Chapter Two

Azure Storage Services

Topics covered in this unit:

- Azure Storage
- Storage Account Replication Techniques
- Consistency
- Shared Access Signatures
- Pricing
- Storage Account
- Protocols
- Microsoft Azure Storage Abstractions
- Browsing and Managing data in Microsoft
- Azure Storage Lab

Azure Storage

Microsoft Azure Storage is your storage resource on the cloud that is scalable, durable and available anytime anywhere. Since you pay as you go, it is cost effective as well. It provides storage for binary, text data, messages, and structured data on the Microsoft Azure platform. Microsoft Azure Storage uses the RESTful web service which makes it accessible from any HTTP client.

Storage Account

A storage account provides different applications access to Microsoft Azure Storage abstractions like Blob, Table, and Queues located in a geographic region. It is the highest level of namespace for accessing storage services.

If you have a Microsoft Azure subscription, it contains a storage account. A storage account has access to a maximum capacity of 500 TB for all storage services. A single user can have up to 5 Storage Accounts.

It lets you explicitly geo-locate to a sub region or set affinity with other services. You can also allocate storage account with compute account either explicitly or by using affinity groups. Content Delivery Network can be enabled at the account level (means that public containers will be retrievable via the CDN URL). CDN as discussed earlier offers developers a global solution for delivering high-bandwidth content by caching blobs and static content of compute instances at physical nodes in the United States, Europe, Asia, Australia and South America.

For security purposes, a Microsoft Azure Storage Account has two independent 512 bit shared secret keys. These keys use HTTP or HTTPS for accessing content. They are used to sign private requests. There are two keys which are used to enable connectivity to the storage account- primary access key and secondary access key. The access keys should be changed periodically to help keep storage connections more secure. Once can achieve more granular security via Shared Access Signatures (discussed in blobs).

Storage Account Replication Techniques

Locally redundant storage (LRS)
- 3 copies in a single facility in a single region
- Copied in separate fault and upgrade domain

Zone-redundant storage (ZRS)
- 3 copies across two or three facilities across a single or across two regions
- Data durability in case of facility failure

Geo-redundant storage (GRS)
- 6 copies, 3 in primary region and 3 in secondary region
- Data durability in case of complete regional outage
- Data copied asynchronously across regions
- Secondary regions are static, and cannot be changed
- Data can be only read from secondary during failover

Lower throughput

Read-access geo-redundant storage (RA-GRS)

GRS + additional benefit of read-access to data stored on secondary region

Ability to read from secondary

There are some performance implications when some one of the replication techniques is used. The below table highlights them:

Performance of Geo Redundant and Local Redundant

Table 2: Geo and Local Redundant

Geo Redundant Storage (GRS) – Ingress	Geo Redundant Storage (GRS) – Egress	Geo Redundant Storage (LRS) – Ingress	Geo Redundant Storage (LRS) – Egress
10 Gibps	20 Gibps	20 Gibps	30 Gibps

NOTE: Geo Redundant slows down your uploading and download of content to MS data centers. Note that GRS does not impact latency of transactions made to the

Protocols

Azure Storage supports REST API only which are HTTP / HTTPS type requests

The Supported HTTP Request Methods are:

GET

HEAD

PUT

DELETE

Some of the different HTTP Responses are:

2xx: Good response, operation successfully completed

4xx: User Error

5xx: Server Error

Consistency Model

- Azure Storage uses **Strong Consistency** model which means it provides all 3 of Consistency, Availability and Partition Tolerance (CAP).
- Access to data in case of failures and even partitioning.
- A PUT operation is returned as successful only if all 3 copies are committed successfully to storage.

Microsoft Azure Storage Abstractions

Blob

Blob is a Microsoft Azure Storage service for simple names files along with metadata for the file. A blob has two resources 'containers' and 'blobs'.

A container is a set of blobs. Every blob must belong to a container.

Naming

Container

- Must begin with a letter or number
- Have only letters, numbers and dash (-)
- Letters must be lowercase
- A minimum of 3 characters and a maximum of 63 characters in length

Blob

- Can have any characters except special and the ones used in URLs
- Can have either upper or lower case
- Cannot exceed 1024 characters in length

Both container and blob names should conform to DNS naming standards

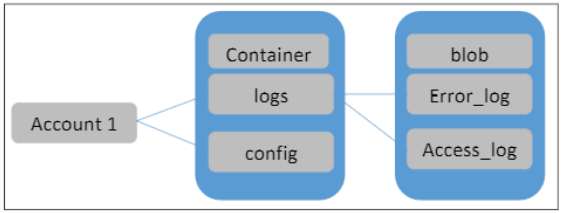

Figure 3: Blob and Container

There are two types of blobs

Block Blobs: are generally used for streaming purposes. Block blobs are made up of blocks each having a block ID. A block blob is created (or modified) by uploading a number of blocks and then committing them by the block ID. Committing is necessary for the block to become a part of the blob. A block blob less than or equal to 64 MB can be uploaded in a single Put Blob operation. Block blobs larger than 64 MB must be uploaded as a set of blocks. Each of these blocks must be less than or equal to 4 MB in size. Multiple blocks can be uploaded in parallel to decrease upload time and can include an MD5 to verify transfer. Blocks can also be uploaded in any order and sequence can be verified in the final commitment step. The size limit for block blobs is 200GB per blob.

Page Blobs: are used for random read/write operations. They are a collection of 512-byte pages. Page blobs are created and initialized with a maximum size, currently 1 TB. To write content to a page blob, you write a page by specifying an offset and a range.

A write operation can overwrite 1 page or up to maximum of 4MB of the page blob and the writes are committed immediately. It is in the form similar to the following URL:

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Chapter One

Azure Fundamentals

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Introduction

Microsoft Azure is a cloud service that provides a platform where we can build, run and deploy applications and store data through an internet accessible medium. It's a part of the larger Microsoft platform. Microsoft provides these services using its own data centres located globally.

It is flexible, open and offers Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS) based solutions. It supports a varied set of operating systems including Linux, different programming languages like PHP, Python, Node.js and new protocols. All Azure SDKs are open source as well. All of this makes the Microsoft Azure cloud model unique enabling us to build reliable, scalable and low cost solutions.

Azure Services

Storage

Azure Storage
Azure Storage provides the flexibility to store and retrieve large amounts of unstructured data, by using various storage services like Blob, Tables, Queues and Files.

StorSimple
StorSimple helps automate and eliminate one of the biggest problems faced by IT organizations—double-digit data growth and the management headaches that come with it. StorSimple uses SSDs and HDDs for low-cost IOPS performance and provides inline de-duplication and compression to reduce overall data footprint. It also delivers massive scaling of storage infrastructure by using Azure for storing rapidly growing, inactive primary data, which often leads to endless storage purchases and infrastructure sprawl.

Azure Import/Export
You can also use the Import/Export service to transfer large quantities of data residing in Blob storage to your on premises installations in a timely and cost-effective manner. You can create and manage import and export jobs in one of two ways: By using the Azure Management Portal and by using a REST interface for the service.

Azure Backup
Azure Backup is a multi-tenant Azure service which enables you to back up your on premises data on Azure. It replaces your existing on premises or offsite backup solution with a reliable, secure and cost competitive cloud based offering.

Site Recovery
Azure Site Recovery helps you to protect important applications by coordinating the replication and recovery of physical or virtual machines. You can replicate data to your own data centre, to

a hosting service provider, or even to Azure to avoid the expense and complexity of building and managing your own secondary location.

Compute

Virtual Machines

Azure Virtual Machines enable you to deploy a Windows Server or Linux image in the cloud. You can select images from a gallery or bring your own customized images.

Cloud Services

Azure Cloud Services remove the need to manage server infrastructure. With Web and Worker roles, they enable you to quickly build, deploy and manage modern applications.

Website and Apps

Azure Web Sites enables you to deploy web applications on a scalable and reliable cloud infrastructure. You can quickly scale up and out or even scale automatically to meet your application needs.

Mobile Services

Azure Mobile Services provides a scalable cloud backend for building Windows Store, Windows Phone, Apple iOS, Android, and HTML/JavaScript applications. Store data in the cloud, authenticate users, and send push notifications to your application within minutes.

Networking

Virtual Network

Azure Virtual Network enables you to create Virtual Private Networks (VPN) within Azure and securely link these with on premises IT infrastructure

ExpressRoute

Azure ExpressRoute enables you to create private connections between Azure datacentres and infrastructure that's on your premises or in a co-location environment.

Traffic Manager

Azure Traffic Manager allows you to load balance incoming traffic across multiple hosted Azure services whether they're running in the same datacentre or across different datacentres around the world.

Database

SQL Database

Azure SQL Database is a relational database service that enables you to rapidly create, extend, and scale relational applications into the cloud.

DocumentDB
Azure DocumentDB is a NoSQL document database service. Designed from the ground and it supports JSON and JavaScript directly inside the database engine.

Content Delivery Network (CDN)

Azure CDN (Content Delivery Network) allows you to deliver high-bandwidth content to end-users around the world with low latency and high availability via a robust network of global data centres.

Big Data/ Analytics

HDInsight
Azure HDInsight Service is a Hadoop-based service that brings an Apache Hadoop solution to the cloud. Gain full value of Big Data with a cloud-based data platform that manages data of any type and any size.

Machine Learning
Azure Machine Learning is a powerful cloud-based predictive analytics service that makes it possible to quickly create and deploy analytics solutions.

Monitoring

Operational Insights
Operational Insights as part of the Microsoft Cloud Management Suite, is software as a service (SaaS) solution tailored for IT operations teams. This service leverages the power of Azure to effortlessly collect, store and analyse log data from virtually any Windows Server and Linux source, from any datacentre or cloud, and turn it into real-time operational intelligence to enable better-informed decisions.

Application Insights
Application Insights comes as part of Visual Studio with automatic instrumentation for ASP.NET or Windows developers. You g.et vital application telemetry data out of the box, including usage, exceptions/crashes, requests, performance and logs

Event Hubs
Event Hubs is a highly scalable publish-subscribe event in gestor that can intake millions of events per second so that you can process and analyse the massive amounts of data produced by your connected devices and applications. Once collected into Event Hubs you can transform and store data using any real-time analytics provider or with batching/storage adapters.

Notification Hubs
Notification Hubs is a massively scalable mobile push notification engine for quickly sending millions of messages to iOS, Android, Windows, or Kindle devices. Tailor notifications to specific users-or entire audiences-with just a few lines of code, and do it across any platform.

Deployment and Management

Resource Manager
The Azure Resource Manager enables you to create reusable deployment templates that declaratively describe the resources that make up your application (for example an Azure Website and a SQL Azure database). This simplifies the process of creating complex environments for development, testing and production in a repeatable manner.

API Management
Microsoft Azure API Management ensures an organization's API program reaches its fullest potential. With API management, organizations can publish web services as APIs reliably, securely and at scale.

Access Control

Active Directory
Azure Active Directory (Azure AD) provides identity management and access control capabilities for your cloud applications. You can synchronize your on premises identities and enable single sign-on to simplify user access to cloud applications.

Multi Factor Authentication
Azure Multi-Factor Authentication helps safeguard access to data and applications while meeting user demand for a simple sign-in process. It delivers strong authentication via a range of easy verification options—phone call, text message, or mobile app notification—allowing users to choose the method they prefer.

Programming and Application

Azure Batch
Azure Multi-Factor Authentication helps safeguard access to data and applications while meeting user demand for a simple sign-in process. It delivers strong authentication via a range of easy verification options—phone call, text message, or mobile app notification—allowing users to choose the method they prefer.

Azure Service Bus
Azure Service Bus is a generic, cloud-based messaging system for connecting just about anything—applications, services, and devices—wherever they are. Connect apps running on Azure, on-premises—or both. You can even use Service Bus to connect household appliances, sensors, and other devices like tablets or phones to a central application or to each other.

Azure Scheduler
Azure Scheduler lets you create jobs in the cloud that reliably invoke services inside and outside of Azure—such as calling HTTP/S endpoints or posting messages to Azure Storage queues. You can choose to run jobs right away, on a recurring schedule, or at some point in the future.

Azure Search
Azure Search Service is a fully managed cloud service that allows developers to build rich search applications using a .NET SDK or REST APIs.

BizTalk Services
BizTalk Services provides out-of-the box, cloud to on-premises, and line-of-business application integration for SAP, Oracle EBS, SQL Server, and PeopleSoft. It allows you to connect with any HTTP, FTP, SFTP, or REST data sources. You can route messages by using various Azure artifacts such as Service Bus Queues, Topics, SQL Database, and Blob store.

Compute Execution Models for applications

Microsoft Azure provides three execution models (or compute options), which can be used separately or combined:

1. Virtual Machines (Infrastructure as a Service)
2. Web Sites (web hosting)
3. Cloud Services (Platform as a Service)

Azure Regions Pairs

Table 1: Azure region pairs

Primary	Secondary
North Central US	South Central US
South Central US	North Central US
East US	West US
West US	East US
North Europe	West Europe
West Europe	North Europe
South East Asia	East Asia
East Asia	South East Asia
East China	North China
North China	East China

We can choose a region to deploy the services based on our location or the location of the Customer. Once the primary region is selected, its corresponding secondary region is allocated for some backup or Data retention process and it is completely taken care by the Azure team and not by the User.

NOTE: Not all services are available in all regions.

For a list of services by region visit:
http://azure.microsoft.com/en-us/regions/#services

Some datacenters have servers grouped inside containers - each containing 1800-2500 servers.

Content Delivery Networks
The Content Delivery Network nodes are located in 24 countries. A Content Delivery Network stores a cached copy of the data at a location closer to the user's location. The first time a user access the data, CDN does this and from next time onwards contents are delivered from the cache rather than the original remote location. The main purpose of this is to make information access faster.

Affinity Groups
An affinity group is basically a way to ensure compute and storage resources are always together and close to one another. By using Affinity groups we tell the Fabric Controller when it is searching for the most suitable container for deploying the service that it should look for a container where it can deploy both in the same Cluster, making them as close as possible. This provides benefits like:

1. Aggregation
2. Reduced latency

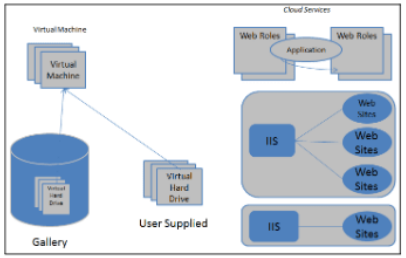

Figure 1: Execution model

Microsoft Azure Datacentre Infrastructure

Regions

Microsoft provides Microsoft Azure services out of 15 regions from across the world, with 2 regions in Australia as well. This is a growing network of Microsoft's self-managed datacenters which provides great reliability, performance, redundancy, backups and recovery while helping Customers keeping the cost low.

Figure 2: Azure Datacentres

(Source: http://azure.microsoft.com/)

3. Lower Costs

Info:
A nice tool to use to see which Azure Affinity Group to use e.g. South America, North America or Asia is to download this tool and run checks from where your clients will be based.

REFERENCE:
http://research.microsoft.com/en-us/downloads/5c8189b9-53aa-4d6a-a086-013d927e15a7/default.aspx

Azure Fabric
The fabric layer is run by a specialized OS called Microsoft Azure which provides provisioning, orchestration and management capabilities for the compute, storage and network resources. It monitors status, health of the system as well as services.

The Microsoft Azure Portal
The Microsoft Azure Management Portal is where we create, view and manage most of our services. It is accessed using the URL https://manage.windowsazure.com/. A Windows Live ID or Microsoft Account is needed to login and start using Microsoft Azure. The portal is HTML based and compatible with various modern browsers.

Types of Accounts

Free
These are primarily for evaluation purposes, enabling a free playground for anyone who wishes to experience Azure Web Sites at no cost. Free web sites have no SLA.

Shared
These reduce some of the restrictive quotas associated with Free, allowing you to run your web sites 24×7. However, shared web sites are still very much limited in capacity and feature set. Shared site have no SLA either.

Basic
These are designed for production of small to medium websites. Basic websites have all Azure Web Sites core abilities at a reduced price.

Standard
These are designed to be used in production for medium to very large web sites. Standard web sites leverage the full range of Azure Web Sites capabilities, enabling advanced scenarios with high-availability and improved development operations (DevOps).

Azure Credentials

Azure Account username and password

This enables the user to Sign-in to Azure account with the Username and password. It is the most common form of Authentication.

Storage Access Keys

When you create a storage account, Azure generates two 512-bit storage access keys, which are used for authentication when the storage account is accessed. By providing two storage access keys, Azure enables you to regenerate the keys with no interruption to your storage service or access to that service.

Key Vault (Preview)

Azure Key Vault—currently in preview—helps safeguard cryptographic keys and secrets used by cloud applications and services. By using Key Vault, you can encrypt keys and secrets (such as authentication keys, storage account keys, data encryption keys, .PFX files, and passwords) by using keys that are protected by hardware security modules (HSMs). Key Vault streamlines the key management process and enables you to maintain control of keys that access and encrypt your data. Developers can create keys for development and testing in minutes, and then seamlessly migrate them to production keys. Security administrators can grant (and revoke) permission to keys, as needed.

Advantages

- High Availability of up to 99.99% uptime
- Interoperability in terms of hybrid applications that reside on-premise but use cloud services
- Easy and faster provisioning of applications, reducing overall 'time to market'. Makes adding services or features to existing applications easier and faster
- Flexibility by scaling as per need, from a few hundred Customers to millions of them. Automatic scaling through 'pay as you go' model makes it easier and quicker to respond to changes
- No upfront cost and low running cost, meaning overall TCO is less. This also means low application lifecycle cost
- Reduced Administrative tasks in terms of Microsoft taking care of upgrades, security, patch management, anti-virus, DoS attacks etc.
- Good pool of development resources plus availability of Non-Microsoft tools makes application development better
- Microsoft Azure SDK for running a version of Microsoft Azure called Microsoft Azure Development Fabric on your computer for working locally on development and debugging and then moving it to cloud
- Security through .NET Access Control Service by integrating identities and using SAML (Security Assertion Markup Language) tokens to determine a user's access level

Privacy and Compliance

To manage Privacy and Security related concerns, Microsoft has created a **Microsoft Azure Trust Center**. Microsoft Azure is compliant with the **E.U. Data Protection Directive (95/46/EC)**.

Microsoft Azure also has several of its services compliant with several compliance programs including **ISO 27001, SAS (Statement on Auditing Standards) 70 types I and II** and does audits for **PCI DSS**, **SOX (Sarbanes Oxley)**and **HIPAA**. The entire list can be found on the Microsoft Azure Trust Center Compliance page.

REFERENCE:

ISO - http://www.iso.org/iso/catalogue_detail?csnumber=42103

SAS - http://www.sas70.com/about.htm

HIPPA- http://en.wikipedia.org/wiki/Health_Insurance_Portability_and_Accountability_Act

SOX – http://en.wikipedia.org/wiki/Sarbanes%E2%80%93Oxley_Act

PCI DSS - https://www.pcisecuritystandards.org/security_standards/

Pricing

All services in Microsoft Azure have separate pricing, however the general Subscription model is divided into three types.

Pay-as-You-Go – A flexible plan that has no upfront cost and no long term commitment. You pay for resources used in a month. Charges are per hour, per transaction and per gigabyte based on the resources.

Enterprise Agreement – You need to sign and make an upfront commitment in terms of usage to get benefit like 99.95% SLA, no restriction on usage (no quotas), annual payments and access to Enterprise portal.

Buy from a Microsoft Reseller – Use Open Volume licensing program to purchase Azure subscription from your existing Microsoft reseller.

IMP: Azure Subscription and Service Limits, Quotas, and Constraints

REFERENCE: http://azure.microsoft.com/en-us/documentation/articles/azure-subscription-service-limits/

For the latest offers visit:

REFERENCE: http://www.windowsazure.com/en-us/pricing/purchase-options/

Detailed pricing information can be found at:

REFERENCE: http://www.windowsazure.com/en- for all services.

Pricing calculator can be used to get an approximate estimate of costs. It can be accessed through the following link:

REFERENCE: http://www.windowsazure.com/en-us/pricing/calculator/