CLOUD COMPUTING - MICROSOFT AZURE

ZEN CLASS   -   MAIN PROJECT - 2

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**Batch**   - CC2WE-E

Project Scope

Create a web application, which is highly available in multiple regions, secure from web attacks, load balanced across regions using Application Gateway.

Architecture Overview

- **Azure Virtual Machine Scale Sets (VMSS)**: Automatically scales the number of VMs based on load, ensuring high availability in each region.
- **Optional for testing**: Used single VM in each region.
- **Azure Application Gateway**: Provides **Layer 7** load balancing, acts as a reverse proxy, and integrates with **Web Application Firewall (WAF)** for protection against web attacks like SQL injection, XSS, etc.
- **Multiple Azure Regions**: Distribute your app across regions to ensure disaster recovery and low latency for users.
- **Azure Traffic Manager**: Globally distributes incoming traffic across multiple regions, ensuring high availability and automatic failover.

Project Architecture
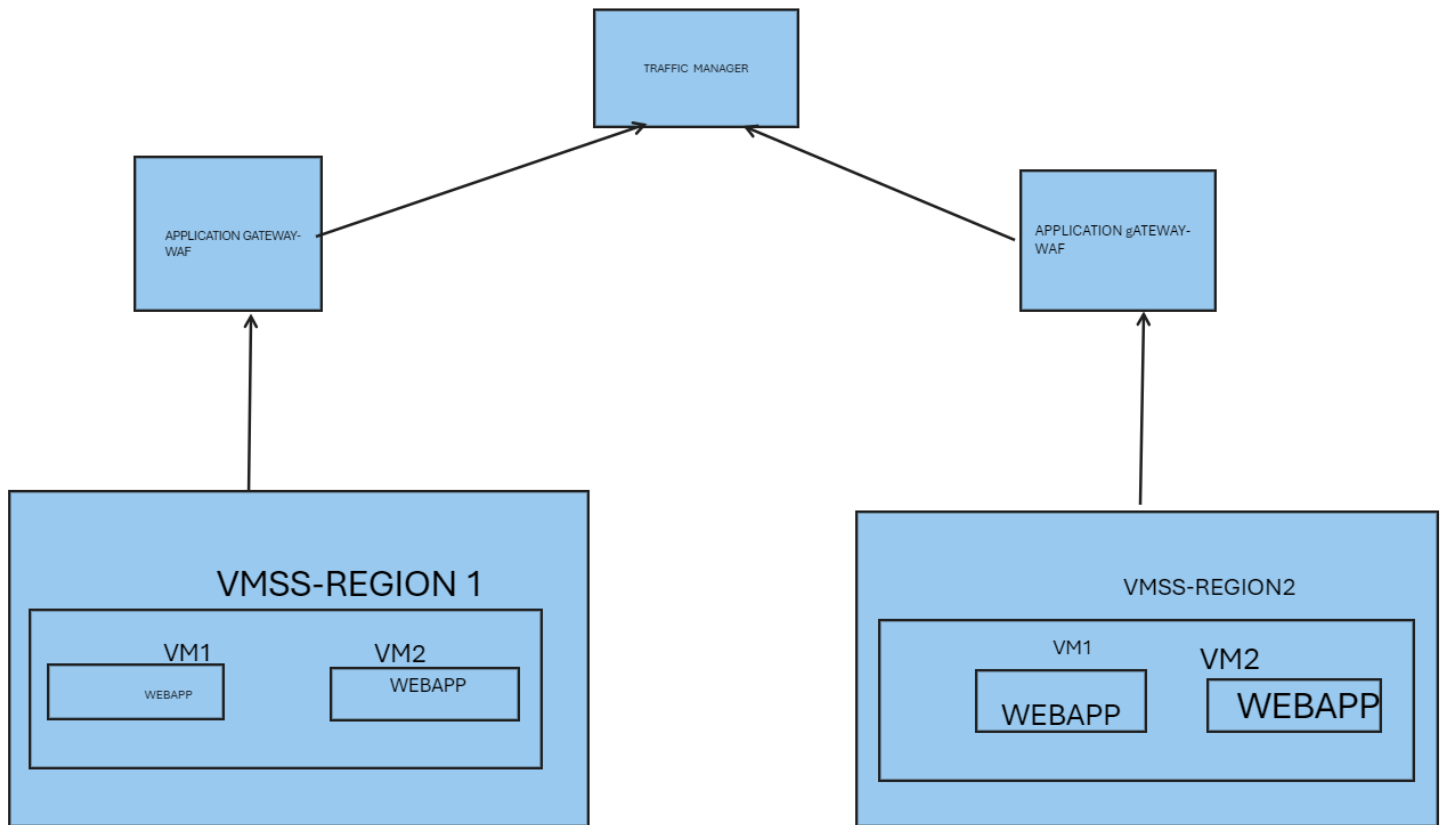
Step-by-Step Setup

1. Login to Azure Portal
2. Created two VM in two region (Norway, Central India)

Home > CreateVm-canonical.ubuntu-24_04-lts-server-20241018125345 | Overview

myapp-norway
Virtual machine

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  - Locks
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- Security
- Backup + disaster recovery
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- Help

∧ Essentials

Resource group (move)	: myapp-norway	Operating system	: Linux (ubuntu 24.04)
Status	: Running	Size	: Standard B1s (1 vcpu, 1 GiB memory)
Location	: Norway East (Zone 1)	Public IP address	: 20.251.161.105
Subscription (move)	: Free Trial	Virtual network/subnet	: myapp-norway-vnet/web-subnet
Subscription ID	: bd7c576e-80d1-497a-adb5-be2427362fbc	DNS name	: Not configured
Availability zone	: 1	Health state	: -
		Time created	: 10/18/2024, 10:59 AM UTC

Tags (edit) : Add tags

Properties Monitoring Capabilities (7) Recommendations Tutorials

🖥 Virtual machine

Computer name	myapp-norway
Operating system	Linux (ubuntu 24.04)
VM generation	V2
VM architecture	x64
Agent status	Ready
Agent version	2.12.0.2
Hibernation	Disabled
Host group	-
Host	-
Proximity placement group	-
Colocation status	N/A
Capacity reservation group	-

🌐 Networking

Public IP address	20.251.161.105 (Network interface myapp-norway253_z1)
Public IP address (IPv6)	-
Private IP address	10.0.1.4
Private IP address (IPv6)	-
Virtual network/subnet	myapp-norway-vnet/web-subnet
DNS name	Configure

📏 Size

Size	Standard B1s
vCPUs	1
RAM	1 GiB

🖼 Source image details

Home > CreateVm-canonical.ubuntu-24_04-lts-server-20241018130349 | Overview >

nginx-centralindia
Virtual machine

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∧ Essentials

Resource group (move)	: myapp-centralindia	Operating system	: Linux (ubuntu 24.04)
Status	: Running	Size	: Standard B1s (1 vcpu, 1 GiB memory)
Location	: Central India (Zone 1)	Public IP address	: 98.70.57.44
Subscription (move)	: Free Trial	Virtual network/subnet	: nginx-centralindia-vnet/web-subnet
Subscription ID	: bd7c576e-80d1-497a-adb5-be2427362fbc	DNS name	: Not configured
Availability zone	: 1	Health state	: -
		Time created	: 10/18/2024, 11:06 AM UTC

Tags (edit) : Add tags

Properties Monitoring Capabilities (7) Recommendations Tutorials

🖥 Virtual machine

Computer name	nginx-centralindia
Operating system	Linux (ubuntu 24.04)
VM generation	V2
VM architecture	x64
Agent status	Ready
Agent version	2.12.0.2
Hibernation	Disabled
Host group	-
Host	-
Proximity placement group	-
Colocation status	N/A
Capacity reservation group	-
Disk controller type	SCSI

🌐 Networking

Public IP address	98.70.57.44 (Network interface nginx-centralindia945_z1)
Public IP address (IPv6)	-
Private IP address	10.0.2.4
Private IP address (IPv6)	-
Virtual network/subnet	nginx-centralindia-vnet/web-subnet
DNS name	Configure

📏 Size

Size	Standard B1s
vCPUs	1
RAM	1 GiB

🖼 Source image details

Source image publisher	canonical

3. SSH to VM and install nginx web server

```
login as: azureuser
azureuser@20.251.161.105's password:
Welcome to Ubuntu 24.04.1 LTS (GNU/Linux 6.8.0-1015-azure x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Fri Oct 18 11:18:26 UTC 2024

  System load:  0.0                Processes:             109
  Usage of /:   5.0% of 28.02GB    Users logged in:       0
  Memory usage: 30%                IPv4 address for eth0: 10.0.1.4
  Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status


The list of available updates is more than a week old.
To check for new updates run: sudo apt update


The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*/copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

azureuser@myapp-norway:~$ sudo apt update
Hit:1 http://azure.archive.ubuntu.com/ubuntu noble InRelease
Get:2 http://azure.archive.ubuntu.com/ubuntu noble-updates InRelease [126 kB]
Get:3 http://azure.archive.ubuntu.com/ubuntu noble-backports InRelease [126 kB]
Get:4 http://azure.archive.ubuntu.com/ubuntu noble-security InRelease [126 kB]
Get:5 http://azure.archive.ubuntu.com/ubuntu noble/universe amd64 Packages [15.0
 MB]
Get:6 http://azure.archive.ubuntu.com/ubuntu noble/universe Translation-en [5982
 kB]
Get:7 http://azure.archive.ubuntu.com/ubuntu noble/universe amd64 Components [38
71 kB]
Get:8 http://azure.archive.ubuntu.com/ubuntu noble/universe amd64 c-n-f Metadata
 [301 kB]
Get:9 http://azure.archive.ubuntu.com/ubuntu noble/multiverse amd64 Packages [26
9 kB]
Get:10 http://azure.archive.ubuntu.com/ubuntu noble/multiverse Translation-en [1
18 kB]
Get:11 http://azure.archive.ubuntu.com/ubuntu noble/multiverse amd64 Components
[35.0 kB]
Get:12 http://azure.archive.ubuntu.com/ubuntu noble/multiverse amd64 c-n-f Metad
ata [8328 B]
Get:13 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 Packages
[597 kB]
Get:14 http://azure.archive.ubuntu.com/ubuntu noble-updates/main Translation-en
[146 kB]
Get:15 http://azure.archive.ubuntu.com/ubuntu noble-updates/main amd64 Component
```

```
No services need to be restarted.

No containers need to be restarted.

No user sessions are running outdated binaries.

No VM guests are running outdated hypervisor (qemu) binaries on this host.
azureuser@myapp-norway:~$ sudo systemctl start nginx
azureuser@myapp-norway:~$ sudo systemctl enable nginx
Synchronizing state of nginx.service with SysV service script with /usr/lib/syst
emd/systemd-sysv-install.
Executing: /usr/lib/systemd/systemd-sysv-install enable nginx
azureuser@myapp-norway:~$ systemctl status nginx
● nginx.service - A high performance web server and a reverse proxy server
     Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: en>
     Active: active (running) since Fri 2024-10-18 11:20:01 UTC; 1min 8s ago
       Docs: man:nginx(8)
   Main PID: 2341 (nginx)
      Tasks: 2 (limit: 1004)
     Memory: 1.7M (peak: 1.9M)
        CPU: 11ms
     CGroup: /system.slice/nginx.service
             ├─2341 "nginx: master process /usr/sbin/nginx -g daemon on; master>
             └─2342 "nginx: worker process"

Oct 18 11:20:01 myapp-norway systemd[1]: Starting nginx.service - A high perfor>
Oct 18 11:20:01 myapp-norway systemd[1]: Started nginx.service - A high perform>
lines 1-14/14 (END)
● nginx.service - A high performance web server and a reverse proxy server
     Loaded: loaded (/usr/lib/systemd/system/nginx.service; enabled; preset: enabled)
     Active: active (running) since Fri 2024-10-18 11:20:01 UTC; 1min 8s ago
       Docs: man:nginx(8)
   Main PID: 2341 (nginx)
      Tasks: 2 (limit: 1004)
     Memory: 1.7M (peak: 1.9M)
        CPU: 11ms
     CGroup: /system.slice/nginx.service
             ├─2341 "nginx: master process /usr/sbin/nginx -g daemon on; master_process on;"
             └─2342 "nginx: worker process"

Oct 18 11:20:01 myapp-norway systemd[1]: Starting nginx.service - A high performance web se>
Oct 18 11:20:01 myapp-norway systemd[1]: Started nginx.service - A high performance web ser>
~
```

```
~
~
lines 1-14/14 (END)
^C
azureuser@myapp-norway:~$ ^[[200~sudo mkdir -p /var/www/myapp
sudo: command not found
azureuser@myapp-norway:~$ ~sudo mkdir -p /var/www/myapp
Command '~sudo' not found, did you mean:
  command 'sudo' from deb sudo (1.9.14p2-1ubuntu1)
  command 'sudo' from deb sudo-ldap (1.9.14p2-1ubuntu1)
Try: sudo apt install <deb name>
azureuser@myapp-norway:~$ sudo mkdir -p /var/www/myapp
azureuser@myapp-norway:~$ sudo chown -R $USER:$USER /var/www/myapp
azureuser@myapp-norway:~$ nano /var/www/myapp/index.html
azureuser@myapp-norway:~$ ls
azureuser@myapp-norway:~$ cat index.html
cat: index.html: No such file or directory
azureuser@myapp-norway:~$ nano index,html
azureuser@myapp-norway:~$ nano /var/www/myapp/index.html
azureuser@myapp-norway:~$ ls
azureuser@myapp-norway:~$ vi index.html
azureuser@myapp-norway:~$ ls
index.html
azureuser@myapp-norway:~$ cat index.html
<!DOCTYPE html>
<html lang="en">
<head>
    <meta charset="UTF-8">
    <meta name="viewport" content="width=device-width, initial-scale=1.0">
    <title>Welcome to My vi Website</title>
</head>
<body>
    <h1>Hello, World! This is a static web page served by vi.</h1>
</body>
</html>

azureuser@myapp-norway:~$ sudo vi /etc/nginx/sites-available/myapp
azureuser@myapp-norway:~$ sudo nginx -t
nginx: the configuration file /etc/nginx/nginx.conf syntax is ok
nginx: configuration file /etc/nginx/nginx.conf test is successful
azureuser@myapp-norway:~$ sudo systemctl reload nginx
azureuser@myapp-norway:~$ 
```
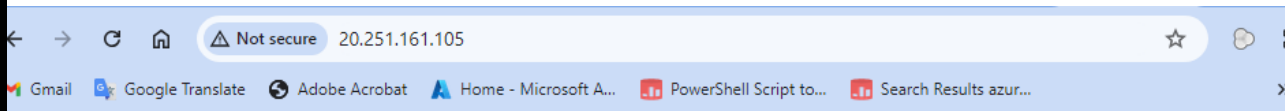
```
azureuser@myapp-norway:~$ cat /etc/nginx/sites-available/myapp
server {
    listen 80;
    server_name 20.251.161.105;  # Replace with your domain or public IP

    root /var/www/myapp;
    index index.html;

    location / {
        try_files $uri $uri/ =404;
    }
}

azureuser@myapp-norway:~$
```
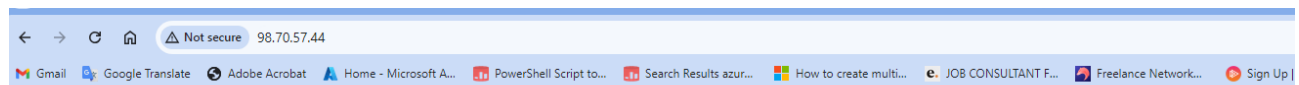
Test Result for VM1

Test Result for VM2

4. Create Application gateway in two region with WAF in prevention mode
5. Add health probe

waf1-centralindia
Application Gateway WAF policy

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- Monitoring
  - Alerts

⊘ Disable   ⇄ Switch to detection mode   🗑 Delete   ↻ Refresh

∧ Essentials   JSON View

Resource group (move)   : myapp-centralindia   Policy state   : ✓ Enabled
Location   : Central India   Policy mode   : Prevention
Subscription (move)   : Free Trial   Associated application g... : 1
Subscription ID   : bd7c576e-80d1-497a-adb5-be2427362fbc
Tags (edit)   : Add tags

⚙ **Policy settings**
Configure multiple settings that apply to all rules within the policy.

↓ **Managed rules**
Configure Azure managed rule sets that protect your web application from common threats.

◆ **Associated application gateways**
Associate this WAF policy to one or more application gateways for protection.

📄 **Custom rules**
Author custom rules to protect your web application from specifically identified threats.

📄 **Log scrubbing rules**

---

myapp-apg-norway
Application gateway

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  - Backend settings
  - Frontend IP configurations
  - Private link
  - SSL settings

🗑 Delete   ↻ Refresh   🗨 Feedback

∧ Essentials   JSON View

Resource group (move)   : myapp-norway   Virtual network/subnet   : myapp-norway-vnet/subnet-norway
Location   : Norway East (Zone 1, 2, 3) Frontend public IP address : 20.251.72.41 (pub2)
Subscription (move)   : Free Trial   Frontend private IP addr... : -
Subscription ID   : bd7c576e-80d1-497a-adb5-be2427362fbc   Tier   : WAF V2
                                                       Availability zone   : 1, 2, 3
Tags (edit)   : Add tags

Show data for last   [1 hour] 6 hours 12 hours 1 day 7 days 30 days

Sum Total Requests   **Sum Failed Requests**

```
2.2                                             2.2
2                                               2
1.8                                             1.8
1.6                                             1.6
1.4                                             1.4
```

---

waf-norway
Application Gateway WAF policy

Search

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- Tags
- Settings
  - Policy settings
  - Managed rules
  - Custom rules
  - Associated application gateways
  - Sensitive data

⊘ Disable   ⇄ Switch to detection mode   🗑 Delete   ↻ Refresh

∧ Essentials   JSON View

Resource group (move)   : myapp-norway   Policy state   : ✓ Enabled
Location   : Norway East   Policy mode   : Prevention
Subscription (move)   : Free Trial   Associated application g... : 1
Subscription ID   : bd7c576e-80d1-497a-adb5-be2427362fbc
Tags (edit)   : Add tags

⚙ **Policy settings**
Configure multiple settings that apply to all rules within the policy.

↓ **Managed rules**
Configure Azure managed rule sets that protect your web application from common threats.

◆ **Associated application gateways**

📄 **Custom rules**

6. Create Traffic Manger to add Endpoint

Home > Load balancing | Traffic Manager >

Create Traffic Manager profile ···

Name *

myapp-trafficmanager

Routing method

Priority

Subscription *

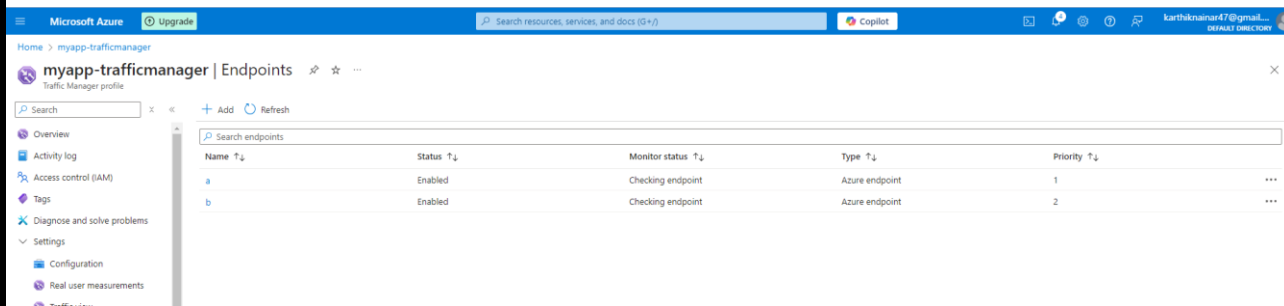Free Trial

Resource group *

myapp-norway

Create new

Resource group location ⓘ

Norway East

7. Add Traffic manager DNS in DNS Configuration and Application gateway ip address in DNS

⩲ Filters   ··· Actions

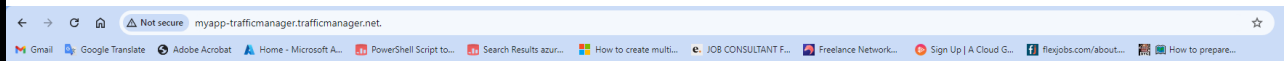|	Type ⓘ	Name ⓘ	Data ⓘ	TTL ⓘ	Delete	Edit
☐	A	@	20.251.72.41	600 seconds	🗑	✎
☐	A	@	4.213.198.240	600 seconds	🗑	✎
☐	A	@	WebsiteBuilder Site	1 Hour	🗑	✎
☐	NS	@	ns09.domaincontrol.com.	1 Hour	Can't delete	Can't edit
☐	NS	@	ns10.domaincontrol.com.	1 Hour	Can't delete	Can't edit
☐	CNAME	www	myapp-trafficmanager.trafficmanager.net.	1 Hour	🗑	✎

Testing

1. Functional Testing

a. Check Connectivity and Performance

Access the Web Application: *Use different regions to access your web application through the Traffic Manager DNS.*

Welcome to nginx!

If you see this page, the nginx web server is successfully installed and working. Further configuration is required.

For online documentation and support please refer to nginx.org.
Commercial support is available at nginx.com.

Thank you for using nginx.

2.Common Vulnerability Tests

Payloads: Test with input values like:
```
sql
```


404 Not Found

nginx/1.24.0 (Ubuntu)

403 Forbidden

Microsoft-Azure-Application-Gateway/v2