# Three-Tier Azure Architecture Deployment Guide

Project: Multi-Tier Web Application Infrastructure
Platform: Microsoft Azure
Prepared By: Hitesh Jangid
Date: 13 July 2025

Architecture Overview

This deployment creates a secure three-tier architecture in Azure with proper network segmentation and access controls. The design follows security best practices by implementing least privilege access between tiers.
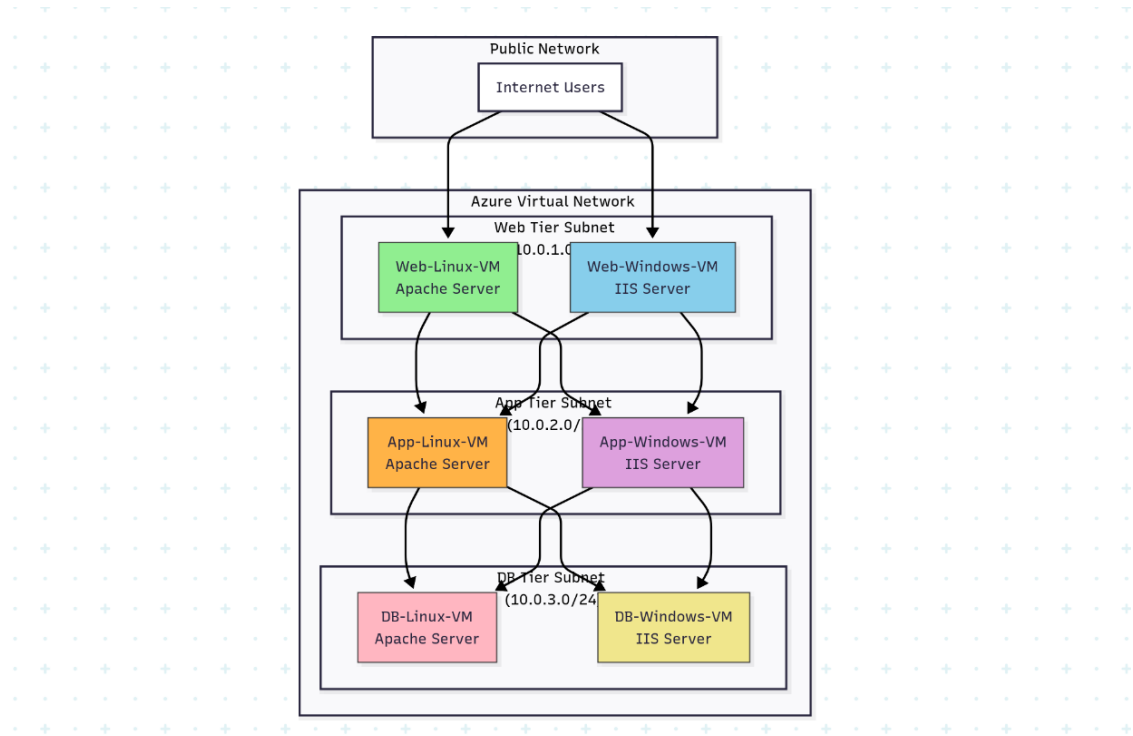
Network Security Architecture
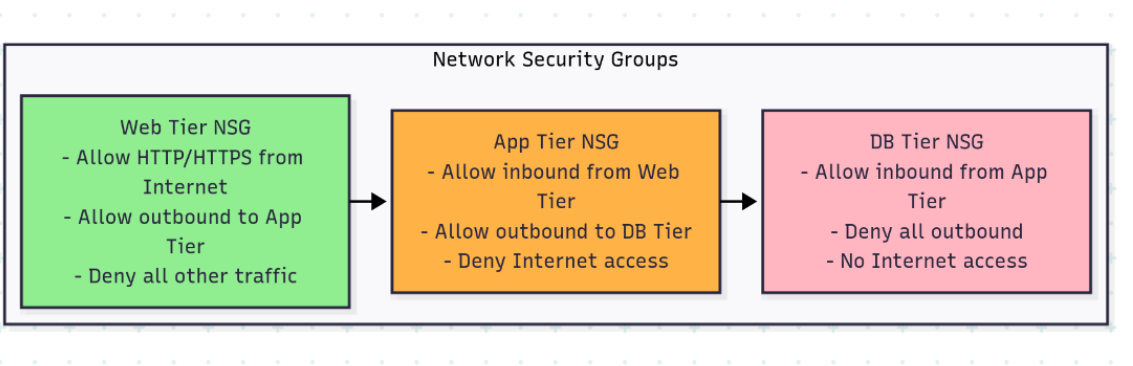
Step-by-Step Implementation

Phase 1: Resource Group and Virtual Network Setup

```
# Create Resource Group
az group create \
  --name HiteshJangid-Qna \
  --location eastus
```

```
# Create Virtual Network
az network vnet create \
  --resource-group HiteshJangid-Qna \
  --name Vnet \
  --address-prefix 10.0.0.0/16 \
  --location eastus
```

Phase 2: Subnet Creation

```
# Create Web Tier Subnet
az network vnet subnet create \
  --resource-group HiteshJangid-Qna \
  --vnet-name Vnet \
  --name subnet-web-tier \
  --address-prefix 10.0.1.0/24
```

```
# Create App Tier Subnet
az network vnet subnet create \
  --resource-group HiteshJangid-Qna \
  --vnet-name Vnet \
  --name subnet-app-tier \
  --address-prefix 10.0.2.0/24
```

```
# Create DB Tier Subnet
az network vnet subnet create \
  --resource-group HiteshJangid-Qna \
  --vnet-name Vnet \
  --name subnet-db-tier \
  --address-prefix 10.0.3.0/24
```

Phase 3: Network Security Groups Configuration

```
# Web Tier NSG
az network nsg create \
  --resource-group HiteshJangid-Qna \
  --name nsg-web-tier \
  --location eastus
```

```
# Allow HTTP from Internet
az network nsg rule create \
  --resource-group HiteshJangid-Qna \
  --nsg-name nsg-web-tier \
```

```
  --name Allow-HTTP \
  --protocol tcp \
  --priority 1000 \
  --destination-port-range 80 \
  --source-address-prefix Internet \
  --access allow
```

Allow HTTPS from Internet
```
az network nsg rule create \
  --resource-group HiteshJangid-Qna \
  --nsg-name nsg-web-tier \
  --name Allow-HTTPS \
  --protocol tcp \
  --priority 1001 \
  --destination-port-range 443 \
  --source-address-prefix Internet \
  --access allow
```

Allow SSH/RDP for management
```
az network nsg rule create \
  --resource-group HiteshJangid-Qna \
  --nsg-name nsg-web-tier \
  --name Allow-SSH-RDP \
  --protocol tcp \
  --priority 1002 \
  --destination-port-range 22,3389 \
  --source-address-prefix Internet \
  --access allow
```

App Tier NSG
```
az network nsg create \
  --resource-group HiteshJangid-Qna \
  --name nsg-app-tier \
  --location eastus
```

Allow traffic from Web Tier
```
az network nsg rule create \
  --resource-group HiteshJangid-Qna \
  --nsg-name nsg-app-tier \
  --name Allow-From-Web \
  --protocol tcp \
  --priority 1000 \
  --destination-port-range 80,443,8080 \
  --source-address-prefix 10.0.1.0/24 \
  --access allow
```

DB Tier NSG
```
az network nsg create \
```

```
  --resource-group HiteshJangid-Qna \
  --name nsg-db-tier \
  --location eastus
```

Allow traffic from App Tier
```
az network nsg rule create \
  --resource-group HiteshJangid-Qna \
  --nsg-name nsg-db-tier \
  --name Allow-From-App \
  --protocol tcp \
  --priority 1000 \
  --destination-port-range 3306,1433,5432 \
  --source-address-prefix 10.0.2.0/24 \
  --access allow
```

Phase 4: Associate NSGs with Subnets
Associate Web Tier NSG
```
az network vnet subnet update \
  --resource-group HiteshJangid-Qna \
  --vnet-name Vnet \
  --name subnet-web-tier \
  --network-security-group nsg-web-tier
```

Associate App Tier NSG
```
az network vnet subnet update \
  --resource-group HiteshJangid-Qna \
  --vnet-name Vnet \
  --name subnet-app-tier \
  --network-security-group nsg-app-tier
```

Associate DB Tier NSG
```
az network vnet subnet update \
  --resource-group HiteshJangid-Qna \
  --vnet-name Vnet \
  --name subnet-db-tier \
  --network-security-group nsg-db-tier
```

Virtual Machine Deployment

Web Tier Virtual Machines
Web Tier Linux VM (Ubuntu with Apache)
```
az vm create \
  --resource-group HiteshJangid-Qna \
  --name vm-web-linux \
  --image Ubuntu2204 \
  --admin-username HiteshJangid \
  --generate-ssh-keys \
  --vnet-name Vnet \
```

```
  --subnet subnet-web-tier \
  --public-ip-sku Standard \
  --size Standard_B2s
```

 # Web Tier Windows VM (Windows Server with IIS)
```
az vm create \
  --resource-group HiteshJangid-Qna \
  --name WindowsVM \
  --image Win2022Datacenter \
  --admin-username HiteshJangid \
  --admin-password 'P@ssw0rd123!' \
  --vnet-name Vnet \
  --subnet subnet-web-tier \
  --public-ip-sku Standard \
  --size Standard_B2s
```

App Tier Virtual Machines
 # App Tier Linux VM
```
az vm create \
  --resource-group HiteshJangid-Qna \
  --name vm-app-linux \
  --image Ubuntu2204 \
  --admin-username HiteshJangid \
  --generate-ssh-keys \
  --vnet-name Vnet \
  --subnet subnet-app-tier \
  --public-ip-sku Standard \
  --size Standard_B2s
```

 # App Tier Windows VM
```
az vm create \
  --resource-group HiteshJangid-Qna \
  --name vm-app-windows \
  --image Win2022Datacenter \
  --admin-username HiteshJangid \
  --admin-password 'P@ssw0rd123!' \
  --vnet-name Vnet \
  --subnet subnet-app-tier \
  --public-ip-sku Standard \
  --size Standard_B2s
```

DB Tier Virtual Machines
 # DB Tier Linux VM
```
az vm create \
  --resource-group HiteshJangid-Qna \
  --name LinuxVM \
  --image Ubuntu2204 \
```

```
  --admin-username HiteshJangid \
  --generate-ssh-keys \
  --vnet-name Vnet \
  --subnet subnet-db-tier \
  --public-ip-address "" \
  --size Standard_B2s

# DB Tier Windows VM
az vm create \
  --resource-group HiteshJangid-Qna \
  --name vm-db-windows \
  --image Win2022Datacenter \
  --admin-username HiteshJangid \
  --admin-password 'P@ssw0rd123!' \
  --vnet-name Vnet \
  --subnet subnet-db-tier \
  --public-ip-address "" \
  --size Standard_B2s
```

Web Server Configuration

Apache Installation on Linux VMs

```bash
#!/bin/bash
# Apache Installation Script for Ubuntu
# Update system packages
sudo apt update && sudo apt upgrade -y

# Install Apache2
sudo apt install apache2 -y
# Enable Apache to start on boot
sudo systemctl enable apache2
# Start Apache service
sudo systemctl start apache2
# Configure firewall
sudo ufw allow 'Apache Full'
sudo ufw --force enable


# Create custom index page
sudo tee /var/www/html/index.html > /dev/null <<EOF
<!DOCTYPE html>
<html>
<head>
    <title>Three-Tier Architecture</title>
    <style>
        body { font-family: Arial, sans-serif; margin: 40px; }
        .container { max-width: 800px; margin: 0 auto; }
        .tier { background: #f0f0f0; padding: 20px; margin: 20px 0; border-radius: 8px; }
```

```
        .web-tier { background: #90EE90; }
        .app-tier { background: #FFB347; }
        .db-tier { background: #FFB6C1; }
    </style>
</head>
<body>
    <div class="container">
        <h1>Three-Tier Architecture - Apache Server</h1>
        <div class="tier web-tier">
            <h2>Web Tier</h2>
            <p>This is the Web Tier running Apache on Linux</p>
            <p>Server: $(hostname)</p>
            <p>IP Address: $(hostname -I | awk '{print $1}')</p>
        </div>
    </div>
</body>
</html>
EOF

# Set proper permissions
sudo chown -R www-data:www-data /var/www/html
sudo chmod -R 755 /var/www/html

# Restart Apache
sudo systemctl restart apache2

echo "Apache installation and configuration completed!"
```

IIS Installation on Windows VMs

```
# IIS Installation Script for Windows Server

# Install IIS with common features
Enable-WindowsOptionalFeature -Online -FeatureName IIS-WebServerRole, IIS-WebServer, IIS-CommonHttpFeatures, IIS-HttpErrors, IIS-HttpLogging, IIS-HttpCompressionStatic, IIS-Security, IIS-RequestFiltering, IIS-StaticContent, IIS-DefaultDocument, IIS-DirectoryBrowsing, IIS-ASPNET45 -All

# Create custom default page
$htmlContent = @"
<!DOCTYPE html>
<html>
<head>
    <title>Three-Tier Architecture</title>
    <style>
        body { font-family: Arial, sans-serif; margin: 40px; }
        .container { max-width: 800px; margin: 0 auto; }
        .tier { background: #f0f0f0; padding: 20px; margin: 20px 0; border-radius: 8px; }
        .web-tier { background: #87CEEB; }
```

```
    .app-tier { background: #DDA0DD; }
    .db-tier { background: #F0E68C; }
  </style>
</head>
<body>
  <div class="container">
    <h1>Three-Tier Architecture - IIS Server</h1>
    <div class="tier web-tier">
      <h2>Web Tier</h2>
      <p>This is the Web Tier running IIS on Windows Server</p>
      <p>Server: $env:COMPUTERNAME</p>
      <p>IP Address: $((Get-NetIPAddress -AddressFamily IPv4 -InterfaceAlias
"Ethernet").IPAddress)</p>
    </div>
  </div>
</body>
</html>
"@
```

```
# Write the HTML content to default page
$htmlContent | Out-File -FilePath "C:\inetpub\wwwroot\index.html" -Encoding UTF8
```

```
# Configure IIS settings
Import-Module WebAdministration
Set-WebConfigurationProperty -Filter "system.webServer/defaultDocument" -Name "enabled"
-Value "true" -PSPath "IIS:\"
Add-WebConfigurationProperty -Filter "system.webServer/defaultDocument/files" -Name "."
-Value @{value="index.html"} -PSPath "IIS:\"
```

```
# Start IIS services
Start-Service W3SVC
Set-Service W3SVC -StartupType Automatic
```

```
Write-Host "IIS installation and configuration completed!"
```

VM Extension Deployment

Deploy Apache on Linux VMs
```
# Deploy Apache on Web Tier Linux VM
az vm extension set \
  --resource-group HiteshJangid-Qna \
  --vm-name vm-web-linux \
  --name customScript \
  --publisher Microsoft.Azure.Extensions \
  --settings '{"fileUris":["https://raw.githubusercontent.com/your-repo/apache-
install.sh"],"commandToExecute":"./apache-install.sh"}'
```

```
# Deploy Apache on App Tier Linux VM
```

```
az vm extension set \
  --resource-group HiteshJangid-Qna \
  --vm-name vm-app-linux \
  --name customScript \
  --publisher Microsoft.Azure.Extensions \
  --settings '{"fileUris":["https://raw.githubusercontent.com/your-repo/apache-install.sh"],"commandToExecute":"./apache-install.sh"}'

# Deploy Apache on DB Tier Linux VM
az vm extension set \
  --resource-group HiteshJangid-Qna \
  --vm-name LinuxVM \
  --name customScript \
  --publisher Microsoft.Azure.Extensions \
  --settings '{"fileUris":["https://raw.githubusercontent.com/your-repo/apache-install.sh"],"commandToExecute":"./apache-install.sh"}'
```

Deploy IIS on Windows VMs
```
# Deploy IIS on Web Tier Windows VM
az vm extension set \
  --resource-group HiteshJangid-Qna \
  --vm-name WindowsVM \
  --name CustomScriptExtension \
  --publisher Microsoft.Compute \
  --settings '{"fileUris":["https://raw.githubusercontent.com/your-repo/iis-install.ps1"],"commandToExecute":"powershell -ExecutionPolicy Unrestricted -File iis-install.ps1"}'

# Deploy IIS on App Tier Windows VM
az vm extension set \
  --resource-group HiteshJangid-Qna \
  --vm-name vm-app-windows \
  --name CustomScriptExtension \
  --publisher Microsoft.Compute \
  --settings '{"fileUris":["https://raw.githubusercontent.com/your-repo/iis-install.ps1"],"commandToExecute":"powershell -ExecutionPolicy Unrestricted -File iis-install.ps1"}'

# Deploy IIS on DB Tier Windows VM
az vm extension set \
  --resource-group HiteshJangid-Qna \
  --vm-name vm-db-windows \
  --name CustomScriptExtension \
  --publisher Microsoft.Compute \
  --settings '{"fileUris":["https://raw.githubusercontent.com/your-repo/iis-install.ps1"],"commandToExecute":"powershell -ExecutionPolicy Unrestricted -File iis-install.ps1"}'
```
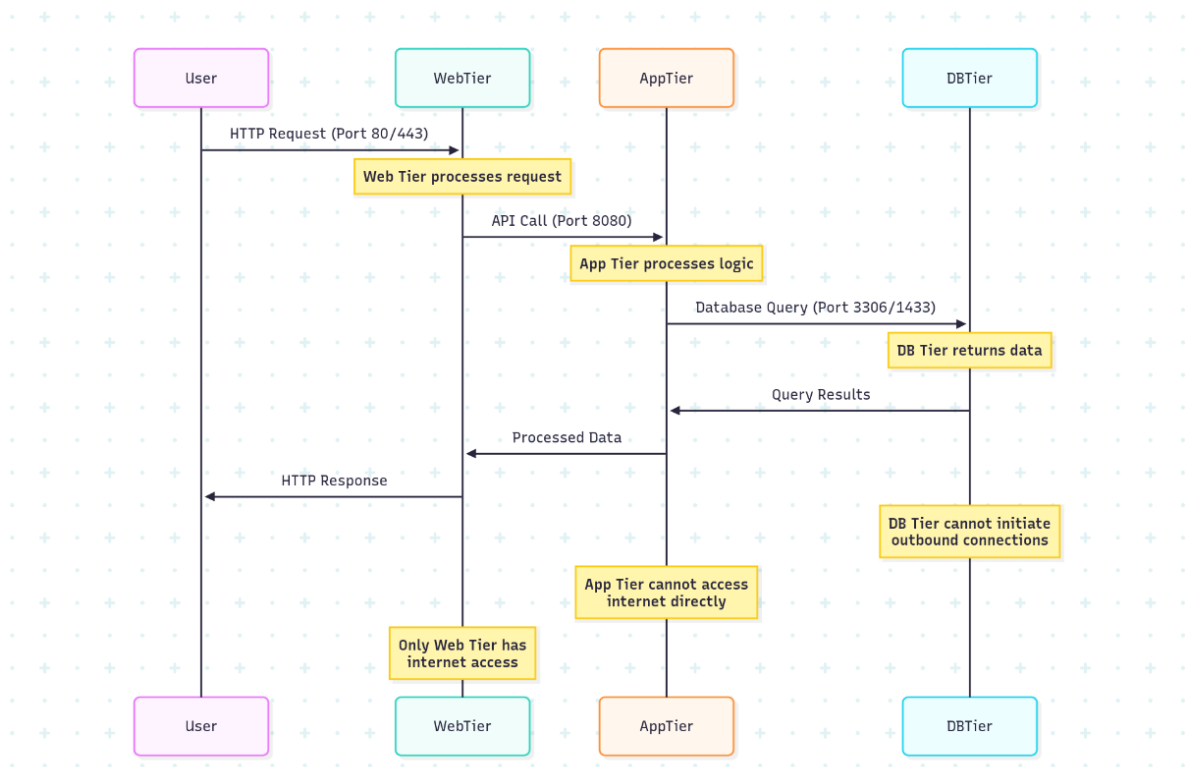
Traffic Flow Validation

Security Validation Tests

Connectivity Testing Scripts

```bash
#!/bin/bash
# Test connectivity between tiers
echo "Testing Web Tier to App Tier connectivity..."
nc -zv 10.0.2.4 80
nc -zv 10.0.2.5 80
echo "Testing App Tier to DB Tier connectivity..."
nc -zv 10.0.3.4 3306
nc -zv 10.0.3.5 1433
echo "Testing DB Tier isolation (should fail)..."
nc -zv 8.8.8.8 80 # This should fail
nc -zv 10.0.1.4 80 # This should fail
```

Monitoring and Maintenance

Resource Monitoring

```
# Enable diagnostic settings for VMs
az monitor diagnostic-settings create \
  --resource-group HiteshJangid-Qna \
  --name vm-diagnostics \
  --resource /subscriptions/{subscription-id}/resourceGroups/HiteshJangid-Qna/providers/
```

```
Microsoft.Compute/virtualMachines/vm-web-linux \
  --metrics '[{"category":"AllMetrics","enabled":true}]' \
  --workspace /subscriptions/{subscription-id}/resourceGroups/HiteshJangid-Qna/providers/
Microsoft.OperationalInsights/workspaces/law-threetier
```

Deployment Checklist

- Resource Group created
- Virtual Network configured with proper address space
- Three subnets created with appropriate CIDR blocks
- Network Security Groups configured with proper rules
- NSGs associated with respective subnets
- Six VMs deployed (2 per tier, 1 Linux + 1 Windows each)
- Apache installed on all Linux VMs
- IIS installed on all Windows VMs
- Web Tier VMs have public IPs
- App and DB Tier VMs have no public IPs
- Connectivity tested between tiers
- Internet access verified only for Web Tier
- DB Tier isolation confirmed

Cost Optimization

```
# Implement auto-shutdown for development VMs
az vm auto-shutdown \
  --resource-group HiteshJangid-Qna \
  --name vm-web-linux \
  --time 1900 \
  --email "Hiteshjangif@duck.com"
```

Troubleshooting Guide

Common Issues and Solutions

1. **VM Connection Issues**
   - Check NSG rules
   - Verify subnet associations
   - Confirm VM status
2. **Web Server Not Responding**
   - Check service status
   - Verify firewall rules
   - Review application logs
3. **Inter-Tier Communication Failures**
   - Validate NSG rules
   - Check routing tables
   - Verify VM network interfaces

Diagnostic Commands

```
# Check Apache status
sudo systemctl status apache2
# Check IIS status
```

Get-Service W3SVC
 # Network connectivity testing
telnet <target-ip> <port>

Cleanup Instructions
 # Remove entire resource group and all resources
az group delete --name HiteshJangid-Qna --yes --no-wait