O'REILLY®

Application Security in Azure

February/2020

Overview

What Applications are We Aiming to Protect?

- Hosted in Microsoft Azure

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- Hosted in Microsoft Azure
  - PaaS (Hosted in Azure App Services)
    - Web applications
    - Serverless (e.g. Functions Apps)

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  - PaaS (Hosted in Azure App Services)
    - Web applications
    - Serverless (e.g. Functions Apps)
  - IaaS (Hosted in virtual machines)
    - Any applications

Topics to Cover in This Course

- Protecting applications hosted in the Microsoft Azure cloud

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- Protecting applications hosted in the Microsoft Azure cloud
    - Protecting secrets in the application code (Azure KV, MSI)

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  - Protecting virtual machines (NSGs)
  - Protecting web applications against common attacks (WAF)

Protecting Secrets in the Application Code

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```
public class ValuesController : ApiController
{
    // GET api/values
    public Dictionary<string, string> Get()
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        var connectingString = "Server=tcp:azuresqlmsidemosrv.database.windows.net,1433;" +
            "Initial Catalog=MSIDEMO;Persist Security Info=False" +
            ";MultipleActiveResultSets=False;" +
            "Encrypt=True;TrustServerCertificate=False;Connection Timeout=30;";

        var capitals = new Dictionary<string, string>();

        using (var sqlConnection = new SqlConnection(connectingString))
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            var sqlCommand = new SqlCommand("SELECT Country, Capital FROM CountryInfo", sqlConnection);

            var accessToken = (new AzureServiceTokenProvider()).GetAccessTokenAsync("https://database.windows.net/").Result;
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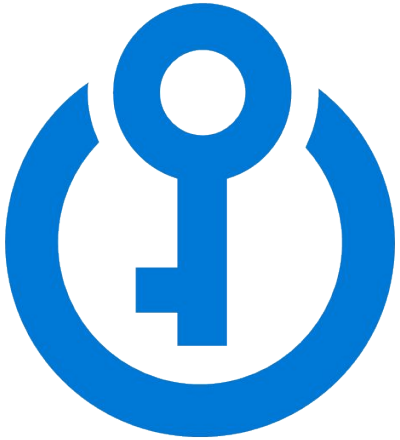
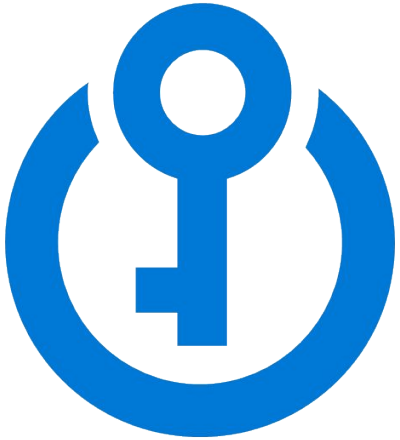


Azure Key Vault

Protecting Secrets in the Application Code



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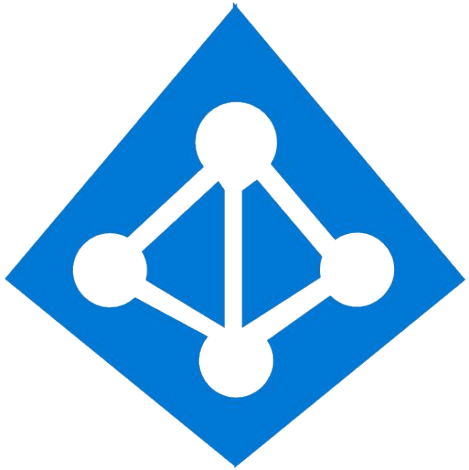

Managed Identity (MSI)

Protecting virtual machines (NSGs)

Protecting virtual machines (NSGs)

Azure VM

Protecting virtual machines (NSGs)

Internet

Incoming

Outgoing

Azure VM

Protecting virtual machines (NSGs)

Internet

Incoming

Outgoing

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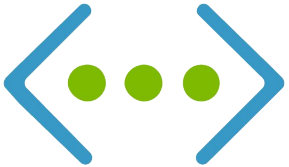
Virtual Networks



Network Security Group

Protecting web applications against common attacks (WAF)

Protecting web applications against common attacks (WAF)

App Services

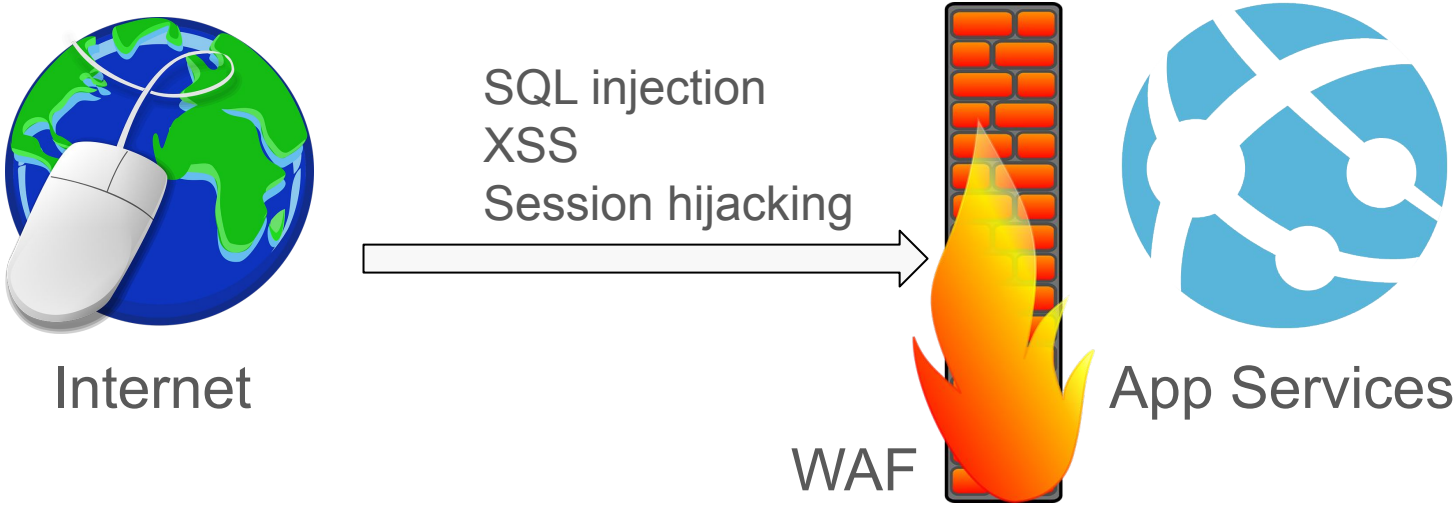
Protecting web applications against common attacks (WAF)

Internet

SQL injection
XSS
Session hijacking

App Services

Protecting web applications against common attacks (WAF)



Application Security Comes Hand in Hand with Data Security

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Application

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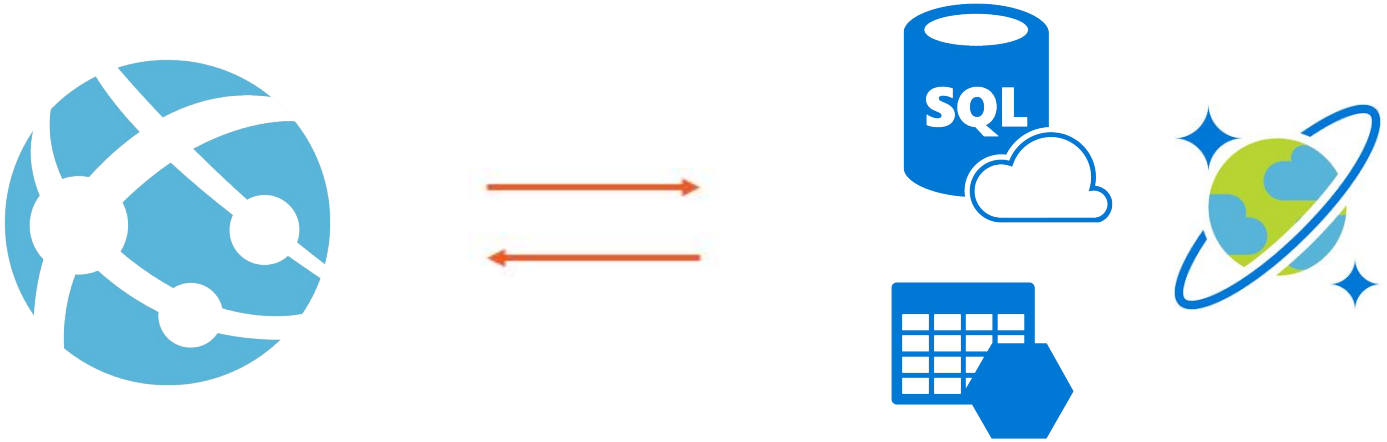
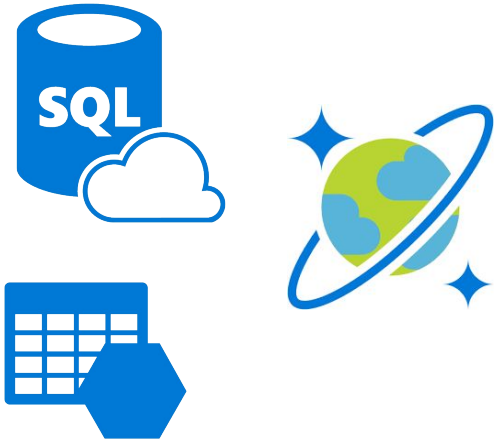


Application

Data

Application Security Comes Hand in Hand with Data Security



Application

Data

Application Security Comes Hand in Hand with Data Security

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- Securing Data in Microsoft Azure

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- Securing Data in Microsoft Azure
  - Securing data in transit
    - SSL/TLS

Application Security Comes Hand in Hand with Data Security

- Securing Data in Microsoft Azure
  - Securing data in transit
    - SSL/TLS
  - Securing data at rest
    - Azure SQL Database
    - Azure Cosmos DB
    - Azure Storage Account

Application Security Comes Hand in Hand with Data Security

- Securing Data in Microsoft Azure
  - Securing data in transit
    - SSL/TLS
  - Securing data at rest
    - Azure SQL Database
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    - Azure Storage Account
  - Securing data in use
    - Azure Confidential Compute

Protecting Secrets in the Code

Azure Key Vault and Managed Identities

Protecting Secrets in the Application Code

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Protecting Secrets in the Application Code

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- Secrets:

Protecting Secrets in the Application Code

- Secrets:
  - Database connection strings

Protecting Secrets in the Application Code

- Secrets:
  - Database connection strings
  - Passwords

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  - Encryption keys

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  - Any sensitive data

Protecting Secrets in the Application Code

- Secrets:
  - Database connection strings
  - Passwords
  - Encryption keys
  - Cache connection strings
  - Any sensitive data
- These secrets should NOT live in the application source code

Protecting Secrets in the Application Code

- Why?

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- Why?
  - Code will be checked into the source control.

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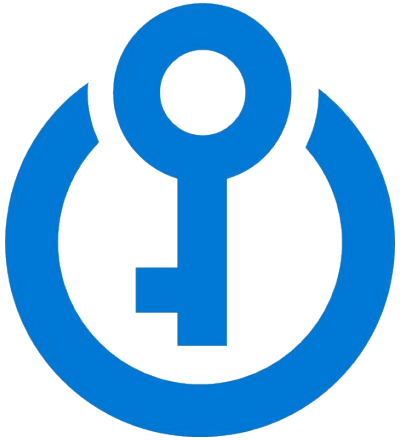
  - No easy way to control access to the secrets.

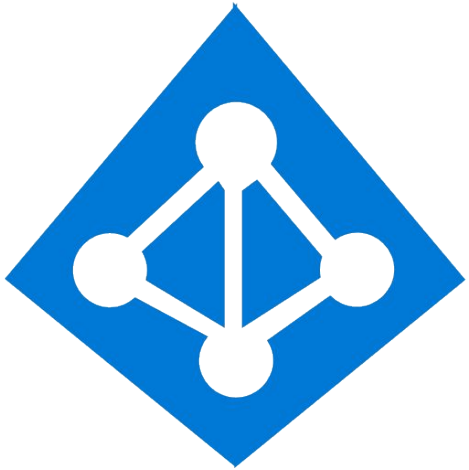
Protecting Secrets in the Application Code

- Why?
  - Code will be checked into the source control.
  - No easy way to rotate or expire these secrets.
  - No easy way to control access to the secrets.
  - Maintenance nightmare

Protecting Secrets in the Application Code

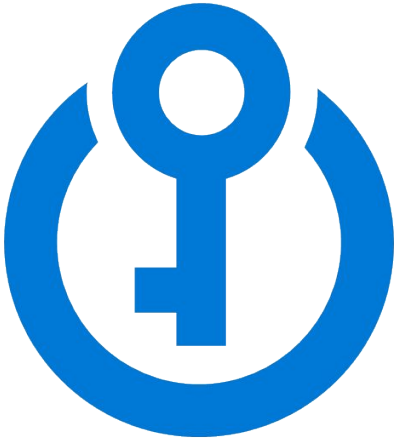


Azure Key Vault



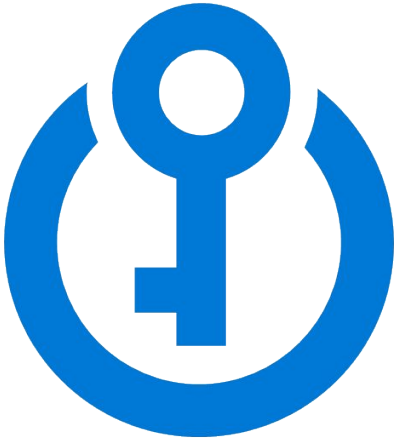
Managed Identity (MSI)

Azure Key Vault



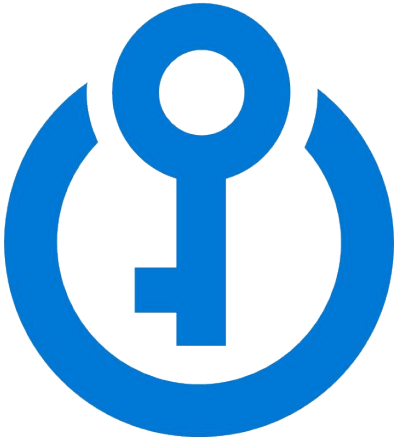
Azure Key Vault

- Can be used to Securely store and tightly control access to:



Azure Key Vault

- Can be used to Securely store and tightly control access to:
  - Tokens



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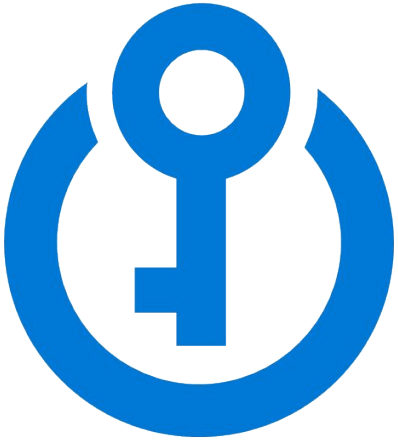

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- Can be used to Securely store and tightly control access to:
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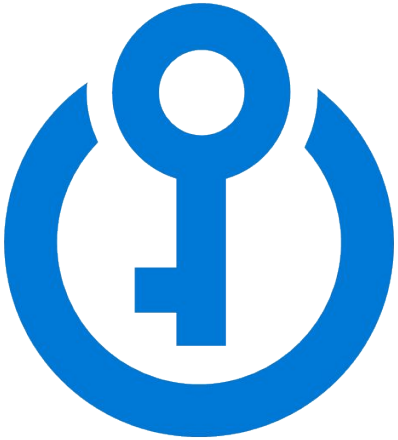

Azure Key Vault

- Can be used to Securely store and tightly control access to:
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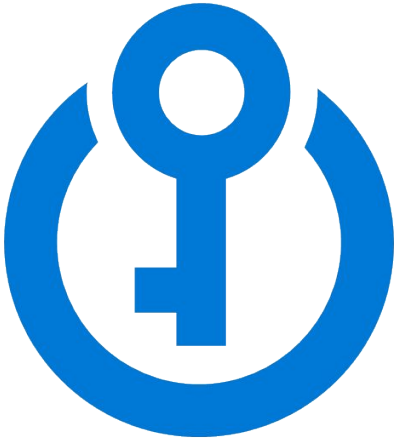
  - Certificates
  - API keys, and other secrets



Azure Key Vault

Stores the connection string
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Azure Key Vault

Use the connection string

Stores the connection string
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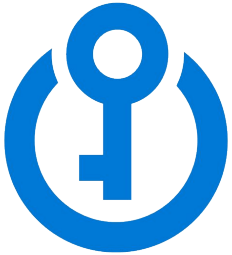

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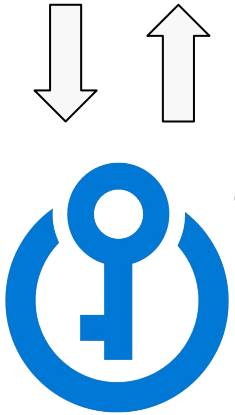

Gets the connection string
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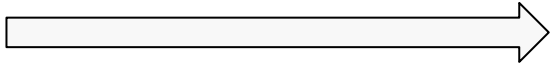
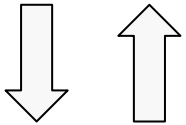
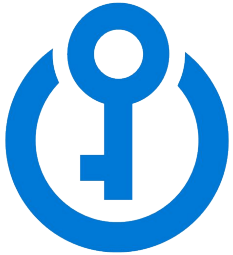
Azure Key Vault

Use the connection string







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Protecting Secrets in the Application Code

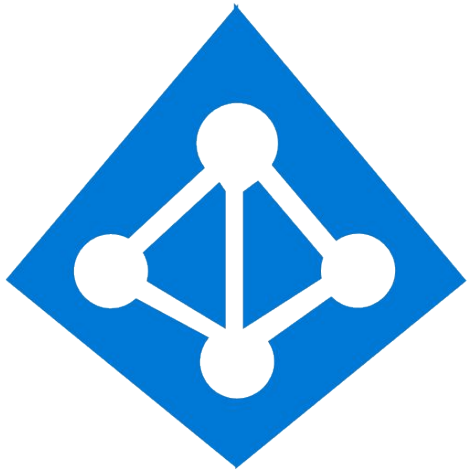
```
[FunctionName("GetSecretFromKV")]
public static  IActionResult Run(
    [HttpTrigger(AuthorizationLevel.Function, "get", "post", Route = null)] HttpRequest req,
    ILogger log)
{
    var kv = new KeyVaultClient(new KeyVaultClient.AuthenticationCallback(GetAccessToken));

    var secretUrl = "https://kv-msi-01.vault.azure.net/secrets/myname/56c2905096f14c689d928da072139c72";
    var secret = kv.GetSecretAsync(secretUrl).Result;
    var myName = secret.Value;

    return myName != null
        ? (ActionResult)new OkObjectResult($"Hello, {myName}")
        : new BadRequestObjectResult("Please pass a name on the query string or in the request body");
}

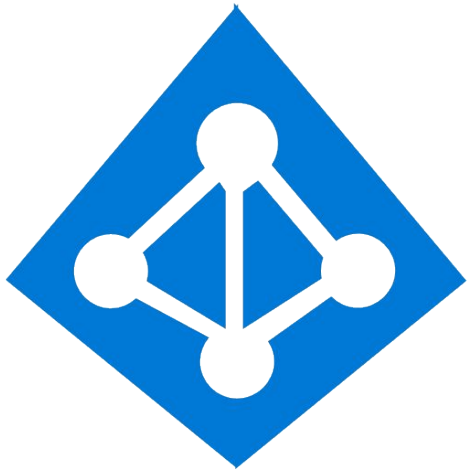
private static async Task<string> GetAccessToken(string authority, string resource, string scope)
{
```

Managed Identity (MSI)



Managed Identity (MSI)

- Provides Azure services with an automatically managed identity.



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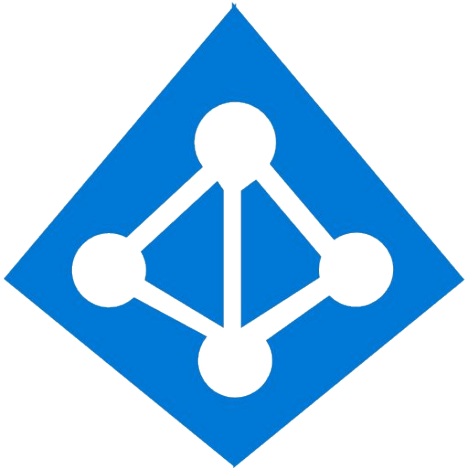
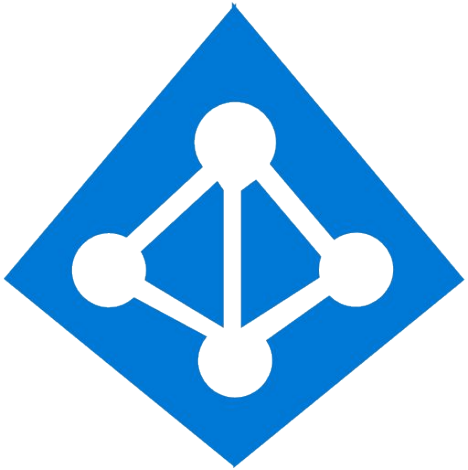


Managed Identity (MSI)

- Provides Azure services with an automatically managed identity.
- Authenticate to any supporting service without any credentials in your code.
- You can achieve **credential-free code**.



Credential-free Code

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    using (var sqlConnection = new SqlConnection(connectingString))
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        sqlConnection.AccessToken = accessToken;

        sqlConnection.Open();

        var reader = sqlCommand.ExecuteReader();

        while (reader.Read())
        {
            capitals.Add(reader["Country"].ToString(), reader["Capital"].ToString());
        }

        sqlConnection.Close();
    }
}
```

Demo

- Protecting secrets with Azure Key Vault
- Credential-free code with Managed Identities (MSI)

Exercise

- Working with the Azure Key Vault
  - Change the existing application to read secrets from KV
  - Verify the updated application

Q&A

Break (5 minutes)

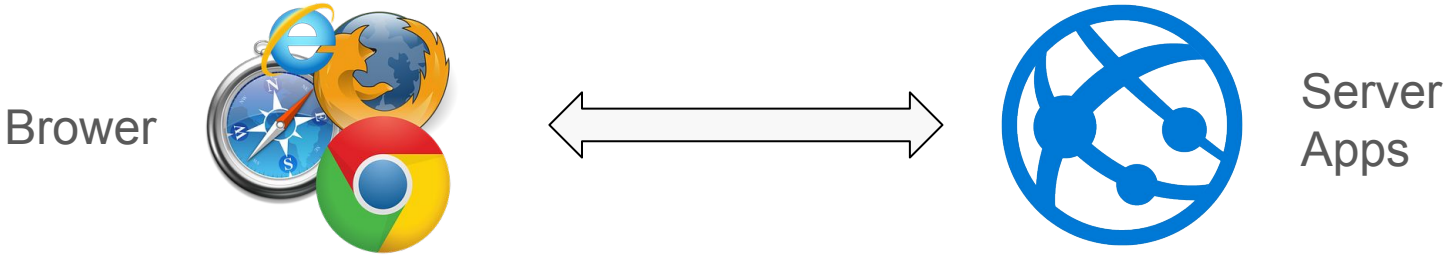
Q&A

Securing Communications

SSL & TLS

Securing Communications

Securing Communications



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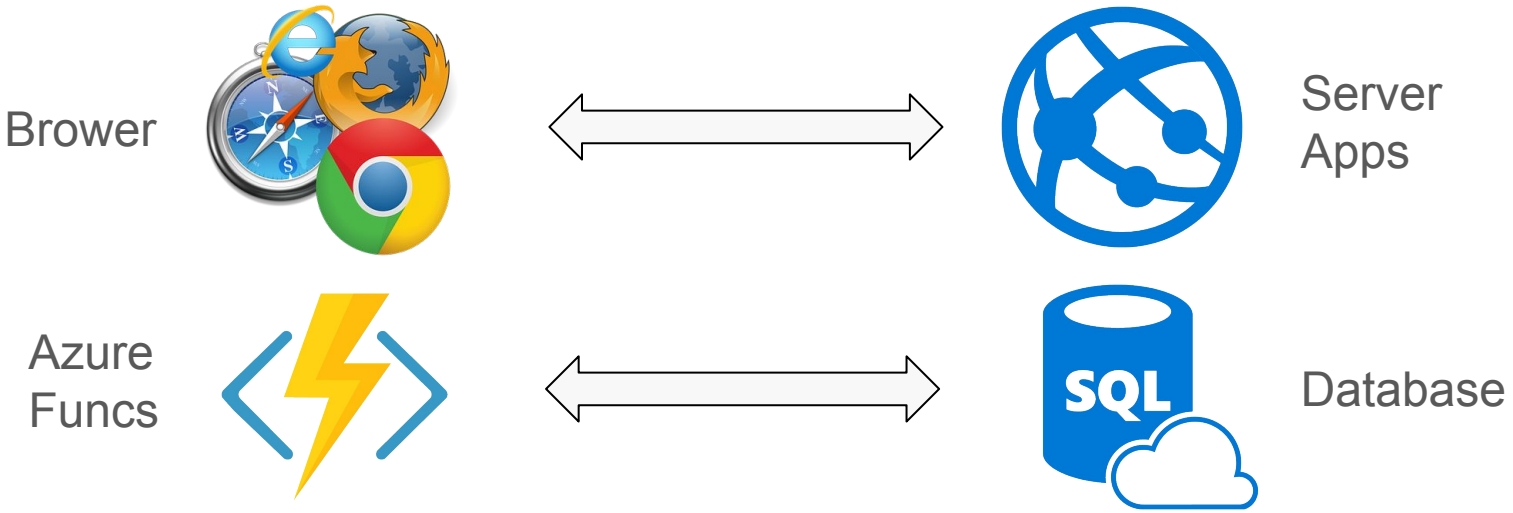

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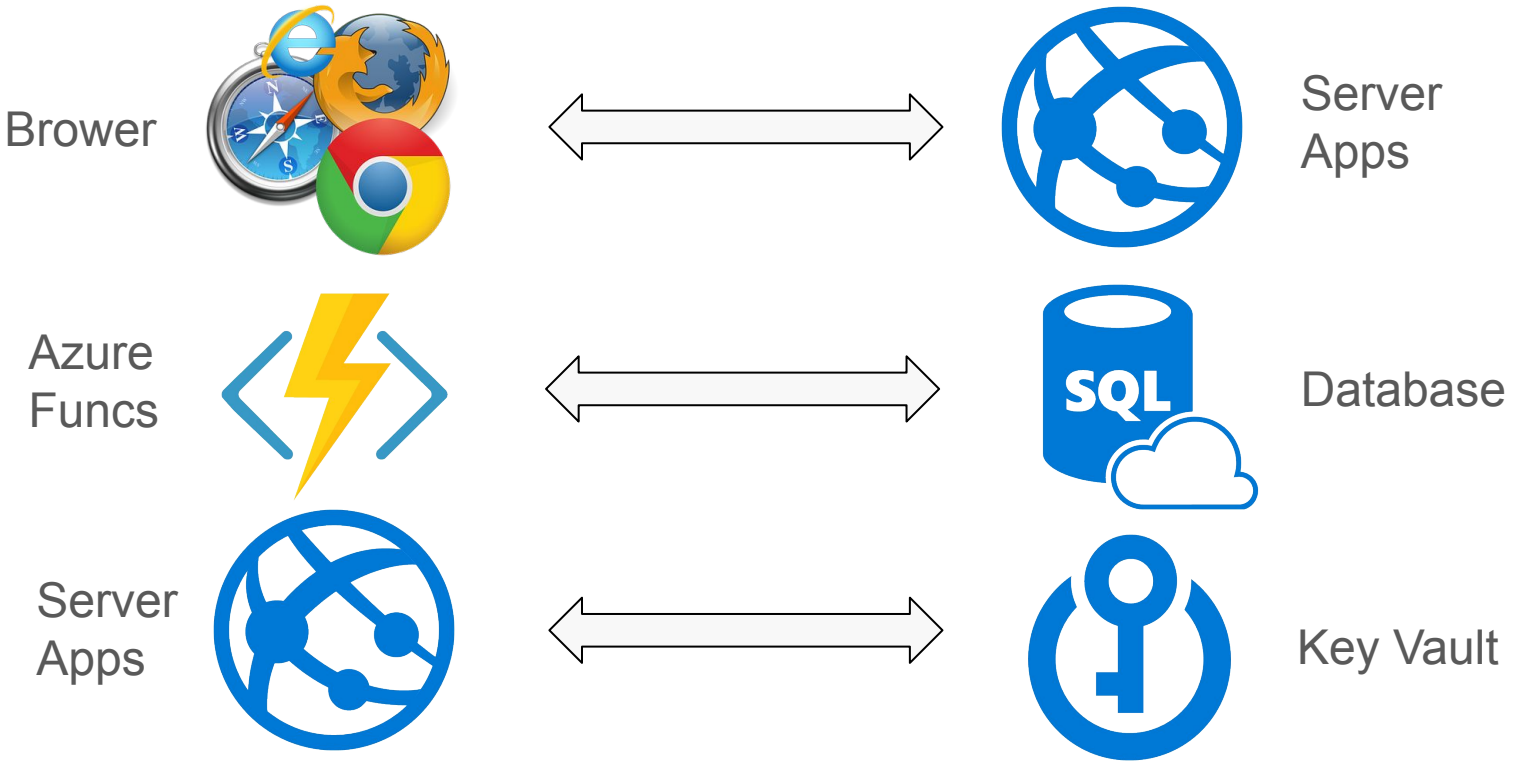

Securing Communications

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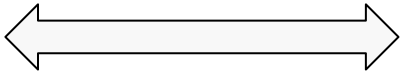
Securing Communications

- All communications should be protected
  - Client to server
  - Server to server
  - Process to process
- SSL/TLS is the main technology used to protect communications
  - Encrypts the packets at the source
  - Decrypts the packets at the destination
  - Public and private keys are used

Securing Communications (SSL)

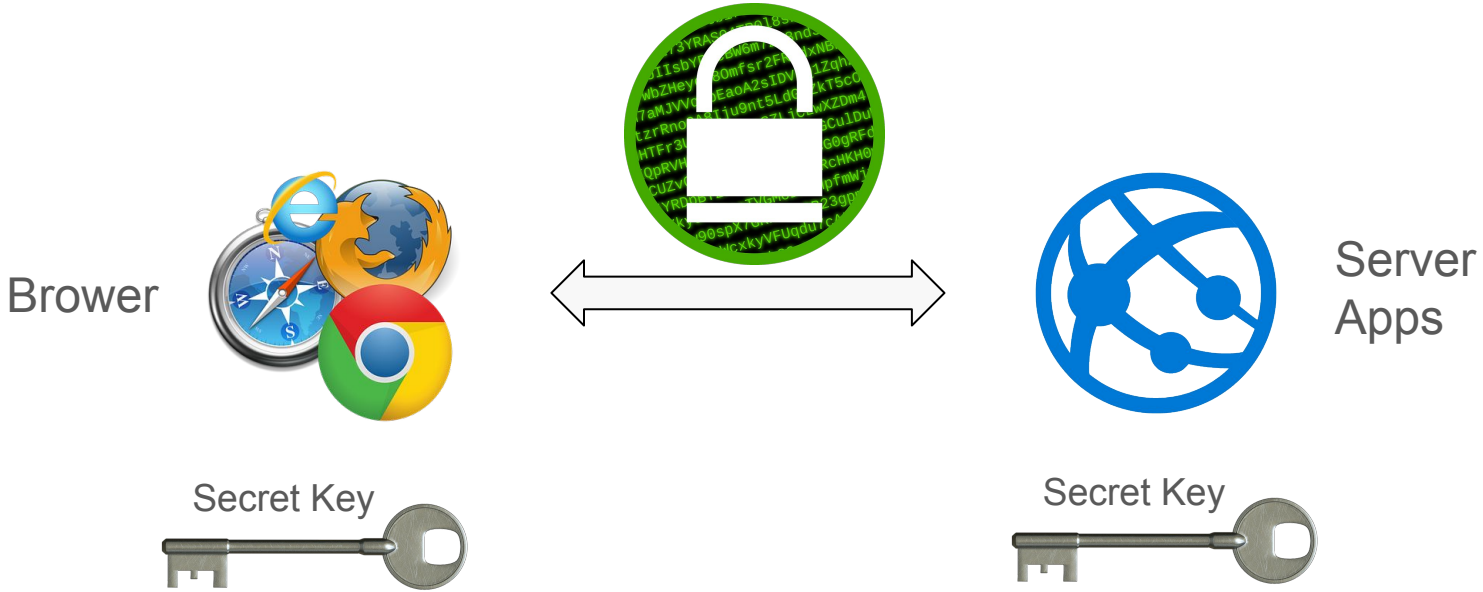
Brower



Server
Apps

Securing Communications (SSL)

Securing Communications (SSL)



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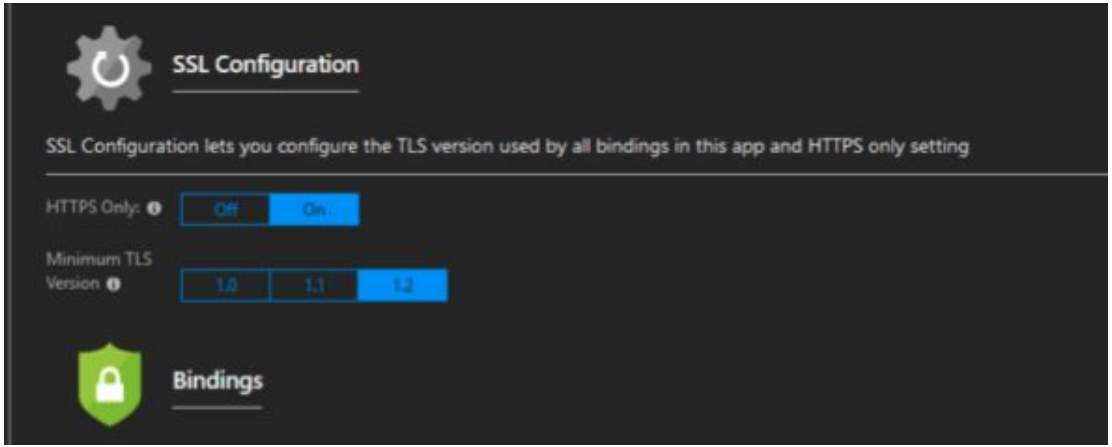

Protecting Virtual Machines

Network Security Groups (NSGs) & ASGs

Protecting virtual machines (NSGs)

Internet

Incoming

Outgoing

Azure VM

Protecting virtual machines (NSGs)

Internet

Incoming

Outgoing

Azure VM

- Unprotected TCP ports:
  - 3389
  - 22
  - 80
  - 443
  - 25, 465
- Any IP is allowed
- Incoming & outgoing

Protecting virtual machines (NSGs)

Internet

Incoming

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Azure VM

Protecting virtual machines (NSGs)

Internet

Incoming

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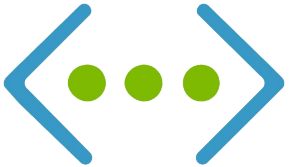
Virtual Networks



Protecting virtual machines (NSGs)

Internet

Incoming

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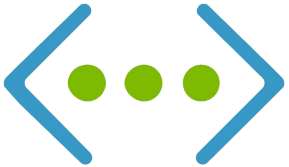
Azure VM

Virtual Networks



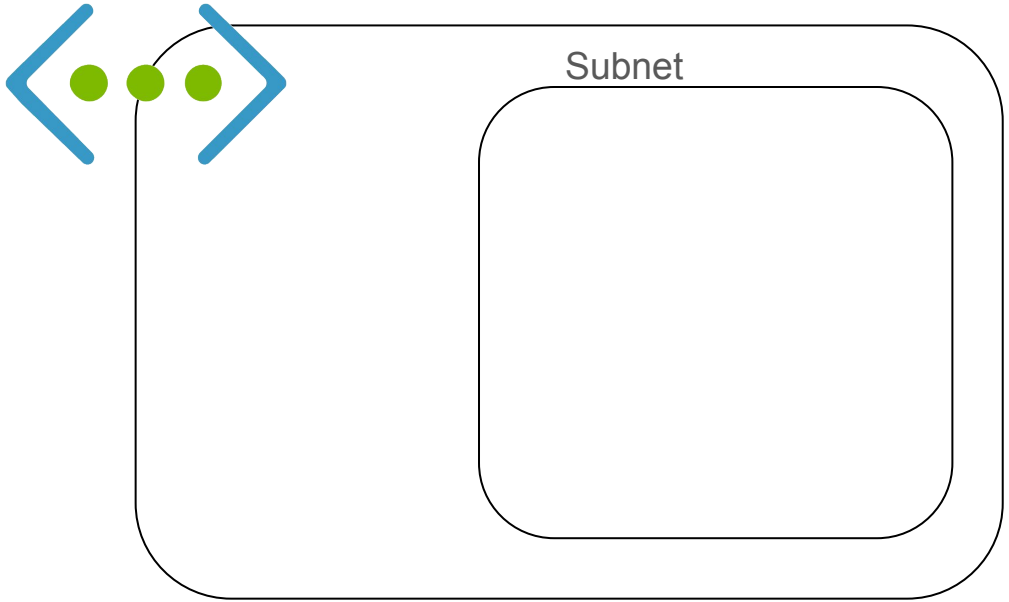
Network Security Group

Protecting virtual machines (NSGs)

Protecting virtual machines (NSGs)

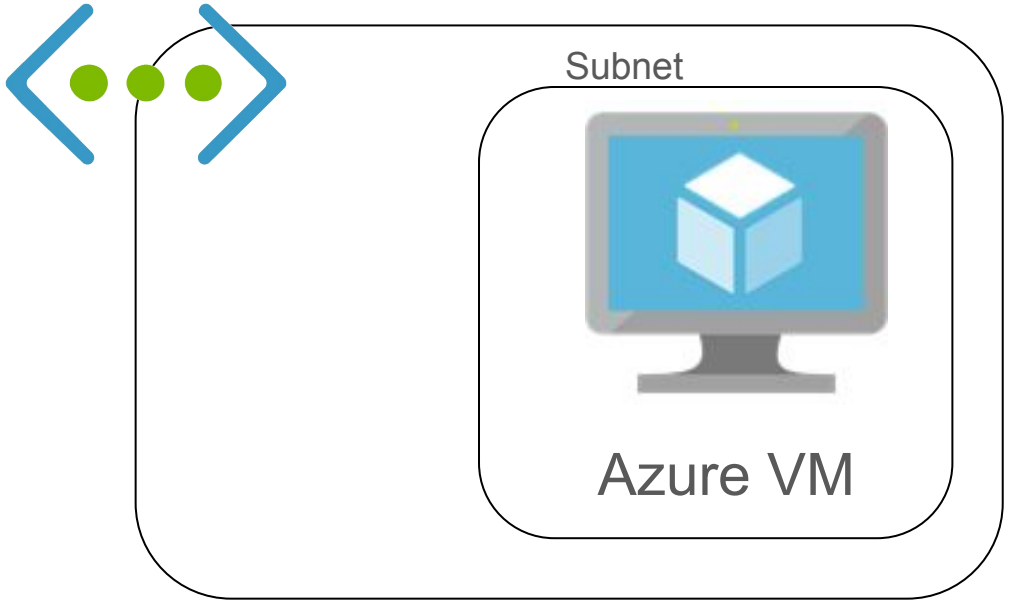
1. Create a VN

Protecting virtual machines (NSGs)



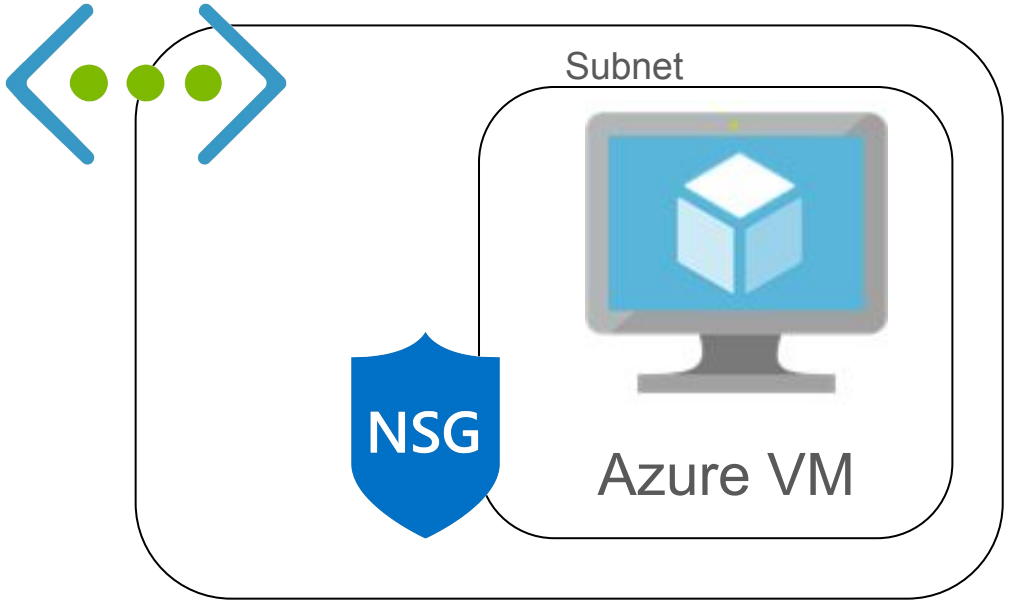
1. Create a VN
2. Add a subnet to VN

Protecting virtual machines (NSGs)



1. Create a VN
2. Add a subnet to VN
3. Add your VM to the subnet

Protecting virtual machines (NSGs)



1. Create a VN
2. Add a subnet to VN
3. Add your VM to the subnet
4. Assign NSG to the subnet

Protecting virtual machines (NSGs)

- Network Security Groups (NSGs)

Protecting virtual machines (NSGs)

- Network Security Groups (NSGs)
  - Filter network traffic to and from Azure resources

Protecting virtual machines (NSGs)

- Network Security Groups (NSGs)
  - Filter network traffic to and from Azure resources
    - Using security rules

Protecting virtual machines (NSGs)

- Network Security Groups (NSGs)
  - Filter network traffic to and from Azure resources
    - Using security rules
      - Inbound

Protecting virtual machines (NSGs)

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  - Filter network traffic to and from Azure resources
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Protecting virtual machines (NSGs)

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    - Security rules have priorities

Protecting virtual machines (NSGs)

- Network Security Groups (NSGs)
  - Filter network traffic to and from Azure resources
    - Using security rules
      - Inbound
      - Outbound
    - Security rules have priorities
      - Lower priority number overrides higher numbers

Security Rules - Inbound

Inbound

AllowVNetInBound

Priority	Source	Source ports	Destination	Destination ports	Protocol	Access
65000	VirtualNetwork	0-65535	VirtualNetwork	0-65535	Any	Allow

AllowAzureLoadBalancerInBound

Priority	Source	Source ports	Destination	Destination ports	Protocol	Access
65001	AzureLoadBalancer	0-65535	0.0.0.0/0	0-65535	Any	Allow

DenyAllInbound

Priority	Source	Source ports	Destination	Destination ports	Protocol	Access
65500	0.0.0.0/0	0-65535	0.0.0.0/0	0-65535	Any	Deny

Security Rules - Inbound

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Security Rules - Outbound

Outbound

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Priority	Source	Source ports	Destination	Destination ports	Protocol	Access
65000	VirtualNetwork	0-65535	VirtualNetwork	0-65535	Any	Allow

AllowInternetOutBound

Priority	Source	Source ports	Destination	Destination ports	Protocol	Access
65001	0.0.0.0/0	0-65535	Internet	0-65535	Any	Allow

DenyAllOutBound

Priority	Source	Source ports	Destination	Destination ports	Protocol	Access
65500	0.0.0.0/0	0-65535	0.0.0.0/0	0-65535	Any	Deny

Security Rules - Outbound

Outbound

AllowVnetOutBound

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Security Rule Properties

Security Rule Properties

1. Name

Security Rule Properties

1. Name
2. Priority (100-4096)

Security Rule Properties

1. Name
2. Priority (100-4096)
3. Source / Destination (IP, IP range or service tag)

Security Rule Properties

1. Name
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3. Source / Destination (IP, IP range or service tag)
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5. Direction (Inbound, Outbound)

Security Rule Properties

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2. Priority (100-4096)
3. Source / Destination (IP, IP range or service tag)
4. Protocol (TCP, UDP, Any)
5. Direction (Inbound, Outbound)
6. Port (Single or range)

Security Rule Properties

1. Name
2. Priority (100-4096)
3. Source / Destination (IP, IP range or service tag)
4. Protocol (TCP, UDP, Any)
5. Direction (Inbound, Outbound)
6. Port (Single or range)
7. Access (Allow, Deny)

Demo

- Controlling incoming and outgoing traffic for VMs
  - Network Security Groups (NSGs)
- Trying Application Security Groups (ASGs)

Exercise

- Working with Network Security Groups (NSGs)
  - Allow Remote Desktop for a VM
  - Examine security rule properties and priority

Q&A

Break (5 minutes)

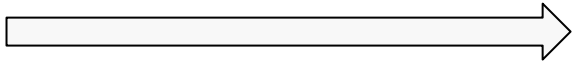
Q&A

Protecting Web Applications

Azure Web Application Firewall (WAF)

Protecting web applications against common attacks (WAF)

Internet



App Services

Protecting web applications against common attacks (WAF)

Internet

SQL injection
XSS
Session hijacking

App Services

Protecting web applications against common attacks (WAF)

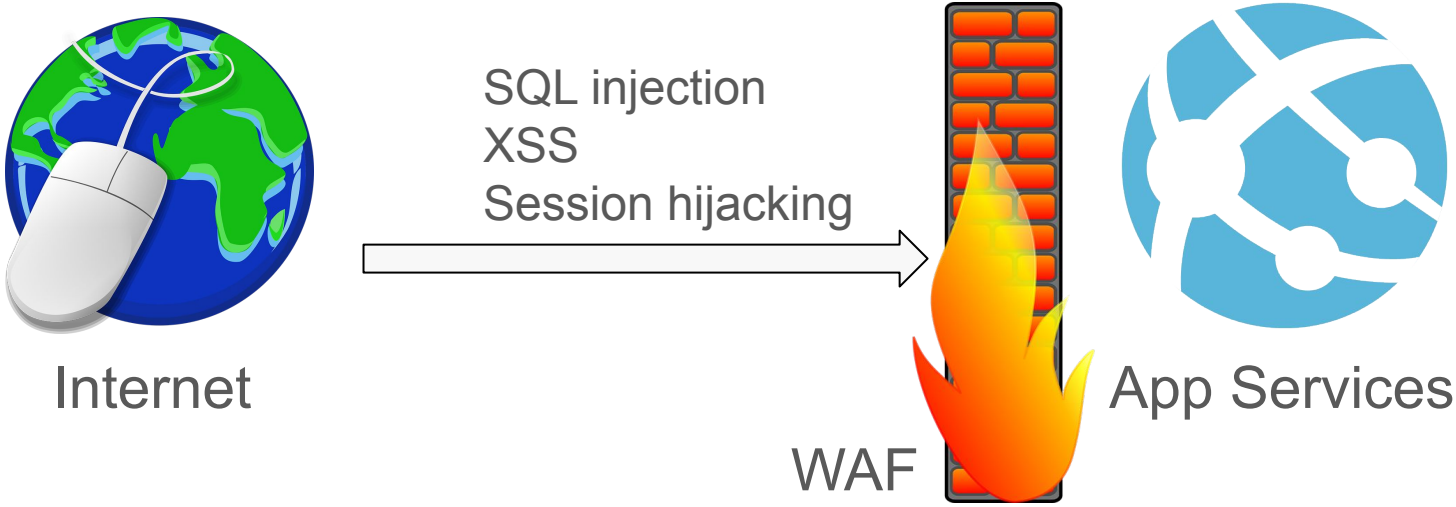
Internet

SQL injection
XSS
Session hijacking

Deal with the attacks at the code level

App Services

Protecting web applications against common attacks (WAF)



Protecting web applications against common attacks (WAF)

Protecting web applications against common attacks (WAF)

- SQL-injection

Protecting web applications against common attacks (WAF)

- SQL-injection
- Cross-site scripting (XSS)

Protecting web applications against common attacks (WAF)

- SQL-injection
- Cross-site scripting (XSS)
- Remote file inclusion

Protecting web applications against common attacks (WAF)

- SQL-injection
- Cross-site scripting (XSS)
- Remote file inclusion
- Missing HTTP headers

Protecting web applications against common attacks (WAF)

- SQL-injection
- Cross-site scripting (XSS)
- Remote file inclusion
- Missing HTTP headers
- Bots, crawlers, scanners

Protecting web applications against common attacks (WAF)

- SQL-injection
- Cross-site scripting (XSS)
- Remote file inclusion
- Missing HTTP headers
- Bots, crawlers, scanners
- Oversized request

Protecting web applications against common attacks (WAF)

- WAF is NOT a stand-alone Azure service

Protecting web applications against common attacks (WAF)

- WAF is NOT a stand-alone Azure service
- You can use WAF with the following:

Protecting web applications against common attacks (WAF)

- WAF is NOT a stand-alone Azure service
- You can use WAF with the following:
    - Azure Application Gateway

Protecting web applications against common attacks (WAF)

- WAF is NOT a stand-alone Azure service
- You can use WAF with the following:
  - Azure Application Gateway
  - Azure Front Door

Azure Application Gateway

Azure Application Gateway

- A web traffic load balancer

Azure Application Gateway

- A web traffic load balancer
- Enables you to manage traffic to your web applications

Azure Application Gateway

- A web traffic load balancer
- Enables you to manage traffic to your web applications
- WAF is one of its many features

Azure Application Gateway

- A web traffic load balancer
- Enables you to manage traffic to your web applications
- WAF is one of its many features
    - Traffic load balancer

Azure Application Gateway

- A web traffic load balancer
- Enables you to manage traffic to your web applications
- WAF is one of its many features
    - Traffic load balancer
    - SSL termination

Azure Application Gateway

- A web traffic load balancer
- Enables you to manage traffic to your web applications
- WAF is one of its many features
    - Traffic load balancer
    - SSL termination
    - URL-based routing

Azure Application Gateway

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    - SSL termination
    - URL-based routing
    - Redirection

Azure Application Gateway

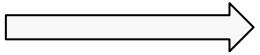
- A web traffic load balancer
- Enables you to manage traffic to your web applications
- WAF is one of its many features
    - Traffic load balancer
    - SSL termination
    - URL-based routing
    - Redirection
    - Session affinity

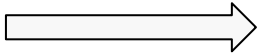
Azure Application Gateway

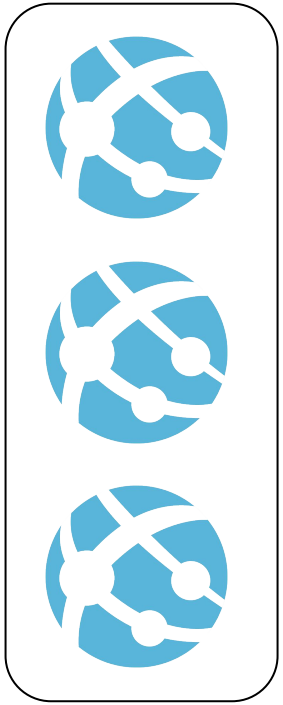
- A web traffic load balancer
- Enables you to manage traffic to your web applications
- WAF is one of its many features
    - Traffic load balancer
    - SSL termination
    - URL-based routing
    - Redirection
    - Session affinity
    - **Web application firewall (WAF)**

Azure Application Gateway

Internet

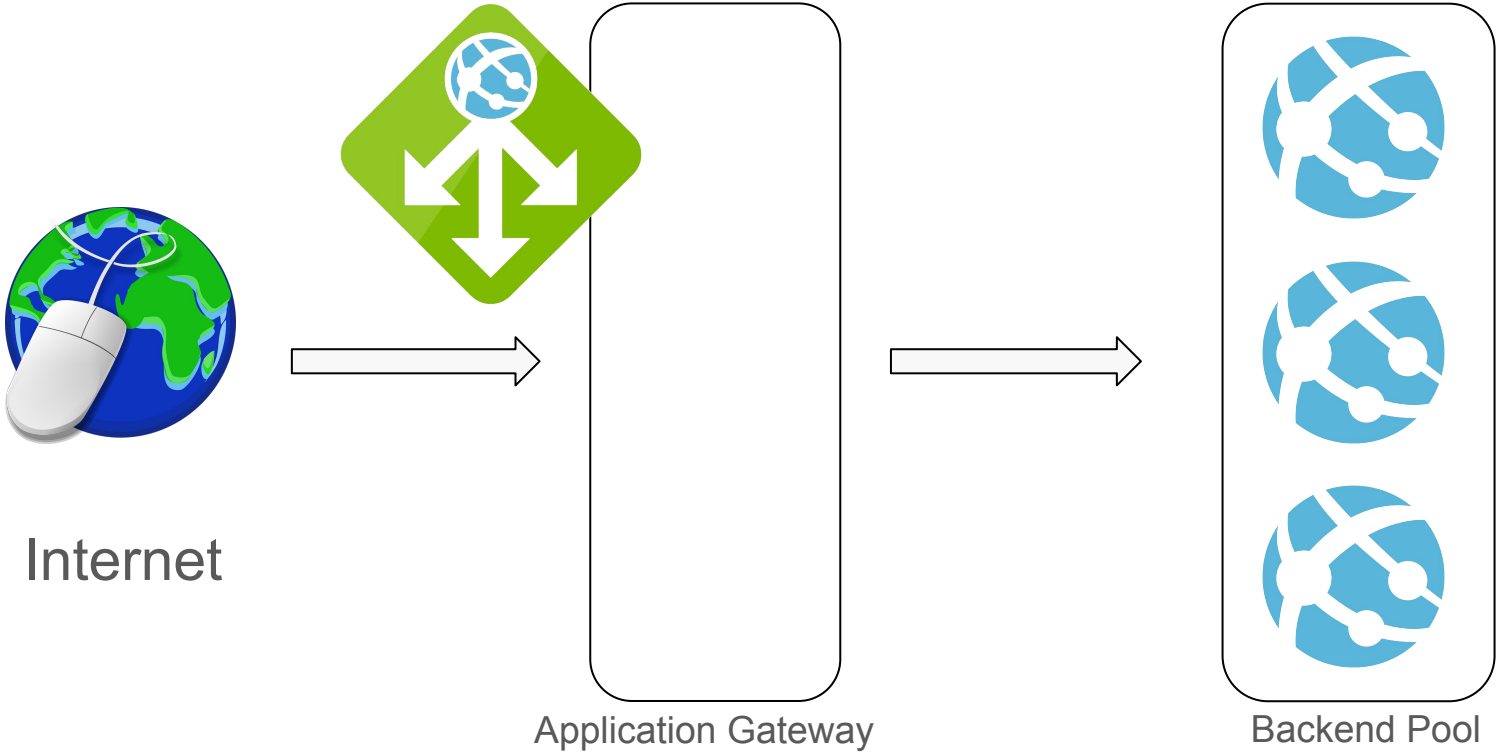




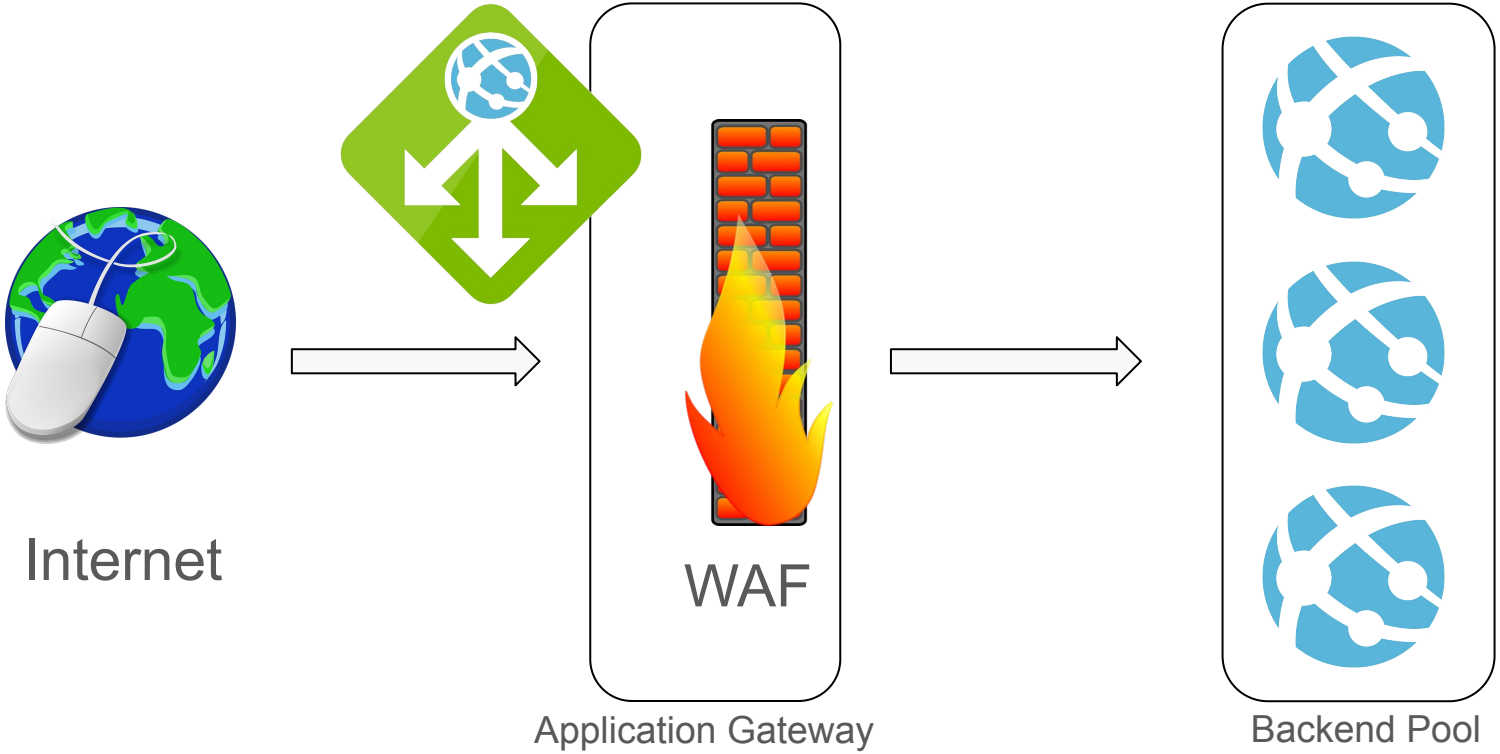


Backend Pool

Azure Application Gateway



Azure Application Gateway



Azure Front Door

Azure Front Door

- A CDN for web applications

Azure Front Door

- A CDN for web applications
- Enables you to optimize your web application traffic

Azure Front Door

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Azure Front Door

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- Enables you to optimize your web application traffic
- WAF is one of its many features
    - Accelerates application performance

Azure Front Door

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Azure Front Door

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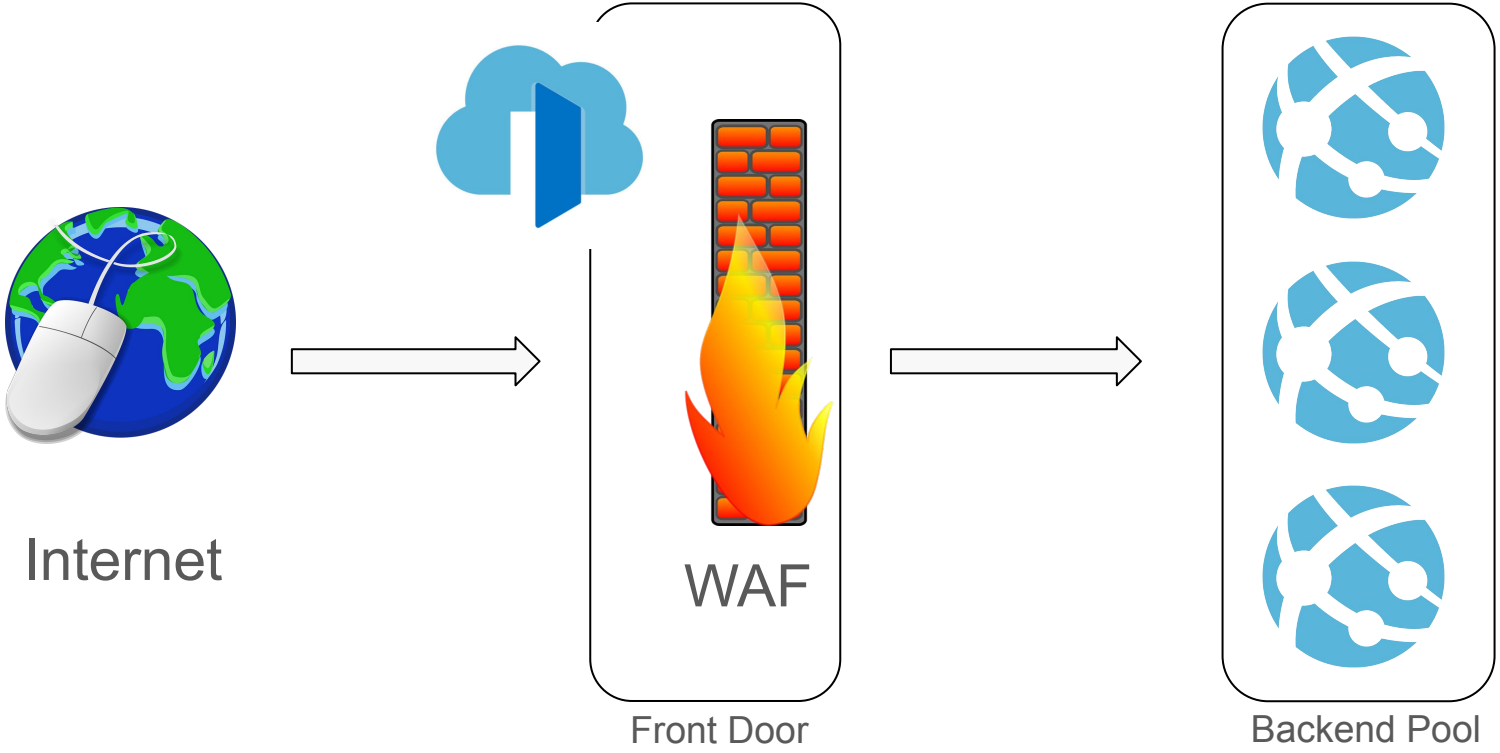
Azure Front Door

- A CDN for web applications
- Enables you to optimize your web application traffic
- WAF is one of its many features
    - Accelerates application performance
    - SSL termination
    - URL-based routing
    - Session affinity
    - **Web application firewall (WAF)**

Azure Application Gateway



Demo

- Protecting an Azure web application using WAF
  - With the Application Gateway
  - With the Azure Front Door

Exercise

- Working with Web Application Firewall (WAF)
  - Application Gateway

Exam AZ-500

Microsoft Azure Security Technologies

Exam AZ-500

- Skills measured (as of December 4, 2019)
  - Manage identity and access (20-25%)
  - Implement platform protection (35-40%)
  - Manage security operations (15-20%)
  - Secure data and applications (30-35%)

https://docs.microsoft.com/en-us/learn/certifications/exams/az-500

Exam AZ-500

Exam AZ-500: Microsoft Azure Security Technologies

The content of this exam was updated on December 4, 2019. Please download the Skills measured document below to see what changed.

Candidates for this exam are Microsoft Azure security engineers who implement security controls, maintain the security posture, manage identity and access, and protect data, applications, and networks. Candidates identify and remediate vulnerabilities by using a variety of security tools, implement threat protection, and respond to security incident escalations. As a Microsoft Azure security engineer, candidates often serve as part of a larger team dedicated to cloud-based management and security and may also secure hybrid environments as part of an end-to-end infrastructure.

Candidates for this exam should have strong skills in scripting and automation; a deep understanding of networking, virtualization, and cloud N-tier architecture; and a strong familiarity with cloud capabilities, Microsoft Azure products and services, and other Microsoft products and services.

Part of the requirements for: Microsoft Certified: Azure Security Engineer Associate
Related exams: none
Important: See details
Go to Certification Dashboard

Exam AZ-500

Microsoft Certified: Azure Security Engineer Associate

Azure Security Engineers implement security controls and threat protection; manage identity and access; and protect data, applications, and networks in cloud and hybrid environments as part of end-to-end infrastructure.

Job role: Security Engineer
Required exams: AZ-500
Important: See details
Go to Certification Dashboard

Certification details

Take one exam

CERTIFICATION EXAM
Microsoft Azure Security Technologies

Earn the certification

ASSOCIATE CERTIFICATION
Microsoft Certified: Azure Security Engineer Associate

Exam AZ-500

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Session on February 6, 2020

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Azure Certified Security Engineer Crash Course

By Mike Pfeiffer

Session on February 18, 2020

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... By the end of this live, hands-on, online course, you'll understand: How the Azure role-based certifications work What topics are most likely to appear on

1 - 2 of 2 search results for az-500

Q&A

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Thank you