

Microsoft Azure Fundamentals Certification and Beyond

Simplified cloud concepts and core Azure fundamentals
for absolute beginners to pass the AZ-900 exam



Steve Miles

Foreword by Peter De Tender, Business Program Manager, Enterprise Skills Initiative (ESI) – Microsoft World Wide Learning (WWL), Azure Technical Trainer



Preface

You can learn more about the update to Microsoft security services at this url:

<https://docs.microsoft.com/en-us/azure/defender-for-cloud/defender-for-cloud-introduction>

To carry out the exercises in this book, you will require the following:

- Access to an internet browser.
- A Microsoft account. If you do not have a Microsoft account, you can create a free account at <https://account.microsoft.com/account>.
- An Azure subscription that has access to create and delete resources in the subscription. If you do not have an Azure subscription, you can create a free Azure account at <https://azure.microsoft.com/free>.
- You can alternatively use the Azure desktop app: <https://portal.azure.com/App/Download>.

Chapter 1

Figures

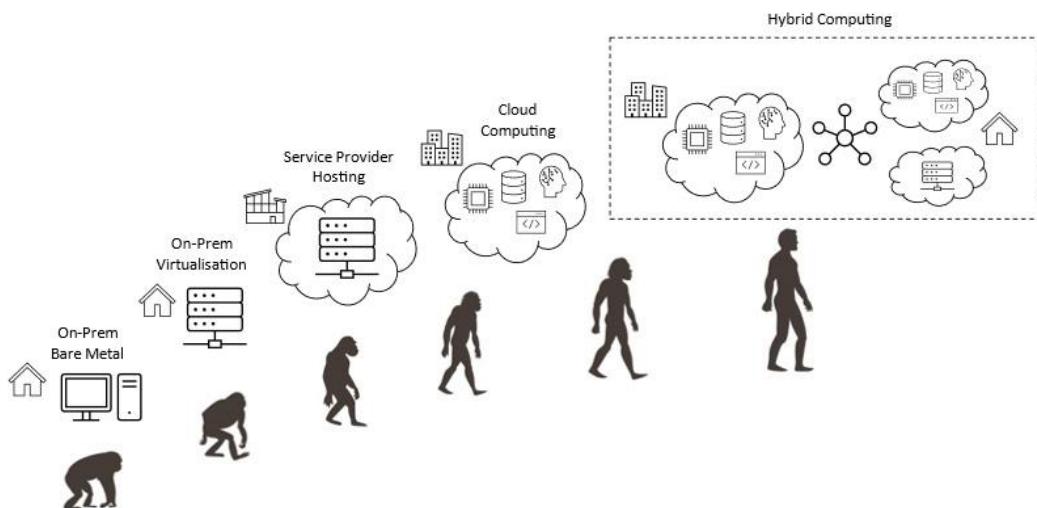


Figure 1.1 – Evolution of cloud computing

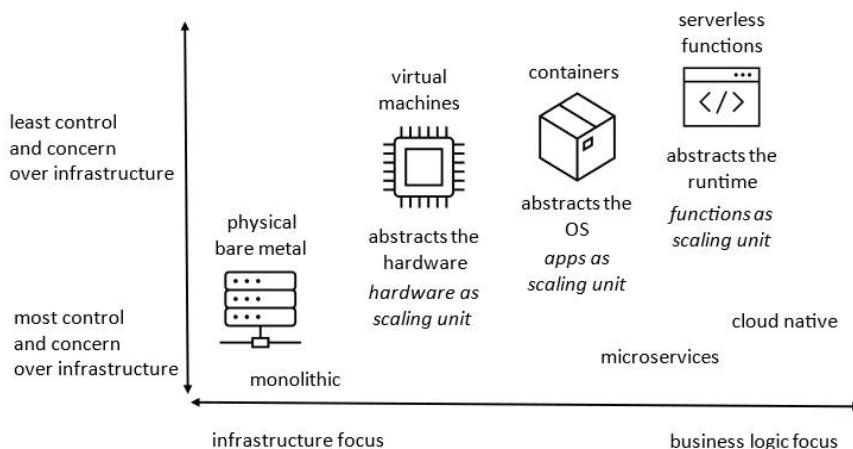


Figure 1.2 – Cloud computing architectures

Responsibility	on-prem	IaaS	PaaS	SaaS	Customer	Microsoft
Information and data	■	■	■	■		
Devices (mobile and PCs)	■	■	■	■		
Accounts and identities	■					
Identity and directory infrastructure	■	■	□	□		
Applications	■	■	□	□		
Network controls	■	■	□	□		
Operating system	■	■	□	□		
Physical hosts	■	□	□	□		
Physical network	■	□	□	□		
Physical data center	■	□	□	□		

Legend: ■ Customer responsibility; □ Microsoft responsibility

Responsibility always retained by customer

Responsibility varies by service type

Responsibility transfers to cloud provider

Figure 1.3 – Shared Responsibility model

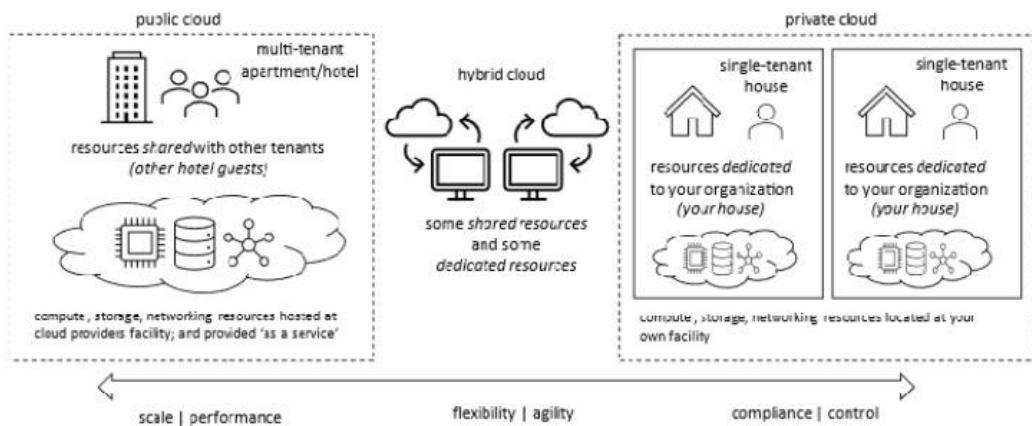


Figure 1.4 – Cloud computing delivery models

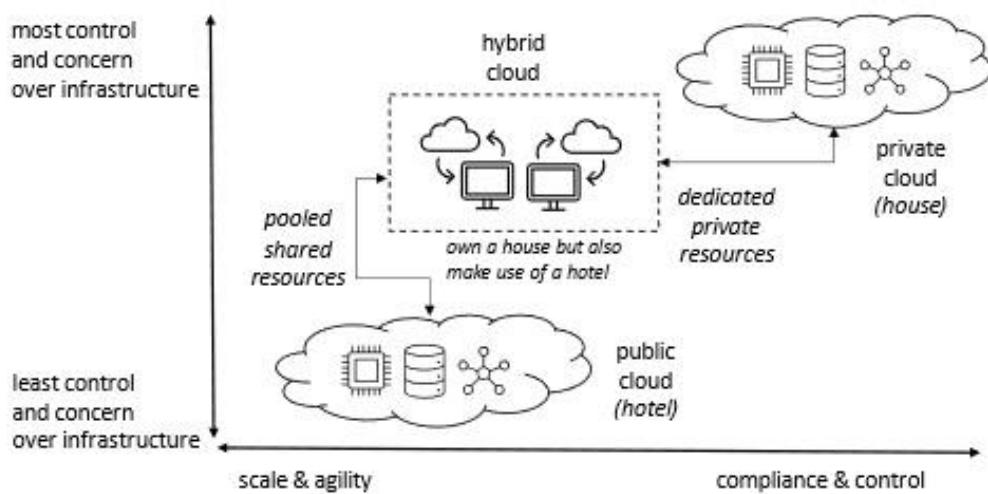


Figure 1.5 – Comparing cloud computing delivery models

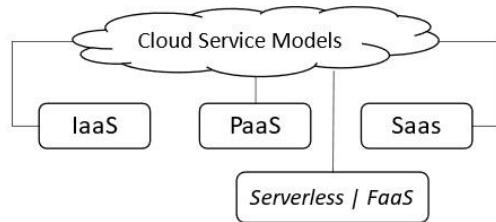


Figure 1.6 – Cloud computing service models

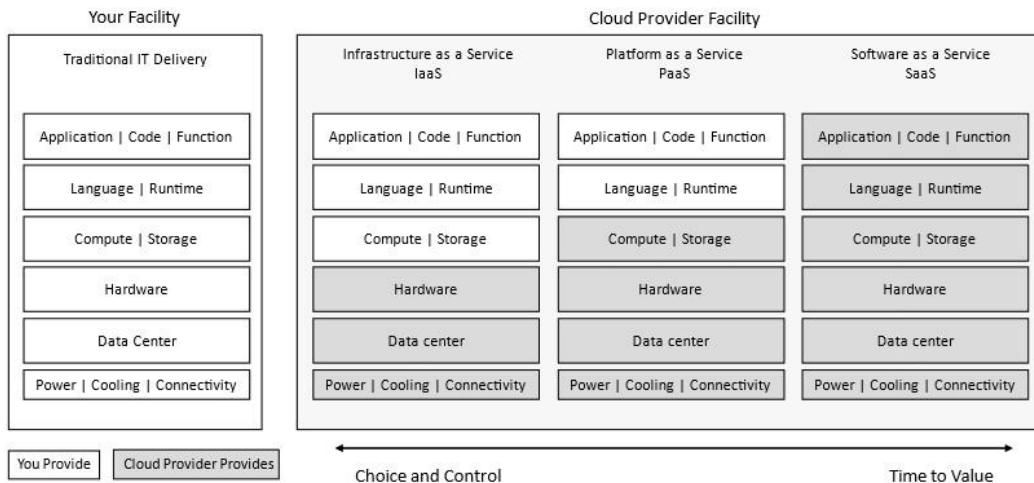


Figure 1.7 – Cloud computing service models – layer providers

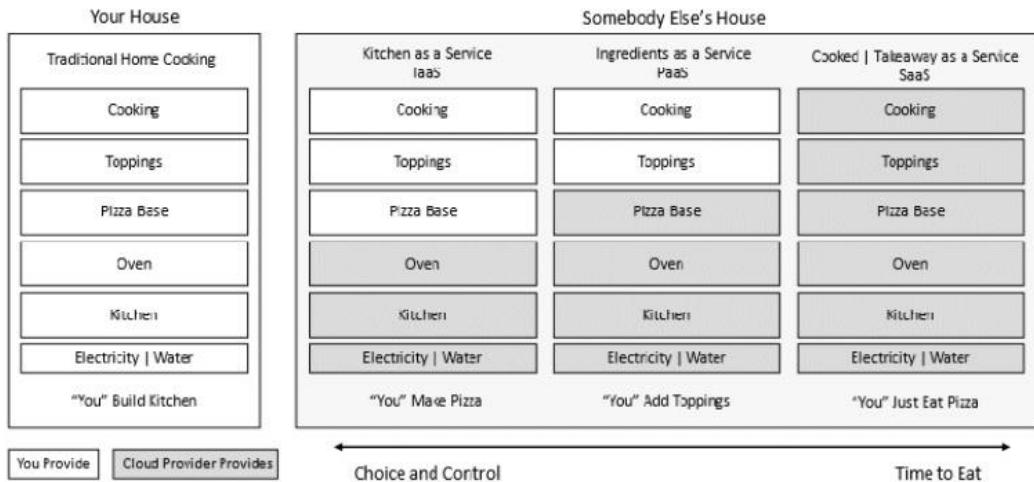


Figure 1.8 – Cloud computing service models – layer analogy

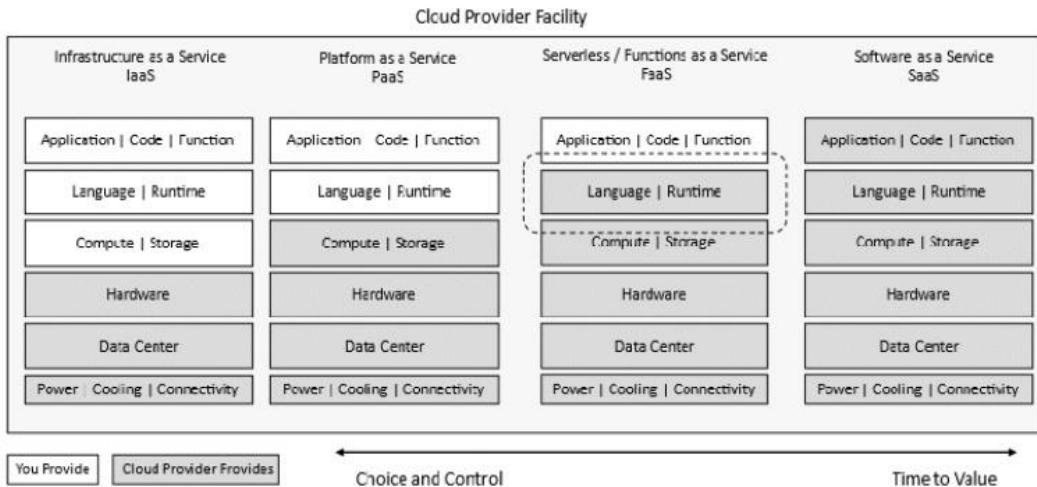


Figure 1.9 – Cloud computing service models – compare and contrast

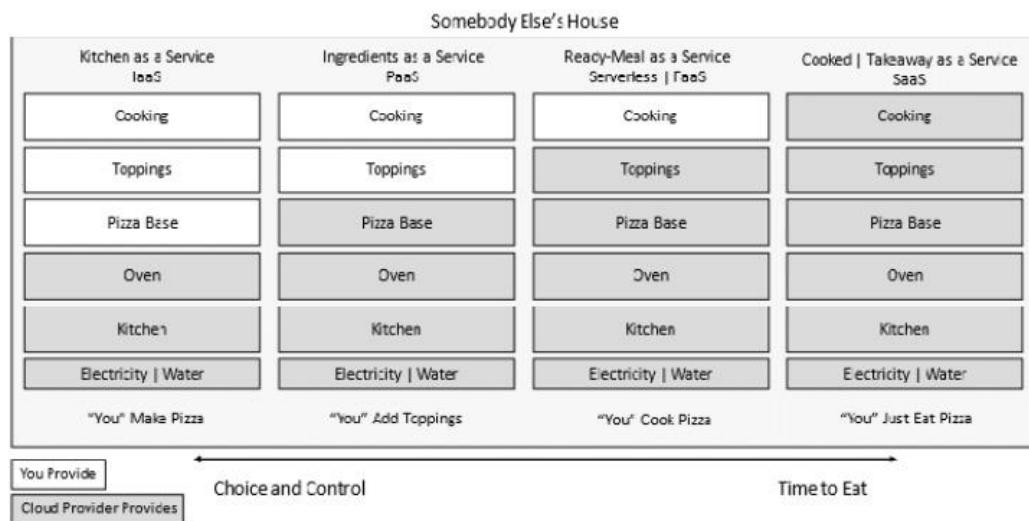


Figure 1.10 – Cloud computing service models – layer providers

Links

You can learn more about the update of Microsoft security services at this url:

<https://docs.microsoft.com/en-us/azure/defender-for-cloud/defender-for-cloud-introduction>

Further reading

This section provides links to additional exam information and study references. Please refer to the supplementary materials pdf for links on each.

- Exam AZ-900: Microsoft Azure Fundamentals: <https://docs.microsoft.com/en-us/learn/certifications/exams/az-900>

- Exam AZ-900: skills outline:
<https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE3VwUY>
- *Describe core Azure concepts:* <https://docs.microsoft.com/en-us/learn/paths/az-900-describe-cloud-concepts>
- *Describe the different types of cloud computing:* <https://docs.microsoft.com/en-us/learn/modules/fundamental-azure-concepts/types-of-cloud-computing>
- *Describe the different categories of cloud services:* <https://docs.microsoft.com/en-us/learn/modules/fundamental-azure-concepts/categories-of-cloud-services>
- Microsoft cloud computing definition: <https://azure.microsoft.com/en-in/overview/what-is-cloud-computing>
- NIST cloud computing definition: <https://www.nist.gov/news-events/news/2011/10/final-version-nist-cloud-computing-definition-published>

Chapter 2

Figures

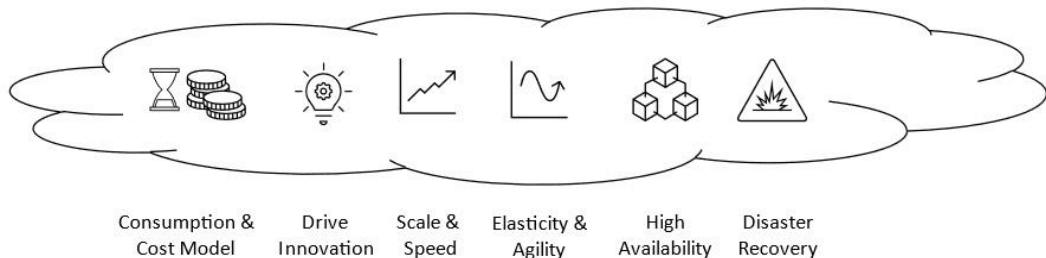


Figure 2.1 – Benefits of cloud computing

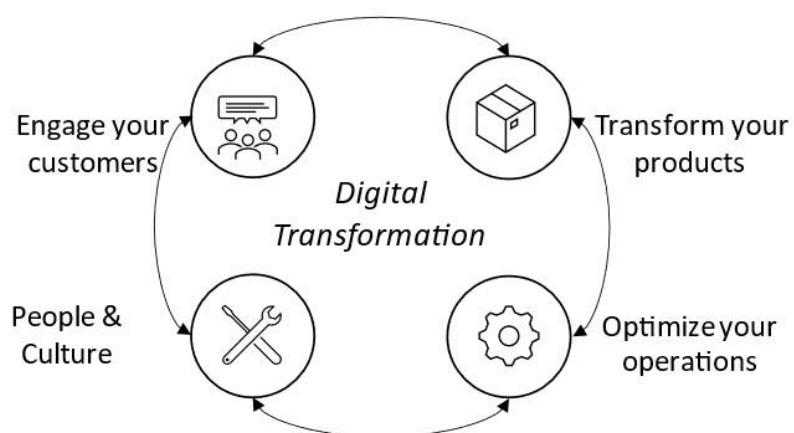


Figure 2.2 – Cloud computing as a digital transformation enabler

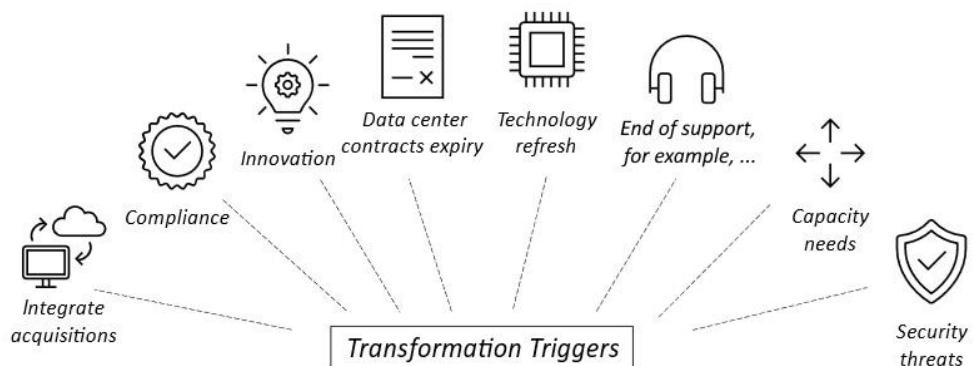


Figure 2.3 – Digital transformation triggers

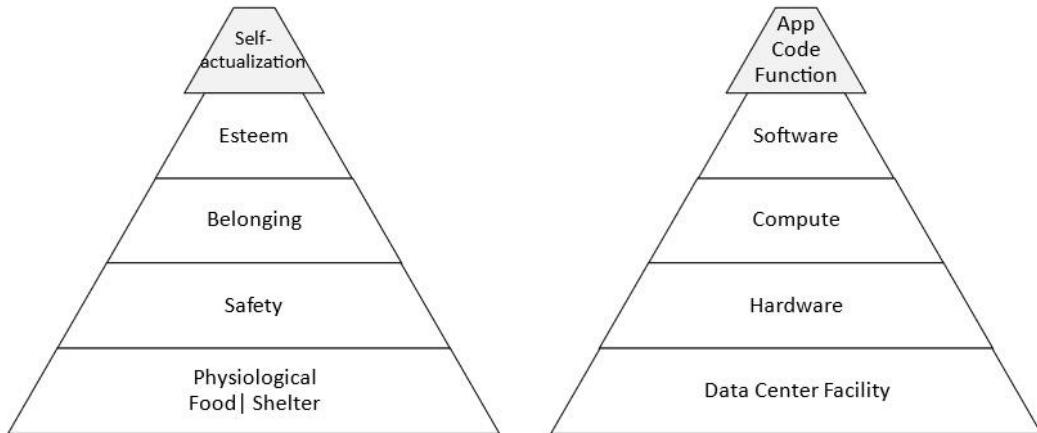


Figure 2.4 – Maslow's hierarchy versus the cloud computing hierarchy of needs

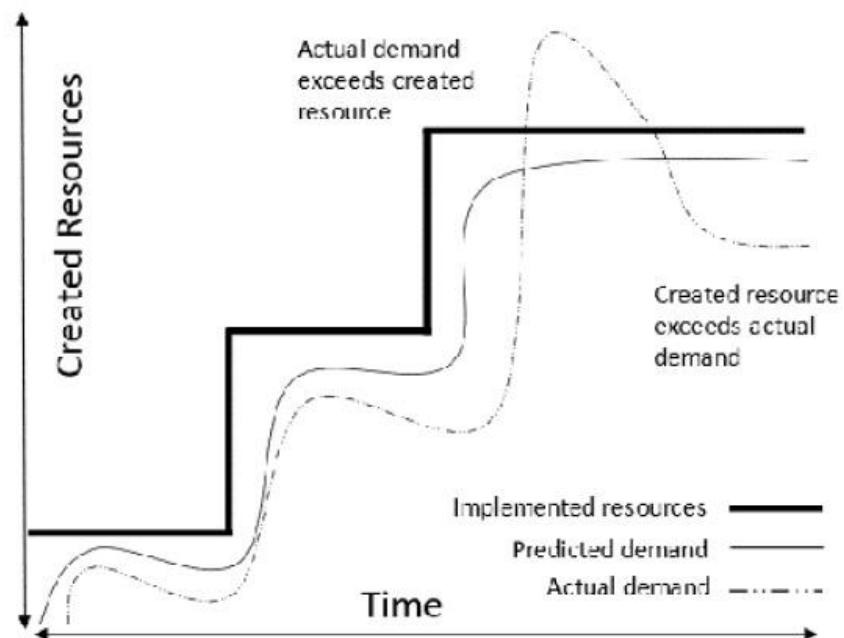


Figure 2.5 – Cloud computing resource demand model

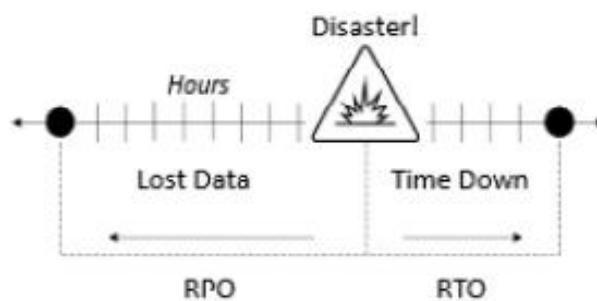


Figure 2.6 – RTO and RPO

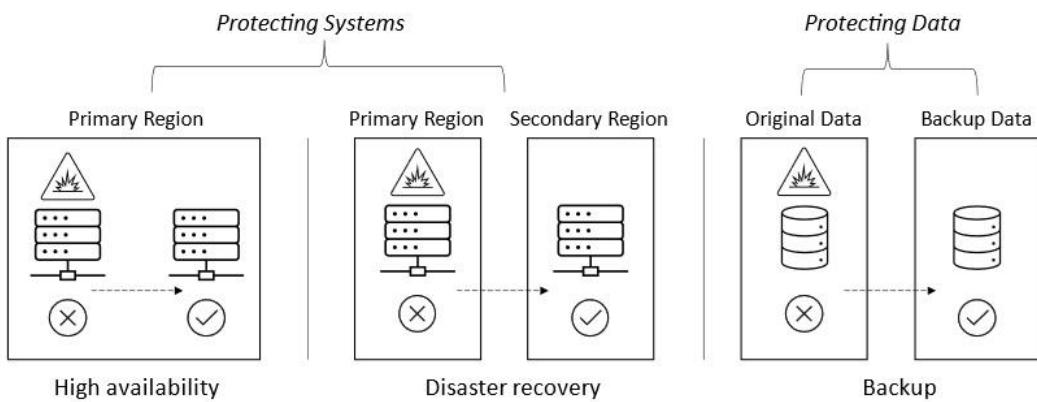


Figure 2.7 – Comparing backup, high availability, and disaster recovery



Figure 2.8 – Challenges to implementing business continuity

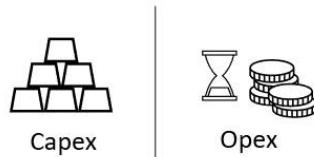


Figure 2.9 – Cost expenditure models

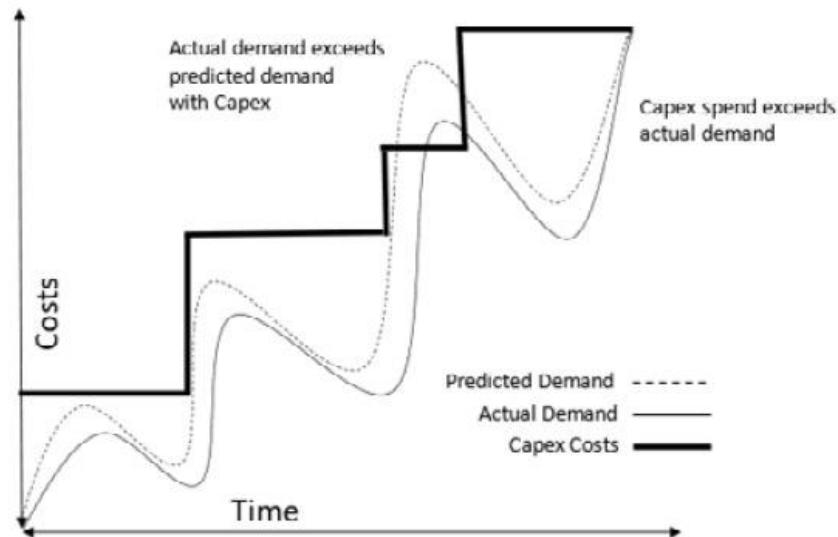


Figure 2.10 – Application of cost expenditure models

Further reading

This section provides links to additional exam information and study references:

- Exam AZ-900: Microsoft Azure fundamentals: <https://docs.microsoft.com/en-us/learn/certifications/exams/az-900>
- Exam AZ-900: skills outline: <https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE3VwUY>
- Discuss Azure fundamental concepts: <https://docs.microsoft.com/en-us/learn/modules/fundamental-azure-concepts>
- Learn the business value of Microsoft Azure: <https://docs.microsoft.com/en-us/learn/paths/learn-business-value-of-azure>
- Describe high availability and disaster recovery strategies: <https://docs.microsoft.com/en-us/learn/modules/describe-high-availability-disaster-recovery-strategies>
- Microsoft **Total Cost of Ownership (TCO)** calculator: <https://azure.microsoft.com/en-us/pricing/tco/calculator/>
- Microsoft Service Level Agreements: <https://azure.microsoft.com/en-us/support/legal/sla/>

Chapter 3

Figures:

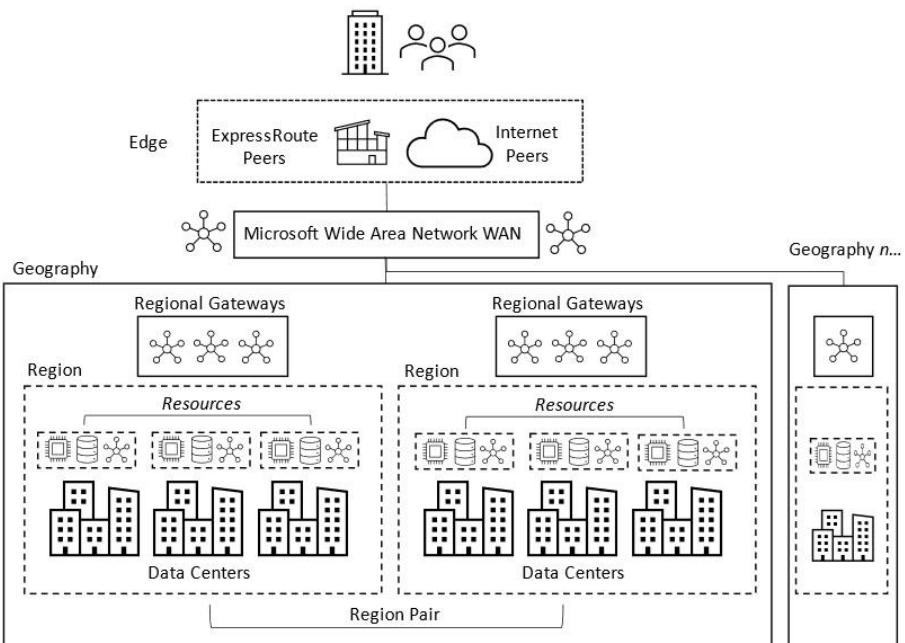


Figure 3.1 – Azure global infrastructure

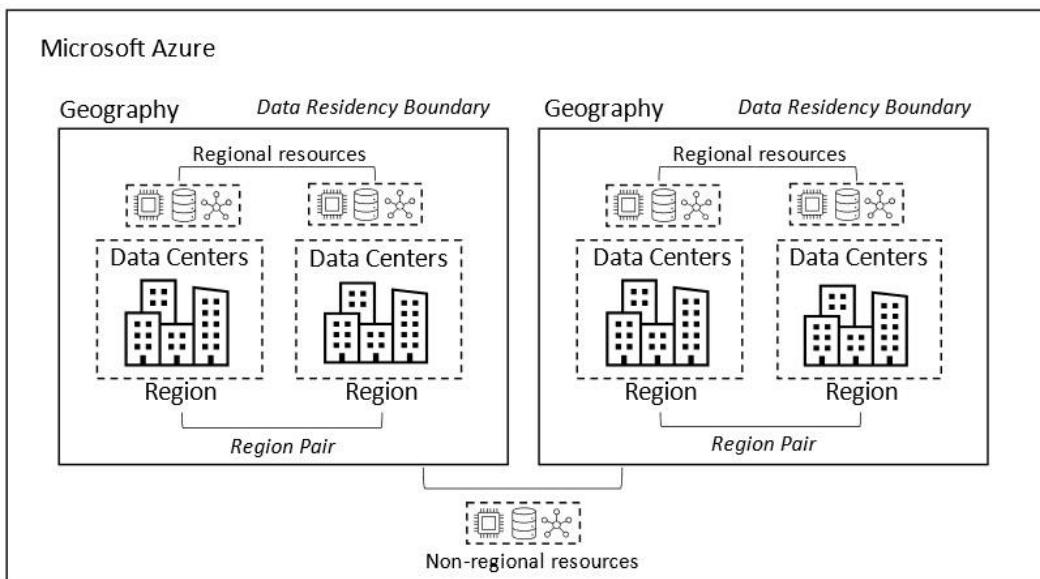


Figure 3.2 – Azure regions and geographies

Home > Create a resource >

Create a virtual machine

Instance details

Virtual machine name *

Region * (1)

Choose these locations for the broadest set of Azure products and long-term capacity growth

Availability options

Image * (1)

Recommended (1)

- (US) East US
- (US) East US 2
- (US) South Central US
- (US) West US 2
- (Asia Pacific) Australia East
- (Asia Pacific) Southeast Asia
- (Europe) North Europe
- (Europe) UK South**

Size * (1)

Administrator account

Username * (1)

Password * (1)

Confirm password * (1)

Figure 3.3 – Azure resource creation region

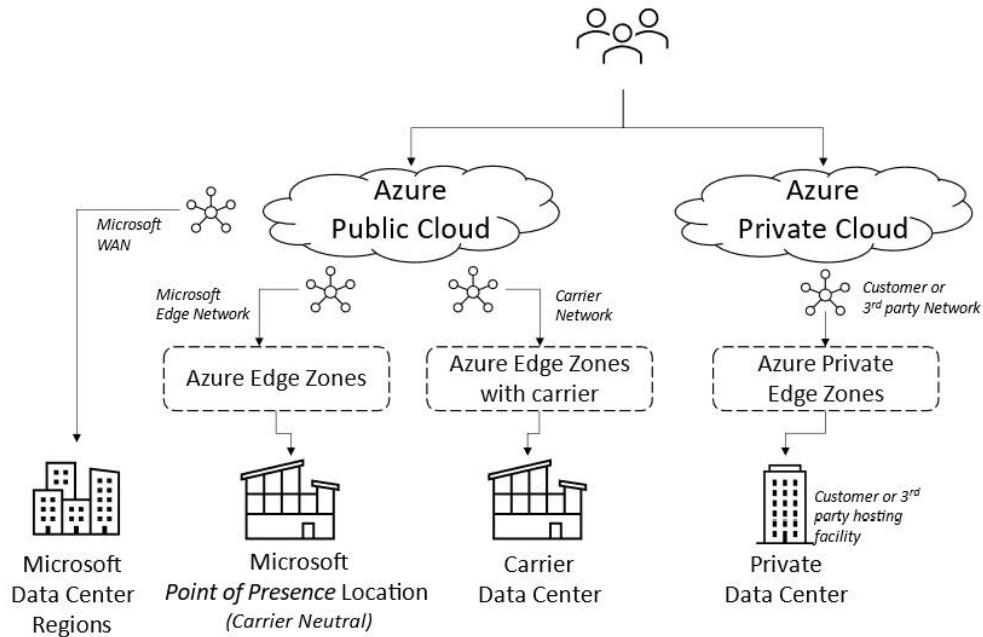


Figure 3.4 – Azure edge zones

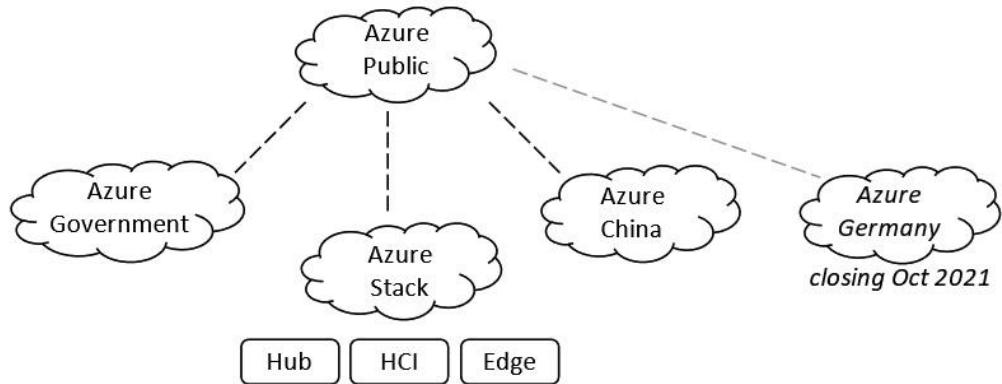


Figure 3.5 – Azure public and non-public clouds put a box around Azure Stack



Figure 3.6 – Azure availability components

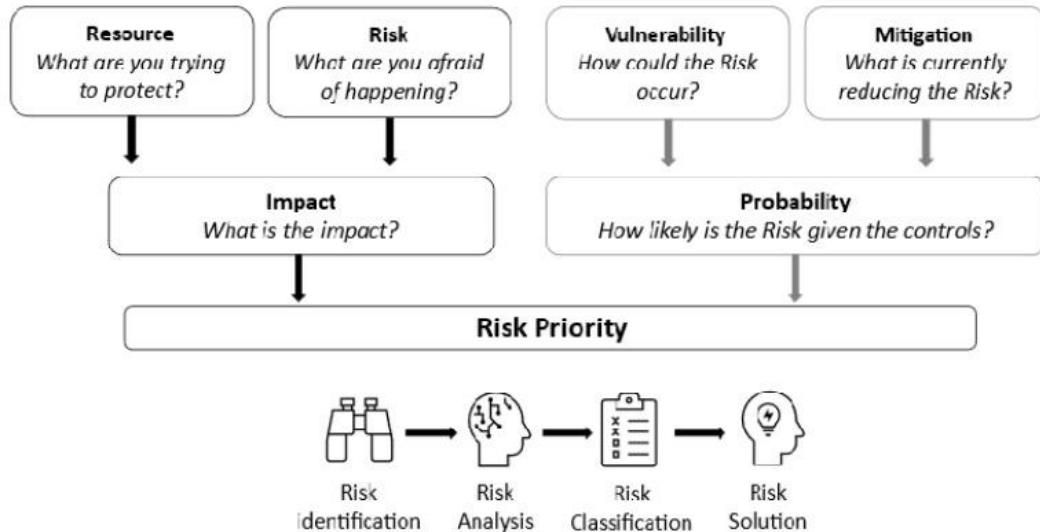


Figure 3.7 – Adopting a risk model

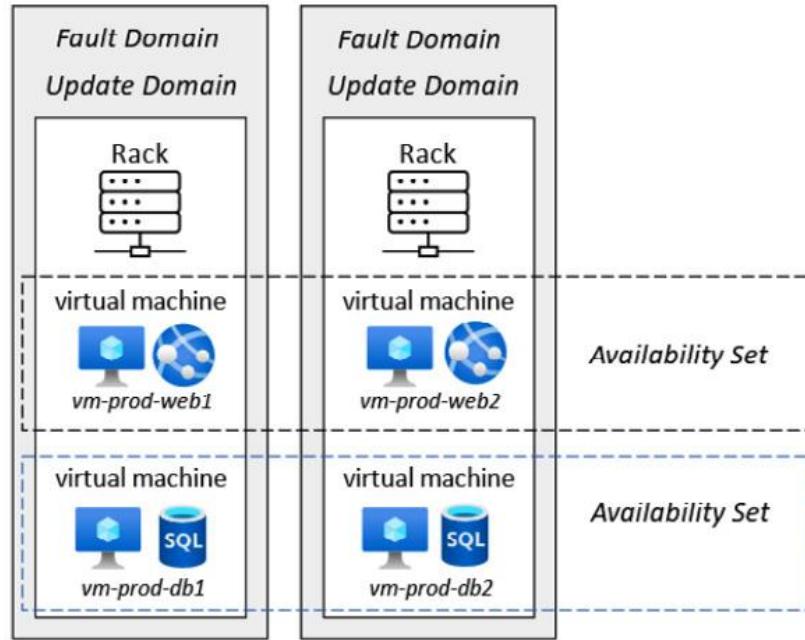


Figure 3.8 – Azure availability sets

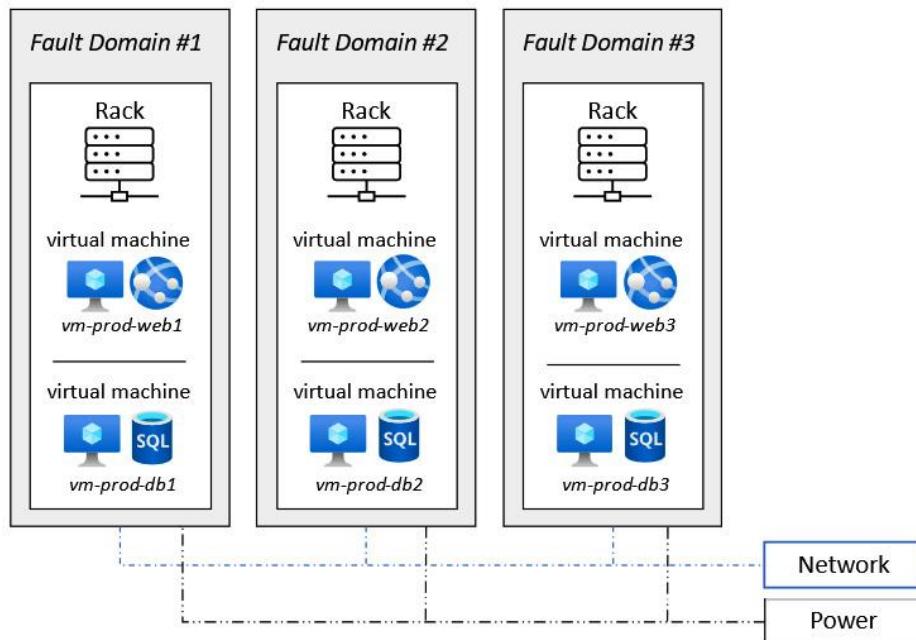


Figure 3.9 – Availability set fault domain

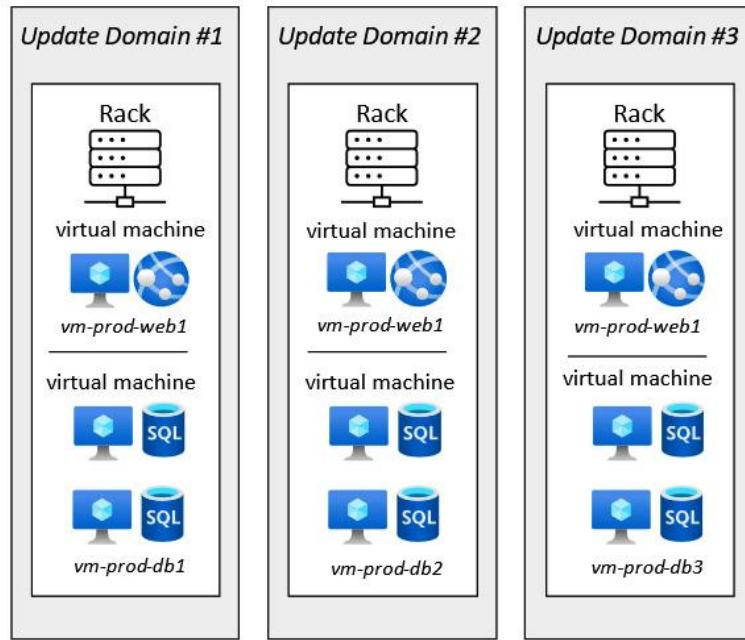


Figure 3.10 – Availability set update domain

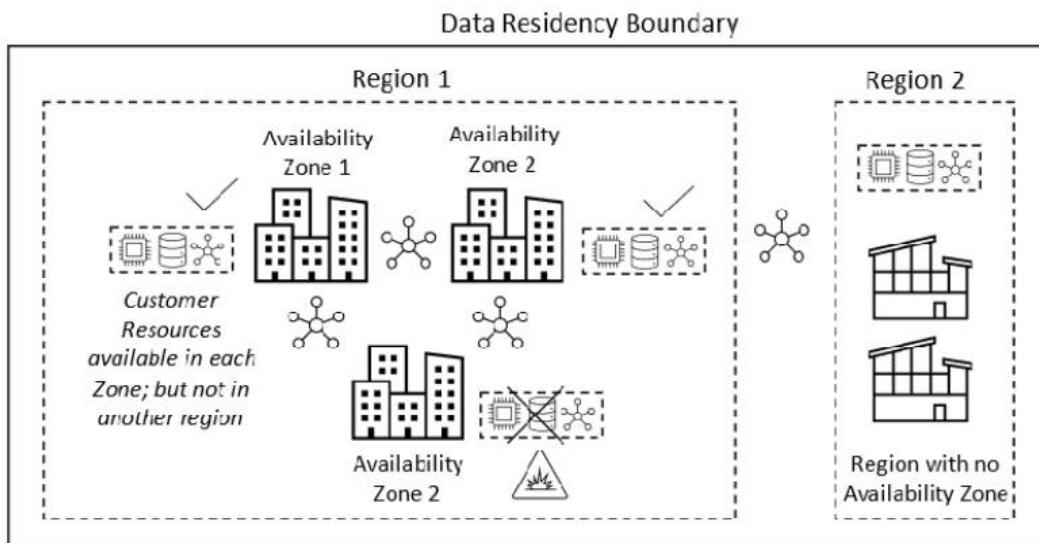


Figure 3.11 – Azure availability zones

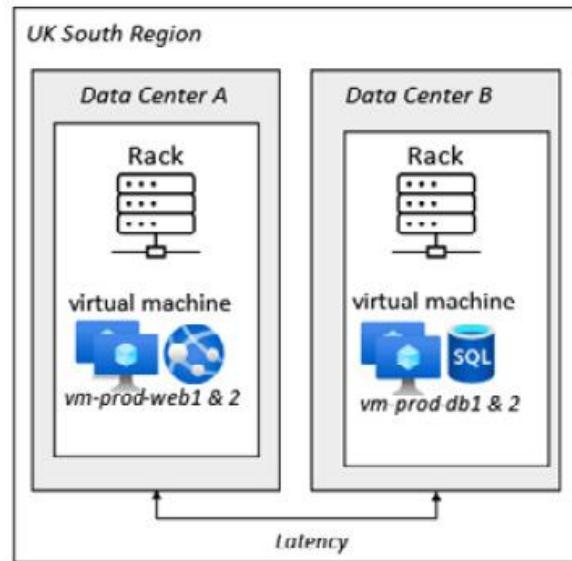


Figure 3.12 – Virtual machine placement without proximity placement groups

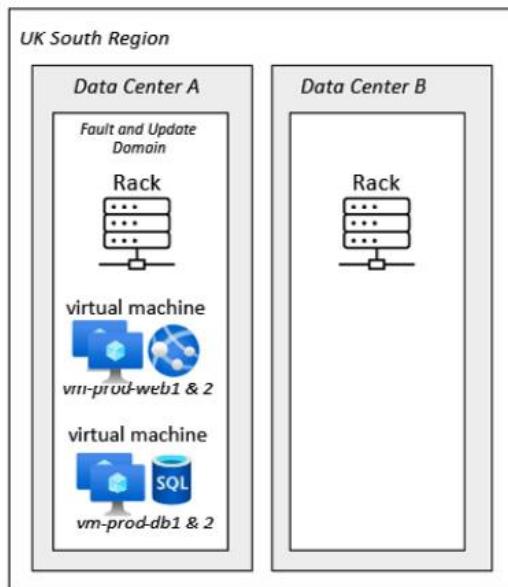


Figure 3.13 – Virtual machine placement without proximity placement groups

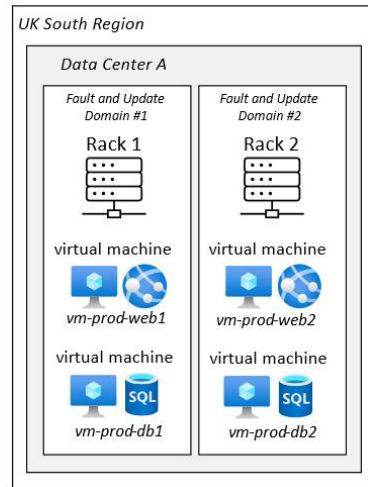


Figure 3.14 – Proximity placement groups and availability sets

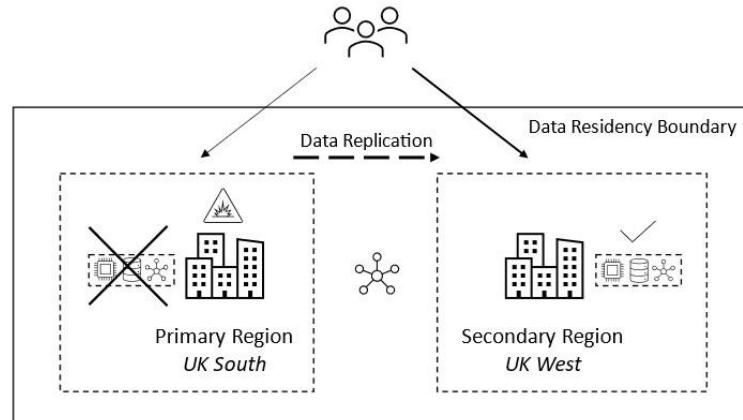


Figure 3.15 – Azure region-to-region protection

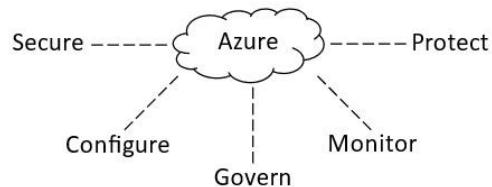


Figure 3.16 – Azure resource management

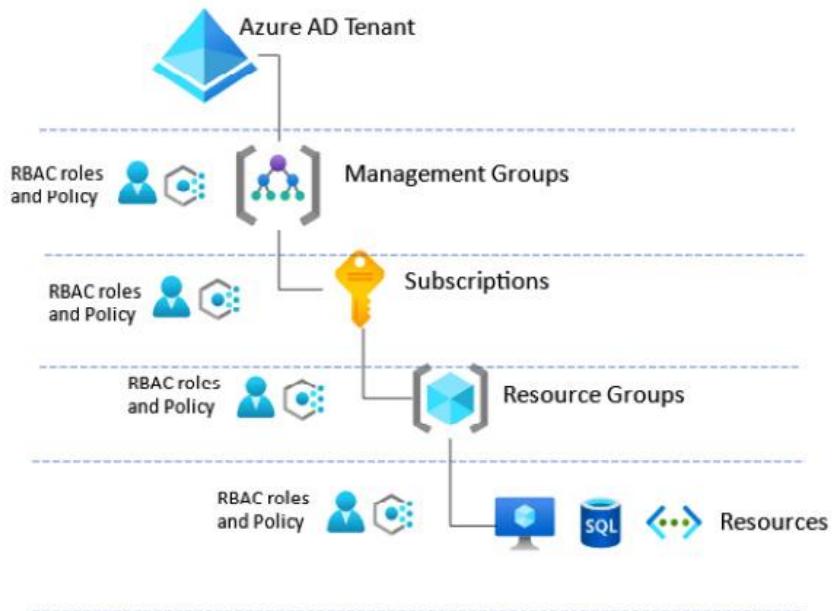


Figure 3.17 – Azure management scopes

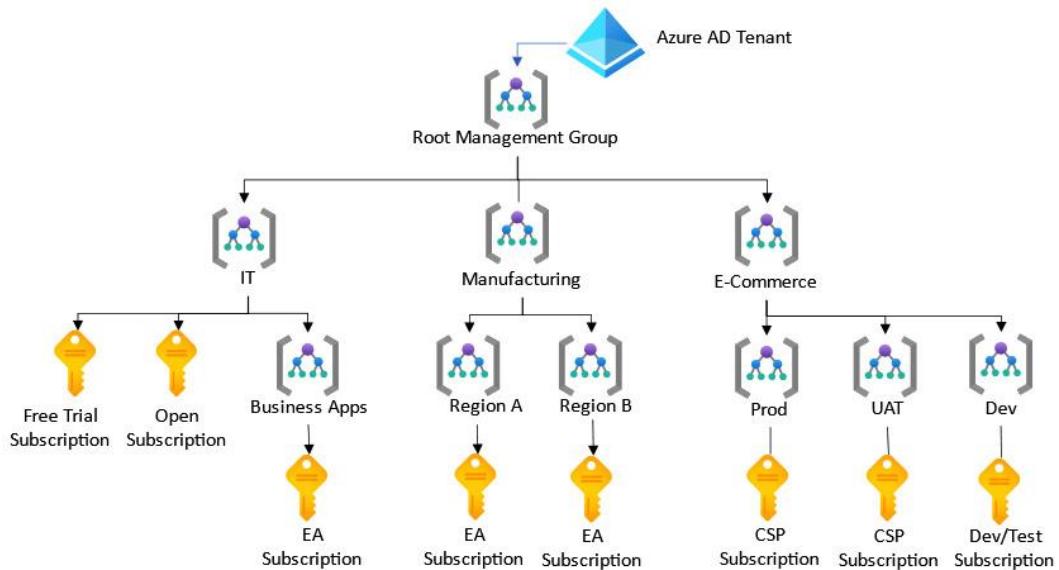


Figure 3.18 – Azure management group and subscription relationships

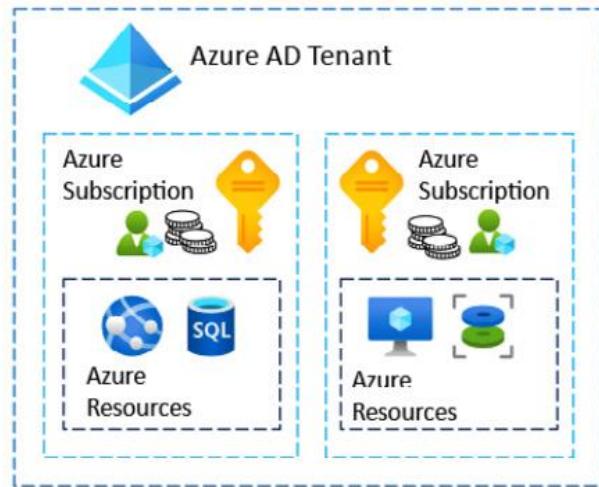


Figure 3.19 – Azure subscriptions

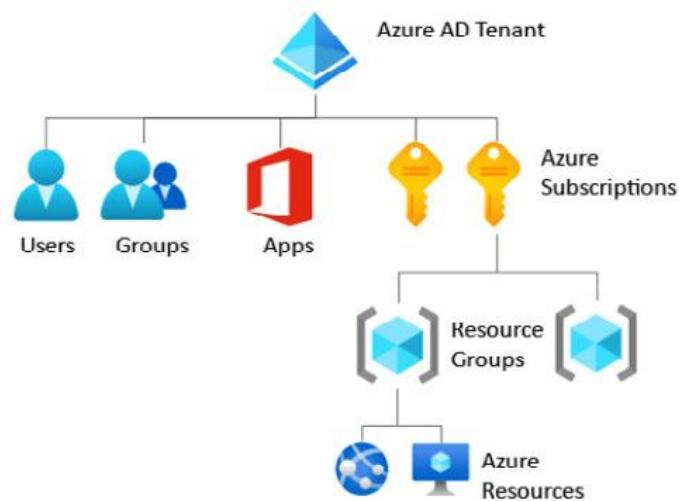


Figure 3.20 – Azure subscription and tenant relationship

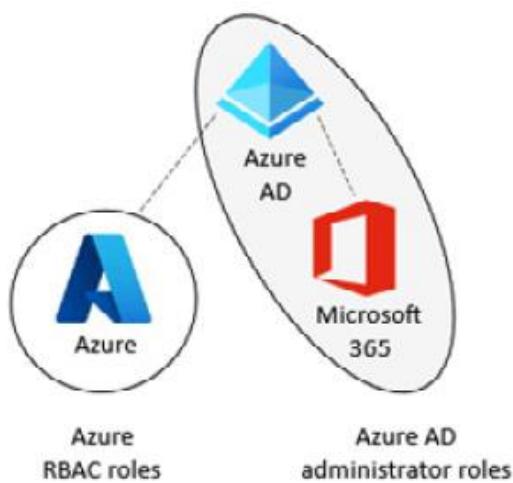


Figure 3.21 – Azure subscription access control

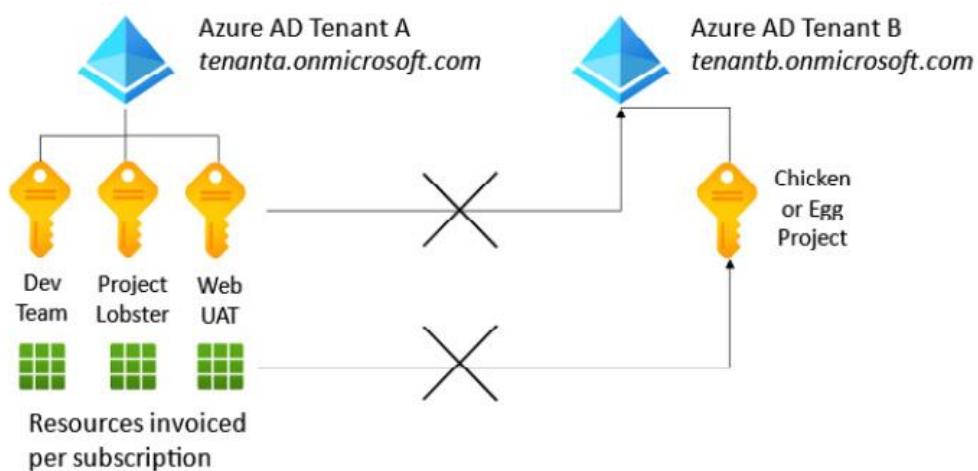


Figure 3.22 – Additional Azure subscriptions

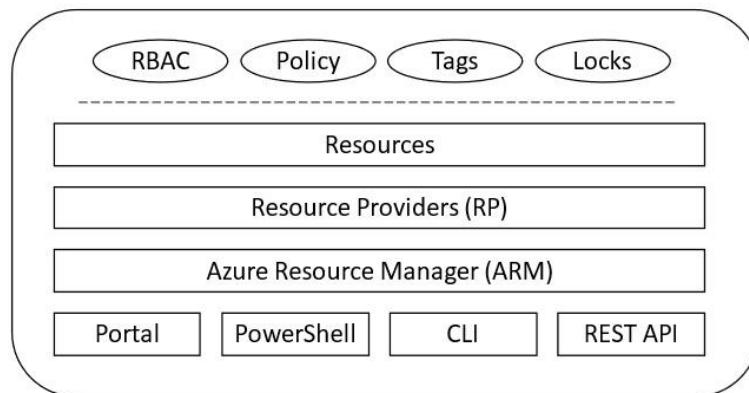


Figure 3.23 – ARM architecture

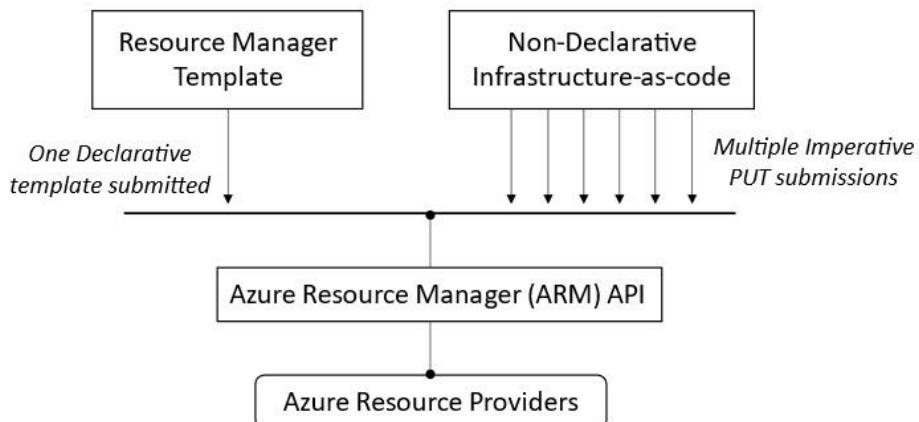


Figure 3.24 – ARM template declarative approach

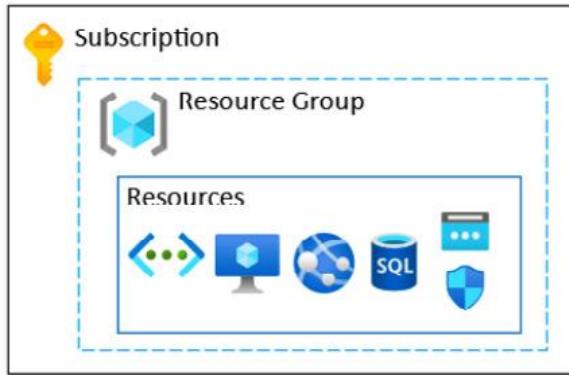


Figure 3.25 – Azure resource group relationships

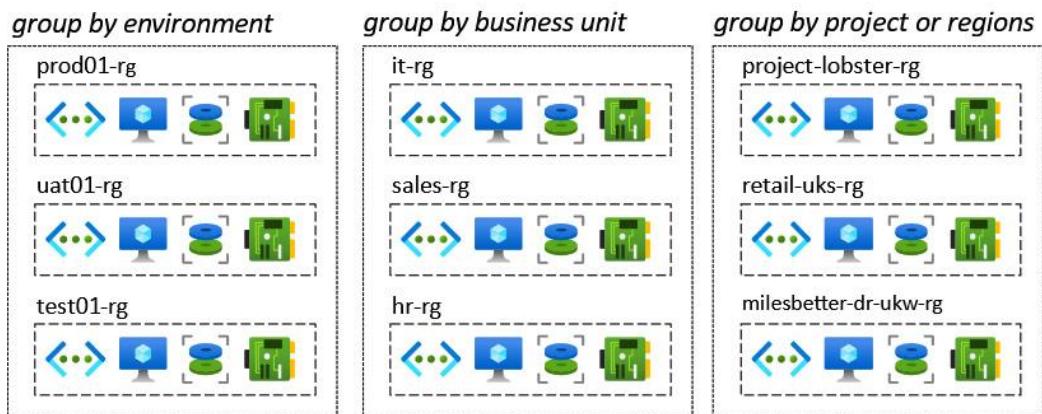


Figure 3.26 – Azure resource group organization

Links

Azure geographies: <https://azure.microsoft.com/en-gb/global-infrastructure/geographies/>.

Azure US Government cloud: <https://portal.azure.us> – *.azurewebsites.us

Azure China cloud: <https://portal.azure.cn> – *.chinacloudsites.cn (*operated by 21Vianet in compliance with Chinese regulations*)

Azure German cloud: <https://portal.microsoftazure.de> – *.azurewebsites.de

As a reference, the Microsoft SLAs for all services can be found at <https://azure.microsoft.com/en-gb/support/legal/sla/>.

ARM templates: <https://docs.microsoft.com/en-us/azure/azure-resource-manager/templates>.

Further reading

This section provides links to additional exam information and study references:

- Exam AZ-900 – Microsoft Azure fundamentals: <https://docs.microsoft.com/en-us/learn/certifications/exams/az-900>
- Exam AZ-900 – skills outline: <https://queryprod.cnsrt.microsoft.com/cms/api/am/binary/RE3VwUY>

- Microsoft Learn: Azure Fundamentals – Describe core Azure architectural components: <https://docs.microsoft.com/en-us/learn/modules/azure-architecture-fundamentals>
- Azure global infrastructure: <https://azure.microsoft.com/en-in/global-infrastructure>
- Azure Edge Zones: <https://docs.microsoft.com/en-us/azure/networking/edge-zones-overview>
- Azure reliability: <https://azure.microsoft.com/en-gb/features/reliability>
- Managing resources: <https://docs.microsoft.com/en-us/azure/azure-resource-manager/management/>

Hands-on exercises

To support your learning with some practical skills, we will look at the hands-on creation of some of the resources covered in this chapter.

The following resources will be created:

- Exercise 1 – Azure management groups
- Exercise 2 – Azure access assignment
- Exercise 3 – Resource groups
- Exercise 4 – Proximity placement groups
- Exercise 5 – Availability sets

Getting started

To get started with these hands-on exercises, you can create a free Azure account from this URL: <https://azure.microsoft.com/free/>.

This free Azure account provides the following:

- 12 months of free services
- \$200 credit to explore Azure for 30 days
- 25+ services that are always free

Exercise 1 – Azure management groups

In this section, we will look at the steps to create and configure management groups.

To recap from a previous section, **Azure management groups**, where management groups were covered, management groups are logical containers that group Azure subscriptions; these can be considered a governance and management layer to target access control and policies.

Important note

In contrast to resource groups, which are a flat structure with no hierarchy or nested resource groups, management groups are implemented based on a hierarchy. They have a nested, that is, root and branch, or parent and child relationship.

Follow these steps to create a management group:

1. Log in to the Azure portal at <https://portal.azure.com>. You can alternatively use the Azure desktop app: <https://portal.azure.com/App/Download>.
2. In the search bar, type in **management groups**; click on **Management groups** from the list of services shown:

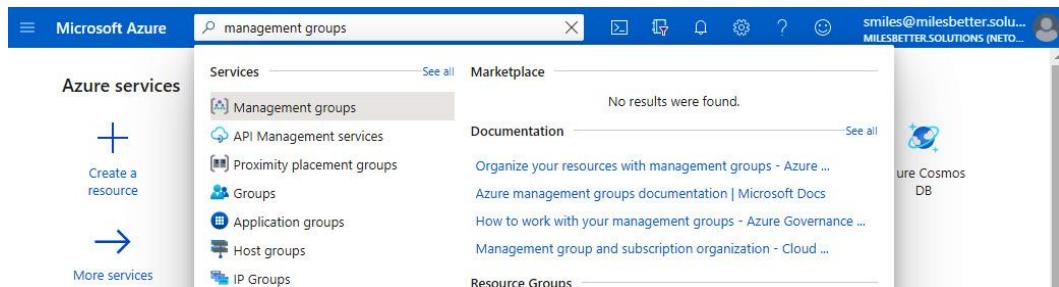


Figure 3.27 – Searching for management groups

3. In the **Management groups** blade, click on the **Start using management groups** button:

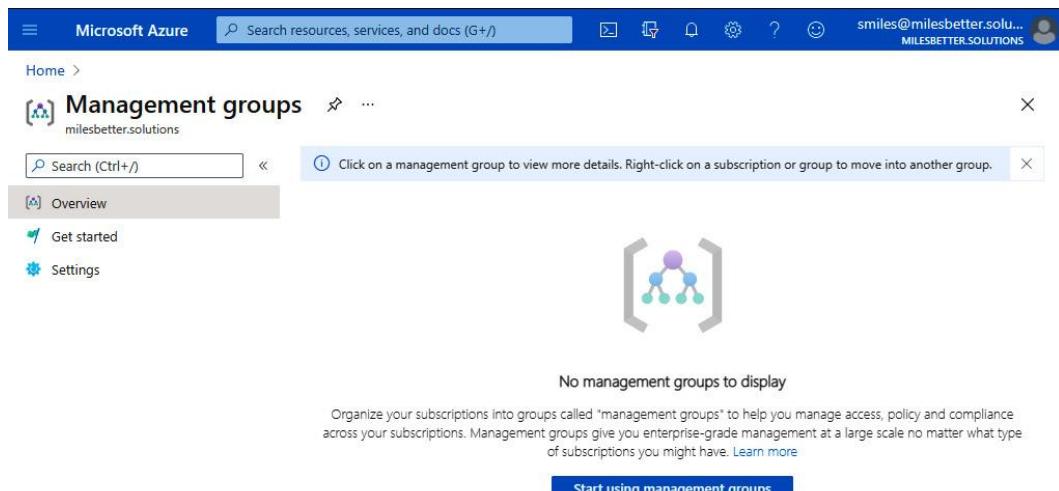


Figure 3.28 – Start using management groups

4. In the **Add management group** blade, you will need to enter a management group ID; see the following note and step on creating an ID:

Microsoft Azure Search resources, services, and docs (G+) ☰ 🔍 📤 🚨 ? 😊 smiles@milesbetter.solutions MILESBETTER.SOLUTIONS

Home >

Management groups

milesbetter.solutions

ⓘ You might experience some delays for a few minutes while Management Groups is setting up your directory.

No management groups to display

Organize your subscriptions into groups called "management groups" to help you manage across your subscriptions. Management groups give you enterprise-grade management of subscriptions you might have. Learn more

[Start using management groups](#)

Add management group

Management group ID (Cannot be updated after creation)*
d94c2ab0-c125-470f-9906-270a676d59dc ✓

Management group display name
Projects

Submit Cancel

Figure 3.29 – Add management group

Important note

The management group ID is often set the same as the display name you wish to use; although, a better practice is to use an actual GUID that you self-generate. How to create this GUID is covered in the next step.

- From the top ribbon of the Azure portal, open Cloud Shell and, using PowerShell, run the following command to create a unique GUID to use:

[guid] :: NewGuid()

The following screenshot shows an example of running the preceding command:

```
Microsoft Azure Search resources, services, and docs (G+) Powerhell | ⚡ ? ⚙️ 📁 {} 🔍
smiles@milesbetter.sol... MILESBETTER.SOLUTIONS (NETO... Requesting a Cloud Shell. Succeeded.
Connecting terminal...
Welcome to Azure Cloud Shell

Type "az" to use Azure CLI
Type "help" to learn about Cloud Shell

MOTD: Save files to $home/clouddrive for persistence across sessions

VERBOSE: Authenticating to Azure ...
VERBOSE: Building your Azure drive ...
PS /home/steve> [guid]::NewGuid()

Guid
-----
d94c2ab0-c125-470f-9906-270a676d59dc
```

Figure 3.30 – Creating a GUID

6. Enter the created management group ID and add a management group display name; click **Submit**:

The screenshot shows the Microsoft Azure Management groups blade. On the left, there's a message about delays during setup. In the center, there's a diagram of a tree structure. Below it, a message says 'No management groups to display' and 'Organize your subscriptions into groups called "management groups" to help you manage across your subscriptions. Management groups give you enterprise-grade management of subscriptions you might have. Learn more'. A blue button labeled 'Start using management groups' is visible. On the right, a modal window titled 'Add management group' is open, asking for a Management group ID (which is filled with a GUID) and a Management group display name (set to 'Projects'). There are 'Submit' and 'Cancel' buttons at the bottom of the modal.

Figure 3.31 – Adding a GUID

7. You will receive a notification that this was completed successfully.

Important note

To view the created management groups, you must have the Management Group Contributor or Reader role assigned.

8. The new management group (called **Projects**) can be seen in the hierarchy from the **Management groups** blade:

The screenshot shows the Microsoft Azure Management groups blade with the 'Overview' tab selected. It displays a list of management groups and their subscriptions. The 'Tenant Root Group' is expanded, showing 6 subscriptions. A new group named 'Projects' is listed with 0 subscriptions. The interface includes a search bar, filter buttons for 'Add', 'Refresh', 'Expand / Collapse all', and 'Feedback', and a message about being a directory admin but not having permissions to access the root management group.

Name	ID	Total subscriptions
Tenant Root Group	2be90e84-8ed1-45fc-b5a5-7369b08fe85f	6
Projects	d94c2ab0-c125-470f-9906-270a676d59dc	0

Figure 3.32 – Review management groups created

9. To move subscriptions into the management group, right-click the subscription to move and select -> **Move**:

The screenshot shows the Microsoft Azure Management groups interface. In the center, there is a table listing subscriptions under the 'Tenant Root Group'. One subscription, 'Project DogOrMuffin', is selected and highlighted with a blue border. A tooltip labeled 'Move' is displayed over this subscription. To the right of the table, a 'Move' blade is open. The 'New parent management group' dropdown menu is set to 'Projects (d94c2ab0-c125-470f-9906-270a676d59dc)'. At the bottom of the blade are two buttons: 'Save' (highlighted in red) and 'Cancel'.

Figure 3.33 – Moving management groups

10. In the **Move** blade, select the management group to move the subscription to and click **Save**; repeat for each subscription to move:

This screenshot is similar to Figure 3.33, showing the Management groups page with the 'Move' blade open. The 'Save' button in the 'Move' blade is highlighted with a red box. The rest of the interface is identical to Figure 3.33, showing the list of subscriptions and the 'Move' operation in progress.

Figure 3.34 – Selecting management groups

11. The new hierarchy can be seen in the management group's blade; the **Projects** management group now contains two subscriptions:

The screenshot shows the Microsoft Azure Management groups interface. At the top, there's a search bar and a user profile. Below it, the title 'Management groups' is displayed with a 'milesbetter.solutions' logo. A sidebar on the left has 'Overview', 'Get started', and 'Settings' options. The main area shows a list of subscriptions under 'Showing 6 subscriptions in 2 groups'. The first group is 'Tenant Root Group' with ID 2be90e84-8ed1-45fc-b5a5-7369b08fe85f and 6 total subscriptions. It contains a 'Projects' group with ID d94c2ab0-c125-470f-9906-270a676d59dc and 2 total subscriptions, which includes 'Project DogOrMuffin' and 'Project Lobster'.

Figure 3.35 – Reviewing the hierarchy

12. Clicking on the management group name opens that particular management group. The **Projects** management group now has two subscriptions (called **Project DogOrMuffin** and **Project Lobster**); **Governance** controls can now be targeted at the subscriptions within the management group:

This screenshot shows the 'Projects' management group details. On the left, a sidebar lists 'Subscriptions', 'Resource Groups', 'Resources', 'Activity Log', 'Access control (IAM)', 'Governance' (with 'Security', 'Policy', 'Deployments'), and 'Cost Management' (with 'Cost analysis', 'Budgets'). The main pane displays the 'Projects' group details: Name is 'Projects', ID is d94c2ab0-c125-470f-9906-270a676d59dc, Access Level is 'Owner', and Path is 'Tenant Root Group / Projects'. It also shows 'Essentials' like Parent management group (Tenant Root Group), Child management groups (0), and Total subscriptions (2). Below this, it shows 'Showing 2 subscriptions in 1 groups' with the same list as Figure 3.35.

Figure 3.36 – Reviewing the management group

In this exercise, we created a management group and moved two subscriptions into that management group. In the following exercise, we will look at Azure access assignment through RBAC.

Exercise 2 – Azure access assignment

In this section, we will look at the steps to assign access to an Azure subscription. You can follow the same steps to assign access to other resources.

To recap from a previous section, [Azure subscription access control](#), where access management was covered, RBAC provides the ability to assign multiple accounts different access levels to a subscription as needed by an organization.

Follow these steps to assign access to a subscription:

1. Log in to the Azure portal at <https://portal.azure.com>. You can alternatively use the Azure desktop app: <https://portal.azure.com/App/Download>.
2. In the subscription you wish to give access to, click **Access control (IAM)** on the **Subscriptions** blade's vertical menu:

The screenshot shows the Microsoft Azure portal interface. At the top, there is a search bar and a navigation bar with 'Microsoft Azure' and 'Home > Subscriptions >'. The main area is titled 'Subscriptions' for 'Project DogOrMuffin' under 'milesbetter.solutions'. On the left, a vertical menu lists 'Overview', 'Activity log', 'Access control (IAM)', 'Tags', 'Diagnose and solve problems', 'Security', and 'Events'. The 'Access control (IAM)' item is selected. On the right, there is a 'Search (Ctrl+/' bar and a 'Cancel subscription' button. Below that, there are sections for 'Essentials' (Subscription ID: 7b18e172-16e5-4b7c-8d83-45bd4b7d5c49, Directory: milesbetter.solutions (NETORGFT8723201.onmicrosoft.com), My role: Account admin, Offer: Pay-As-You-Go, Offer ID:), and a 'My role' section.

Figure 3.37 – Subscription access

3. To assign a role to another user in the directory, click **+ Add** and select **Add role assignment**:

The screenshot shows the 'Access control (IAM)' blade for 'Project DogOrMuffin'. The left sidebar has 'Overview', 'Activity log', 'Access control (IAM)' (which is selected and highlighted in grey), 'Tags', and 'Diagnose and solve problems'. On the right, there is a search bar, a 'Download role assignments' button, and a 'Add' button. A dropdown menu is open over the 'Add' button, listing 'Add role assignment', 'Add role assignment (Preview)', 'Add co-administrator', and 'Add custom role'. The 'Add role assignment' option is highlighted with a blue bar.

Figure 3.38 – Assigning roles

4. In the **Add role assignment** blade, select the role to assign a user.
5. Then, select the user(s) to assign that role and click **Save**.
6. You will receive a notification that this was completed successfully.
7. Navigate back to the **Role assignments** tab, and the new user role assignment can be seen:

Name	Type	Role	Scope	Condition
milesbetter.solutions admin@NETORGFT8723201.onmicrosoft.com	User	Management Group Contributor	This resource	None
steve miles smiles@milesbetter.solutions	User	Management Group Contributor	This resource	None
steve miles smiles@milesbetter.solutions	User	Owner	Management group (inh...)	None
Barney Mottershaw-Miles barney@netorgft8723201.onmicrosoft.com	User	User Access Administrator	This resource	None

Figure 3.39 – Reviewing assigned access

In this exercise, we added a role assignment to a user through RBAC. In the following exercise, we will look at creating a resource group.

Exercise 3 – resource groups

In this section, we will look at the steps to create resource groups.

To recap from a previous section where resource groups were covered, a resource group is a logical entity that groups resources that share the same life cycle, permissions, and policies.

Important note

In contrast to management groups, resource groups are a flat structure. There is no hierarchy or nested resource groups. There is no root/branch or parent/child relationship.

Follow these steps to create a resource group:

1. Log in to the Azure portal at <https://portal.azure.com>. You can alternatively use the Azure desktop app: <https://portal.azure.com/App/Download>.
2. In the search bar, type in **resource groups**; click on **Resource groups** from the list of services shown.
3. In the **Resource groups** blade, click on the **Create resource group** button or use the **+ Add** button from the top menu bar of the blade.
4. In the **Create a resource group** wizard blade, the **Basics** tab provides the following information:
 - a) **Subscription:** Select the subscription to create the resource group in.
 - b) **Resource group:** Enter the name for the resource group.

- c) **Region:** Select the region that is required.
5. Select **Next: Tags** and add any tags as required. Click **Next: Review + create**.
 6. On the **Review + create** tab, review your settings; you may go back to the **Basics** or **Tags** tab and make any edits if required. Once you have confirmed your settings are as required, you can click **Create**.
- You will receive a notification that the resource group was created successfully.

7. In the **Resource groups** blade, the created resource group can be seen:

The screenshot shows the Microsoft Azure Resource groups blade. At the top, there's a header bar with the Microsoft Azure logo, a search bar, and various navigation icons. Below the header, the title 'Resource groups' is displayed, along with a 'Subscription' dropdown set to 'all'. A table lists one resource group: 'DogOrMuffin-ML-RG' (Type: Project, Location: UK South). The table has columns for Name, Subscription, and Location. There are also filter and grouping options at the bottom of the table.

Figure 3.40 – Resource groups

8. Click into the resource group, and resources can now be created within this resource group:

The screenshot shows the Microsoft Azure Resource group details blade for 'DogOrMuffin-ML-RG'. The left sidebar contains a navigation menu with sections like Overview, Activity log, Access control (IAM), Tags, Events, Deployments, Security, Policies, Properties, Locks, Cost Management, Monitoring, Insights (preview), and Alerts. The main content area is titled 'Overview' and displays basic information: Subscription (change) to 'Project DogOrMuffin', Deployment status 'No deployments', Subscription ID '7b18e172-16e5-4b7c-8d83-45bd4b7d5c49', Location 'UK South', and Tags (change) with a link to 'Click here to add tags'. Below this is a table with columns for Name, Type, and Location, showing no resources currently. At the bottom, there are buttons for 'Create resources' and 'Clear filters / Show hidden'.

Figure 3.41 – Reviewing the resource group

9. When creating new resources, you can now select the created resource group (created in this exercise as **DogOrMuffin-ML-RG**) to create the new resources within.

In this exercise, we looked at creating resource groups. In the following exercise, we will look at creating proximity placement groups.

Exercise 4 – proximity placement groups

In this section, we will look at the steps to create proximity placement groups.

To recap from a previous section, **Proximity placement groups**, where proximity placement groups were covered, a proximity placement group is a logical entity that groups compute resources, so they are located physically close to each other. This is useful where low latency is a requirement.

Follow these steps to create a proximity placement group:

1. Log in to the Azure portal at <https://portal.azure.com>. You can alternatively use the Azure desktop app: <https://portal.azure.com/App/Download>.
2. In the search bar, type in **proximity placement groups**; click on **Proximity placement groups** from the list of services shown.
3. In the **Proximity placement groups** blade, click on the **Create proximity placement group** button or use the **+ Add** button from the top menu bar of the blade.
4. In the **Create Proximity Placement Groups** wizard blade, the **Basics** tab provides the following information:
 - a) **Subscription:** Select the subscription to be billed for this resource.
 - b) **Resource group:** Select an existing resource group or select **Create new**.
 - c) **Region:** Enter the region into which resources should be deployed that will be associated with the proximity placement group.
 - d) **Proximity placement group name:** Enter a name for the proximity placement group.
5. Select **Next: Tags** and add any tags as required. Click **Next: Review + create**.
6. On the **Review + create** tab, review your settings; you may go back to the **Basics** or **Tags** tab and make any edits if required. Once you have confirmed your settings are as required, you can click **Create**.

You will receive a notification that the proximity placement group was created successfully.

7. In the **Proximity placement groups** blade, the created group can be seen:

The screenshot shows the Microsoft Azure portal interface. At the top, there's a navigation bar with 'Microsoft Azure', a search bar, and various icons. Below the navigation bar, the page title is 'Proximity placement groups'. A sub-header indicates the scope: 'milesbetter.solutions (NETORGFT8723201.onmicrosoft.com)'. There are several action buttons: '+ Add', 'Manage view', 'Refresh', 'Export to CSV', 'Open query', 'Feedback', and 'Assign tags'. Below these are filter options: 'Subscription == all', 'Resource group == all', 'Location == all', and a 'No grouping' dropdown set to 'List view'. The main content area shows a single record: 'DogOrMuffin-ML-PPG'. The table columns are 'Name', 'Group ...', 'Type', 'Subscription', 'Resource group', and 'Location'. The row shows: Name 'DogOrMuffin-ML-PPG', Group '0', Type 'Standard', Subscription 'Project DogOrMuffin', Resource group 'DogOrMuffin-ML-RG', and Location 'UK South'. There's also a '...' button at the end of the row.

Figure 3.42 – Reviewing the created group

8. When creating a resource that can utilize a proximity placement group, select the proximity placement group to use with that resource.

Important note

The resource you are creating must be in the same region as the availability set; otherwise, there will be no availability sets available for you to select.

In this exercise, we looked at creating proximity placement groups. In the following exercise, we will look at creating availability sets.

Exercise 5 – availability sets

In this section, we will look at the steps to create availability sets.

To recap from a previous section, **Availability sets**, where they were covered, availability sets are used to provide redundancy for a virtual machine to protect from failures within an individual data center, such as a hardware cluster failure.

Follow these steps to create an availability set:

1. Log in to the Azure portal at <https://portal.azure.com>. You can alternatively use the Azure desktop app: <https://portal.azure.com/App/Download>.
2. In the search bar, type in **availability set**; click on **Availability sets** from the list of services shown.
3. In the **Availability sets** blade, click on the **Create availability set** button or use the **+ Add** button from the top menu bar of the blade.
4. In the **Create availability set** wizard blade's **Basics** tab, provide the following information:
 - a) **Subscription**: Select the subscription to be billed for this resource.
 - b) **Resource group**: Select an existing resource group or select **Create new**.
 - c) **Name**: Enter a name for the availability set.

- d) **Region:** Enter the region into which resources should be deployed that will be associated with the availability set.
 - e) **Fault domains:** Enter the number of fault domains required, or accept the provided value if already at the maximum.
 - f) **Update domains:** Enter the number of update domains required.
 - g) Click **Next: Advanced**.
5. In the **Advanced** tab, select a proximity placement group if required.
- Select **Next: Tags** and add any tags as required. Click **Next: Review + create**.
6. On the **Review + create** tab, review your settings; you may go back to the **Basics**, **Advanced**, or **Tags** tab and make any edits if required. Once you have confirmed your settings are as required, you can click **Create**.
- You will receive a notification that the availability set was created successfully.
7. In the **Availability sets** blade, the created availability set can be seen:

Name	Resource group	Location	Subscription
DogOrMuffin-ML-AS	DogOrMuffin-ML-RG	UK South	Project DogOrMuffin

Figure 3.43 – Availability sets

8. When creating a resource that can utilize availability sets, you can now select the availability set to use with that resource.

Important note

The resource you are creating must be in the same region as the availability set; otherwise, there will be no availability sets available for you to select.

In this exercise, we looked at creating availability sets.

Chapter 4

Technical requirements

To carry out the hands-on labs in this chapter, you will need the following:

- An Azure subscription so that you can create and delete resources in the subscription. If you do not have an Azure subscription, you can create a free Azure account from this URL:
<https://azure.microsoft.com/free>.
- Access to an internet browser; you will be logging into the Azure portal at
<https://portal.azure.com>.

Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Figures

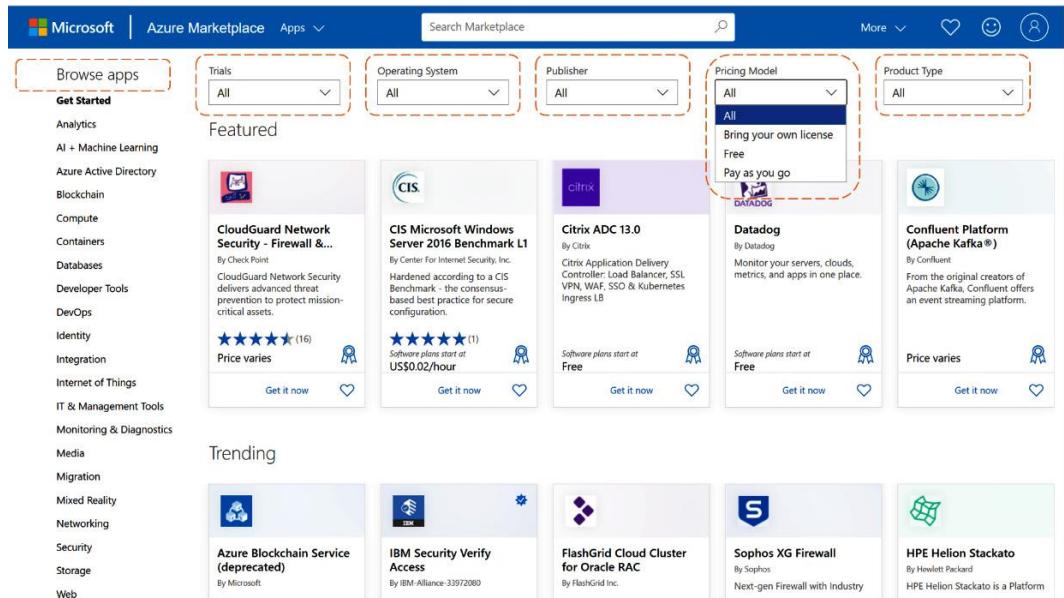


Figure 4.1 – Azure Marketplace

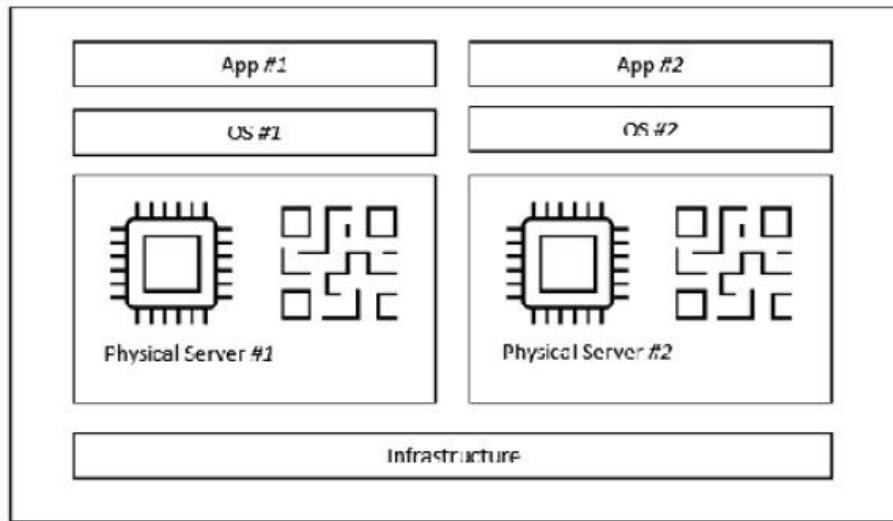


Figure 4.2 – Traditional physical servers approach

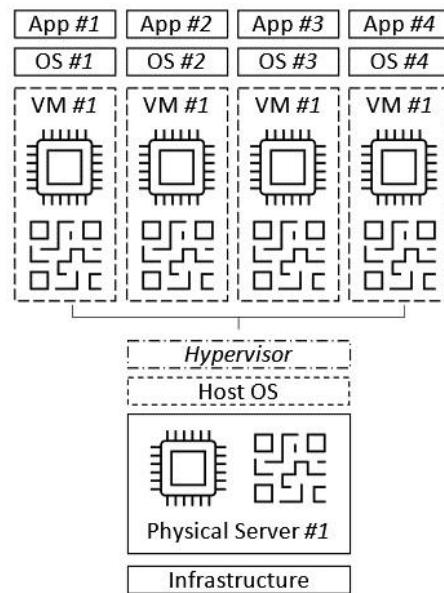


Figure 4.3 – Virtualization approach

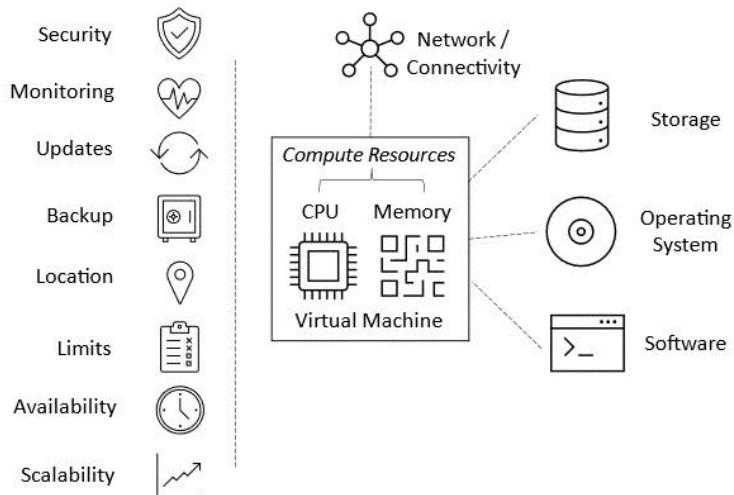


Figure 4.4 – VM components and considerations

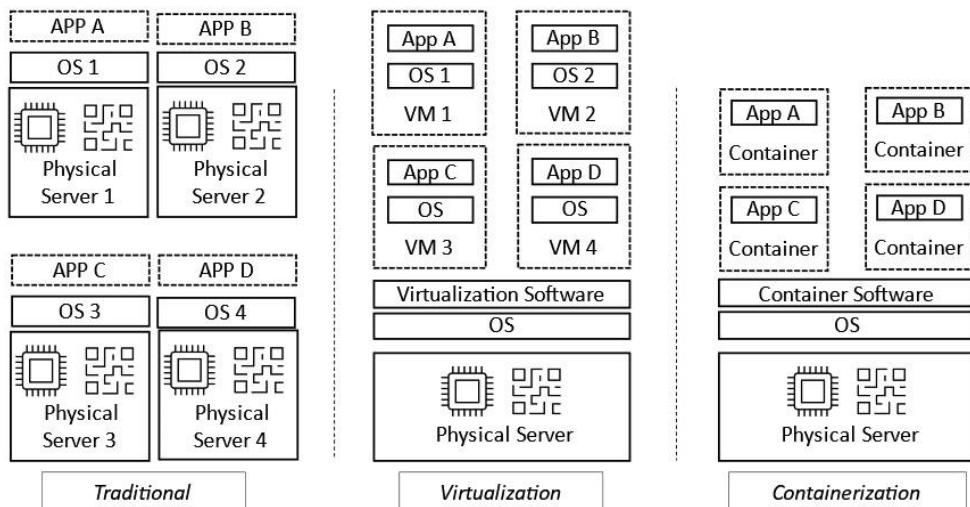


Figure 4.5 – Traditional versus virtualization versus containerization

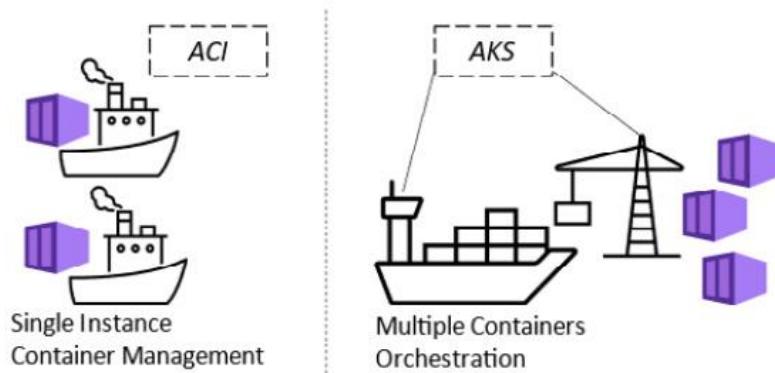


Figure 4.6 – ACI versus AKS

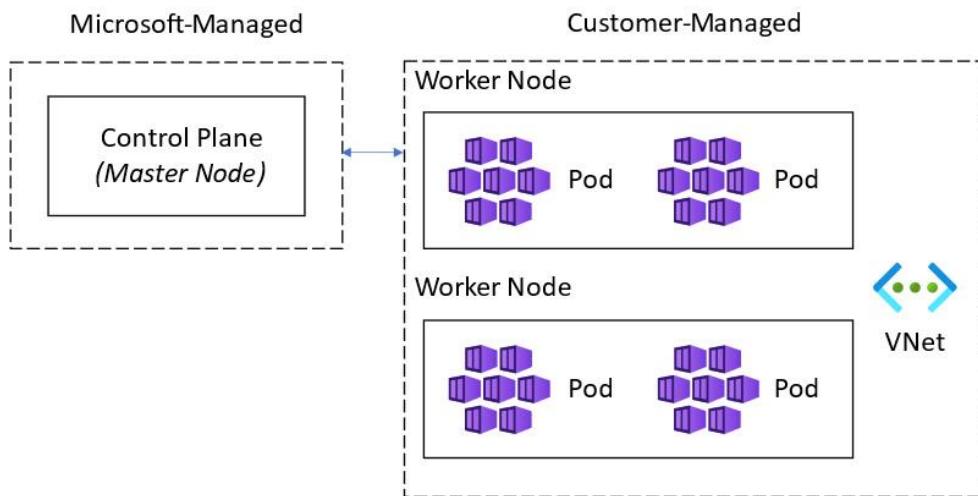


Figure 4.7 – AKS high-level service architecture

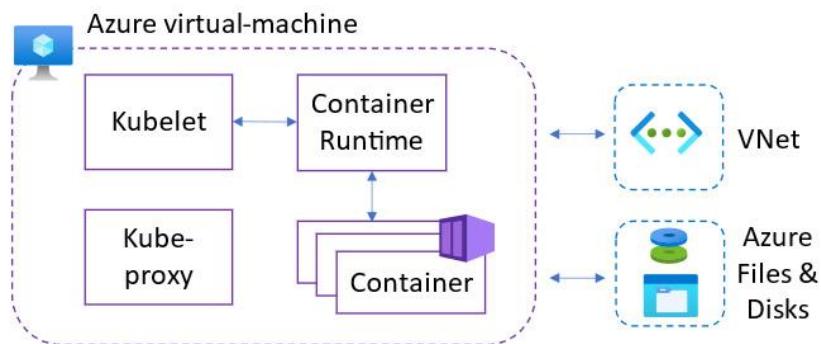


Figure 4.8 – Worker node high-level service architecture

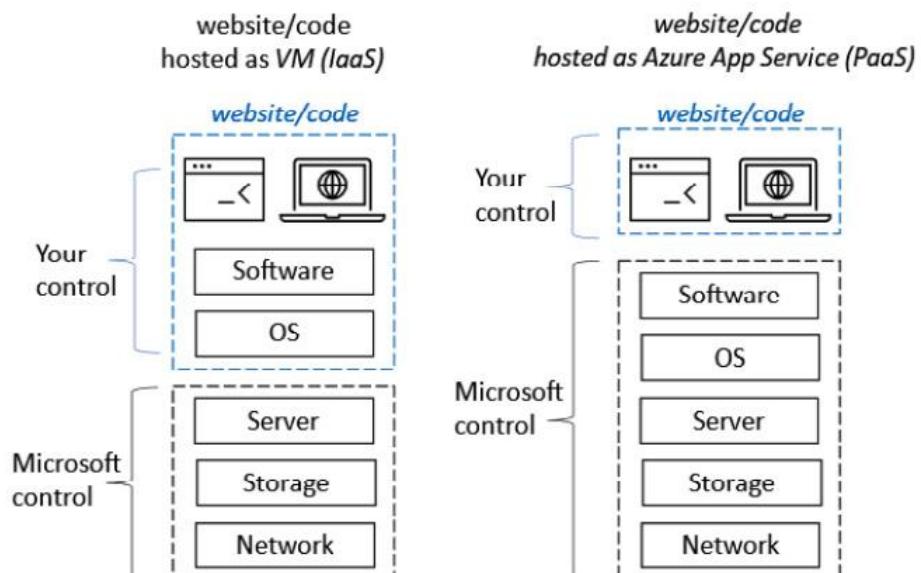


Figure 4.9 – Azure App Service

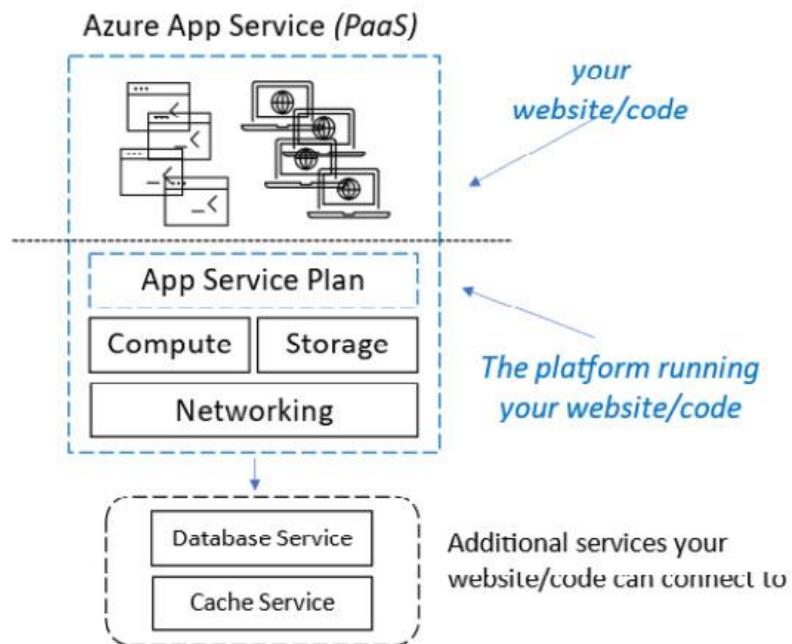


Figure 4.10 – Azure App Service plan

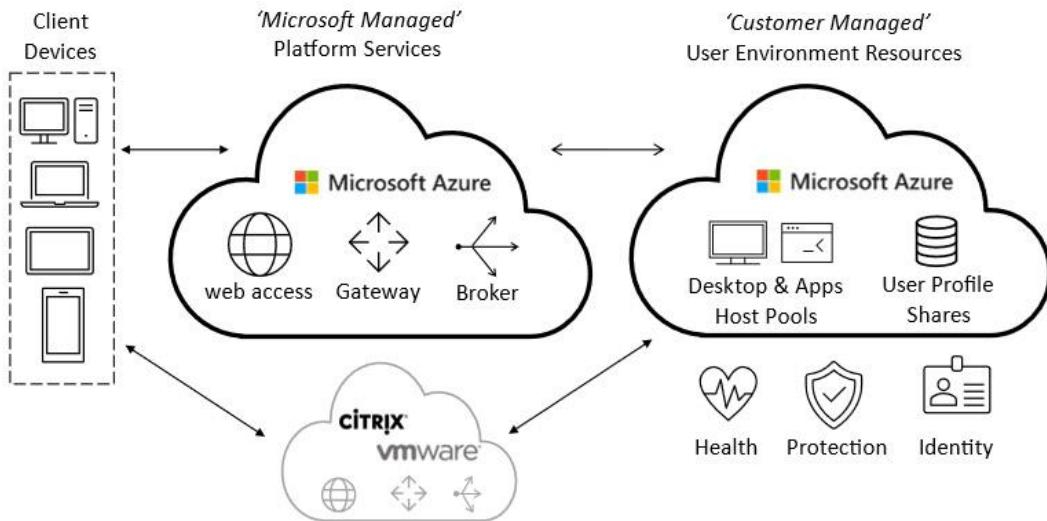


Figure 4.11 – Virtual Desktop

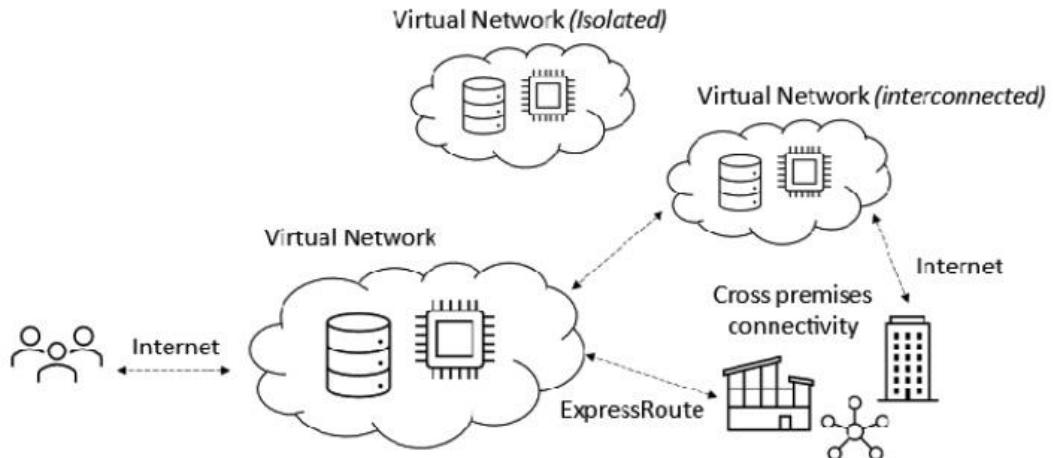


Figure 4.12 – Azure Virtual Networks

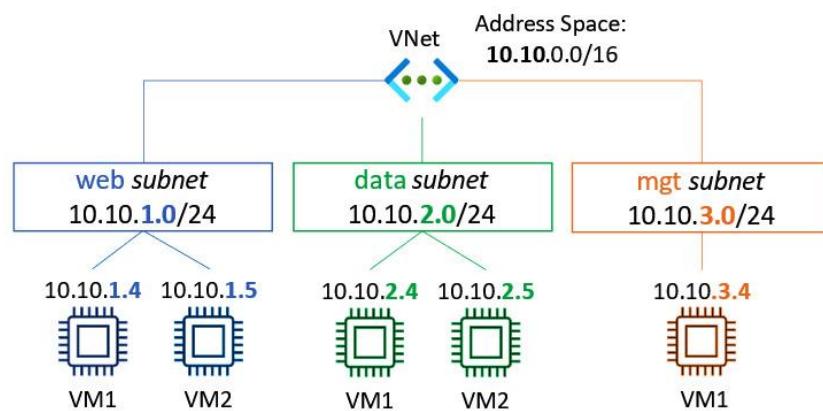


Figure 4.13 – VNet segmentation

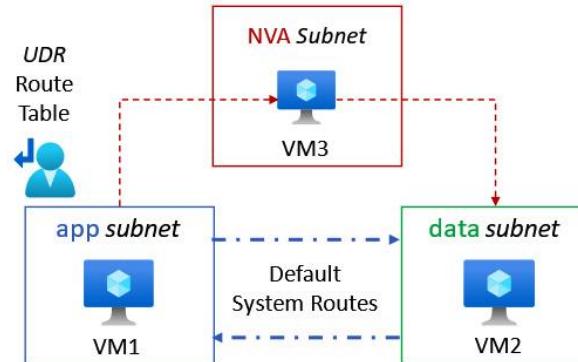


Figure 4.14 – Internal VNet routing

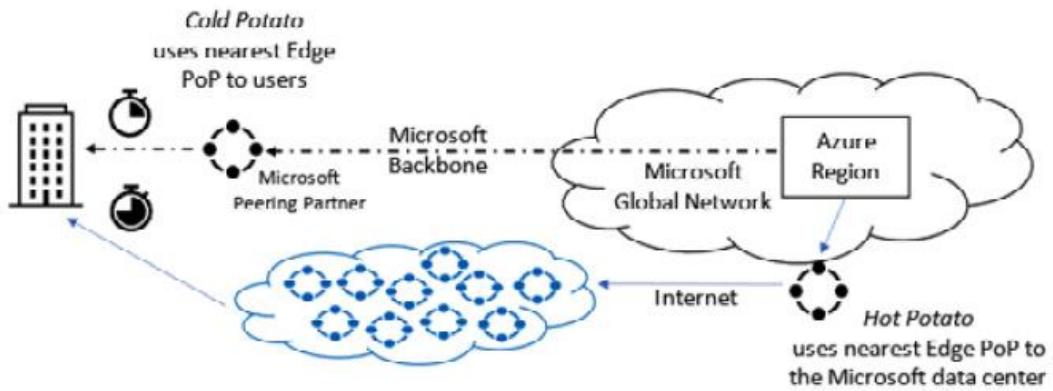


Figure 4.15 – Hot- versus cold-potato routing

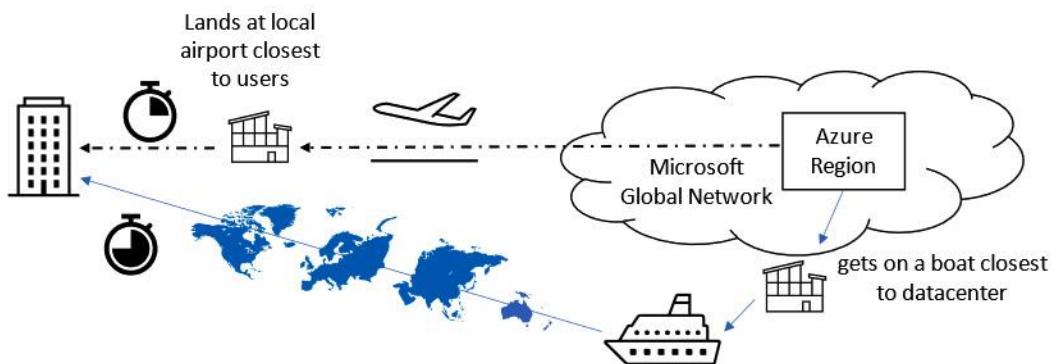


Figure 4.16 – Air travel versus shipping routes

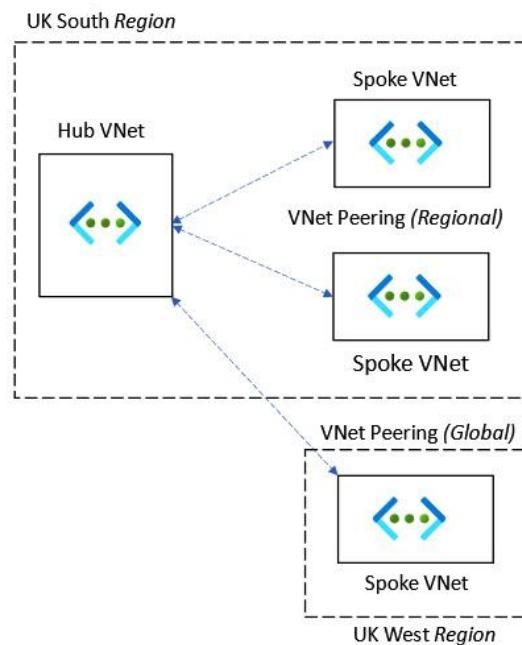


Figure 4.17 – VNet peering

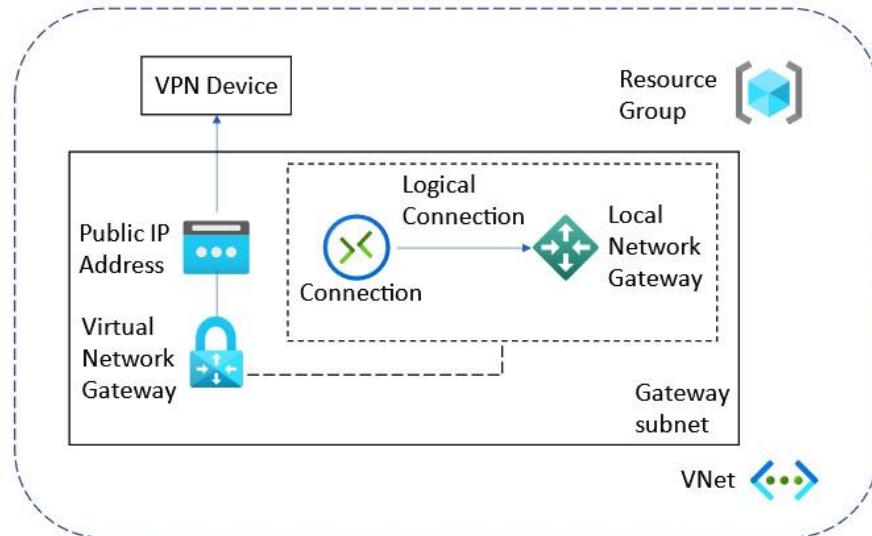


Figure 4.18 – VPN gateway resources

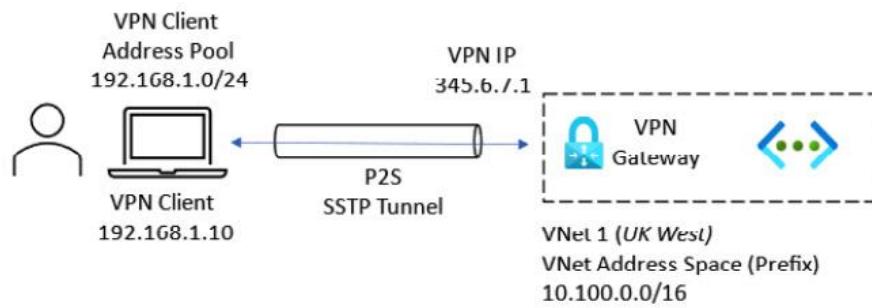


Figure 4.19 – Point-to-Site VPN

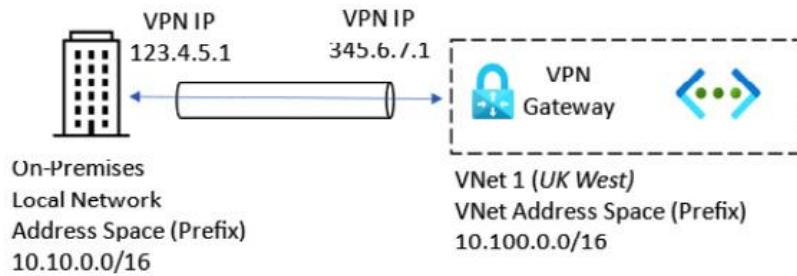


Figure 4.20 – Site-to-Site VPN

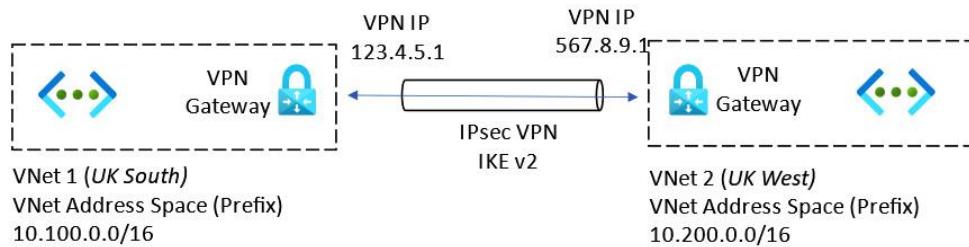


Figure 4.21 – VNet-to-VNet VPN

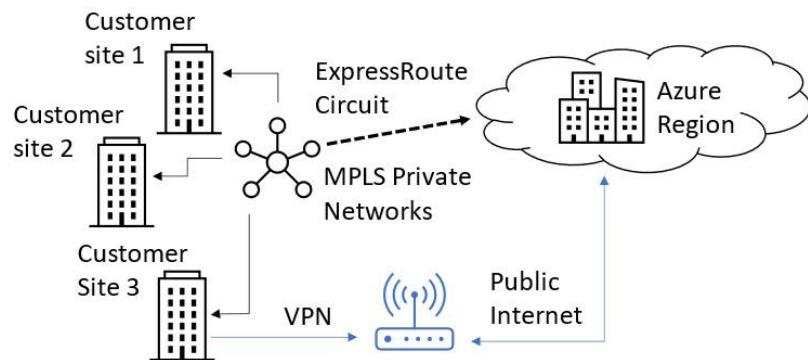


Figure 4.22 – ExpressRoute

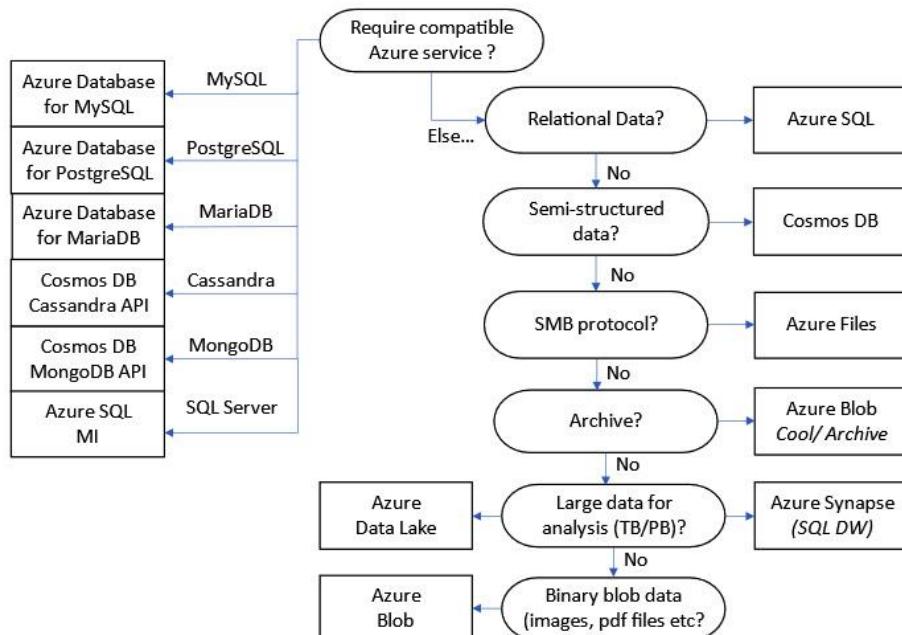


Figure 4.23 – Selecting a data store

Code

The following are the endpoints of each of the Azure storage services:

- Blob storage: <https://<storage-account>.blob.core.windows.net>
- Data Lake Storage Gen2: <https://<storage-account>.dfs.core.windows.net>
- Azure Files: <https://<storage-account>.file.core.windows.net>
- Queue storage: <https://<storage-account>.queue.core.windows.net>
- Table storage: <https://<storage-account>.table.core.windows.net>

Links

Azure Marketplace:

- <https://azuremarketplace.microsoft.com>
- https://portal.azure.com/#blade/Microsoft_Azure_Marketplace/MarketplaceOffersBlade

Sizes for virtual machines in Azure: <https://docs.microsoft.com/azure/virtual-machines/sizes>.

Hands-on exercises

To support your learning with some practical skills, we will learn how to create some of the resources that we looked at in this chapter.

We will look at the following exercises:

- Exercise 1 – creating a VNet
- Exercise 2 – creating a storage account
- Exercise 3 – creating a VM
- Exercise 4 – creating an Azure container instance
- Exercise 5 – creating an Azure web app

Getting started

To get started with these hands-on exercises, you must create a free Azure account at <https://azure.microsoft.com/free>.

This free Azure account provides the following:

- 12 months of free services
- \$200 credit to explore Azure for 30 days
- 25+ services that are always free

Let's move on to the first exercise.

Exercise 1 – creating a VNet

In this section, we will look at how to create a VNet.

Follow these steps to create a VNet:

9. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.
10. In the search bar, type **virtual network** and click on **Virtual Network** from the list of services shown.
11. On the **Virtual networks** blade, click on **+ Create**. It should be at the top of the blade.
12. Set the **Project details** and **Instance details** settings as required via the **Basics** tab.
13. Click **Next: IP Addresses**.
14. On the **IP Addresses** tab, create an IPv4 address space and subnets; you can use the existing defaults or adjust them as required for your scenario. It is recommended to use a NAT gateway for outbound internet access from a subnet; alternatively, you can use an NVA.
15. Click **Next: Security**.
16. On the **Security** tab, choose to enable or disable **BastionHost**, **DDoS Protection Standard**, and **Firewall**, as required for your scenario.
17. Click **Next: Tags** and add any tags as required. Then, click **Next: Review + create**.
18. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.
19. You will receive a notification that the resource group was created successfully.
20. From the **Virtual networks** blade, you will be able to see the VNet that was created:

The screenshot shows the Azure portal's 'Virtual networks' blade. At the top, there are navigation links for 'Home >' and a search bar. Below that is a header with 'Virtual networks' and filter options: 'Subscription == Project Lobster', 'Resource group == all', 'Location == all', and a 'Create' button. A message indicates 'Showing 1 to 1 of 1 records.' Below this, a table lists one item: 'lob-vnet1-uk' with a checkmark next to it, under the columns 'Name', 'Resource group', 'Location', and 'Subscription'. There are also 'List view' and 'More' buttons at the bottom right of the table.

Figure 4.24 – Virtual networks

In this exercise, we looked at creating a VNet. In the next exercise, we will look at creating a storage account.

Exercise 2 – creating a storage account

In this section, we will look at how to create a storage account.

Follow these steps to create a storage account:

1. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.
2. In the search bar, type `storage account` and click on **Storage accounts** from the list of services shown.
3. On the **Storage accounts** blade, click on **+ Create**. It should be at the top of the blade.
4. On the **Basics** tab, set the **Project details** and **Instance details** settings as required.
5. Click **Next: Advanced**.
6. On the **Advanced** tab, set the **Security**, **Data Lake Storage Gen2**, **Blob**, **Azure Files**, **Tables**, and **Queues** settings as required.
7. Click **Next: Networking**.
8. On the **Networking** tab, set the **Network connectivity** and **Network routing** settings as required.
9. Click **Next: Data Protection**.
10. On the **Data protection** tab, set the **Recovery** and **Tracking** settings as required.
11. Click **Next: Tags** and add any tags as required. Then, click **Next: Review + create**.
12. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.
13. You will receive a notification stating that the resource group was created successfully.
14. From the **Storage accounts** blade, you will be able to see the storage account that was created:

The screenshot shows the Azure Storage accounts blade. At the top, there's a breadcrumb navigation 'Home > Storage accounts'. Below it is a header with a 'Create' button, a 'Manage view' dropdown, a 'Refresh' button, a 'CSV' export button, a 'Query' button, a 'Feedback' button, and a 'Delete' button. There are also buttons for 'Assign tags' and 'Add filter'. A search bar says 'Filter for any field...' and dropdown filters for 'Subscription == Project Lobster', 'Resource group == all', and 'Location == all' are visible. Below the filters, a message says 'Showing 1 to 1 of 1 records.' A table lists one record: 'lobsa1uks' (Storage account), 'StorageV2' (Kind), 'Bisque-RG' (Resource group), 'UK South' (Location), and 'Project Lobster' (Subscription). There are also 'Name ↑', 'Type ↑', 'Kind ↑', 'Resource group ↑', 'Location ↑', and 'Subscription ↑' buttons. A 'List view' dropdown is also present.

Figure 4.25 – Storage accounts

In this exercise, we looked at creating a storage account. In the next exercise, we will look at creating a VM.

Exercise 3 – creating a VM

In this section, we will learn how to create a VM.

Follow these steps to create a VM:

1. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.
2. In the search bar, type **virtual machines** and click on **Virtual machines** from the list of services.
3. On the **Virtual machines** blade, click on **+ Create** and then **Virtual machine**. This option should be at the top menu of the blade.
4. On the **Basics** tab, set the **Project details**, **Instance details**, **Administrative accounts**, **Inbound port rules**, and **Licensing** settings as required.
5. Click **Next: Disks**.
6. On the **Disks** tab, set the **Disk options** settings as required; add any **data disks** that are required.
7. Click **Next: Networking**.
8. On the **Networking** tab, set the **Network interface** and **Load balancing** settings as required.
9. Click **Next: Management**.
10. On the **Management** tab, set all the settings that are required.
11. Click **Next: Advanced**.
12. On the **Advanced** tab, set all the settings that are required.
13. Click **Next: Tags** and add any tags that are required. Then, click **Next: Review + create**.
14. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.
15. You will receive a notification stating that the resource group was created successfully.
16. From the **Virtual machines** blade, you will be able to see the VM that was created:

The screenshot shows the Azure portal's 'Virtual machines' blade. At the top, there are navigation links for 'Home', 'Virtual machines', and a user profile. Below the header is a toolbar with various icons for creating new resources, switching views, managing reservations, and more. The main area displays a table of virtual machines. A single row is selected, showing the following details:

Name	Subscription	Resource group	Location	Status	Operating system	Size
crayfish1-vm	Project Lobster	BISQUE-RG	UK South	Running	Windows	Standard_D2s_v3

Figure 4.26 – Virtual machines

In this exercise, we successfully created a VM. In the next exercise, we will look at creating an Azure container instance.

Exercise 4 – creating an Azure container instance

In this section, we will look at how to create an Azure container instance.

Follow these steps to create a container:

1. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portalAzure.com/App/Download>.
2. In the search bar, type **container instance** and click on **Container instances** from the list of services shown.
3. From the **Virtual networks** blade, click on **+ Create**. It should be at the top of the blade.
4. On the **Basics** tab, set the **Project details** and **Container details** settings as required.
5. Click **Next: Networking**.
6. On the **Networking** tab, set the **Networking** settings as required.
7. Click **Next: Advanced**.
8. On the **Advanced** tab, leave the settings as is.
9. Click **Next: Tags** and add any tags as required. Then, click **Next: Review + create**.
10. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.
11. You will receive a notification stating that the resource group was created successfully.
12. From the **Container instances** blade, we will be able to see the container that was created:

The screenshot shows the Microsoft Azure Container Instances blade. At the top, there's a header with the Microsoft Azure logo, a search bar, and user information (smiles@milesbetter.solu... MILESBETTER SOLUTIONS (NETO...)). Below the header, the title is 'Container instances' with a back arrow and three dots. Underneath the title, it says 'milesbetter.solutions (NETORGFT8723201.onmicrosoft.com)'. There are several buttons: '+ Create', 'Manage view', 'Refresh', 'Export to CSV', 'Open query', 'Assign tags', and 'Feedback'. Below these are filters: 'Subscription == all', 'Resource group == all', 'Location == all', and 'Add filter'. A message 'Showing 1 to 1 of 1 records.' is displayed. The main table has columns: Name, Resource group, Location, Status, OS type, Total c..., Subscription, and a more options icon. One record is listed: 'lobster-container-demo' (Resource group: Bisque-RG, Location: UK South, Status: Succeeded, OS type: Windows, Total c...: 1, Subscription: Project Lobster).

Figure 4.27 – Container instance

In this exercise, we looked at creating an Azure container instance. In the next exercise, we will look at creating a web app.

Exercise 5 – creating an Azure web app

In this section, we will look at the steps to create a web app.

Follow these steps to create a web app:

1. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.
2. In the search bar, type **app service** (or **web app**) and click on **App Services** from the list of services.
3. From the **Virtual machines** blade, click on **+ Create** and then **Virtual machine**. This option should be at the top menu of the blade.
4. From the **Basics** tab, set the **Project Details** and **Instance Details** settings as required. Then, set **App Service Plan** to use an existing one or create new App Service plan, and set the size as required.
5. Click **Next: Deployment**.
6. From the **Deployment** tab, leave the settings as is.
7. Click **Next: Monitoring**.
8. From the **Monitoring** tab, enable **Application Insights**.
9. Click **Next: Tags** and add any tags as required. Then, click **Next: Review + create**.
10. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.
11. You will receive a notification stating that the resource group was created successfully.
12. From the **App Services** blade, you can see the web app that was created:

The screenshot shows the Microsoft Azure portal's App Services blade. At the top, there's a navigation bar with 'Microsoft Azure', a search bar, and user information ('smiles@milesbetter.solu... MILESBETTER.SOLUTIONS (NETO...')). Below the navigation is a breadcrumb trail 'Home > App Services' and the page title 'App Services'. A sub-header indicates the resource group is 'milesbetter.solutions (NETORGFT8723201.onmicrosoft.com)'. The main area contains a table with the following data:

Name	Status	Location	Pricing Tier	App Service Plan	Subscription	App Type
lobster-webapp-demo	Running	UK South	Free	ASP-BisqueRG-a157	Project Lobster	Web App

Figure 4.28 – App Services

In this exercise, we successfully created an App Service web app.

Chapter 5

Technical requirements

To carry out the hands-on labs in this chapter, you will need the following:

- An Azure subscription that can create and delete resources in the subscription. If you do not have an Azure subscription, you can create a free Azure account by going to <https://azure.microsoft.com/free>.
- Access to an internet browser so that you can log into the Azure portal: <https://portal.azure.com>.
- Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.
- A Twitter account and an Outlook account for sending notifications (<https://help.twitter.com/en/using-twitter/create-twitter-account> and <https://www.microsoft.com/en-gb/microsoft-365/outlook/>, respectively).

Figures

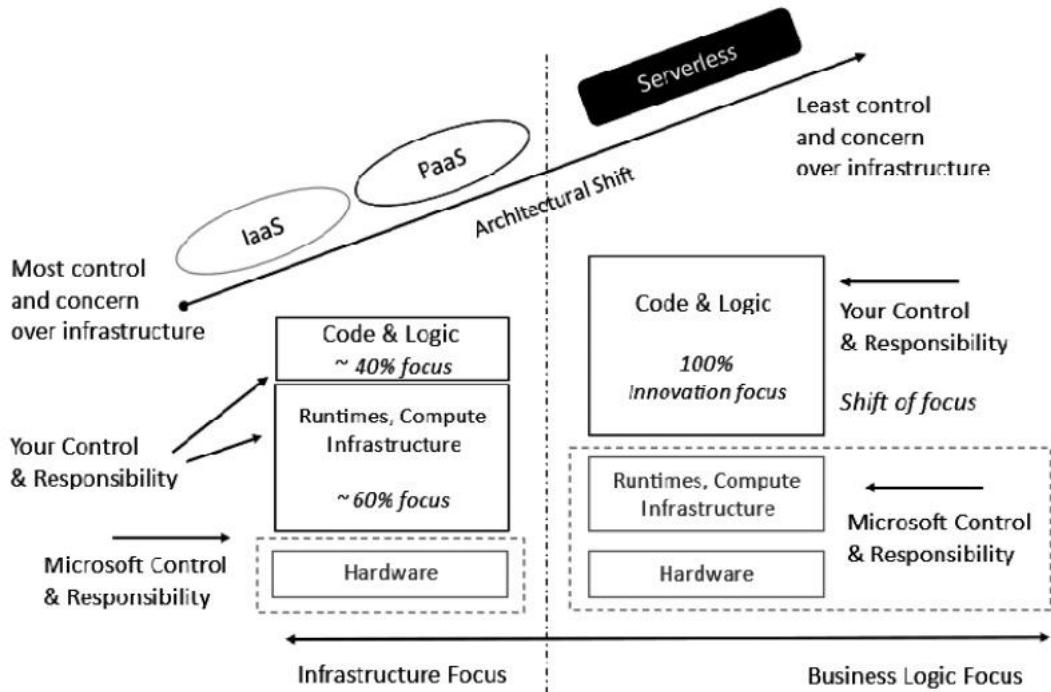


Figure 5.1 – Serverless positioning

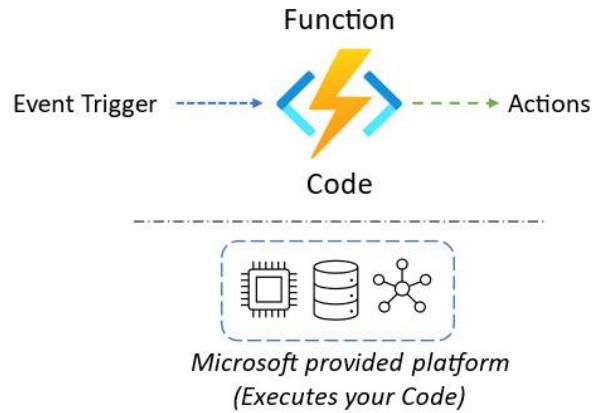


Figure 5.2 – Serverless code execution platform

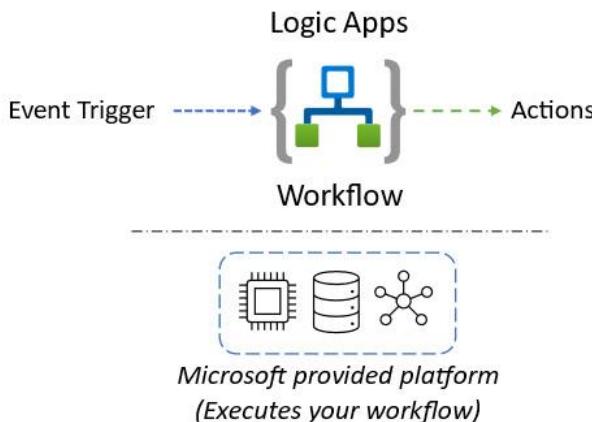


Figure 5.3 – Serverless workflow/orchestration platform

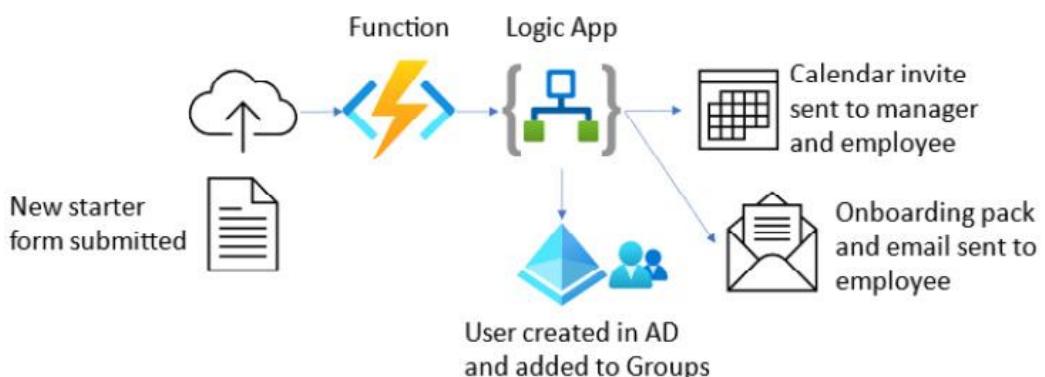


Figure 5.4 – Serverless use case scenario

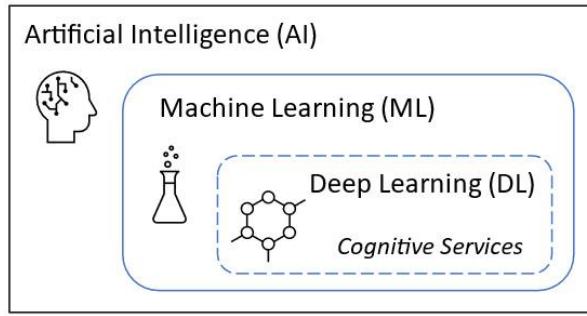


Figure 5.5 – Artificial intelligence inter-relations

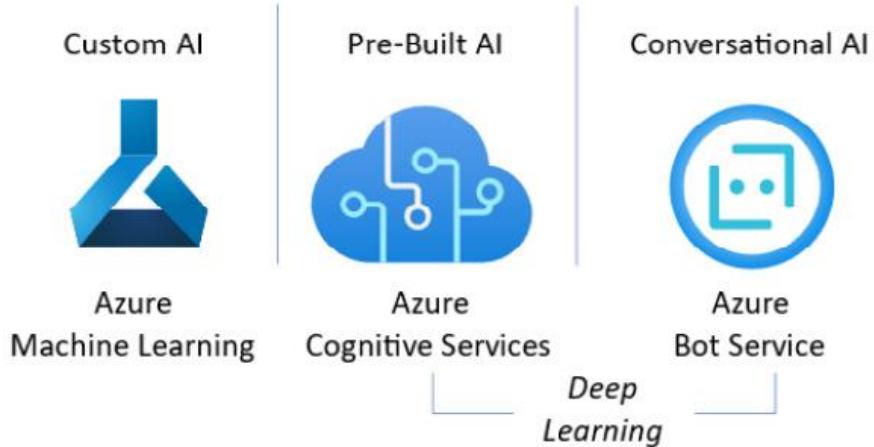


Figure 5.6 – Microsoft AI platform services

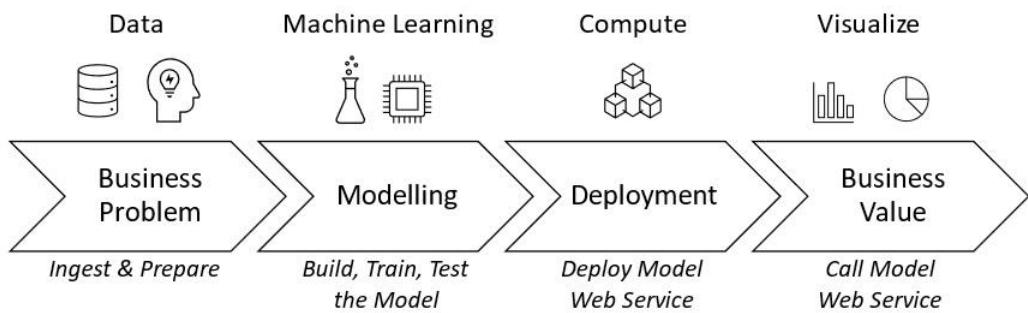


Figure 5.7 – Azure Machine Learning solution approach



Figure 5.8 – Sadie, Mrs Smile's Muffins, or Daisy

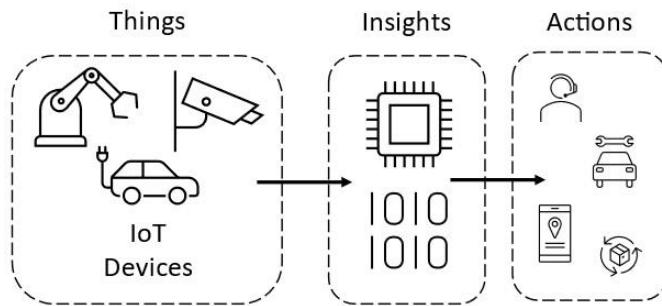


Figure 5.9 – Core IoT elements

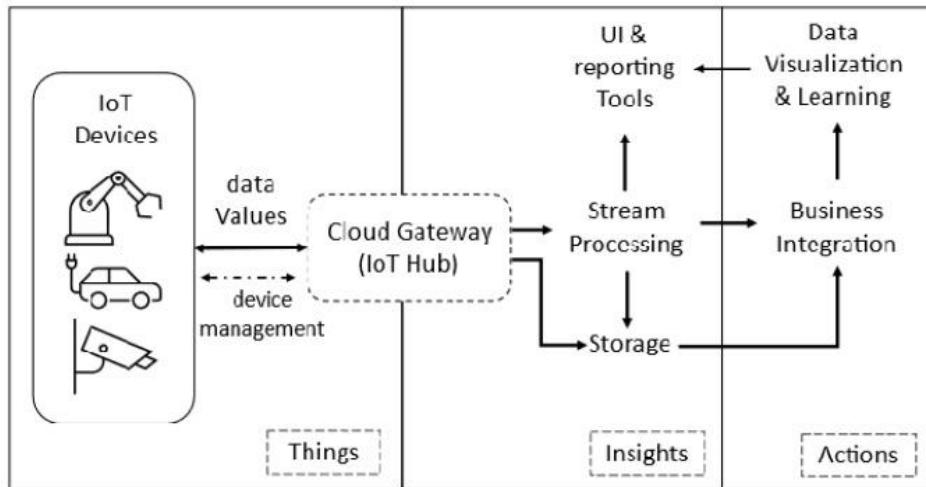


Figure 5.10 – Azure IoT reference architecture

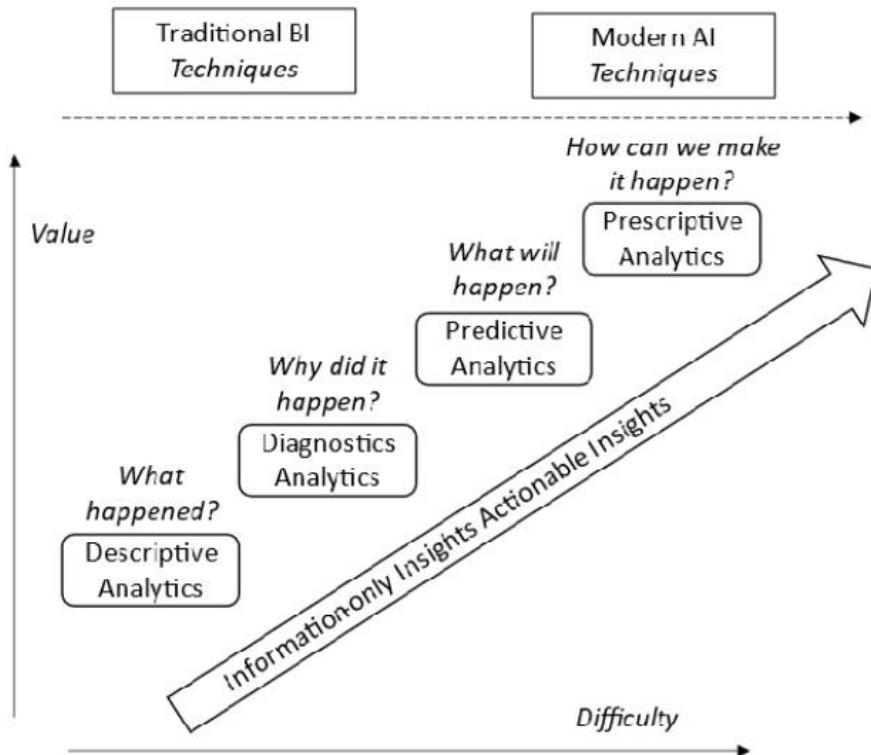


Figure 5.11 – Analytics techniques

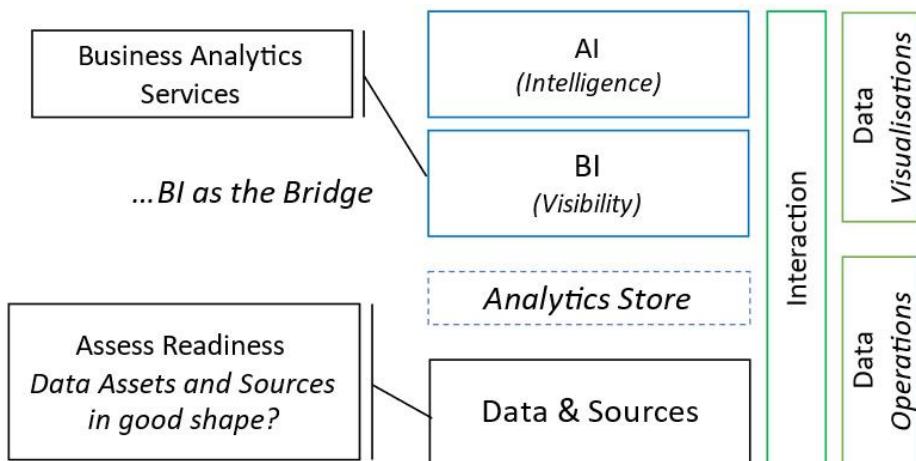


Figure 5.12 – Analytics as a bridge

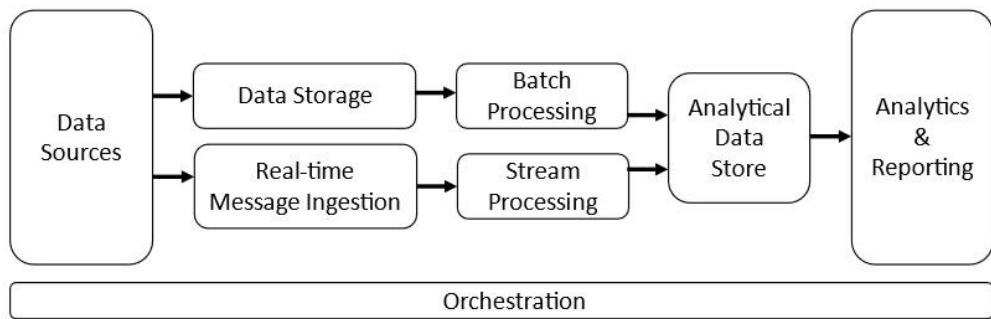


Figure 5.13 – Big data and analytics architecture

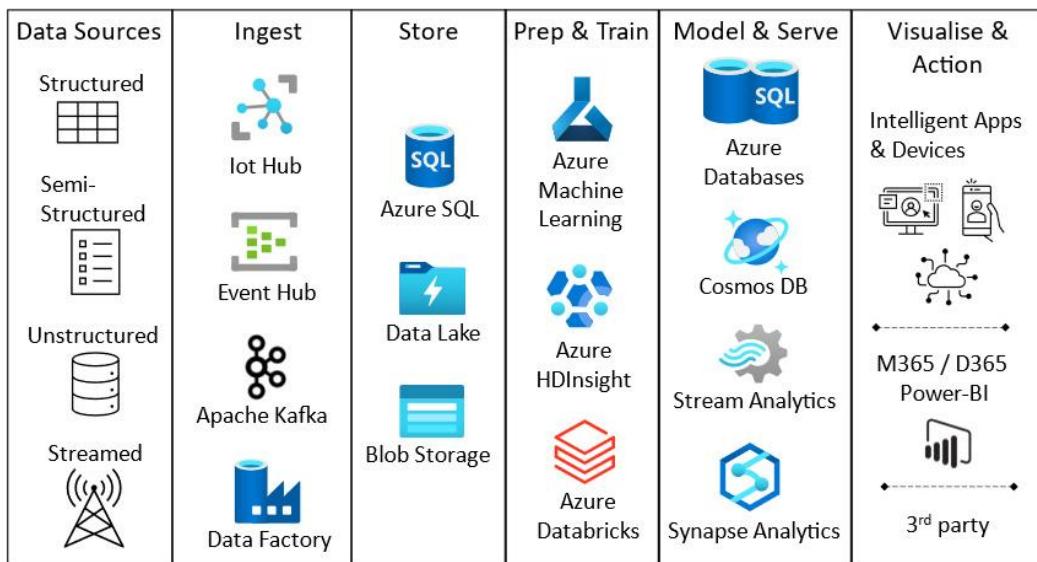


Figure 5.14 – Azure data landscape

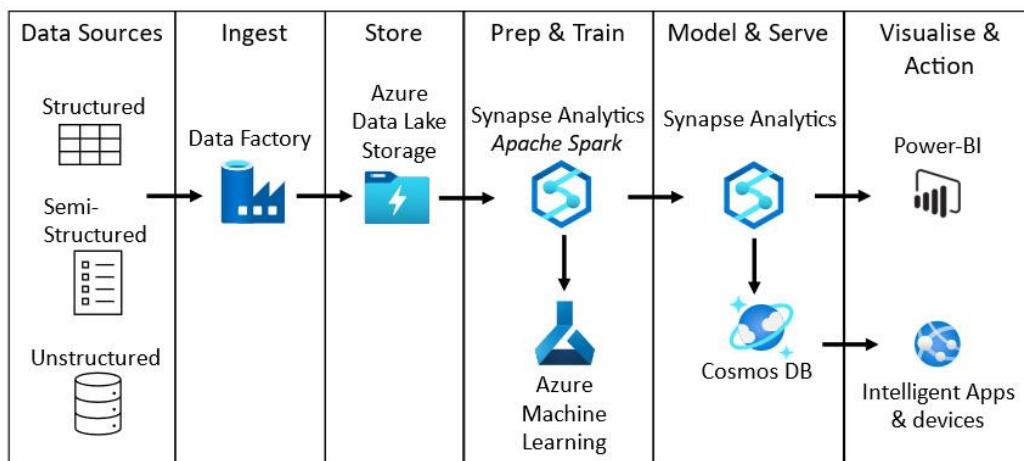


Figure 5.15 – Azure Synapse Analytics solution architecture

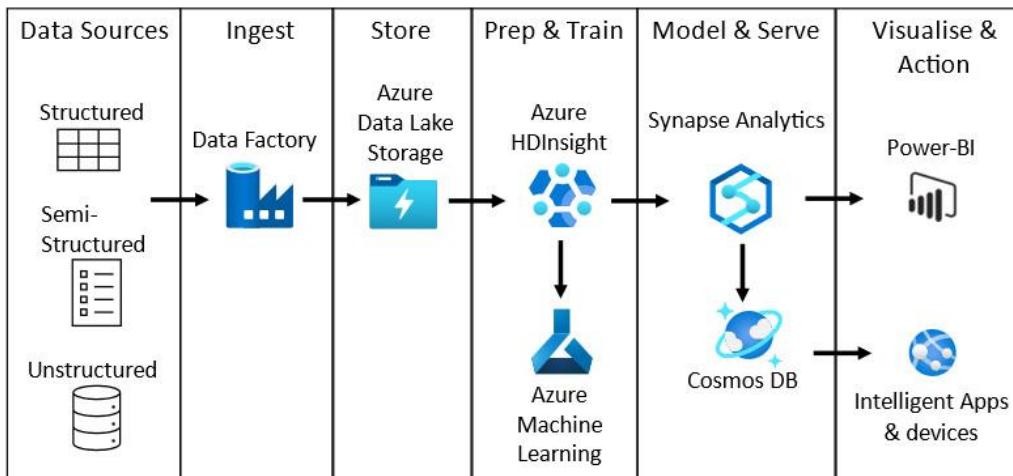


Figure 5.16 – Azure HDInsight solution architecture

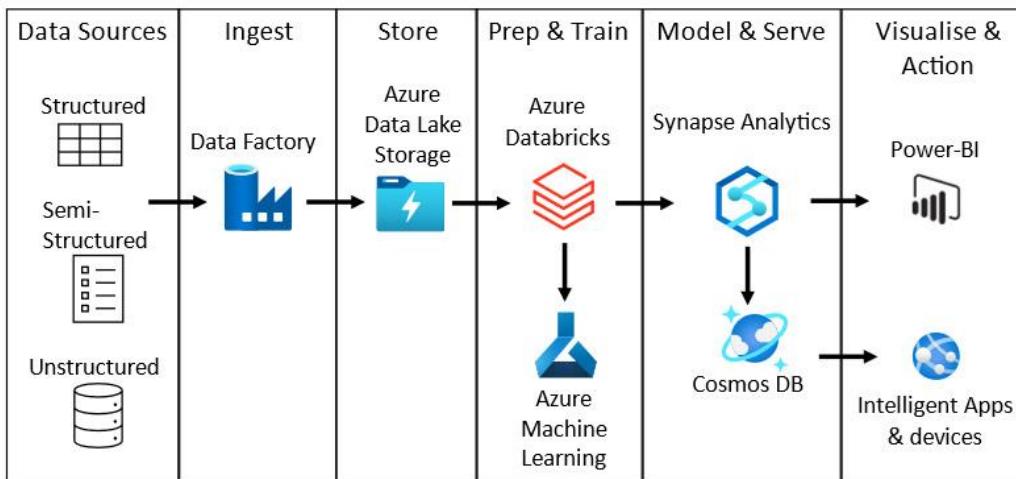


Figure 5.17 – Azure Databricks solution architecture

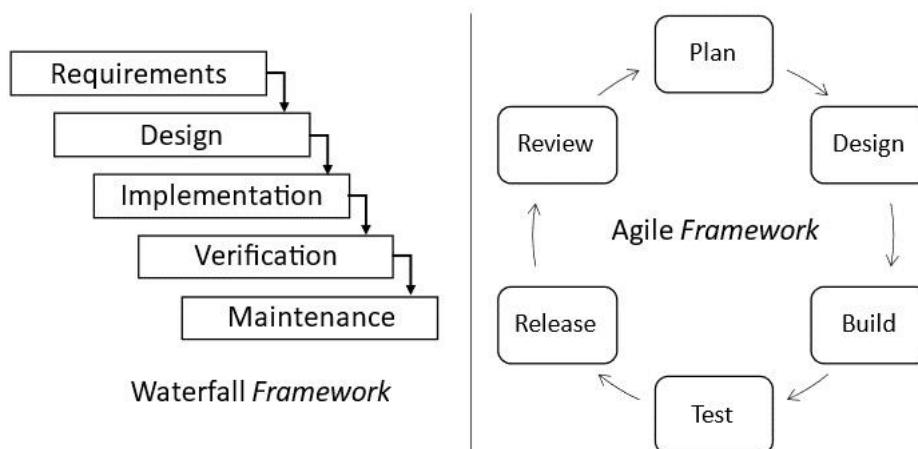


Figure 5.18 – Waterfall and agile frameworks

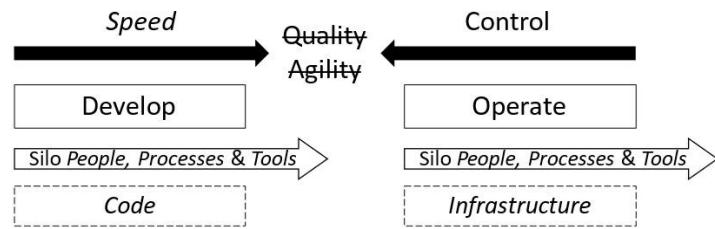


Figure 5.19 – Opposing team cultures

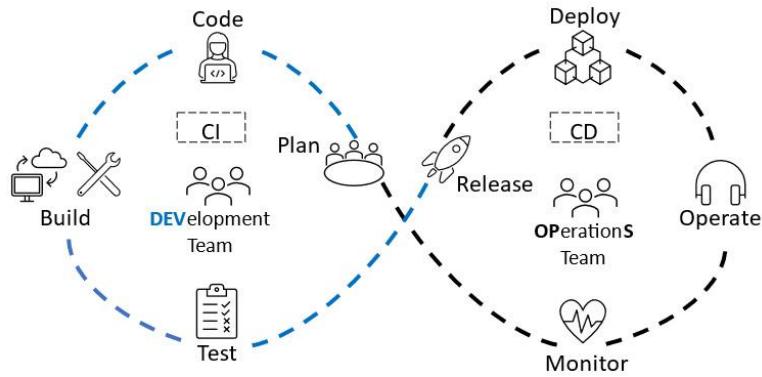


Figure 5.20 – The DevOps process flow

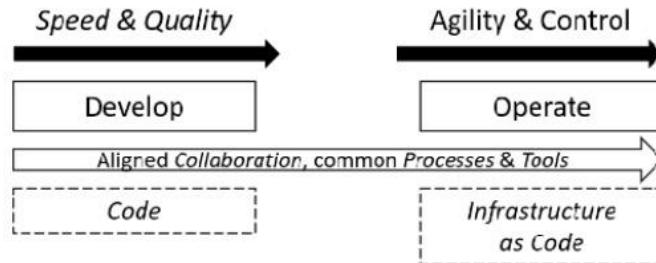


Figure 5.21 – Unified team culture and alignment of goals

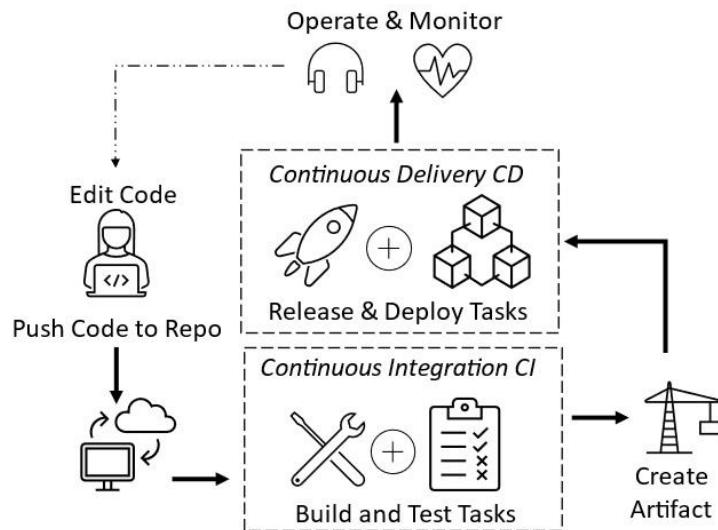


Figure 5.22 – Continuous integration/continuous delivery

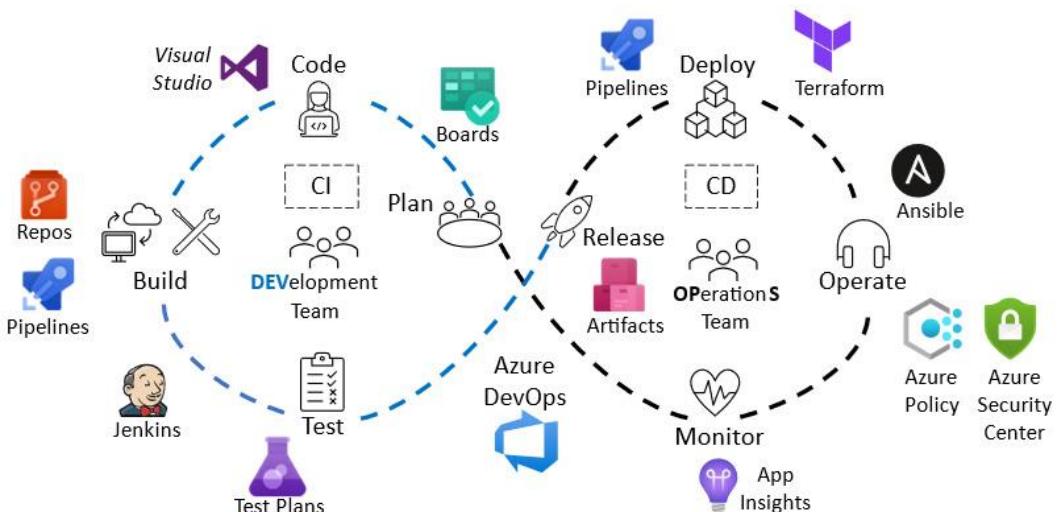


Figure 5.23 – Azure DevOps services

Further reading

This section provides links to additional exam information and study references:

- Exam AZ-900: Microsoft Azure Fundamentals:
<https://docs.microsoft.com/learn/certifications/exams/az-900>
- Exam AZ-900: skills outline:
<https://query.prod.cms.rt.microsoft.com/cms/api/binary/RE3VwUY>
- Microsoft Learn: Azure Fundamentals – Describe core solutions on Azure:
<https://docs.microsoft.com/learn/paths/az-900-describe-core-solutions-management-tools-azure>

- Azure Serverless, Azure Logic Apps, and Azure Functions:
<https://docs.microsoft.com/azure/logic-apps/logic-apps-serverless-overview>
- Azure IoT: <https://docs.microsoft.com/azure/iot-fundamentals>
- Artificial intelligence (AI): <https://docs.microsoft.com/azure/architecture/data-guide/big-data/ai-overview>
- Cognitive Services: <https://docs.microsoft.com/learn/paths/explore-computer-vision-microsoft-azure/>
- Big data and analytics: <https://azure.microsoft.com/solutions/big-data/#solution-architectures>
- Azure DevOps: <https://docs.microsoft.com/azure/devops/?view=azure-devops>

Hands-on exercises

To support your learning with some practical skills, we will complete some hands-on exercises surrounding some of the resources covered in this chapter.

The following exercises will be covered:

- Exercise 1 – Creating a serverless solution using an Azure Function
- Exercise 2 – Creating a serverless solution using an Azure Logic App
- Exercise 3 – Creating an IoT solution using an Azure IoT Hub
- Exercise 4 – Creating an AI solution using a Bot Service

Getting started

To get started with these hands-on exercises, you must create a free Azure account at <https://azure.microsoft.com/free>.

This free Azure account provides the following:

- 12 months of free services
- \$200 credit to explore Azure for 30 days
- 25+ services that are always free

In addition, you will also need a Twitter account and an Outlook account to send notifications.

Exercise 1 – Creating a serverless solution using an Azure Function

This section will look at the steps to create a simple *Hello World* type of serverless solution example that will use a function based on an HTTP trigger. When we pass a value, code will be triggered to execute and return a response.

This could be the basis for a very simple inventory or assets, a lookup solution, or any solution that requires a message to be displayed when there is an HTTP request.

In the following subsections, the process of creating a solution has been segregated into tasks for ease of understanding.

Task – Accessing the Azure portal

1. Log into the Azure portal: <https://portal.azure.com>.

Task – Creating a Function App

2. In the search bar, type `function app`; click on **Function App** from the results list.
3. From the **Function App** blade, click on the **+ Create** button on the top toolbar.
4. From the **Basics** tab, set the **Project Details** settings as required.
5. Set the **Instance Details** settings as follows:
 - **Function App name:** Enter a name; this must be globally unique.
 - **Publish:** Leave this set to **code**.
 - **Runtime Stack:** Set this to **.NET**.
 - **Version:** Set this to **3.1**.
 - **Region:** Set this to the region that's closest to you.
6. Leave all other tabs with their default settings.
7. Click **Review + create**.
8. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make edits if required. Once you have confirmed your settings, click **Create**.
9. When the deployment is complete, you will receive a notification stating that the deployment succeeded. Now, click **Go to resource** from the **deployment** blade or navigate to the **Azure Function App** instance.

Task – Creating an HTTP triggered function

1. On the **Function App** blade, click the created **Function App**.
2. On the left menu, in the **Functions** section, click **Functions**.
3. Click **+ Add** from the top toolbar.
4. From the **Add function** pop-up window, click **HTTP trigger** from the **Select a template** section and click **Add**:

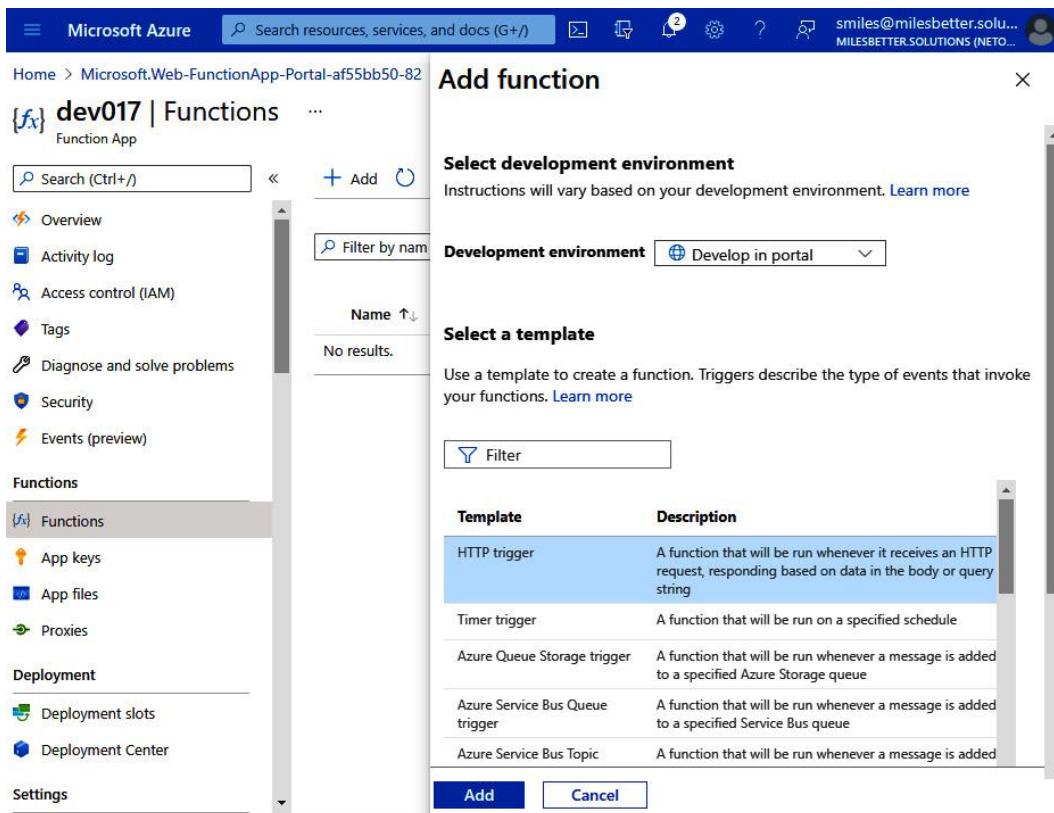


Figure 5.25 – Add function

- From the **Function** blade, click **Code + Test** from the left menu:

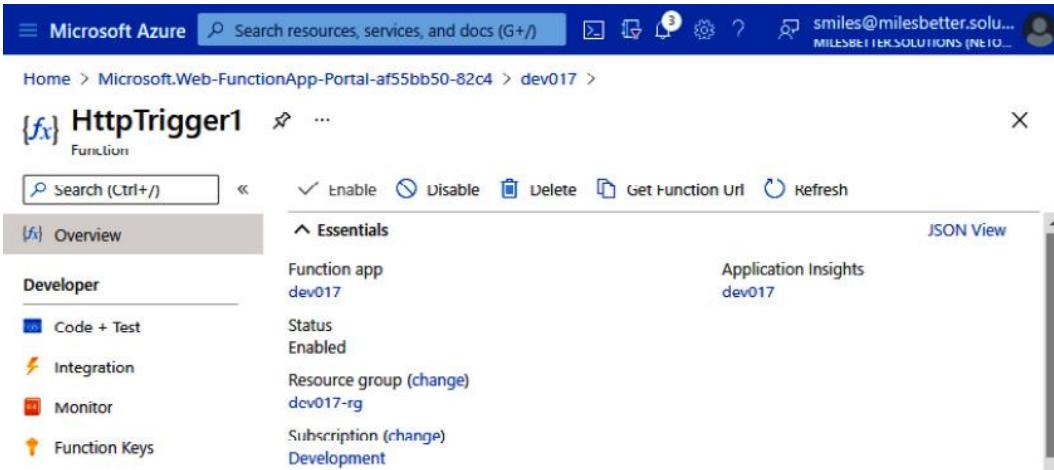


Figure 5.26 – Function blade

- From the **Code + Test** blade, you will see some auto-generated sample code; this will return a `hello (name)` message:

```

1  #r "Newtonsoft.Json"
2
3  using System.Net;
4  using Microsoft.AspNetCore.Mvc;
5  using Microsoft.Extensions.Primitives;
6  using Newtonsoft.Json;
7
8  public static async Task<ActionResult> Run(HttpContext req, ILogger log)
9  {
10    log.LogInformation("C# HTTP trigger function processed a request.");
11
12    string name = req.Query["name"];
13
14    string requestBody = await new StreamReader(req.Body).ReadToEndAsync();
15    dynamic data = JsonConvert.DeserializeObject(requestBody);
16    name = name ?? data?.name;
17
18    string responseMessage = string.IsNullOrEmpty(name)
19      ? "This HTTP triggered function executed successfully. Pass a name in the query string or in the request body for a personalized response."
20      : $"Hello, {name}. This HTTP triggered function executed successfully.";
21
22    return new OkObjectResult(responseMessage);
23 }

```

Figure 5.27 – Function app code

Task – Testing the function trigger

1. Click **Get function URL** from the top toolbar of the code editor and copy the function URL; the key value should be set to the default.
2. Open a new browser tab and paste in the copied function URL. The function will run when the page is requested and execute the code; this will prompt/require a name to be returned in the string or body response:



Figure 5.28 – HTTP URL trigger

3. Append `&name=yourname` to the end of the URL.
4. When you hit **Enter**, your function will run and return the name you entered:



Figure 5.29 – HTTP URL response

In this exercise, we looked at creating a Function App to display a `hello (name)` message when there is an HTTP request; that is, a URL is called. In the following exercise, we will look at creating a serverless solution using an Azure Logic App.

Exercise 2 – Creating a serverless solution using an Azure Logic App

This section will look at the steps to create an Azure Logic App that acts as a social media tracker; when a new tweet is posted that matches the set criteria, an email notification will be sent. Alternatively, it could notify a Teams or Slack channel, for example. This could be the basis for other solutions, such as an RSS feed tracker.

In the following subsections, the process of creating a solution has been segregated into tasks for ease of understanding.

Task – Accessing the Azure portal

1. Log into the Azure portal: <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – Creating a Logic App

2. In the search bar, type `the logic apps`; click on **Logic Apps** from the results list.
3. From the **Logic Apps** blade, click on the **+ Add** button on the top toolbar, and then **+ Consumption**.
4. From the **Basics** tab, set the **Project Details** settings as required.
5. Set the **Instance details** settings as follows:
 6. **Logic App name:** Enter a name; this must be globally unique.
 7. **Region:** Set this to the region that's closest to you.
 8. Leave all other tabs with their default settings.
 9. Click **Review + create**.
10. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make edits if required. Once you have confirmed your settings, click **Create**.
11. When the deployment is complete, you will receive a notification that the deployment succeeded. Now, click on **Go to resource** from the **Deployment** blade or navigate to the **Azure logic app** instance.

Task – Creating a Twitter trigger

1. From the **Logic App** blade, click the created **Logic App**.
2. From the left menu, in the **Development tools** section, click **Logic app designer**.
3. From the **Logic Apps Designer** blade, scroll down to the **Templates** section and find the template named **Email yourself new tweets about a certain keyword via Outlook**:

Tip

You may want to pause for a second as you are scrolling through the templates to look at what else you can create – something that you may want to come back to later to try out. This may include the template that lets you share your tweets to Facebook, posts your Instagram posts to Twitter, notifies you when a file is created in Dropbox, copies a file to OneDrive, and so on.

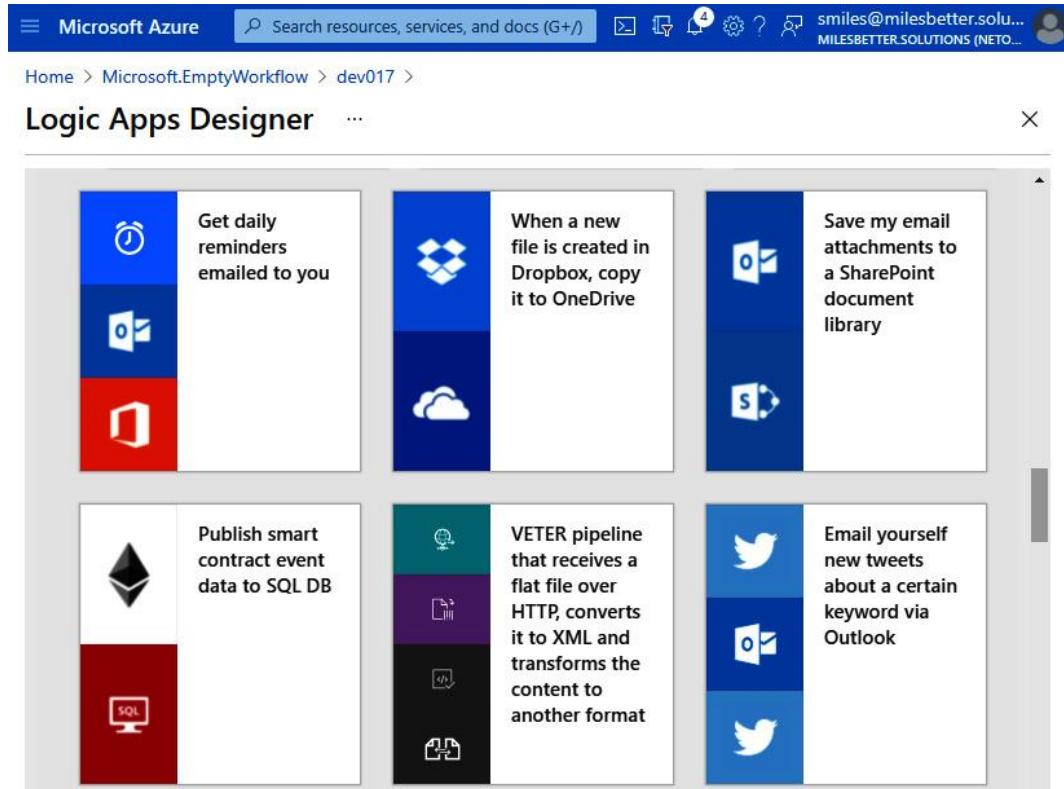


Figure 5.30 – Logic Apps Designer

4. Click on the template to open it and click **Use this template**.
5. From the **Logic Apps Designer** window, you must connect both your Twitter account and your Outlook account:
 - **Twitter:** Click on the + symbol on the Twitter entry; enter a name for the connection, click **Sign in**, and follow the prompts to complete the sign-in process.
 - **Outlook:** Click on the + symbol on the Outlook entry; enter a name for the connection, click **Sign in**, and follow the prompts to complete the sign-in process:

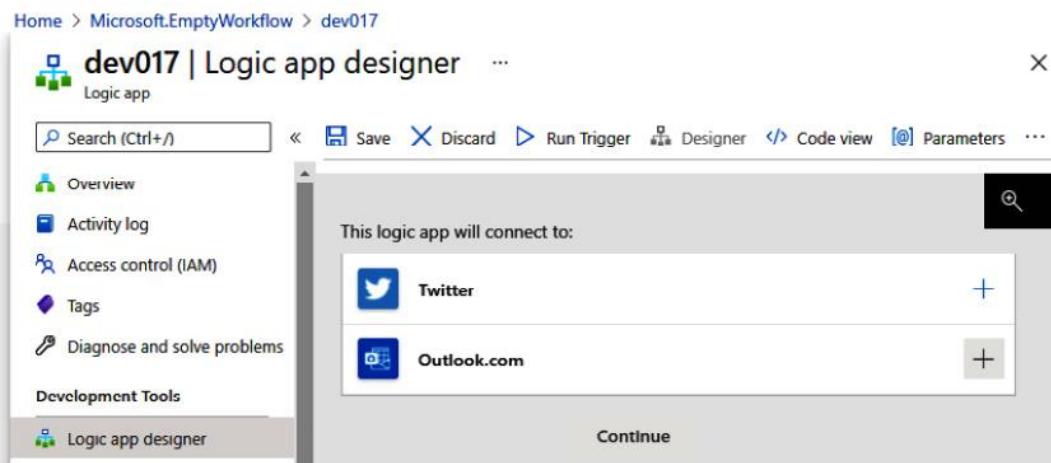


Figure 5.31 – Logic app connections

6. Click **Continue** once both Twitter and Outlook have successful connections; each item will have a green tick next to it.
7. In the **When a new tweet appears** box, enter the search text you wish to use; we will use `#AZ900FundamentalsPacktLogicAppTwitterDemo` in this example:

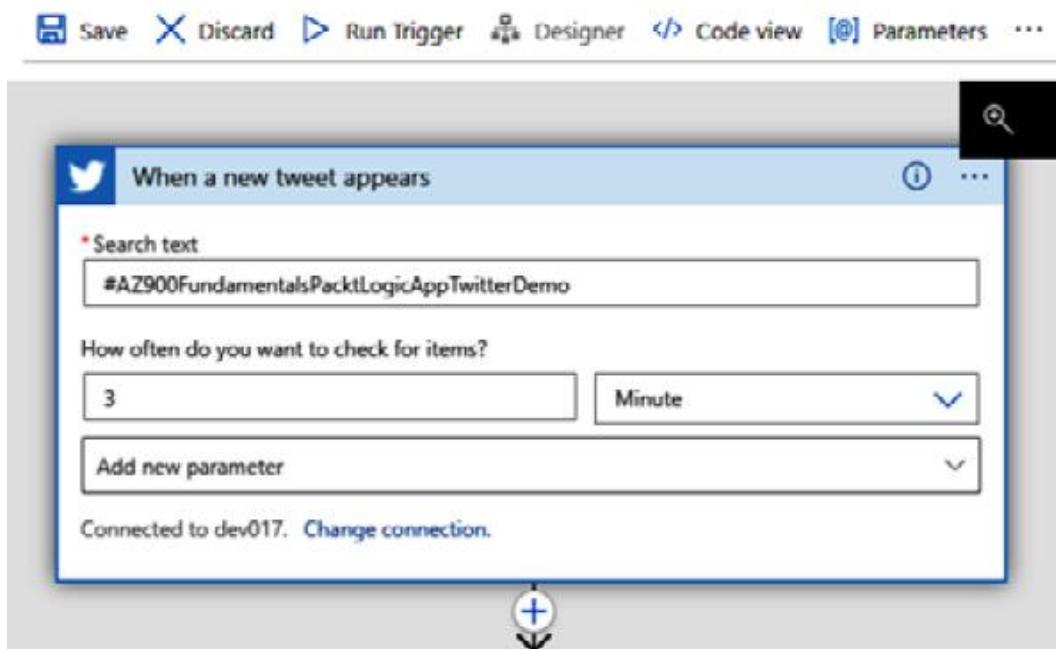


Figure 5.32 – Logic app workflow

8. In the **Send email** box, enter an email address that you want the notifications to be sent to:



Figure 5.33 – Logic app workflow

- Finally, click **Save** from the top toolbar. With that, you are ready to test.

Task – Testing the Twitter trigger

- Click **Run Trigger** and then **Run** from the top toolbar:

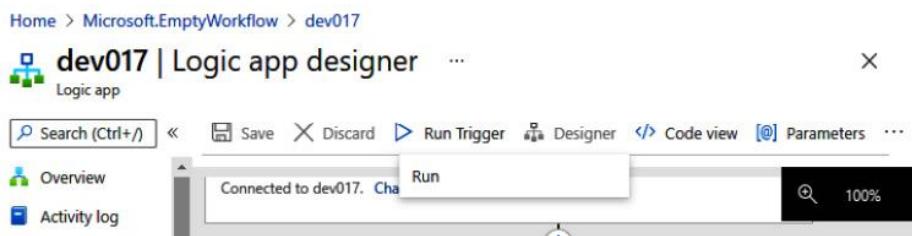


Figure 5.34 – Logic app Run Trigger

- Open Twitter and paste in the search text we entered previously; that is,
`#AZ900FundamentalsPacktLogicAppTwitterDemo`:



Figure 5.35 – Twitter post

3. You will receive an email notification of the new tweet:

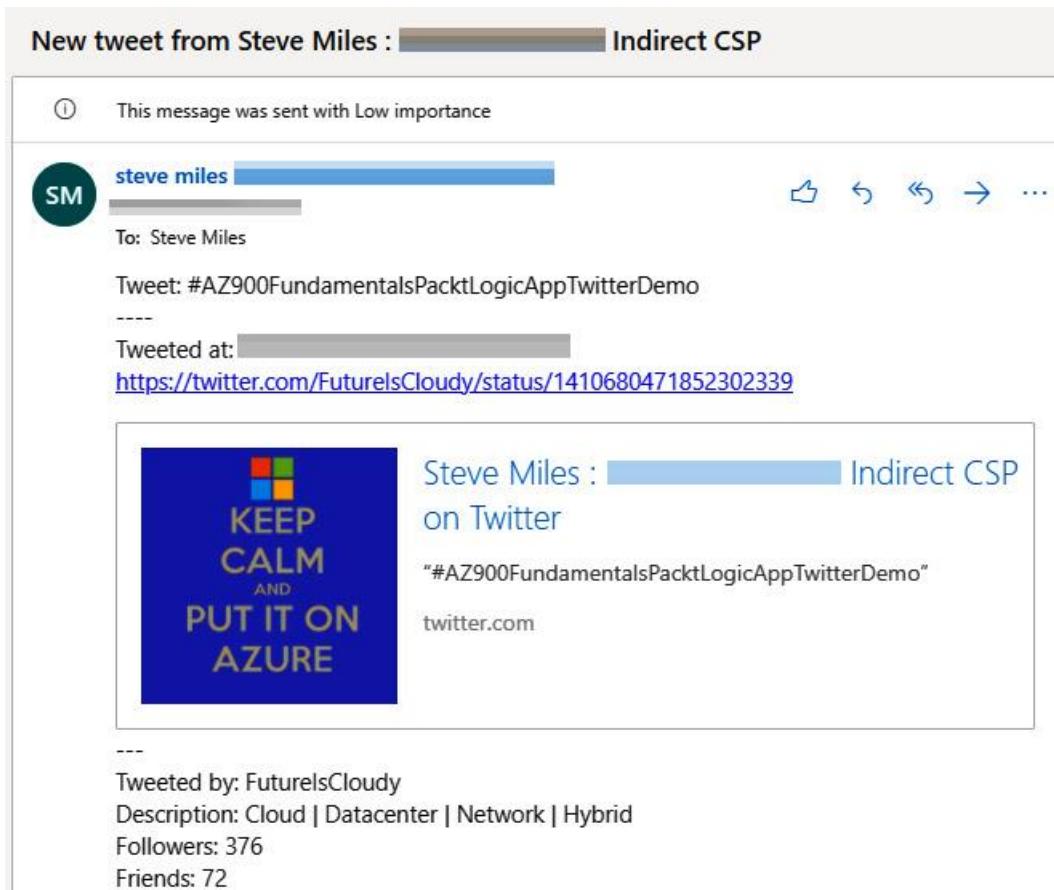


Figure 5.36 – Logic app email notification of tweet

In this exercise, we looked at creating a Logic App to send an email notification when there is a new Tweet containing a search term. In the following exercise, we will look at creating an IoT solution using an Azure IoT Hub.

Exercise 3 – Creating an IoT solution using an Azure IoT Hub

This section will look at the steps to create an IoT hub that can receive sensor data from a Raspberry Pi (**Sensor-Enabled Device**) simulator.

This could be the basis for any simple data collection solution from a sensor on any device.

In the following subsections, the process of creating a solution has been segregated into tasks for ease of understanding.

Task – Accessing the Azure portal

1. Log into the Azure portal: <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – Creating an IoT hub

2. In the search bar, type `iot hub`; click on **IoT Hub** from the results list.
3. From the **IoT Hub** blade, click on the **+ Create** button on the top toolbar.
4. From the **Basics** tab, set the **Subscription** and **Resource group** settings as required.
5. Set the region closest to you.
6. Enter a **unique** name for your IoT hub.
7. Click **Next: Networking**; leave the default settings as-is.
8. Click **Next: Management**; set **Pricing** and set **Scale tier** to **F1: Free tier**.
9. Click **Review + create**.
10. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.
11. When the deployment is complete, you will receive a notification stating that the deployment succeeded. Now, click on **Go to resource** from the **Deployment** blade or navigate to the **Azure IoT Hub** instance.

Task – Creating an IoT device

1. From the **IoT Hub** blade, go to the **Explorers** section from the left menu and click **IoT devices**.
2. From the top toolbar, click **+ New**.
3. Provide an ID for your device and click **Save**:

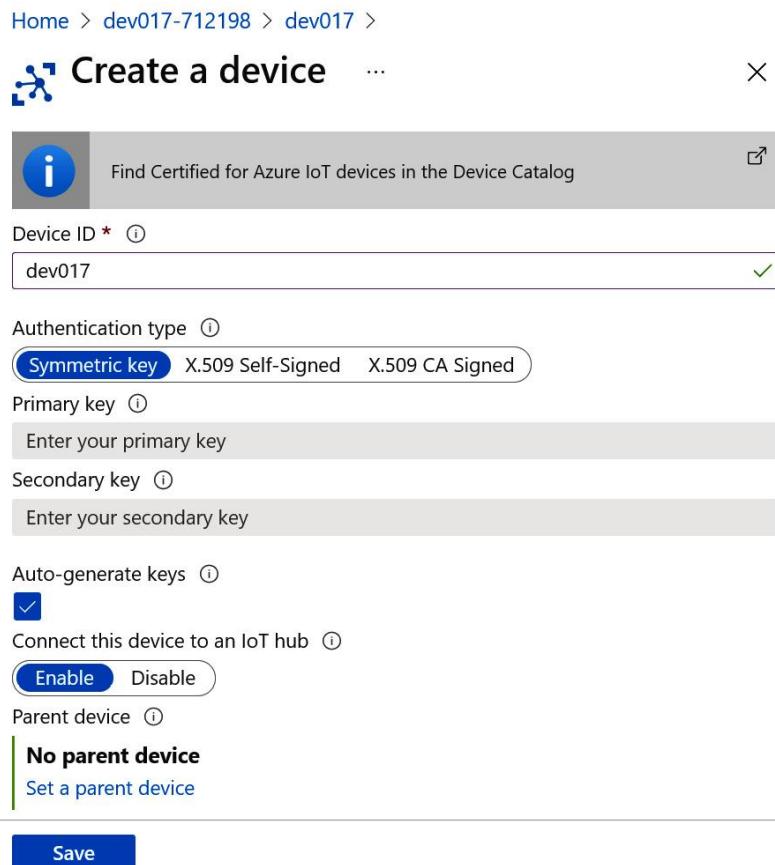


Figure 5.37 – Create a device

4. Click **refresh** from the top toolbar if your device does not appear. Then, click your device to open its respective blade.
5. From the **Device** blade, copy the **Primary Connection String** value:

Tip

This will be used in the next task to authenticate to the Raspberry Pi simulator.

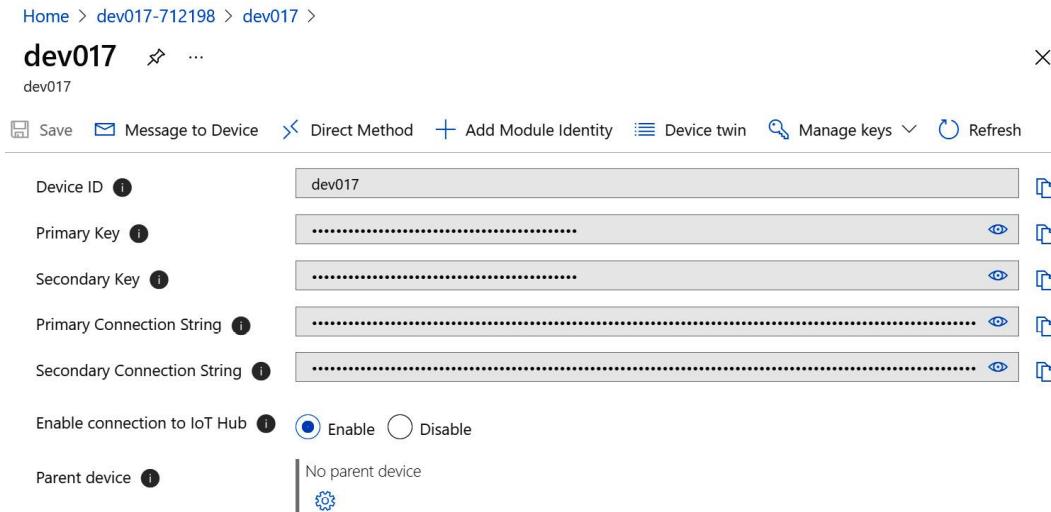


Figure 5.38 – IoT device connection string

Task – Configuring the Raspberry Pi simulator

1. From a browser, enter the following URL: <https://aka.ms/RaspPi>.
2. Once the simulator has loaded, click on the **Next** button shown as **Step 1** on the **Simulator Wizard** screen.
3. As shown on the **Simulator Wizard** screen, as **Step 2**, review the information shown regarding copying the device connection string from the Azure portal IoT hub you created in the previous task. Then, click the **Next** button.
4. As shown on the **Simulator Wizard** screen, as **Step 3**, review the information shown regarding placing the placeholder on line 15 with the Azure IoT Hub device connection string, as well as the instruction to click **Run** or type `npm start` in the console window to run the application. Then, click the **Got it** button.
5. From the top-right code area, locate line 15, which shows `const connectionString =`.
6. Replace the following entry with the Azure IoT Hub primary key connection string you copied in the previous task; that is, '`[Your IoT hub device connection string]`'.

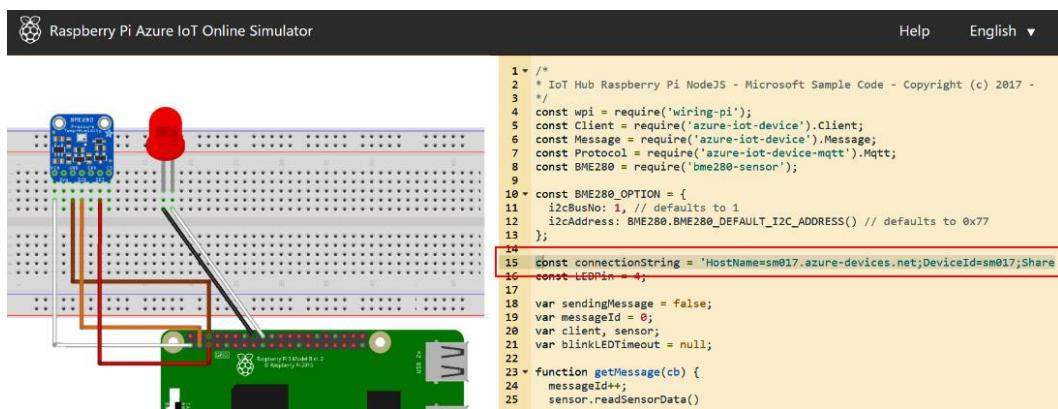
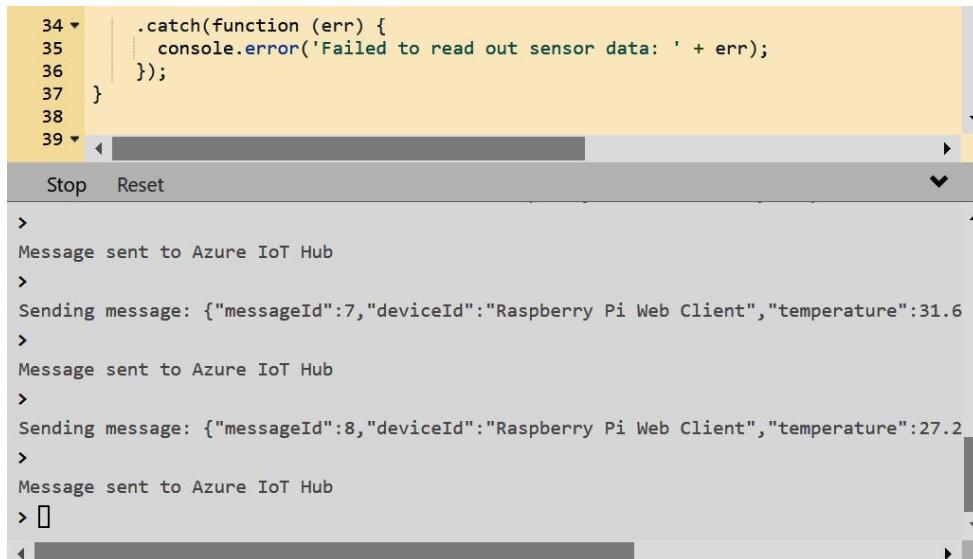


Figure 5.39 – Raspberry Pi simulator

Task – Testing the solution

7. Click **Run** or type `npm start` to run the application from the bottom-right console area.
8. You will now see messages stating that data is being sent from the device to the Azure IoT Hub; the red LED will also flash:



The screenshot shows a terminal window with the following content:

```

34  .catch(function (err) {
35    |   console.error('Failed to read out sensor data: ' + err);
36  });
37 }
38
39 < Stop Reset >
Message sent to Azure IoT Hub
>
Sending message: {"messageId":7,"deviceId":"Raspberry Pi Web Client","temperature":31.6
>
Message sent to Azure IoT Hub
>
Sending message: {"messageId":8,"deviceId":"Raspberry Pi Web Client","temperature":27.2
>
Message sent to Azure IoT Hub
> []

```

Figure 5.40 – Raspberry Pi simulator

9. Click **Stop**; you will see a message stating that the sample has stopped. The red LED will also stop flashing.
10. From the Azure portal, access the **Azure IoT Hub** blade. Then, from the **Overview** section, scroll down to view the messages that have been received:

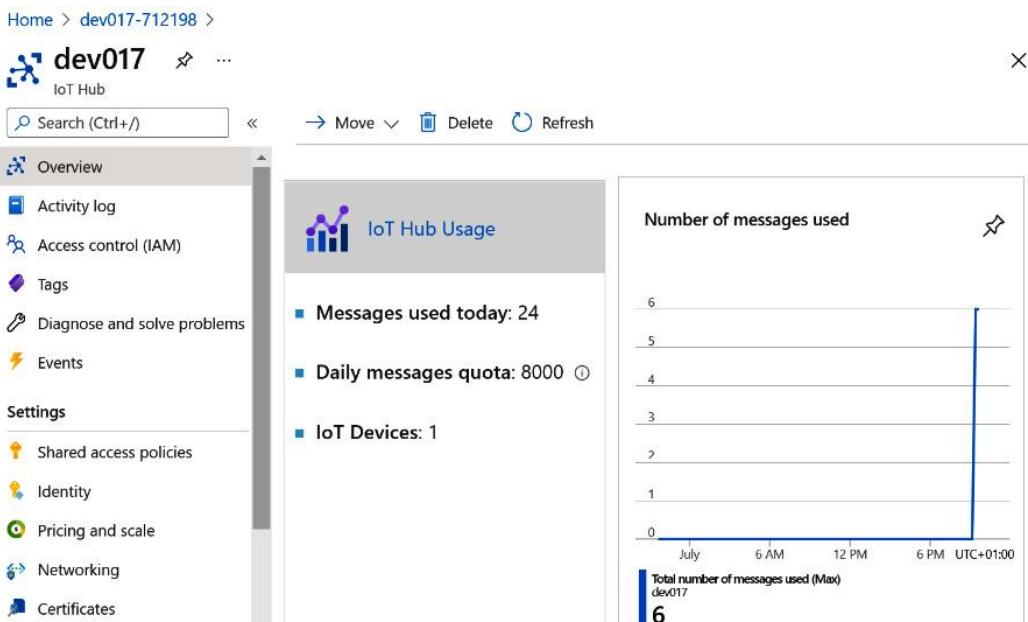


Figure 5.41 – IoT Hub Usage

In this exercise, we looked at creating an Azure IoT hub and sent it messages from a device with a sensor using a simulator. In the following exercise, we will look at creating an IoT solution using a Bot Service.

Exercise 4 – Creating an AI solution using a Bot Service

This section will look at the steps to create a Bad Joke **Knowledge Base (KB)** Bot Service as part of AI Cognitive Services. This could be the basis for building any customer services chatbot or conversational client application.

In the following subsections, the process of creating a solution has been segregated into tasks for ease of understanding.

Task – Accessing the Azure portal

1. Log into the Azure portal: <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – Creating a QnA maker

2. From a browser, enter the following URL: <https://www.qnamaker.ai>.
3. Sign into this site using the Microsoft account associated with the Azure subscription you wish to use.
4. Once you've signed in, from the **Create a knowledge base** screen, click on **Create a QnA Service** via **STEP 1** of the **QnA Maker** site. Upon doing this, you will be redirected to the Azure portal, which will open in a new browser tab:

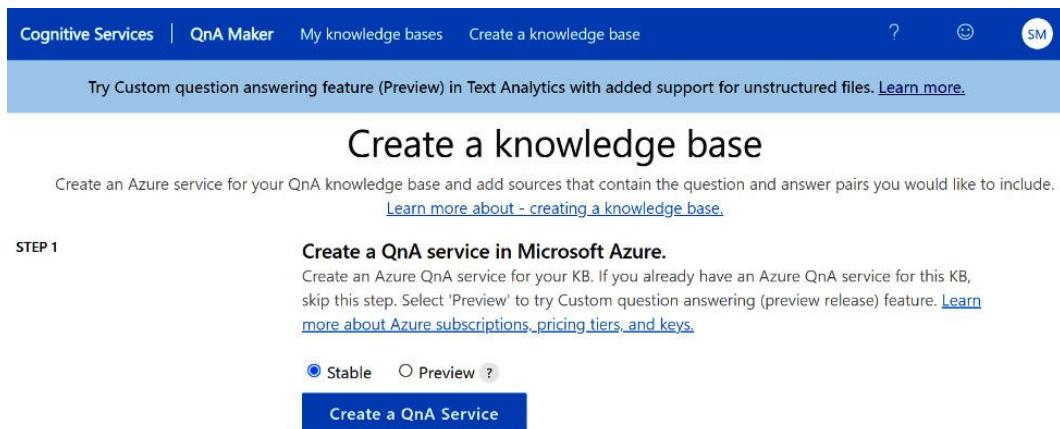


Figure 5.42 – Create a QnA Service

5. From the **QnA Maker Create** blade, from the **Basics** tab, set the **Subscription** and **Resource group** settings as required:
 - **Name:** Enter a unique name to be used.
 - **Pricing tier:** Select **Free F0**.
 - **Azure Search location:** Choose a location.
 - **Azure Search pricing tier:** Select **Free F**.
 - **Website location:** Choose a location.

- App Insights location: Choose a location.
6. Click **Review + create**.
 7. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.
 8. When the deployment is complete, you will receive a notification stating that the deployment succeeded. Return to the **QnA Maker** portal and from **STEP 2**, click **Refresh**.

Task – Configuring QnA Maker

1. From **STEP 2**, select the following as required; **Microsoft Azure Directory ID**, **Azure subscription name**, **Azure QnA service**, and **Language**:

STEP 2 Connect your QnA service to your KB.

After you create an Azure QnA service, refresh this page and then select your Azure service using the options below

Refresh

* Microsoft Azure Directory ID

* Azure subscription name

* Azure QnA service

* Language

Figure 5.43 – Connecting the bot service

2. From **STEP 3**, name your KB as you wish.
3. From **STEP 4**, choose a **Chit-chat** setting.
4. From **STEP 5**, click **Create your KB**; an empty QnA will be created:

STEP 5 Create your KB

The tool will look through your documents and create a knowledge base for your service. If you are not using an existing document, the tool will create an empty knowledge base table which you can edit.

Create your KB

Figure 5.44 – Creating a bot knowledge base

5. From the QnA Knowledge base screen, click **Add QnA pair**; this will add a new row to the KB table.
6. In the **Question** cell, enter your question (or input) text; in the **Answer** cell, enter your answer (or response) text:

Knowledge base

The screenshot shows the Microsoft Bot Framework's QnA Knowledge base interface. At the top, there is a search bar labeled "Search the KB" and a button to "View options". Below the search bar, it says "93 QnA pairs". There is a "Enable rich editor" toggle switch, a page navigation bar with pages 1 through 10, and a "Next >" button. The main area displays four QnA pairs:

Question	Answer
How long is a piece of String? X	<p>Twice as long from the center to the end</p> <p>Source: Editorial</p> <p>Add alternative phrasing</p> <p>Add follow-up prompt</p>
Fish swims into a concrete wall... X	Dam
Two gold fish in a tank... X	one says you drive, I will operate the gun
A horse walks into a bar... X	• barman says.. why the long face

Figure 5.45 – Populating the bot knowledge base

7. Repeat **Steps 19 and 20** as required.
8. Click **Save and train** from the top-right toolbar.

Task – Testing the solution

1. From the top toolbar, click -> **Test**.
2. Enter text from the question values you created earlier; the answer value you created will be returned. In our example, the response is the joke punchline; the following are some examples:

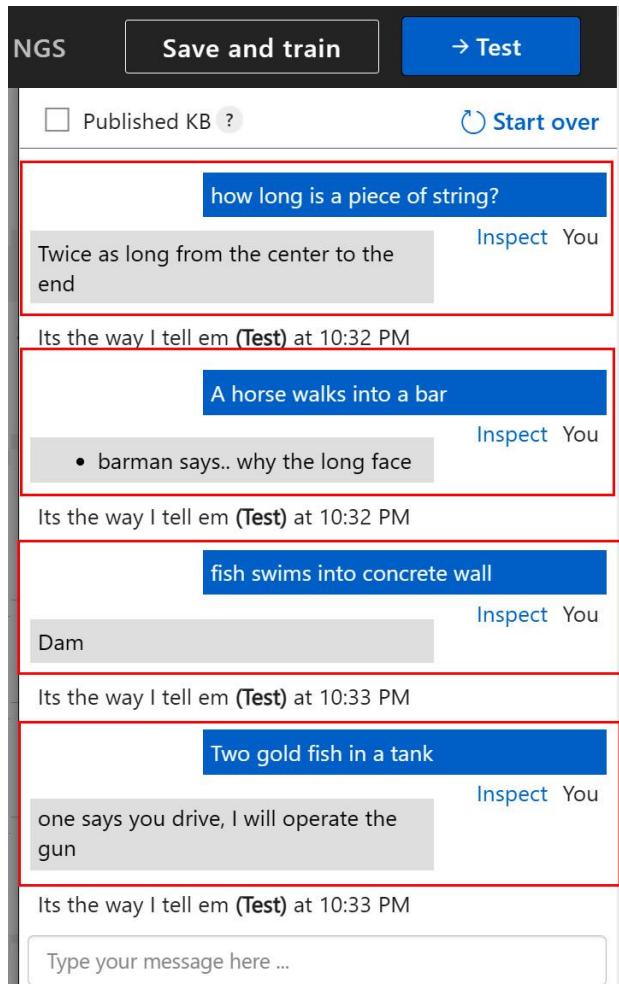


Figure 5.46 – Testing the bot knowledge base

With that, we have completed this chapter's exercises.

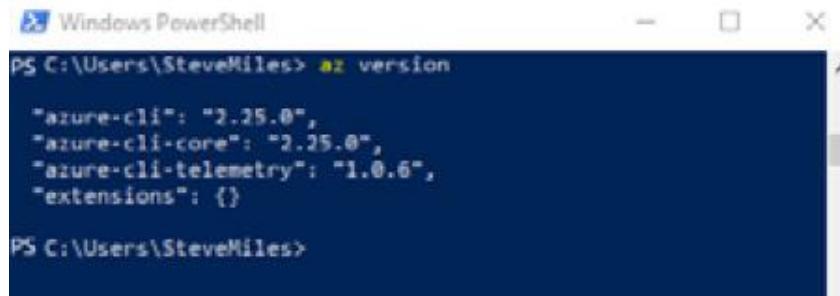
Chapter 6

Technical requirements

To carry out the hands-on labs in this chapter, you will need the following:

- An Azure subscription that has access to create and delete resources in the subscription. If you do not have an Azure subscription, you can create a free Azure account at <https://azure.microsoft.com/free>.
- Access to an internet browser; you will log in to the Azure portal: <https://portal.azure.com>.
- Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.
- A Windows 10 device with *PowerShell 7.x or later* and rights to install *Azure PowerShell* and the *Azure CLI*: <https://docs.microsoft.com/powershell/scripting/install/installing-powershell-core-on-windows>.

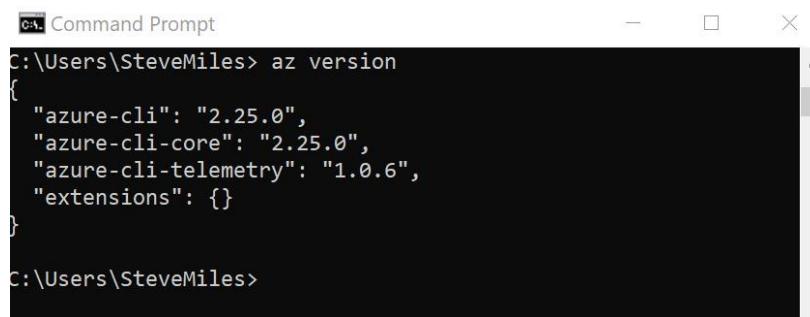
Figures



```
Windows PowerShell
PS C:\Users\SteveMiles> az version
{
    "azure-cli": "2.25.0",
    "azure-cli-core": "2.25.0",
    "azure-cli-telemetry": "1.0.6",
    "extensions": {}
}

PS C:\Users\SteveMiles>
```

Figure 6.1 – The `az version` command from PowerShell



```
Command Prompt
C:\Users\SteveMiles> az version
{
    "azure-cli": "2.25.0",
    "azure-cli-core": "2.25.0",
    "azure-cli-telemetry": "1.0.6",
    "extensions": {}
}

C:\Users\SteveMiles>
```

Figure 6.2 – The `az version` command from the Windows Command Prompt

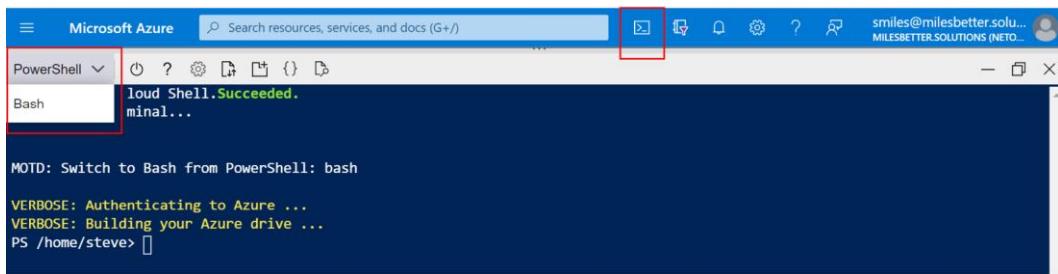


Figure 6.3 – Azure Cloud Shell with the PowerShell interface via the Azure portal

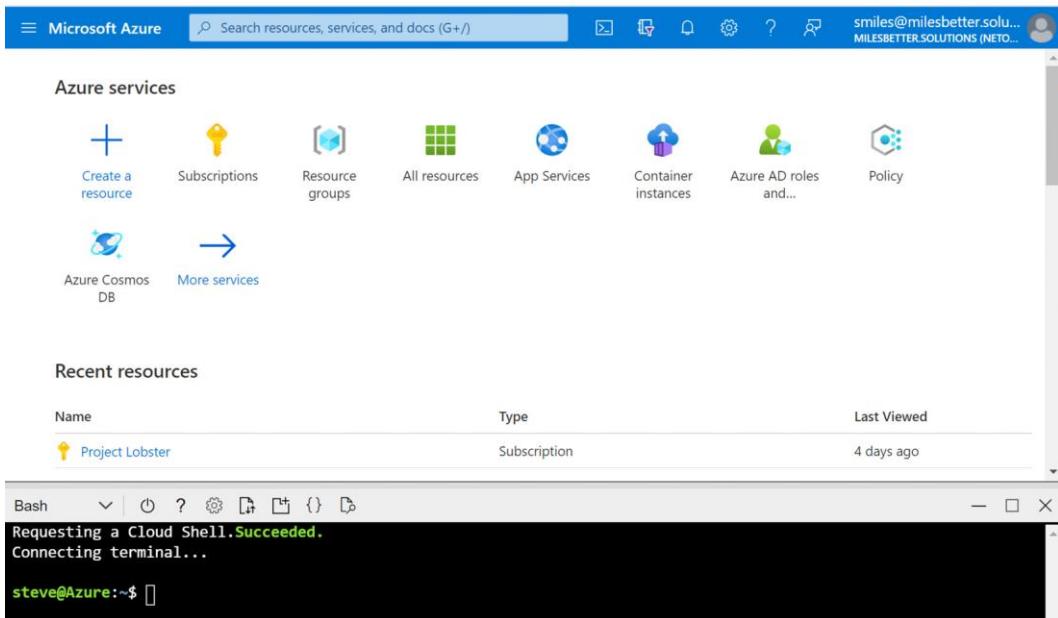


Figure 6.4 – Azure Cloud Shell with the Bash interface via the Azure portal

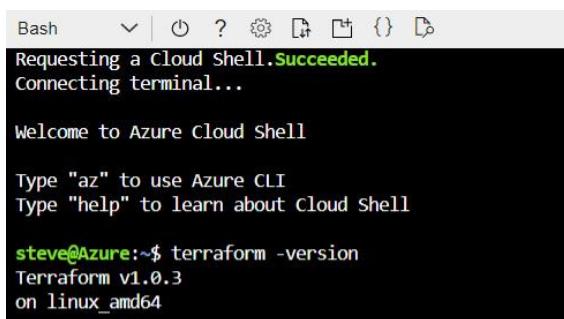


Figure 6.5 – Terraform version

Figure 6.6 – Terraform commands

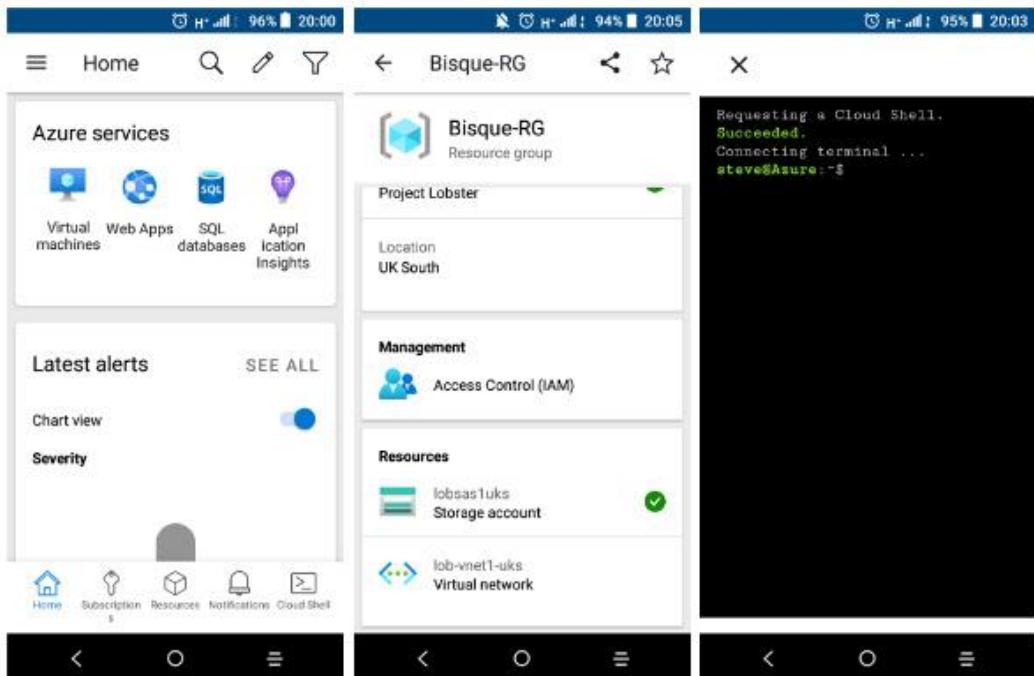


Figure 6.7 – Azure mobile app interface

Home >

Advisor | Overview

Search (Ctrl+ /) < ...

Feedback Download as CSV Download as PDF Try the new Advisor Score (preview)

Try the new Advisor score experience to better prioritize recommendations and measure impact. →

Cost	Security	Reliability
1 Recommendation 1 High impact 0 Medium impact 0 Low impact	2 Recommendations 1 High impact 0 Medium impact 1 Low impact	1 Recommendation 0 High impact 1 Medium impact 0 Low impact
1 Impacted resource	1 Impacted resource	1 Impacted resource

Operational excellence	Performance
You are following all of our operational excellence recommendations See list of operational excellence recommendations	You are following all of our performance recommendations See list of performance recommendations

Tips & tricks

- ① You can customize Advisor to process recommendations for resources that matter to you the most.
- ② You can buy virtual machine reserved instances to save money over pay-as-you-go costs.

Download recommendations as PDF
Download recommendations as CSV

Try Advisor Score
Preview the new Advisor score experience today. Easily prioritize recommendations, track progress, and measure impact.
Try now

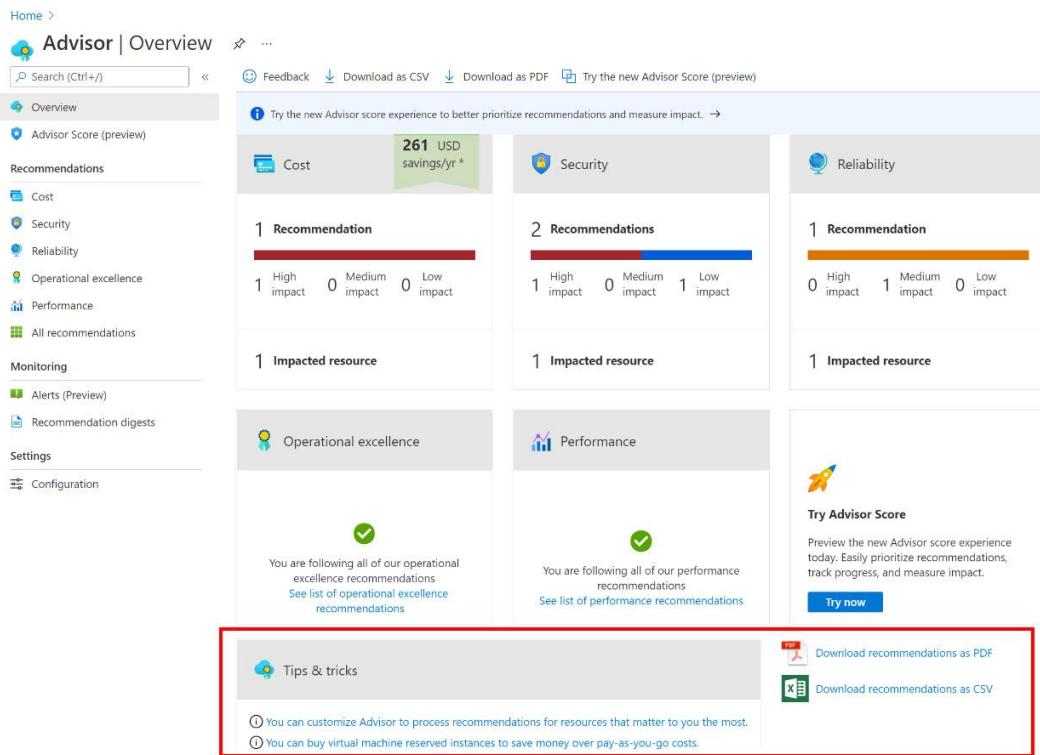


Figure 6.9 – Azure Advisor recommendations

Home >

Advisor | Overview

Search (Ctrl+ /) < ...

Feedback Download as CSV Download as PDF Try the new Advisor Score (preview)

Try the new Advisor score experience to better prioritize recommendations and measure impact. →

Cost	Security	Reliability
1 Recommendation 1 High impact 0 Medium impact 0 Low impact	2 Recommendations 1 High impact 0 Medium impact 1 Low impact	1 Recommendation 0 High impact 1 Medium impact 0 Low impact
1 Impacted resource	1 Impacted resource	1 Impacted resource

Operational excellence	Performance
You are following all of our operational excellence recommendations See list of operational excellence recommendations	You are following all of our performance recommendations See list of performance recommendations

Tips & tricks

- ① You can customize Advisor to process recommendations for resources that matter to you the most.
- ② You can buy virtual machine reserved instances to save money over pay-as-you-go costs.

Download recommendations as PDF
Download recommendations as CSV

Try Advisor Score
Preview the new Advisor score experience today. Easily prioritize recommendations, track progress, and measure impact.
Try now

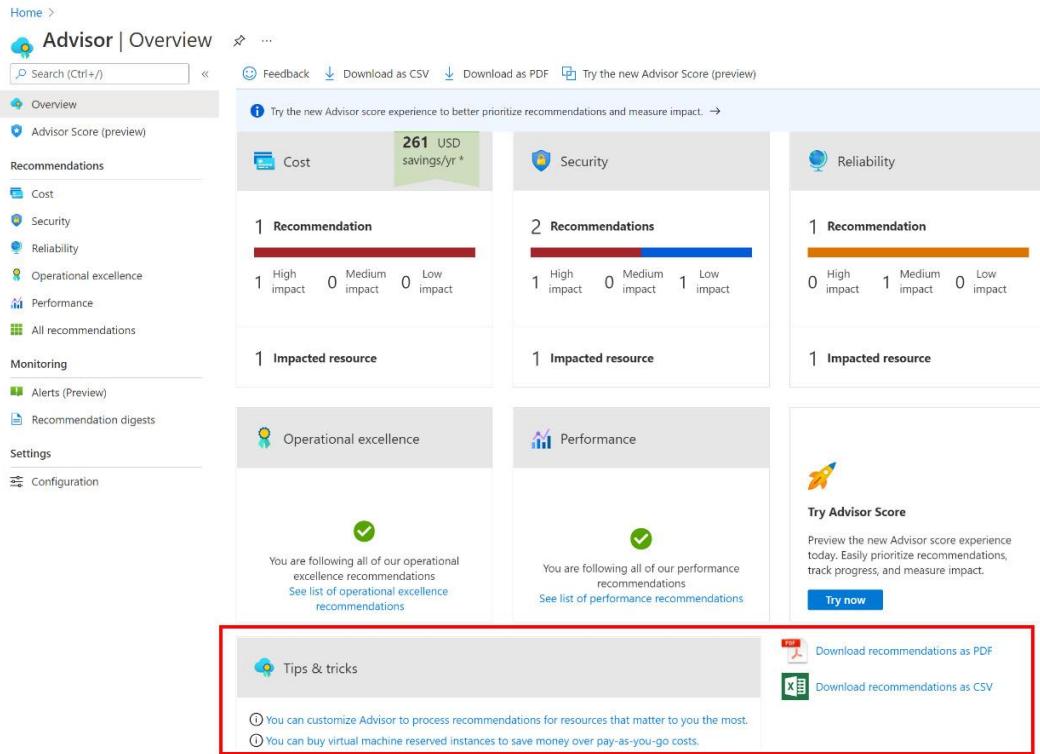


Figure 6.9 – Azure Advisor recommendations

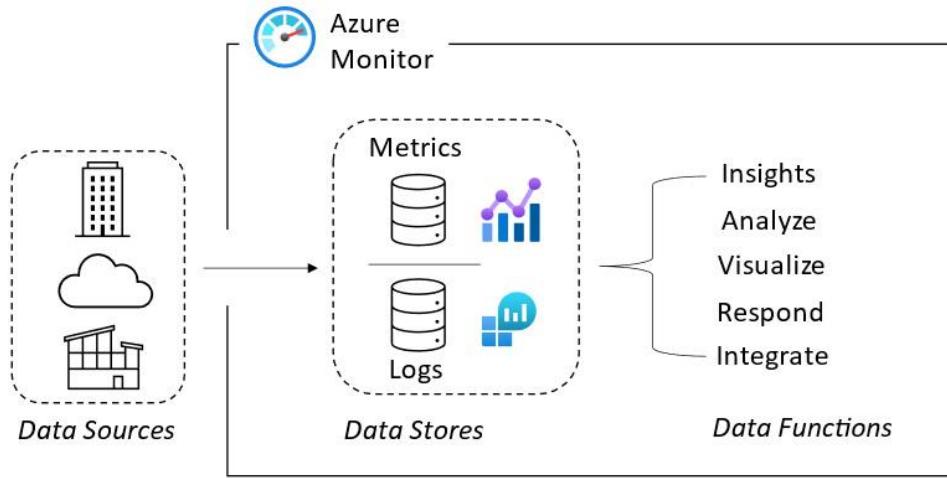


Figure 6.10 – Azure Monitor components architecture

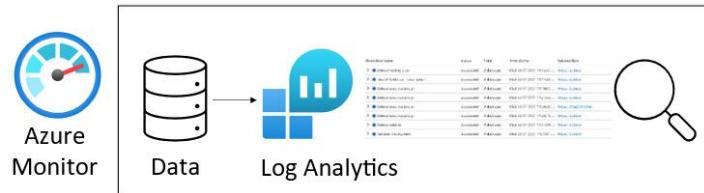


Figure 6.11 – Azure Monitor log data



Figure 6.12 – Azure Monitor metric data

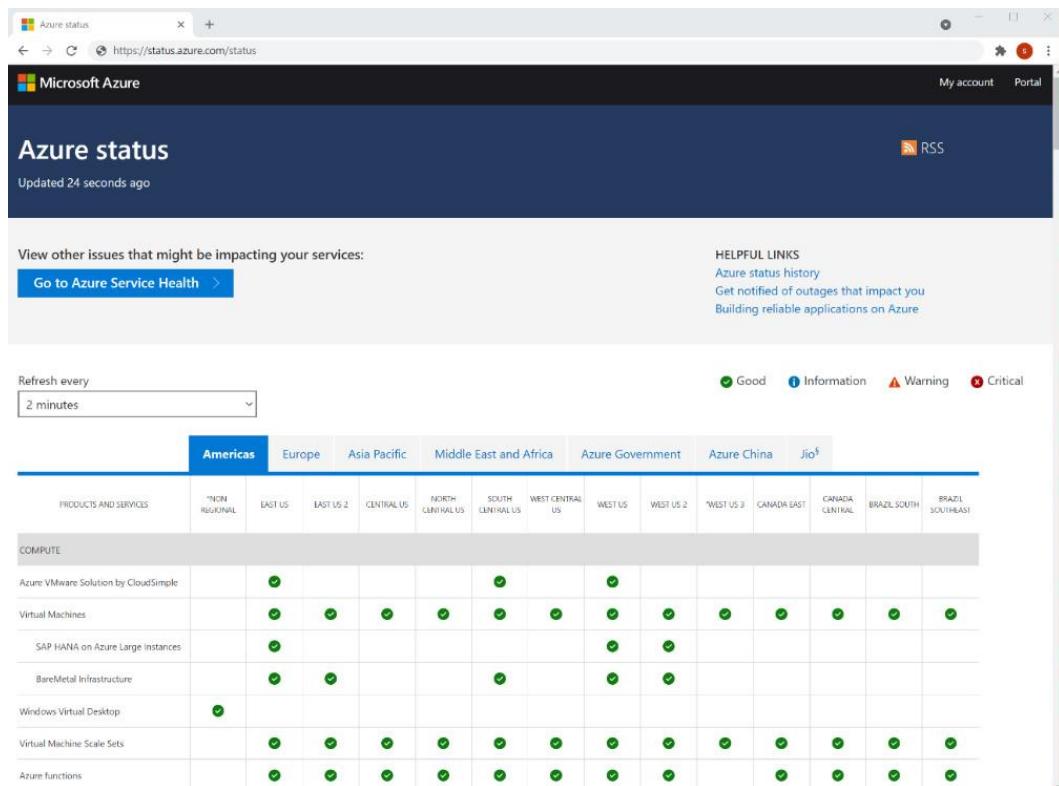


Figure 6.13 – The Azure status page

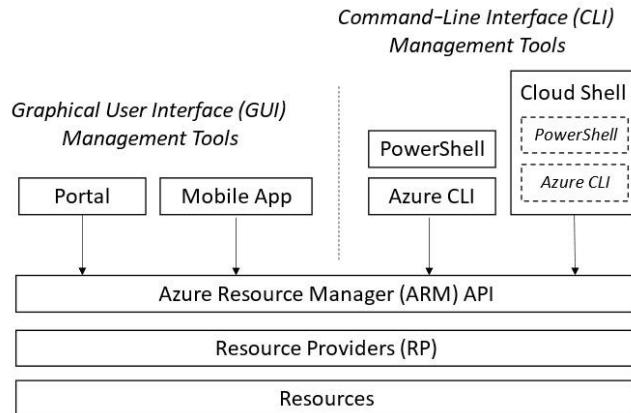


Figure 6.14 – Azure management tools

Links

More information on the Azure mobile app can be found at <https://azure.microsoft.com/get-started/azure-portal/mobile-app/>.

Cost: Recommendations provided for optimizing and reducing costs: <https://docs.microsoft.com/azure/advisor/advisor-cost-recommendations>.

Security: Recommendations provided to protect against vulnerabilities and threats: <https://docs.microsoft.com/azure/advisor/advisor-security-recommendations>.

Reliability (formerly High Availability): Recommendations provided for the availability, resilience, and continuity of your workloads: <https://docs.microsoft.com/azure/advisor/advisor-high-availability-recommendations>.

Operational Excellence: Recommendations provided for implementing best practices, resources manageability, service health, and governance:

<https://docs.microsoft.com/azure/advisor/advisor-operational-excellence-recommendations>.

Performance: Recommendations provided for optimizing a workload's responsiveness to demand: <https://docs.microsoft.com/azure/advisor/advisor-performance-recommendations>.

Further reading

This section provides links to additional exam information and study references:

- Exam AZ-900: Microsoft Azure fundamentals:
<https://docs.microsoft.com/learn/certifications/exams/az-900>
- Exam AZ-900: Skills outline:
<https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE3VwUY>
- Microsoft Learn: Azure Fundamentals – Describe core solutions on Azure:
<https://docs.microsoft.com/learn/paths/az-900-describe-core-solutions-management-tools-azure>

Hands-on exercise

To support your learning with some practical skills, we will look at some of the tools that were covered in this chapter by completing some hands-on exercises.

The following exercises will be carried out:

- Exercise 1 – installing Azure PowerShell
- Exercise 2 – installing the Azure CLI
- Exercise 3 – creating resources using PowerShell from Cloud Shell
- Exercise 4 – creating resources using the Azure CLI from Cloud Shell
- Exercise 5 – exploring Azure Service Health

Getting started

To get started with these hands-on exercises, you can use an existing account that you have created as part of the exercises for any chapter in this book. Alternatively, you can create a free Azure account by going to <https://azure.microsoft.com/free>.

This free Azure account provides the following:

- 12 months of free services
- \$200 credit to explore Azure for 30 days

- 25+ services that are always free

Exercise 1 – installing Azure PowerShell

In this section, you'll learn how to install the **Azure PowerShell** module.

The following steps must be carried out on the OS of a machine you have admin access to; this could be physical or virtual. We are using a Windows 10 device for this exercise – **Windows 10 Pro 20H2** using **PowerShell 7** for reference:

1. On your device, search for **Windows PowerShell 7** and click **Open**.

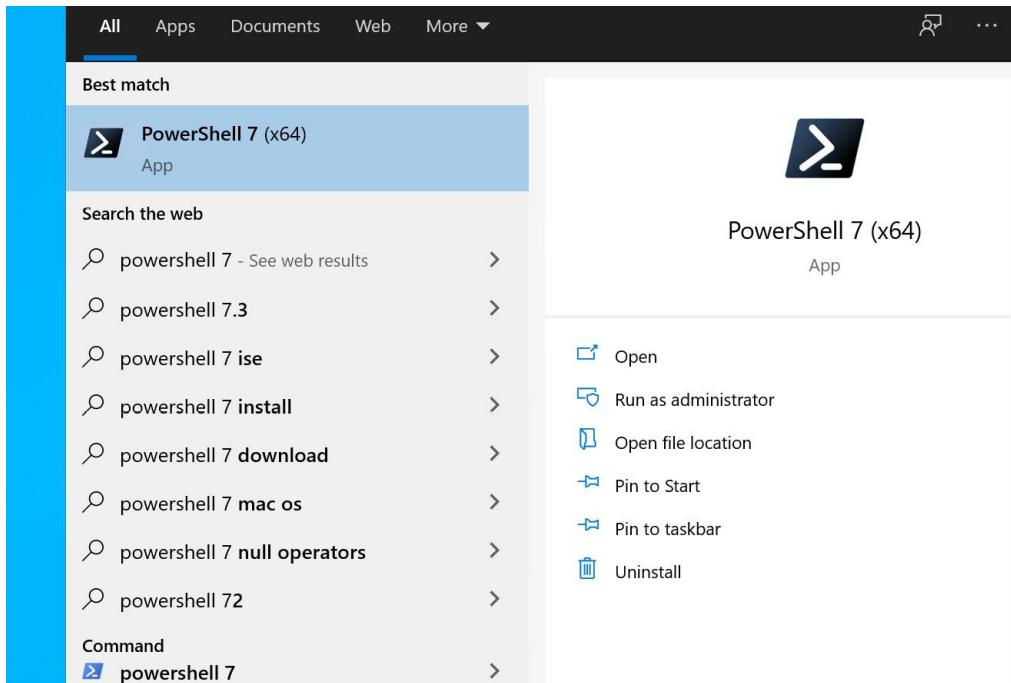


Figure 6.15 – Searching for PowerShell

2. Check the version of PowerShell by running the following command from within PowerShell:

```
$PSVersionTable.PSVersion
```

The output will look as follows:

```
Administrator: PowerShell 7 (x64)
PowerShell 7.1.3
Copyright (c) Microsoft Corporation.

https://aka.ms/powershell
Type 'help' to get help.

PS C:\Users\vmadmin> $PSVersionTable.PSVersion

Major  Minor  Patch  PreReleaseLabel BuildLabel
----  -----  -----  -----  -----
7      1       3

PS C:\Users\vmadmin>
```

Figure 6.16 – PowerShell version

3. Enter the following command; the PowerShell script execution policy must be set to **remote signed** or **less restrictive**:

```
Set-ExecutionPolicy -ExecutionPolicy RemoteSigned -Scope CurrentUser
```

Confirm this using the following command:

```
Get-ExecutionPolicy -List
```

The output will be as follows:

A screenshot of a Windows PowerShell window titled "Administrator: PowerShell 7 (x64)". The window shows the command "Set-ExecutionPolicy -ExecutionPolicy RemoteSigned -Scope CurrentUser" being run, followed by "Get-ExecutionPolicy -List". The output of "Get-ExecutionPolicy -List" is a table:

Scope	ExecutionPolicy
MachinePolicy	Undefined
UserPolicy	Undefined
Process	Undefined
CurrentUser	RemoteSigned
LocalMachine	RemoteSigned

Figure 6.17 – Setting the execution policy

4. Enter the following command to install the Az module:

```
Install-Module -Name Az -AllowClobber -Scope CurrentUser -Repository PSGallery -Force
```

The following screenshot shows the installation progress:

A screenshot of a Windows PowerShell window titled "Administrator: PowerShell 7 (x64)". The window shows the command "Install-Module -Name Az -AllowClobber -Scope CurrentUser -Repository PSGallery -Force" being run. The output shows the progress of the package installation:

```
PowerShell 7.1.3
Copyright (c) Microsoft Corporation.

Installing package 'Az'
  Installing dependent package 'Az.ApplicationInsights'
  [oooooooo] ] 
  Installing package 'Az.ApplicationInsights'
  [          ] 
  Downloaded 0.00 MB out of 0.21 MB.
```

Figure 6.18 – PowerShell version

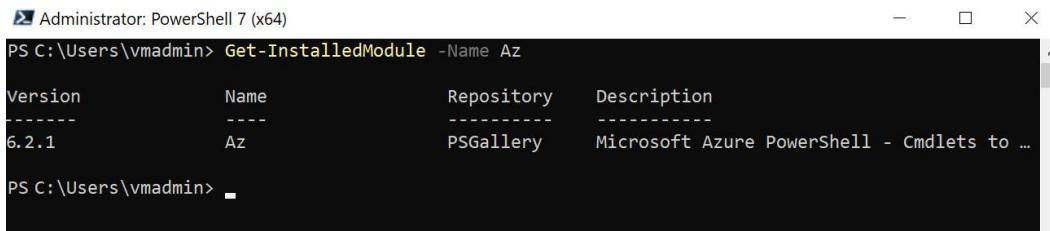
You will see the following when the Az module is imported if the version of PowerShell you're using is not supported:

```
"This version of Az.Accounts is only supported on Windows PowerShell 5.1 and PowerShell 7.0.6 or greater, open https://aka.ms/install-powershell to learn how to upgrade. For further information, go to https://aka.ms/azpslifecycle."
```

Enter the following command to check the version of the PowerShell module that's been installed:

```
Get-InstalledModule -Name Az
```

The output will look as follows:



Version	Name	Repository	Description
6.2.1	Az	PSGallery	Microsoft Azure PowerShell - Cmdlets to ...

Figure 6.19 – PowerShell module version

5. Enter the following to update all the Powershell modules to their latest versions:

```
Update-Module
```

6. The following command will update the Azure PowerShell module:

```
Update-Module -Name Az
```

In this exercise, we looked at installing the Azure Powershell module. We will install the Azure CLI in the following exercise.

Exercise 2 – installing the Azure CLI

In this section, you'll learn how to install the Azure CLI.

The following steps must be carried out on the OS of a machine you have admin access to; this could be physical or virtual. We are using a Windows 10 device for this exercise – [Windows 10 Pro 20H2](#) using [PowerShell 7](#) for reference. Once installed, the CLI can be accessed via [PowerShell](#) or the [Windows Command Prompt \(CMD\)](#):

1. From your device, search for [Windows PowerShell 7](#) and click **Open**.

Enter the following command:

```
Invoke-WebRequest -Uri https://aka.ms/installazurecliwindows -OutFile .\AzureCLI.msi; Start-Process msieexec.exe -Wait -ArgumentList '/I AzureCLI.msi /quiet'; rm .\AzureCLI.msi
```

The following screenshot shows the installation progress:



Figure 6.20 – Installing the Azure CLI via PowerShell

2. Close PowerShell and reopen it, Then, enter the following command to run the CLI from PowerShell:

```
az login
```

3. When the pop-up Azure sign-in page appears, as shown in the following screenshot, sign in:

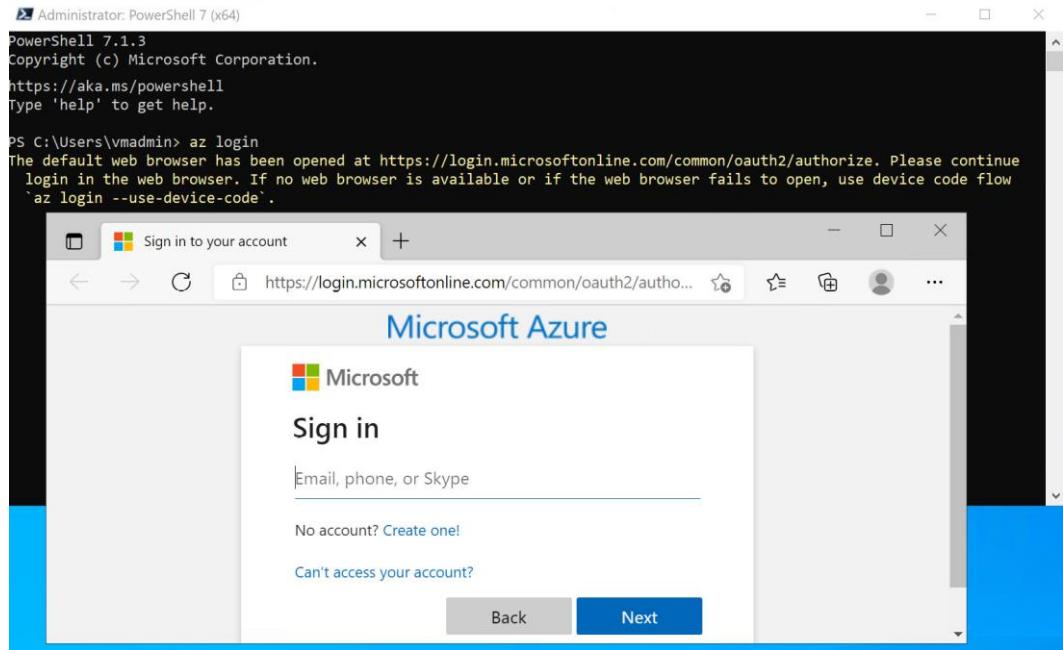


Figure 6.21 – Azure Sign in page

4. Enter the following command to check the version of the CLI that's been installed:

```
az version
```

The output will look as follows:

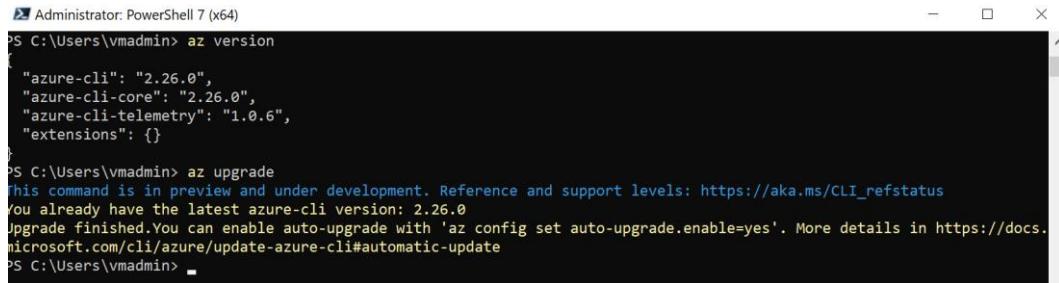
```
Administrator: PowerShell 7 (x64)
PS C:\Users\vmadmin> az version
{
  "azure-cli": "2.26.0",
  "azure-cli-core": "2.26.0",
  "azure-cli-telemetry": "1.0.6",
  "extensions": {}
}
PS C:\Users\vmadmin>
```

Figure 6.22 – CLI version

5. Enter the following command to update to the latest version:

```
az upgrade
```

6. The output will look as follows:



```
Administrator: PowerShell 7 (x64)
PS C:\Users\vmadmin> az version
{
    "azure-cli": "2.26.0",
    "azure-cli-core": "2.26.0",
    "azure-cli-telemetry": "1.0.6",
    "extensions": {}
}
PS C:\Users\vmadmin> az upgrade
This command is in preview and under development. Reference and support levels: https://aka.ms/CLI_refstatus
You already have the latest azure-cli version: 2.26.0
Upgrade finished. You can enable auto-upgrade with 'az config set auto-upgrade.enable=yes'. More details in https://docs.microsoft.com/cli/azure/update-azure-cli#automatic-update
PS C:\Users\vmadmin>
```

Figure 6.23 – CLI upgrade

7. The command's output in the preceding screenshot shows that the latest updates have been installed and that no upgrade is available; this final command concludes this exercise.

We looked at installing the Azure CLI in this exercise. In the following exercise, we will create a resource group and a virtual machine using PowerShell from Cloud Shell.

Exercise 3 – creating resources using PowerShell from Cloud Shell

In this section, we'll learn how to interact with Azure environments using PowerShell as the CLI tool and Cloud Shell as the shell environment for running commands.

The following subsections will show you how to create the necessary resources. These have been segregated into tasks for ease of understanding:

Task – accessing the Azure portal

1. Log in to the Azure portal by going to <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – setting up Cloud Shell (skip this task if you've already completed it)

2. Click on the Cloud Shell **code** icon on the top toolbar of the portal; if this is the first time you have used Cloud Shell and no storage has been mounted to persist files, you will be prompted to create a storage account. Select your subscription and then click on **Create storage**:

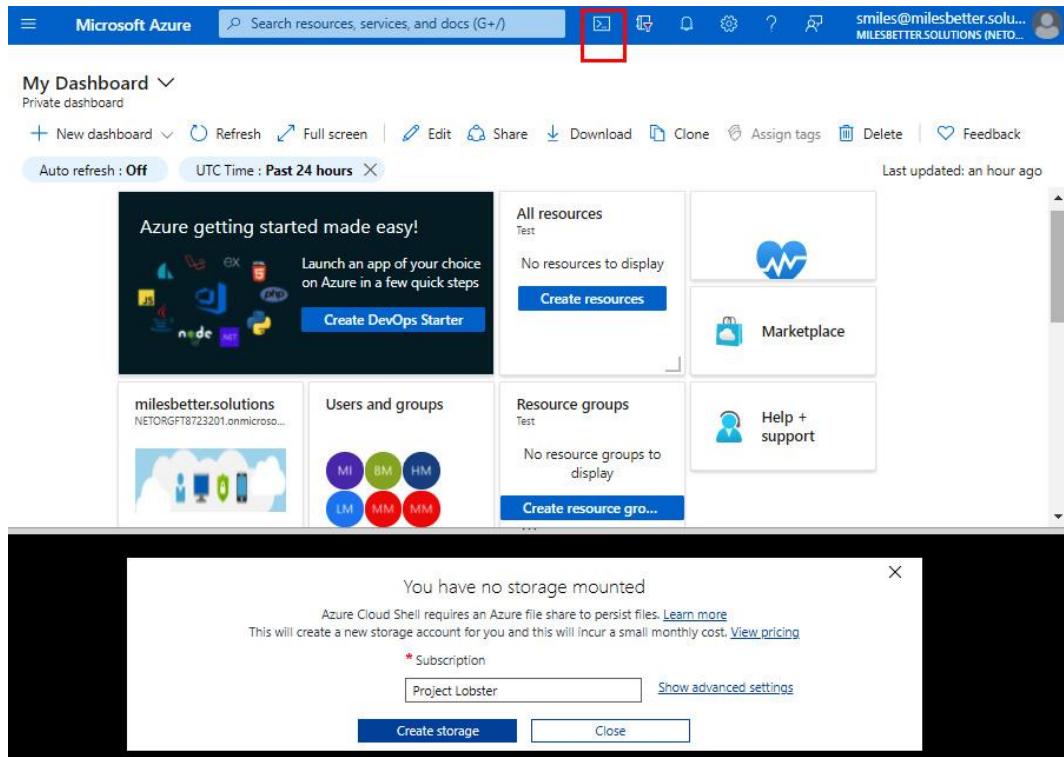


Figure 6.24 – Cloud Shell setup

- Once the storage account has been created, you will be connected to a terminal running the shell environment you will use to run commands.

Task – creating a resource group

1. **PowerShell** should be set as the CLI within Cloud Shell for this exercise.
 2. In this exercise, we will use an example location; you may use a location that meets your needs. You can use the following command to find a location to use to create resources in:

Get-AzLocation

3. To create a resource group, enter the following command:

```
New-AzResourceGroup -Name Project1-RG -Location "UK South"
```

The output will look as follows:

Figure 6.25 – Creating a resource group

4. To show the resource group that has just been created, enter `Get-AzResourceGroup` or `Get-AzResourceGroup | Format-Table`.
5. The created resource group will also appear in the portal UI.

The screenshot shows the Azure Resource Groups blade. It displays two resource groups: 'cloud-shell-storage-westeurope' (Subscription: Project Lobster, Location: West Europe) and 'Project1-RG' (Subscription: Project Lobster, Location: UK South). The 'Project1-RG' row is highlighted with a red box. Below the blade is a PowerShell window titled 'PowerShell' showing the output of the command `Get-AzResourceGroup`. The output lists properties for each resource group, with the details for both groups highlighted with red boxes.

Name	Subscription	Location
cloud-shell-storage-westeurope	Project Lobster	West Europe
Project1-RG	Project Lobster	UK South

```

PS /home/steve> Get-AzResourceGroup
ResourceGroupName : cloud-shell-storage-westeurope
Location         : westeurope
ProvisioningState : Succeeded
Tags             :
ResourceId       : /subscriptions/bc9be499-ae2c-4c03-80a1-55b232f87b99/resourceGroups/cloud-shell-storage-westeurope

ResourceGroupName : Project1-RG
Location         : uksouth
ProvisioningState : Succeeded
Tags             :
ResourceId       : /subscriptions/bc9be499-ae2c-4c03-80a1-55b232f87b99/resourceGroups/Project1-RG

```

Figure 6.26 – Showing resource groups

Task – creating a virtual machine

1. To create a virtual machine, enter the following code:

```

New-AzVm
    -ResourceGroupName "myResourceGroup"
    -Name "MyVM"
    -Location "UK South"
    -VirtualNetworkName "myVnet"
    -SubnetName "mySubnet"
    -SecurityGroupName "myNetworkSecurityGroup"

```

2. When prompted, enter a username and password.

Figure 6.27 – Creating a virtual machine

3. You will see a progress message while the virtual machine is being created.

Figure 6.28 – Virtual machine creation progress

4. Once the virtual machine has been created, you will see a **ProvisioningState** of **Succeeded**.

Figure 6.29 – Virtual machine created

5. To show the virtual machine that was just created, enter the following command:

get-AzVM

6. The created virtual machine will also appear in the portal UI.

Name	Subscription	Resource group	Location	Status	Operating system	Size
MyVM	Project Lobster	myResourceGroup	UK South	Running	Windows	Standard_D2s_v3

```

PowerShell
PS /home/steve> get-AzVM
ResourceGroupName Name Location      VmSize OsType ProvisioningState Zone
-----          --   -----      -----   -----           -----
MYRESOURCEGROUP MyVM uksouth Standard_D2s_v3 Windows Succeeded
PS /home/steve>

```

Figure 6.30 – Showing the created virtual machine

In this exercise, we looked at creating a resource group and a virtual machine using PowerShell via Cloud Shell. In the following exercise, we will create a resource group and a virtual machine using the Azure CLI from Cloud Shell.

Exercise 4 – creating resources using the Azure CLI from Cloud Shell

In this exercise, you'll learn how to interact with Azure environments using the Azure CLI as the CLI tool and Cloud Shell as the shell environment for running commands.

The following subsections will show you how to create all the necessary resources for this exercise. These have been segregated into tasks for ease of understanding:

Task – accessing the Azure portal

1. Log in to the Azure portal by going to <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – setting up Cloud Shell (skip this task if you've already completed it)

2. Click on the Cloud Shell **code** icon on the top toolbar of the portal. If this is the first time you have used Cloud Shell and no storage has been mounted to persist files, you will be prompted to create a storage account. Select your subscription and then click on **Create storage**:

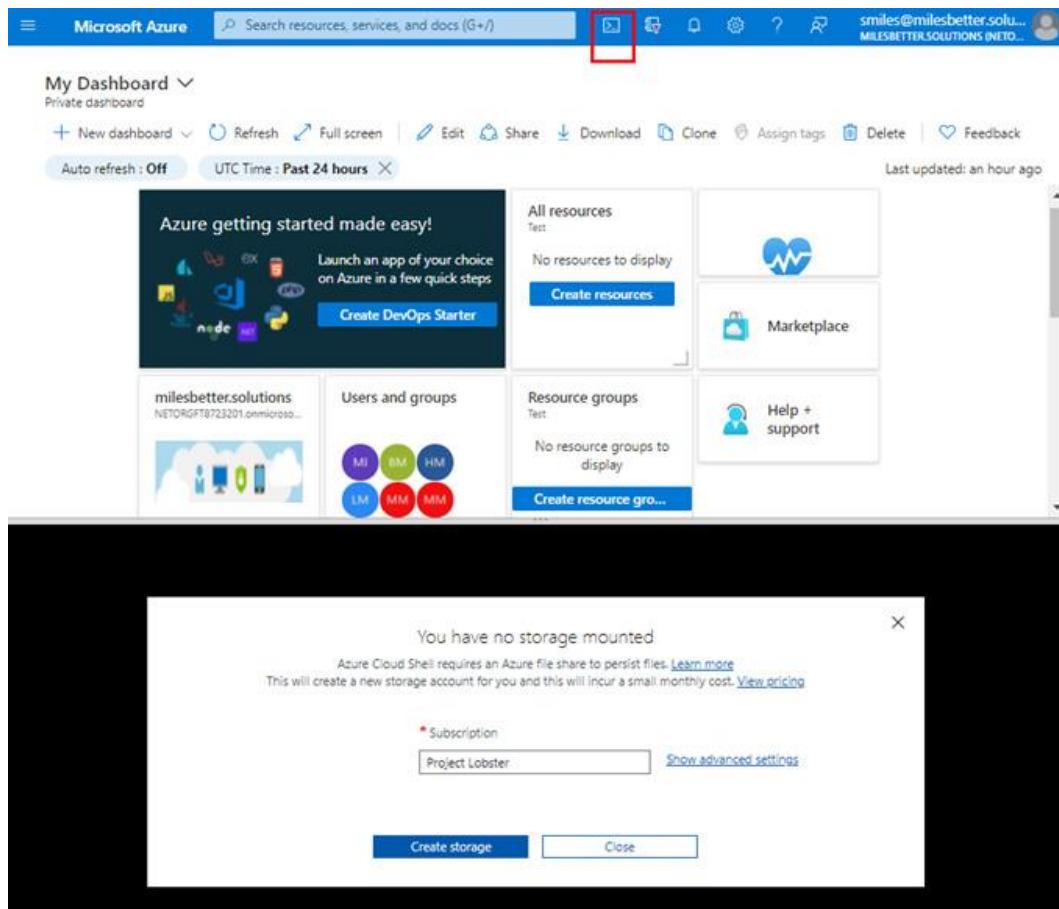


Figure 6.31 – Cloud Shell setup

- Once the storage account has been created, you will be connected to a terminal running the shell environment you will use to run commands.

Task – creating a resource group

- Bash** should be set as the CLI within Cloud Shell for this exercise.
- To create a resource group, enter the following command:

```
az group create -l uksouth -n Project1-RG
```

- The output will look as follows:

```
Bash
steve@Azure:~$ az group create -l uksouth -n Project1-RG
{
  "id": "/subscriptions/hc9he499-ae2c-4083-88a1-55b232f87h99/resourceGroups/Project1-RG",
  "location": "uksouth",
  "managedBy": null,
  "name": "Project1-RG",
  "properties": {
    "provisioningState": "Succeeded"
  },
  "tags": null,
  "type": "Microsoft.Resources/resourceGroups"
}
steve@Azure:~$ []
```

Figure 6.32 – Creating a resource group

4. To show the resource group that has just been created, enter `az group list` or `az group list --out table`.
5. The created resource group will also appear in the portal UI.

The screenshot shows the Azure portal's Resource Groups blade. It lists three resource groups: 'cloud-shell-storage-westeurope' (West Europe), 'NetworkWatcherRG' (UK South), and 'Project1-RG' (UK South). The 'Project1-RG' row is highlighted with a red box. Below the portal, a terminal window titled 'Bash' shows the command `az group list --out table` being run. The output table lists the same three resource groups with their names, locations, and status (all Succeeded).

Name	Location	Status
cloud-shell-storage-westeurope	westeurope	Succeeded
Project1-RG	uksouth	Succeeded
NetworkWatcherRG	uksouth	Succeeded

Figure 6.33 – Showing the created resource group

Task – creating a virtual machine

1. To create a virtual machine, enter the following code:

```
az vm create \
    --resource-group Project1-RG \
    --name myVM \
    --image win2019datacenter \
    --admin-username azureuser
```

2. When prompted, enter a username and password:

The screenshot shows a terminal window with the command `az vm create` being run. The command includes parameters to create a VM named 'myVM' in the 'Project1-RG' resource group, using the 'win2019datacenter' image, and setting the admin username to 'azureuser'. The terminal then prompts for an Admin Password, which is partially visible as 'Admin Password: [REDACTED]'.

Figure 6.34 – Creating a virtual machine

3. You will see a **Running** message while the virtual machine is being created.
 4. Once the virtual machine has been created, the following information will be returned:

Figure 6.35 – Virtual machine created

5. To show the virtual machine that has just been created, enter the following command:

```
az vm list --out table
```

6. The created virtual machine will also appear in the portal UI.

The screenshot shows the Azure portal interface. At the top, there's a navigation bar with 'Dashboard > Virtual machines' and a search bar containing 'milesbetter.solutions (NETORGFT8723201.onmicrosoft.com)'. Below the search bar are several buttons: '+ Create', 'Switch to classic', 'Reservations', 'Manage view', 'Refresh', 'Export to CSV', 'Open query', 'Assign tags', and three dots. A filter bar follows, with dropdowns for 'Subscription == all', 'Resource group == all', 'Location == all', and an 'Add filter' button. The main area displays a table of one record:

Name	Subscription	Resource group	Location	Status	Operating system	Size
myVM	Project Lobster	Project1-RG	UK South	Running	Windows	Standard

Below the table, there are navigation controls: '< Previous', 'Page 1 of 1', and 'Next >'. At the bottom, there's a terminal window titled 'Bash' showing the command 'az vm list --out table' and its output:

```
steve@Azure: ~ $ az vm list --out table
Name   ResourceGroup    Location    Zones
myVM  PROJECT1-RG      uksouth
```

Figure 6.36 – Showing the created virtual machine

In this exercise, we created a resource group and a virtual machine using the Azure CLI from Cloud Shell. The following exercise looks at using Azure Service Health in the Azure portal.

Exercise 5 – exploring Azure Service Health

In this section, you'll learn how to interact with Azure Service Health in the Azure portal:

Task – accessing the Azure portal

1. Log in to the Azure portal by going to <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – exploring Azure Service Health

2. From the search box at the top of the portal, enter **Service Health** and click on **Service Health** from the results.
3. On the **Service Health** page, there is a left-hand navigation menu. Here, you can view **ACTIVE EVENTS, HISTORY, RESOURCE HEALTH, and ALERTS**.
4. From **Service issues**, under the **ACTIVE EVENTS** section, you can launch a *guided tour* and view the current service issues or issues that have been resolved in the past 7 days that may be impacting your resources; the map will show color status dots for each region you have resources in. This can be seen in the following screenshot:

The screenshot shows the Microsoft Azure Service Health page. At the top, there's a blue header bar with the Microsoft Azure logo and a search bar. Below it, the URL is 'Service Health | Service issues'. The left sidebar has a navigation menu with several sections: ACTIVE EVENTS (with 'Service issues' selected), HISTORY, RESOURCE HEALTH, and ALERTS. The ACTIVE EVENTS section includes links for 'Planned maintenance', 'Health advisories', and 'Security advisories'. The HISTORY section has a link to 'Health history'. The RESOURCE HEALTH section has a link to 'Resource health'. The ALERTS section has a link to 'Health alerts'. Above the main content area, there are buttons for 'Save View', 'Delete View', and 'Add service health alert'. To the right of these buttons are dropdown menus for 'Subscription' (2 selected) and 'Region' (187 selected). Below these is a world map with a red box highlighting a specific region. The main content area displays a message: 'No service issues found' and 'See all past issues in the [health history](#)'. A blue button labeled 'Launch guided tour' is visible. At the bottom, there's a table titled 'Issues resolved in the past 7 days' with columns for 'Issue Name', 'Subscription(s)', 'Service(s)', and 'Region(s)'. One row is shown: 'Connectivity Issues' (Subscription: a3d3aba4-c645-4ad..., Service: Network Infrastructure, Region: North Europe).

Figure 6.37 – Service Health

5. In the **ACTIVE EVENTS** section, you can also click through to see any **Planned maintenance** events that may impact your resources, **Health advisories**, and **Security advisories**; for each, there is a click-through link to see all past issues in the **Health history** section
6. In the **Health History** section, you can click on a service issue, find out more information about the impact, any updates, and download a summary report and a **Root Cause Analysis (RCA)** report.
7. In the **Resource health** section, you can view the health of any individual resource you have created within your subscription(s) so that you know if everything is running as expected. If any problems are impacting its running, you will be told and actions you can take will be

provided. For example, if a VPN gateway is not running normally, a hyperlink will be provided so that you can reset it.

8. In the **Health alerts** section, you can add a service health alert rule so that a notification is sent based on a set of service health criteria.

With that, we've covered the hands-on exercises for this chapter.

Chapter 7

Technical requirements

To carry out the hands-on labs in this chapter, you will require the following:

- An Azure subscription that has access to create and delete resources in the subscription. If you do not have an Azure subscription, you can create a free Azure account from this link: <https://azure.microsoft.com/free>.
- Access to an internet browser, as you will log in to the Azure portal at <https://portal.azure.com>.
- You can alternatively use the Azure desktop app, available at <https://portal.azure.com/App/Download>.

It is important to note that in November 21 some Microsoft Security Services have been renamed. These are renamed as follows:

- **Azure Security Center** and **Azure Defender** are now called **Microsoft Defender for Cloud**
- **Azure Defender plans** to **Microsoft Defender plans**
- **Azure Sentinel** is now called **Microsoft Sentinel**
- **Azure Defender for IoT** is now called **Microsoft Defender for IoT**
- **Azure Defender for SQL** is now called **Microsoft Defender for SQL**
- **Microsoft Cloud App Security** is now called **Microsoft Defender for Cloud App**
- **Microsoft Defender for Business** is introduced as a new Service SKU

You can learn more about the update of Microsoft security services at this url:

<https://docs.microsoft.com/en-us/azure/defender-for-cloud/defender-for-cloud-introduction>

Figures

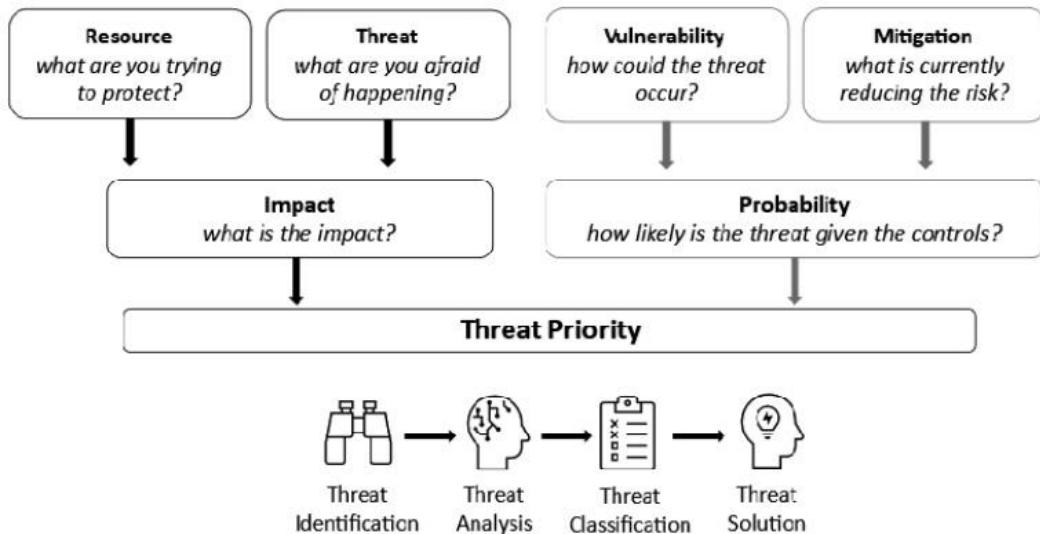


Figure 7.1 – Threat priority model

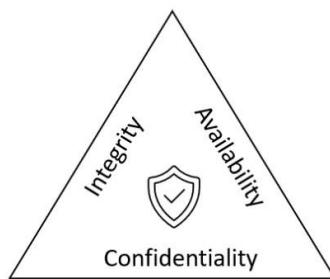


Figure 7.2 – Security posture CIA triangle

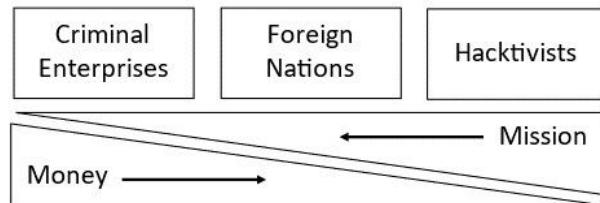


Figure 7.3 – Attack motivations

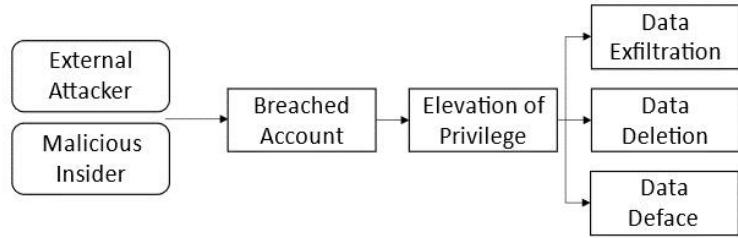


Figure 7.4 – Attack chain

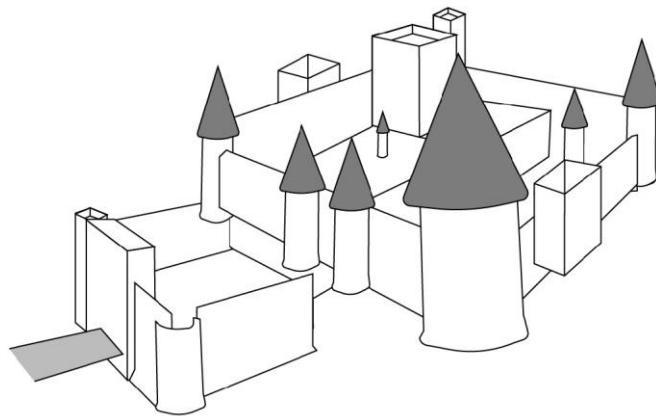


Figure 7.5 – Medieval castle defense approach

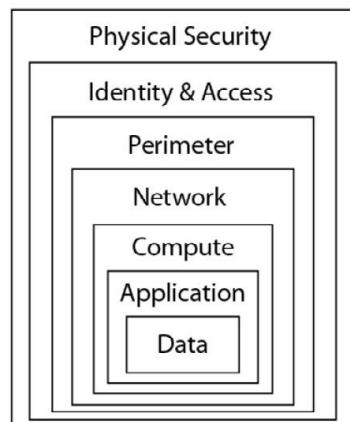


Figure 7.6 – DiD approach layers

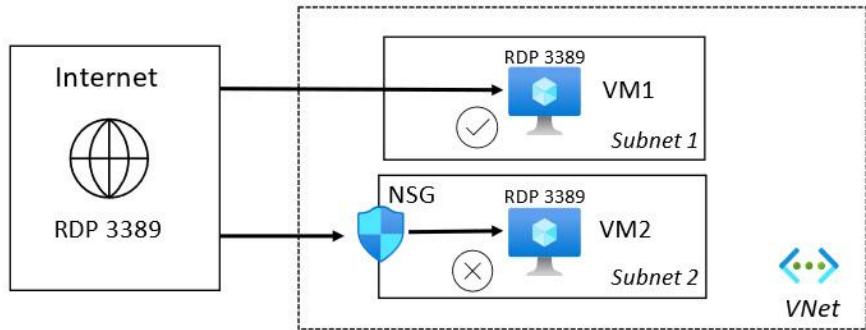


Figure 7.7 – VM access

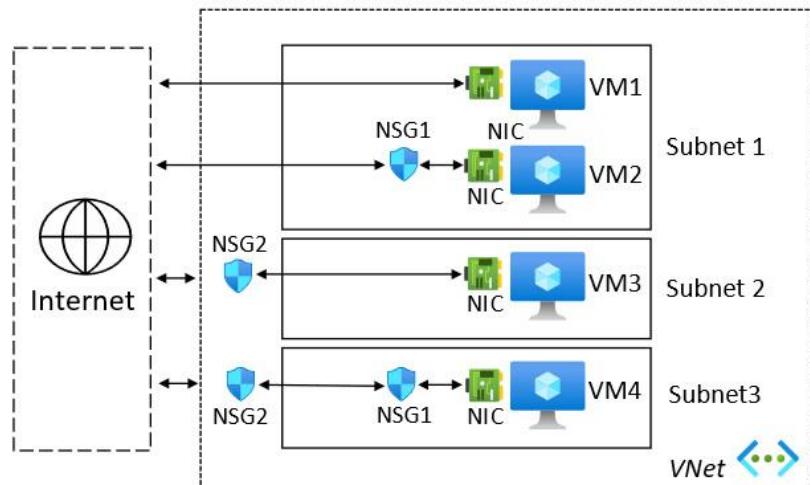


Figure 7.8 – NSG association

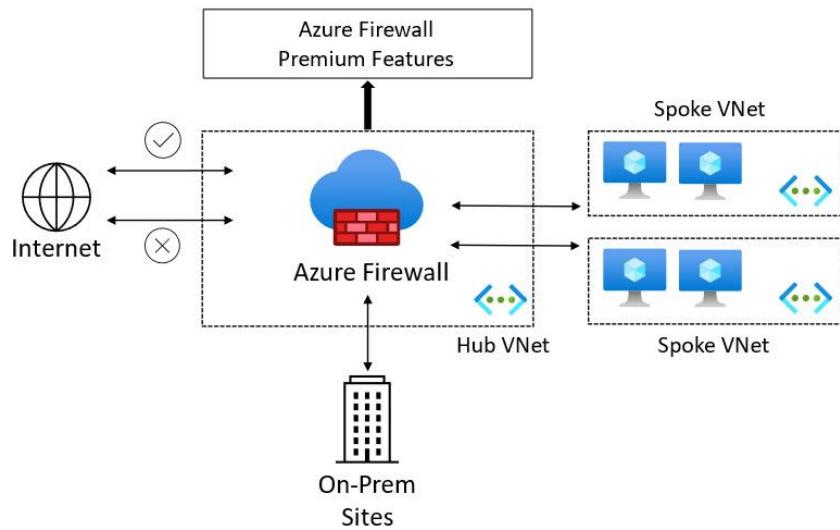


Figure 7.9 – Azure Firewall

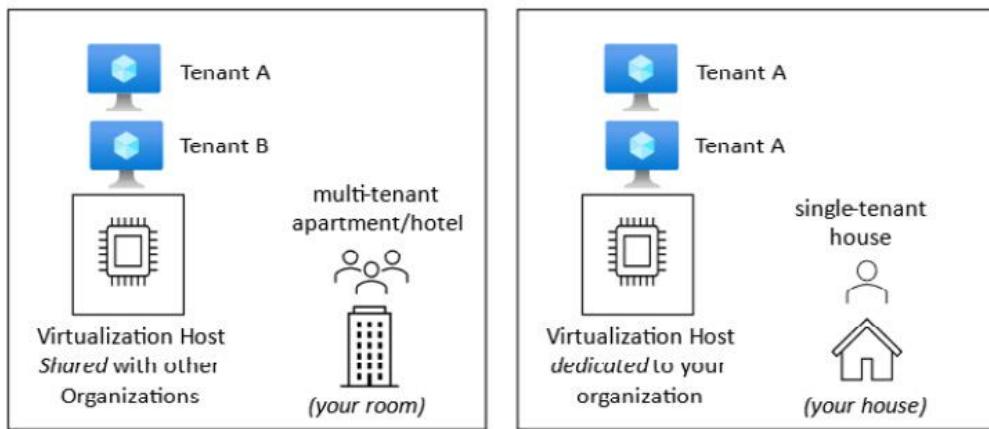


Figure 7.10 – Azure Dedicated Host

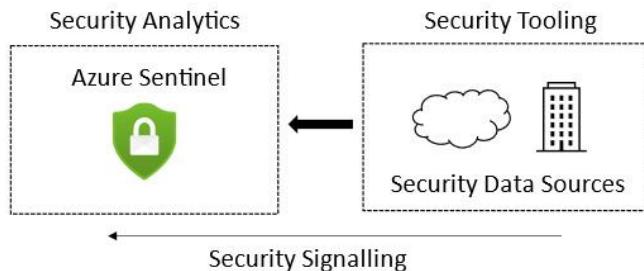


Figure 7.11 – Sentinel positioning

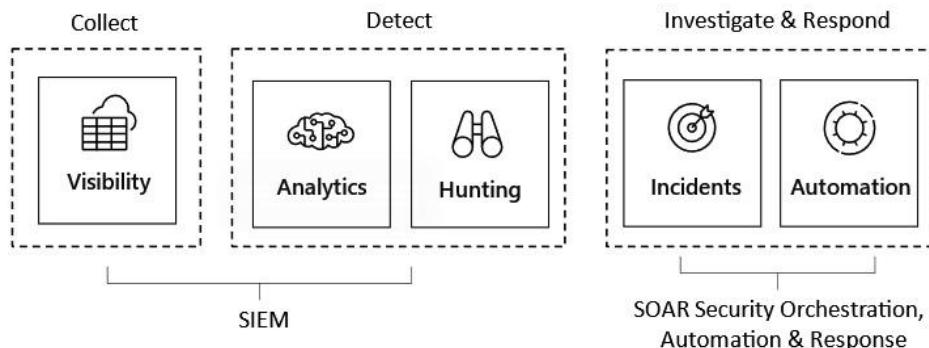


Figure 7.12 – Sentinel security operations proposition

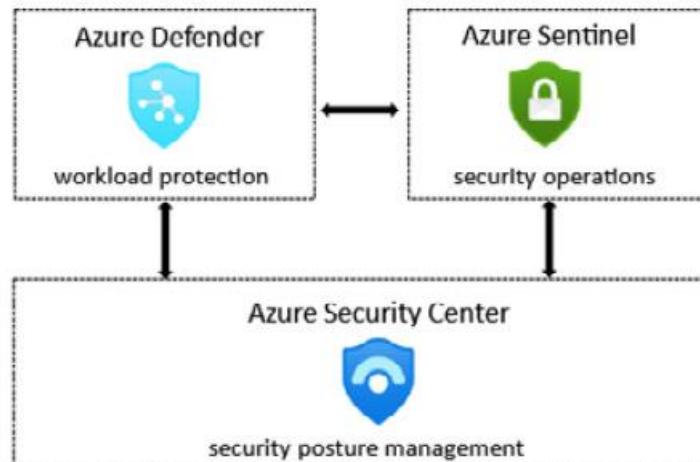


Figure 7.13 – Security center positioning

Links

Further information and best practices on Network Appliances can be found at the following links:

- <https://azure.microsoft.com/solutions/network-appliances>
- <https://azure.microsoft.com/blog/best-practices-to-consider-before-deploying-a-network-virtual-appliance>

Load-balancing options: <https://docs.microsoft.com/azure/architecture/guide/technology-choices/load-balancing-overview>.

Additional information and study references

This section provides links to additional exam information and study references, as follows:

- **Exam AZ-900: Microsoft Azure Fundamentals:**
<https://docs.microsoft.com/learn/certifications/exams/az-900>
- **Exam AZ-900: Microsoft Azure Fundamentals – Skills Measured:**
<https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE3VwUY>
- **Microsoft Learn: Azure Fundamentals part 4 – Describe general security and network security features:**
<https://docs.microsoft.com/learn/paths/az-900-describe-general-security-network-security-features>

Hands-on exercise

To support your learning with some practical skills, we will look at the hands-on creation of some of the resources covered in this chapter.

The following exercises will be carried out:

- Exercise 1 – Create an Azure key vault.
- Exercise 2 – Secure network access using an NSG.

Getting started

To get started with these hands-on exercises, you will need an Azure subscription that has access to create and delete resources in the subscription. You can use an existing account that you created as part of the exercises from any chapter in this book; alternatively, you can create a free Azure account from this link: <https://azure.microsoft.com/free>.

This free Azure account provides the following:

- 12 months of free services.
- USD \$200 credit to explore Azure for 30 days.
- 25+ services that are always free.

Exercise 1 – Create an Azure key vault

This section will look at installing Azure Key Vault and then storing a secret, which will be a password in this exercise.

In the following sub-sections, you can see the procedure to complete the exercise, segregated into tasks for a better understanding.

Task: Access the Azure portal

1. Log in to the Azure portal at <https://portal.azure.com>. You can alternatively use the Azure desktop app, found at <https://portal.azure.com/App/Download>.

Task: Create an Azure key vault

2. In the search bar, type in **key vaults**; click **key vaults** from the results list.
3. From the **Key vaults** blade, click the **+ Create** button on the top toolbar.
4. From the **Basics** tab, set project details settings as required for the subscription and the resource group.
5. Set **Instance details** settings, as follows:
 - **Key vault name**—Enter a name.
 - **Region**—Set as required.

- **Pricing tier**—Leave set to **Standard**.
6. Set **Recovery options** settings, as follows:
 - **Days to retain deleted vaults**—Leave set to **90** days.
 - **Purge protection**—Leave set to **Disabled**.
 7. Click **Next: Access policy**; leave at default settings.
 8. Click **Next: Networking**; leave at default settings.
 9. Click **Review + create**.
 10. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings are as required, you can click **Create**.
 11. When the deployment is complete, you will receive a notification that the deployment succeeded.
 12. Click **Go to resource** from the **Deployment** blade; alternatively, navigate to the Azure Key Vault instance.

Task: Add a secret to the key vault

1. From the **Key Vault** blade of the instance created, click **Secrets** under **Settings**.
2. Click **+ Generate/Import**.
3. From the **Create a secret** blade, set the following:
 - Upload options—Leave set to Manual.
 - Name—Enter a name for this secret.
 - Value—Enter the secret you wish to store (that is, a password).
 - Content type—Set as required.
 - Set activation date—Set as required.
 - Set expiration date—Set as required.
 - Enabled—Leave as Yes.
4. Click **Create**.
5. You will receive a notification that the secret was successfully created.
6. You will now see the secret listed in secrets under **Settings** for the key vault instance.

In this exercise, we successfully created an Azure key vault and created a secret. In the following exercise, we will look at securing network access using an NSG.

Exercise 2 – Secure network access using an NSG

This section will look at creating an NSG and associating with a subnet; adding an inbound rule, allowing us to connect to a VM over RDP while restricting connections to access from a known IP address only; then, creating an outbound rule to deny internet access.

For this exercise, we will create a new VM.

In the following sub-sections, you can see the procedure to complete the exercise, segregated into tasks for a better understanding.

Task: Access the Azure portal

1. Log in to the Azure portal at <https://portal.azure.com>. You can alternatively use the Azure desktop app, found at <https://portal.azure.com/App/Download>.

Task: Create a VM

2. In the search bar, type in **virtual machines**; click **Virtual machines** from the list of services.
3. From the **Virtual machines** blade, click **+ Create** and then **Virtual machine** from the top menu of the blade.
4. Set **Project and Instance details** and **Administrative accounts** as required.
5. Set **Public inbound port rules** to **None**.
6. Set **Licensing** at the default of unchecked (that is, **No**) to use an existing Windows Server license.
7. Click **Next: Disks**.
8. Leave set at defaults.
9. Click **Next: Networking**.
10. From **Network interface**, set the following:
 - **Virtual network**—Use the default provided.
 - **Subnet**—Use the default provided.
 - **Public IP**—Click **Create new**, then enter a name and click **OK**.
 - **NIC network security group**—Select **None**.
 - Leave all other settings at defaults.
11. Click **Next: Management**.
12. Leave set at defaults.
13. Click **Next: Advanced**.

14. Leave set at defaults.
15. Click **Next: Tags** and add any tags as required; click **Next: Review + create**.
16. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings are as required, you can click **Create**.
17. You will receive a notification that the resource was created successfully.

Task: Create an NSG

1. In the search bar, type in **network security groups**; click **network security groups** from the list of services.
2. From the **Virtual machines** blade, click **+ Create** from the top menu of the blade.
3. Set **Project and Instance details** and **Administrative accounts** as required.
4. Click **Next: Tags** and add any tags as required; click **Next: Review + create**.
5. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings are as required, you can click **Create**.
6. You will receive a notification that the resource was created successfully.
7. Click **Go to resource** from the deployment blade; alternatively, navigate to the Azure NSG instance.

Task: Associate NSG to a subnet

1. From the **Created NSGs** blade of the instance created, click **Subnets** under **Settings**.
2. Click **+ Associate** from the top toolbar.
3. Select the VNet and subnet of the VM you created in the previous exercise from the **Associate subnet** blade.
4. Click **OK**.
5. You will receive a notification that the changes were saved successfully.

Task: Attempt to connect to a VM using RDP

1. Navigate to the VM created in this exercise.
2. From the **Overview** pane, click **Connect** and then click **RDP**.
3. From the **Connect** pane, click **Download RDP file**.
4. Open the downloaded file and click **Connect**.

5. You will see a message box that says **Remote Desktop can't connect to the remote computer**. This is to be expected, and we will resolve this in the next task to allow a connection.

Task: Add an inbound rule to allow RDP access

1. From the **Virtual machines** blade, click **Networking** under **Settings**. You will see that from the inbound port rules, all inbound connections are denied unless their source is the VNet or Azure Load Balancer.
2. From **Inbound port rules** blade, click **Add inbound port rule**.
3. Open a browser and from Google, type `what's my ip` and note your IP for the next step.
4. From the **Add inbound security rule** blade, leave all other options at their defaults apart from the following:
 - Source—Select IP addresses.
 - Source IP addresses/CIDR ranges—Set to your IP from the previous step.
 - Service—Select RDP.
 - Action—Ensure Allow is set.
 - Name—Provide a name, such as `AllowInbound_RDP_KnownIP`.
 - Description—Enter as required.
5. Click **Add**.
6. You will receive a notification that the rule was created successfully.
7. Open the downloaded file again and click **Connect**.
8. This time, you will be prompted to enter your credentials and will be able to connect to the VM successfully.

Task: Access the internet from the VM

1. While logged in to the VM, open a browser and confirm you have reached the internet by visiting a site such as www.milesbetter.solutions (you may need to adjust **Internet Explorer (IE)** security settings). We will restrict this access to the internet in the next exercise.

Task: Add an outbound rule to deny internet access

2. From the **Virtual machines** blade, click **Networking** under **Settings**; you will see from the **Outbound port rules** tab that all outbound connections are allowed to the internet.
3. From **Outbound port rules** blade, click **Add outbound port rule**.

4. From the **Add outbound security rule** blade, leave all other options at default apart from the following:
 - Destination—Select Service tag.
 - Destination service tag—Select Internet.
 - Destination port ranges—Enter the symbol ***** (asterisk symbol).
 - Action—Ensure Deny is set.
 - Priority—Enter a value of **200**.
 - Name—Provide a name, such as **DenyOutbound_Internet**.
 - Description—Enter as required.
5. Click **Add**.
6. You will receive a notification that the rule was created successfully.
7. From the VM, open a browser again and confirm you can no longer reach the internet by visiting a site such as **www.milesbetter.solutions**.
8. This time, you will see a message from the browser such as **Can't reach this page**.

In this exercise, we successfully created an NSG and associated with a subnet; we added an inbound rule that allows us to connect to a VM over RDP while restricting connections to be able to access from a known IP address only; then, we created an outbound rule to deny internet access.

Chapter 8

Technical requirements

To carry out the hands-on labs in this chapter, you will require the following:

- An Azure subscription that has access to create and delete resources in the subscription. If you do not have an Azure subscription, you can create a free Azure account from this URL: <https://azure.microsoft.com/free>.
- Access to an internet browser. You will need to log in to the Azure portal: <https://portal.azure.com>.
- You can alternatively use the Azure desktop app: <https://portal.azure.com/App/Download>.

Figures

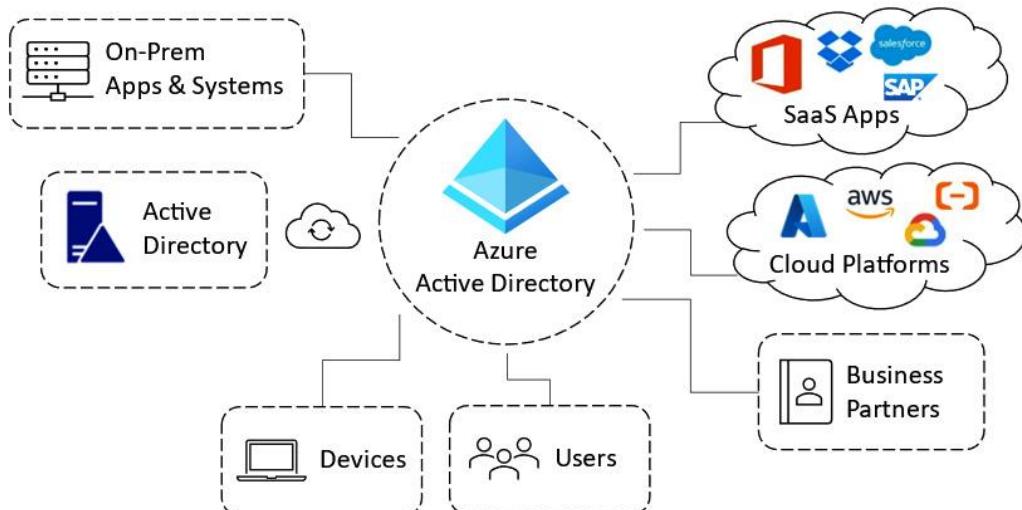


Figure 8.1 – Active AD

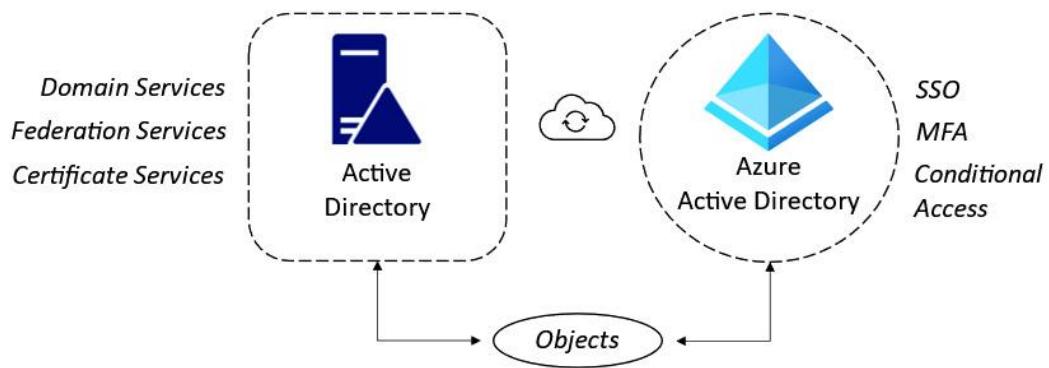


Figure 8.2 – AD and Azure AD

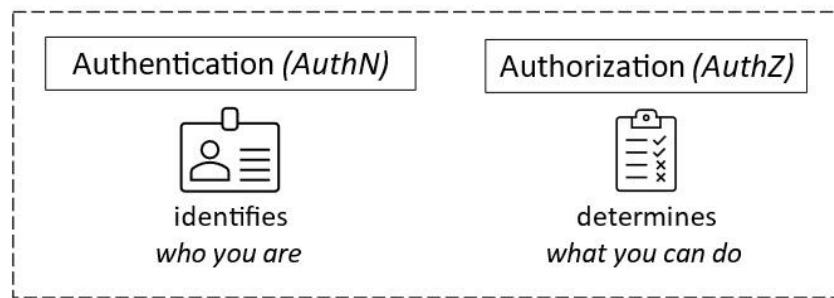


Figure 8.3 – Authentication and authorization

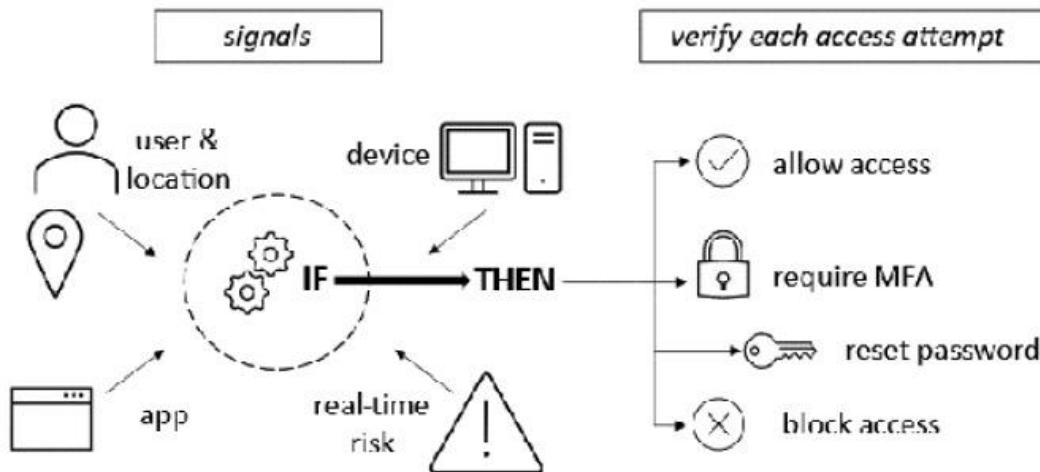


Figure 8.4 – Conditional Access

Further reading

This section provides links to additional exam information and study references:

- Exam AZ-900: Microsoft Azure fundamentals

<https://docs.microsoft.com/learn/certifications/exams/az-900>

- Exam AZ-900: Skills outline
<https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE3VwUY>
- Microsoft Learn: Azure Fundamentals – Describe identity, governance, privacy, and compliance features
<https://docs.microsoft.com/learn/paths/az-900-describe-identity-governance-privacy-compliance-features/>

Links

What is Azure AD Connect?: <https://docs.microsoft.com/azure/active-directory/hybrid/what-is-azure-ad-connect>.

Hands-on exercises

To support your learning with some practical skills, we will look at hands-on examples of some of the topics covered in this chapter.

The following exercises will be carried out:

- Exercise 1 – creating a new tenant instance of Azure AD
- Exercise 2 – creating users and groups in Azure AD

Getting started

To get started with the hands-on exercises, you will need an Azure subscription that has access to create and delete resources. You can use an existing account that you created as part of the exercises from any chapter in this book. Alternatively, you can create a free Azure account from this URL: <https://azure.microsoft.com/free>.

This free Azure account provides the following:

- 12 months of free services
- \$200 credit to explore Azure for 30 days
- 25+ services that are always free

Exercise 1 – creating a new tenant instance of Azure AD

This section will look at creating a new tenant instance of Azure AD using the Azure portal.

In the following sub-sections, you can see the procedure to complete the exercise, segregated into tasks for better understanding.

Task – accessing the Azure portal

1. Log in to the Azure portal: <https://portal.azure.com>. You can alternatively use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – creating a new tenant for an organization

2. In the search bar, type in **Azure Active Directory**. Click **Azure Active Directory** from the results list.
3. In the Azure AD **Overview** blade, click **Manage tenants** on the top toolbar.
4. In the **Switch tenant** blade, click **+ Create** on the top toolbar.
5. In the **Create a tenant** blade, on the **Basics** tab, leave **Tenant type** set to **Azure Active Directory**.
6. In the **Configuration** tab, set the following as required:
 - Organization name
 - Initial domain name
 - Country/Region
7. Click **Next: Review + create**.
8. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings are as required, you can click **Create**.
9. You will receive a notification that the task succeeded, and the new tenant and an instance of Azure AD were created.
10. Your account performing this task becomes the first user of this tenant and will automatically be assigned the **Global Admin** role.

In this exercise, we successfully created a new tenant and an instance of Azure AD. In the following exercise, we will look at creating users and groups on Azure AD.

Exercise 2 – creating users and groups in Azure AD

This section will look at creating users and groups for Azure AD using the Azure portal. You can use an existing Azure AD instance to perform this exercise if you wish.

In the following sub-sections, you can see the procedure to complete the exercise, segregated into tasks for a better understanding:

Task – accessing the Azure portal

1. Log in to the Azure portal: <https://portal.azure.com>. You can alternatively use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – creating a new user

2. In the search bar, type in **users**. Click **Users** from the results list.
3. In the **Users** blade, click **+ New user** on the top toolbar.
4. On the **New user** page, ensure the **Create user** option is selected.
5. Set the **Identity** settings as follows:
 - **User name:** *Enter a name*. This will be the username for the user to sign in with (this will form their UPN). If you have added custom domain names to Azure AD, these will appear here in the dropdown; select the domain name you wish to give the user to sign in with.
 - **Name:** *Set as required*. This is a descriptive name for the user.
 - **First name and Last name:** *Optional*.
6. For the **Password** settings, select as required.
7. For the **Groups and Roles** setting, select as required.
8. For the **Block sign-in** setting, leave it at the default setting.
9. For the **Usage location** setting, set the location of the user as required.
10. For the **Job Info** setting, enter as required or leave at the default setting.
11. Click **Create**.

You will receive a notification that the user was successfully created.

12. You will now see the user listed in the **Users** blade; the **User principal name** column is what the user will enter to sign in.

Task – creating a new guest (B2B) user

1. In the search bar, type in **users**. Click **Users** from the results list.
2. In the **Users** blade, click **+ New guest user** on the top toolbar.
3. On the **New user** page, ensure the **Invite user** option is selected.
4. Set the **Identity** settings as follows:
 - **Name:** *Set as required*. This is a descriptive name for the user.
 - **Email address:** *Set as required*. This will be where the invite is sent and must be associated with a Microsoft account to allow access.
 - **First name and Last name:** *Optional*.
5. For the **Personal message** setting, select as required.

6. For the **Groups and Roles** setting, select as required.
7. For the **Block sign-in** setting, leave it at the default setting.
8. For the **Usage location** setting, set the location of the user as required.
9. For the **Job Info** setting, enter as required or leave at the default setting.
10. Click **Invite**.

You will receive a notification that the user was successfully invited.

11. You will now see the user listed in the **Users** blade; the **User principal name** column is what the user will enter to sign in.
12. The invited guest user will now receive an email to accept the invitation.
13. The invited guest user will sign in with the Microsoft AD tenant associated with the email address.

Task – creating a group and adding a user

1. In the search bar, type in **groups**. Click **Groups** from the results list.
2. In the **Groups** blade, click **+ New Group** on the top toolbar.
3. Select the group type as required. Leave as the default of **Security** for this exercise.
4. Enter a group name as required.
5. Enter a group description as required.
6. Set an Azure AD roles assignment as required. Leave as the default of **No** for this exercise.
7. Select the membership type as required. Leave as the default of **Assigned** for this exercise.
8. Set **Owners** as required. Leave as the default of **No owners selected** for this exercise.
9. Set **Members** as required. Select the created new user from the previous task for this exercise.
10. Click **Create**.

You will receive a notification that the group was successfully created.

11. You will now see the group listed in the **Groups** blade.
12. Click the group you created. From the **Overview** screen, you will see the number of users in this group.
13. Click **Members** from the **Manage** section on the left navigation toolbar of the group screen.

14. From the **Members** page for the group, you will see the users added to this group. You can remove users from the top toolbar and perform bulk operations.

In this exercise, we successfully created a new user and a new guest user in Azure AD, and then created a new group and added a user.

Chapter 9

Technical requirements

To carry out the hands-on labs in this chapter, you will require the following:

- An Azure subscription that can create and delete resources in the subscription. If you do not have an Azure subscription, you can create a free Azure account at <https://azure.microsoft.com/free>.
- Access to an internet browser to log into the Azure portal: <https://portal.azure.com>.
- Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Figures

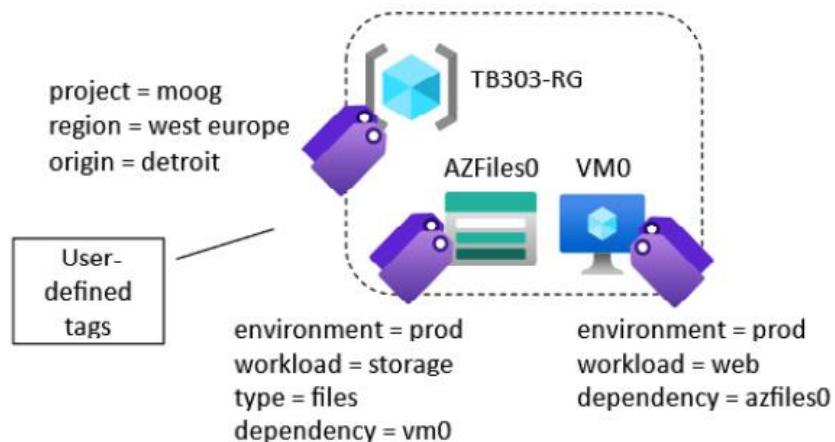


Figure 9.1 – Resource tags

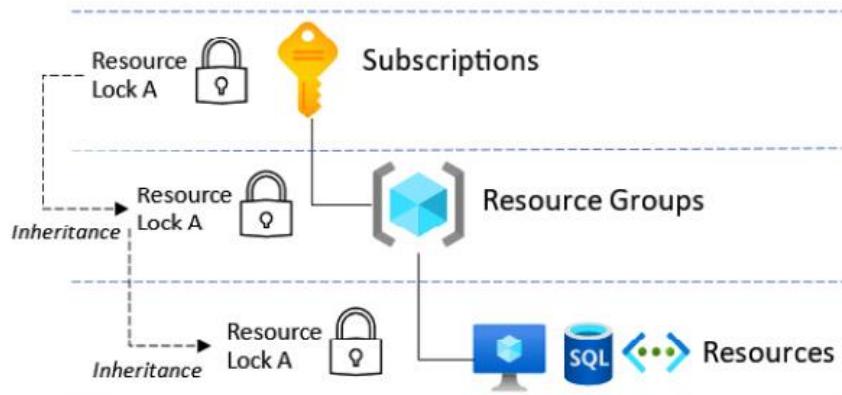


Figure 9.2 – Azure resource locks

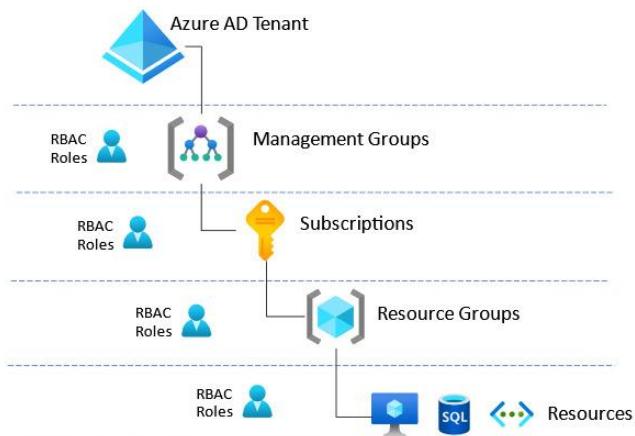


Figure 9.3 – RBAC scope level

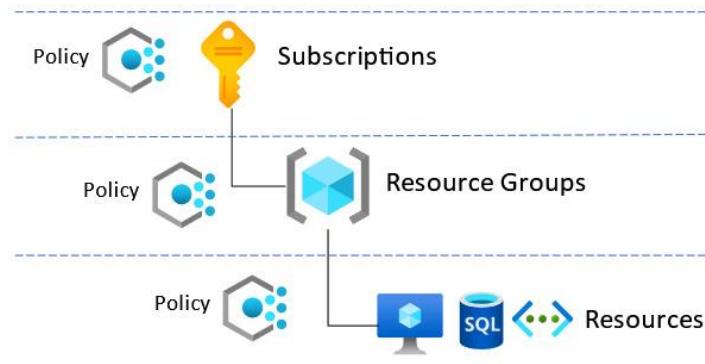


Figure 9.4 – Azure Policy scope level

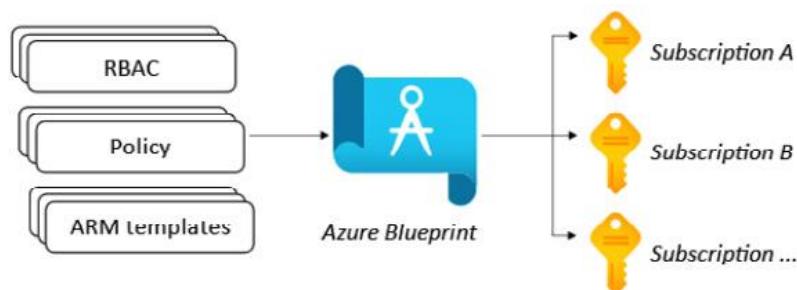


Figure 9.5 – Azure Blueprints

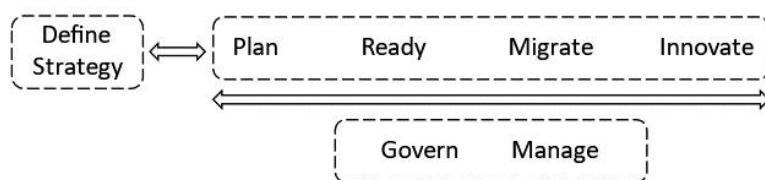


Figure 9.6 – Azure CAF methodologies

Links

The CAF documentation can be accessed via the following URL:

<https://docs.microsoft.com/azure/cloud-adoption-framework>.

Hands-on exercises

To support your learning with some practical skills, we will create some of the resources that were covered in this chapter.

The following exercises will be carried out:

- Exercise 1 – assigning access with RBAC
- Exercise 2 – creating a custom RBAC role
- Exercise 3 – adding a resource lock to a resource group
- Exercise 4 – enabling resource tagging with Azure Policy
- Exercise 5 – limiting the resource creation location with Azure Policy

Getting started

To get started with these hands-on exercises, you will need an Azure subscription that has access to create and delete resources in the subscription; you can use an existing account that you have created as part of the exercises from any chapter in this book. Alternatively, you can create a free Azure account by going to <https://azure.microsoft.com/free>.

This free Azure account provides the following:

- 12 months of free services
- \$200 credit to explore Azure for 30 days
- 25+ services that are always free

Exercise 1 – assigning access with RBAC

This section will assign access to the resource group with RBAC using the Azure portal.

The following subsections cover how to complete this exercise, segregated into tasks for ease of understanding.

Task – accessing the Azure portal

1. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – creating a new resource group that requires access

2. In the assigning with RBAC:resource group requiring access, creating" search bar, type **resource groups**; click **Resource groups** from the results list.
3. From the **Resource groups** blade, click **+ Create** via the top toolbar.
4. From the **Basics** tab, set the **Project** and **Resource** details as required.
5. Click **Next: Review + create**.
6. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings are as required, you can click **Create**.
7. You will receive a notification that the resource group was created successfully.
8. Click **Go to resource group** from the **Notifications** blade. Alternatively, navigate to the resource group instance.

Task – assigning access to a resource group

1. From the created **Resource groups** blade, click **Access control (IAM)** from the left-hand side menu.
2. From the **Roles** tab, review the built-in roles; under the **Details** column, you can click on **View** to see the permissions that role will grant.
3. From the **Role assignments** tab, review the current assignments.
4. From the **Check access** tab, please review the options for **My Access** and **Check access**, and then click **Add role assignment**.
5. From the **Role** tab, click **Owner** or the role you wish to assign.
6. Click **Next**.
7. For this exercise, leave **Assign access to** set to the default of **User, Group, or Service Principal**.
8. From **Members**, select the members to be assigned the role.
9. Click **Next**.
10. Click **Next: Review + assign**.
11. You will receive a notification that the role assignment was added.
12. Click the **Role assignments** tab from the **Access control (IAM)** blade and review the new assignment that was created.

In this exercise, we successfully created a resource group and assigned the RBAC role to a user for access. In the following exercise, we will look at creating a custom RBAC role.

Exercise 2 – creating a custom RBAC role

This section will look at creating a custom RBAC role.

You can use an existing Azure AD instance to perform this exercise if you wish.

The following subsections cover how to complete this exercise, segregated into tasks for ease of understanding.

Task – accessing the Azure portal

1. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – creating a custom RBAC role

2. In the search bar, type **subscriptions**; click **Subscriptions** from the results list.
3. From the **Subscriptions** blade, click on your subscription.
4. From the left menu of the **Subscriptions** blade, click **Access Control (IAM)**.
5. From the **Access control** blade, click **+Add**.
6. Then, click **Add custom role**.
7. From the **Create a custom role** blade, on the **basics** tab, enter the following information:
 - Custom role name.
 - Description.
 - Baseline permissions: *leave as the default of Start from scratch.*
8. Click **Next**.
9. From the **Permissions** tab, click **+Add permissions**.
10. From the **Add permissions** blade, you can now search for each permission to add. You can now select the actions you wish the custom role to have. Then, click **Add** for each permission you wish to add.
11. From the **Permissions** tab, click **+Add permissions**.
12. Evaluate whether you need to add any exclude permissions; click **Add** or **Cancel** to return to the main blade to continue.
13. Click **Next: Review + create**.
14. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.

15. You will receive a message stating that the new custom RBAC role was created; click **OK** on the message.

16. From the main **Access control (IAM)** blade, you will now be able to search/locate the new custom role that was created from the **Roles** tab.

In this exercise, we successfully created a custom RBAC role. In the following exercise, we will look at applying a resource lock to a resource group.

Exercise 3 – creating resource locks

This section will look at adding a resource lock to a resource group using the Azure portal.

The following subsections show how to complete this exercise, segregated into tasks for ease of understanding.

Task – accessing the Azure portal

1. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – adding a resource lock to a resource group

2. In the search bar, type **resource groups**; click **Resource groups** from the results list.
3. From the **Resource group** blade, open the resource group you created in the previous exercise. Alternatively, create a new resource group (*using the previous exercise's steps*) or use an existing resource group for this exercise.
4. From the **Resource groups** page, click **Locks** under settings from the left navigation menu.
5. From the **Locks** blade, click **+ Add**.
6. From the **Add lock** screen, enter a lock name as required and select **Delete** as the lock type. Then, add any notes as required.
7. You will now see the created lock appear on the list of locks on the **Locks** blade of the resource group.

Task – testing the lock function

1. From the **Overview** blade of the resource group that the lock was created for, click **Delete resource group** from the top toolbar.
2. From the **Delete** blade, type the resource group's name and click **Delete**.
3. You will receive a notification that the resource group failed to be deleted and that it cannot be deleted as it is locked.

In this exercise, we successfully added a delete resource lock to a resource group and validated its operation. In the following exercise, we will look at resource tagging and Azure Policy.

Exercise 4 – enabling resource tagging with Azure Policy

This section will look at enabling resource tagging with Azure Policy using the Azure portal.

The following subsections show how to complete this exercise, segregated into tasks for ease of understanding.

Task – accessing the Azure portal

1. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – creating a policy assignment

2. In the search bar, type **policy**; click **Policy** from the results list.
3. From the **Policy** blade, click **Assignments** under **Authoring** via the left navigation menu.
4. Click **Assign policy** from the top toolbar.
5. From the **Policy definition** field, under **Basics** on the **Basics** tab, click the **ellipsis** button on the right-hand side of the text box.
6. From the **Available Definitions** page that appears, in the search box, enter **require a tag**.
7. From the policy definition search results, click **Require a tag on resource groups**.
8. Click **Select**.
9. From the **Parameters** tab, in the **Tag Name** field, enter **Environment** as the text value.
10. Click **Next: Review + create**.
11. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.
12. You will receive a notification, stating that the policy assignment succeeded.

Task – testing the policy function

1. In the search bar, type **resource groups**; click **Resource groups** from the results list.
2. From the **Resource groups** blade, click the **+ Create** button via the top toolbar.
3. From the **Basics** tab, set the **Project** and **Resource** details as required.
4. Click **Next: Review + create**.

5. On the **Review + create** tab, click **Create**.
6. You will receive a notification, stating that the resource group failed to be created; click **View error details**.
7. In the **summary** tab, you will see that the policy disallowed the resource; this is the required expected behavior.
8. From the **Tags** tab, enter the name that was defined in the policy; in our exercise, this text value was **Environment**.
9. For this exercise, enter **Production** as the text value.
10. Click **Next: Review + create**.
11. On the **Review + create** tab, click **Create**.
12. You will receive a notification, stating that the resource group was created successfully this time.
13. Search for **Tags** or navigate to the **Tags** blade in the portal. You will see that your tag has been created. Upon clicking your tag, the page for the tag will show all the resources that have been tagged with it.
14. The final task is to clean up and delete the assigned policy that was created in this exercise.
15. From the **Assignments** blade, locate the assignment to delete from the list. Then, right-click and select **Delete assignment** from the pop-up menu.

In this exercise, we successfully created a policy to deny creating a resource that does not have a tag. In the following exercise, we will look at limiting the resource creation location with Azure Policy.

Exercise 5 – limiting the resource creation location with Azure Policy

This section will look at limiting the resource creation location with Azure Policy using the Azure portal.

The following subsections cover how to complete this exercise, segregated into tasks for ease of understanding.

Task – accessing the Azure portal

1. Log into the Azure portal at <https://portal.azure.com>. Alternatively, you can use the Azure desktop app: <https://portal.azure.com/App/Download>.

Task – removing the policy assignment from the previous exercise

2. Before starting this exercise, if you created the policy assignment for the previous exercise and have not deleted this yet, do so now by performing the following step.

3. From the **Assignments** blade, locate the assignment to delete from the list. Then, right-click and select **Delete assignment** from the pop-up menu.

Task – creating a policy assignment

4. In the search bar, type **policy**; click **Policy** from the results list.
5. From the **Policy** blade, click **Assignments** under **Authoring** on the left navigation menu.
6. Click **Assign policy** from the top toolbar.
7. From the **Policy definition** field, under **Basics** on the **Basics** tab, click the **ellipsis** button on the right-hand side of the text box.
8. From the **Available Definitions** page that appears, in the search box, enter **allowed locations**.
9. From the policy definition search results, click **Allowed locations**.
10. Click **Select**.
11. From the **Parameters** tab, select the allowed locations for resource creation.
12. Click **Next: Review + create**.
13. On the **Review + create** tab, review your settings; you may go back to the previous tabs and make any edits if required. Once you have confirmed your settings, click **Create**.
14. You will receive a notification that the policy assignment succeeded.

Task – testing the policy function

1. In the search bar, type **virtual machines**; click **Virtual machines** from the results list.
2. From the **Virtual machines** blade, click the **+ Create** button via the top toolbar and select **Virtual machine**.
3. From the **Basics** tab, set the **Project** details as required.
4. From the **Instance details** tab, select a **region** that is **NOT** on the allowed location for the policy; *this is so we can test the limits of the region that was set in the policy.*
5. You will receive a notification about policy enforcement stating that *in this example, the region selected does not match that allowed in the policy of a location that resources can be created in:*

Policy enforcement. Value does not meet requirements on resource: Microsoft.Compute/virtualMachines

The field 'Location' with the value '(Europe) West Europe' is denied

6. To remediate this, from the **Instance details** tab, select a **region** that **IS** in the allowed location for the policy; *this is so we can test the limits of the region that was set in the policy.*
7. You will no longer receive the policy enforcement message and will be allowed to continue with resource creation in the policy allowed location.
8. The final task is to clean up and delete the assigned policy that was created in this exercise; this can be achieved by performing the following step.
9. From the **Assignments** blade, locate the assignment to delete from the list. Then, right-click and select **Delete assignment** from the pop-up menu.

In this exercise, we successfully limited the resource creation location with Azure Policy.

Chapter 10

Technical requirements

To carry out the hands-on exercise in this chapter, you will require the following:

- Access to an internet browser

Figures

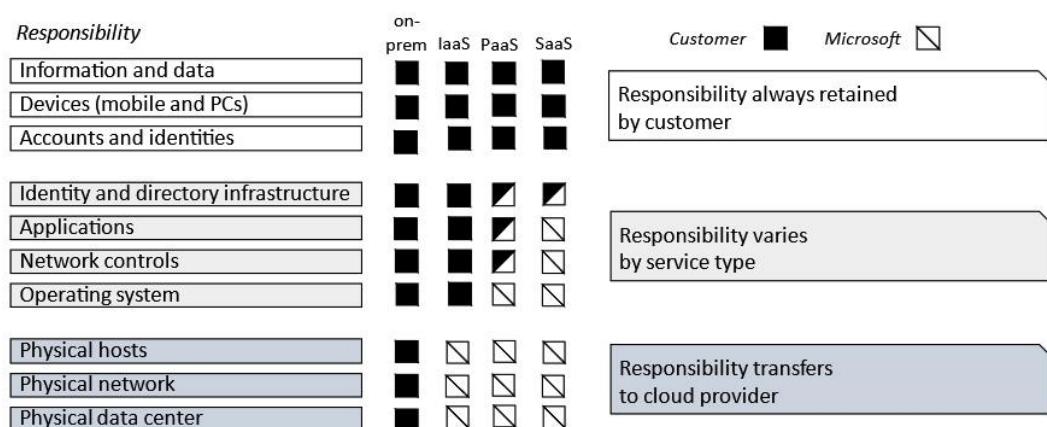


Figure 10.1 – Shared responsibility model

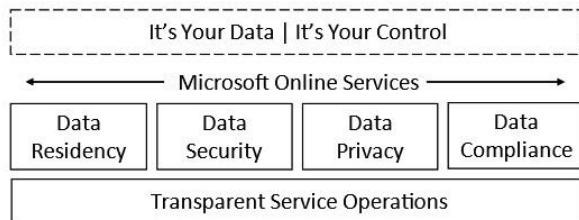


Figure 10.2 – Microsoft trusted cloud principles

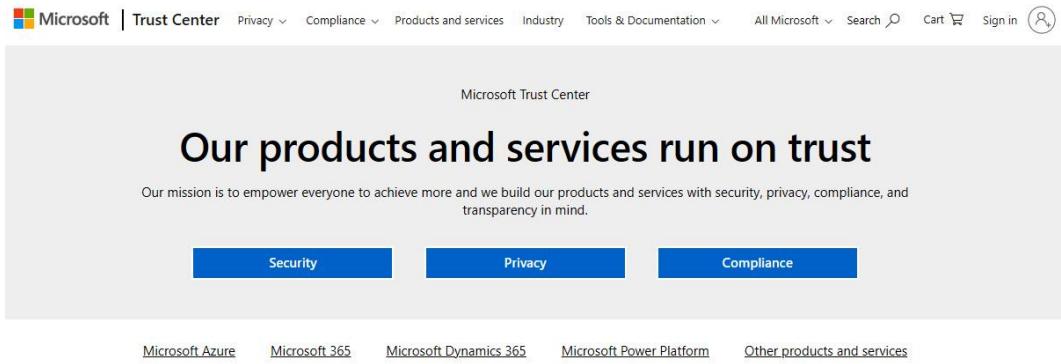


Figure 10.3 – Microsoft Trust Center

The screenshot shows the Microsoft Privacy Statement page. At the top, there's a navigation bar with links for Privacy dashboard, Privacy report, Privacy resources, and Privacy Statement. Below the navigation is a header with the Microsoft logo and the text "Microsoft Privacy Statement". A subtext reads "Last Updated: April 2021 What's new?". On the right side, there are "Expand All" and "Print" buttons. The main content area starts with a paragraph about the importance of privacy and how Microsoft processes personal data. It then lists sections such as "Personal data we collect", "How we use personal data", "Reasons we share personal data", "How to access and control your personal data", and "Cookies and similar technologies". The "Personal data we collect" section contains detailed information about data collection through interactions and product usage.

Figure 10.4 – Microsoft Privacy Statement

Product Terms

Feedback Program: None selected Effective Date: Present Day Terms en-US

Search Terms Select a program

Product Terms

- Welcome
- Summary of Changes
- Universal License Terms
 - For Online Services
 - For all Software
- Online Services Privacy & Security Terms
- Product Offerings
 - Software
 - Online Services
- Other Legal Terms
- Glossary
- CAL and ML Equivalency Licenses
- Subscription License Suites
- Notices
- Professional Services
- Program Agreement Supplemental Terms
- Promotions
- Software Assurance Benefits
- Storage Array, Azure Data Box, Azure Stack Edge, and Azure Stack Hub Ruggedized Terms
- Student Use Benefits and Academic Programs

Product Terms

The terms formerly contained in the "Online Services Terms" have been moved into the "Product Terms" and no longer exist as standalone terms. The unified Product Terms are incorporated by reference into agreements governing Customer's use of Microsoft Products and Professional Services.

Access to versions of the Product Terms and Online Services Terms published prior to February 2021 are available [here](#). Updates that Microsoft makes from time to time to Use Rights apply to Customer as set forth in Customer's agreement.

All references to the following terms in applicable Microsoft agreements now refer to corresponding sections in the Product Terms, or to linked content within the Product Terms.

PREVIOUS REFERENCE	LOCATION IN PRODUCT TERMS
Use Rights	Located at the "Use Rights" tab within each product offering entry at Product Offerings .
Product Terms	This site.
Online Services Terms	The terms formerly contained in the Online Services Terms have been moved into the Product Terms and no longer exist as a standalone terms.
Other Legal Terms	See left navigation.
Product-Specific License Terms	See Product Offerings .
License Model Terms	Located at the "License Model" tab within each product offering entry at Product Offerings .
Universal License Terms	See Universal License Terms .

Get Started

To find your terms, simply start at [Product Offerings](#). From here navigate to one of the listed products or services and view all terms that apply to its use.

How to Use This Site

While the Product Terms brings together the terms for all products and services offered in our licensing programs, it also provides the ability to filter and view only the terms relevant to the Product(s) you license under your selected licensing program. This allows for detailed, specific information on the product and program of interest.

Figure 10.5 – Microsoft Product Terms site

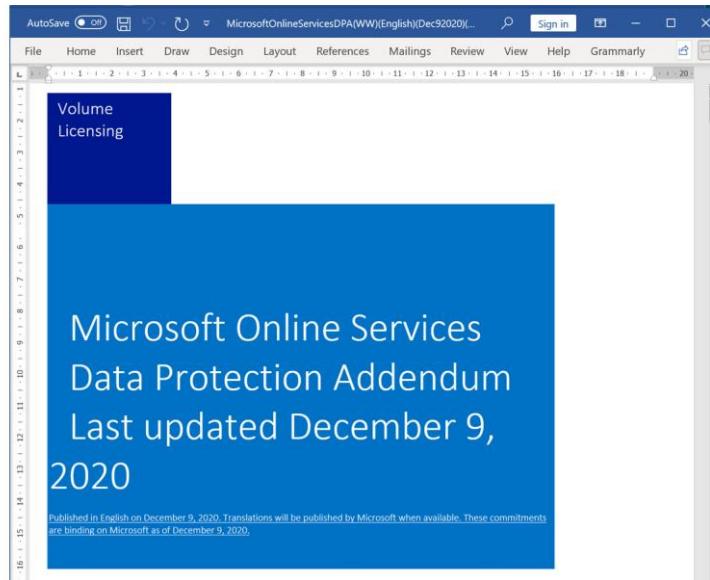


Figure 10.6 – Data Protection Addendum

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Portal Free account

Azure compliance documentation

If your organization needs to comply with legal or regulatory standards, start here to learn about compliance in Azure.

Compliance offerings

Global	Global	US government	US government
CIS benchmark CSA STAR Attestation CSA STAR Certification CSA STAR self-assessment SOC 1 SOC 2 SOC 3	ISO 20000-1 ISO 22301 ISO 27001 ISO 27017 ISO 27018 ISO 27701 ISO 9001 WCAG	CII CNSSI 1253 DFARS + CMMC DoD IL2 DoD IL4 DoD IL5 DoD IL6 DoE 10 CFR Part 810 EAR FedRAMP	FIPS 140 IRS 1075 ITAR NDAA Section 889 NIST 800-161 NIST 800-171 NIST 800-53 NIST 800-63 NIST CSF Section 508 VPATs
Financial services	Financial services	Financial services	Healthcare and life sciences
23 NYCR Part 500 (US) AFM and DNB (Netherlands) AMF and ACPR (France) APRA (Australia) CFTC 1.31 (US) EBA (EU) FCA and PRA (UK) FFIEC (US) FINMA (Switzerland)	FINRA 4511 (US) FSC (Japan) FSA (Denmark) GLBA (US) KNF (Poland) MAS and ABS (Singapore) NBB and FSCA (Belgium) OSFI (Canada)	OSPAR (Singapore) PCI 3DS PCI DSS RBI and IRDAI (India) SEC 17a-4 (US) SEC Regulation SCI (US) SOX (US) TruSight	ASIP HDS (France) EPCS (US) GxP (FDA 21 CFR Part 11) HIPAA (US) HITRUST MARS-E (US) NEN 7510 (Netherlands)
Automotive, education, energy, media, and telecommunication	Regional - Americas	Regional - Asia Pacific	Regional - EMEA
Argentina PDPA		Australia IRAP	EU Cloud CoC

Figure 10.7 – Azure compliance documentation

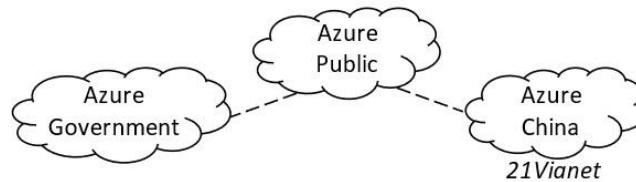


Figure 10.8 – Azure Sovereign Region cloud

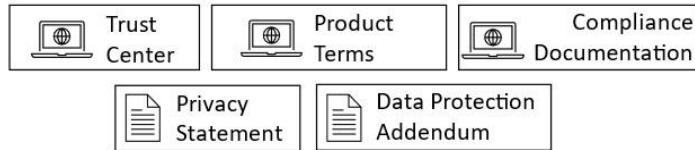


Figure 10.9 – Azure privacy and compliance resources

Links

The Trust Center can be accessed from: <https://www.microsoft.com/trust-center>:

The Microsoft Privacy Statement can be accessed from
<https://privacy.microsoft.com/privacystatement>:

The Product Terms site can be accessed from <https://www.microsoft.com/licensing/terms>:

The current and archived versions of the Data protection addendum can be downloaded from the Product Terms site and can also be accessed from

<https://www.microsoftvolumelicensing.com/DocumentSearch.aspx>

The Azure Compliance documentation can be accessed at

<https://docs.microsoft.com/azure/compliance>

Hands-on exercise

To support your learning with some practical skills, we will explore some of the resources and information covered in this chapter.

The following exercise will be carried out:

- Exercise – exploring Microsoft Trust Center Portal.

Getting started

To get started with this hands-on exercise, you will need the following:

- Access to an internet browser

Exercise – exploring Microsoft Trust Center Portal

This section will help you explore the Microsoft Trust Center Portal.

Task – accessing Microsoft Trust Center Portal

1. From a browser, navigate to <https://www.microsoft.com/trust-center>.

Task – exploring the Trust Center Portal

2. The Trust Center Portal can be explored using the *top navigation bar*. The core navigation components to explore can be found in the **Privacy**, **Compliance**, and **Tools & Documentation** drop-down menus. In addition to this, from the **Products and services** navigation component, you can view guidance on security, privacy, compliance, the data's location, GDPR, and more:

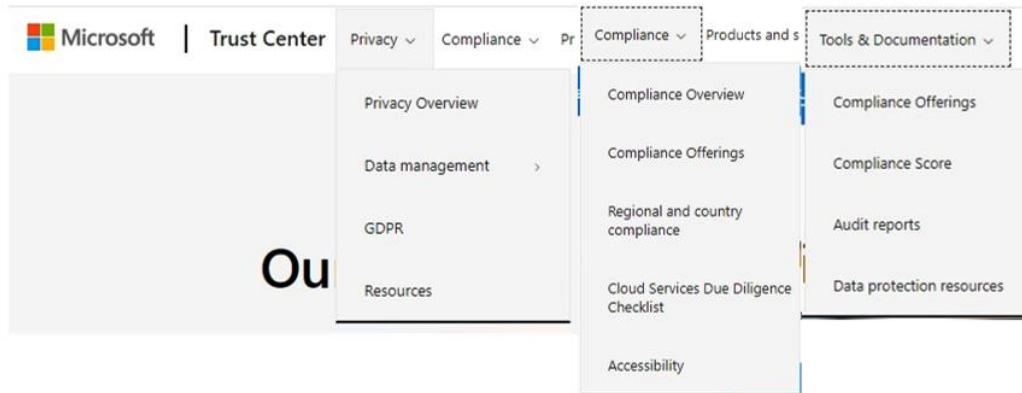


Figure 10.10 – Azure Trust Center Portal

- From the **Privacy** menu, click **Resources**; among other resources, such as GDR, you will be able to access some of the core privacy resources outlined in the chapter, such as the privacy statement, terms, and data protection addendum. These can be seen in the following screenshot:

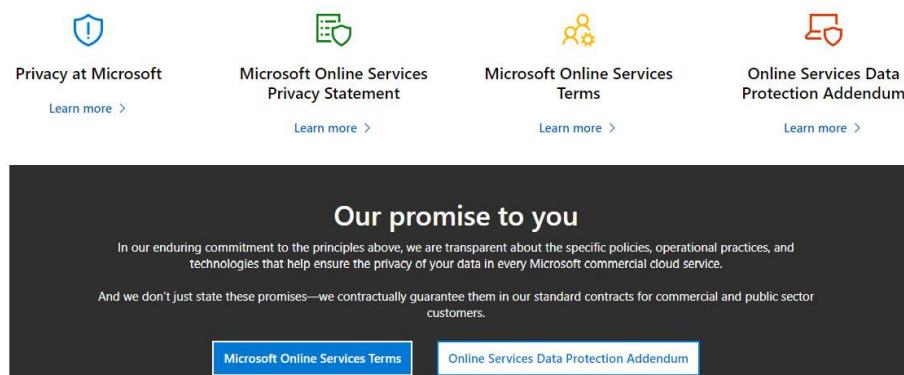


Figure 10.11 – Privacy resources

- From the **Compliance** menu, you can click through the items to explore each one, such as an overview of compliance, the compliance offerings, regional and country compliance, and so on.
- From **Products and services**, you can click through to learn about the specific details of each Microsoft product and service.
- From the **Tools & Documentation** menu, you can click through the items to explore each one, such as audit reports and data protection resources. These can be seen in the following screenshot:

Information about how Microsoft cloud services protect your data, and how you can manage cloud data security and compliance for your organization.

The screenshot shows a search interface at the top with fields for 'Select start date' and 'to Select end date', dropdowns for 'Document Type', 'Cloud Service', and 'Industries'. A 'Sign in' link is also present. Below the search is a navigation bar with links: Audited Controls, Compliance Guides, FAQ and White Papers, ISO Reports, Microsoft 365 Quarterly Pulse Report, PCI DSS, Pen Test and Security Assessments. The main content area displays a table of documents:

Title	Series	Description	Date	Actions
Professional Services GDPR Control Mapping 10.29.19.xlsx		Comprehensive mapping of Microsoft Service Controls to GDPR obligations for Professional Services.	2019-11-06	
Office 365 - Audited Controls NIST 800_53A Rev 4		This spreadsheet provides information about Microsoft Office 365 controls, implementation details, and audit test procedures for NIST 800-53 standard. Combining this info... Show more	2019-05-08	
Office 365 - Audited Controls ISO 27001:2013		This spreadsheet provides information about Microsoft Office 365 controls, implementation details, and audit test procedures for ISO 27001 standard. Combining this info... Show more	2019-05-08	
Office 365 - Audited Controls ISO 27018:2014		This spreadsheet provides information about Microsoft Office 365 controls, implementation details, and audit test procedures for ISO 27018 standard. Combining this info... Show more	2019-05-08	
Office 365 GDPR control mapping 5.24.18		Comprehensive mapping of Microsoft Service Controls to GDPR obligations for Office 365	2019-05-07	

Figure 10.12 – Trust document resources

In this exercise, we explored the Microsoft Trust Center Portal.

Chapter 11

Technical requirements

To carry out the hands-on labs in this chapter, you will need the following:

- Access to an internet browser.
- A Microsoft account; you can use the same account that you have used for the other exercises in this book. If you do not have a Microsoft account, you can create a free account at <https://account.microsoft.com/account>.

Figures

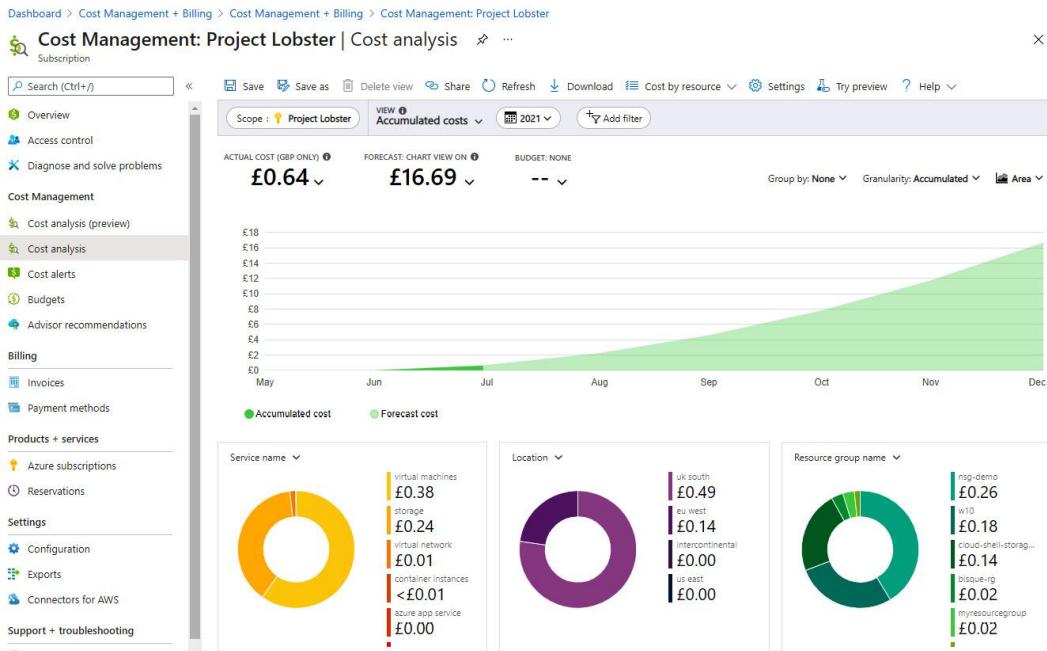


Figure 11.1 – Azure Cost Management

Figure 11.2 – Azure Pricing calculator

Category	On-premises	Azure
Compute	US\$98,353	US\$13,353
Data centre	87%	5%
Networking	5%	4%
Storage	0%	31%
IT labour	5%	14%

Category	On-premises	Azure
Compute	US\$63,170.80	US\$1,260.00
Data centre	US\$85,187.80	US\$60.00
Networking	US\$1,072.00	US\$40.00
Storage	US\$61,070.00	US\$150.41
IT labour	US\$1,072.00	US\$1,072.00
Total	US\$98,353.00	US\$13,353.00

Figure 11.3 – TCO calculator

Links

Explore flexible purchasing options for Azure: <https://azure.microsoft.com/pricing/purchase-options>

The Azure Pricing calculator is shown in the following screenshot and can be accessed from <https://azure.microsoft.com/pricing/calculator>:

The TCO calculator is shown in the following screenshot and can be accessed from <https://azure.microsoft.com/pricing/tco/calculator>:

Further reading

This section provides links to additional exam information and study references:

- Exam AZ-900: Microsoft Azure fundamentals:
<https://docs.microsoft.com/learn/certifications/exams/az-900>
- Exam AZ-900: skills outline:
<https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE3VVWUY>
- Microsoft Learn: Azure Fundamentals – Describe Azure cost management and service-level agreements: <https://docs.microsoft.com/learn/paths/az-900-describe-azure-cost-management-service-level-agreements>

Hands-on exercises

To support your learning with some practical skills, we will look at the hands-on use of some of the tools covered in this chapter.

The following exercises will be carried out:

- Exercise 1 – using the Azure Pricing calculator
- Exercise 2 – using the TCO calculator

Getting started

To get started with these hands-on exercises, you will need the following:

- Access to an internet browser.
- A Microsoft account; you can use the same account that you have used for the other exercises in this book. If you do not have a Microsoft account, you can create a free account at <https://account.microsoft.com/account>.

Exercise 1 – using the Azure Pricing calculator

In this exercise, you will create a price estimate with the Azure Pricing calculator; the estimate will be for a simple single-instance Windows VM hosted in the North Europe (Dublin) region.

Task – accessing the Azure Pricing calculator

1. Open a browser and sign into the Azure pricing calculator using your Microsoft account:
<https://azure.microsoft.com/pricing/calculator>.

Task – adding a VM to the estimate

2. From the products tab, click **Virtual Machines**.
3. Scroll down to the VM line item that has been added to the estimate.
4. Adjust the default VM settings to the following for this exercise (or as required):
 - **Region:** North Europe.
 - **Operating System:** Windows.
 - **Type:** (OS only).
 - **Tier:** Standard.
 - **Category:** General purpose.
 - **Instance Series:** Dds v4-series (or as required).
 - **Instance:** D2ds v4 (or as required).
 - **Virtual Machines:** Leave as **qty** of 1 and running for 730 hours.
5. Leave **Savings options** as is.
6. Expand **Managed Disks** and adjust the default settings to the following for this exercise:
 - **Tier:** Premium SSD
 - **Disk Size:** S15: 256 GiB
 - **Disks (qty):** 1
7. Leave **Storage Transactions** as is.
8. Expand **Bandwidth** and adjust the default settings to the following for this exercise:
 - **Data transfer type:** Internet egress
 - **Source region:** North Europe
 - **Routed via:** Microsoft Global Network
 - **Outbound data transfer:** 10 GiB
9. Leave **Support** as is.
10. Leave **Programmes and Offers** as is.
11. From the bottom right of the estimate screen, set the currency as required.

Task – saving, exporting, and sharing the estimate

1. From the bottom left of the **Estimate** screen, click **Save as** and enter a name for your estimate.
2. You will see a message stating that the estimate has been saved and that it can be viewed by clicking on the **Saved estimates** tab. Click **Done**.
3. To export the estimate, click **Export**.
4. To share the estimate, click **Share**.

In this exercise, we created an estimate for an Azure resource to be used in a solution using the Azure Pricing calculator. In the next exercise, we will use the TCO calculator.

Exercise 2 – using the TCO calculator

This exercise will create a cost comparison; for example, a typical on-premises environment moving to Azure. You could substitute this with the details of an actual on-premises infrastructure and any workloads you have details of.

Task – accessing the TCO calculator

1. Open a browser and enter the following URL:
<https://azure.microsoft.com/pricing/tco/calculator>.

Task – defining your workloads

2. From the **Define your workloads** section, click on the **information** icon next to each selected field.
3. From the **Server** section, select the following information or use your example data:
 - Enter a name for the workload or use the provided default.
 - **Workload:** Windows/Linux Server.
 - **Environment:** Virtual Machines.
 - **Operating system:** Windows.
 - **Operating system license:** Datacenter.
 - **VMs:** 100.
 - **Virtualization:** VMware.
 - **Cores:** 4.
 - **Ram:** 8.
 - **Optimize by:** Memory
 - **Windows Server 2008/2008 R2:** Off

4. Add any additional server workloads as required.
5. From the **Databases** section, enter the following information or use your example data:

Enter a name for the database, or use the provided default.

- **Source Database:** Microsoft SQL Server.
- **License:** Standard.
- **Environment:** Virtual Machines.
- **Operating system:** Windows.
- **Operating system license:** Datacenter.
- **VMs:** 15.
- **Virtualization:** VMware.
- **Cores:** 8.
- **RAM:** 32.
- **Optimize by:** Memory.
- **Windows Server 2008/2008 R2:** Off.
- **Destination Service:** SQL Database Managed Instance.
- **Managed instance tier:** General purpose.
- **Managed instance cores:** 8.
- **SQL Server storage:** 100.
- **SQL Server backup:** 100.

6. Add any additional databases as required.
7. From the **Storage** section, enter the following information or use your example data:

Enter a name for the storage or use the provided default

- **Storage type:** Local Disk/SAN.
- **Disk type:** SSD.
- **Capacity:** 2 TB.
- **Backup:** 2 TB.
- **Archive:** 8 TB.
- **IOPS:** 4,000.

8. Add additional storage as required.
9. From the **Networking** section, enter the following information or use your example data:

- Outbound bandwidth: 100 GB

10. Click **Next**.

Task – adjusting your assumptions

11. From the **Adjust assumptions** screen, review all the options and alter them as required.

Alternatively, leave the default assumptions as is.

12. Click **Next**.

Task – viewing the report

13. From the **View report** screen, review the cost savings report.

14. You can modify your entries by scrolling to the bottom of the screen and clicking **Back**.

15. You can **download**, **share**, and **save** the report.

In this exercise, we created a cost comparison for an on-premises environment moving to Azure.

Chapter 12

Technical requirements

To carry out the hands-on labs in this chapter, you will need the following:

- Access to an internet browser.
- A Microsoft account; you can use the same account that you have used for the other exercises in this book. If you do not have a Microsoft account, you can create a free account by going to <https://account.microsoft.com/account>.

Links

You can get the latest updates on preview services and their statuses from the following URLs:

- <https://azure.microsoft.com/updates>
- <https://azurecharts.com/presence/rollout>
- <https://azurecharts.com/timeline>

Some preview services are subject to additional terms; you can find this information by going to the *Supplemental Terms of Use for Microsoft Azure Previews* at <https://azure.microsoft.com/support/legal/preview-supplemental-terms>.

You can keep up to date with the latest service announcements from the Microsoft Azure blog announcements page at <https://azure.microsoft.com/blog/topics/announcements>.

Additional information and study references

This section provides links to additional exam information and study references:

- *Exam AZ-900: Microsoft Azure fundamentals:* <https://docs.microsoft.com/learn/certifications/exams/az-900>
- *Exam AZ-900: skills outline:* <https://query.prod.cms.rt.microsoft.com/cms/api/am/binary/RE3VwUY>
- *Microsoft Learn: Azure Fundamentals – Describe Azure cost management and service level agreements:* <https://docs.microsoft.com/learn/paths/az-900-describe-azure-cost-management-service-level-agreements>

Hands-on exercise

To support your learning with some practical skills, we will use some of the resources we covered in this chapter by performing some hands-on exercises.

The following exercises will be carried out:

- Exercise 1 – exploring the SLA for a service
- Exercise 2 – exploring Azure Preview features

Getting started

To get started with these hands-on exercises, you will need an Azure subscription that can create and delete resources in the subscription. You can use an existing account that you have created as part of the exercises from any chapter in this book. Alternatively, you can create a free Azure account at <https://azure.microsoft.com/free>.

This free Azure account provides the following:

- 12 months of free services
- \$200 credit to explore Azure for 30 days
- 25+ services that are always free

Exercise 1 – exploring the SLA for a service

This section will look at the resources we can use to gather information on the SLA for a service; we will look at the SLA information for **App Service**, **Virtual Desktop**, **Virtual Machines**, and **Load Balancer**.

The following subsections cover how to complete this exercise. They have been segregated into tasks for ease of understanding.

Task – accessing the SLA summary for Azure services

1. From a browser, go to <https://azure.microsoft.com/support/legal/sla/summary>:

The screenshot shows a Microsoft Edge browser window displaying the 'Service-level agreements summary' page on the Azure website. The URL is https://azure.microsoft.com/en-gb/support/legal/sla/summary/. The page title is 'SLA summary for Azure services'. It was last updated in June 2021. The content includes sections for 'API Management' and 'App Configuration', both of which have detailed descriptions and links to 'View full details'. The 'API Management' section states guarantees for Standard and Premium tiers. The 'App Configuration' section states a guarantee for Configuration Stores.

Figure 12.1 – SLA summary for Azure services

Task – viewing the SLA for App Service

2. From the **SLA summary for Azure services** page, scroll down and locate **App Service**.
3. Note what Microsoft specifies they will guarantee and the amount of available time expressed as a percentage; note what doesn't have an SLA.
4. Click on **View full details**. *You can open this in a new tab or window if you prefer.*
5. By looking at the SLA for the individual service, you will see a format that is the same across all services that you should familiarize yourself with.
6. **Expand and explore** the content in the **Introduction**, **General Terms**, and **SLA details** sections:

The screenshot shows a Microsoft Edge browser window displaying the 'SLA for App Service' page on the Azure website. The URL is https://azure.microsoft.com/en-gb/support/legal/sla/app-service/v1_4/. The page title is 'SLA for App Service'. It was last updated in July 2016. A note states that Apps running in a customer subscription will be available 99.95% of the time. No SLA is provided for Apps under either the Free or Shared tiers. Below this, there are three expandable sections: 'Introduction', 'General Terms', and 'SLA details'.

Figure 12.2 – SLA for App Service

7. You can view the **Version History** details of an SLA, **download** the SLA, and **learn more** about the service to go to the product information page for that service.

Task – viewing the SLA for Azure Virtual Desktop

1. From the **SLA summary for Azure services** page, scroll down and locate **Azure Virtual Desktop**.
2. Note that Microsoft does not offer a **financially backed SLA** for this service and that they use the language **...strive to attain at least...**, which means there is no guarantee on the service level available. They note that the Virtual Machine SLA covers the availability of any session hosts.

Task – viewing the SLA for a virtual machine

1. From the **SLA summary for Azure services** page, scroll down and locate **Cloud Services and Virtual Machines**.
2. Note the difference in what is guaranteed for virtual machines that have two or more instances deployed in the same Availability Set and any single-instance virtual machines using premium storage for all disks; ensure you deploy virtual machines in a way that provides the availability and SLA that you need.
3. Click on **View full details**. **You can open this in a new tab or window if you prefer.**
4. **Expand and explore** the content in the **Introduction**, **General Terms**, and **SLA details** sections.

Task – viewing the SLA for Load Balancer

1. From the **SLA summary for Azure services** page, scroll down and locate **Load Balancer**.
2. Note what Microsoft indicates they will guarantee and the amount of time available expressed as a percentage; note what type of Load Balancer SKU does not have an SLA provided.
3. Click on **View full details**. **You can open this in a new tab or window if you prefer.**
4. **Expand and explore** the content in the **Introduction**, **General Terms**, and **SLA details** sections.

In this exercise, we looked at the resources that we can use to gather information on the SLA for a service.

In the next exercise, we will look at where to find information for Azure Preview features.

Exercise 2 – exploring Azure Preview features

In this exercise, we will learn where to find information about Azure Preview features.

The following subsections cover how to complete this exercise. They have been segregated into tasks for ease of better understanding.

Task – exploring the Azure updates site

1. From a browser, go to <https://azure.microsoft.com/updates/?status=inpreview>.
2. From this URL, you can see all the Azure updates that are in preview.

Task – exploring the Azure Preview portal

1. From a browser, go to <https://preview.portal.azure.com>.

From this URL, you can view the preview features for the Azure portal; the title of the page shows **Preview** in brackets so that you know that this is the Preview portal you are exploring. This can be seen in the following screenshot:

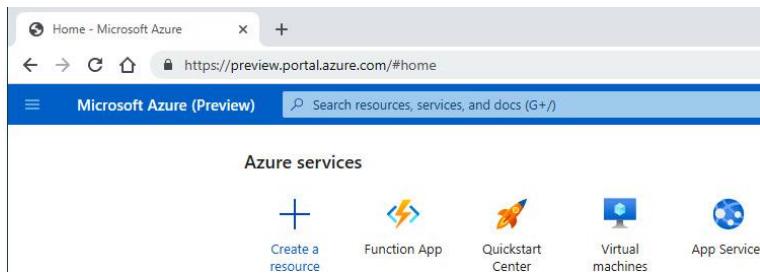


Figure 12.3 – Azure portal – Preview features

Task – exploring Preview features

1. In the search bar, type **preview features** and click **Preview features** from the results list.
2. From the **Preview features** blade, you can explore all the preview features available; you can filter to show only those available for a particular subscription and all the states; that is, if these are not registered or if you have registered them for use.
3. From the top toolbar, you can **Register** for any preview to try out and **unregister** any that you do not wish to be available.
4. You can click on the **Documentation** hyperlink from the **Learn more** column or click on a preview feature from the list, which will open a pop-up blade containing more information about this feature. It will also provide the same hyperlink to the documentation that's relevant to this preview feature; the **Register** option is also available from this screen. The following screenshot shows the **Previews** features in the Azure portal:

The screenshot shows the Microsoft Azure portal interface. On the left, there's a sidebar with 'Dashboard' and 'Preview features'. The main area is titled 'Exploring pre-release features with Preview Features'. It includes a search bar, filter options ('Subscription: Test', 'State: All states', 'Type: All types'), and a table of features. One feature is selected: 'On-demand VM guest patching preview'. A detailed modal window on the right provides information about this feature, including its name, state, provider, release date, and description. It also has 'Register' and 'Close' buttons.

Display name	State	Provider	Release ...	Learn more
On-demand VM guest patching preview	Not registered	Microsoft.Compute	07/11/2019	Documentation
Allow ExpressRoute Direct	Not registered	Microsoft.Network	01/06/2018	Documentation
VMOorchestratorMultiFD	Not registered	Microsoft.Compute	01/03/2020	Documentation
VMOorchestratorSingleFD	Not registered	Microsoft.Compute	01/03/2020	Documentation
Hotpatch preview	Not registered	Microsoft.Compute	05/03/2020	Documentation
Automatic VM guest patching preview	Not registered	Microsoft.Compute	05/03/2020	Documentation
AKS Gen2 VM Preview	Not registered	Microsoft.ContainerS...	06/05/2020	Documentation

Figure 12.4 – Azure portal – Preview features

In this exercise, we looked at where to find information about Azure Preview features.

Chapter 13

Test answers

Practice test 1 – cloud concepts

1. (b)
2. (a), (b), (c)

Answer (d) is a characteristic of the hybrid cloud delivery model.

3. (a), (b), (c)

Answer (d) is a characteristic of the hybrid cloud delivery model.

4. (a)

Answer (b) is a characteristic of the IaaS cloud delivery model; answer (c) is a characteristic of the serverless/function as a service (FaaS) delivery model.

5. True

6. (b), (c).

Answer (a) is an IaaS service type.

7. False—*an app service is a PaaS service type.*

8. True

9. True

10. True

11. True

12. (a).

Answer (b) describes HA.

13. (a).

Answer (b) describes agility.

14. All are true

15. (c)

Answers (a) and (b) protect systems, not data.

Practice test 2 – core Azure services

16. (a)

Answer (b) is recommended to protect against a single data center outage in a region; answer (c) is recommended to protect against an entire region failure; answer (d) is recommended where low latency is required between infrastructure components.

17. (a), (b), (c), (d)

Answer (e) is not a management scope; it is a governance control.

18. (a), (b)

Management groups can only contain subscriptions, not resources or resource groups.

19. **False**—*a subscription acts as a billing mechanism.*

20. (b), (c)

21. **True**

22. **False**

Azure AD-assigned roles do not span Azure roles; access must be explicitly given to access Azure resources.

23. **False**

The Azure Global Administrator does not have default access to Azure resources.

24. **False**

Only the Owner role can create access to others.

25. **False**

Only external business-to-business (B2B) and guest-invited users can be given access to Azure resources.

26. (c)

Security Posture Management

27. (a), (b), (c)

28. **True**

29. (a), (b), (c)

30. (b)

Answer (a) is for general-purpose workloads with a balanced CPU-to-memory ratio; answer (c) is for CPU-intensive workloads with a high CPU-to-memory ratio; answer (d) is for graphical workloads where a GPU is required.

Practice test 3 – core solutions and management tools

31. (c)

32. False

33. True

34. True

35. False

This statement describes ARM templates, not Azure Policy.

Azure Policy is a set of rules for resource creation and management that apply across multiple subscriptions.

36. True

37. (a), (b), (c), (d)

38. True

39. True

40. True

41. (c)

Answer (a) describes Azure HDInsight; answer (b) describes Azure Databricks; answer (d) describes Azure SQL Database.

42. (a)

Answer (b) describes Azure Cognitive Services, and answer (c) describes Azure Machine Learning.

43. (b)

Answer (a) describes Azure IoT Hub, and answer (c) describes Azure Sphere.

44. (a)

Answer (b) describes GitHub, and answer (c) describes Azure DevTest Labs.

45. (b)

Answer (a) describes Azure Advisor, and answer (c) describes Azure Service Health.

Practice test 4 – security features

46. (a), (b), (c)

Azure Traffic Manager is a HA solution, not a security solution.

47. (a), (b), (c)

A VPN is a network connectivity solution, not a security solution.

48. False

An Azure firewall is required to control access and filter traffic for resources across multiple regions or virtual networks.

49. False

An Azure Key Vault instance is required to encrypt credentials used in code or during the deployment of a VM.

50. (c)

Answer (a) describes Azure Key Vault, and answer (b) describes Azure Security Center.

51. True

52. False

An NSG cannot be associated with the virtual network layer.

You can only associate an NSG with a network interface or a subnet and must be within the same region as the VM it will be used with.

53. False

This describes the zero-trust strategy.

54. False

This describes a DiD approach.

55. True

Practice test 5 – identity, governance, privacy, compliance

56. Yes

57. Yes

58. (a)

Answer (b) describes the authorization process.

59. True

60. (a), (b), (c)

61. (a), (b), (c)

62. True

63. (c)

Answer (a) describes Azure Blueprints, and answer (b) describes RBAC.

64. True

65. True

66. False

This describes the Azure Microsoft Cloud Adoption Framework (CAF) for Azure.

Azure compliance documentation is an online documentation site that provides detailed information and resources about legal and regulatory standards and compliance on Azure to an organization.

67. True

68. False

Azure China is operated by 21Vianet; this is for compliance with Chinese government regulations.

69. (a)

Answer (b), the Microsoft Trust Center, is a publicly accessible web portal that acts as a single point of focus for an organization that needs resources and in-depth information regarding the Microsoft principles of security, privacy, and compliance; answer (c), Azure compliance documentation, is an online documentation site that provides detailed information and resources about legal and regulatory standards and compliance on Azure to an organization.

70. (a)

Answer (b), the Products Terms site, is an online portal containing a legal agreement and licensing terms and conditions that an organization must comply with through Microsoft commercial licensing programs; answer (c), the DPA, is an addendum to the Product Terms site; it defines security terms and data processing for any online services an organization subscribes to under the Product Terms site.

Practice test 6 – cost management, SLA, and service life cycle

71. (a), (b), (c), (d)

72. (b), (d)

Resources such as network interfaces, NSGs, resource groups, and storage accounts are not billable, and traffic going into a region (ingress) from the internet, on-premises, another region, or the same region is not charged.

73. (a), (b), (d)

Traffic going into a region (ingress) from the internet, on-premises, another region, or the same region is not charged.

74. True

75. True

76. (a)

Answer (b) describes the Azure Total Cost of Ownership (TCO) calculator, and answer (c) describes Azure Cost Management.

77. False

Only services that are GA have an SLA.

78. (b), (c)

79. (b), (c)

Adding multiple services will negatively impact and reduce your SLA; this is due to the nature of compound SLAs.

80. (a)

Previews and free services are not provided with a financially backed SLA and are not entitled to service credits for any service downtime. Claims must be raised by the customer, and there is no automatic claims process for breach of SLA.