Caltech | Center for Technology & Management Education

Post Graduate Program in Cloud Computing

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PG CC - Microsoft Azure Architect Design: AZ:304

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Design a Solution for Backup and Recovery

Learning Objectives

By the end of this lesson, you will be able to:

- Classify the architectural best practices for reliability into categories
- Recommend a solution for recovery in different regions
- Recommend a solution for Azure backup management
- Design a solution for data archiving and retention

A Day in the Life of an Azure Architect

You are working as an Cloud Architect in an automobile company. The company needs a business continuity solution for the deployment of an order processing system to Azure.

The order processing system would use Azure Linux and Windows Server VMs.

The system uses multiple Azure subscriptions and has a wide portfolio of products deployed across subscriptions. You need to design a solution keeping the below requirements in mind:

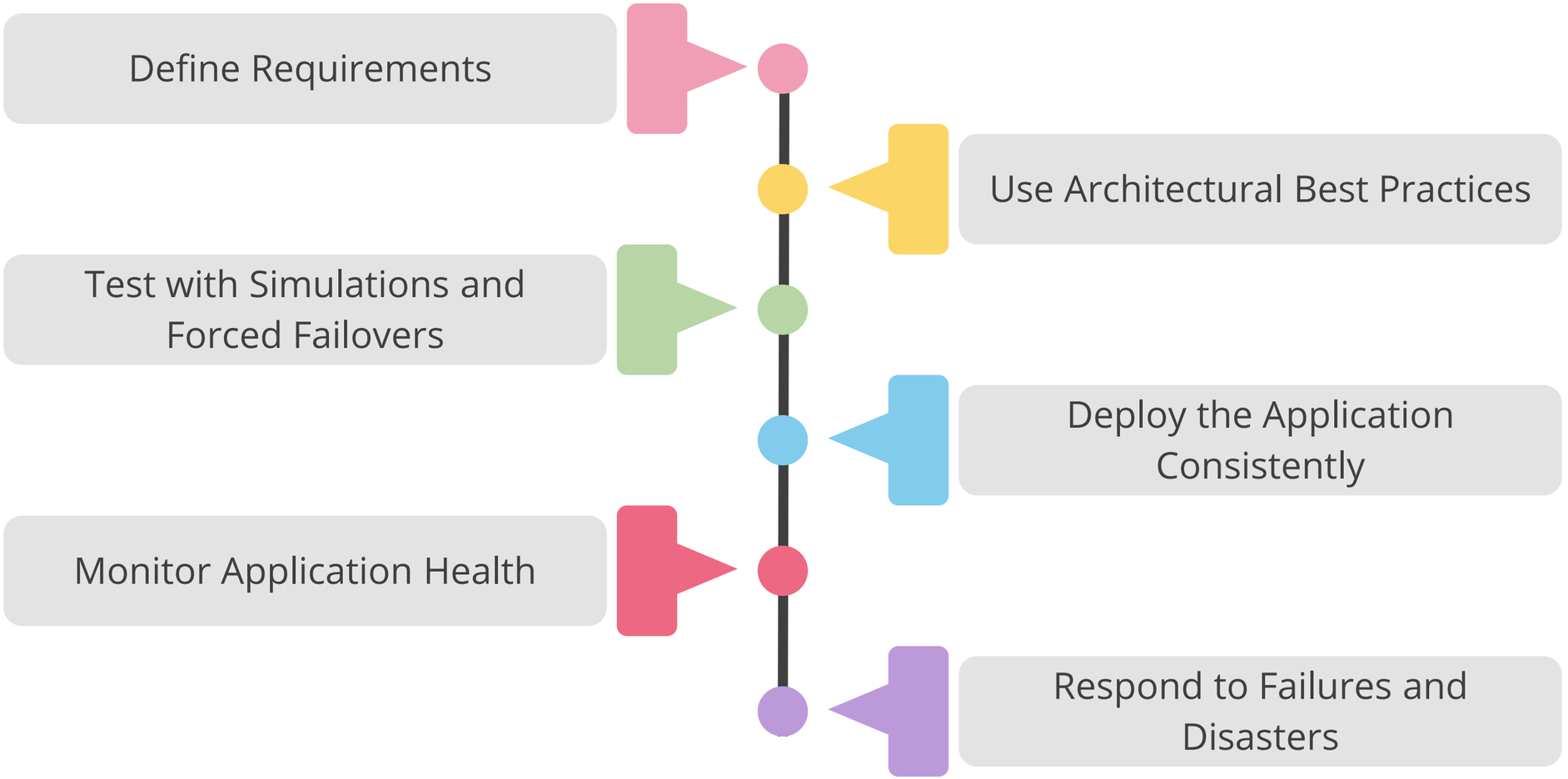
- There should be no business interruption if an Azure region fails
- You need to keep the cost minimized
- Your data should be safe and recoverable with this solution.

To achieve all of the above, along with some additional features, we would be learning a few concepts in this lesson that will help you find a solution for the above scenario.

Recommend a Recovery Solution for Azure Workloads

Architectural Best Practices for Reliability

The architectural best practices for reliability are:



Define Requirements

Define requirements using the criteria given:

1. Identify workloads and usage
2. Plan for usage patterns
3. Establish availability metrics (MTTR/MTBF)
4. Establish recovery metrics (RTO/RPO)
5. Determine workload availability targets
6. Understand service-level agreements

Recovery Time Objective

Recovery time objective (RTO) is the maximum acceptable time that an application can be unavailable after an incident.

- If RTO is 90 minutes, you must be able to restore the application to a running state within 90 minutes from the start of a disaster.
- If you have a very low RTO, consider a second deployment running in standby mode.

Recovery Point Objective

Recovery point objective (RPO) is the maximum duration of data loss that is acceptable during a disaster.

Example:

Data stored in a single database with no replication to other databases and hourly backups could result in the loss of an hour's worth of data.

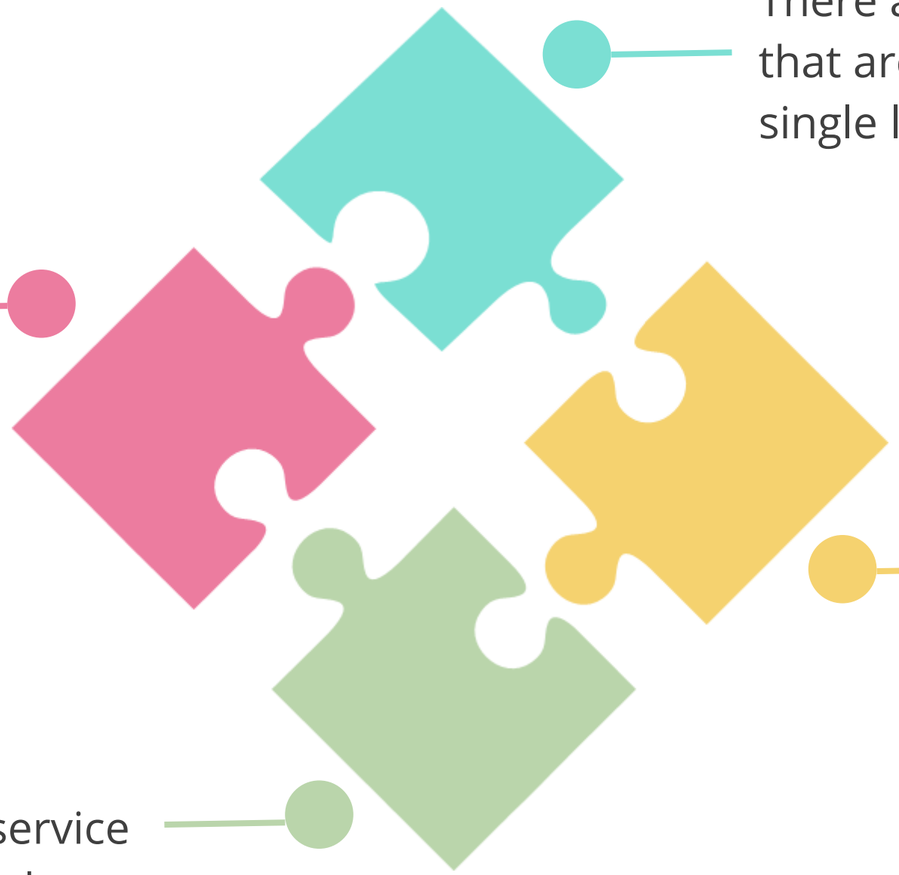
Use Architectural Best Practices

The following is a list of architectural best practices:

- Perform a failure mode analysis (FMA)
- Create a redundancy plan
- Design for scalability
- Plan for subscription and service requirements
- Use load-balancing to distribute requests
- Build availability requirements into your design
- Manage your data

Azure Service Dependencies

The following Azure services are dependent on one another:



There are no services that are dependent on a single logical data center

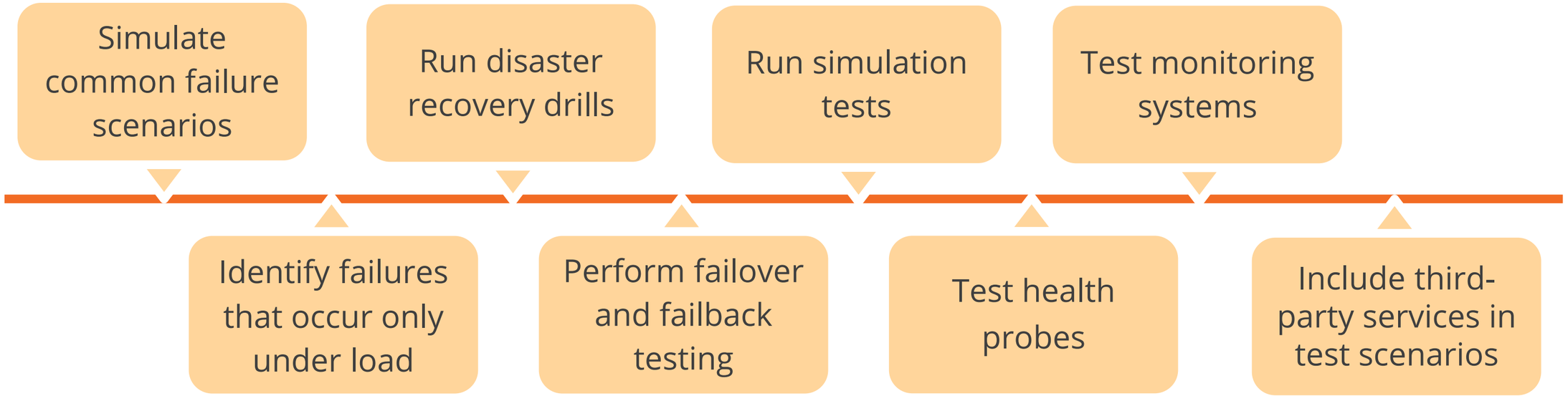
Customer-specific regions in which their data will be stored

Non-regional services are deployed to two or more regions

Azure service dependency documentation

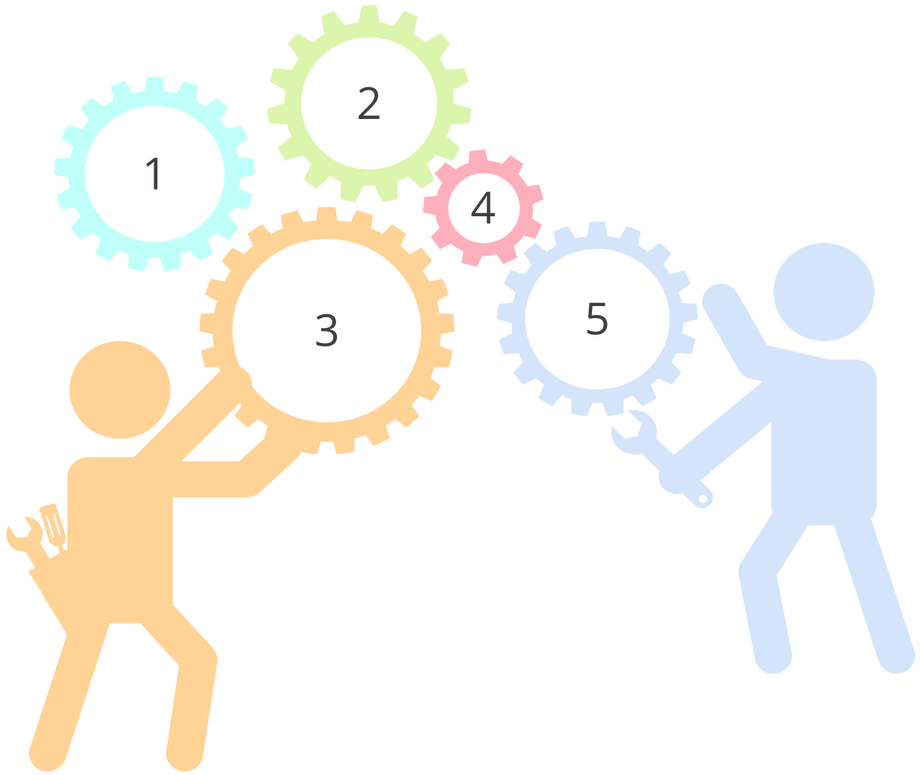
Test with Simulations and Forced Failovers

The steps involved in simulating a common failure scenario are as follows:



Deploy Applications Consistently

The stages in deploying a consistent application are as follows:



- Automate your application deployment process
- Design your release process to maximize availability
- Have a rollback plan for deployment
- Log and audit deployments
- Document the application release process

Monitor Application Health

The following factors are often used to take care of the application's health:

- Measure remote call statistics and share the data with the application team
- Track transient exceptions and retries over an appropriate time frame
- Implement health probes, check functions, and monitor third-party services
- Train multiple operators to monitor the application and to perform manual recovery steps

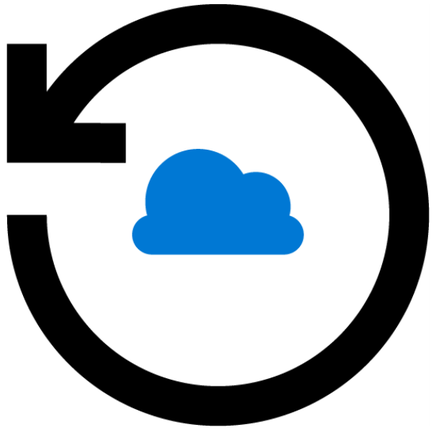
Monitor Application Health

The following factors are often used to take care of the application's health:

- Check long-running workflows
- Maintain application logs
- Set up an early warning system
- Operate within Azure subscription limits

Respond to Failures and Disasters

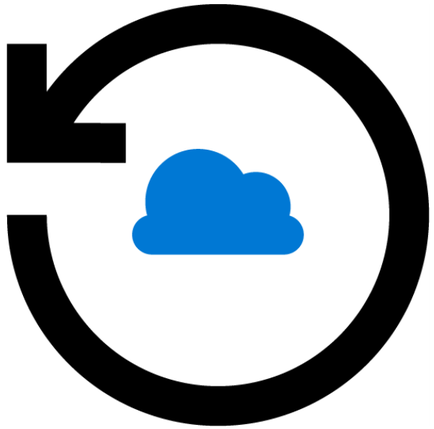
In the case that the application fails, the following operations are carried out:



- Plan for Azure support interactions
- Document and test your disaster recovery plan
- Failover manually when required
- Prepare for application failure

Respond to Failures and Disasters

In the case that the application fails, the following operations are carried out:



- Recover from data corruption
- Recover from a network outage
- Recover from a dependent service failure
- Recover from a region-wide service disruption

Design and Azure Site Recovery Solution

Azure to Azure Site Recovery

Replicate Azure VMs to any other Azure location.

Automatically deploys ASR Mobility Service extension to protected machines.

Replicates:

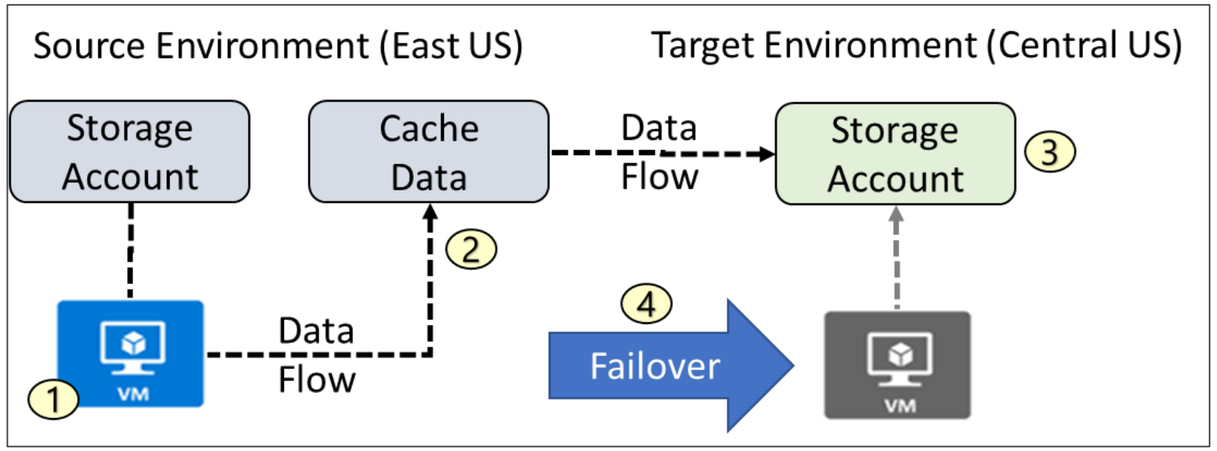
- VMs
- Virtual Networks
- Availability Sets
- Storage accounts
- Optionally – User can specify own VNets, Storage Accounts and Availability Sets

Replicates HTTPS channel on 443:

- Generates Azure egress cost for outbound traffic from primary region

Azure to Azure Architecture

These are steps of azure-to-azure architecture:



- VM is registered with Azure Site Recovery
- Data is continuously replicated to cache
- Cache is replicated to the target storage account
- During failover the virtual machine is added to the target environment

Azure to Azure Site Recovery: Network Traffic

ASR traffic is only outbound from protected VMs.

Access to ASR URLs:

*.blob.core.windows.net	for storage account writes
login.microsoftonline.com	authorization and authentication to the ASR URLs
*.hypervrecoverymanager.windowsazure.com	ASR service communication channel
*.servicebus.windows.net	monitoring and diagnostics

Azure to Azure Site Recovery: Network Traffic

ASR traffic is only outbound from protected VMs.

Outbound security rules for NSGs:

Site Recovery service and monitoring IP addresses (location specific)

Location	Site Recovery service IPs	Site Recovery monitoring IP
Central US	40.69.144.231	52.165.34.144

Snapshots and Recovery Points

Recovery points are created from snapshots

Site Recovery snapshots:

Crash-consistent

Data that was on the disk when the snapshot was taken

App-consistent

All the information in a crash-consistent snapshot, plus all the data in memory and transactions in progress

Assisted Practice

Azure Site Recovery

Duration: 10 Min.

Problem Statement:

As an Azure Architect, you've been asked to assist your company with an Azure backup and recovery solution. Your data should be safe and recoverable with this Azure backup solution.

Assisted Practice: Guidelines

Steps to create Azure site recovery are:

1. Login to your Azure portal
2. Search and select recovery services vault
3. Enter the required details and create a recovery service vault

Recommend a Solution for Recovery in Different Regions

Azure to Azure Disaster Recovery Architecture

The Azure to Azure disaster recovery architecture is shown below:

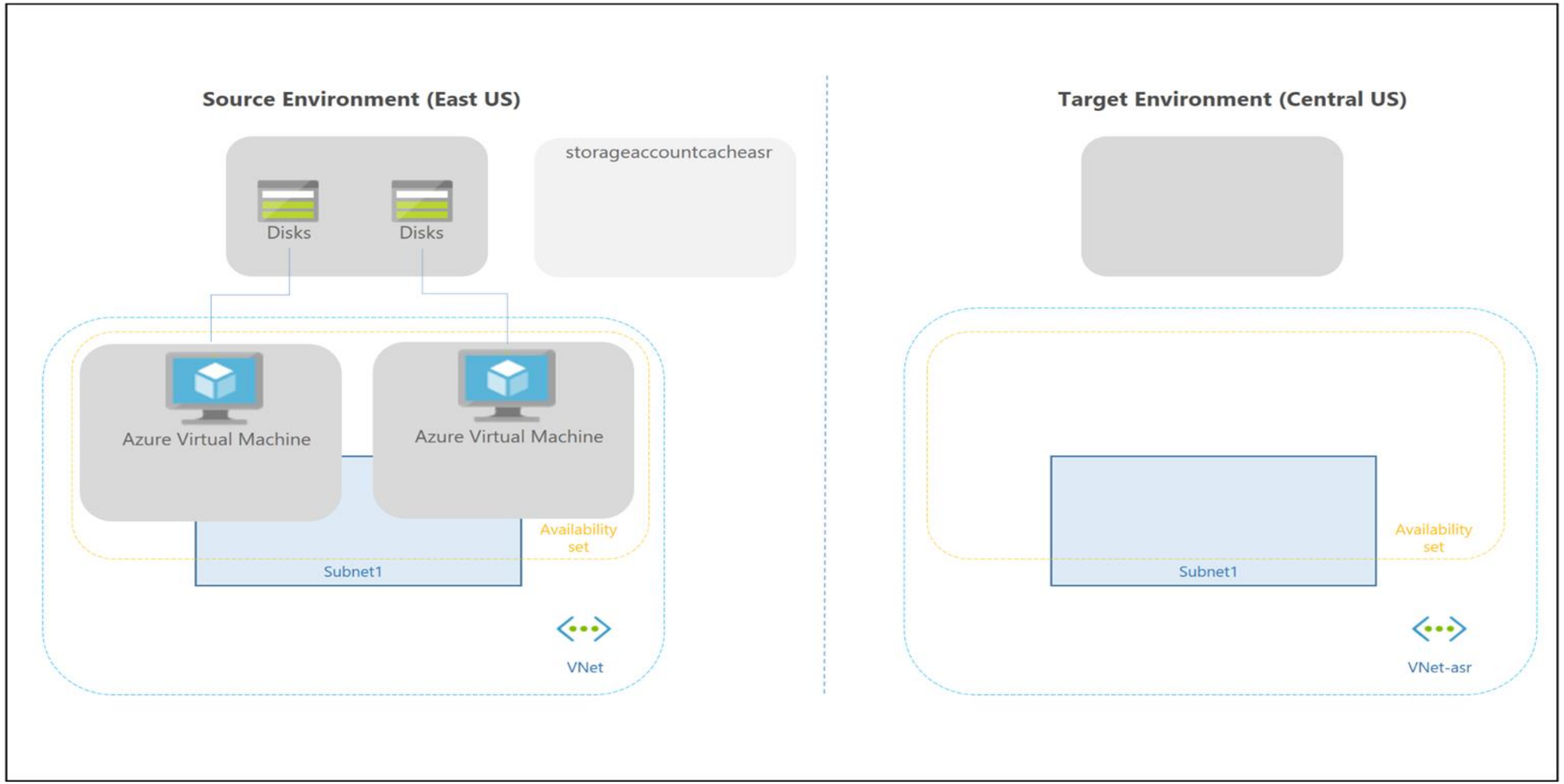


Image source: https://docs.microsoft.com/en-in/

Architectural Components

These are the architectural components of disaster recovery:

- VMs in the source region
- Source VM storage
- Source VM networks
- Cache storage account
- Target resources

Architectural Components

The architectural components and requirements of disaster recovery are:

Components	Requirements
VMs in the source region	One or more Azure VMs in a supported source region.
Source VM storage	Non-managed disks can be distributed through storage accounts, whereas managed disks can be used in Azure VMs.
Source VM networks	In the source field, VMs can be found in one or more subnets of a virtual network.
Cache storage account	Using a cache means that production applications running on a VM have minimal effects.
Target resources	Target resources are used during replication and failover.

Replication Process

The replication process architecture is shown below:

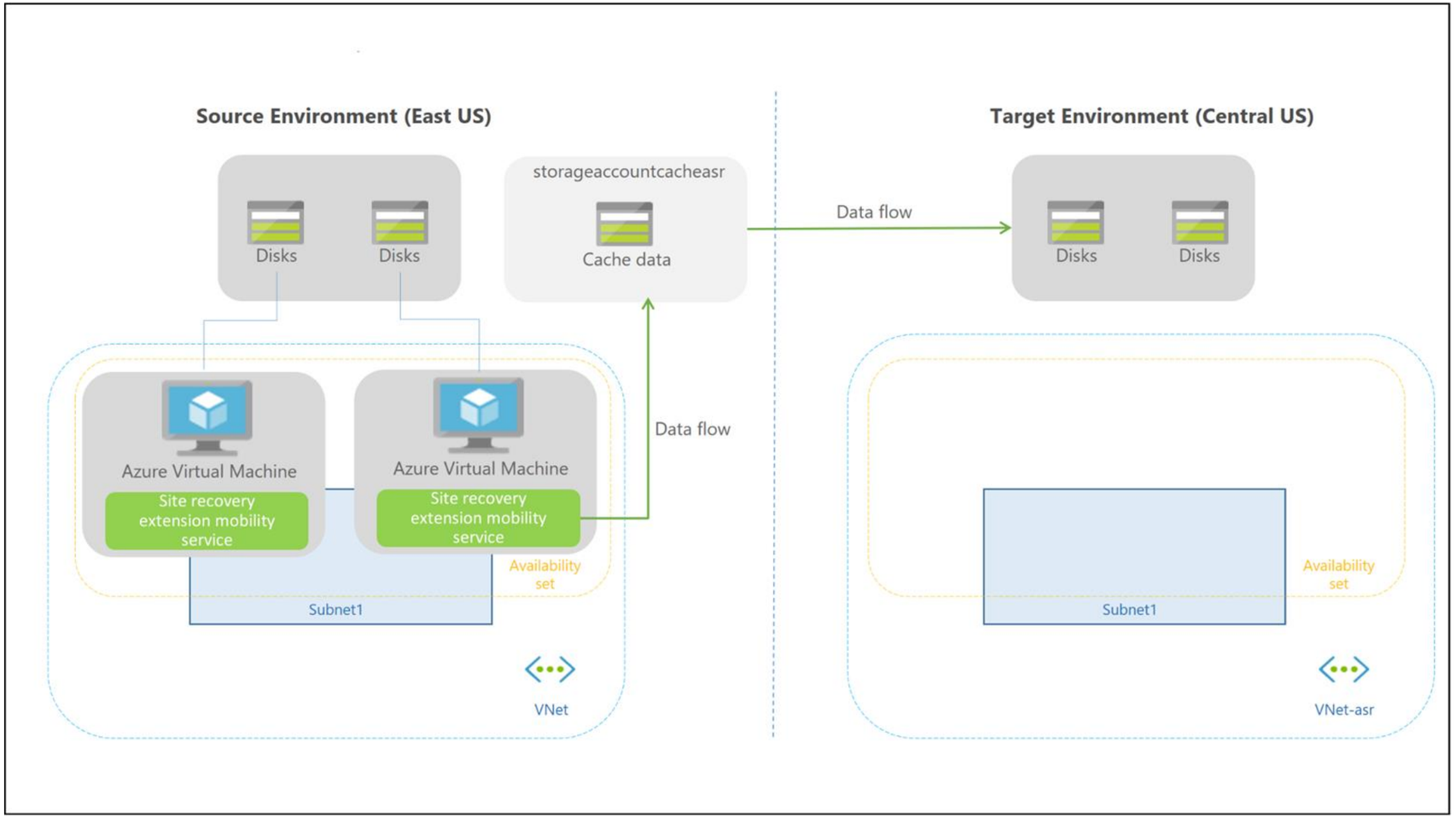


Image source: https://docs.microsoft.com/en-in/

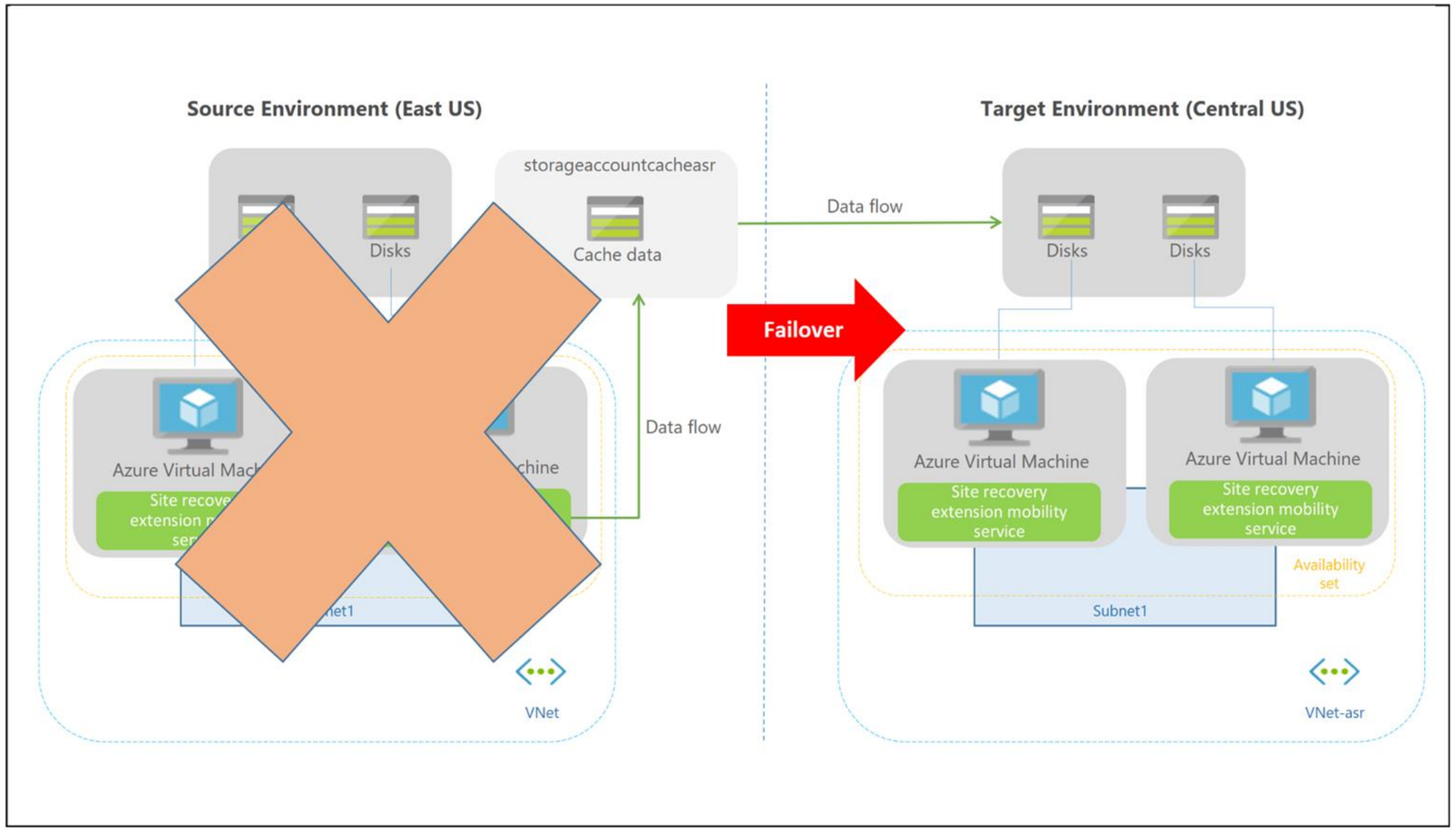
Replication Process

When replication is enabled for an Azure VM:

- The site recovery mobility service extension is installed on the VM.
- The extension registers the VM with site recovery.
- Continuous replication begins for the VM.
- Disk writes are transferred to the cache storage.
- Data is processed and sent to a target storage account or a replicated disk.
- Crash-consistent recovery points are generated every five minutes after data processing.

Failover Process

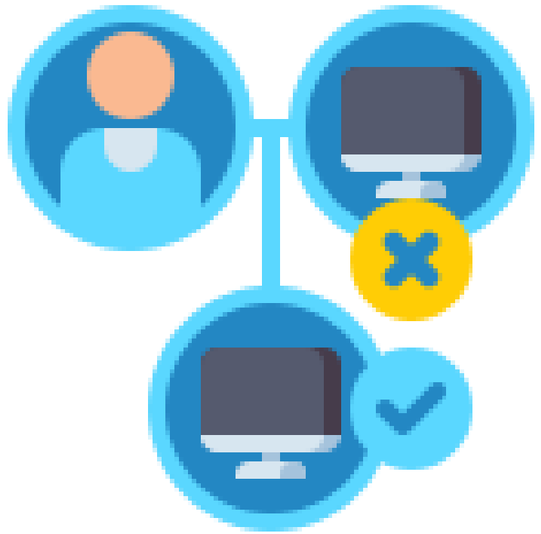
The failover process architecture is shown below:



Source: https://docs.microsoft.com/en-in/

Failover Process

When a user initiates a failover, the VMs are created in the target resource group, target virtual network, target subnet, and in the target availability set.

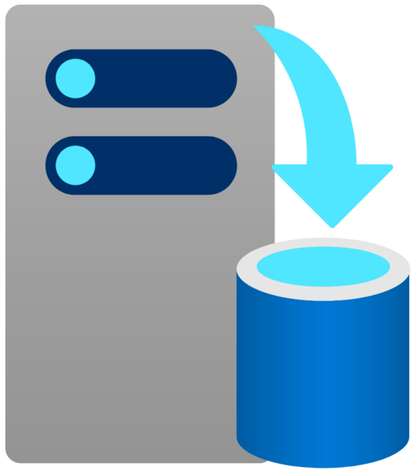


The user can use any recovery point during a failover.

Recommend a Solution for Azure Backup Management

Microsoft Azure Backup Overview

Microsoft Azure Backup Service offers simple and reliable backup and protection for critical data in an easily recoverable way from any location.



Microsoft Azure Backup Benefits

Reliable offsite data protection

- Convenient offsite protection
- Safe data
- Encrypted backups

A simple and integrated solution

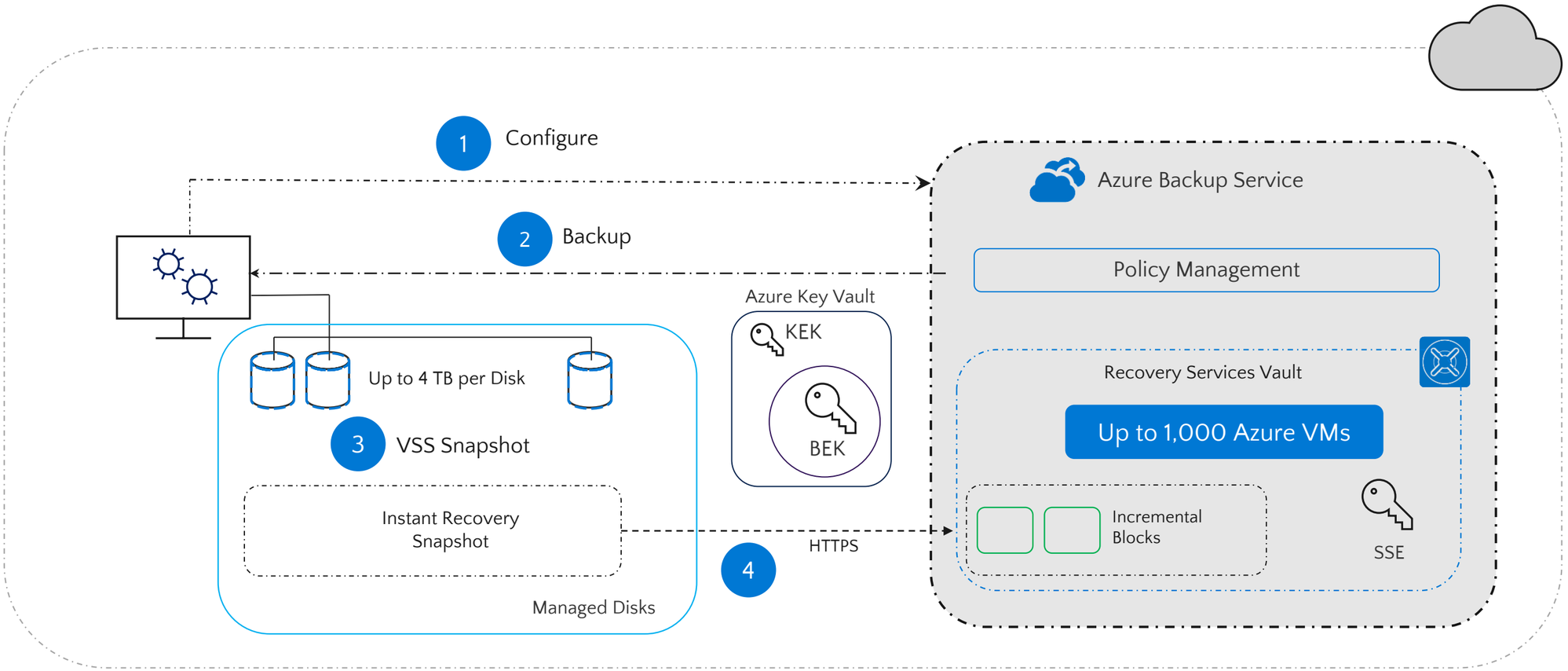
- Familiar interface
- Azure integration

Efficient backup and recovery

- Efficient use of bandwidth and storage
- Flexible configuration
- Flexible in recovery

Azure VM Backup Architecture

The following figure illustrates the architecture of Azure Backup Service:



Azure Backup Key Features

- Simple configuration and management
- Block-level incremental backups
- Data integrity verified in the cloud
- Configurable retention policies

Simple and familiar user interface to configure and monitor backups from Windows Server and System Center Data Protection Manager

Azure Backup Key Features

- Simple configuration and management
- Block-level incremental backups
- Data integrity verified in the cloud
- Configurable retention policies

Automatic incremental backups track file and block level changes, only transferring the changed blocks, hence reducing the storage and bandwidth utilization

Azure Backup Key Features

- Simple configuration and management
- Block-level incremental backups
- Data integrity verified in the cloud
- Configurable retention policies

Backed up data is also automatically checked for integrity once the backup is complete. As a result, any corruptions due to data transfer are automatically identified and repair is attempted in the next backup

Azure Backup Key Features

- Simple configuration and management
- Block-level incremental backups
- Data integrity verified in the cloud
- Configurable retention policies

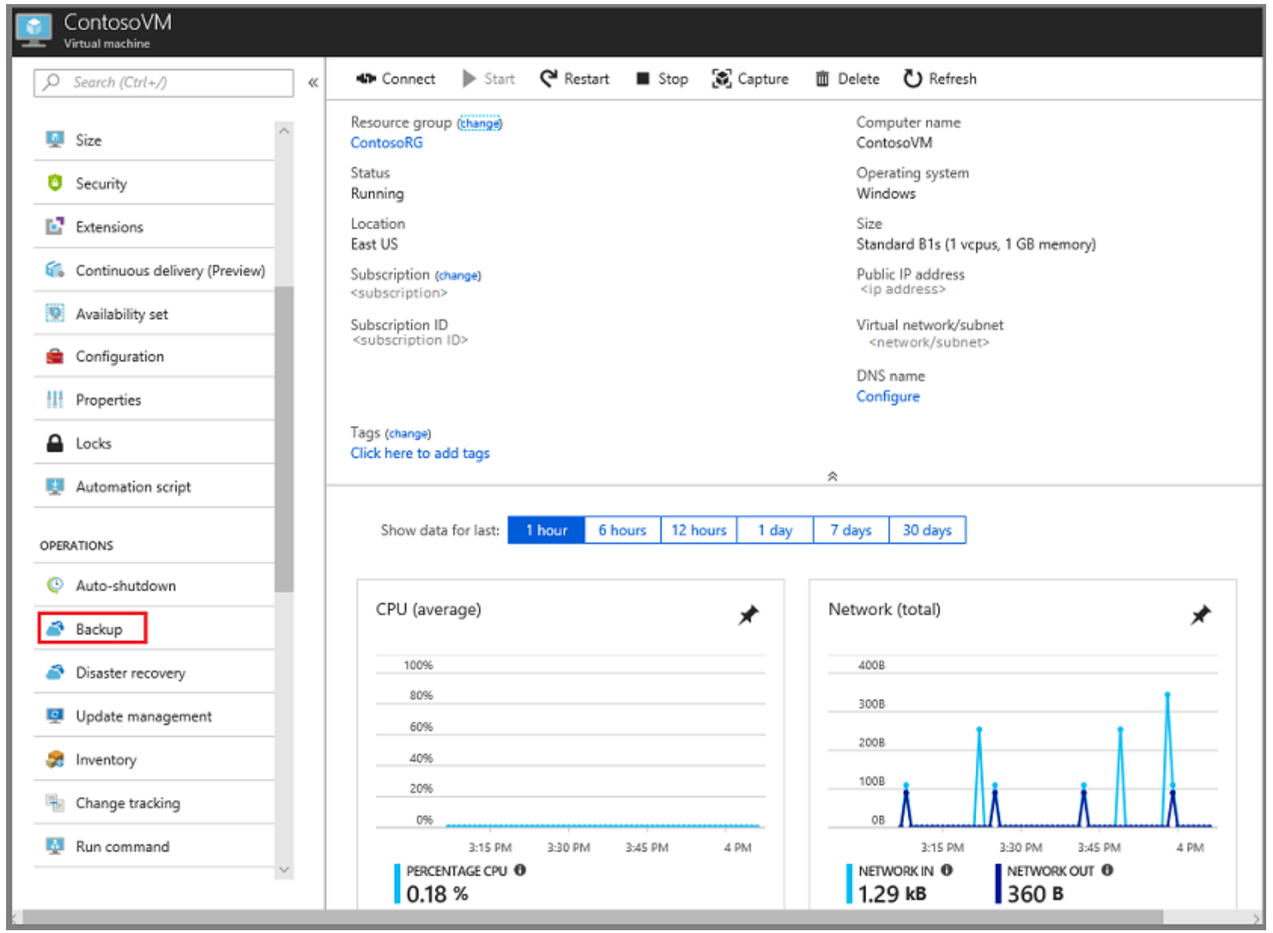
Retention policies are used to control how long a backup will be saved in Azure. This helps to meet business policies and manage backup costs

Azure IaaS Backup Components

Component	Benefits	Limits	What is protected?	Where are backups stored?
Azure Backup Server (can be deployed in Azure and on-premises)	• App aware snapshots (VSS) • Full flexibility for when to take backups • Recovery granularity (all) • Can use Recovery Services vault • Linux support on Hyper-V and VMware VMs • Backup and restore VMware VMs • Does not require a System Center license	• Cannot backup Oracle workload • Always requires live Azure subscription • No support for tape backup	• Files • Folders • Volumes • VMs • Applications • Workloads • System State	• Recovery Services vault • Locally attached disk
Azure IaaS VM Backup	• Native backups for Windows/Linux • No specific agent installation required • Fabric-level backup with no backup infrastructure needed	• Backup VMs once-a-day • Restore VMs only at disk level • Cannot back up on-premises	• VMs • All disks (using PowerShell)	Recovery Services vault

Recovery Services Vault Overview

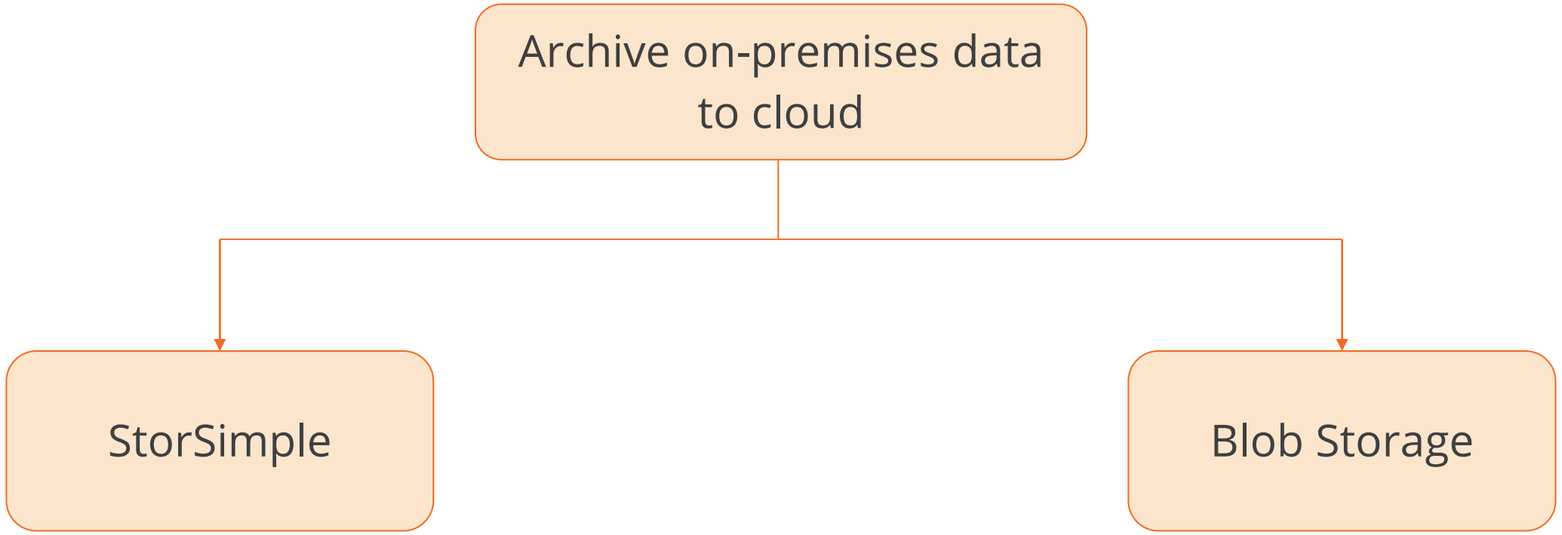
A Recovery Services vault is a storage entity in Azure that houses data.



Design a Solution for Data Archiving and Retention

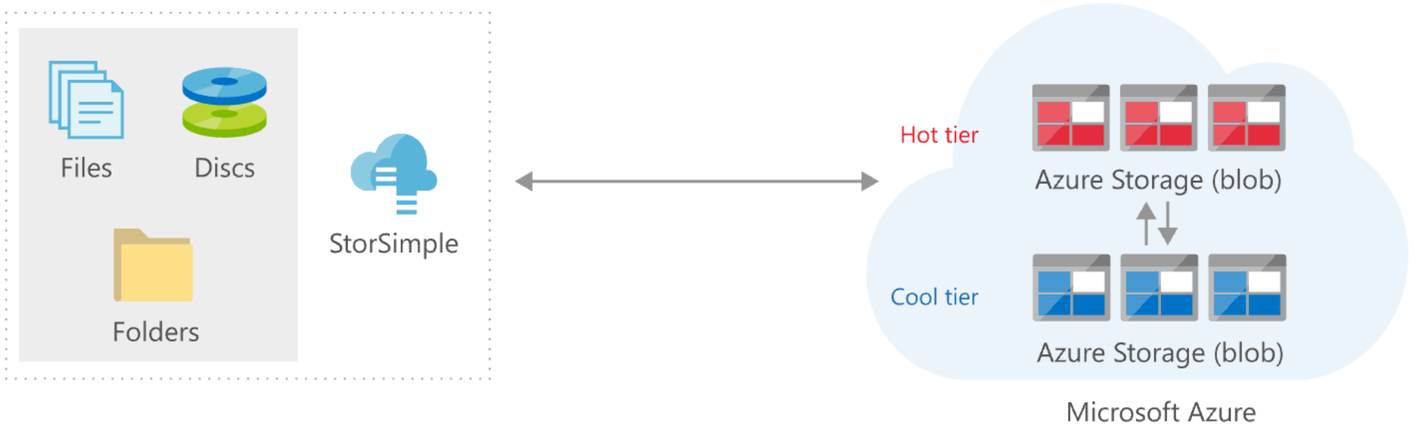
Archive On-Premises Data to Cloud

Azure Blob Storage can be used to archive your on-premises data.



Archive On-Premises Data to Cloud

Azure StorSimple appliance running on-premises can tier data to Azure Blob storage (both hot and cool tier).

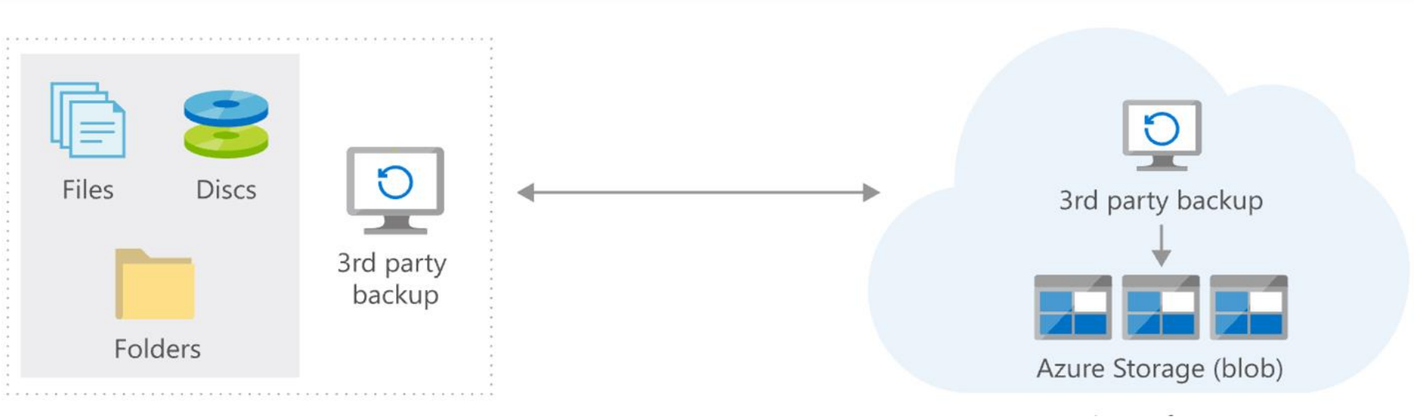


Azure StorSimple

StorSimple can be used to archive data from on-premises to Azure.

Archive On-Premises Data to Cloud

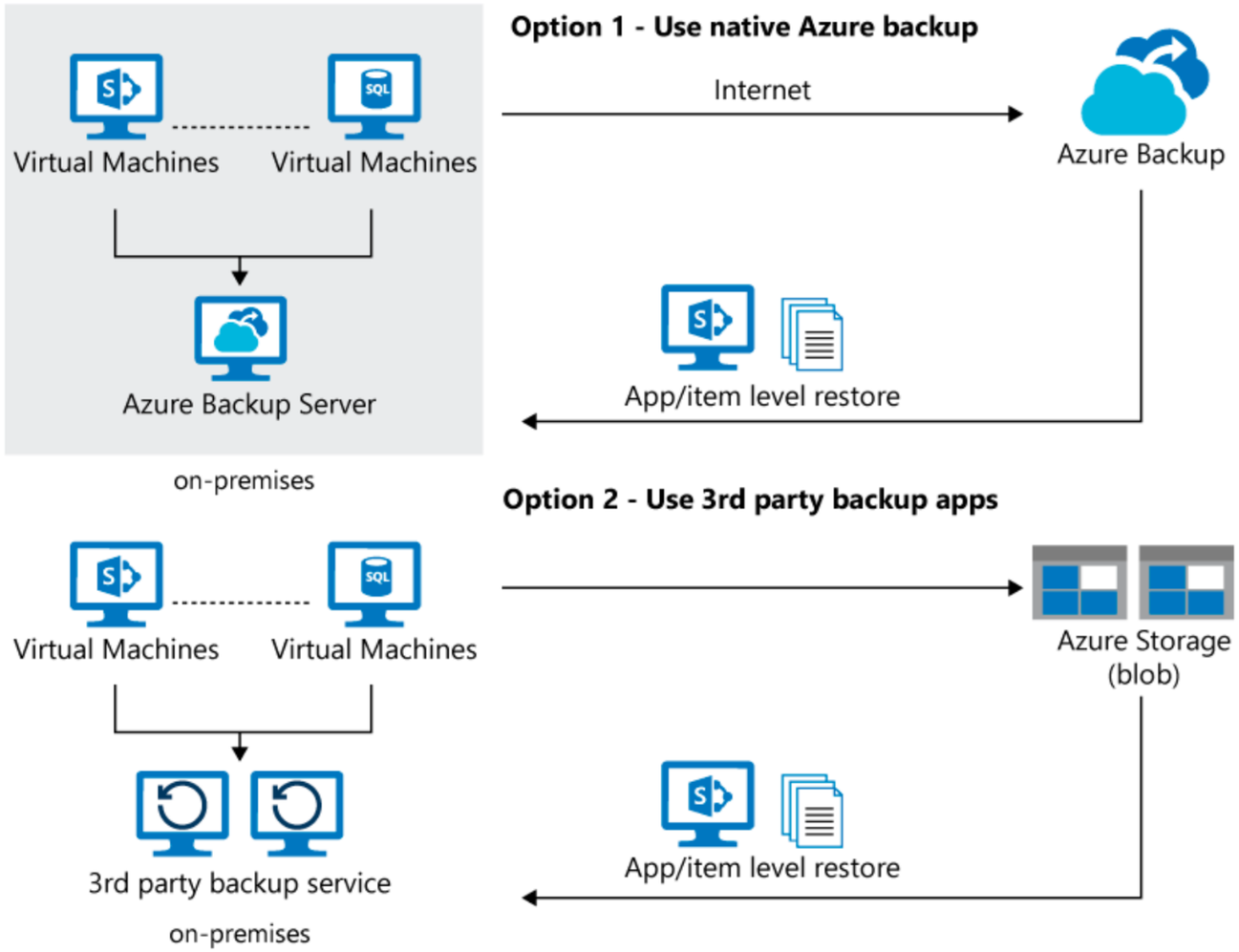
Blob Storage is a cool or archive tier on Azure Blob Storage, which is used to back up data that is less frequently accessed, while a hot tier is used to store data that's frequently accessed.



Azure Blob Storage

Backup On-Premises Applications and Data to the Cloud

Back up data and applications from an on-premises system to Azure using Azure Backup.

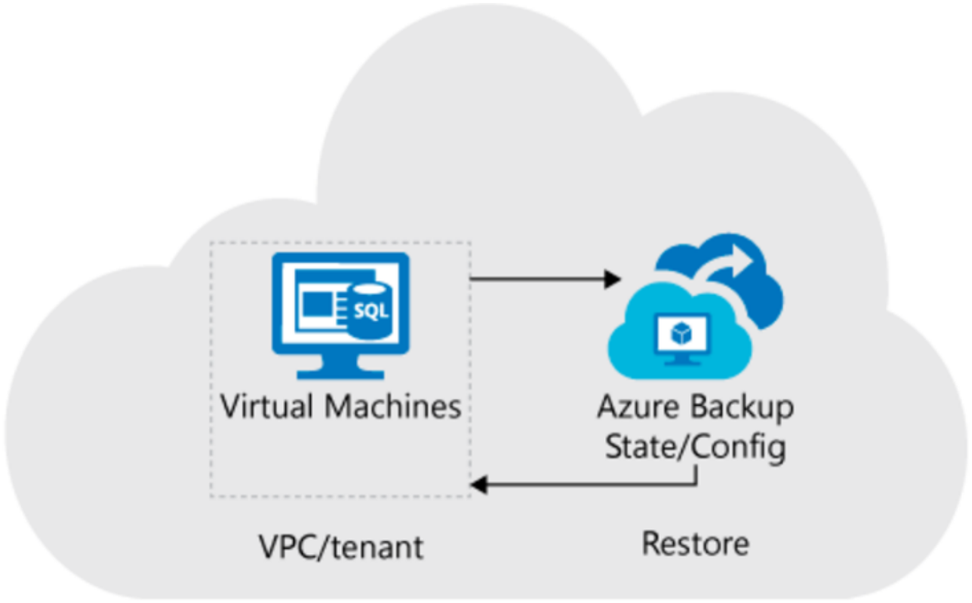


Backup On-Premises Applications and Data to the Cloud

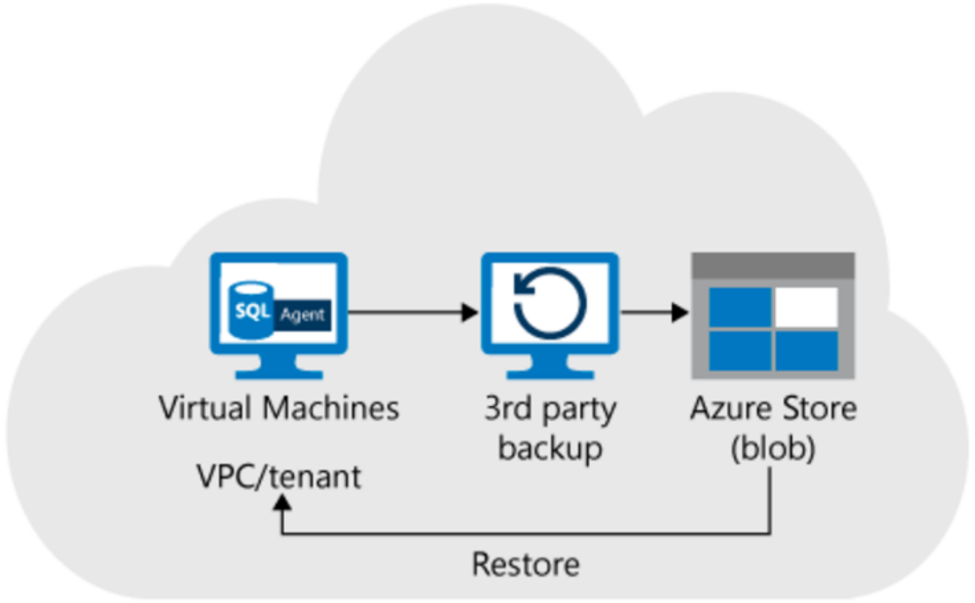
Azure Backup Server	Manages the configuration of restore procedures and orchestrates machine backups
Azure Backup Service	Runs on the cloud and holds the recovery points, enforce policies, and enables you to manage data and application protection
Blob Storage	Backs up data and applications for partner solutions such as Commvault

Backup Cloud Applications and Data to the Cloud

The two important components required to back up cloud applications and data to the cloud are Azure Backup Service and Blob Storage.



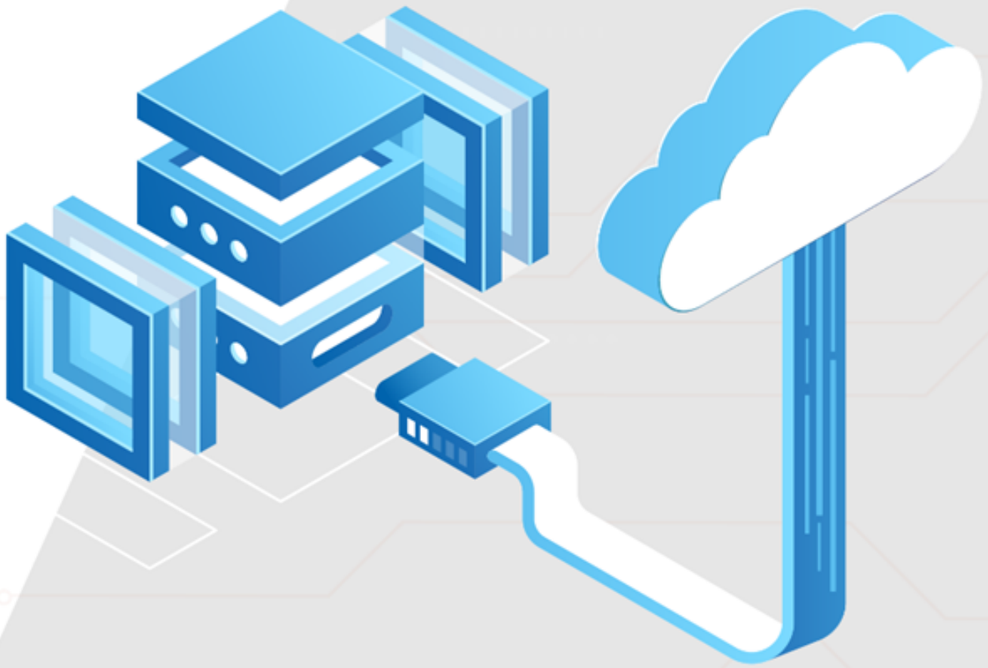
Option 1 - Use native Azure backup



Option 2 - Use 3rd party backup apps

Key Takeaways

- Defining the requirements, deploying the application regularly, and monitoring the health are all important facets in sustaining reliability.
- Recovery time objective (RTO) is the maximum acceptable time that an application can be unavailable after an incident.
- The architectural components of disaster recovery are VMs in the source region, their storage and networks, cache storage account, and target resources.
- The two important components required to back up cloud applications and data to the cloud are Azure Backup Service and Blob Storage.



Thank you