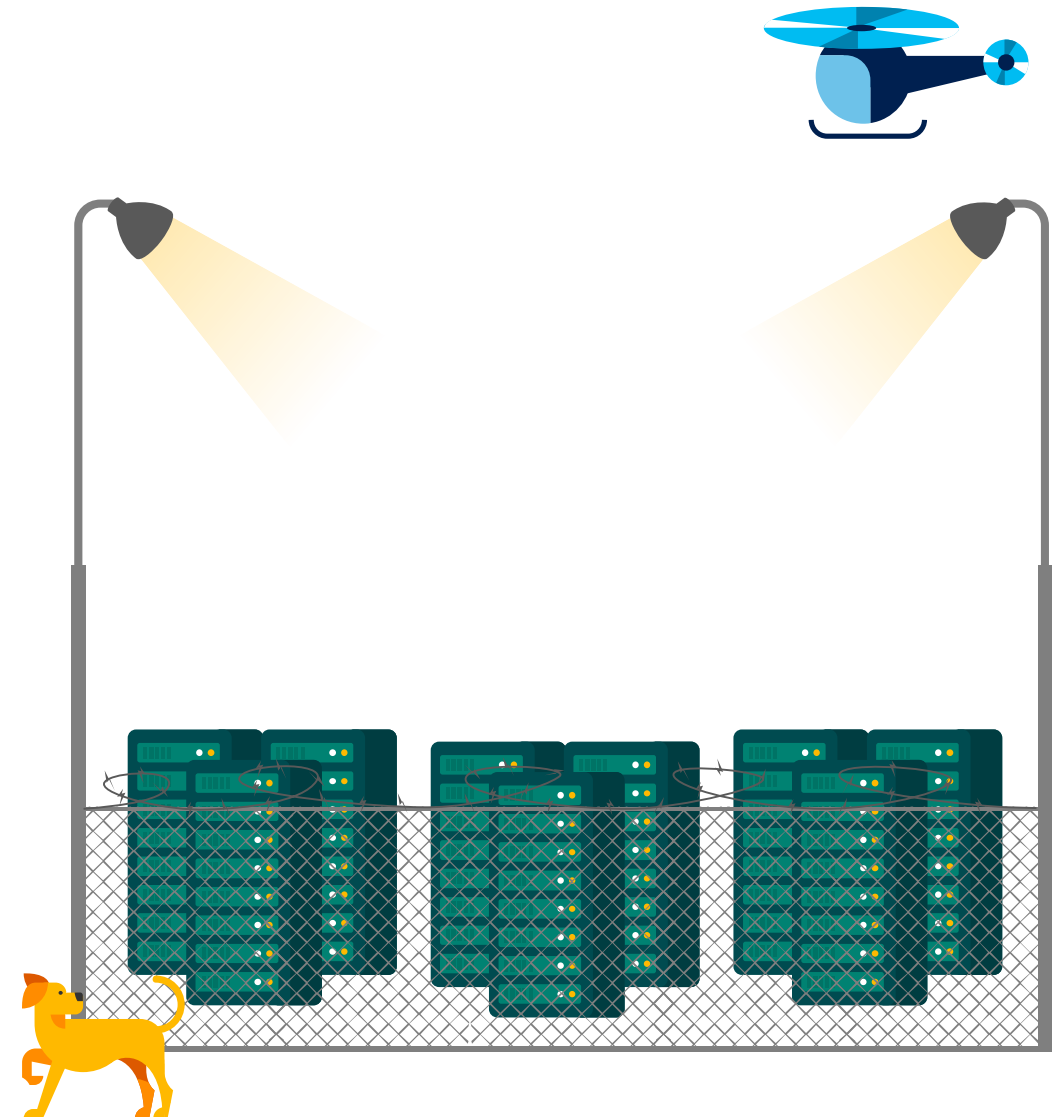
Customizing using SDKs/APIs



* At General Availability

Security features

Identity Management & Authentication	Azure Active Directory
Access Control & Authorization	Azure RBAC for Account Management File & Folder level POSIX ACLs
Auditing	Azure Diagnostic Audit Logs
Data Protection & Encryption	Encryption on the wire using HTTPS Transparent Service side encryption using service & customer managed keys

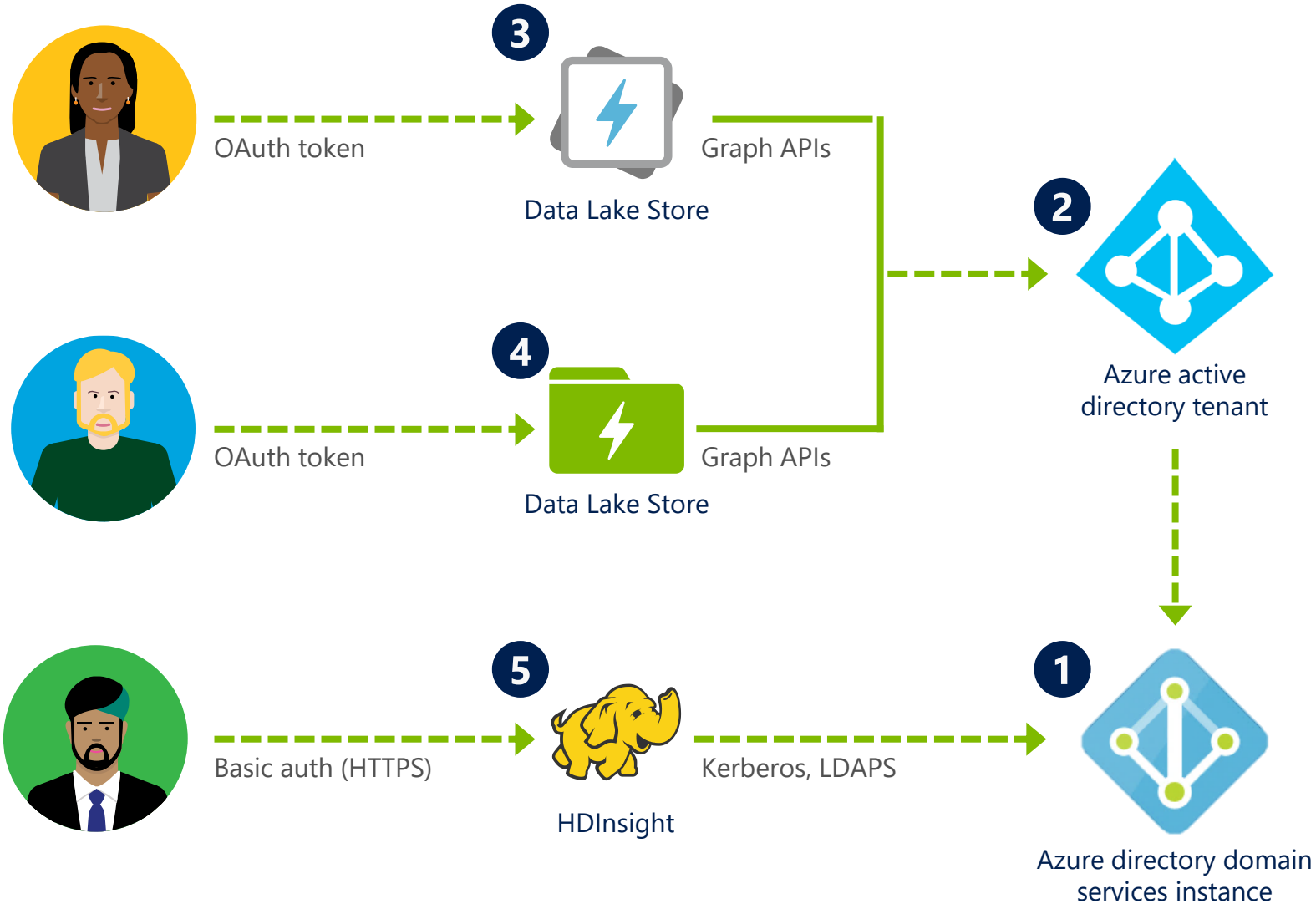


ADL Store Security: AAD integration

- ⚡ Multi-factor authentication based on OAuth2.0
- ⚡ Integration with on-premises AD for federated authentication
- ⚡ Role-based access control
- ⚡ Privileged account management
- ⚡ Application usage monitoring and rich auditing
- ⚡ Security monitoring and alerting
- ⚡ Fine-grained ACLs for AD identities



Leveraging Azure Active Directory



- 1 Create ADDS instance in separate VNET
- 2 Add users to AAD Tenant
- 3 Add users to ADLA RBAC roles
- 4 Add users to ADLS RBAC roles & file system ACLs
- 5 Join HDInsight cluster to ADDS instance

ADL Store security: Role-based access

- ⚡ Each file and directory is associated with an owner and a group
- ⚡ Files or directories have separate permissions (read(r), write(w), execute(x)) for owners, members of the group, and for all other users
- ⚡ Fine-grained access control lists (ACLs) rules can be specified for specific named users or named groups

The screenshot displays the 'Add User Wizard' interface for 'ntadanalytics - PREVIEW'. It is divided into two main sections: 'Select file permissions' and 'Assign selected permissions'.

Select file permissions:

- Accounts:** A list of accounts is shown, with 'ntadlstore' selected.
- Permissions Table:** A table with columns 'ACCOUNT', 'PATH', 'READ', 'WRITE', 'EXECUTE', and 'APPLY TO'.

ACCOUNT	PATH	READ	WRITE	EXECUTE	APPLY TO
ntadlstore	/system	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	This folder and all children
ntadlstore	/	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	This folder only

Assign selected permissions:

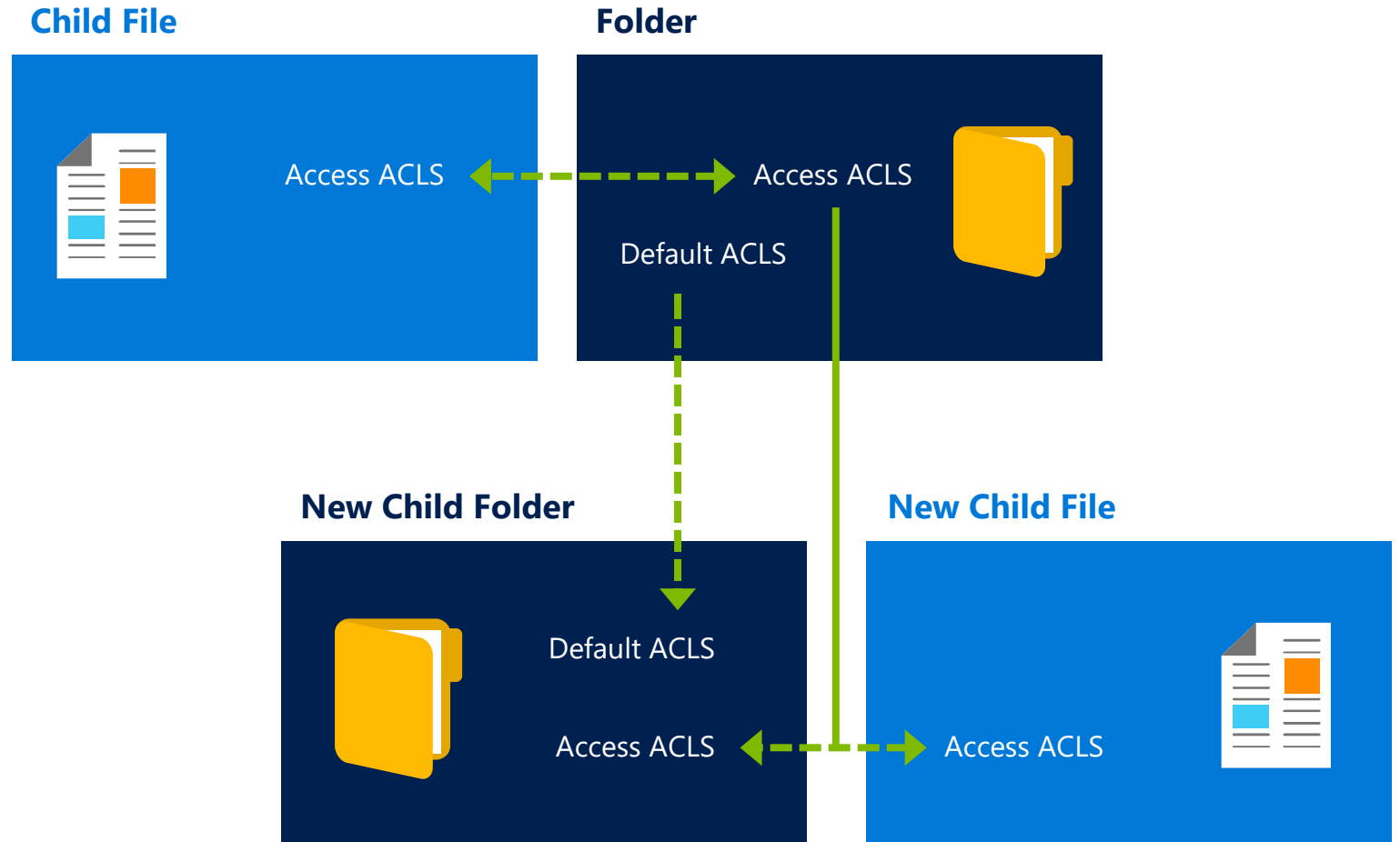
- Task List:** A list of tasks showing the status of permission assignments.

TASK	STATUS
Assign Data Lake Analytics Developer role to account ntadanalytics	Completed
Assign Read and write permissions to ntadanalytics (Catalog)	Completed
Assign Read and write permissions to master (Database)	Completed
Assign Nishant Thacker rwx permissions to '/system' and all its children on ntadlstore.	Completed. 2 succeeded, 0 failed.
Assign Nishant Thacker rwx permissions to '/' on ntadlstore.	Completed. 1 succeeded, 0 failed.

Granular control of file and folder access

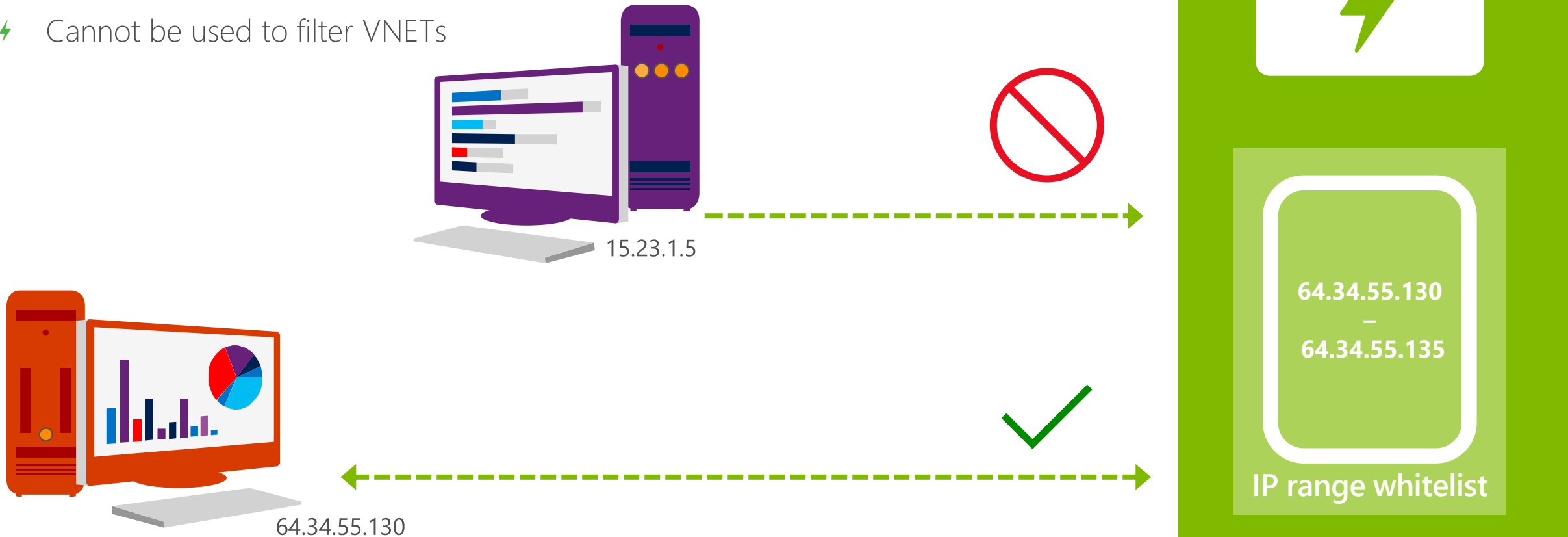
POSIX-Style ACLs with full compatibility with HDFS/WebHDFS

- ⚡ Generate default ACLs for files and folders
- ⚡ Customize for fine-tuned control
- ⚡ Access ACLs control how a user can access to the file or folder
- ⚡ Default ACLs used to construct the Access ACL of new children
- ⚡ Default ACLs copied to the Default ACL of new child folders



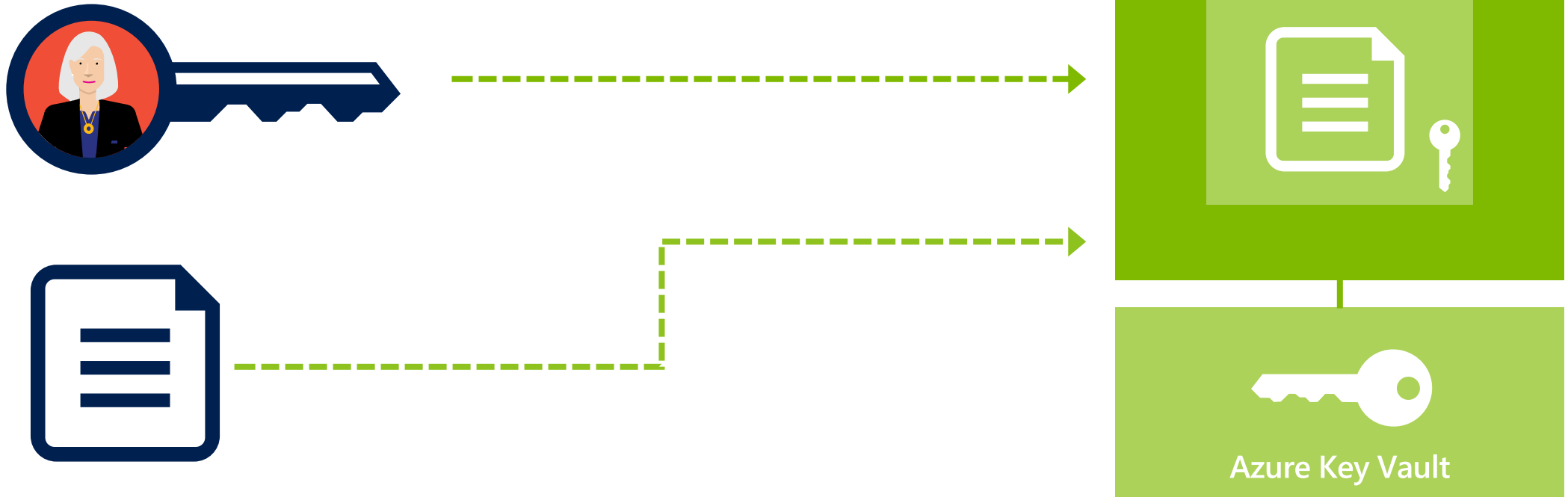
IP address ACLs

- ⚡ Access rights based on IP range
- ⚡ Applies to traffic from inside or outside Azure
- ⚡ Cannot be used to filter VNETs



Encryption of data at rest*

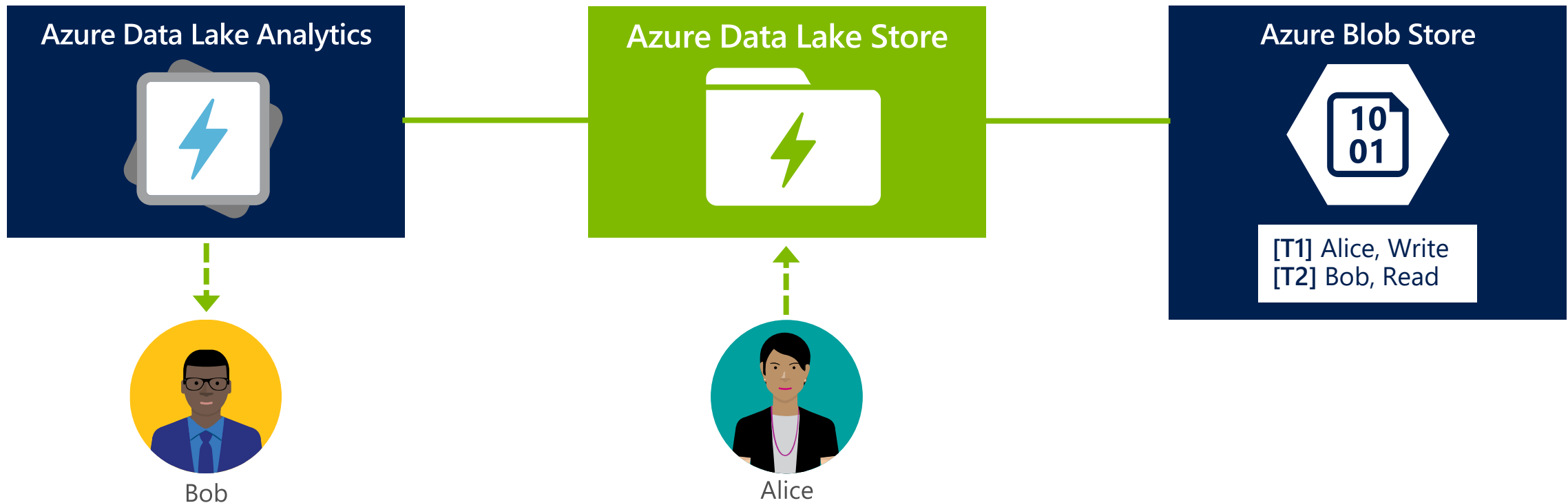
- ⚡ Provides transparent server-side encryption
- ⚡ Choice made at account creation to enable encryption
- ⚡ Service managed keys or user managed keys



* In Private Preview

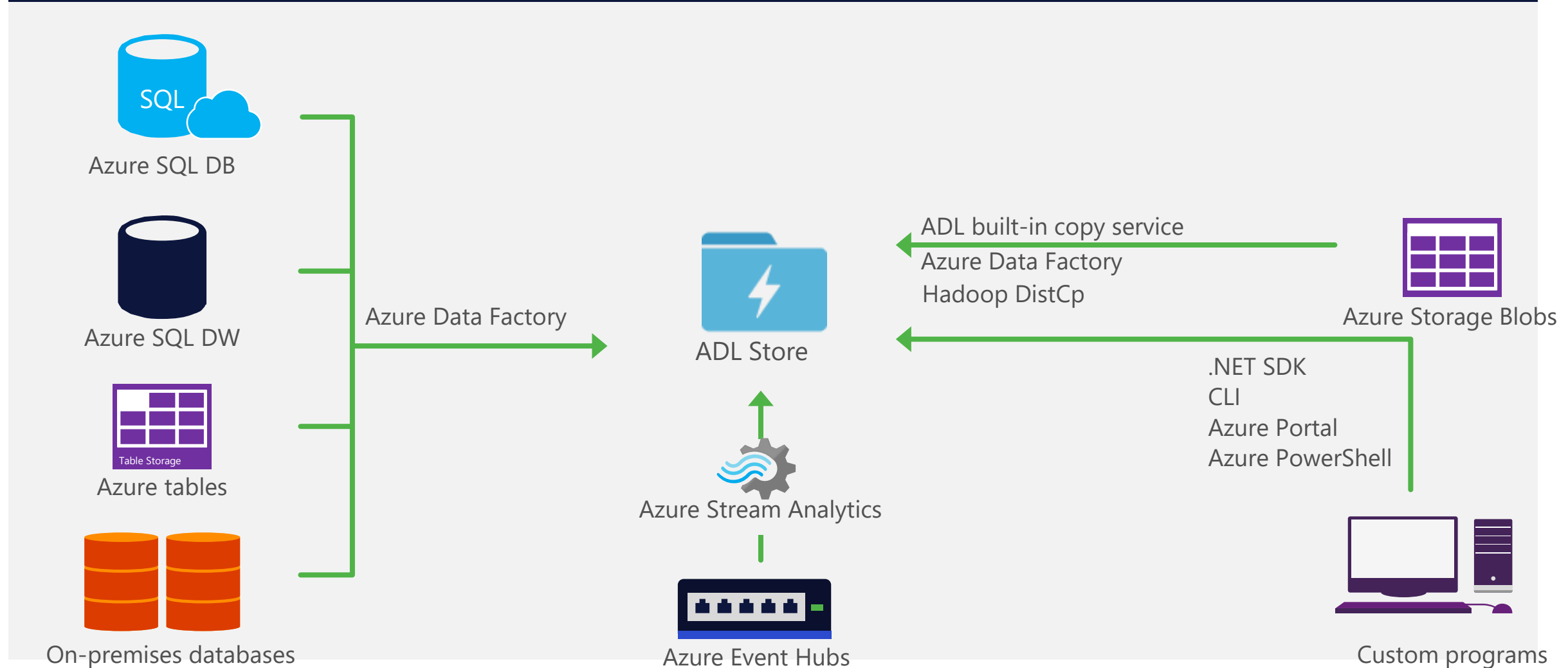
Audit logs for data access

- ⚡ Logs are available in JSON format
- ⚡ Sample U-SQL scripts are available on [GitHub](#) to-read logs
- ⚡ Enhancement to logs will continue through GA



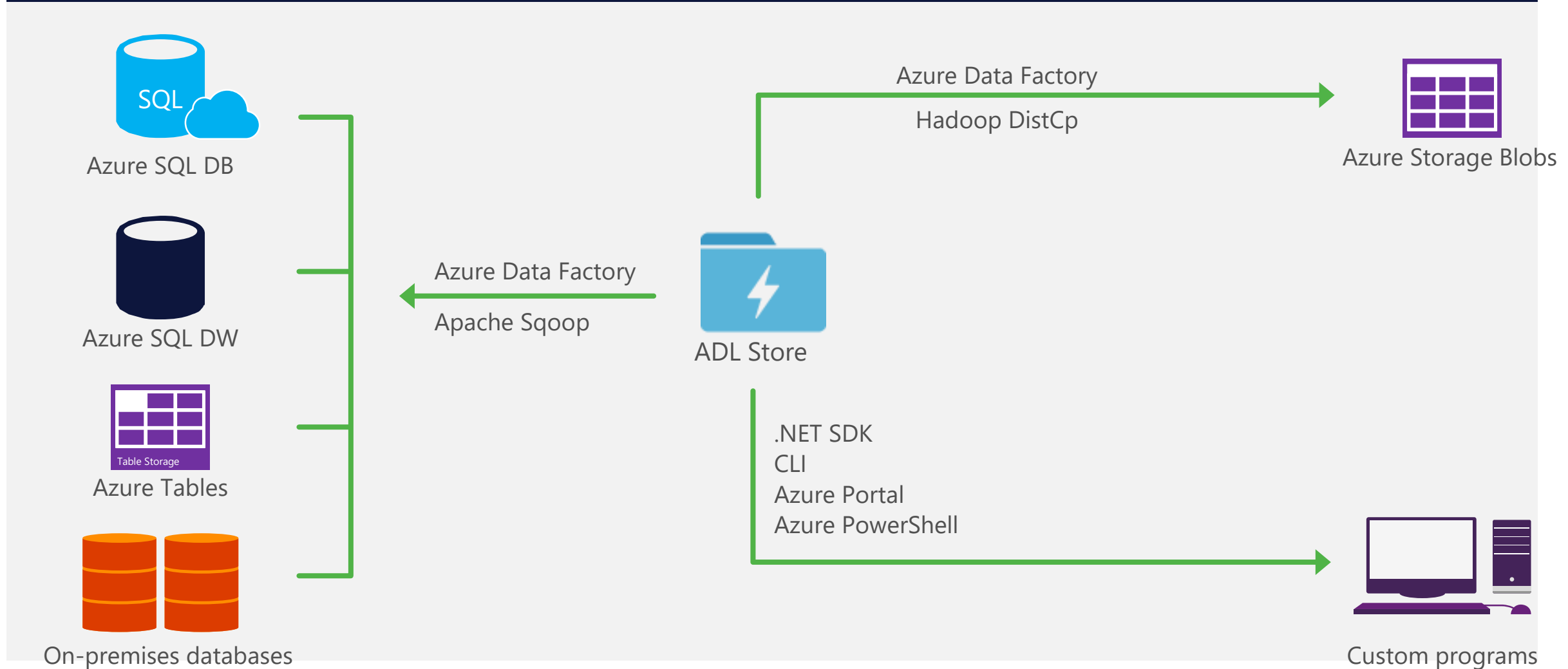
ADL Store: Ingress

Data can be ingested into Azure Data Lake Store from a variety of sources

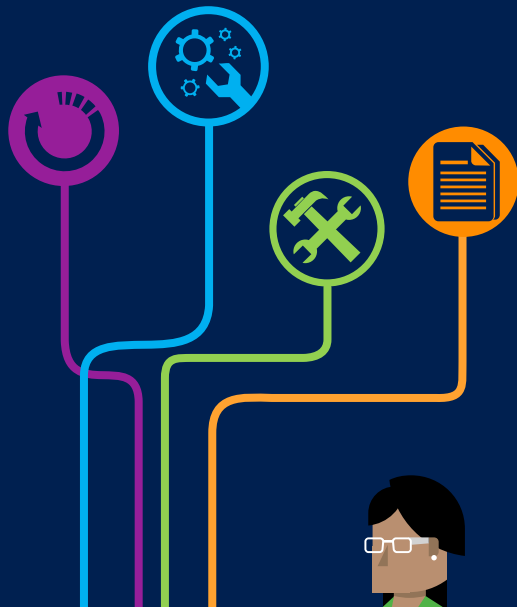


ADL Store: Egress

Data can be exported from Azure Data Lake Store into numerous targets/sinks



Creating a new ADL Store



Internal Microsoft Azure Marketplace > Data + Storage > Azure Data Lake Store > New Data Lake Store Report bug Search resources

New Data Lake Store


Azure Data Lake Store
Microsoft

Azure Data Lake Store is a hyper scale repository for big data analytic workloads. It is designed to be an enterprise wide repository of every type of data collected in a single place for the purposes of operational and exploratory analytics.

Highlights:

- A Hadoop Distributed File System for the CloudM
- No fixed limits on file size
- No fixed limits on account size
- Unstructured and structured data in their native format
- Massive throughput to increase analytic performance
- High durability, availability and reliability
- Azure Active Directory access control
- Intuitive management console

[Twitter](#) [Facebook](#) [LinkedIn](#) [YouTube](#) [Google+](#) [Email](#)



Create

Name
demo ☒
demo.azuredatalake.net

Pricing ⓘ
Pay-As-You-Go

* Subscription >
Azure conversion

* Resource Group >
ntteststrata1031
[Create a resource group](#)


* Location >
East US 2


☒ Pin to dashboard


Create


ADL Store: Properties



 demo
Data Lake Store

 Settings

 Delete

 Data Explorer

Essentials ^

Resource group
ntteststrata1031

Status
Running

URL
https://demo.azuredatalake.net

WebHDFS URI
swebhdfs://demo.azuredatalake.net

Pricing tier
Pay-As-You-Go

Location
East US 2

Subscription
[Azure conversion](#)

Subscription ID
15c5cb6e-191a-40ea-9f69-08207a17fe97


[All settings →](#)


Monitoring

Total Storage Utilization


Settings


DATA LAKE STORE

 Properties >

 Data Explorer >

RESOURCE MANAGEMENT

 Users >

 Tags >

Properties
demo

STATUS
Running

PRIMARY LOCATION
East US 2

CREATED
10/13/2015 7:33:19 PM

SUBSCRIPTION NAME

SUBSCRIPTION ID

Viewing Users and their Roles & Privileges



demo
Data Lake Store

Settings Delete Data Explorer

Essentials

Resource group
ntteststrata1031
Status
Running
URL
https://demo.azure.com
WebHDFS URI
swebhdfs://demo.azure.com

Users
demo

+ Add Roles

USER	ROLE	ACCESS
▶ [User Icon]	Owner, Contributor	Inherited
▶ [User Icon]		
[User Icon]		
[User Icon]		
[User Icon]	Subscr	
[User Icon]		

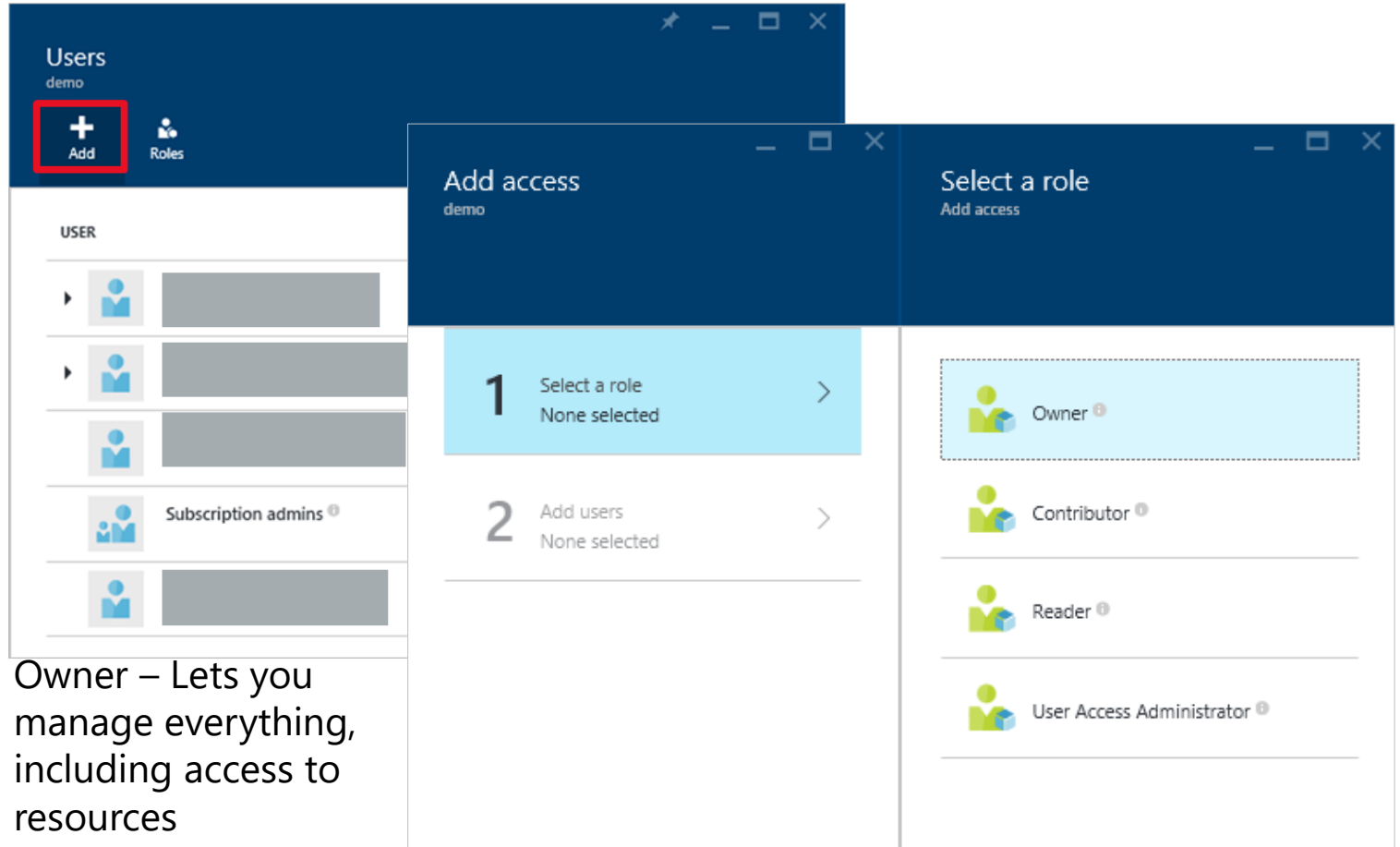
Roles
demo

NAME	USERS	GROUPS
[User Icon] Owner ⓘ	4	1
[User Icon] Contributor ⓘ	2	0
[User Icon] Reader ⓘ	0	0
[User Icon] User Access Administrator ⓘ	0	0

Adding Users



A new user can be added in the role of Owner, Contributor, Reader or User Access Administrator



Owner – Lets you manage everything, including access to resources

Contributor – Lets you manage everything, except access to resources

Reader – Lets you view everything, but not make changes

User Access Administrator – Lets you manage user access to Azure resources

File Upload



Azure Portal lets you upload files directly to ADL Store

The screenshot shows the Azure Portal interface for a 'demo' Data Lake Store. The top navigation bar includes 'New Folder', 'Upload', 'Access', 'Rename Folder', 'Folder Properties', and 'Delete Folder'. The main content area displays a table with the following data:

NAME	SIZE	LAST MODIFIED
OlympicAthletes.tsv	526 KB	10/13/2015 8:07:30 PM

On the right side, the 'Upload files' blade is open. It contains the following text and controls:

- Upload is in progress. Please do not close this blade until upload has completed.
- Select files: OlympicAthletes.tsv (with a file icon)
- OlympicAthletes.tsv (with a close icon)
- ☒ Allow overwrite existing files
- Start upload button

File Preview



Properties
File

Preview Download Rename File Delete

NAME
SearchLog_output.tsv

TYPE
File

SIZE
3.5 KB

LAST MODIFIED TIME
10/1/2015, 12:29:13 PM

PATH
adl://datalakedemoadl.azuredata...

WEBHDFS PATH
swebhdfs://datalakedemoadl.azure...

File Preview
SearchLog_output.tsv

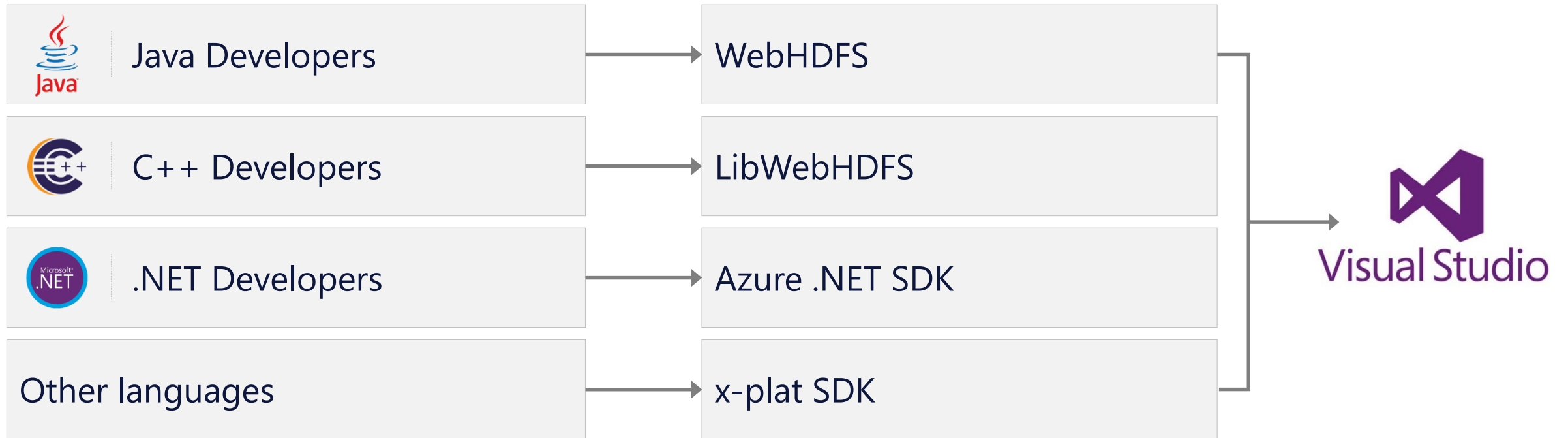
Format

0	1	2	3	4
399266	2012-02-15T11:53:16.00...	"en-us"	"how to make nachos"	73
382045	2012-02-15T11:53:18.00...	"en-gb"	"best ski resorts"	614
382045	2012-02-16T11:53:20.00...	"en-gb"	"broken leg"	74
106479	2012-02-16T11:53:50.00...	"en-ca"	"south park episodes"	24
906441	2012-02-16T11:54:01.00...	"en-us"	"cosmos"	1213
351530	2012-02-16T11:54:01.00...	"en-fr"	"microsoft"	241
640806	2012-02-16T11:54:02.00...	"en-us"	"wireless headphones"	502
304305	2012-02-16T11:54:03.00...	"en-us"	"dominos pizza"	60
460748	2012-02-16T11:54:04.00...	"en-us"	"yelp"	1270
354841	2012-02-16T11:59:01.00...	"en-us"	"how to run"	610

- ⚡ Input and output files can be previewed directly in the portal without having to download them.
- ⚡ The preview shows the first few rows.
- ⚡ Column numbers are automatically assigned
- ⚡ Understands CSV and TSV formats.

App Development – Languages and Tools

Azure Data Lake Store supports multiple languages for application development



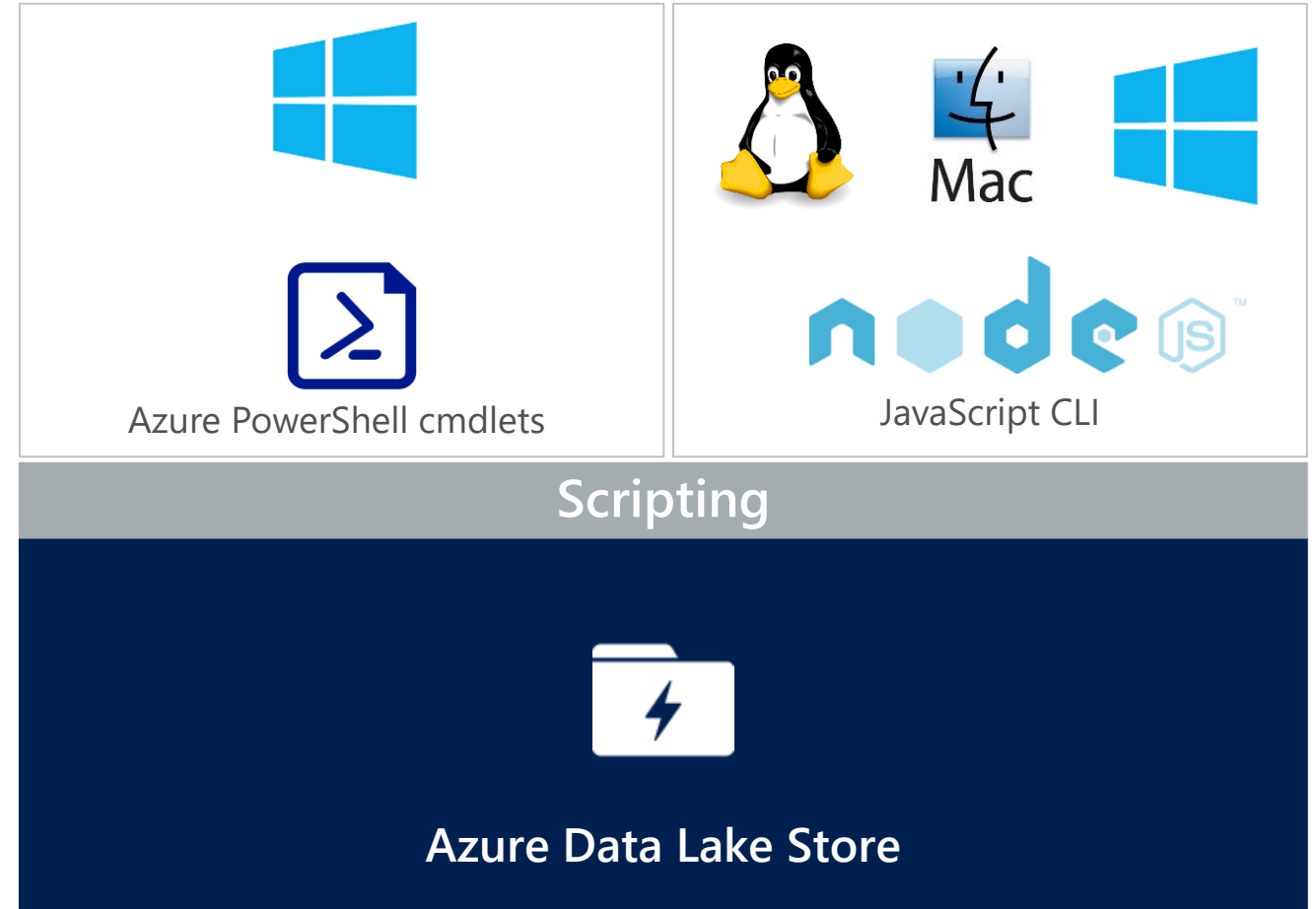
Note: If you are using Hadoop (Map Reduce programs or Hive or HBase) or Spark, then you will not be programming directly to the Azure Data Lake Store as they all will transparently access Azure Data Lake Store under the covers.

Developing scripting applications

Provides native Windows and cross-platform (Mac, Linux) scripting experience

Scripting operations include

- ⚡ Create new directories
- ⚡ Listing the contents of a directory
- ⚡ Upload files to directory
- ⚡ Delete files/directories
- ⚡ Rename files/directories
- ⚡ ...



Costs breakdown by stage

Ingestion

Number of write transactions

Storage

Data stored per month

Processing

Number of read transactions
Number of write transactions

Egress

Number of read transactions

Get all the advantages
of ADL Store with
cost concepts
you are familiar with

