

A presentation slide for the 'Azure Fundamentals' course. The background is a bright blue sky with white clouds and a sunburst effect on the left. A large, stylized target graphic with concentric circles is positioned on the left side. The Ingram Micro logo is in the top right, followed by 'CLOUD' and the tagline 'More as a Service'. The main title 'Azure Fundamentals' is in large white font, with the subtitle 'Move your workloads to the Cloud' below it. A red banner with yellow text states 'COURSE WILL START AT 9h15'. The presenter's name 'Diego Lens' and the date 'May 3, 2023' are at the bottom right. A small copyright notice is in the bottom left.

INGRAM MICRO CLOUD
► *More as a Service*

Azure Fundamentals

Move your workloads to the Cloud

COURSE WILL START AT 9h15

Diego Lens
May 3, 2023

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A presentation slide for the 'Azure Fundamentals' course, identical to the one above. It features a blue sky background with clouds, a sunburst, and a target graphic. The text includes the Ingram Micro logo, 'CLOUD', 'More as a Service', 'Azure Fundamentals', 'Move your workloads to the Cloud', 'COURSE WILL START AT 9h15', 'Diego Lens', and 'May 3, 2023'. A small copyright notice is also present.

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► *More as a Service*

Azure Fundamentals

Move your workloads to the Cloud

COURSE WILL START AT 9h15

Diego Lens
May 3, 2023

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DAY 1
09h15 - Start

09h15 - 17h00 Session with Lunch break


DAY 2
09h15 - Start

09h15 - 17h00 Session with Lunch break

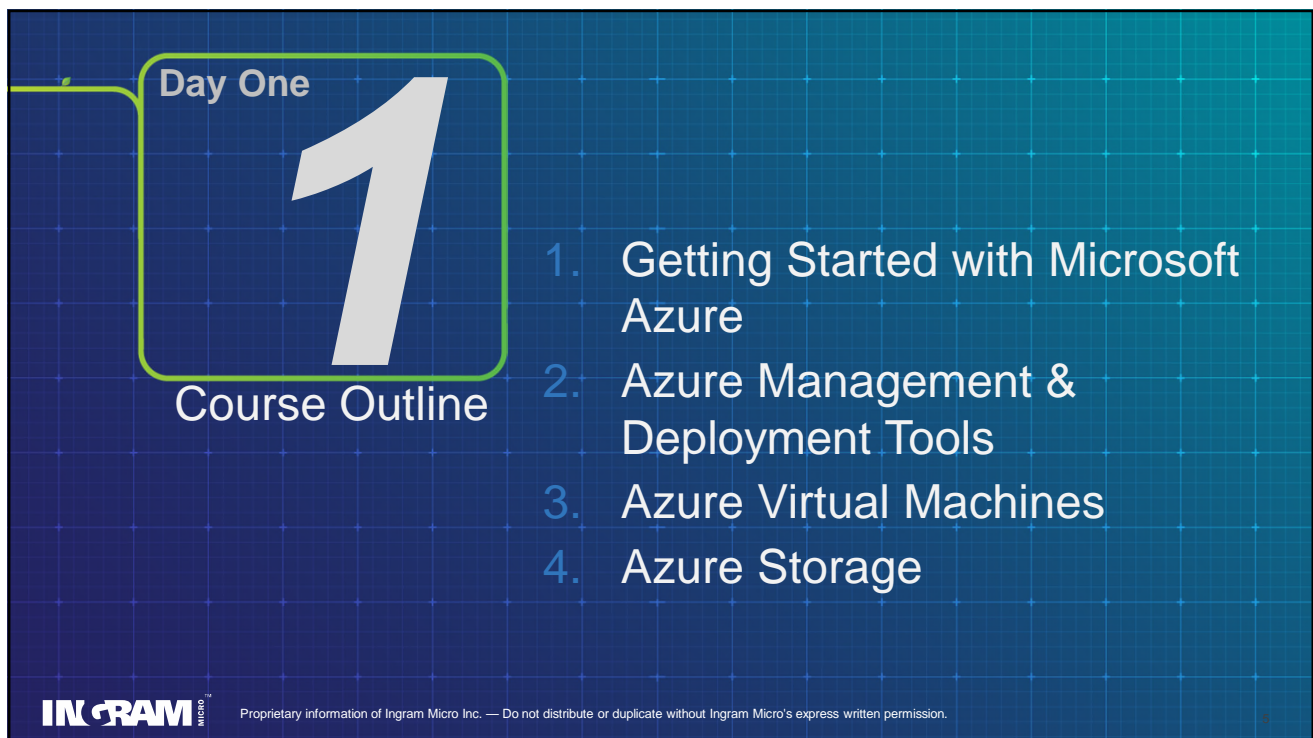
Azure Fundamentals
Move your workloads to the Cloud

Diego Lens
March 02, 2021



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Day One

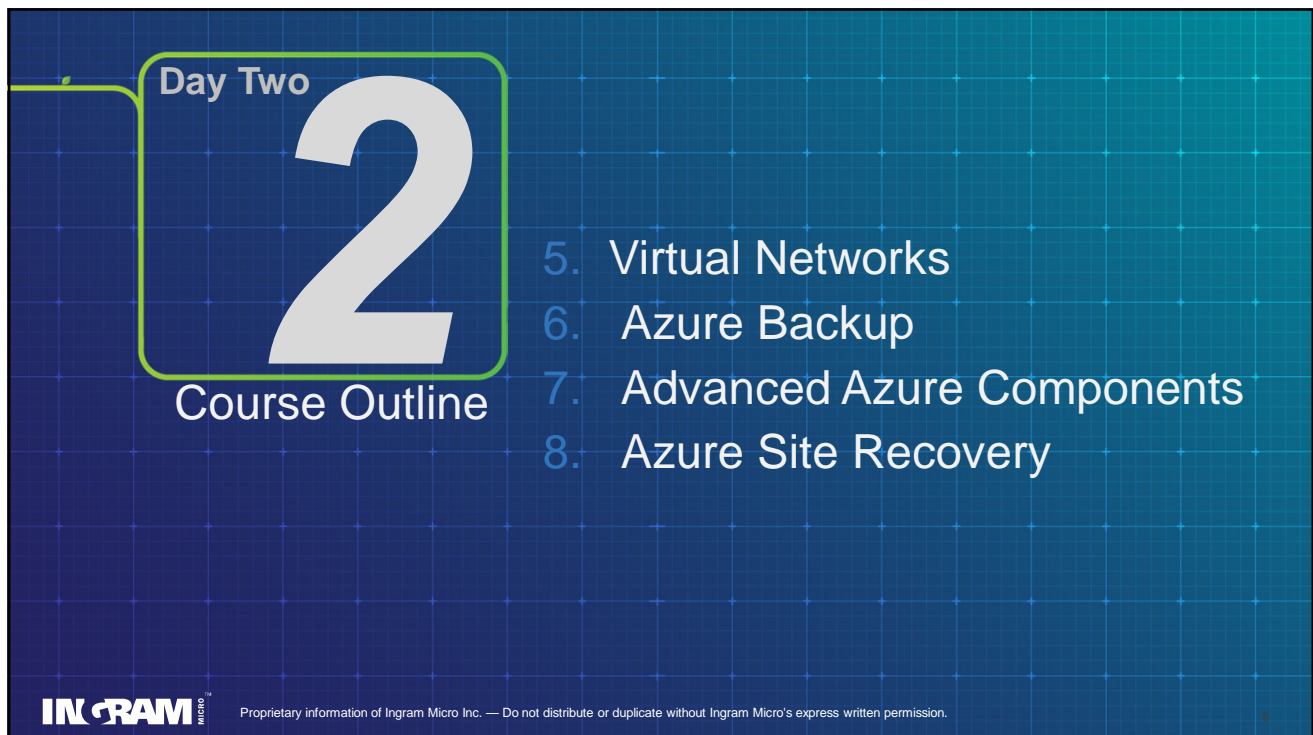
1

Course Outline

1. Getting Started with Microsoft Azure
2. Azure Management & Deployment Tools
3. Azure Virtual Machines
4. Azure Storage

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Day Two

2

Course Outline

5. Virtual Networks
6. Azure Backup
7. Advanced Azure Components
8. Azure Site Recovery

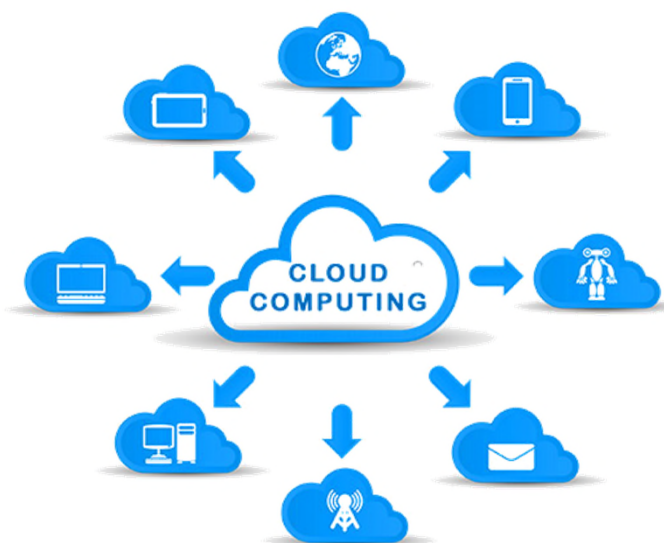
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Module 0 Introduction

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Digital Transformation



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If you want to stay current and keep your business growing, you'll have to adapt.

"It is not the strongest of the species that survive, nor the most intelligent, but the one most responsive to change."

– Charles Darwin

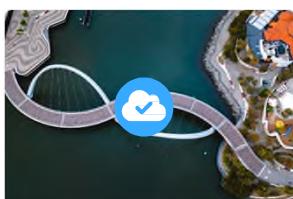
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Growth Solutions

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More as a Service



Modern Cloud Platforms

Transform Into the New Norm

Go boldly into the future with innovative infrastructure and platform solutions built for driving profitability and growth through key app modernization, data & insights, and cloud strategies.

App Modernization

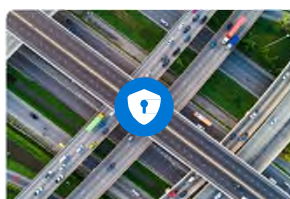
DevOps, Containers, Microservices

Infrastructure

Data & Insights

DB (PaaS), Analytics, Warehousing, AI/ML

Infrastructure



Seamless Security

Build your Business with True Peace of Mind

Move forward towards a bright business future with total asset and data protection including seamless sign-on, endpoint security, identity security, and complete security operations management.

Endpoint

Modern Endpoint, MDR/XDR, Server Security

Identity

Authentication, Identity & Access Management

Security operations

Vulnerability Mfg, Tier 2 SOC Analytics, SIEM



Connected Workplace

Together We Achieve More

Work together, work smarter and stay productive, from anywhere with our comprehensive suite of collaboration apps, digital experiences, and virtual desktops, designed to help you do more.

Collaboration Apps

Productivity Suits, conferencing

Virtual Desktops

Remote Work, Desktop Virtualization, OS

Employee Experience

Workflow insights, resources, learning



Business Performance

Work at the Speed of Modern Business

Build a fine-tuned business engine to power your performance with our tailor-made technological approach to equip your teams with CRM, ERP software, and imaginative workforce automation.

CRM

Customer Relationship Management

ERP

Enterprise Resource Planning

Workforce Automation

No/low Code, Power Automate

<http://bit.ly/ingramcloud>

<https://ingram.cloudchampion.nl>

<https://ingram.cloudchampion.be>

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Ingram Micro Cloud Enablement 2023



Enablement
<http://bit.ly/ingramcloud>

Cloud Champion
<https://ingram.cloudchampion.be>
<https://ingram.cloudchampion.nl>

Newsletter
<http://bit.ly/imc-email>

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More as a Service

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Modern Cloud Platforms
Transform Into the New Norm

Go boldly into the future with innovative infrastructure and platform solutions built for driving profitability and growth through key app modernization, data & insights, and cloud strategies.

- App Modernization**
DevOps, Containers, Microservices, Infrastructure
- Data & Insights**
DB (PaaS), Analytics, Workflowing, AI/ML, Infrastructure

16.8 %
App Modernization market to grow by 2025 CAGR

20.7 %
Public Cloud Spending growth in 2023

40%
Firms with a Cloud-Native-First strategy in 2023

Modern Cloud Platforms

Microsoft Azure Story Telling

Subscribe Here

Microsoft Azure Assessment & Migration

2 March 2023 | 09:15 - 12:00 CET

We will discuss how to prepare for a Full Datacenter Migration: Moving All On-Premises Resources to the Cloud (Lift & Shift)

Microsoft Azure Fundamentals

15 February 2023 | 09:00 - 12:00 CET

Microsoft Azure is a Public Cloud environment that can help companies eliminate expensive costs of having to purchase, manage, and maintain on-premises hardware and application infrastructure.

Azure Lighthouse & Azure Cost Management

16 March 2023 | 10:00 - 11:00 CET

Learn how Azure Lighthouse and Azure Cost Management will help you with the service maintenance.

Azure Fraud Prevention

Subscribe Here

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Seamless Security



Seamless Security

Build your Business with True Peace of Mind

Move forward towards a bright business future with total asset and data protection including seamless sign-on, endpoint security, identity security, and complete security operations management.

- Endpoint**
Modern Endpoint, MDR/MDR, Server Security
- Identity**
Authentication, Identity & Access Management
- Security operations**
Vulnerability Mng, Tier 2 SOC Analytics, SIEM

\$129B

Cybersecurity Public Cloud Services Spend by 2025 Globally

+50%

organizations will be using MDR by 2025

60%


security deployments are in the Public Cloud



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Connected Workplace



Connected Workplace

Together We Achieve More

Work together, work smarter and stay productive, from anywhere with our comprehensive suite of collaboration apps, digital experiences, and virtual desktops, designed to help you do more.

- Collaboration Apps**
Productivity Suite, conferencing
- Virtual Desktops**
Remote Work, Desktop Virtualization, OS
- Employee Experience**
Workflow insights, resources, learning

+21%


Virtual Desktop market CAGR growth by 2030

+50%

Team collaboration software growth by 2030.

57%

Reason for digital investments : Employee Experience




EX + CX = TX

Employee Experience + Customer Experience = Total Experience

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Business Performance

Work at the Speed of Modern Business

Build a fine-tuned business engine to power your performance with our tailor-made technological approach to equip your teams with CRM, ERP software, and imaginative workforce automation.

- CRM**
Customer Relationship Management
- ERP**
Enterprise Resource Planning
- Workforce Automation**
No-Flow Code, Power Automate

Business Performance

We want to help modernize and transform your business. With a focus on facilitating your team's needs, we are taking a tailor-made technological approach to personalize what strategies work best for you.

CRM:
CRM technology directly aligns with our growth mindset – at the end of the day, the goal of CRM is to foster and sustain existing and future customer relationships. Through this technology, you can generate multichannel marketing campaigns, nurture sales-ready leads and align sales and marketing with planning and tracking tools that integrate with existing apps and services.

ERP:
In the evolving digital landscape, it is imperative to stay up to date with the latest technologies to move forward. An ERP software suite can help manage day-to-day business processes that push beyond just financial data – discover how you can accelerate your business, grow your customer base and increase your profit margins with ERP.

Workflow Automation:
Workflow Automation is your go-to resource for building custom apps that connect to your existing data and systems, without the need for code. Through low-code platforms, you can build solutions that support workflow automation, AI, secure data access, seamless data analysis and visualization capabilities

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Stay up to date : Subscribe for Email

Stay updated


- Latest trends
- Latest trainings
- Events
- Tradeshow

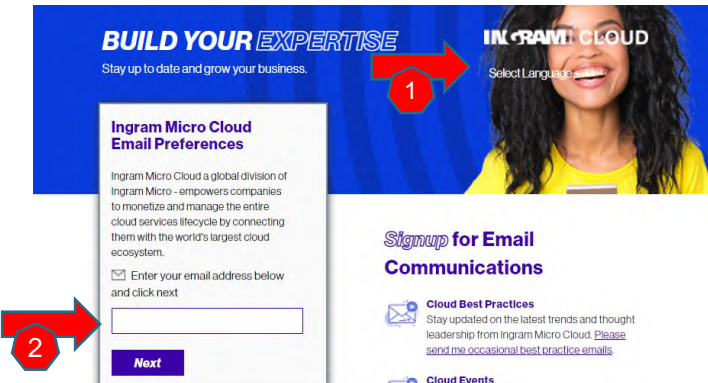
Subscribe : <http://bit.ly/imc-email>

Enablement
<http://bit.ly/ingramcloud>

Cloud Champion
<https://ingram.cloudchampion.be>
<https://ingram.cloudchampion.nl>

Questions
cloud@ingrammicro.be
cloud@ingrammicro.nl





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Benefits of Using Cloud

- High Availability
- Scalability & elasticity
- Agility / Flexibility
- Fault Tolerance & Disaster Recovery
- Capital expenditures versus operations expenditures (Capex – Opex)
- Consumption/Subscription Based Model
- Every Day new capabilities

Highly Reliable
Scalable
Available

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Every Day new capabilities

- <https://azure.microsoft.com/en-us/updates/>
- **Every day new capabilities announced for Azure**



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Website you should know !

- Ingram Micro Cloud Marketplace
 - <https://be.cloud.im> <https://nl.cloud.im>
- Ingram Micro Cloud Champion Portal
 - <https://ingram.cloudchampion.be>
 - <https://ingram.cloudchampion.nl>
- Microsoft Cloud Journeys
 - <http://bit.ly/ingramcloud>

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Module 1

Getting Started with Microsoft Azure

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Microsoft Azure



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Azure Datacenter

- Physical Buildings
- Located all over the globe
- House a Group of networked Computer Servers



Amsterdam



Cheyenne

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Azure Availability Zones

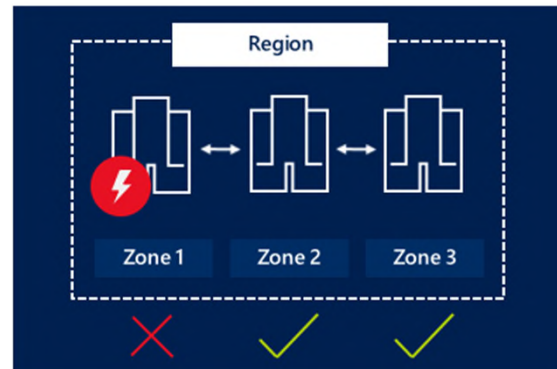
Unique Physical Locations within an Azure region

Offer High Availability to protect Applications and Data from Datacenter Failures

Each zone is made up one or more datacenters

Independent Power, Cooling, Networking

Zone Redundant Services



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Azure Regions

- Today 60+ Azure Regions around the world
- A Set of Availability Zones
- Deployed in latency-defined perimeter
- Connected through dedicated low-latency network
- Own Service Availability and Pricing



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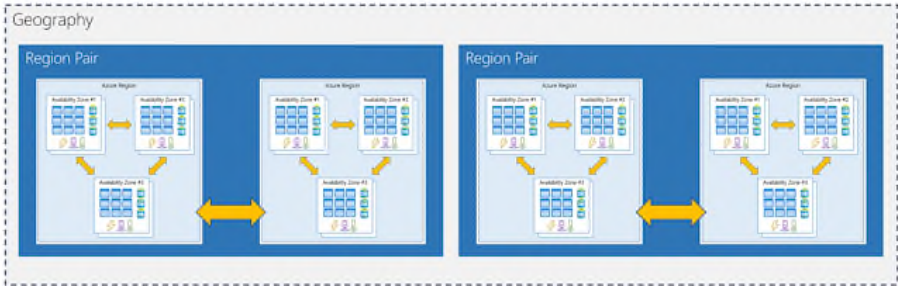
Azure Regions worldwide



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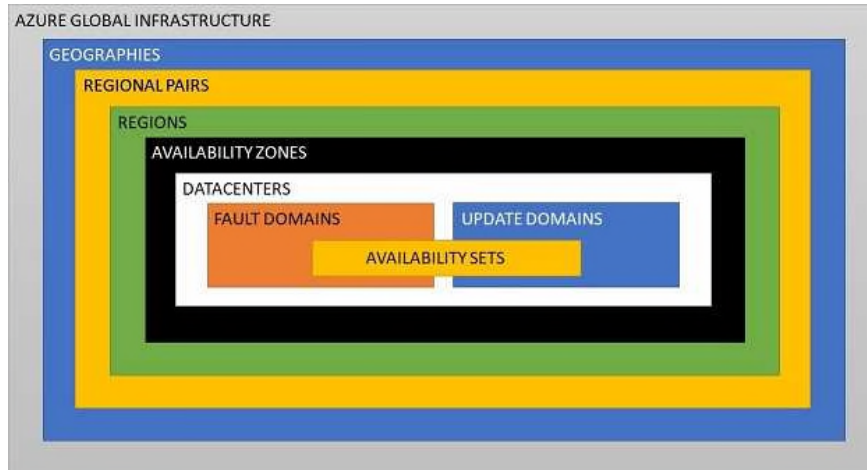
Azure Region Pairs

Azure Regions are paired together for disaster recovery purposes
Relationship between two Azure Regions
Each Azure region is always paired with another region in the same Geography
Geography, such as US, Europe, Asia



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The Bigger Picture



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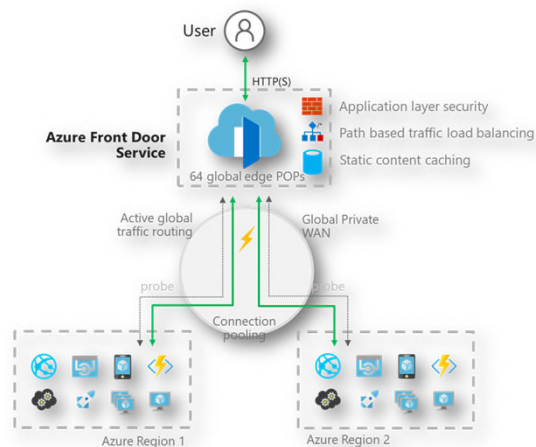
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Azure Point of Presence (PoPs)

Azure Access Point

Physical location where traffic can enter the Microsoft Global Network

Belgium has a PoP in Brussels



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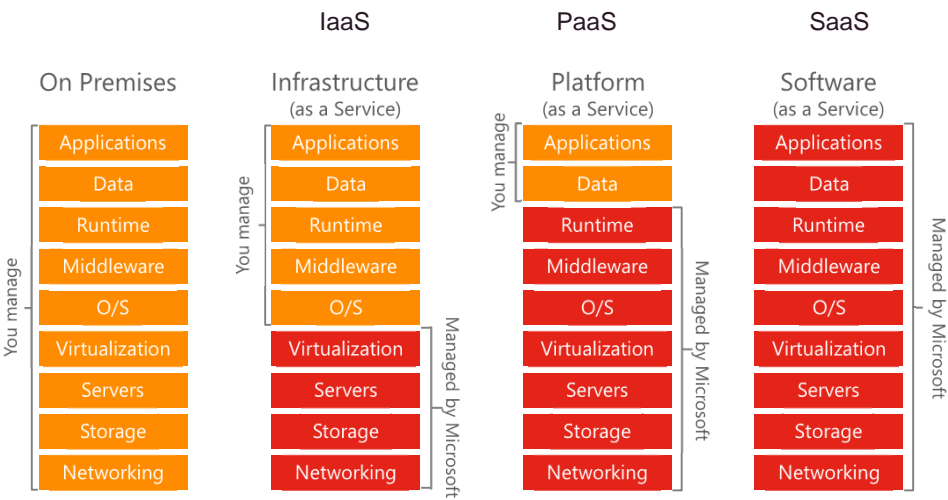
28

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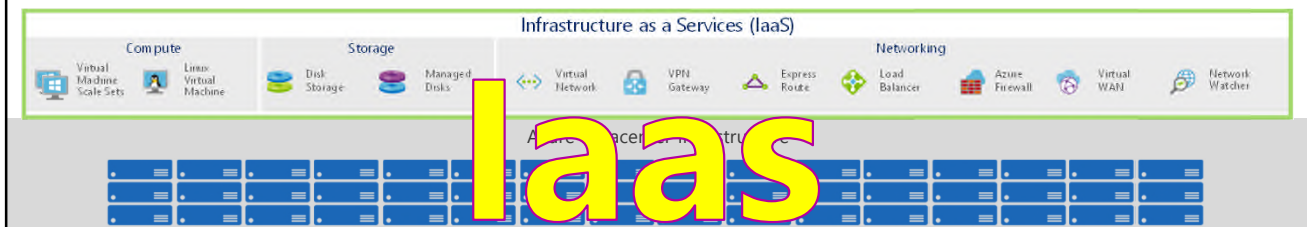
IaaS, PaaS, SaaS



Cloud Service Delivery Models

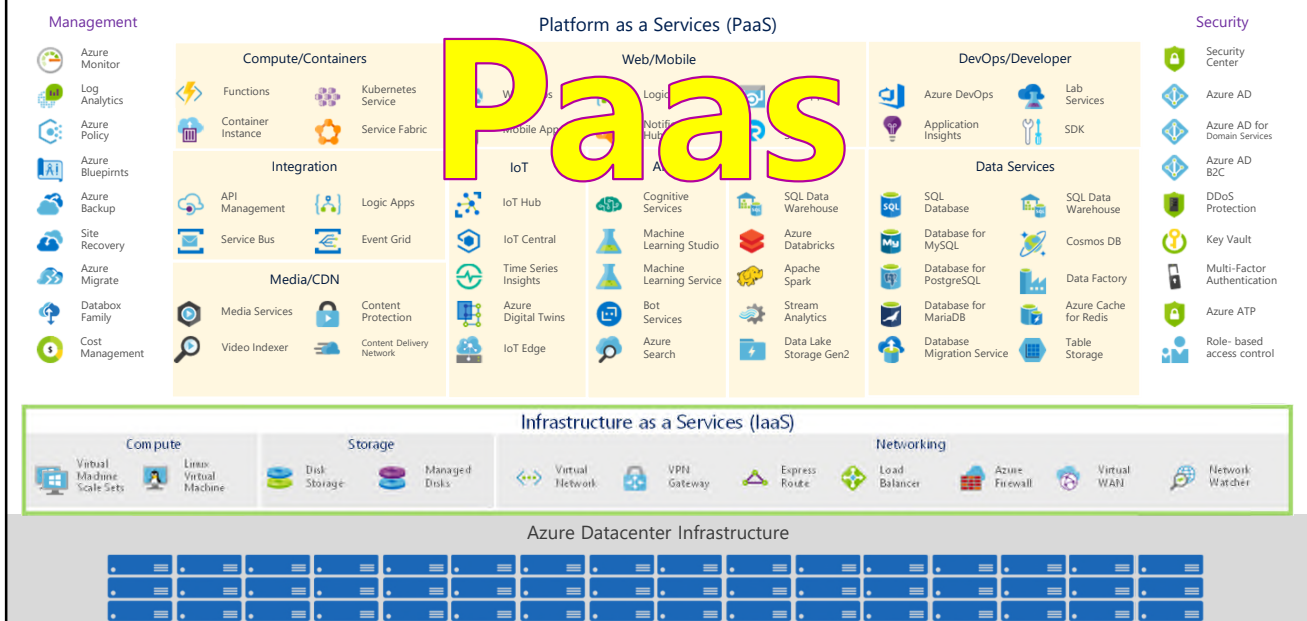


IaaS resources in Azure

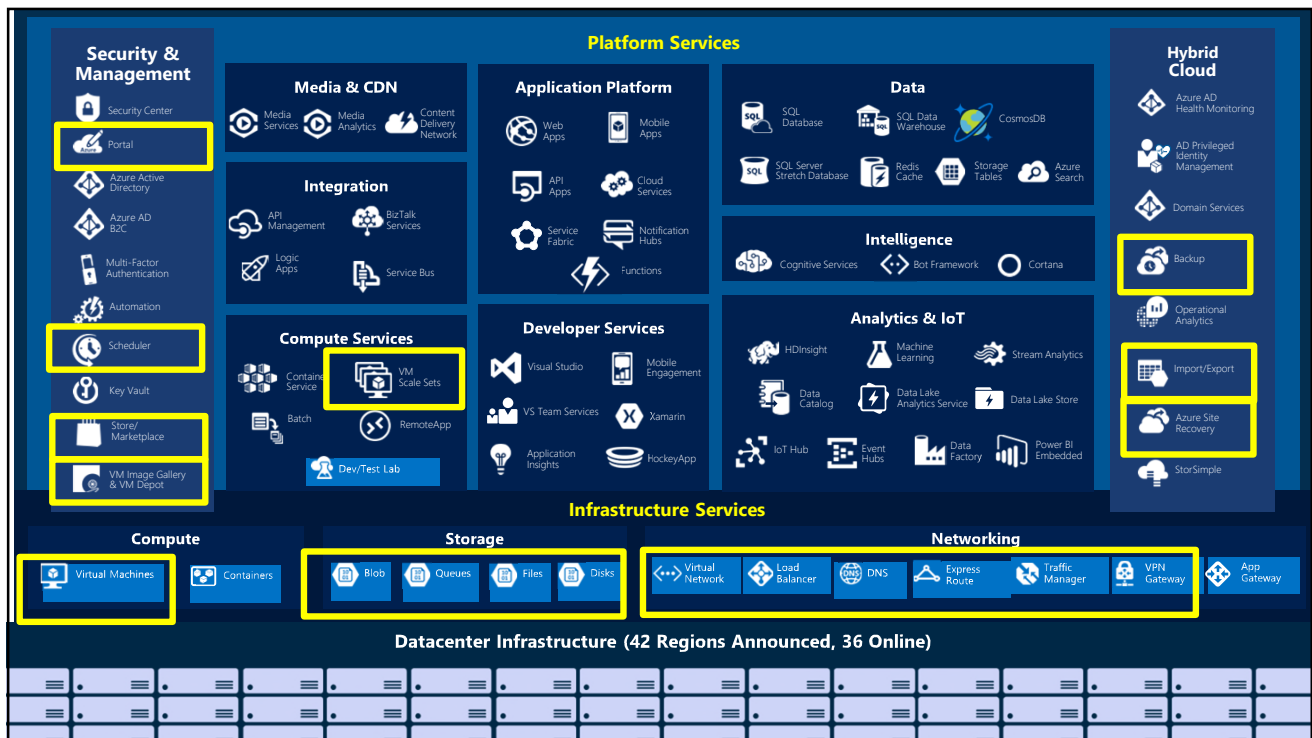


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PaaS resources in Azure



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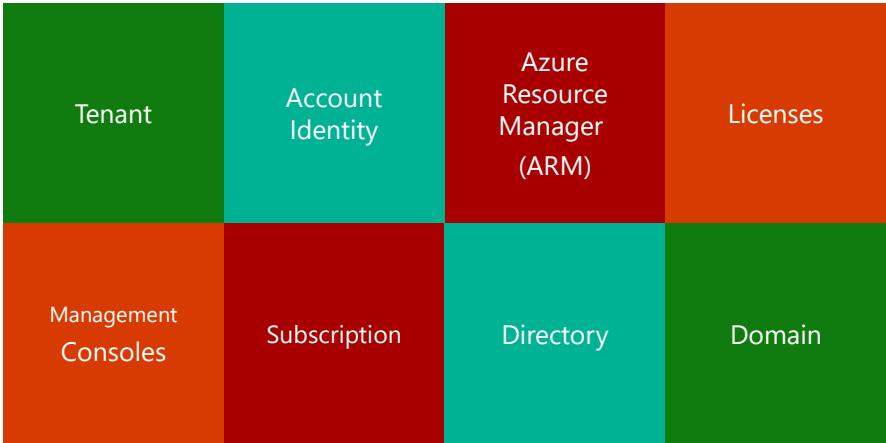
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Azure Vocabulary



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Vocabulary



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Azure Tenant



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Azure Tenant

Tenant



company.onmicrosoft.com

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Azure Tenant Domain Name

Tenant



company.onmicrosoft.com

- Unique Name
 - Tenant did exist already (Office 365 / Dynamics)
 - Created with Ingram Micro Cloud Marketplace
 - Free Azure Tenant : <https://azure.microsoft.com/en-us/free/>
- You cannot change the Tenant name

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Azure Active Directory

Tenant



company.onmicrosoft.com

Azure
Active
Directory



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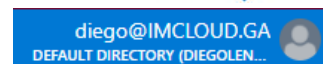
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Azure Active Directory

- Created in a specific Region, verified in this location :
 - <https://admin.microsoft.com>
 - > Settings > Org settings > Organizational Profile > Data Location
- Name
 - <https://portal.azure.com>
 - > Top right corner
- Name Change
 - [https:// admin.microsoft.com](https://admin.microsoft.com)
 - > Settings > Org Settings > Organizational Profile > Organization Information
- Azure Active Directory ID



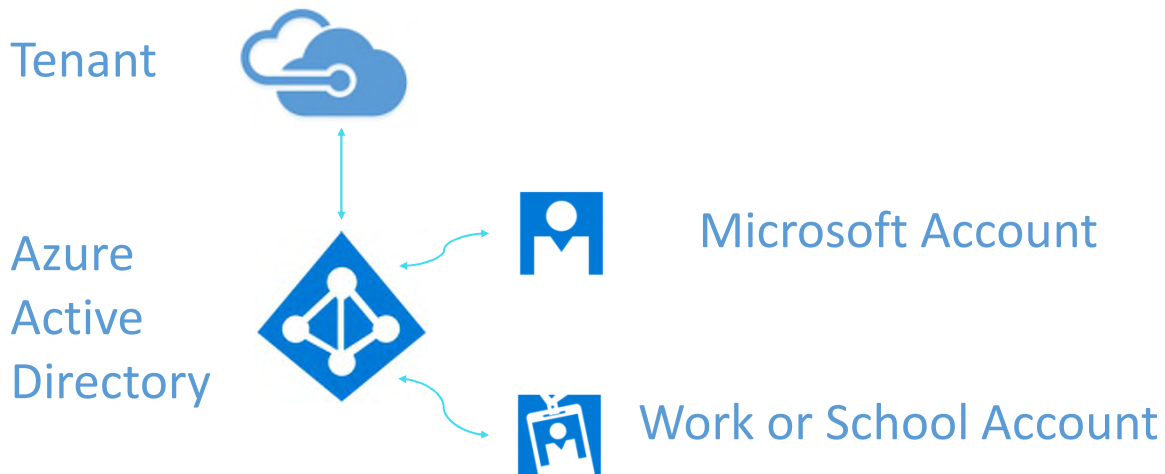
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Azure AD Authentication



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MFA – Multi-factor Authentication

More than 99.9% of these identity-related attacks are stopped by using multi-factor authentication (MFA) and blocking legacy authentication.

Enabling MFA is simple, and you can use the Microsoft Authenticator App on your mobile device. It is especially critical to enable it on privileged accounts, such as Global Admin, User Access Admin, Owner, Contributor, etc. **We recommend enabling it on ALL accounts!**

Get the app on your phone

Scan the QR code with your Android or iOS mobile device.



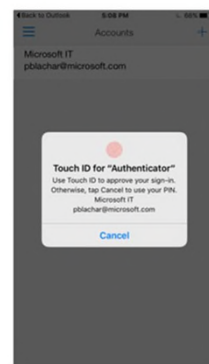
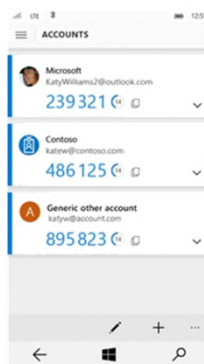
Google Play

Get the app



App Store

Get the app



[Microsoft Mobile Phone Authenticator App](#) | [Microsoft Security](#)

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Tenant Domain Name(s)

Tenant



company.onmicrosoft.com

Azure
Active
Directory



ingrammicro.com
ingrammicro.be
ingrammicro.eu
interact.be

Custom Domain Names
(unique in Azure)

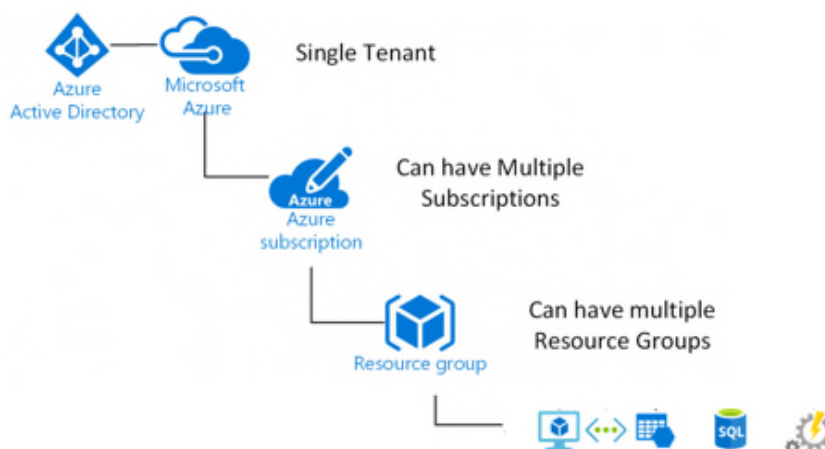
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General Azure Security



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Azure Subscription (after July, 21 2021)



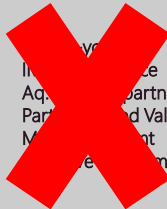
NCE

- ✓ Pay-as-you-Go
- ✓ IMC Marketplace
- ✓ Acq. through partners
- ✓ Partner Added Value
- ✓ RI's IMC Enabled
- ✓ Incentive Programs +
- ✓ Azure Plan
- ✓ Azure Cost Management
- ✓ Azure Lighthouse
- ✓ Calendar Month Bill



CSP

- ✓ Pay-as-you-Go
- ✓ IMC Marketplace
- ✓ Acq. through partners
- ✓ Partner Added Value
- ✓ RI's IMC Enabled
- ✓ Incentive Programs +



EA

- ✓ Classic +ARM Deployment
- ✓ Annual Financial Commitment



Open

- ✓ Pre-Consumption SKU's
- ✓ Classic Deployments



Direct

- ✓ Credit Card Linked
- ✓ Pay-as-you-Go
- ✓ ARM Deployments
- ✓ No Support
- ✓ No Partner Insights
- ✓ No Discount
- ✓ No Incentives



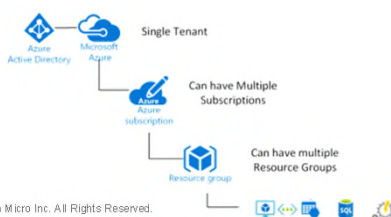
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Resources and Resource Groups

- Resource
 - A manageable item available through Azure. VMs, web apps, databases, etc.
- Resource group
 - A container that holds related resources
 - You decide how to allocate resources to Resource Groups



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Azure Resource



Azure Resource Group

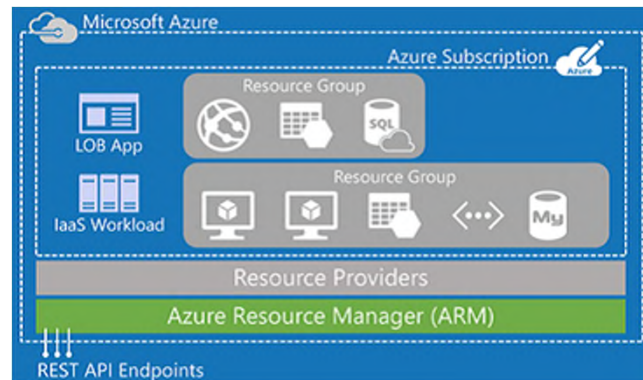


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Azure Resource Manager (ARM)

- Referred as Control Planes
- Works with Resource Groups
- Template-driven (JSON)
- Faster Compared to PowerShell
- User Rights (RBAC)
- Resource Tags
- multi-region
- <https://portal.azure.com>



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Legacy Azure platform : ASM

- Referred as Classic
- Deprecated
- Sequentially Resource Creation
- Not Compatible with ARM
- VMs created in ASM should be migrated to ARM by 1 September 2023 !

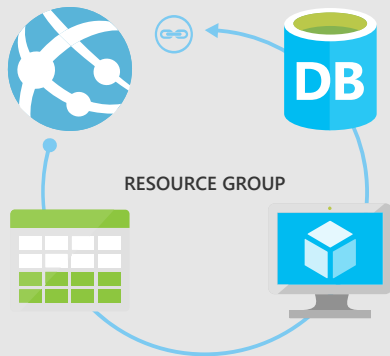
<https://azure.microsoft.com/en-us/updates/classicvmretirement/>

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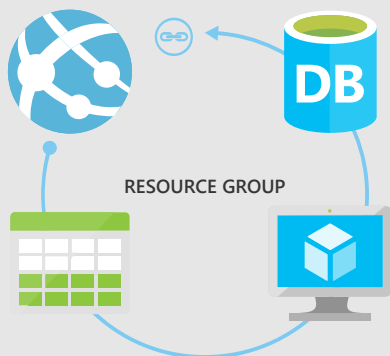
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Resource Group

- container for multiple resources
- resources exist in one resource group
- resource groups can span regions
- resource groups can span services

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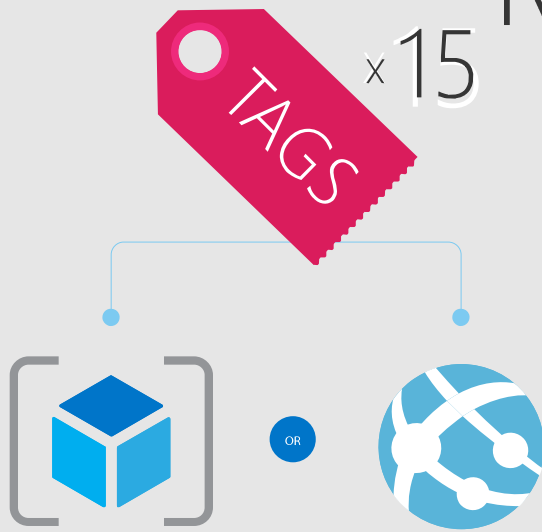


Deployment

- tracks template execution (JSON)
- created within a resource group
- allows nested deployments

50

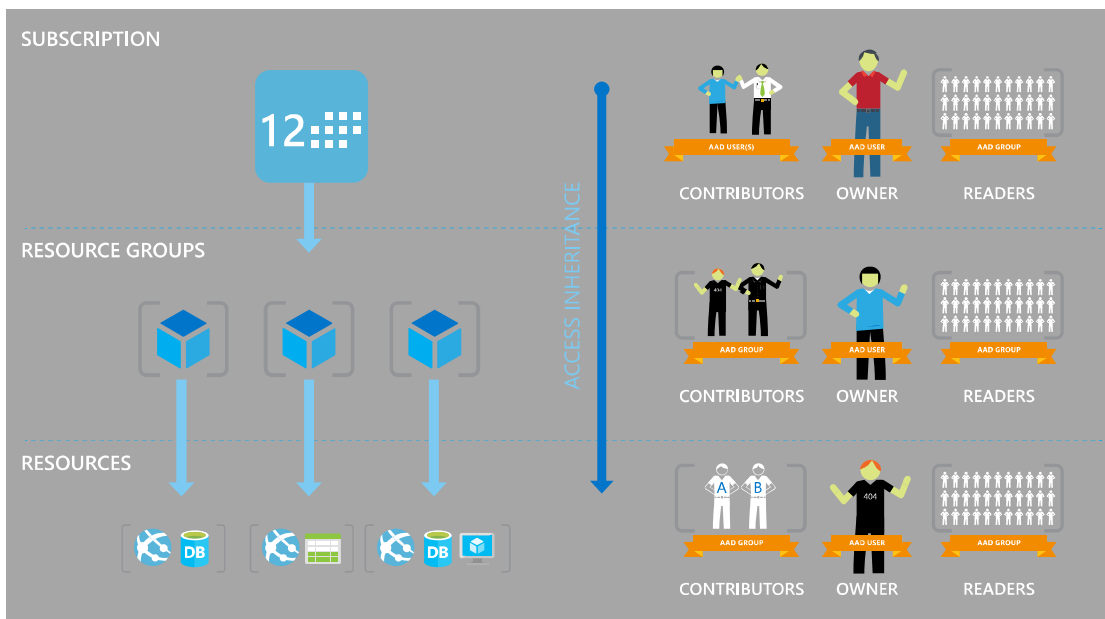
Resource Tags



- Name-value pairs assigned to resources or resource groups
- Subscription-wide taxonomy
- Each resource can have up to 15 tags

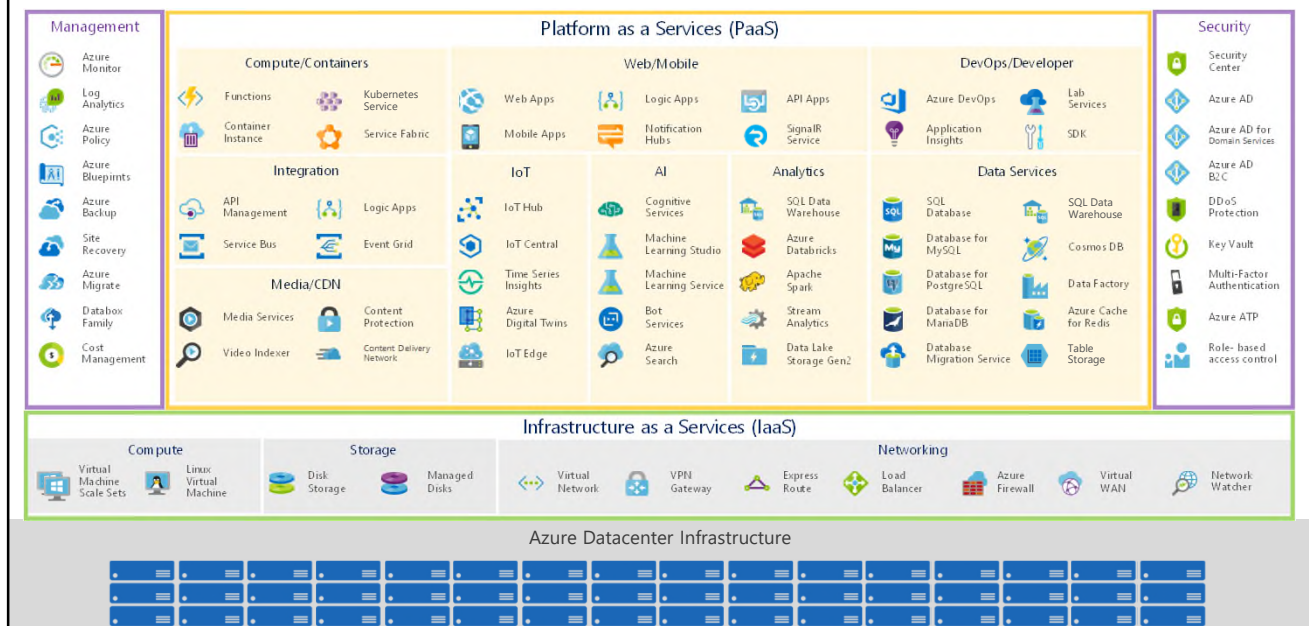
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Role Based Access Control (RBAC)



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All Resources in Azure



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Azure Portal : portal.azure.com

The screenshot shows the Microsoft Azure Portal interface with the following sections:

- Azure services**: A row of icons for Virtual machines, Storage accounts, App Services, SQL databases, Azure Database for PostgreSQL, Azure Cosmos DB, Kubernetes services, Function Apps, Azure Databricks, and Cognitive Services.
- Make the most out of Azure**: Five cards for Explore, Monitor, Secure, Optimize, and Connect.
- Recent resources**: A table listing recent resources with columns for NAME, TYPE, and LAST VIEWED.
- Useful links**: Links for getting started, discovering products, keeping current with updates, and news from the Azure team.

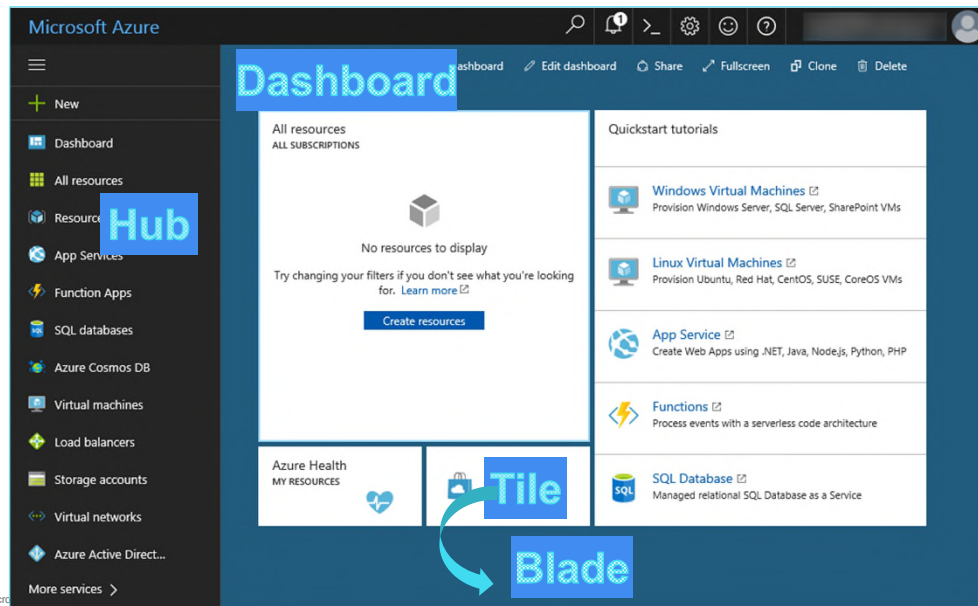
NAME	TYPE	LAST VIEWED
contosoLoanapp	App Service	Thu 5:08 PM
contosoLoanapp	Application Insights	Thu 5:08 PM
contosoLoanappsp	App Service plan	Thu 5:08 PM
ContosoLoanApp-vnet	Virtual network	Thu 5:07 PM
contosoLoanappdiag492	Storage account	Thu 5:07 PM
loanbackend	Virtual machine	Thu 5:07 PM
loanbackend-ip	Public IP address	Thu 5:07 PM
loanbackend-nsg	Network security group	Thu 5:06 PM

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Azure Dashboard



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Demo:
Azure Portal

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Lab 1: Getting Started With Microsoft Azure

(ingram azure fundamentals)

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Module 2

Azure Management & Deployment Tools

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Azure Management Tools



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Azure Portal : portal.azure.com

Recent resources

NAME	TYPE	LAST VIEWED
contosoLoanApp	App Service	Thu 5:08 PM
contosoLoanApp	Application Insights	Thu 5:08 PM
contosoLoanApp	App Service plan	Thu 5:08 PM
contosoLoanApp-vnet	Virtual network	Thu 5:07 PM
contosoLoanApp-diag492	Storage account	Thu 5:07 PM
loanbackend	Virtual machine	Thu 5:07 PM
loanbackend-ip	Public IP address	Thu 5:07 PM
loanbackend-nsg	Network security group	Thu 5:06 PM

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Choose the right Azure command-line tool

- Managing and Administering Azure Resources from the command line
- Azure PowerShell
- Azure CLI
- Azure Cloud Shell



Azure PowerShell
vs Azure CLI

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PowerShell Az Module

- Starting December 2018, the Azure PowerShell Az module is in general release
- Shorter Commands
- Improved stability
- Cross-Platform Support
- Recommended : Uninstall AzureRM module
- Install Azure Az Module

PowerShell

```
Install-Module -Name Az -AllowClobber
```

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<https://docs.microsoft.com/en-us/powershell/azure/install-az-ps?view=azps-1.2.0>

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AzureRM : Legacy Azure PowerShell Module

- <https://docs.microsoft.com/en-us/powershell/azure/install-azurerm-ps?view=azurerm-ps-5.4.0>

PowerShell	Copy
<pre># Install the Azure Resource Manager modules from the PowerShell Gallery Install-Module -Name AzureRM -AllowClobber</pre>	
PowerShell	Copy
<pre>Get-Module AzureRM -ListAvailable Select-Object -Property Name,Version,Path</pre>	
PowerShell	Copy
<pre>Import-Module -Name AzureRM</pre>	

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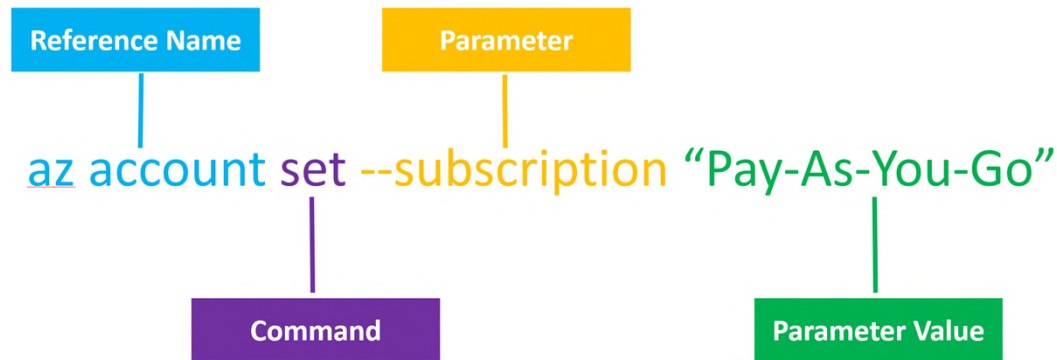
Azure CLI (Open Source)

- Command-line tool along-side Azure PowerShell
- Focused on Mac/Linux/BASH/cmd.exe
- Simple to automate
- Easy to learn
- CLI 1.0 written with Node.js
- CLI 2.0 written in Python
- offer better cross-platform capabilities

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Azure CLI Syntax

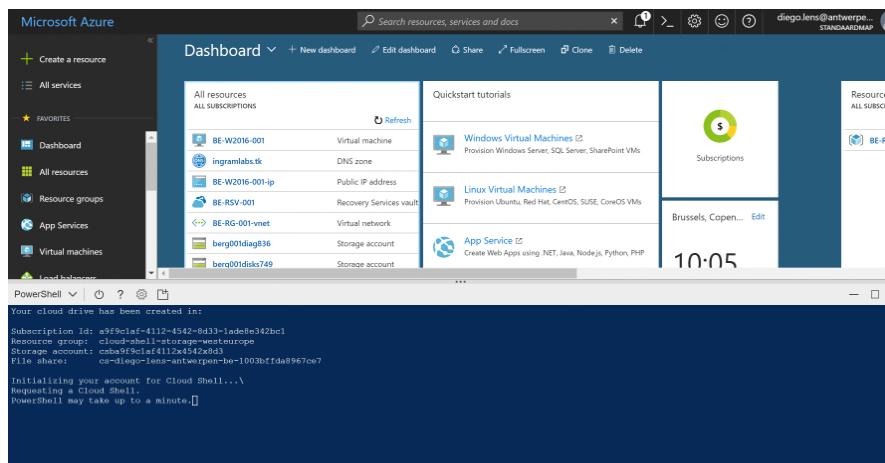


<https://learn.microsoft.com/en-us/cli/azure/reference-index?view=azure-cli-latest>

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Azure Cloud Shell



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Azure Cloud Shell requirements

- Requires an Azure File Share
- While Enabling Azure Cloud Shell, Azure will create :
 - Resource Group
 - Storage Account
 - File Share
- Called : Clouddrive
- Azure Cloud Shell in Cloud Shell Only mode :
 - <https://shell.azure.com>



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Azure Deployment Tools



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Choose the right Azure deployment tool

Implement **Infrastructure as Code (IaC)**

IaC Tooling for Azure includes :

- Azure Resource Manager Templates (ARM Templates)
- Azure Bicep
- Azure Terraform

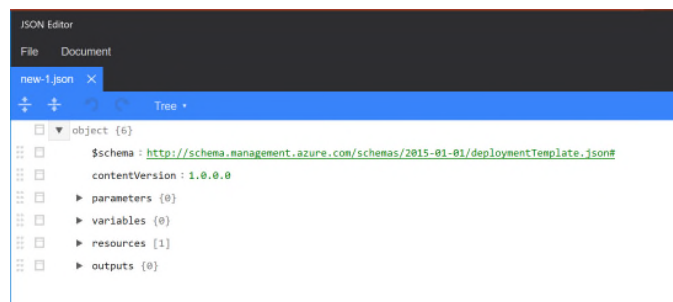
<https://techcommunity.microsoft.com/t5/azure-events/azure-deployments-ama/ec-p/3560291#M342>

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Azure Resource Manager Templates

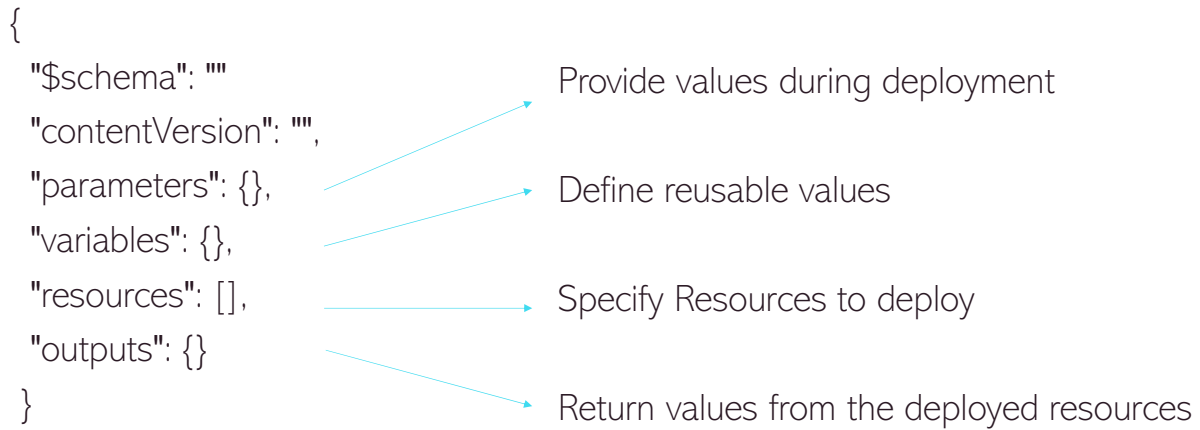
- Expressed in JSON format
- Use a JSON Editor
- Create your First Template :
- <https://docs.microsoft.com/en-us/azure/azure-resource-manager/resource-manager-create-first-template?>



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Basic ARM Template Structure



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Azure QuickStart Templates

<https://azure.microsoft.com/en-us/resources/templates/>

Templates > Create an Azure VM with a new AD Forest

Create an Azure VM with a new AD Forest



by Simon Davies
Last updated: 4/21/2017

Deploy to Azure

Browse on GitHub

This template creates a new Azure VM, it configures the VM to be an AD DC for a new Forest

This Azure Resource Manager template was created by a member of the community and not by Microsoft. Each Resource Manager template is licensed to you under a license agreement by its owner, not Microsoft. Microsoft is not responsible for Resource Manager templates provided and licensed by community members and does not screen for security, compatibility, or performance. Community Resource Manager templates are not supported under any Microsoft support program or service, and are made available AS IS without warranty of any kind.

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Export an ARM Template

Automation

Export template

IMCLOUD-AD-RG | Export template

Resource group Directory: IM Cloud

Download Add to library (preview) Deploy Visualize template

To export related resources, select the resources from the Resource Group view then select the "Export template" button.

☒ Include parameters

Template Parameters Scripts

Parameters (7)

Variables (0)

Resources (11)

```

1 {
2   "$schema": "https://schema.management.azure.com/schemas/2019-04-01/deploymentTemplate.json#",
3   "contentVersion": "1.0.0.0",
4   "parameters": {
5     "virtualMachines_adVM_name": {
6       "defaultValue": "adVM",
7       "type": "String"
8     },
9     "virtualNetworks_adVNET_name": {
10      "defaultValue": "adVNET",
11      "type": "String"
12     },
13     "networkInterfaces_adNIC_name": {
14      "defaultValue": "adNIC",
15      "type": "String"
16     },
17     "loadBalancers_adLoadBalancer_name": {
18      "defaultValue": "adLoadBalancer",
19      "type": "String"
20     },
21     "publicIPAddresses_adPublicIP_name": {
22      "defaultValue": "adPublicIP",
23      "type": "String"
24     }
25   },
26   "resources": [
27     {
28       "type": "Microsoft.Network/publicIPAddresses",
29       "name": "[concat(parameters('adPublicIP_name'), 'adPublicIP')]",
30       "apiVersion": "2019-02-01",
31       "location": "[location]",
32       "properties": {
33         "publicIPAddressVersion": "IPv4",
34         "publicIPAllocationMethod": "Static",
35         "dnsSettings": {
36           "domainNameLabel": "[concat(parameters('adPublicIP_name'), 'adPublicIP')]"
37         }
38       }
39     },
40     {
41       "type": "Microsoft.Network/loadBalancers",
42       "name": "[concat(parameters('adLoadBalancer_name'), 'adLoadBalancer')]",
43       "apiVersion": "2019-08-01",
44       "location": "[location]",
45       "properties": {
46         "frontendIPConfigurations": [
47           {
48             "name": "adFrontendIPConfiguration",
49             "properties": {
50               "publicIPAddresses": [
51                 "[resourceId('Microsoft.Network/publicIPAddresses', parameters('adPublicIP_name'), 'adPublicIP')]"
52               }
53             }
54           }
55         ],
56         "backendIPConfigurations": [
57           {
58             "name": "adBackendIPConfiguration",
59             "properties": {
60               "subnet": {
61                 "id": "[resourceId('Microsoft.Network/subnets', parameters('adVNET_name'), 'adSubnet')]"
62               }
63             }
64           }
65         ],
66         "loadBalancingRules": [
67           {
68             "name": "adLoadBalancingRule",
69             "properties": {
70               "frontendIPConfiguration": "[resourceId('Microsoft.Network/loadBalancers/frontendIPConfigurations', parameters('adLoadBalancer_name'), 'adFrontendIPConfiguration')]",
71               "backendIPConfiguration": "[resourceId('Microsoft.Network/loadBalancers/backendIPConfigurations', parameters('adLoadBalancer_name'), 'adBackendIPConfiguration')]",
72               "protocol": "TCP",
73               "frontendPort": 80,
74               "backendPort": 80
75             }
76           }
77         ],
78         "provisioningState": "Succeeded"
79       }
80     },
81     {
82       "type": "Microsoft.Compute/virtualMachines",
83       "name": "[parameters('virtualMachines_adVM_name')]",
84       "apiVersion": "2019-07-01",
85       "location": "[location]",
86       "properties": {
87         "hardwareProfile": {
88           "virtualMachineReference": {
89             "id": "[resourceId('Microsoft.Compute/virtualMachineReferences', parameters('adVNET_name'), 'adVirtualMachineReference')]"
90           }
91         },
92         "osProfile": {
93           "computerName": "[parameters('virtualMachines_adVM_name')]",
94           "adminUsername": "Administrator",
95           "adminPassword": "Password1234"
96         },
97         "storageProfile": {
98           "imageReference": {
99             "publisher": "MicrosoftWindowsServer",
100            "offer": "WindowsServer",
101            "sku": "2019-Datacenter",
102            "version": "20H2"
103          },
104          "osDisk": {
105            "createOption": "FromImage",
106            "managedBy": "true",
107            "storageAccountType": "Premium_LRS"
108          }
109        },
110        "networkProfile": {
111          "networkInterfaces": [
112            {
113              "id": "[resourceId('Microsoft.Network/networkInterfaces', parameters('adNIC_name'), 'adNIC')]"
114            }
115          ]
116        },
117        "provisioningState": "Succeeded"
118      }
119    }
120  ]
121 }

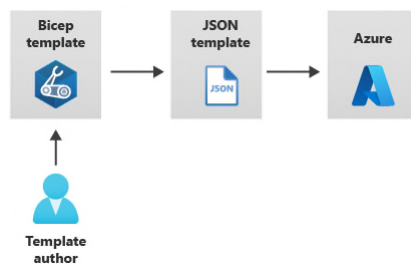
```

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Azure Bicep

- New effort to define Azure-native language for Infrastructure as Code (IaC)
- Azure Bicep is Open-Source
- Azure Bicep will transpile into an ARM-JSON template
- Provides abstract layer and reduces pain of working with JSON



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Comparing Bicep and JSON

```
param location string = resourceGroup().location
param storageAccountName string = 'toylaunch${uniqueString(resourceGroup().id)}'

resource storageAccount 'Microsoft.Storage/storageAccounts@2019-06-01' = {
  name: storageAccountName
  location: location
  sku: {
    name: 'Standard_LRS'
  }
  kind: 'StorageV2'
  properties: {
    accessTier: 'Hot'
  }
}
```

Bicep

```
{
  "$schema": "https://schema.management.azure.com/schemas/2019-04-01/deploymentTemplate.json#",
  "contentVersion": "1.0.0.0",
  "metadata": {
    "_generator": {
      "name": "bicep",
      "version": "0.3.255.40792",
      "templateHash": "2629167571522382857"
    }
  },
  "parameters": {
    "location": {
      "type": "string",
      "defaultValue": "[resourceGroup().location]"
    },
    "storageAccountName": {
      "type": "string",
      "defaultValue": "[format('toylaunch{0}', uniqueString(resourceGroup().id))]"
    }
  },
  "functions": [],
  "resources": [
    {
      "type": "Microsoft.Storage/storageAccounts",
      "apiVersion": "2019-06-01",
      "name": "[parameters('storageAccountName')]",
      "location": "[parameters('location')]",
      "sku": {
        "name": "Standard_LRS"
      },
      "kind": "StorageV2",
      "properties": {
        "accessTier": "Hot"
      }
    }
  ]
}
```

ARM Template

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<https://learn.microsoft.com/en-us/training/paths/fundamentals-bicep>

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Azure Terraform

- Hashicorp Terraform is an **Infrastructure as Code (IaC)** tool for provisioning and managing cloud infrastructure
- Manage infrastructure across multiple cloud providers
 - Azure
 - AWS
 - GCP
 - ...
- Uses Hashicorp Configuration Language (HCL)



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Demo: Azure Management Tools

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Lab 2: Azure Management Tools

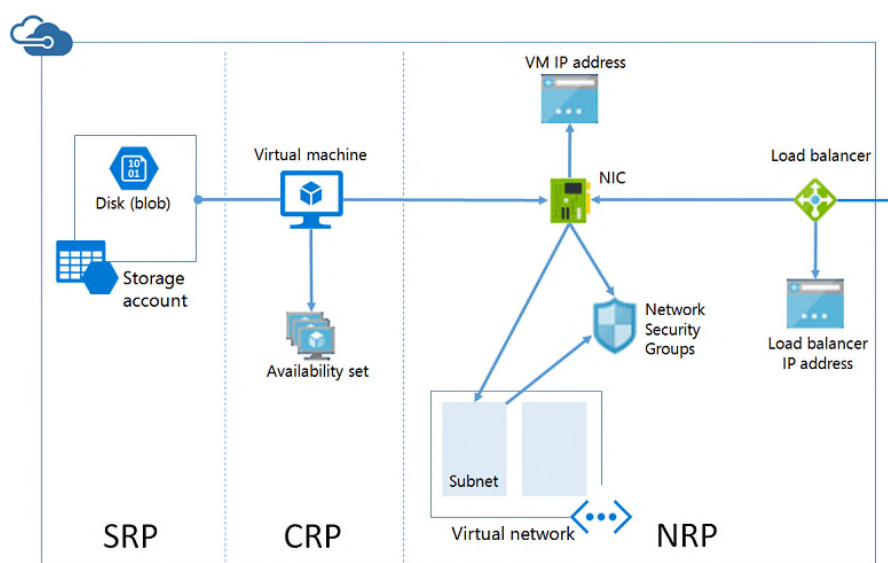
78

Module 3

Azure Virtual Machines

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Azure Virtual Machine Resources



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Azure Virtual Machines in 2016

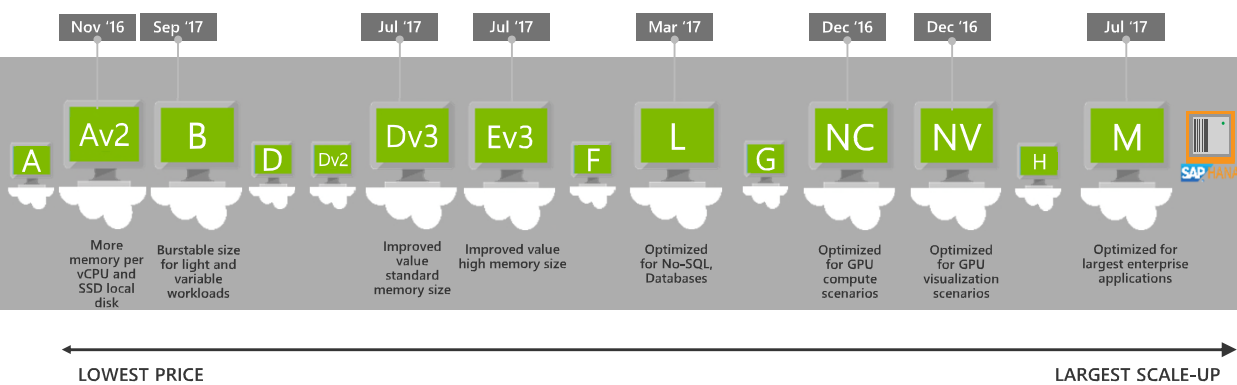


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Azure Virtual Machines in 2017



Doubling the compute offerings since last Ignite!

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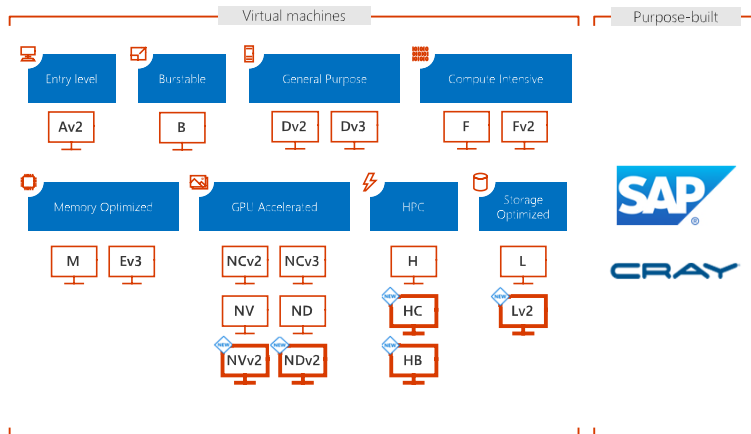
<https://docs.microsoft.com/en-us/azure/virtual-machines/linux/sizes>

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Azure Virtual Machines in 2018



What's new and on the roadmap?

- NVv2 for graphic intensive applications in Preview
- NDv2 accelerate machine training and HPC New Ev3 and Esv3
- Lv2 VMs currently in limited public preview.
- H-series VMs coming soon:
- HC for computationally intensive workloads
- HB for memory bandwidth driven workloads

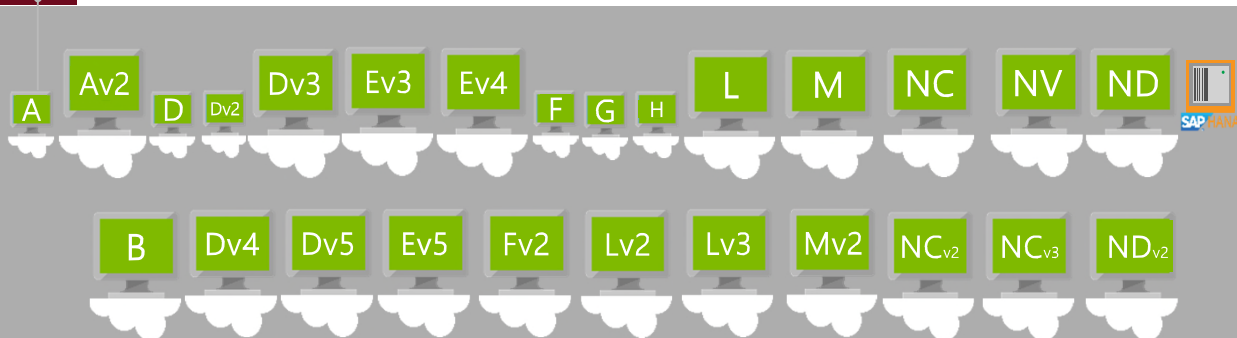
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Azure Virtual Machines in 2023

Retire
08-2024



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<https://azure.microsoft.com/en-us/pricing/details/virtual-machines/series/>

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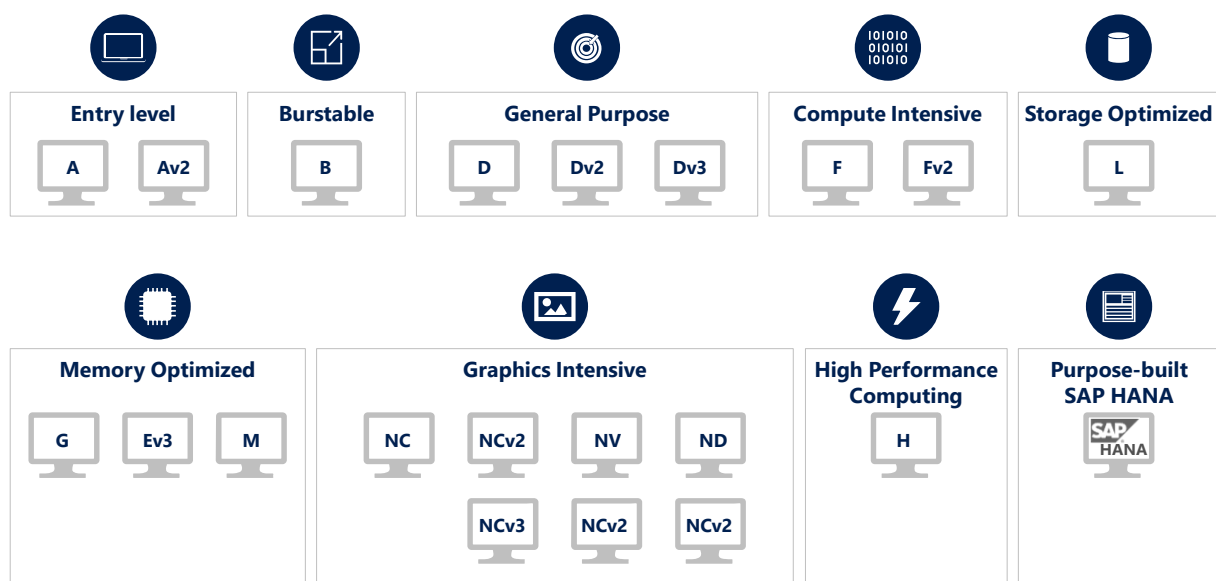
84

Select the Right Virtual Machine



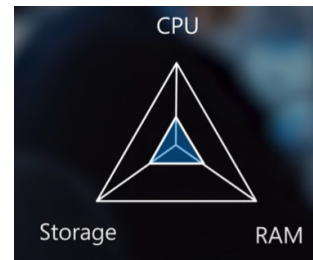
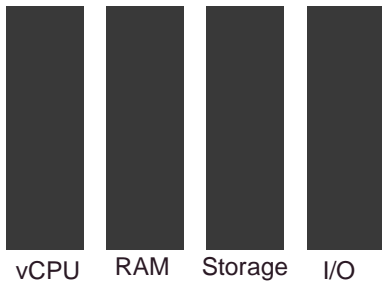
85

Compute Options for all Types of Apps



86

D-Series : General Purpose



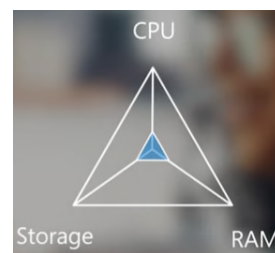
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A-Series : Entry Level



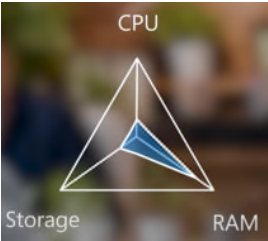
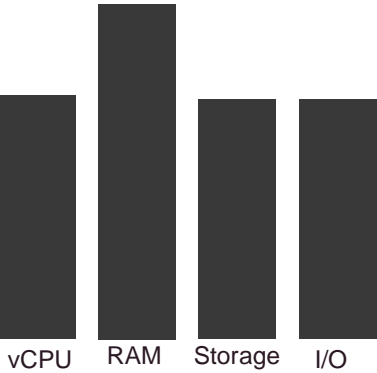
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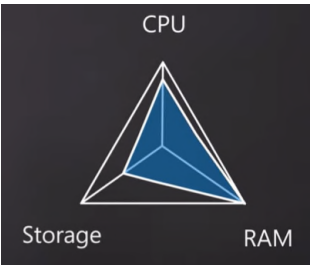
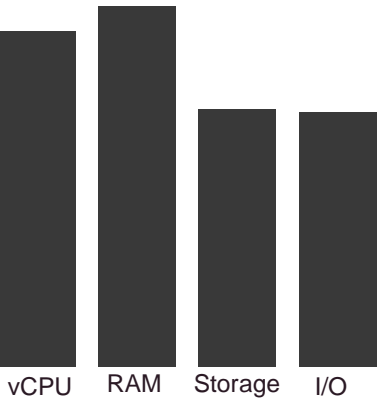
88

E-Series : Memory Optimized



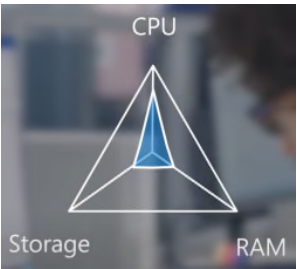
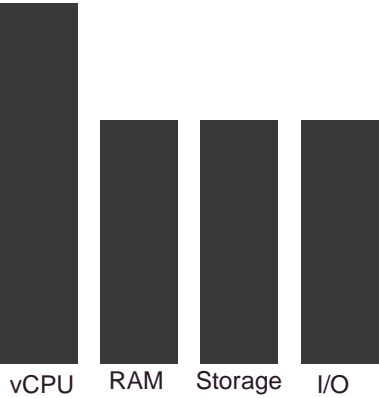
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M-Series : Memory + CPU Optimized



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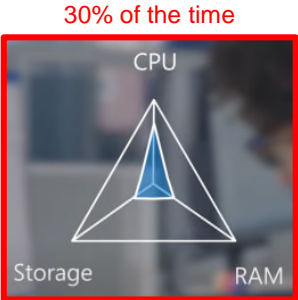
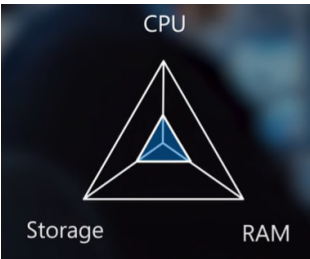
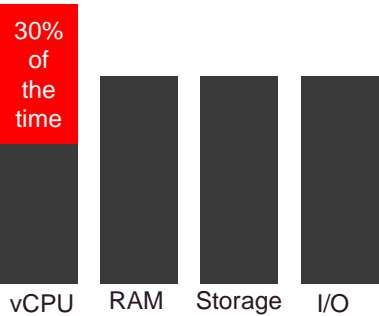
F-Series : CPU Optimized



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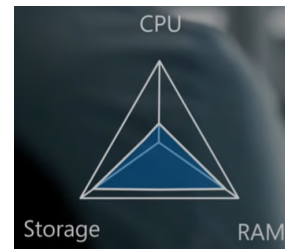
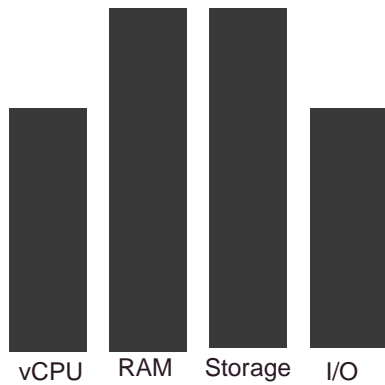
B-Series : Burst



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L-Series : Storage + RAM Optimized



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Azure VM Size Naming

<Family> [Sub-family] <#> [m][r][s]...[_v#]

Family series indicates target workload.

Number of vCPUs in the VM

Optional sub-family further differentiates workloads (e.g. NC for GPU Compute; NV for GPU Visualization) ND for Deep Learning

One or more **additive features**:

- d = Disk, local are present
- h = Hibernation capable
- i = Isolated
- l = Low memory
- m = Memory intensive
- n = NVMe
- t = Tiny memory
- r = RDMA
- s = Premium Storage capable
- a = AMD Based Processor

Version # of family, incremented with 10%+ performance improvements

<https://docs.microsoft.com/en-us/azure/virtual-machines/vm-naming-conventions>

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Compare the Virtual Machines

<https://azure-instances.info/>

Azure-Instances.info Easy Azure Virtual Machines Comparison

Azure VM

Region: europe-west Cost: Monthly Columns Compare Selected Clear Filters CSV

Filter: Min Memory (GiB): 0 Min vCPUs: 0

Name	Memory	vCPUs	Linux Pay As You Go
A0			\$14.6 monthly
A1	1.75 GiB	1	\$43.8 monthly
A1 v2	2 GiB	1	\$29.93 monthly
A2	3.5 GiB	2	\$87.6 monthly
A2 v2	4 GiB	2	\$63.51 monthly
A2m v2	16 GiB	2	\$90.52 monthly
A3	7 GiB	4	\$175.2 monthly
A4	14 GiB	8	\$350.4 monthly
A4 v2	8 GiB	4	\$133.59 monthly
A4m v2	32 GiB	4	\$189.6 monthly
A5	14 GiB	2	\$197.1 monthly
A6	28 GiB	4	\$394.2 monthly
A7	56 GiB	8	\$788.4 monthly

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Azure Billing

- Priced on a per-hour basis
- Billed on a per-minute basis

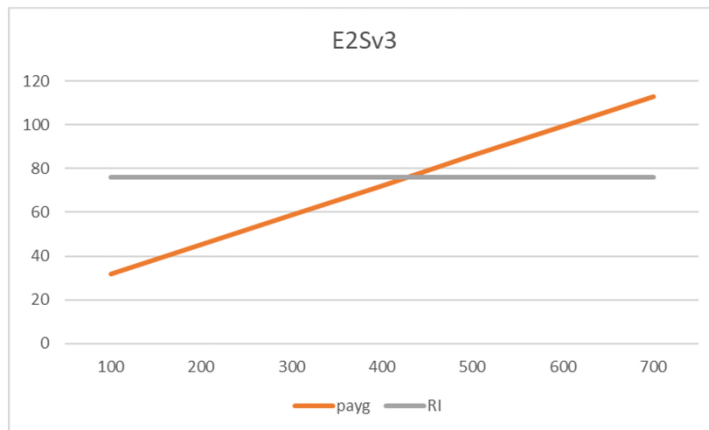
• VM Status

- Running (billable)
- Stopped (Deallocated) (not billable)
- Stopped (*) (billable !)

(*) The VM is stopped but still deployed to a physical host (Shutdown in VM)

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Reserved Instances versus PAYG



hrs	PAYG	RI
100	31,78	76,19
200	45,28	76,19
300	58,78	76,19
400	72,28	76,19
500	85,78	76,19
600	99,28	76,19
700	112,78	76,19
800	126,28	76,19

(1 month = 730 hours)

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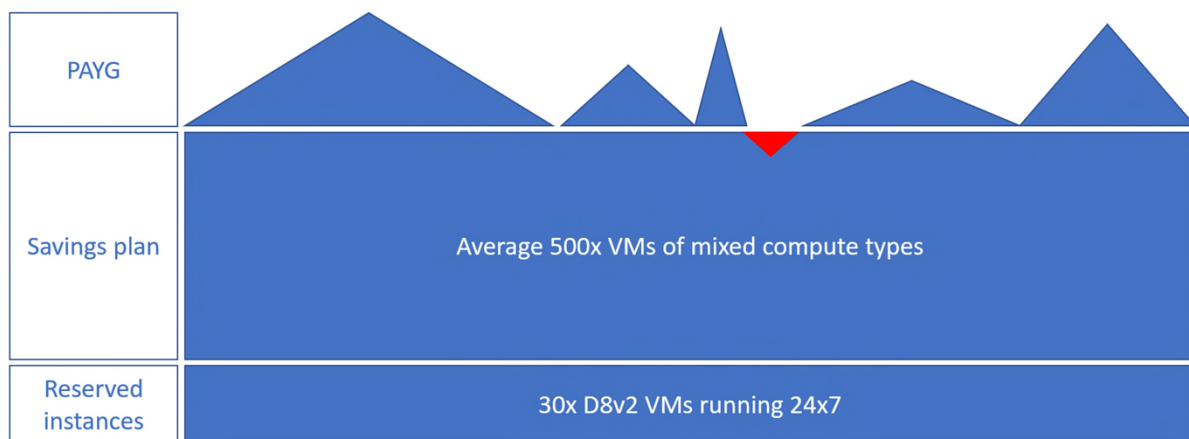
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Azure Savings Plan

NEW



<https://learn.microsoft.com/en-us/answers/questions/1082760/azure-reserved-instance-vs-azure-savings-plan-best>

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Virtual Machines & Storage



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Select the right Storage

Managed Disks	Unmanaged Disks
Standard Storage	Premium Storage

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Unmanaged Disk retired on 20 september 2025

- Begin deprecating unmanaged disks on September 30, 2022 (for new installations)
- Functionality completely retired on September 30, 2025
- For existing installations : Plan migration

<https://azure.microsoft.com/en-in/updates/azure-unmanaged-disks-will-be-retired-on-30-september-2025/>

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Storage Types Compared

	Ultra disk	Premium SSD v2	Premium SSD	Standard SSD	Standard HDD
Disk type	SSD	SSD	SSD	SSD	HDD
Scenario	IO-intensive workloads such as SAP HANA , top tier databases (for example, SQL Oracle), and other transaction-heavy workloads.	Production and performance-sensitive workloads that consistently require low latency and high IOPS and throughput	Production and performance sensitive workloads	Web servers, lightly used enterprise applications and dev/test	Backup, non-critical, infrequent access
Max disk size	65,536 gibibyte (GiB)	65,536 GiB	32,767 GiB	32,767 GiB	32,767 GiB
Max throughput	4,000 MB/s	1,200 MB/s	900 MB/s	750 MB/s	500 MB/s
Max IOPS	160,000	80,000	20,000	6,000	2,000
Usable as OS Disk?	No	No	Yes	Yes	Yes

Price 128 GB Disk - - € 20,00 € 6,86 (*) € 5,43 (*)

(*) Transactions not included

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Managed / ~~Unmanaged~~ Disks

Managed Disks (introduced February 2017)

Only Specify Type and Size of Storage

- Two Storage Types Available : Premium & Standard
- Sizes : P4 – P50 or S4 – S50

No Storage Account Creation needed (LUN)

Better reliability for Availability Sets

Different Storage Scale Units (Stamps)

Local Redundant Storage (LRS) & Zone Redundant Storage (ZRS)

~~Unmanaged Disks (retired September 30, 2022)~~

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Storage Remarks

- **Standard Disk : Additional Cost for Transactions**
- **Premium Disk : No Additional Transaction Cost**
- **Storage Q&A : <http://aka.ms/DiskQnA>**



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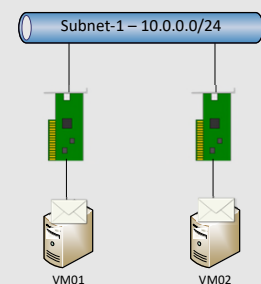
Virtual Network (VNet)



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What is a virtual network (VNet) ?

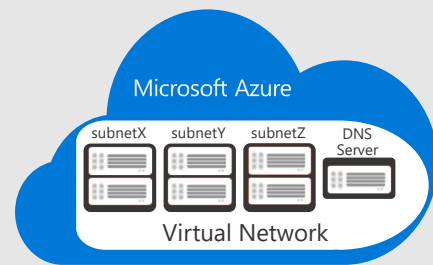
- Logical Network Security Boundary
- Address Space
 - Not overlapping Address Ranges
 - Private IP Address space (example 10.0.0.0/16)
 - Only Reachable within the Vnet
- Subnets
 - In an VNet Address Space you can have one or more Subnets
 - Example 10.0.0.0/24 and 10.0.1.0/24 and 10.0.3.0/24
 - By Default no security boundary between Subnets
 - Services in each Subnet can talk to each other



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Virtual Network (VNet) and SubNet

- Logical isolation with control over the network
- Create subnets and isolate traffic with network security groups
- Support for Static IP addresses
- Support for Internal Load Balancing
- DNS options – BYO or Microsoft Azure-provided
- Extend your trust boundary – VMs on the same Network



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Create Virtual Machines



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Create Virtual Machines using portal

Microsoft Azure

Search resources, services, and docs (G+/I)

Home >

Create a resource ...

Get started

Search services and marketplace

Getting Started? Try our Quickstart center

Recently created

Popular products See more in Marketplace

Categories

- AI + Machine Learning
- Analytics
- Blockchain
- Compute
- Containers
- Databases
- Developer Tools
- DevOps
- Identity
- Integration

Windows Server 2019 Datacenter
Create | Learn more

Ubuntu Server 20.04 LTS
Create | Learn more

Web App
Create | Docs | MS Learn

SQL Database
Create | Docs | MS Learn

Function App
Create | Docs

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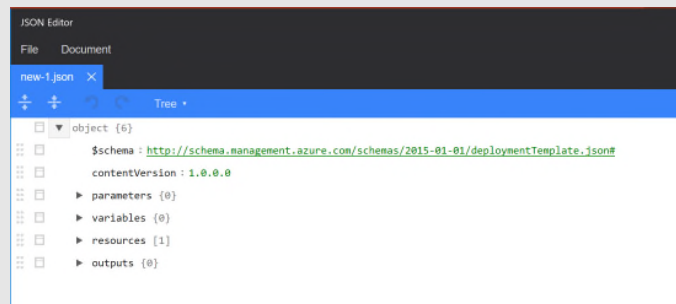
ARM Templates



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Resource Manager Templates

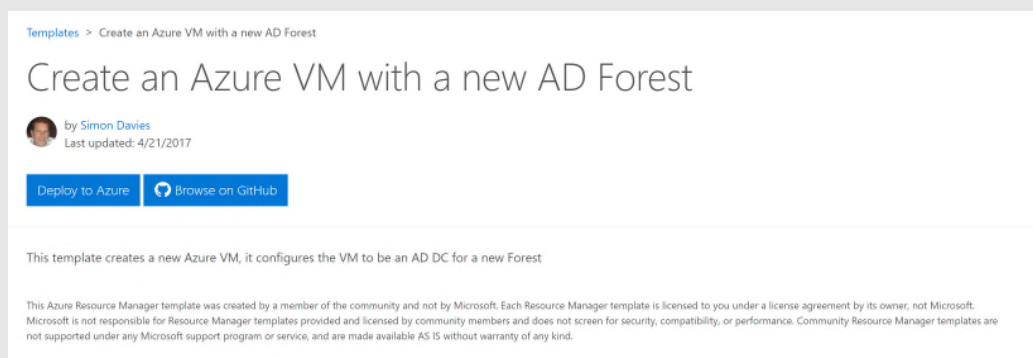
- Are JSON-Files
- Use a JSON Editor
- Create your First Template :
<https://docs.microsoft.com/en-us/azure/azure-resource-manager/resource-manager-create-first-template?>



111

Creating VM from Azure QuickStart Template

<https://azure.microsoft.com/en-us/resources/templates/>



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Export an ARM Template

Automation

Export template

IMCLOUD-AD-RG | Export template

Resource group: Directory: IM Cloud

Download Add to library (preview) Deploy Visualize template

To export related resources, select the resources from the Resource Group view then select the "Export template" button.

Include parameters

Template Parameters Scripts

Parameters (7)

Variables (0)

Resources (11)

(parameters('publicIPAddresses_adV...'))

(Microsoft.Network/publicIPAddres...

(parameters('virtualNetworks_adV...'))

(Microsoft.Network/virtualNetworks...

(parameters('availabilitySets_adV...'))

(Microsoft.Compute/availabilitySet...

(concat(parameters('virtualMachin...'))

(/CreateADForest))

(Microsoft.Compute/virtualMachin...

(parameters('schedules_shutdown...'))

(microsoft.devtestlab/schedules)

(parameters('loadBalancers_adLoa...'))

(Microsoft.Network/loadBalancers)

(concat(parameters('loadBalancers...'))

(/LBBE))

(Microsoft.Network/loadBalancers)

(concat(parameters('loadBalancers...'))

(/adRDP))

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Additional Resources

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Microsoft Azure App for Android



Microsoft Azure

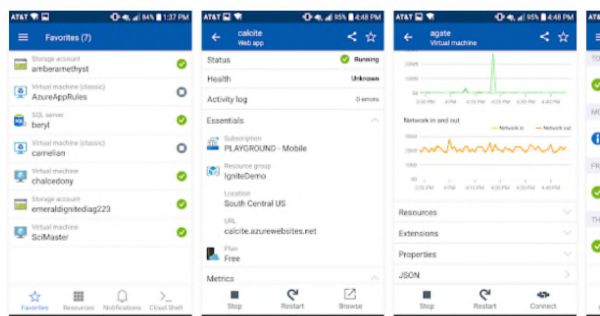
Microsoft Corporation Business

★★★★★ 484

PEGI 3

This app is compatible with all of your devices.

Installed



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Microsoft Azure App for iPhone



Microsoft Azure

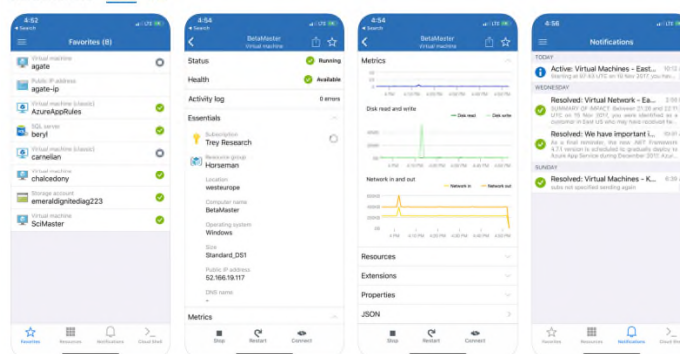
Azure – anytime, anywhere

Microsoft Corporation

★★★★★ 156 Ratings

Free

Screenshots iPhone iPad



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```

graph TD
    myVM[myVM  
Virtual Machine] --> parameters[parameters("storageAccountName")  
Storage Account]
    myVM --> nic1[nic1  
Network Interface]
    myVM --> nic2[nic2  
Network Interface]
    nic1 --> myLB[myLB  
Load Balancer]
    nic1 --> myVNET[myVNET  
Virtual Network]
    nic2 --> myVNET
    myLB --> myPublicIP[myPublicIP  
Public IP Address]
  
```

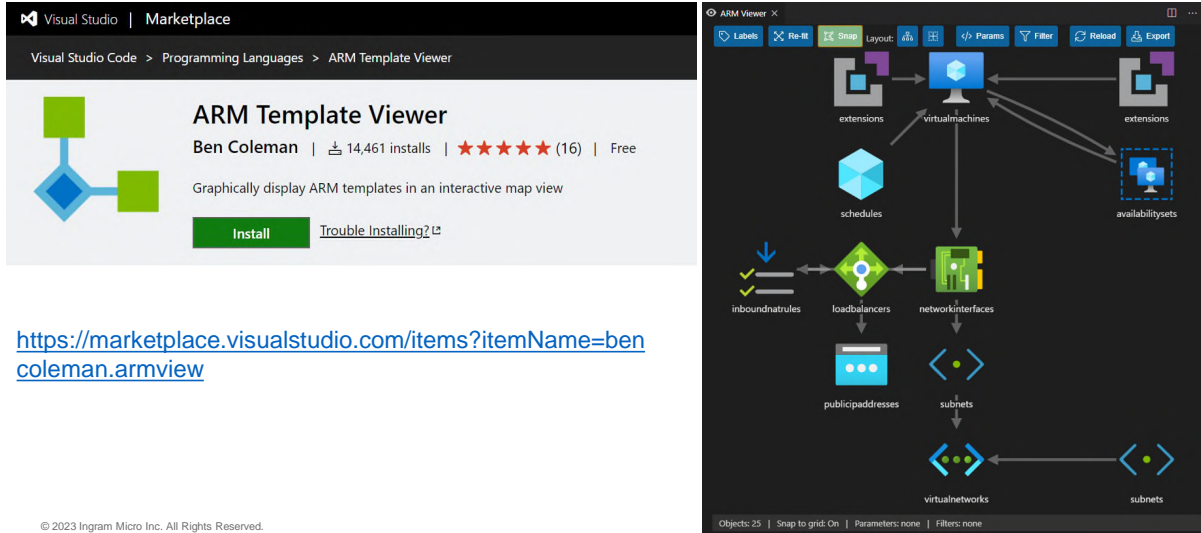


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[illegible]

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Visual Studio Code & ARM Viewer (Extension)



Visual Studio | Marketplace

Visual Studio Code > Programming Languages > ARM Template Viewer

ARM Template Viewer
Ben Coleman | 14,461 installs | ★★★★★ (16) | Free

Graphically display ARM templates in an interactive map view

[Install](#) [Trouble Installing?](#)

<https://marketplace.visualstudio.com/items?itemName=ben-coleman.armview>

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ARM Viewer X

Labels | Snap | Layout | Params | Filter | Reload | Export

extensions virtualmachines extensions availabilitysets

schedules

inboundnatrules loadbalancers networkinterfaces

publicaddresses subnets

virtualnetworks subnets

Objects: 25 | Snap to grid: On | Parameters: none | Filters: none

INGRAM MICRO CLOUD

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- Stop your Virtual Machines after the exercises !



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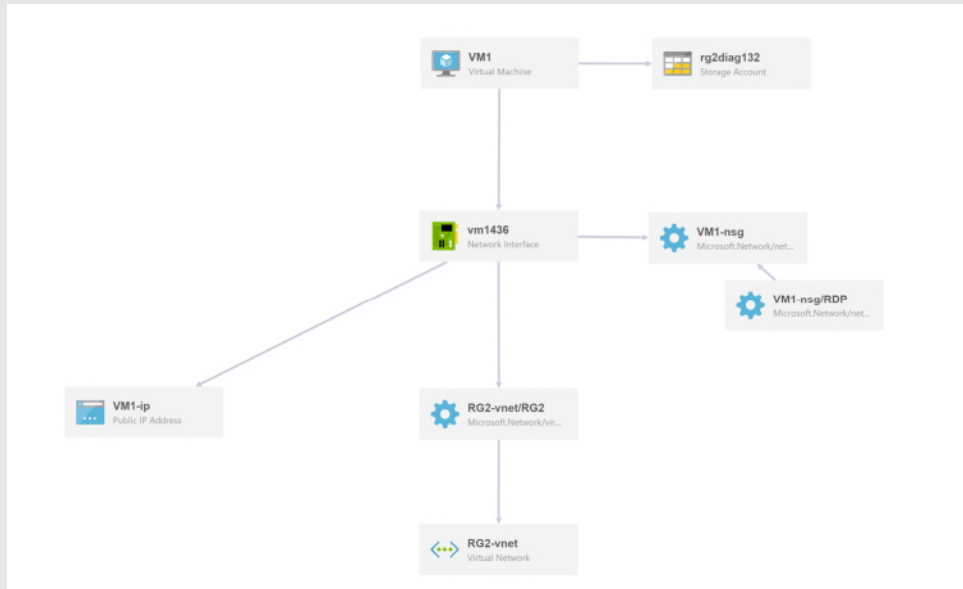
Demo: Azure Virtual Machines

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Lab 3: Azure Virtual Machines

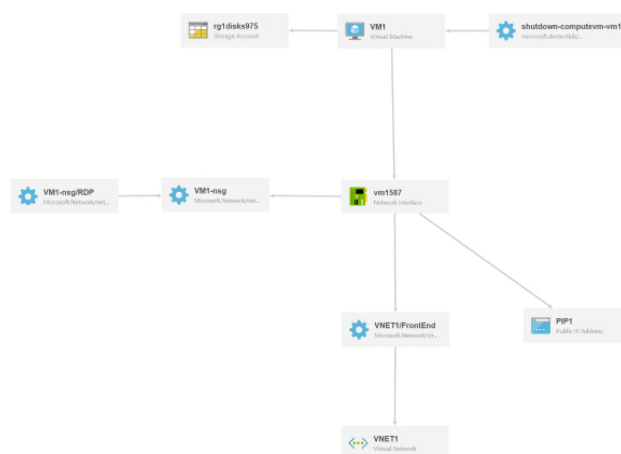
122

VM1



123

VM1



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Active Directory Template

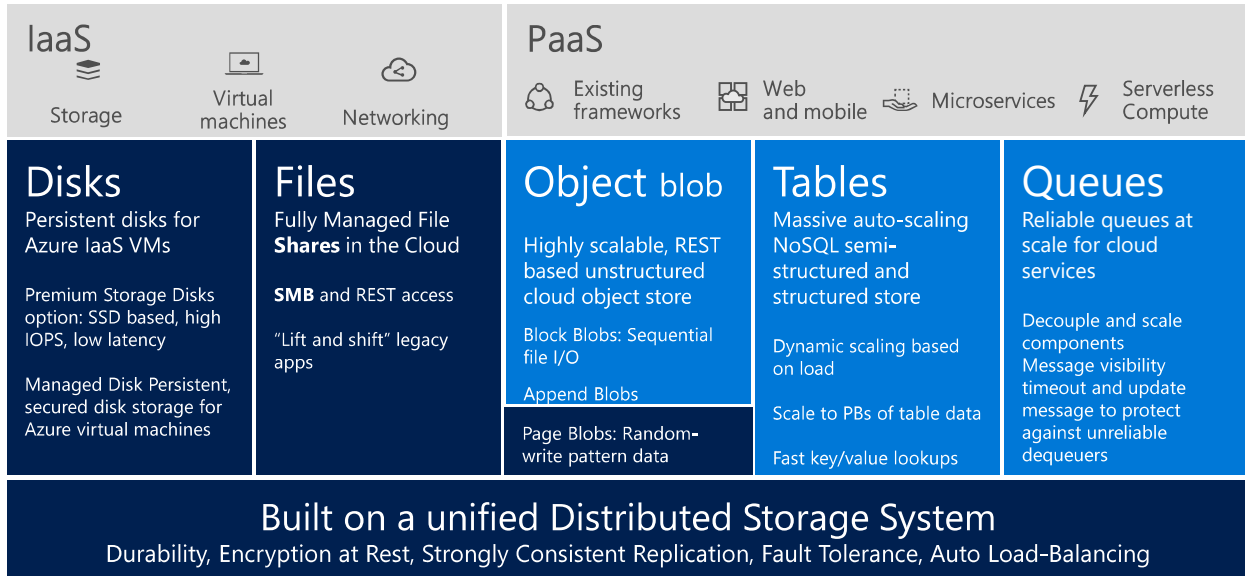


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Module 4: Azure Storage

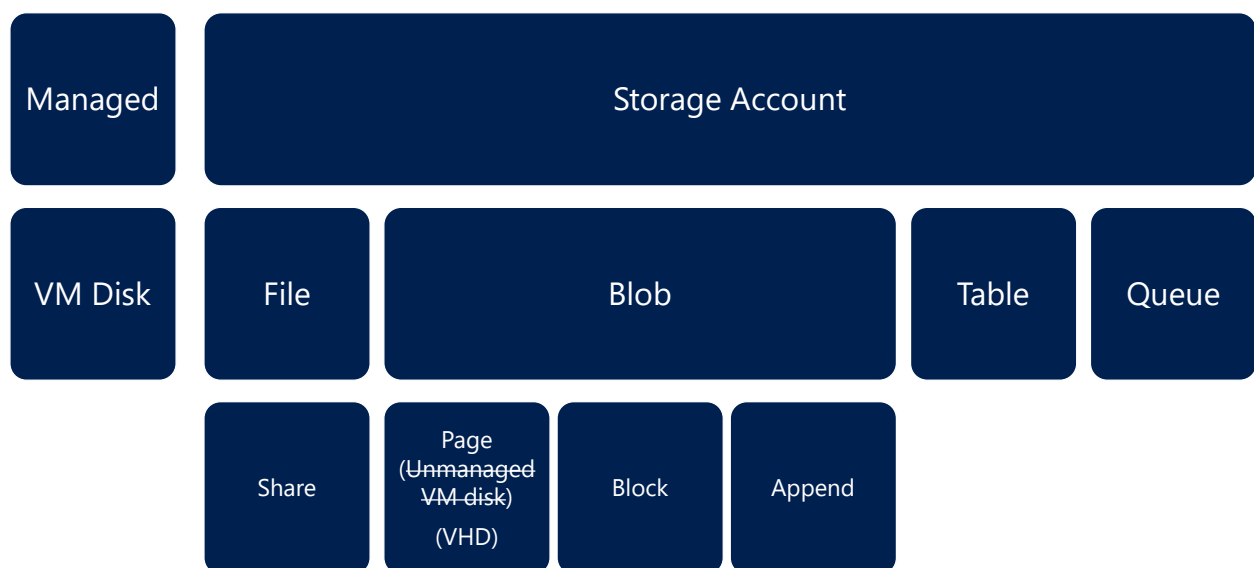
126

Azure Storage Services



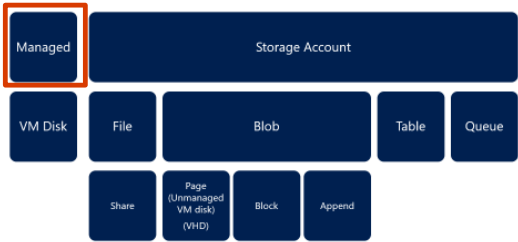
127

Azure Storage Overview



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Azure Managed Storage



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Azure Managed Storage

	Ultra disk	Premium SSD v2	Premium SSD	Standard SSD	Standard HDD
Disk type	SSD	SSD	SSD	SSD	HDD
Scenario	IO-intensive workloads such as SAP HANA , top tier databases (for example, SQL, Oracle), and other transaction-heavy workloads.	Production and performance-sensitive workloads that consistently require low latency and high IOPS and throughput	Production and performance sensitive workloads	Web servers, lightly used enterprise applications and dev/test	Backup, non-critical, infrequent access
Max disk size	65,536 gibibyte (GiB)	65,536 GiB	32,767 GiB	32,767 GiB	32,767 GiB
Max throughput	4,000 MB/s	1,200 MB/s	900 MB/s	750 MB/s	500 MB/s
Max IOPS	160,000	80,000	20,000	6,000	2,000
Usable as OS Disk?	No	No	Yes	Yes	Yes

Price 128 GB Disk	-	-	€ 20,00	€ 6,86 (*)	€ 5,43 (*)
				(*) Transactions not included	

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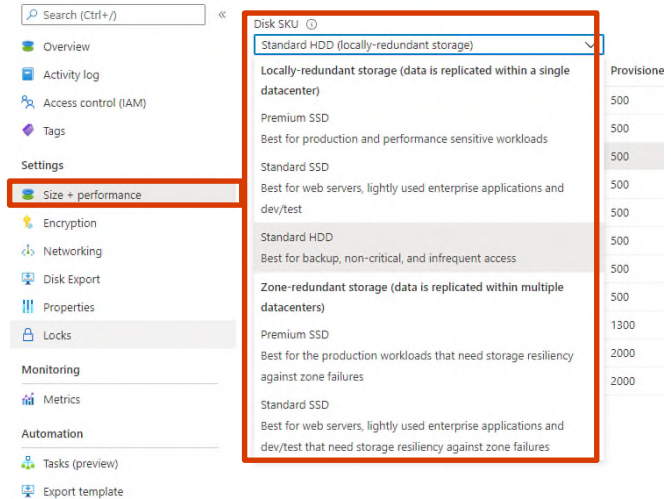
130

Change Disk SKU & Performance Tier (premium)

Select Settings > Disk

Click {Disk}

Select Settings > Size + performance

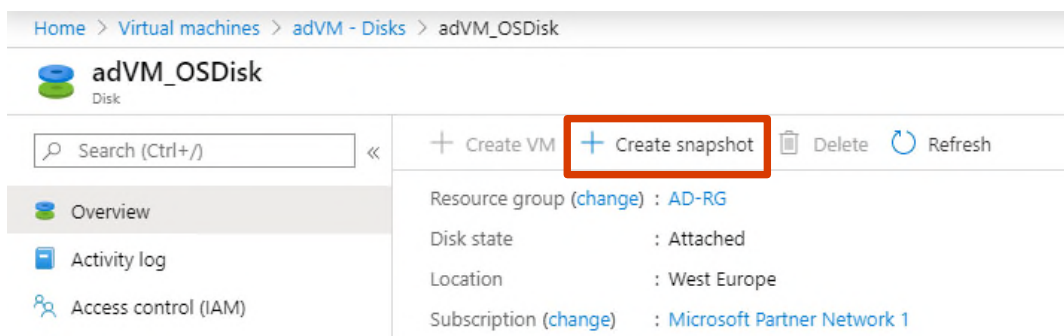


<https://docs.microsoft.com/en-us/azure/virtual-machines/disks-performance-tiers-portal>

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Create a Snapshot of a Managed disk

- Select the Disk
- Select + Create snapshot



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Restore a Snapshot to a disk

- Create a new Managed Disk
- Resource Type :
 - Snapshot
- Source Snapshot

Project details

Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.

Subscription * ⓘ

Microsoft Partner Network 1

Resource group * ⓘ

AD-RG

[Create new](#)

Disk details

Disk name * ⓘ

Region * ⓘ

(Europe) West Europe

Availability zone

None

Source type ⓘ

Snapshot

*Source snapshot ⓘ

SNAPWEND

Size * ⓘ

1024 GiB
Premium SSD
[Change size](#)

133

Replace disk by newly created disk

- Select the VM
- Select Swap OS Disk > Select the newly created disk

WEN-0 - Disks
Virtual machine

Search (Ctrl+/) <<

[Edit](#)
[Refresh](#)
[Encryption](#)
[Swap OS Disk](#)

ⓘ Managed disks created since June 10, 2017 are encrypted at rest with Storage Se
 ⓘ Disk caching cannot be changed for L-Series and B-series virtual machines.
 ⓘ Ultra Disk compatibility is not available for this location.

Disk settings

Enable Ultra Disk compatibility ⓘ

☐ Yes
 ☐ No

OS disk

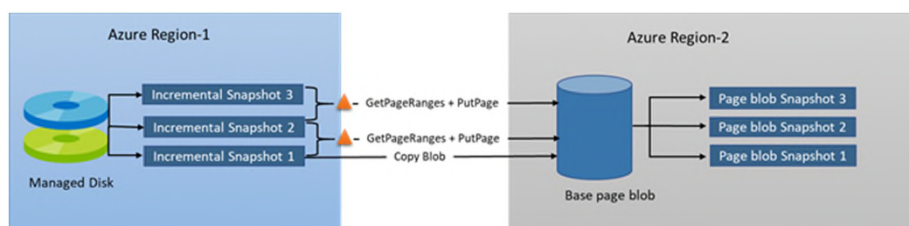
Name

WEN-0_OsDisk_1_5820097e6236476e983585ec621a00cb

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Incremental Snapshots of Managed Disks

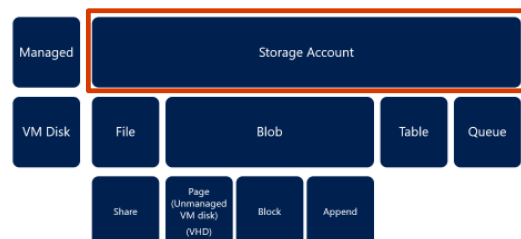
- This feature is in preview since September 2019
- Advantage : Cost-effective Point-in-time backup
- Billed for the delta changes since last snapshot
- Stored on standard HDD (Page Blob) (ZRS)
- Only in : East US, East US2, Central US West C US, Canada



<https://azure.microsoft.com/en-us/blog/introducing-cost-effective-increment-snapshots-of-azure-managed-disks-in-preview/>
<https://docs.microsoft.com/en-us/azure/virtual-machines/linux/disks-incremental-snapshots>

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Storage Accounts



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Creating a Storage Account

- Unique Name
- Account Type
- Performance
- Replication
- Location

The cost of your storage account depends on the usage and the options you choose below. [Learn more](#)

* Name .core.windows.net

Deployment model ☒ Resource manager ☐ Classic

Account kind

Performance ☒ Standard ☐ Premium

Replication

* Storage service encryption (blobs and files) ☐ Disabled ☒ Enabled

* Secure transfer required ☐ Disabled ☒ Enabled

* Subscription

* Resource group ☒ Create new ☐ Use existing

* Location

Create Storage accounts

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Storage Accounts

- Up to 500 TB of data per account
- Maximum of 200 storage accounts per subscription
- Three types of accounts
 - Blob storage, GPv1, GPv2
- Four types of replication
 - LRS, ZRS, GRS, and RA-GRS (Read access geo-redundant storage)
- Support optional 256-bit AES encryption for "data at rest"

Create storage account

The cost of your storage account depends on the usage and the options you choose below. [Learn more](#)

* Name .core.windows.net

Deployment model ☒ Resource manager ☐ Classic

Account kind

Performance ☒ Standard ☐ Premium

Replication

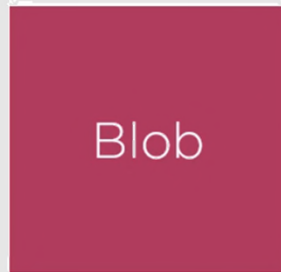
Microsoft Azure

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Storage Account Types



General Purpose v1
Blob, File, Table, Queue
Supports deploying with
Classic Deployment Model



Blob Storage Account
Blobs only
Blob Storage Tiers



General Purpose v2
Supports all latest features
Blob, File, Table, Queue

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Azure Storage Account Replication



Typically >300mi

Async



Secondary

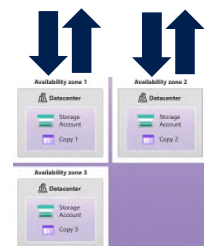


Typically >300mi

Async



Secondary



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
- Availability : 99.9%
- 3 Disks

GRS

- 6 replicas, 2 regions (3/region)
- Protects against major regional disasters
- Asynchronous to secondary
- Availability 99.99%
- 6 Disks

RA-GRS

- GRS + Read access to secondary
- Separate secondary endpoint
- RPO delay to secondary can be queried
- Availability 99.99%
- 6 Disks

ZRS

- GRS + GRS
- Synchronously across datacenters
- Availability 99.9%
- 3 Disks/3 Datacenters

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Locally redundant storage

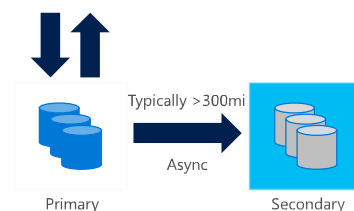
- Replicates your data three times within a storage scale unit (collection of racks of storage nodes) in the same region.
- A write request returns successfully only once it has been written to all three replicas
- Fault domain (FD) is a group of nodes that represent a physical unit of failure and can be considered as nodes belonging to the same physical rack.
- Upgrade domain (UD) is a group of nodes that are upgraded together during the process of a service upgrade (rollout).
- Replicas are spread across UD's and FD's within one storage scale unit



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Geo redundant storage

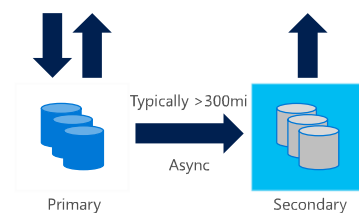
- Geo-redundant storage (GRS) replicates your data to a secondary region that is hundreds of miles away from the primary region
- Update is first committed to the primary region, where it is replicated three times.
- Update is replicated asynchronously to the secondary region, where it is also replicated three times.
- With GRS both the primary and secondary regions manage replicas across separate fault domains and upgrade domains within a storage scale unit
- The replica is not available unless Microsoft initiates failover to the secondary region.
- If an application wants to read from the secondary region the user should enable RA-GRS.
- The secondary region is pre determined based on the primary region, and cannot be changed



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Read-access Geo-redundant storage

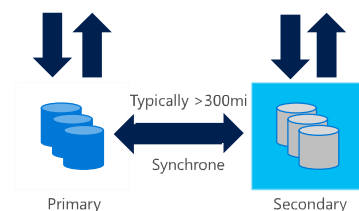
- Read-access geo-redundant storage (RA-GRS) provides read-only access to the data in the secondary location
- When you enable read-only access to your data in the secondary region, your data is available on a secondary endpoint, in addition to the primary endpoint for your storage account
- The access keys for your storage account are the same for both the primary and secondary endpoints.
- Your application has to manage which endpoint it is interacting with when using RA-GRS.
- RA-GRS is intended for high-availability purposes.
- 99.99 % Uptime



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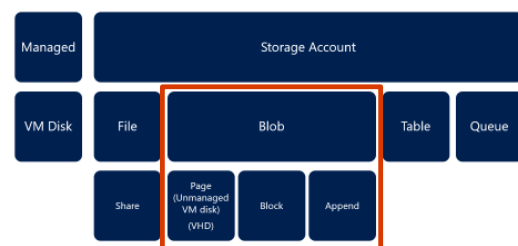
Zone redundant storage

- Zone-redundant storage (ZRS) replicates your data synchronously across datacenters within one or two regions in addition to storing three replicas
- Simplify the development of highly available applications
- ZRS provides durability for storage objects of at least 99.999999999% over a given Year
- ZRS is currently available for preview in the following regions, with more regions coming soon:
 - US East 2
 - US Central
 - France Central



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Blob Storage



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Blob Storage

Azure's Object Storage platform

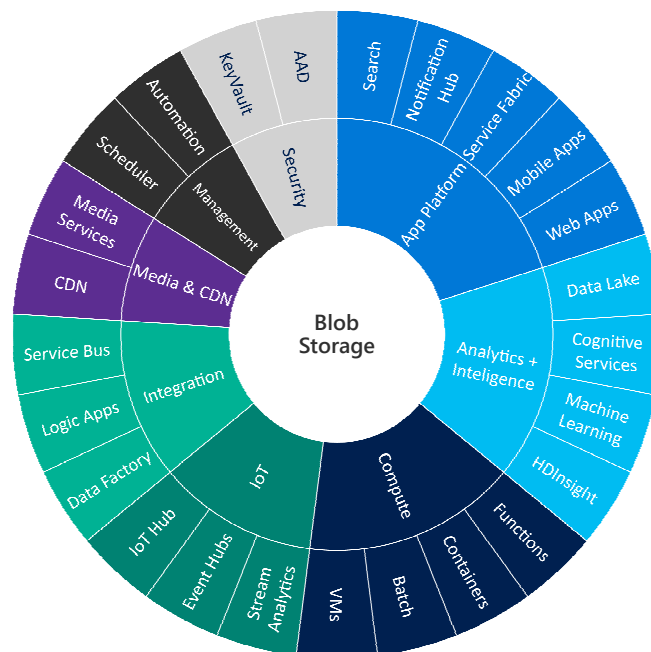
Binary Large Object (Blob)

Store and serve unstructured data

App and Web scale data
Backups and Archive
Big Data from IoT,
Genomics, etc.

Broad integration for Blobs across Azure services

Enables many scenarios through massive scale performance, high availability, and low cost

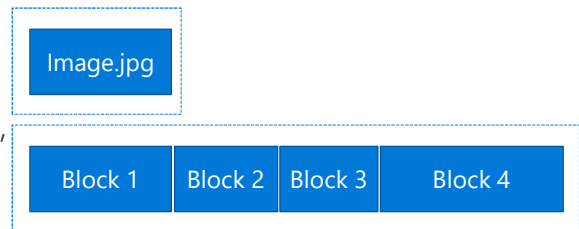


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Types of Blobs

Block Blobs

Most object storage scenarios like documents, images, videos, etc.



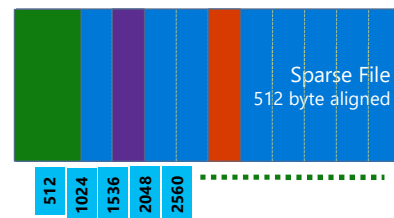
Append Blobs

Multi-writer append only scenarios
Logging, Big Data Analytics output



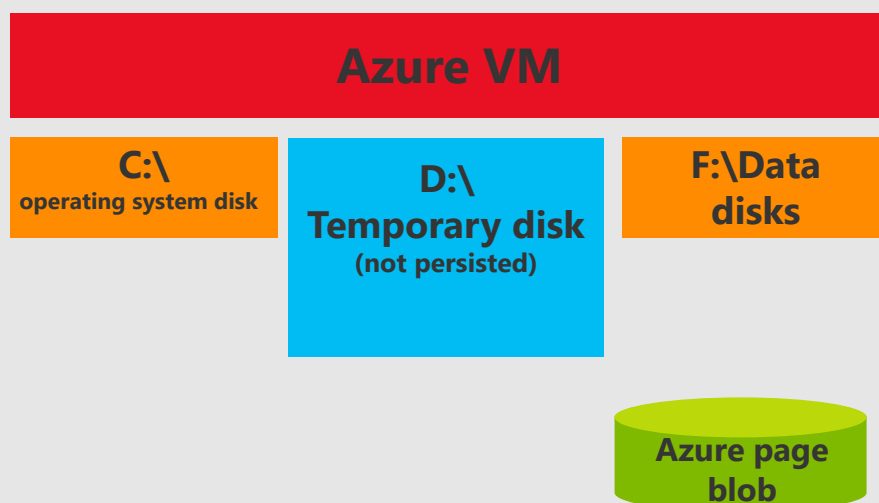
Page Blobs

Page aligned random reads and writes I/O
IaaS Disks, Event Hub, Block level backup



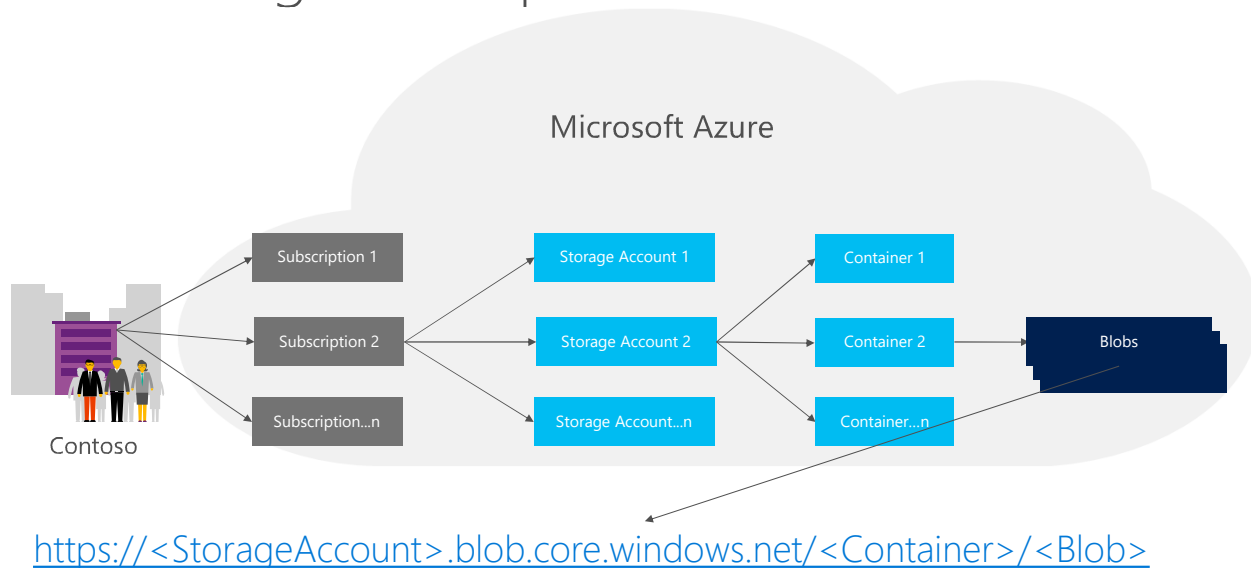
147

Page Blobs (Unmanaged Disks) (vhd)



148

Blob Storage Concepts



149

Storage Containers Access Policies

- Three access policies
 - Private – Blobs can't be read or enumerated anonymously
 - Container – Blobs can be read and enumerated anonymously
 - Blob – Blobs can be read anonymously, but cannot be enumerated

New container

Blob service (dxxmstorage)

* Name

Access type ⓘ

Private

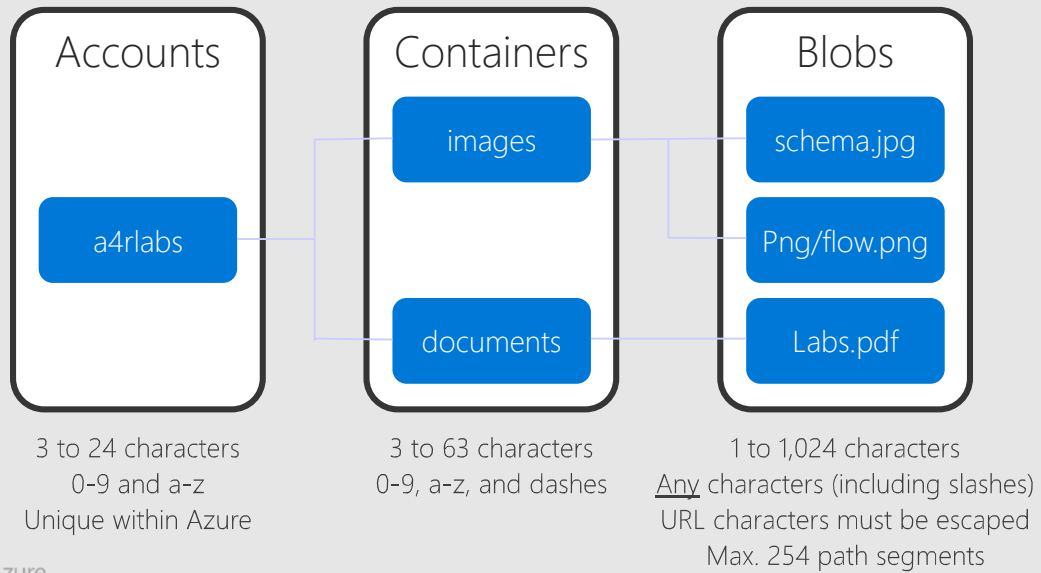
Blob

Container

Microsoft Azure

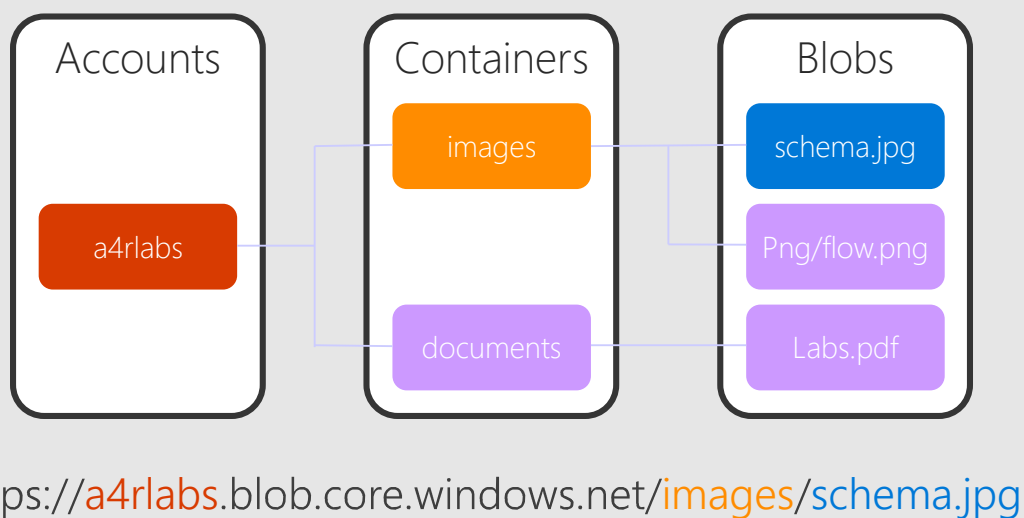
150

Blob Storage



151

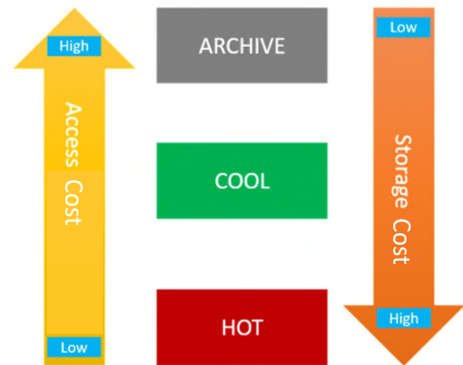
Blob URLs



152

Block Blob Storage Access Tiering

- You may only tier your object storage data to hot, cool, or archive in Blob Storage or General Purpose v2 (GPv2)
- Do the setting in the **Access Tier** attribute
- Hot Access Tier
 - Data in Active Use
- Cool Access Tier
 - Short Term Backup
- Archive Access Tier
 - remain in the archive tier for at least 180 days
 - (ONLY AVAILABLE ON BLOB Level)



153

Comparison Storage Tiers

The following table shows a comparison of the hot, cool, and archive storage tiers.

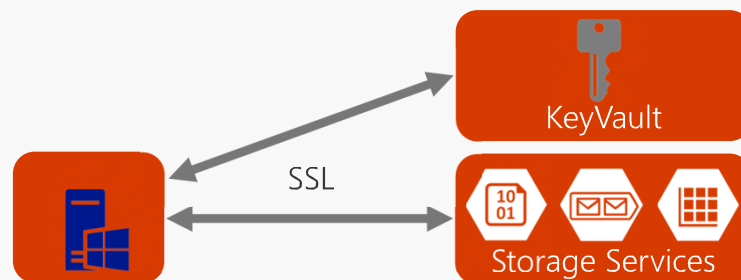
	Hot storage tier	Cool storage tier	Archive storage tier
Availability	99.9%	99%	N/A
Availability (RA-GRS reads)	99.99%	99.9%	N/A
Usage charges	Higher storage costs, lower access and transaction costs	Lower storage costs, higher access and transaction costs	Lowest storage costs, highest access and transaction costs
Minimum object size	N/A	N/A	N/A
Minimum storage duration	N/A	30 days (GPv2 only)	180 days
Latency (Time to first byte)	milliseconds	milliseconds	< 15 hrs
Scalability and performance targets	Same as general-purpose storage accounts	Same as general-purpose storage accounts	Same as general-purpose storage accounts

154

Encryption at Rest

Blob Storage Service Encryption

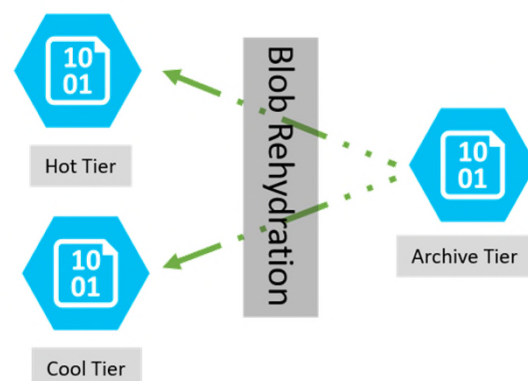
- Blob Storage Service automatically encrypts your data
- SSL used to secure data sent to Storage Service
- Microsoft manages all key management practices including compliance
- What's next: "Bring your own key" for server side encryption at rest



155

Azure Blob Rehydration

- Bring Azure Storage from Archive Tier to :
 - Hot Tier
 - Cool Tier
- Takes several hours (up to 15 hours)



156

Versioning

Snapshots

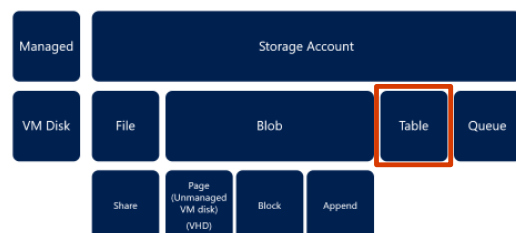
Read only copy of a blob at a point in time
Same name as blob with a datetime stamp

Can be read, copied/restored or deleted

CopyBlob to make a write-able new blob from a snapshot
CopyBlob to restore a snapshot over the current version
Snapshots are not copied with a normal CopyBlob operation
Blob Deletion requires deletion of all snapshots

157

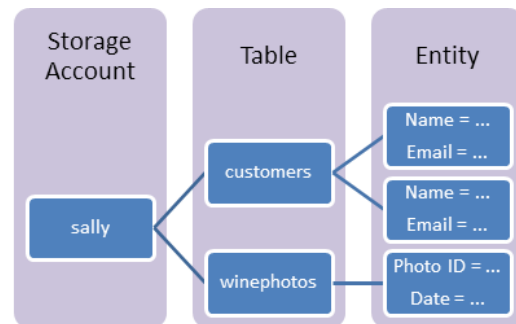
Table Storage



158

What is Table Storage ?

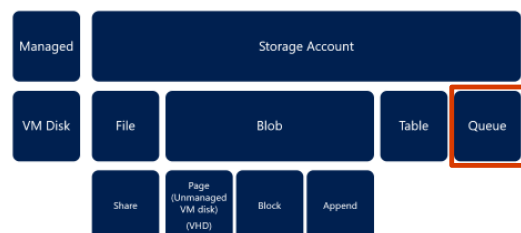
- Large amounts of Structured Data
- NoSQL datastore
- Structured Non-relational Data
- No schema needed
- Accessing data using the OData protocol and LINQ queries



<http://<storage account>.table.core.windows.net/<table>>

159

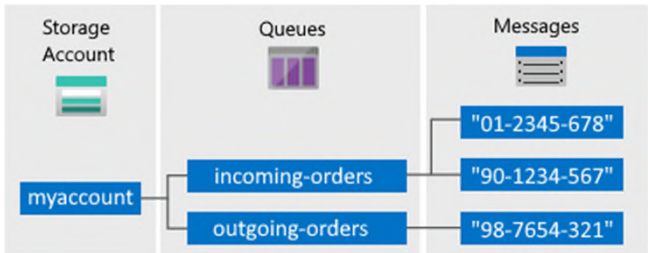
Queue Storage



160

What is Queue Storage ?

- Large numbers of messages
- A queue message can be up to 64 KB in size
- Protocol http & https

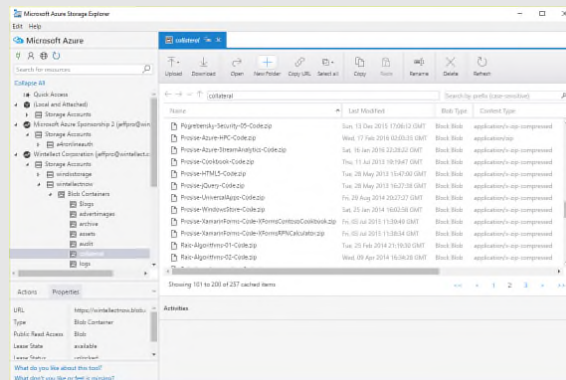


`https://<storage account>.queue.core.windows.net/<queue>`

161

Azure Storage Explorer

- Free cross-platform tool for managing Azure Storage
- <http://storageexplorer.com/>



Microsoft Azure

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Accessing Storage Accounts



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Storage Account Access Keys & SAS Tokens

a) Storage Account Access Keys

- Your storage account is assigned two private access keys on creation that are used for authentication
- Can be rotated but application access needs to be modified (except for VMs)

b) For limited access use Shared Access Signature (SAS)

- A shared access signature (SAS) is a token that can be appended to a URL that enables delegated access to a storage resource
- Anyone who possesses the token can access the resource it points to with the permissions it specifies, for the period of time that it is valid

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Request Authorization Options - Compared

Individual Request Signing

- Possession of access key authorizes all operations
- To revoke access to client, key must be regenerated
- Authorization in header
- Appropriate only for secure, trusted application deployments

SAS Tokens

- SAS tokens can grant limited, specific privileges
- SAS tokens have explicit expiration, and can be revoked (stored policy)
- Authorization in URL
- Requires custom token issuer service
- Best for most scenarios
- Enables bypass of middle tier

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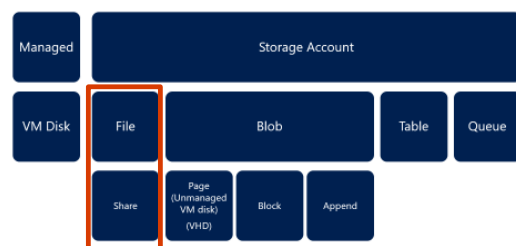
Account SAS Example

<https://myaccount.blob.core.windows.net/mycontainer/myblob?sv=2015-04-05&ss=b&srt=o&sp=r&se=2016-09-30T23:57:53Z&st=2016-09-14T15:57:53Z&spr=https&sig=BWLBIFazbsn96gJL2I0wKjkRRBaH9qvtF5qtsLuulPk%3D>

Parameter	Description
sv=2015-04-05	SAS protocol version
ss=b	Services allowed
srt=o	Resource types allowed
sp=r	Permissions granted
st=2016-09-14T15:57:53Z	Start (valid from date/time)
se=2016-09-30T23:57:53Z	Expiration (valid until date/time)
spr=https	Allowed protocols (https or https,http)
sig=BWLBIFd8gl38avg...	Signature

166

Azure Files



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Azure Files: Capabilities

What is Azure Files?

- Fully Managed Cloud File Storage for use with IaaS and On Premises instances

Multiple protocols & Operating Systems

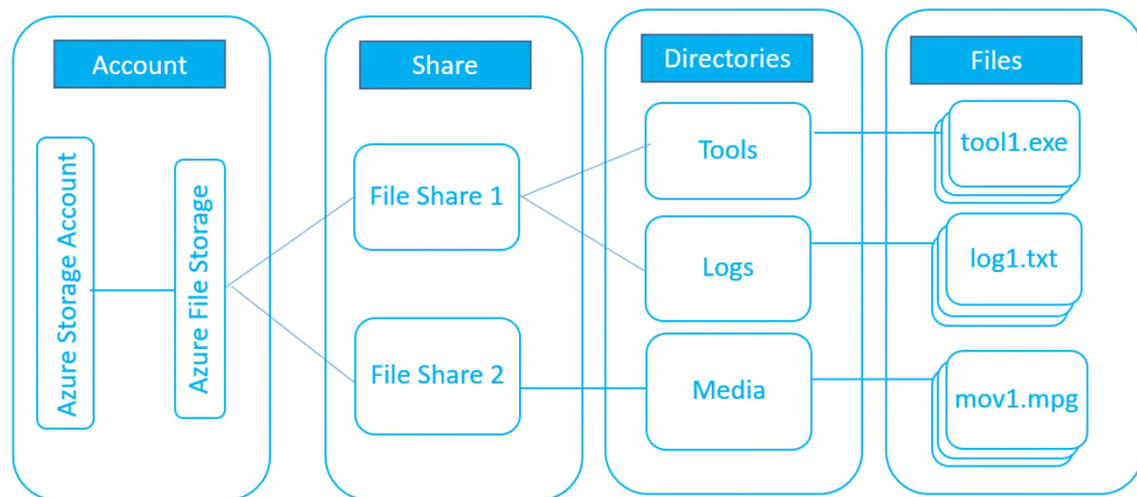
- SMB 2.1, 3.0, and REST
- Mount from both Windows & Linux

Globally accessible

- Accessible from both On Premises and IaaS instances

168

Azure Files : SMB Share



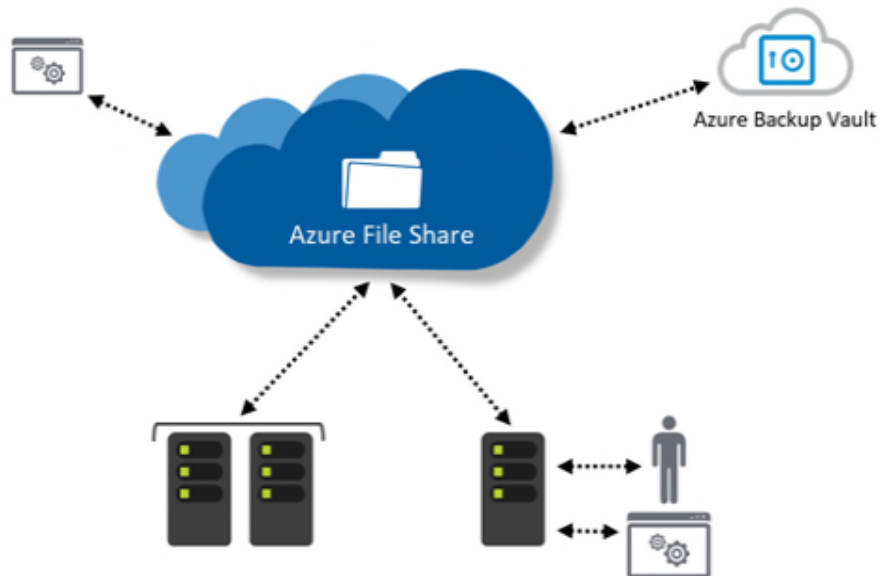
169

Azure Files vs. Disks vs. Blobs

	Azure Files	Azure Disks	Azure Blobs
Scenario	Life & Shift applications which leverage native file system	Persistent disks to Azure Virtual Machines	Massively scale out object storage
Protocol	SMB 2.1/3.0, REST	VHD, REST	REST
Accessibility	SMB – Worldwide (requires Port 445) REST – Worldwide	VHD – Azure Data Center REST (Page Blob) – Worldwide	REST –Worldwide
Durability	LRS, GRS	LRS, GRS, RA-GRS (for Page Blob)	LRS, GRS, RA-GRS
Object Size	Up to 1 TB file	Up to 1 TB Disks (Can stripe up to 64 disks on G VM)	Up to 1 TB/Blob
Max IOPS (8K)	1000	5000 (Premium) 500 (Standard)	500 request/sec
Throughput	Up to 60 MB/s per share	Up to 200 MB/s per disks (Premium) Up to 60 MB/s per disk (Standard)	Up to 60 MB/sec per blob

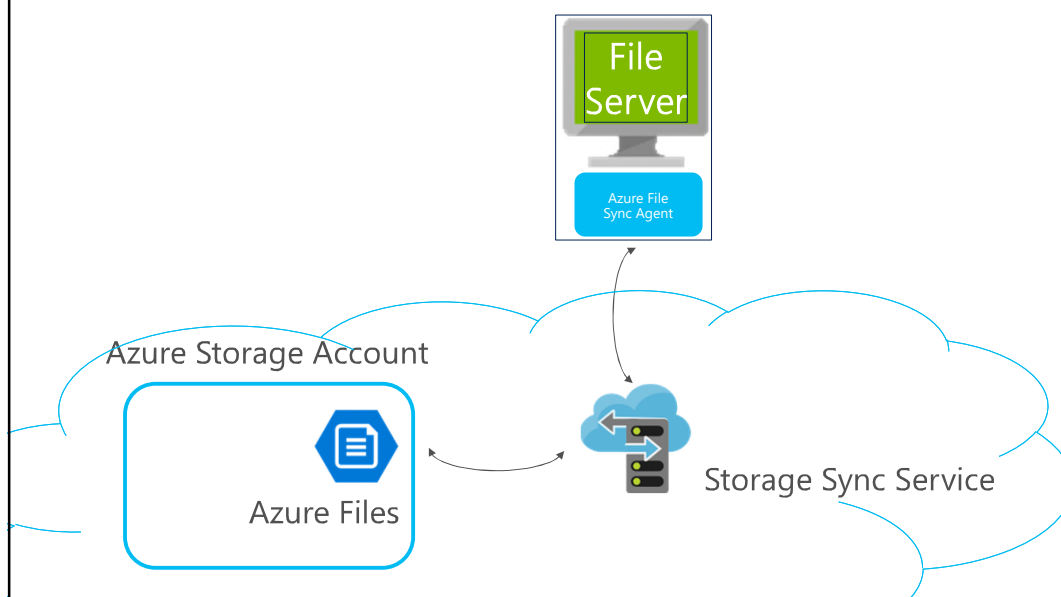
170

Azure File Sync : On Premises – Cloud File Share



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Azure File Sync (AFS) Components



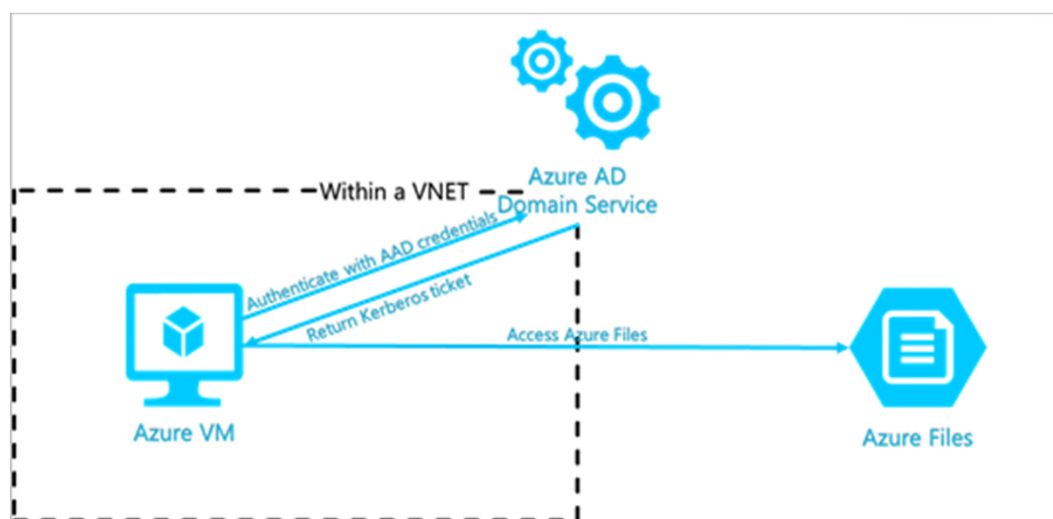
172

Azure Files and User Permissions (Preview 24-09-2018)



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Azure Files with User Authentication



<https://docs.microsoft.com/en-us/azure/storage/files/storage-files-active-directory-overview>

174

Azure Files and User Authentication

1. Setup Azure Active Directory Domain Services
2. Enable Azure AD authentication over SMB
3. Configure share-level permissions for Azure Files

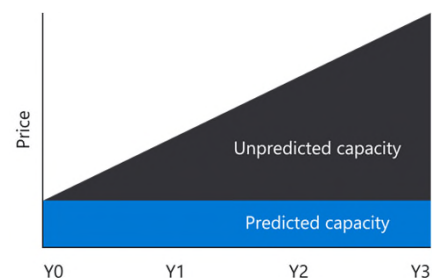
1. RBAC Roles

2. <https://docs.microsoft.com/en-us/azure/storage/files/storage-files-active-directory-enable>

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Azure Storage Reservations (Ignite 2019)

- Announced during Ignite 2019
- Available in Standard Storage Accounts (Hot – Cool – Archive)
 - Blob Storage
 - General Purpose v2
- NOT available in Premium Storage Accounts
- Available today in 100 TB increments
- One-Year / Three-Year
- <https://azure.microsoft.com/en-us/pricing/reserved-capacity/>



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Demo: Azure Storage Accounts

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Lab 4: Configure Azure Storage

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Module 5: Azure Virtual Networks

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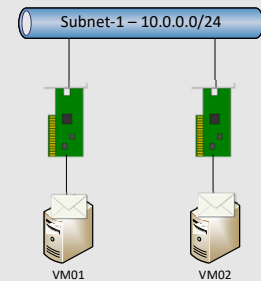
VNets and SubNets



180

What is a virtual network (VNet) ?

- Logical Network Security Boundary
- Address Space
 - Not overlapping Address Ranges
 - Private IP Address space (example 10.0.0.0/16)
 - Only Reachable within the Vnet
- Subnets
 - In an VNet Address Space you can have one or more Subnets
 - Example 10.0.0.0/24 and 10.0.1.0/24 and 10.0.3.0/24
 - By Default no security boundary between Subnets
 - Services in each Subnet can talk to each other



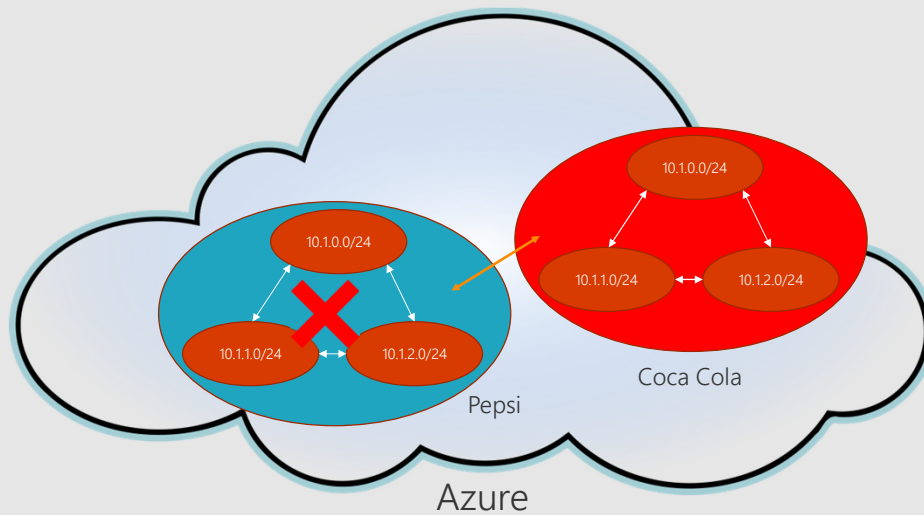
181

VNet considerations

- A Vnet cannot span Azure regions
- Every Vnet is isolated from every other Vnet
- Do not use overlapping network addresses
- Don't waste address spaces
 - 10.0.0.0/8 includes 16 million IP Addresses

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Azure Virtual Networks



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SubNet considerations

- Azure reserves the first four Addresses
- Azure reserves the last Address
- Example : 10.1.0.0/24
 - Reserved : 10.1.0.0 / 10.1.0.1 / 10.1.0.2 / 10.1.0.3 / 10.1.0.255
- VLANs not Supported
- MultiCast & BroadCast not supported
- You Cannot Reserve IP Addresses
- Do Not Assign Manually IP Addresses in VM's

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IPv4 Address Basics

- An IP address is made up of pieces:
 - For networks: **Network prefix** + **subnet number**
 - For devices: **Network prefix** + **subnet number** + **machine number**
- Division is determined by subnet mask:
 - **255.255.0.0** = **/16**
 - **255.255.255.0** = **/24**
- Network examples:
 - Network address: **10.1.0.0/16**
 - Subnets: **10.1.0.0/24**, **10.1.1.0/24**, **10.1.2.0/24**
- Machine examples:
 - **10.1.0.4**, **10.1.0.5**, **10.1.0.6**, **10.1.0.7**, ...

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Possible Address Spaces for VNets

- Azure VNets can only use private IP address spaces
 - 192.168.X.X
 - 172.16.X.X
 - 10.X.X.X
- Carve those spaces into:
 - Multiple VNets: each with a network address
 - Multiple subnets per VNet: each with a network address
- We'll get to Internet addresses & routing later

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Azure Public IP Address SKUs

Basic

The original public IP address
 Static or dynamic allocation
 Assigned to any public IP-addressable resource
 Can be assigned to a specific availability zone
 Not zone redundant

Standard

Different price point
 Static allocation only
 Assigned to vNICs or Standard Internet-facing load balancers
 Zone redundant by default



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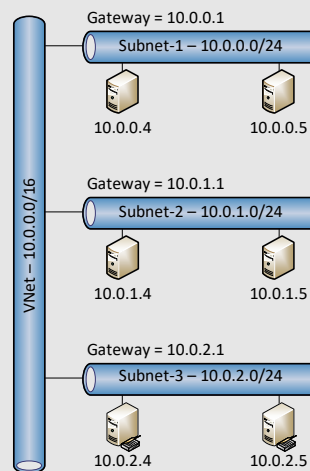
DNS

- Specify your own DNS Server (On-Prem or in Azure)
 - Or
- Azure Provided Name Resolution
- If you have multiple VNet's interconnected, you need to have your own DNS Server

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VNet and Subnet Example

- Simple example VNET:
 - Network address: 10.0.0.0/16
- Divide the IP space into 3 subnets:
 - Subnet-1: 10.0.0.0/24
 - Subnet-2: 10.0.1.0/24
 - Subnet-3: 10.0.2.0/24
- Each subnet routes to other subnets in VNet via default gateway
 - 10.0.0.1, 10.0.1.1, 10.0.2.1
- Addresses available to VMs
 - 10.0.0.4 – 10.0.0.254
 - 10.0.1.4 – 10.0.1.254
 - 10.0.2.4 – 10.0.2.254



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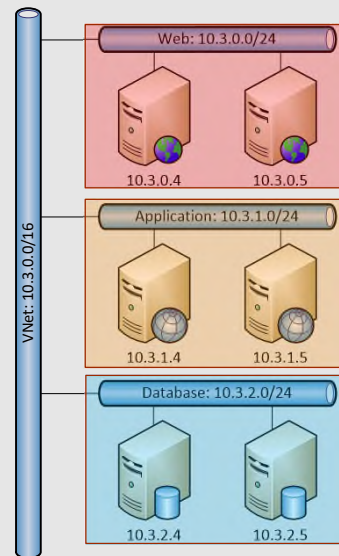
Virtual network capabilities

- IP address allocation:
 - Dynamic (default) — support for static IP address assignments
- Traffic routing:
 - User defined routes and forced tunneling
- Traffic filtering:
 - Network Security Groups

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Why Create Subnets?

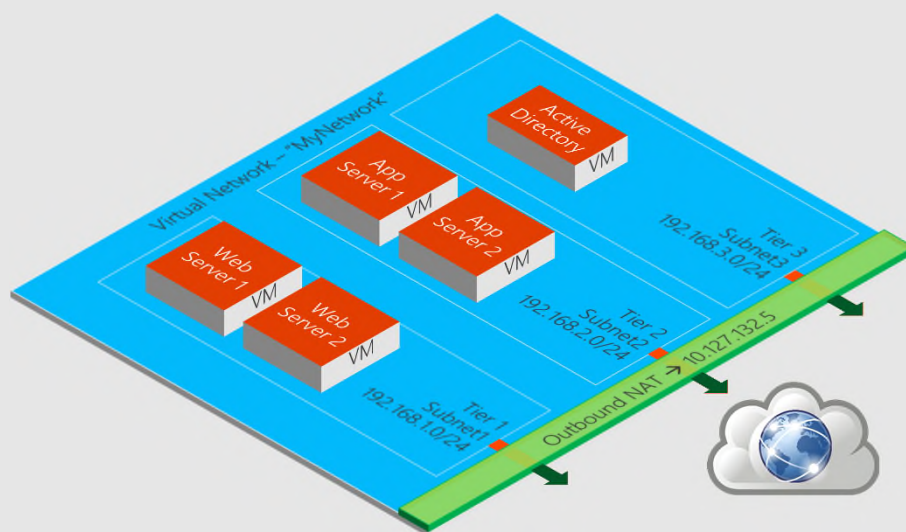
- Old theory:
 - Manage broadcast domains
- In Azure:
 - Create security boundaries within a VNet
 - Different security policies for each subnet



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Access to the Internet



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Network Security Groups



193

Distributed Layer-4 Firewall Rules

- You don't need to deploy a firewall appliance for simple protocol/port firewall rules
- Create policies
- Called Network Security Groups (NSGs)

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What is an NSG?

- A set of prioritised stateful inbound rules
- A set of prioritised stateful outbound rules
- Each rule blocks or allows based on:
 - Source address/location
 - Destination address/location
 - Source protocol (TCP/UDP/*)
 - Destination protocol (TCP/UDP/*)
 - Source port (range)
 - Destination port (range)
 - Direction (in/out)
 - Priority (to have general/granular rules)
 - Low number = high priority

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Default Rules in a New Network Security Group

Inbound security rules					
Petri-Subnet1NSG					
<div> <div>+</div> <div>Default rules</div> </div>					
Search inbound security rules					
PRIORITY	NAME	SOURCE	DESTINATION	SERVICE	ACTION
65000	AllowVnetInBound	VirtualNetwork	VirtualNetwork	Custom (ANY/Any)	Allow ...
65001	AllowAzureLoadBalancerInBound	AzureLoadBalancer	Any	Custom (ANY/Any)	Allow ...
65500	DenyAllInBound	Any	Any	Custom (ANY/Any)	Deny ...

Outbound security rules					
Petri-Subnet1NSG					
<div> <div>+</div> <div>Default rules</div> </div>					
Search outbound security rules					
PRIORITY	NAME	SOURCE	DESTINATION	SERVICE	ACTION
65000	AllowVnetOutBound	VirtualNetwork	VirtualNetwork	Custom (ANY/Any)	Allow ...
65001	AllowInternetOutBound	Any	Internet	Custom (ANY/Any)	Allow ...
65500	DenyAllOutBound	Any	Any	Custom (ANY/Any)	Deny ...

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Possible Scopes of an Network Security Groups

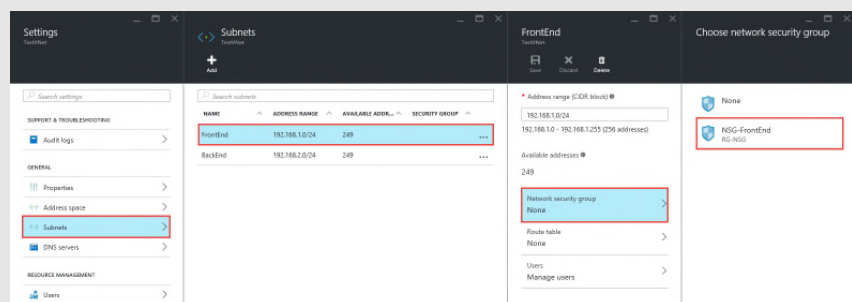
- You have two options
- Assign NSG to each Virtual NIC
 - Not recommended!
 - Too many NSGs and too complex to troubleshoot
- Assign NSG to subnet
 - Recommended by Microsoft!
 - Create set of rules in single NSG for a subnet
 - Deploy 1 subnet for every security policy in a VNet
 - VM picks up policy when joining a subnet
- You can reuse NSGs
 - Might not be a good idea!
 - Subnet specialisations could get too complex

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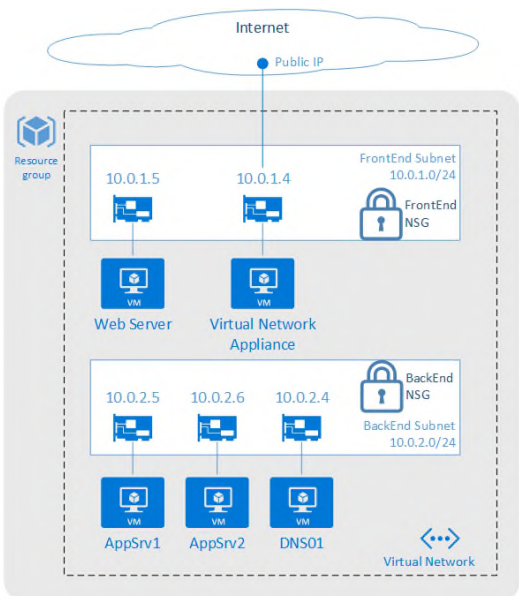
Assign Network Security Group

- Select the Vnet
- Select Subnets
- Select the Subnet
- Click Network Security Group
- Assign your NSG



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Network Security Groups



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Network Security Group Service Tags

- VirtualNetwork
- AzureLoadBalancer
- Internet
- AzureCloud
- AzureTrafficManager
- Storage
- Sql
- AzureActiveDirectory

AllowVNetInBound						
Priority	Source	Source ports	Destination	Destination ports	Protocol	Access
65000	VirtualNetwork	0-65535	VirtualNetwork	0-65535	All	Allow
AllowAzureLoadBalancerInBound						
Priority	Source	Source ports	Destination	Destination ports	Protocol	Access
65001	AzureLoadBalancer	0-65535	0.0.0.0/0	0-65535	All	Allow

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Create Virtual Network

Create virtual network

* Name
robinsvnet ✓

* Address space ⓘ
10.0.0.0/16
10.0.0.0 - 10.0.255.255 (65536 addresses)

* Subnet name
RobinsSubnet1 ✓

* Subnet address range ⓘ
10.0.0.0/24
10.0.0.0 - 10.0.0.255 (256 addresses)

* Subscription
Azure Free Trial ▼

* Resource group ⓘ
☐ Create new ☒ Use existing
RobinBookRG ▼

* Location
West US ▼

☒ Pin to dashboard

Create

201

Leave Guest OS of the VM with DHCP Config

Internet Protocol Version 4 (TCP/IPv4) Properties

General

You can get IP addresses and DNS server addresses from your network administrator. This capability is supported by the network administrator.

DANGER

☒ Obtain an IP address automatically

☐ Use the following IP address:

IP address:

Subnet mask:

Default gateway:

☒ Obtain DNS server address automatically

☐ Use the following DNS server addresses:

Preferred DNS server:

Alternative DNS server:

☐ Validate settings upon exit

Advanced...

OK Cancel

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Testing Bandwidth, Throughput, Latency



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Bandwidth/Throughput Testing

- Recommended Tool : NTttTCP
- Throughput Benchmark Tool from Microsoft
- <https://docs.microsoft.com/en-us/azure/virtual-network/virtual-network-bandwidth-testing>
- <https://github.com/microsoft/ntttcp/releases/download/v5.35/NTttcp.exe>

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Test VM Network Latency

- Measure Network Latency
- Exclude other types of latency (Application Latency)
- <https://docs.microsoft.com/en-us/azure/virtual-network/virtual-network-test-latency>
- <https://github.com/microsoft/latte/releases/download/v0/latte.exe>









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Network Connections to a VNet



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Virtual network connectivity

Cloud		Customer	Segment and workloads
	Internet Connectivity		<ul style="list-style-type: none"> • Consumers • Access over public IP • DNS resolution • Connect from anywhere
	Secure point-to-site connectivity		<ul style="list-style-type: none"> • Developers • POC Efforts • Small scale deployments • Connect from anywhere
	Secure site-to-site VPN connectivity		<ul style="list-style-type: none"> • SMB, Enterprises • Connect to Azure compute
	ExpressRoute private connectivity		<ul style="list-style-type: none"> • SMB & Enterprises • Mission critical workloads • Backup/DR, media, HPC • Connect to Microsoft services

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Public Inbound Access From The Internet

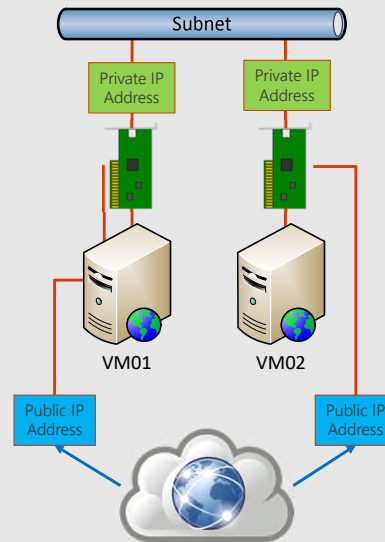
- Option 1: Per-VM Public IP (PIP) Address
 - Not recommended!
 - Each VM has a direct connection from the Internet
- Option 2: Load Balancer
 - Recommended
 - The load balancer is the single entry point to the VNet from the Internet

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Per VM Public IP (PIP) Address

- You can have 1 public IP address per VM
 - Assigned to the vNIC
- Address assigned by Azure
- Not advisable!
 - Too much management
 - Adds cost (even if it's small)
 - Impossible to do load balancing, etc
 - Only option for Basic A-Series VMs

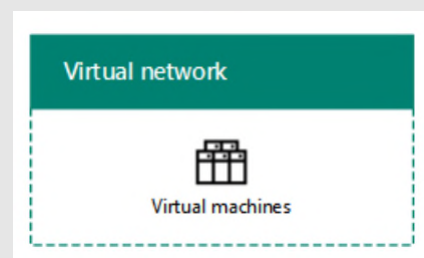


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Cloud-Only VNet

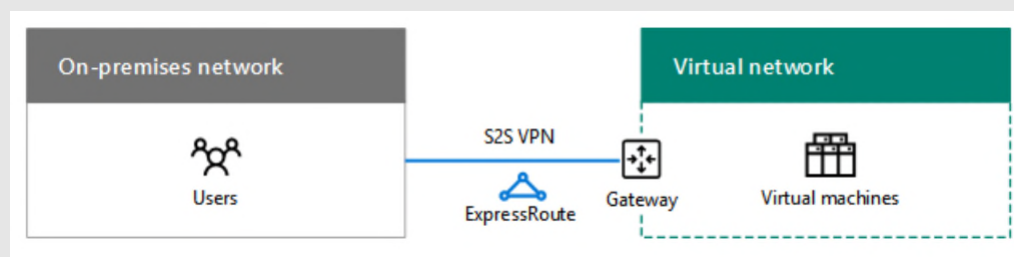
- no connection to an on-premises network



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Cross-Premises Network

- site-to-site (S2S)
 - Or
- ExpressRoute
- Azure Gateway



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Azure VPN Gateway



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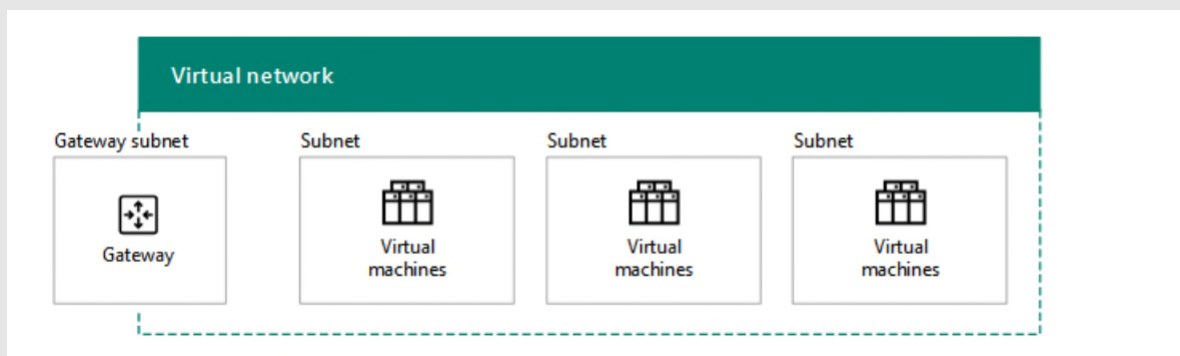
Azure VPN Gateway

- Used to allow private connections
 - From an outside source
 - To an Azure VNet
- Max of 1 gateway per VNet
 - Deployed into small (/29) dedicated subnet

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Azure VPN Gateway and Multiple Subnets

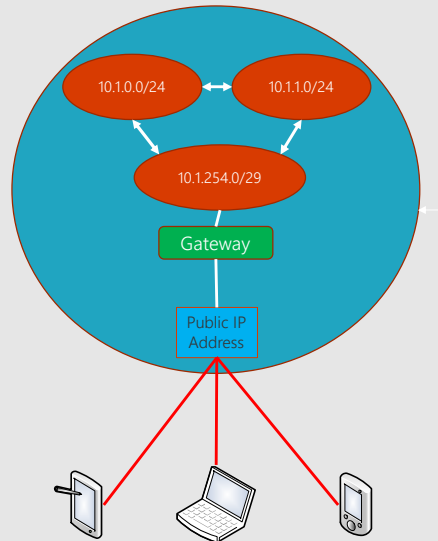
- Subnet for Front-End Servers
- Subnet for Back-End Servers
- DMZ



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Point-to-Site VPN

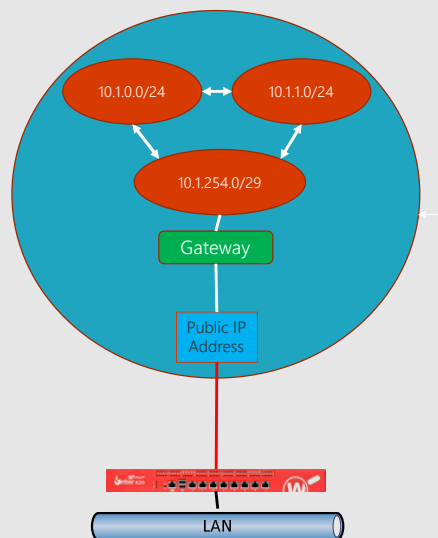
- A user creates a VPN connection to a VNet from their device
- Private & secure tunnel over the Internet
- Managed on a per-user basis
- Management/access is not scalable
- Intended for "administrators" as a back door



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Site-to-Site (S2S) VPN

- VPN connection to a VNet from an external network
- Private & secure tunnel over the Internet
- Pros:
 - Low cost
 - Fast deployment
 - Central management
 - Perfect for small/medium enterprise (SME)
- Cons
 - Only supports connections to VNets
 - Microsoft cannot give SLA for the Internet
 - Not a WAN solution



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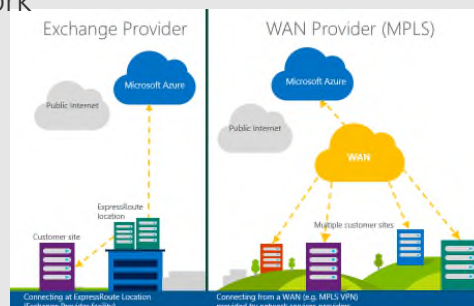
Azure VPN Gateway Specifications

VPN GATEWAY TYPE	PRICE	BANDWIDTH	S2S TUNNELS	P2S TUNNELS
Basic	€0.04/hour	100 Mbps	Max 10 1-10: Included	Max 128 1-128: Included
VpnGw1	€0.1603/hour	650 Mbps	Max 30 1-10: Included 11-30: €0.013/hour per tunnel	Max 128 1-128: Included
VpnGw2	€0.4133/hour	1 Gbps	Max 30 1-10: Included 11-30: €0.013/hour per tunnel	Max 128 1-128: Included
VpnGw3	€1.0542/hour	1.25 Gbps	Max 30 1-10: Included 11-30: €0.013/hour per tunnel	Max 128 1-128: Included

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ExpressRoute

- Private WAN Connection
- Pros:
 - SLA on network connection
 - Physically private network
 - All Azure services
 - Complex routing
- Cons:
 - Limited ISP availability
 - Quite expensive



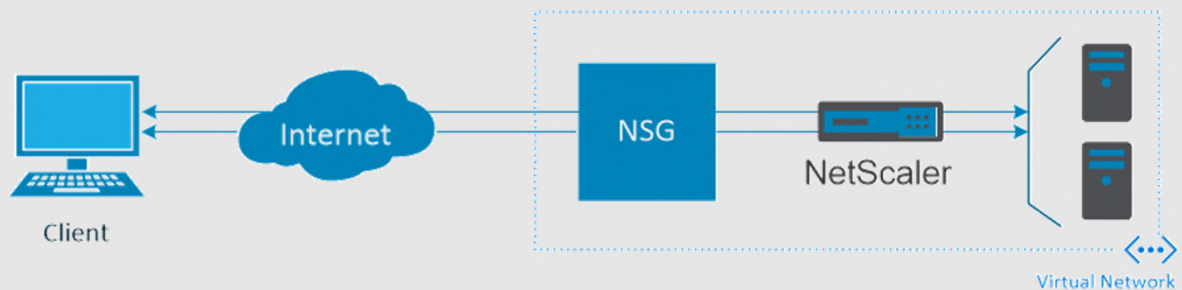
218

Network Virtual Appliances



219

NetScaler Virtual Appliance on Azure



220

SonicWall on Azure

- Coming Soon ...

221

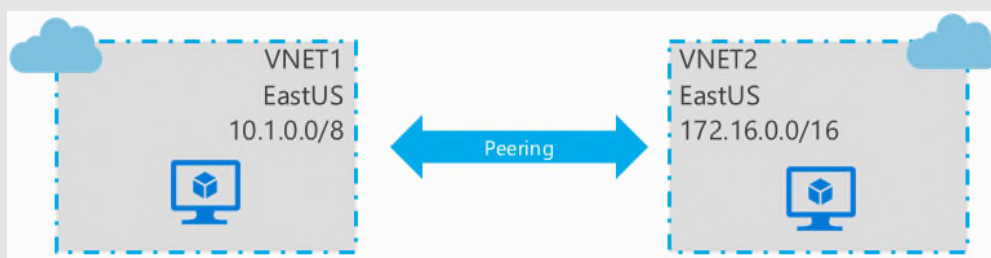
Connecting VNets



222

Connecting Two Vnet's (same Region)

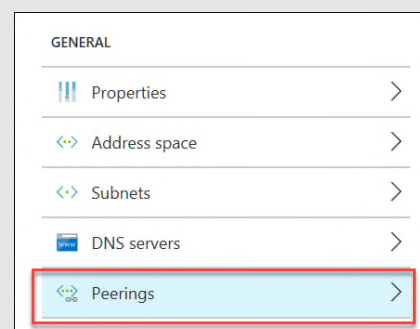
- Same Region
- Use VNet Peering



223

VNET Peering

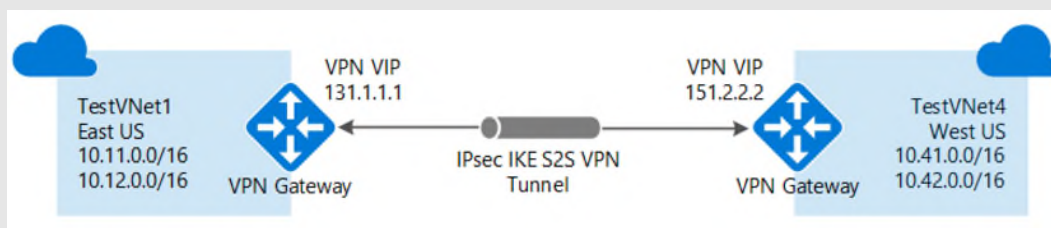
- Low-latency, high-bandwidth connection between VNETs
- Connect two VNETs in the same region
- Utilizes the Azure Backbone network
- No Encryption as traffic is isolated and on the MS backbone
- VNET address spaces cannot overlap
- VNET peering is between 2 VNETs
- VNETs can be in different subscriptions



224

Connecting Two VNet's (different Region)

- When the Region is different
- Two times a VPN Gateway Needed

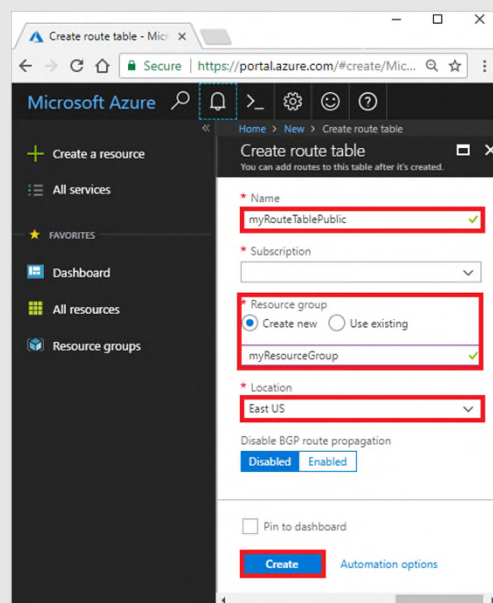


225

User-Defined Routing : Route Table

- Table of Customized Routes
- Assigned to a Subnet

<https://docs.microsoft.com/en-us/azure/virtual-network/tutorial-create-route-table-portal>



226

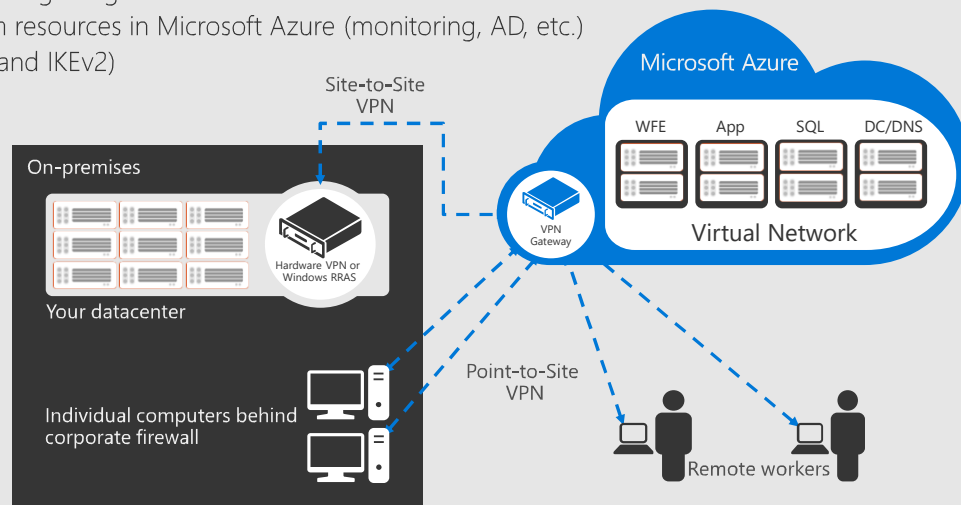
Comparing Hybrid Options

CAPABILITIES ↑		Bandwidth	Security	Management	Workloads
	ExpressRoute	10 Mbps – 10 Gbps Committed Bandwidth	Private isolated network between provider and Azure. Control over routing and traffic.	Configure once, simple to add new virtual networks	Enterprise Connectivity Mission Critical Disaster Recovery Hybrid Applications
	Site-to-Site	~80 Mbps – ~200Mbps No performance commitment	Encrypted tunnel over the Internet	Configuration of IPSEC VPN device for each Virtual Network Created	Hybrid Applications Dev/Test Secure Management
	Point-to-Site	~80 Mbps – ~200Mbps No performance commitment	Encrypted tunnel over the Internet	Configuration with each individual client machine.	Dev/Test Secure Management

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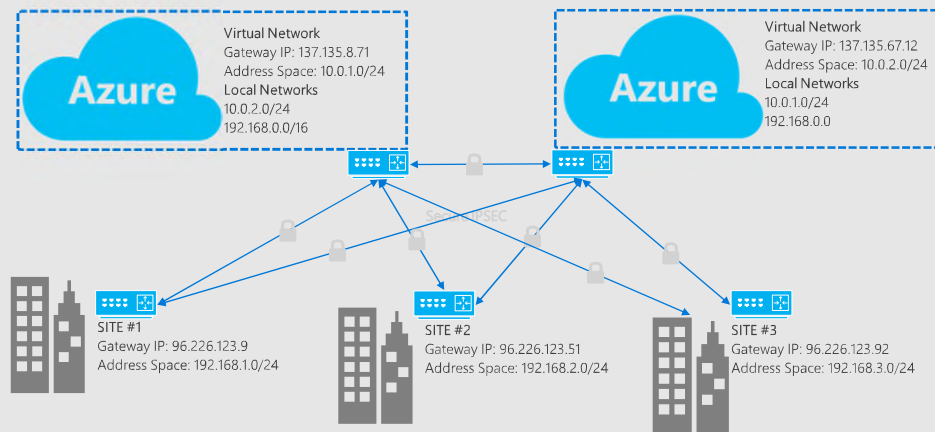
Site-to-Site Virtual Network

- Extend on-premises to the cloud securely (IPSec)
- On-ramp for migrating services to the cloud
- Use on-prem resources in Microsoft Azure (monitoring, AD, etc.)
- IPSec (IKEv1 and IKEv2)



228

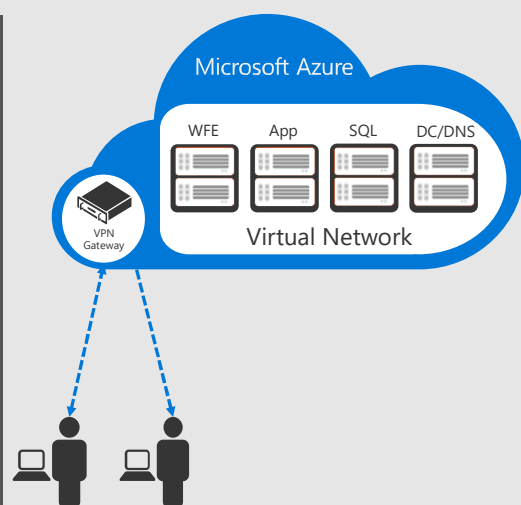
Multi-Site Virtual Networks



229

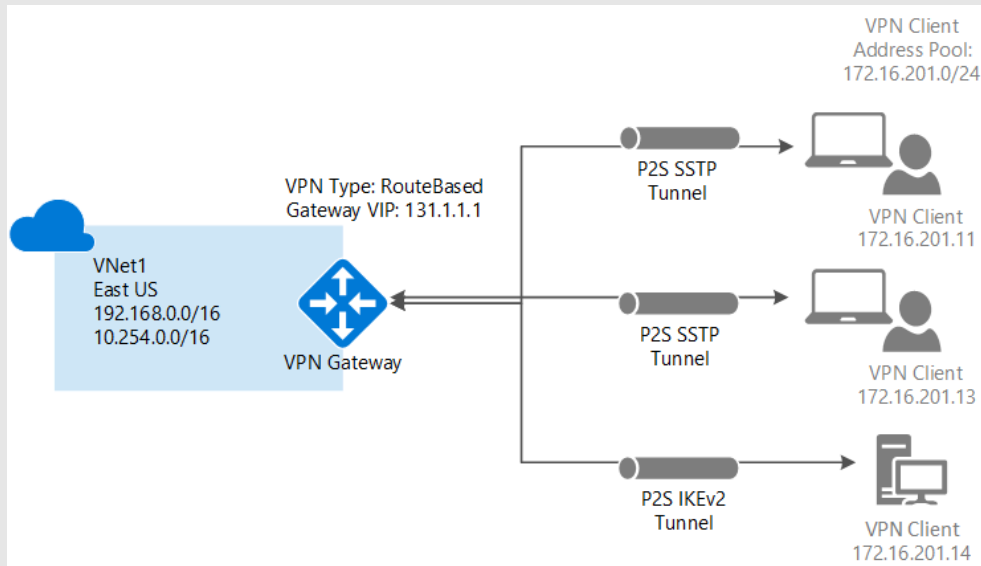
Virtual Networks & P2S Connectivity

- Connect from anywhere securely
- Secure Sockets Tunneling Protocol (SSTP)
- Ideal for secure management, prototyping, development, & demos
- P2S and S2S coexist on the same gateway (must be dynamic)



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Point-to-Site Virtual Network Gateway Config



231

Networking : What you need to know

- you cannot add a new NIC that is connected to a subnet that is in a different VNet

232

Demo: Azure Networking

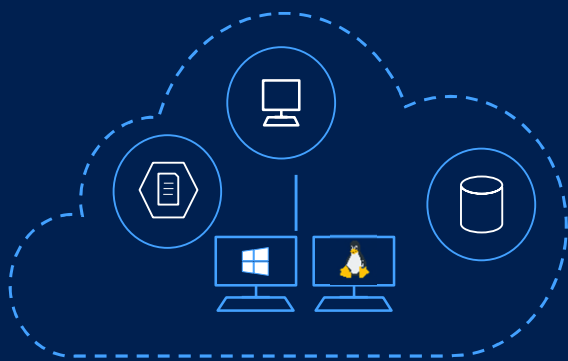
233

Lab 5: Microsoft Azure Networking

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Module 6: Azure Backup

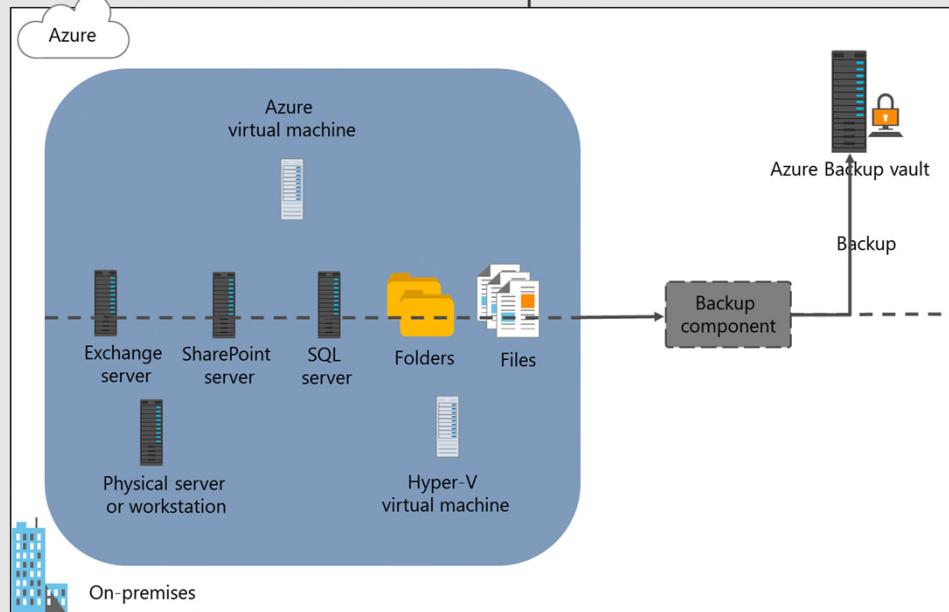
235



Protecting Azure Resources

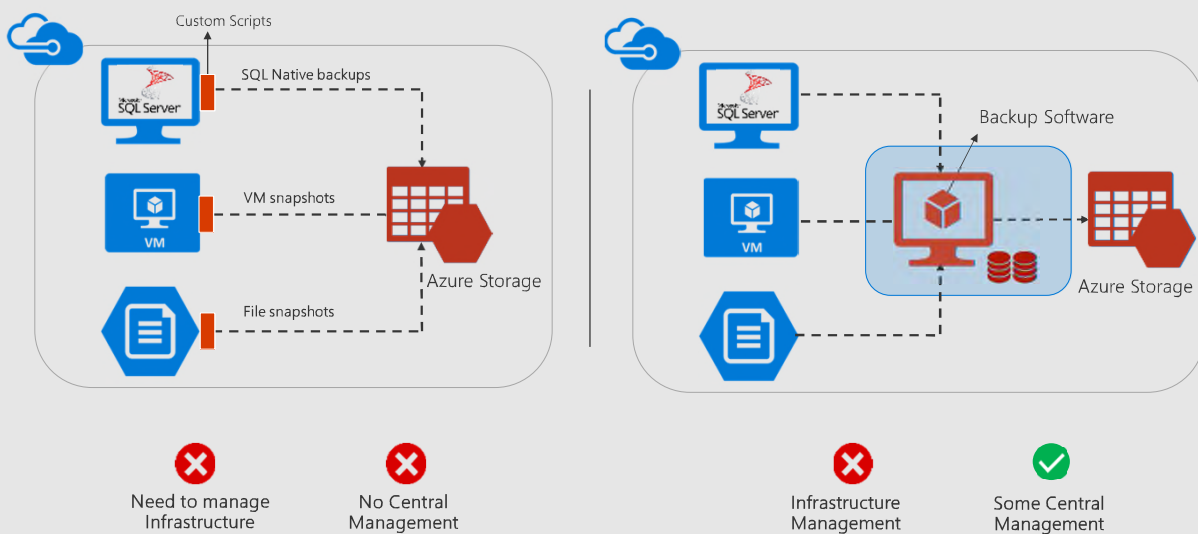
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Overview of Azure Backup



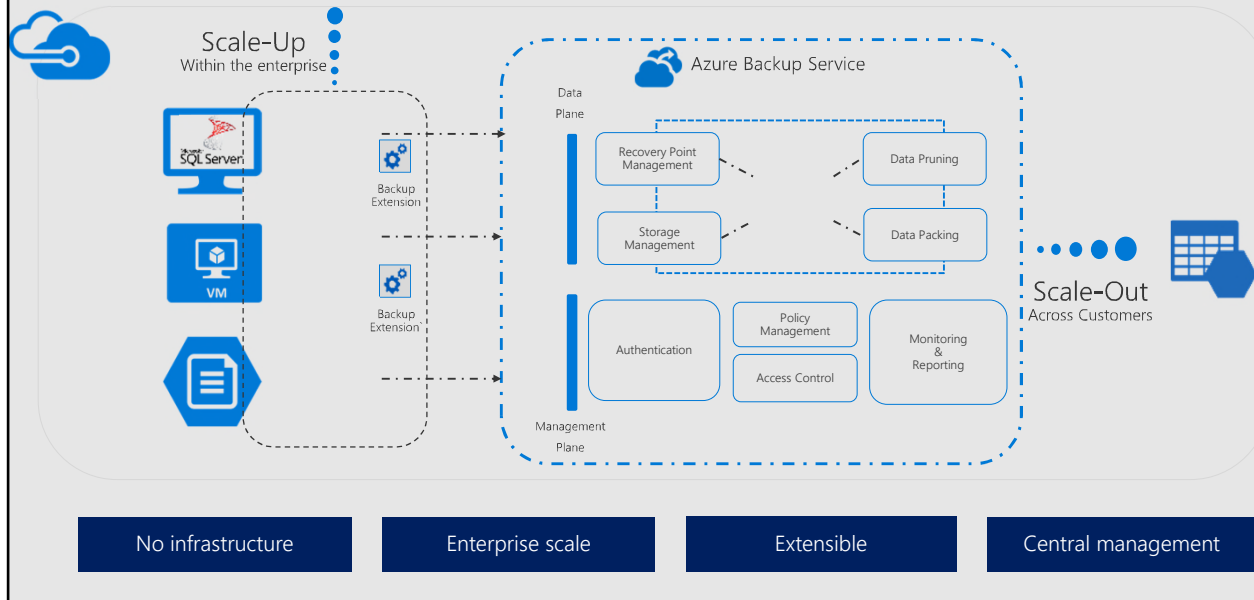
237

Conventional backup approaches



238

Azure Backup – Architecture matters



239

Azure Backup Components

- **Recovery Services Vault**
- **Azure Recovery Services Agent (MARS)**
- **Azure Backup Server (MABS)**

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What can you Backup ?

- **On-premises Files/Folders using MARS agent**
- **On-premises VMs using DPM or MABS Server**
- **Azure VMs using MARS agent**
- **Azure Managed Disks**
- **Azure File shares**
- **SQL Server in Azure VMs**
- **SAP HANA database in Azure VMs**
- **Azure Database for postgreSQL**
- **Azure Blobs**

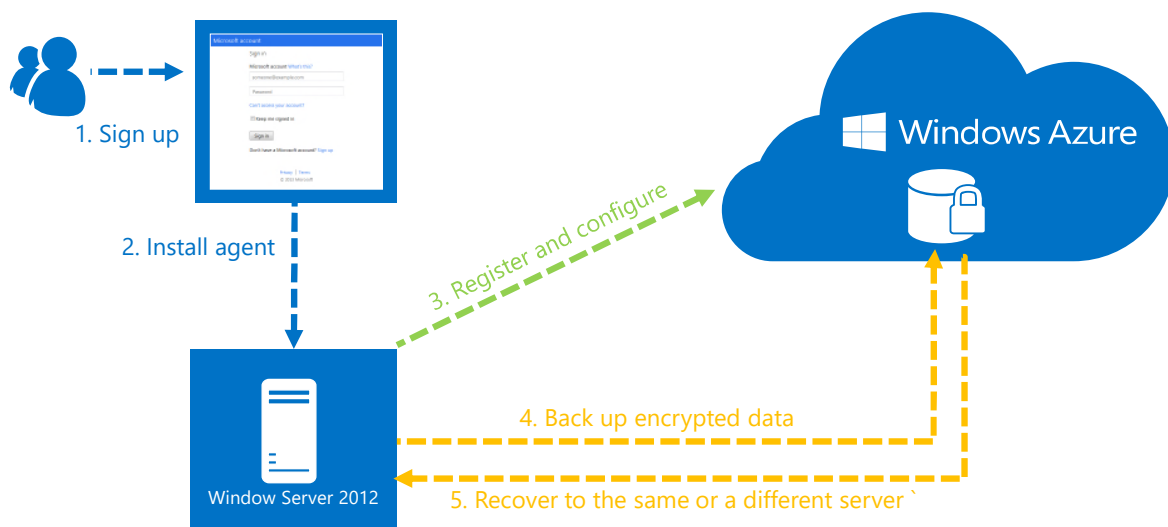
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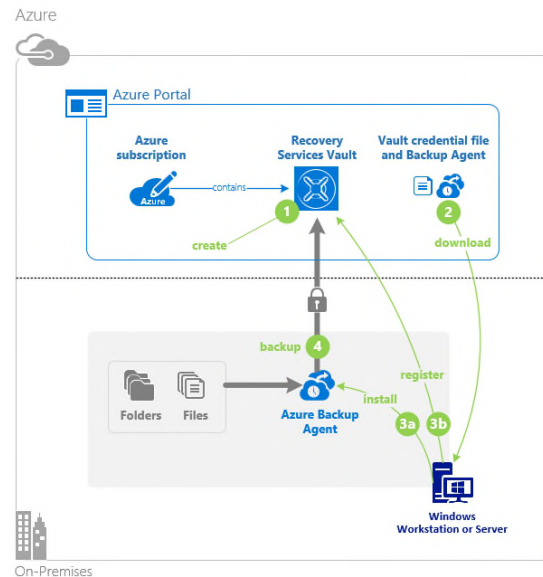
241

How Windows Azure Backup works



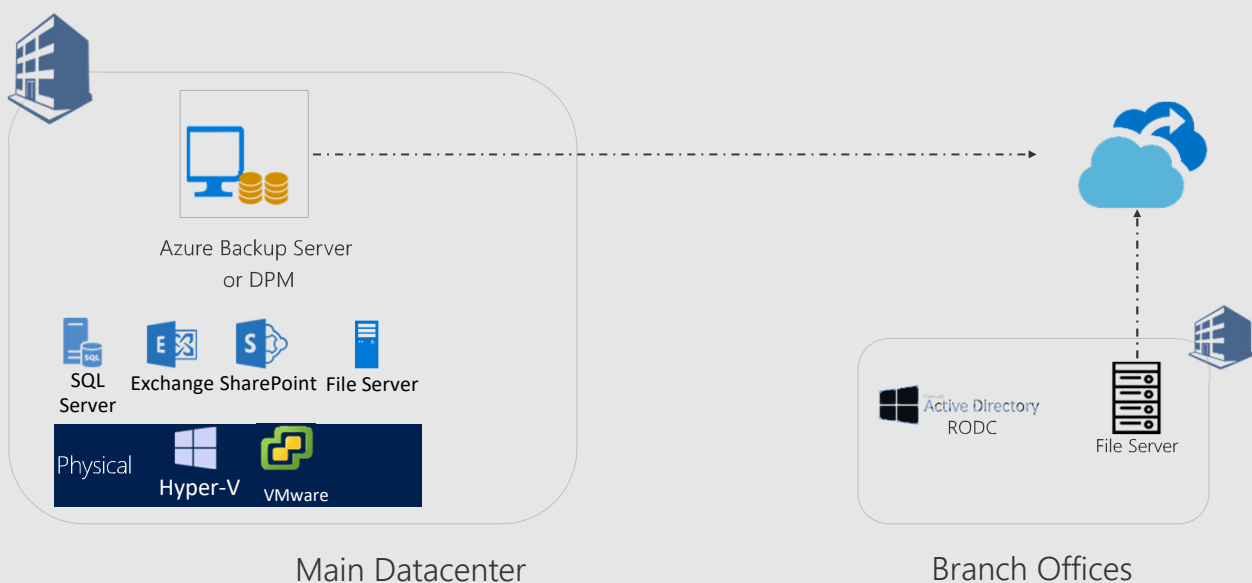
242

Backup Windows Files and Folders (On-Premises)



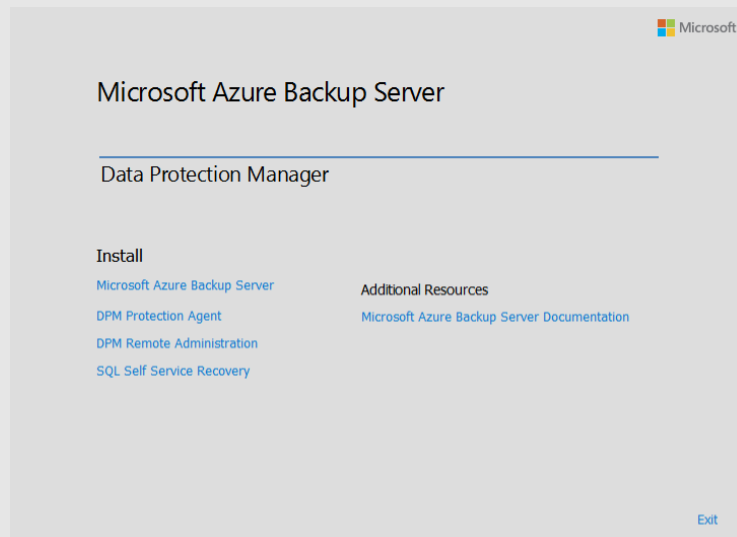
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Azure Backup Server (Hybrid Model)



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Azure Backup Server Installation v3



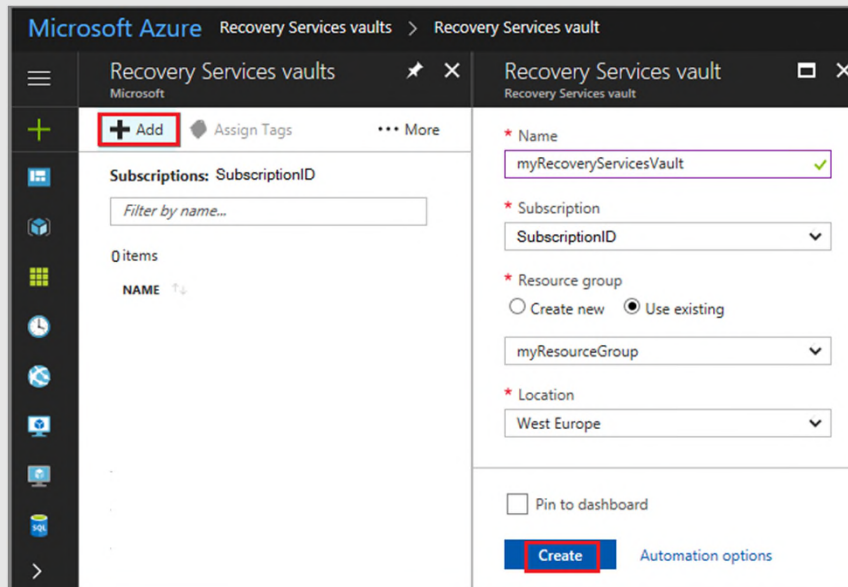
245

How to Setup Azure Backup



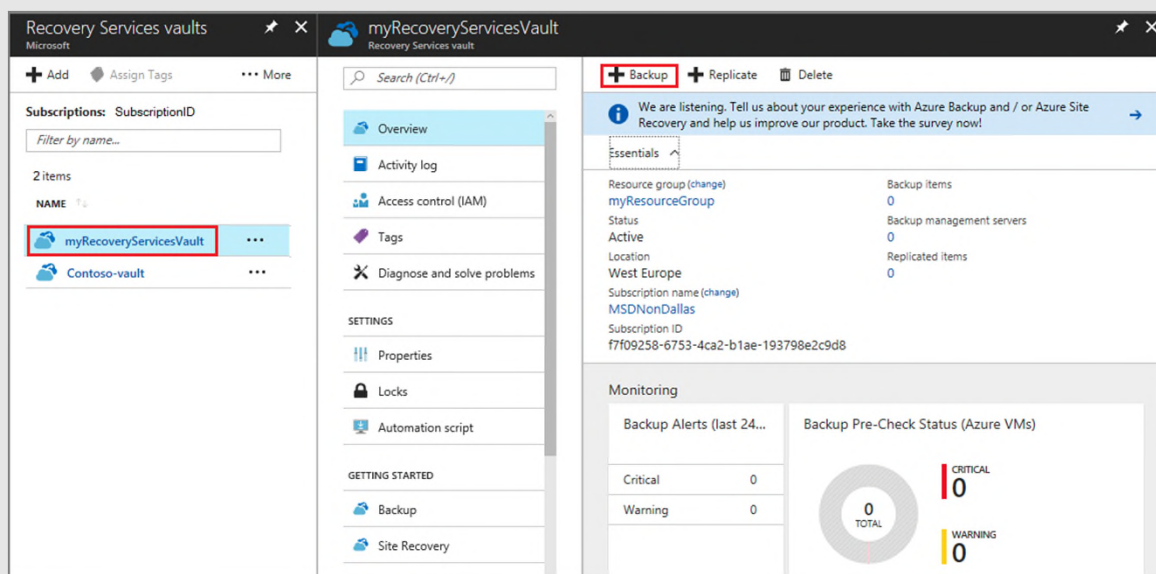
246

1. Create Recovery Services Vault



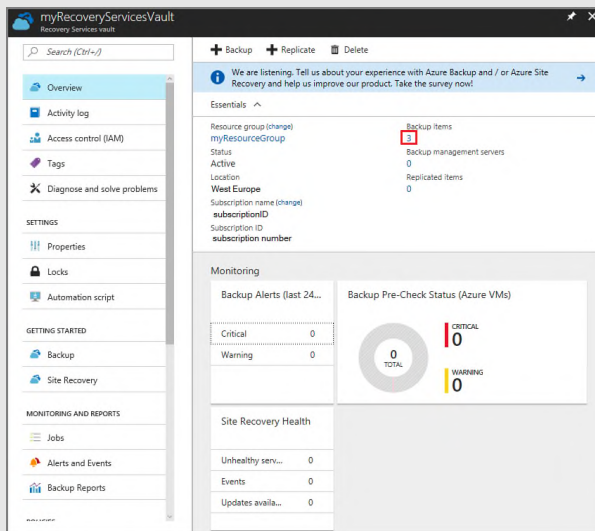
247

2. Create a Backup Policy



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3. Start your Initial Backup



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Delete Recovery Services Vault

- Delete All Backup Jobs first
- Delete RSV

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Resources

- Azure Backup's Cloud-First Approach
- <https://azure.microsoft.com/blog/azure-backup-cloud-first-architecture/>
- Azure Backup blogs
- <http://blog.azure.com/tag/azure-backup/>
- Azure Backup videos
- <https://channel9.msdn.com/Series/Azure-Backup>
- Azure Backup landing page
- <http://azure.microsoft.com/en-us/services/backup/>
- Feedback (UserVoice)
- <https://feedback.azure.com/forums/258995-azure-backup-and-scdpm/>

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Demo: Azure Backup

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Lab 6: Microsoft Azure Backup

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Veeam and Azure



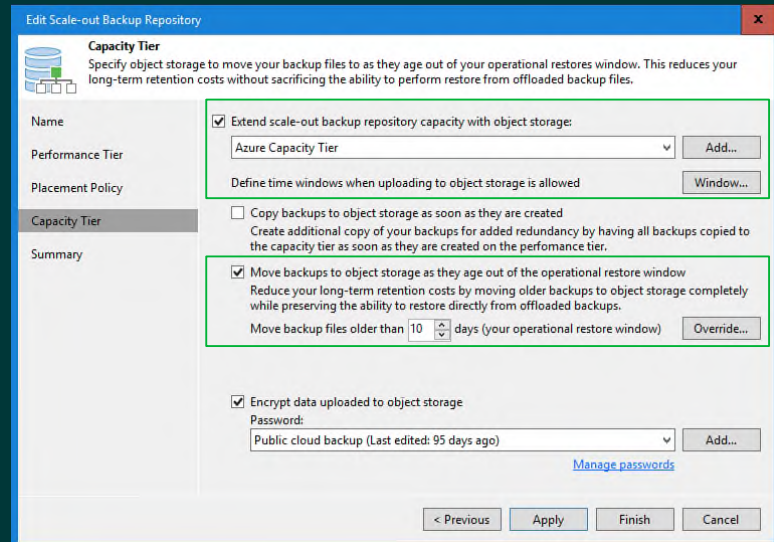
254

Veeam Object Storage Repository

Repository intended for long-term data storage in Azure Cloud

Object Storage Repository can be used for

- Scale-out backup repository as Capacity Tier
- Scale-out backup repository as Archive Tier

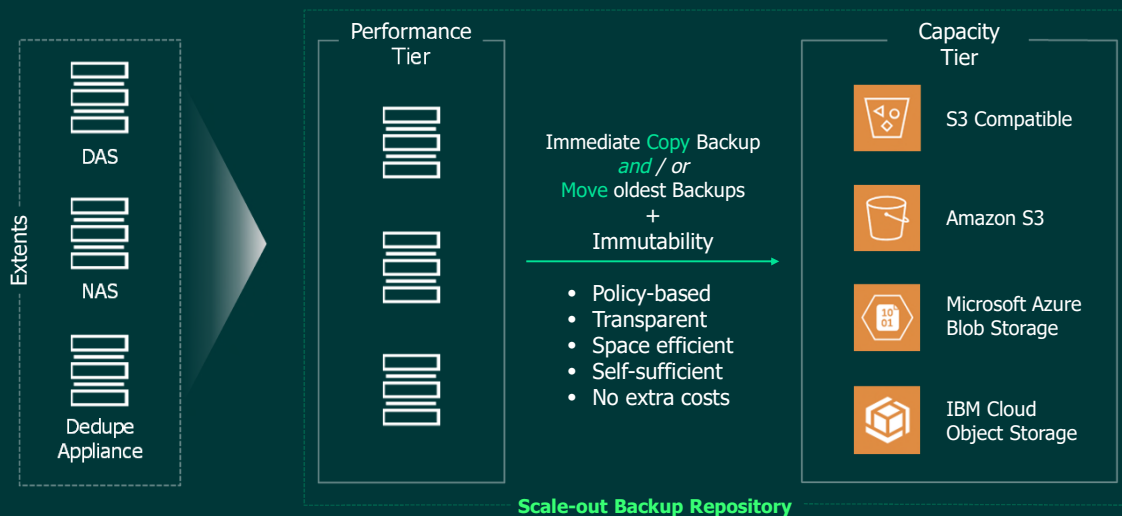


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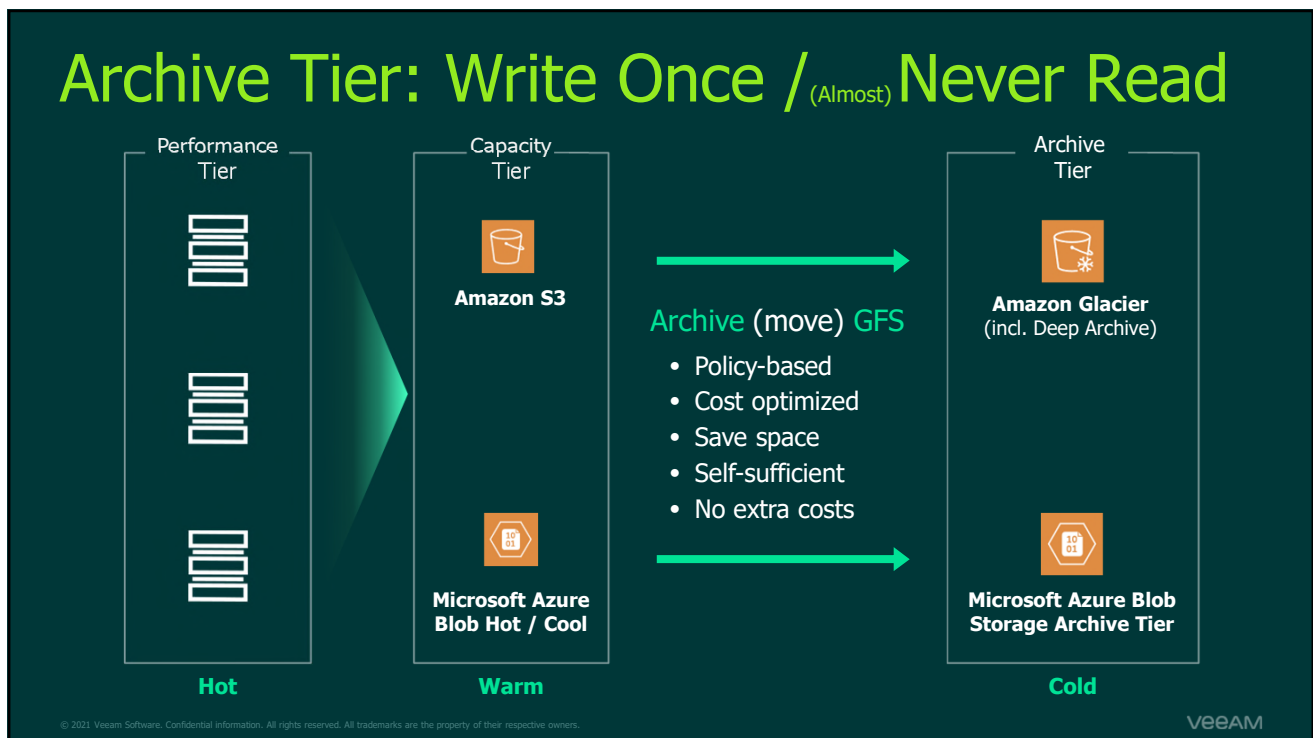
SOBR - Capacity Tier



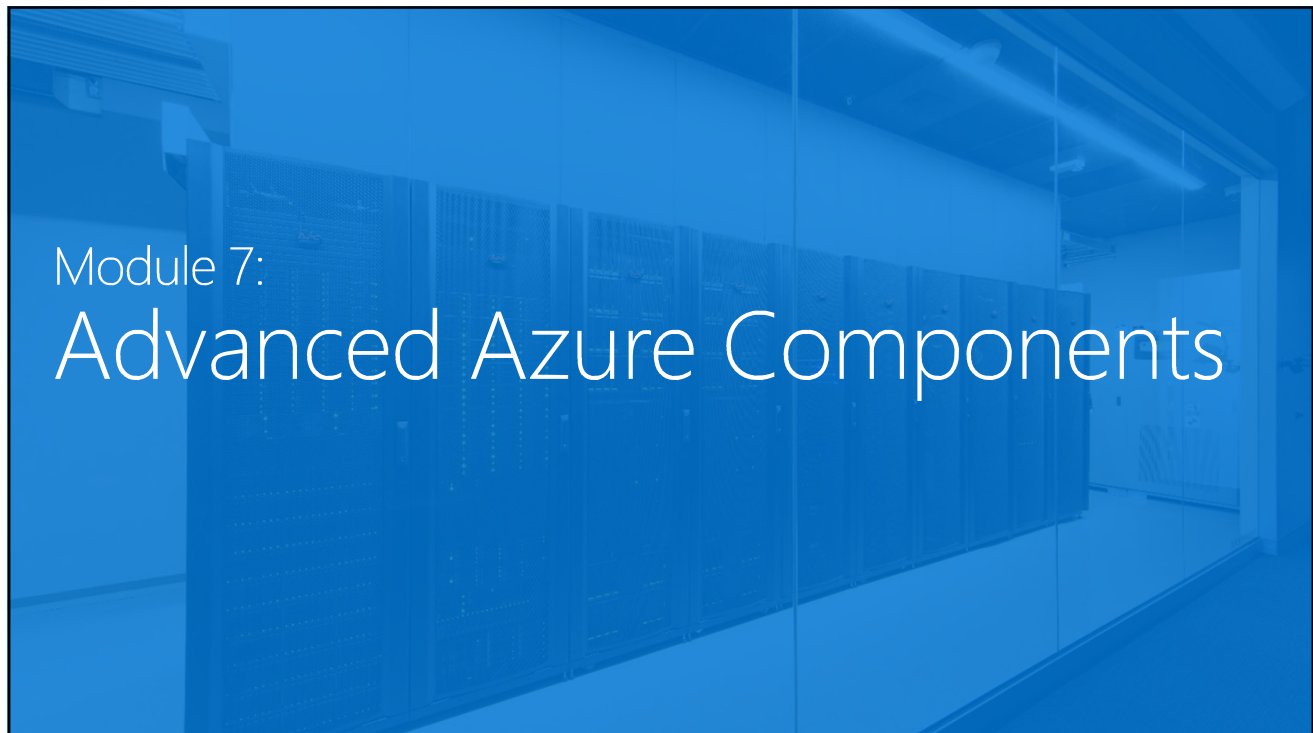
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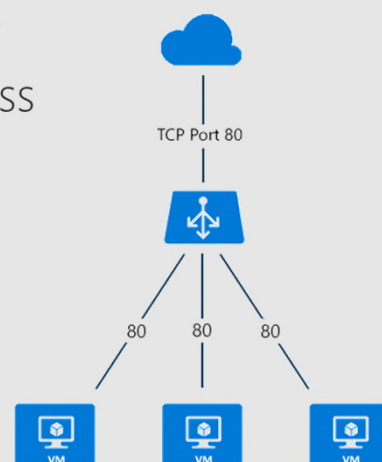
Azure Load Balancer



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Public Load Balancer

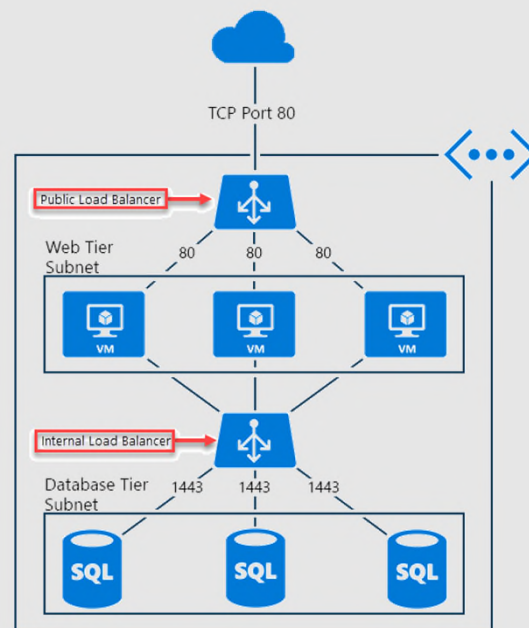
- Public IP Address and Port Number
- Incoming Traffic to Private IP Address



260

Internal Load Balancer

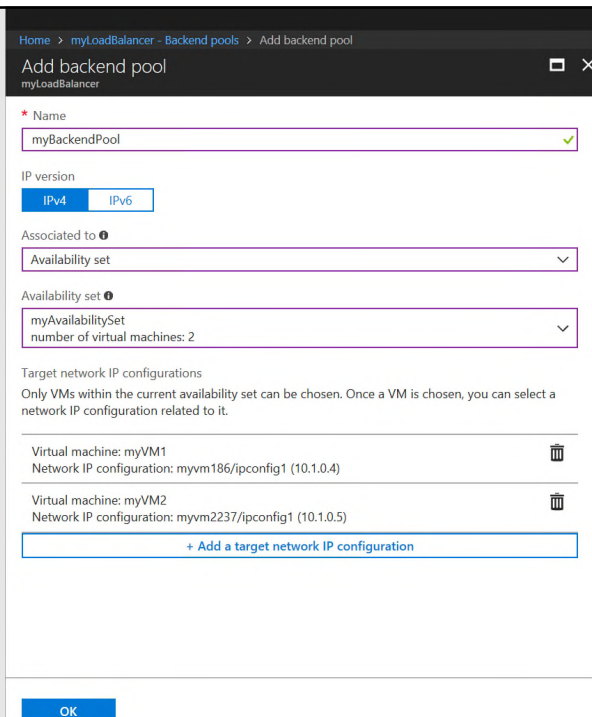
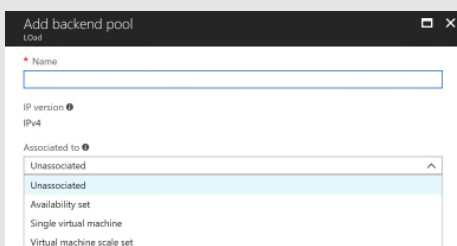
- Inside a Virtual Network



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Backend Pool

- Distribute Traffic to IP Addresses of Machines in an Availability Set



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Health Probe

- Monitor the Status of your Application Service
- Add/Remove Dynamically VMs from the Load Balancer
- Health Checks

Home > myLoadBalancer - Health probes > Add health probe

Add health probe
myLoadBalancer

* Name
myHealthProbe ✓

IP version
IPv4

Protocol
HTTP TCP

* Port
80

* Path ⓘ
Healthprobe.aspx ✓

* Interval ⓘ
15 seconds ✓

* Unhealthy threshold ⓘ
2 consecutive failures

OK

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Load Balancing Rule

- Define how traffic is distributed to the VMs
- Assign Backend Pool
- Assign Health Probe
- Define Persistency
- Load Balancing License based on number of Rules

Home > myLoadBalancer - Load balancing rules > Add load balancing rule

Add load balancing rule
myLoadBalancer

* Name
myHTTPRule

* IP Version
☒ IPv4 ☐ IPv6

* Frontend IP address ⓘ
LoadBalancerFrontEnd

Protocol
☒ TCP ☐ UDP

* Port
80

* Backend port ⓘ
80

Backend pool ⓘ
myBackendPool (2 virtual machines)

Health probe ⓘ
myHealthProbe (HTTP:80/Healthprobe.aspx)

Session persistence ⓘ
None

Idle timeout (minutes) ⓘ
4

Floating IP (direct server return) ⓘ
Disabled Enabled

OK

<https://docs.microsoft.com/en-us/azure/load-balancer/load-balancer-get-started-internet-portal>

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Azure Load Balancer SKU's

	Standard SKU	Basic SKU
Backend Pool Size	Up to 1000 instances	Up to 100 instances
Health Probe	TCP, HTTP, HTTPS	TCP, HTTP
Backend Pool	Any VM	VMs in Availability Set
Pricing	Based on LB Rules	No Charge

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Azure Traffic Manager



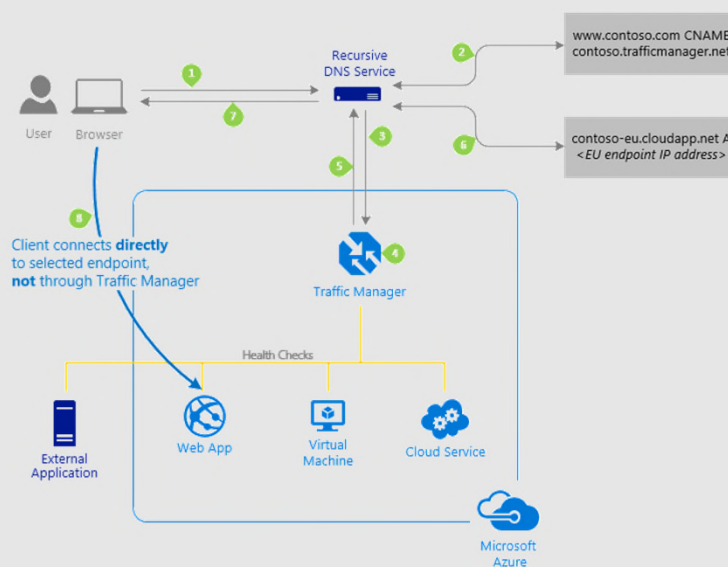
266

Azure Traffic Manager

- Second Load Balancing Solution
- Distribute User Traffic in different Regions
- Using DNS to Direct Client Request to the most appropriate Service

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Azure Traffic Manager





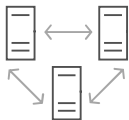
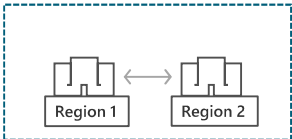
268

Availability Set



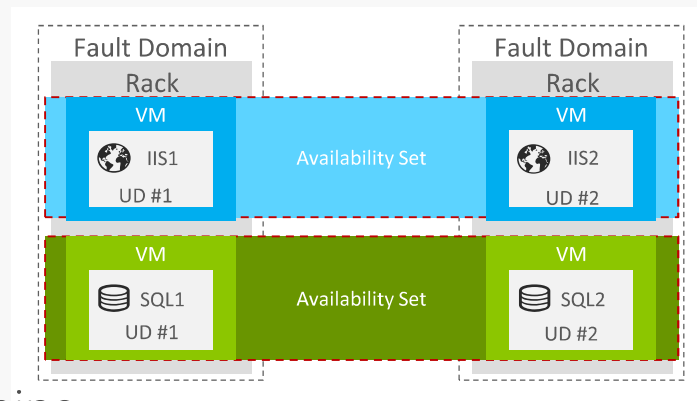
269

High availability options

Industry-only	High availability SLA		Disaster recovery
VM SLA 99.9%	VM SLA 99.95%	VM SLA 99.99%	Regions 54
			
Single VM Protection with Premium Storage	Availability sets Protection against failures within datacenters	Availability zones Protection from entire datacenter failures	Region pairs Protection from disaster with Data Residency compliance

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VM Availability Sets

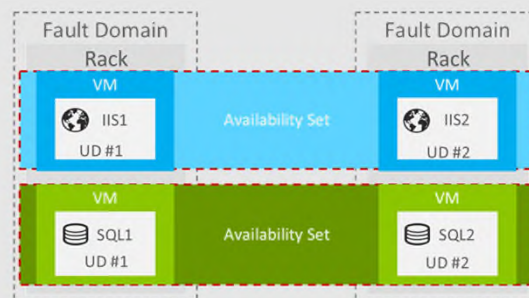


- Fault Domains
- Update Domains

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Fault Domains (FD)

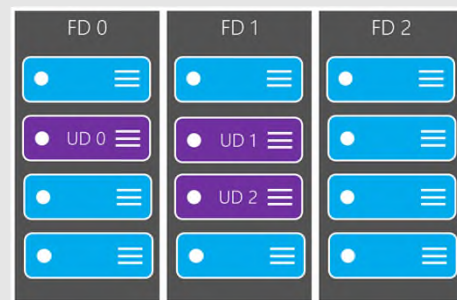
- A space with VMs that share the same subsystems, like :
 - Network Switch or Power Source
- VMs running in an Availability Set are running in different Fault Domains
- Azure guarantees to spread them across Fault Domains



272

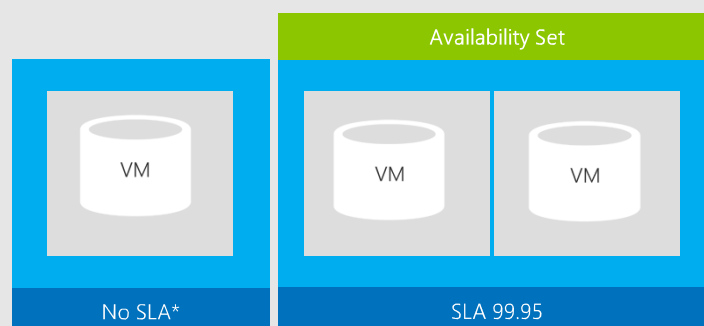
Update Domains

- Updates are Planned Events
- Example : Restart after patched VMs
- Patching is Scheduled in Update Domains
- There are normally 5 different Update Domains



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How Does this Relate to the SLA?



* No guaranteed SLA for single VM instance

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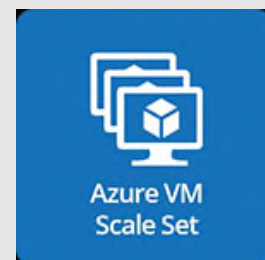
Scale Set (VMSS)



275

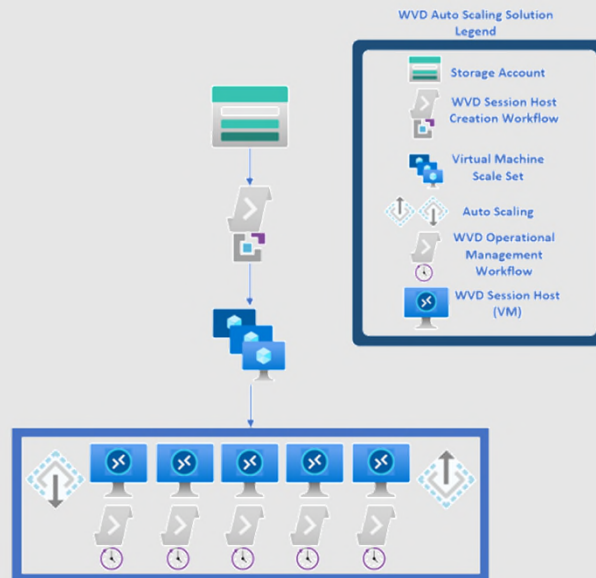
Virtual Machine Scale Set

- Create thousands of identical virtual machines in minutes
- Quickly scale your big compute and big data applications
- Rely on integrated load balancing and auto-scaling
- Run Cassandra, Cloudera, Hadoop, MongoDB and Mesos



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VMSS and Azure Virtual Desktop



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Module 8: Azure Site Recovery (ASR)

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Disaster Recovery Plan

- **After a Disaster :**
 - **How much data do you accept that may be lost ?**
 - **How much downtime do you accept ?**

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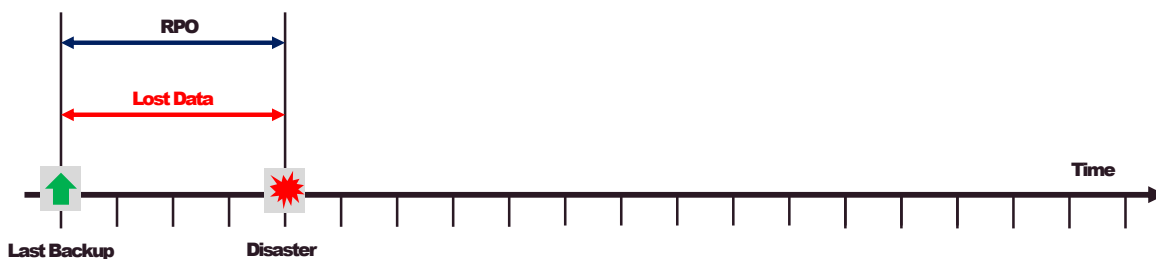
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Recovery Point Objective (RPO)

- **RPO :**
 - **Maximum tolerable amount of data loss measured in time**
 - **For Azure Backup usually 1 DAY**
 - **For Azure Site Recovery as low as 30 seconds till 5 minutes**
 - **Azure Site Recovery oldest recovery point : 72 hours**



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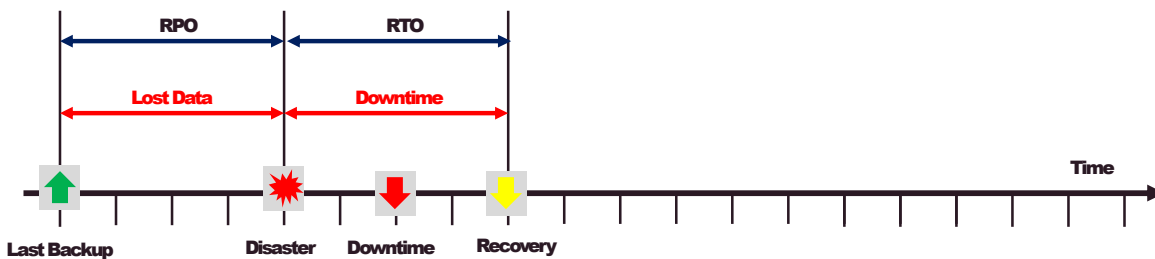
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Recovery Time Objective (RTO)

• RTO :

- **maximum tolerable amount of time needed to bring all critical systems back online**
 - For Azure Backup multiple Hours
 - For Azure Site Recovery multiple Minutes



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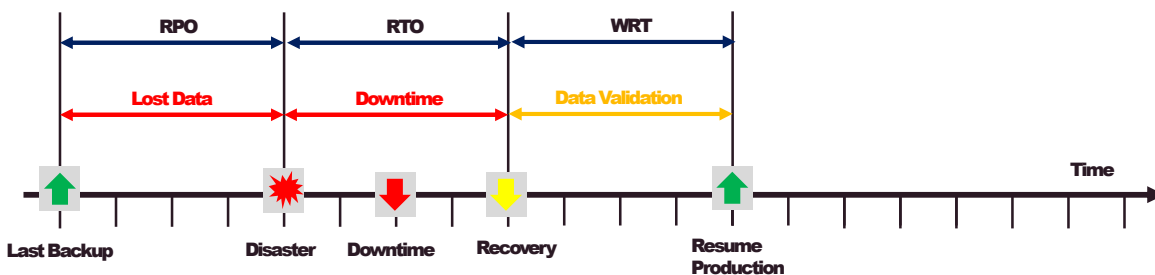
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Work Recovery Time (WRT)

• WRT :

- **Maximum tolerable amount of time to verify the recovered systems and/or data integrity**



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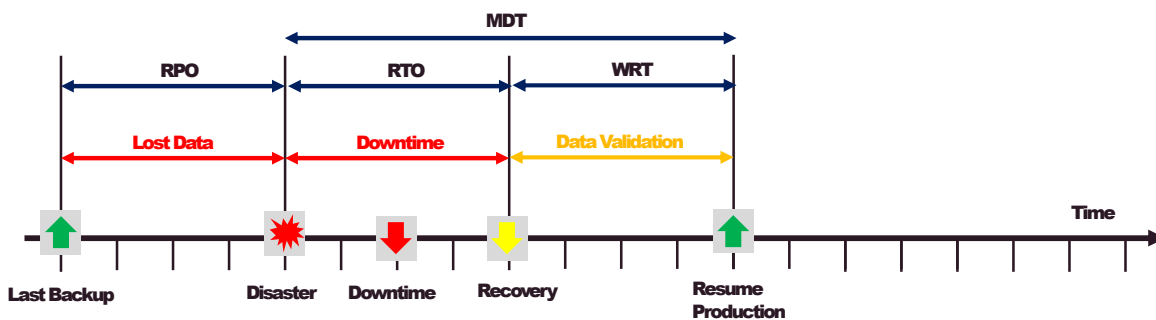
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Maximum Tolerable Downtime (MTD)

• MDT :

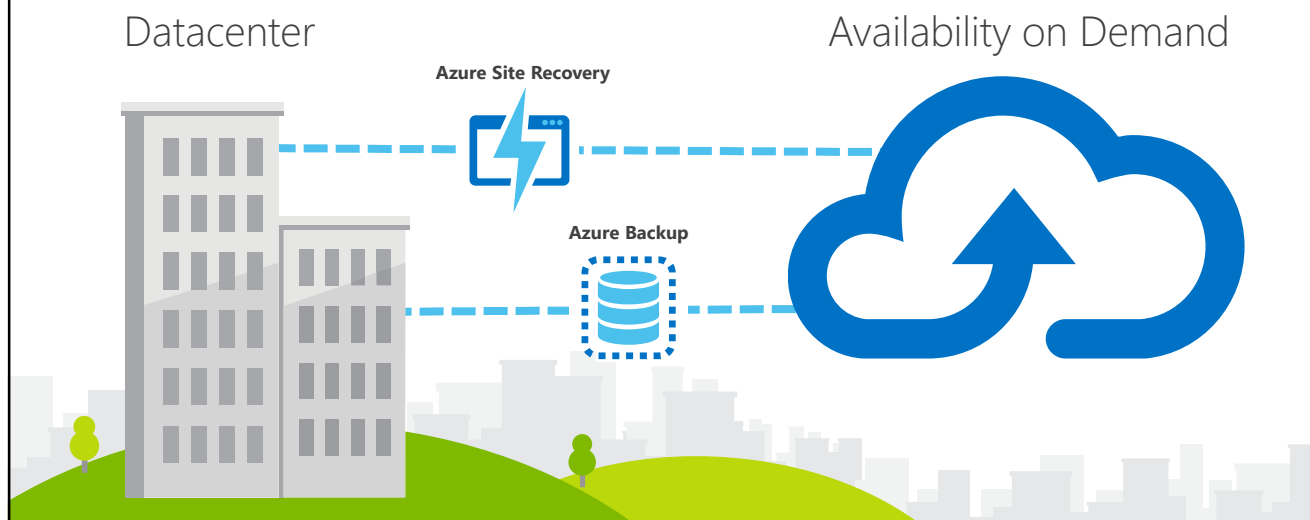
- total amount of time that a business process can be disrupted without causing any unacceptable consequences



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Azure Site Recovery



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Azure Backup + Azure Site Recovery

• Increase the Oldest Recovery Point time

- **Azure Backup : Multiple Years**
- **Azure Site Recovery : 72 Hours**

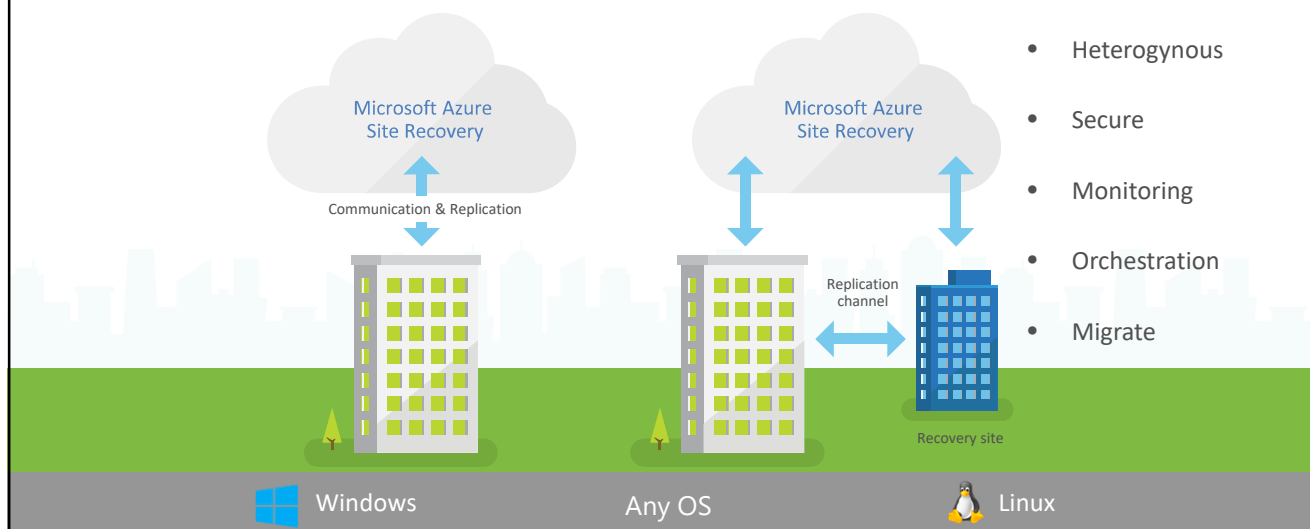
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Replicate: on-prem or Azure
Secure Hyper-V, VMware, and physical servers



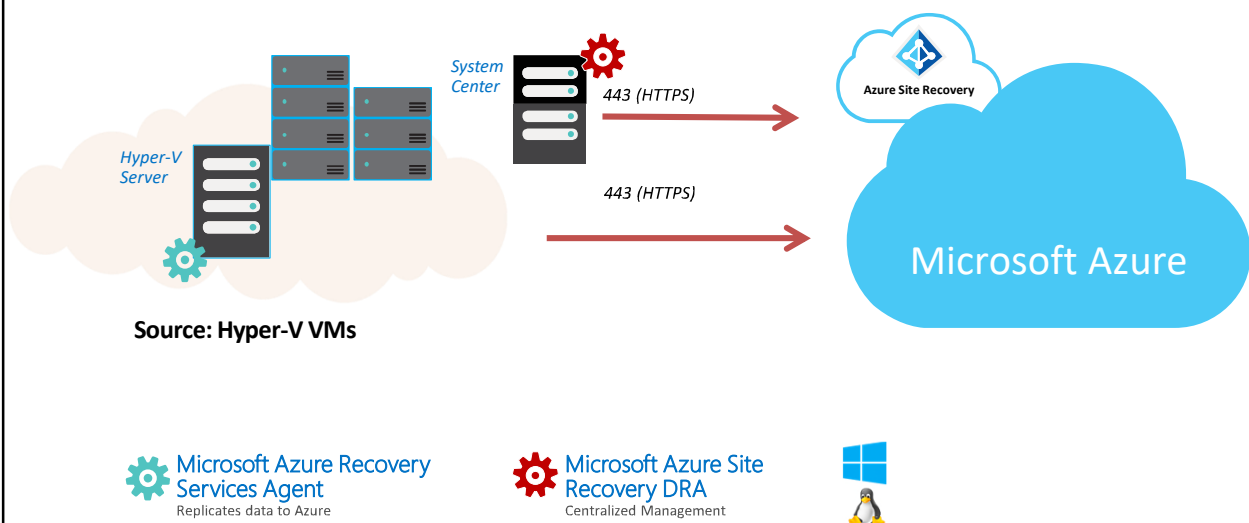
286

Use Cases

Planned failover	Unplanned failover	Testing and staging	Migration
			
<ul style="list-style-type: none"> Execute a failover in a controlled manner for testing or for controlled business need. 	<ul style="list-style-type: none"> Process focused orchestrated disaster recovery. 	<ul style="list-style-type: none"> Mirror production deployments to Azure. Use the DR copy as a testing/staging environment. 	<ul style="list-style-type: none"> Replicate to Azure, validate the deployment, application behaviors, etc. Disconnect from on-premises.

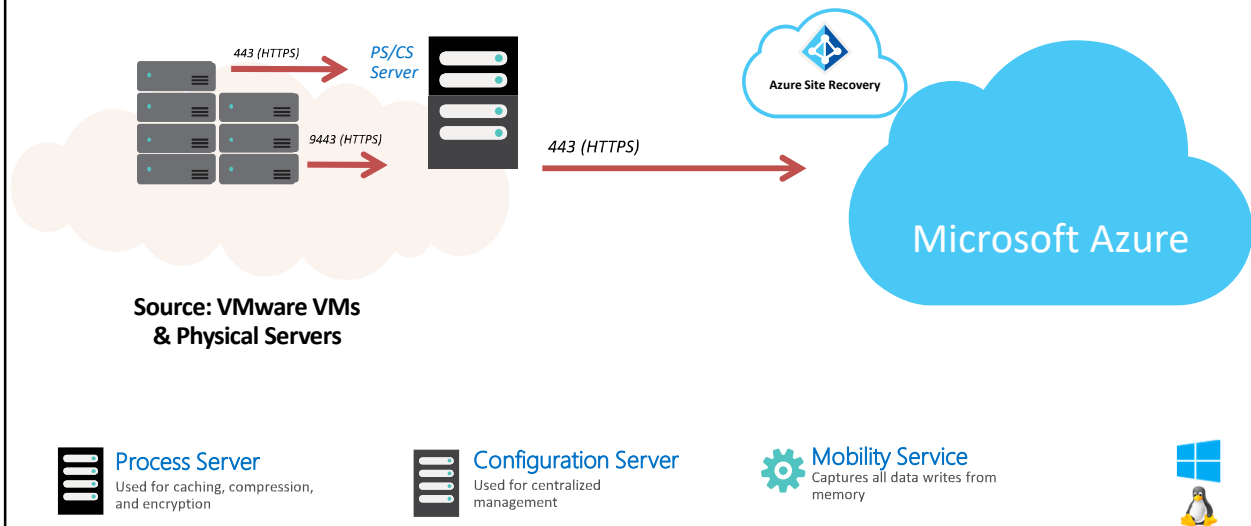
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Hyper-V : No need for VPN or extra Infrastructure



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VMware and Physical Servers Process Server / Configuration Server



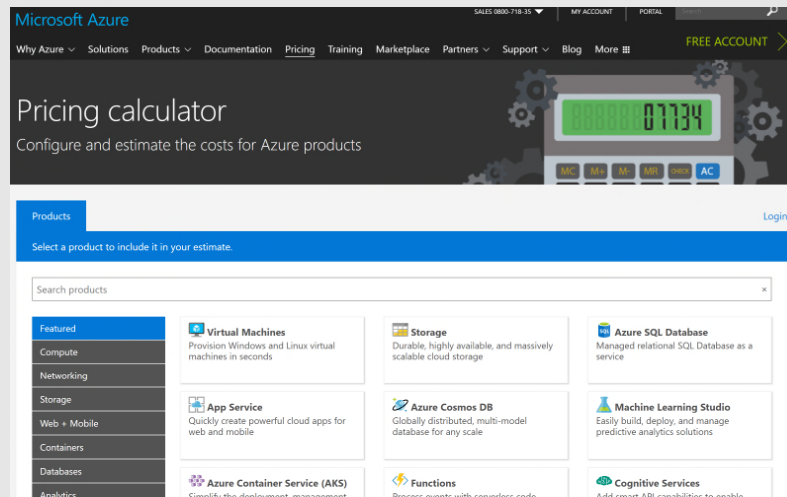
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Module 9: Azure Pricing Calculator

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Azure Pricing Calculator

- <https://azure.microsoft.com/en-us/pricing/calculator/>



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Virtual Machines

- Price calculated per Second
- In the calculator : Price for 730 hours (= 1 Month)
- You do not need keep all VMs Powered On
- Virtual Machine running from :
 - 7h till 23h (5 days a week) = 350 hours
- Don't forget your Data-Disk !
- Outbound Traffic : € 74 per Terabyte
- Prices different per Region

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Storage Account

- Managed or UnManaged
- Block Blob Storage
 - Hot
 - Cool
 - Archive
- Page Blob Storage
- File Storage

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VPN Gateway

- Basic
 - VPN GW1
 - VPN GW2
 - VPN GW3
-
- Price calculated for uptime (Use 730 Hours)

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VPN Gateway (examples)

VPN Gateways

Setting up a virtual network is free of charge. However, we do charge for the VPN gateway that connects to on-premises and other virtual networks in Azure. This charge is based on the amount of time that gateway is provisioned and available.

VPN GATEWAY TYPE	PRICE	BANDWIDTH	S2S TUNNELS	P2S TUNNELS
Basic	~€22.17/month	100 Mbps	Max 10 1-10: Included	Max 128 1-128: Included
VpnGw1	~€116.97/month	650 Mbps	Max 30 1-10: Included 11-30: 60.013/hour per tunnel	Max 128 1-128: Included
VpnGw2	~€301.65/month	1 Gbps	Max 30 1-10: Included 11-30: 60.013/hour per tunnel	Max 128 1-128: Included
VpnGw3	~€769.52/month	1.25 Gbps	Max 30 1-10: Included 11-30: 60.013/hour per tunnel	Max 128 1-128: Included

- VNet-VNet = Free (ONE REGION ONLY)
- VNet-OnPrem = Outbound Traffic
- FAQ : <https://docs.microsoft.com/en-us/azure/vpn-gateway/vpn-gateway-vpn-faq>

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Azure Backup

- Local Redundant Storage
- Geo Redundant Storage

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Log Analytics

- Free : 500 MByte

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Automation

- 500 minutes of Process automation are Free

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Demo: Azure Pricing Calculator

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Lab 9: Microsoft Azure Pricing Calculator

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