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# Research & Development Document

## CIDR Ranges of Azure VNet, Subnet, VNet Peering, and Use Case Deployment

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## 1. Introduction to Azure Virtual Network (VNet)

An **Azure Virtual Network (VNet)** is a logically isolated network in Azure. It enables secure communication between Azure resources, the internet, and on-premises networks.

### Key Features:

- Private IP address space using CIDR
- Subnet segmentation
- Network Security Groups (NSGs)
- Route tables
- VNet peering
- VPN Gateway & ExpressRoute support

## 2. CIDR Ranges in VNets and Subnets

**CIDR (Classless Inter-Domain Routing)** notation defines IP address ranges for VNets and subnets. CIDR allows the allocation of address blocks in a hierarchical, efficient manner.

### Example:

- VNet CIDR: 10.0.0.0/16 → Contains 65,536 IP addresses
- Subnet 1: 10.0.1.0/24 → 256 IPs
- Subnet 2: 10.0.2.0/24 → 256 IPs

Azure reserves 5 IPs per subnet:

- Network address
- Broadcast address (reserved)

- First 3 usable IPs (reserved for Azure services)

#### **CIDR Notation Table:**

<b>CIDR</b>	<b>Total IPs</b>	<b>Usable IPs</b>
/24	256	251
/25	128	123
/26	64	59
/27	32	27
/28	16	11

### **3. Subnetting in Azure**

Subnets allow segmentation of the VNet to apply policies (e.g., NSGs, UDRs) at subnet level. They enable:

- Logical isolation
- Role separation (e.g., Web, App, DB tiers)
- Granular control over traffic flow and IP ranges
- Load balancing and firewall targeting at subnet level

Recommended to use /24 or /26 for small environments. Subnets must not overlap.

### **4. VNet Peering in Azure**

**VNet Peering** connects two VNets and allows communication through private IPs.

**Types of Peering:**

1. **Intra-region Peering** – VNets in the same Azure region
2. **Global VNet Peering** – VNets in different Azure regions

**Benefits:**

- Low-latency, high-bandwidth connectivity
- Private and secure communication
- No public internet exposure
- Shared services like DNS, Azure Bastion

**Limitations:**

- Transitive peering is **not supported** (i.e., VNet A peered to B, B to C doesn't mean A can talk to C)
- Cannot use overlapping address spaces

## **5. Prerequisites to Create VNets and VMs**

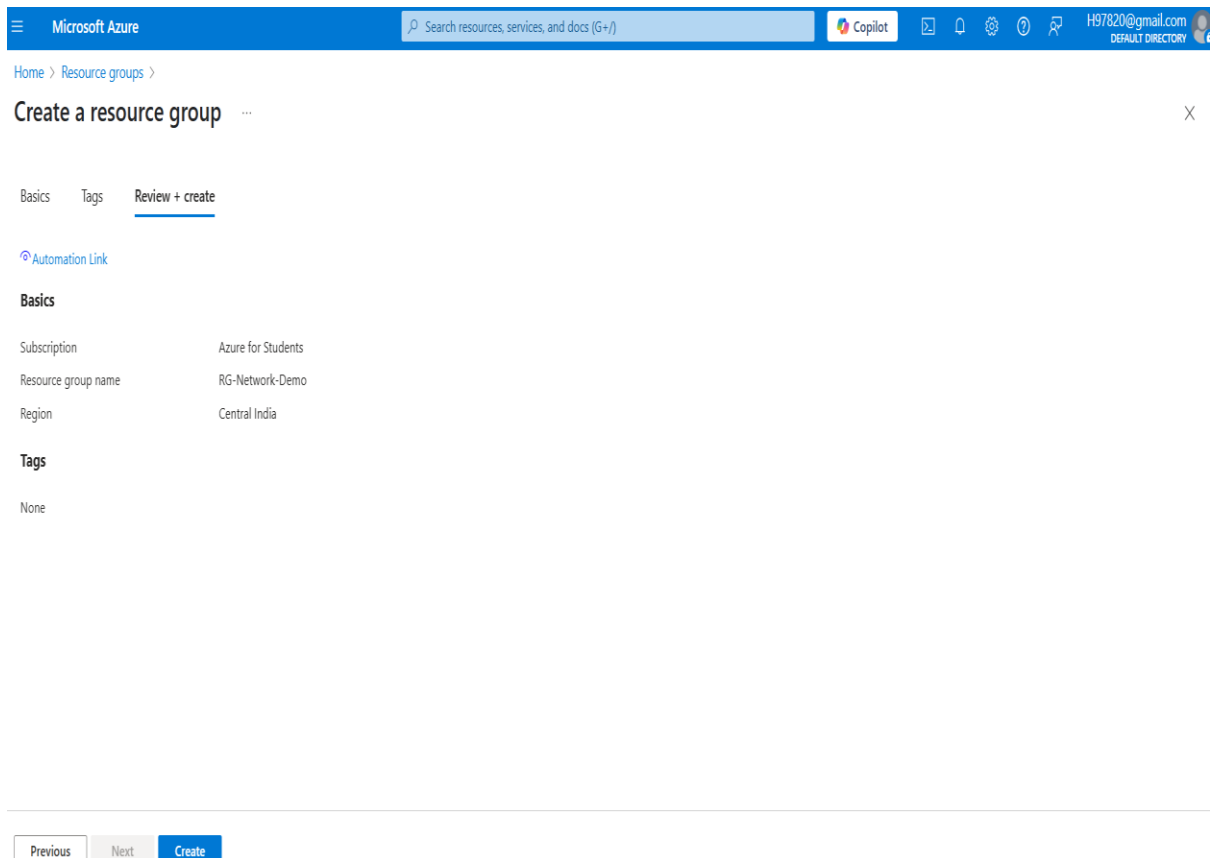
- Active Azure Subscription
- Resource Group created
- Understanding of IP/CIDR ranges
- Azure Portal access
- Basic networking knowledge (IP, ping, routing)
- Admin credentials for deploying VMs

## 6. Use Case: Deploying VNets, Subnets, VMs, and Peering

**Objective:** Create a virtual network setup with multiple subnets, deploy Windows and Linux VMs in separate subnets, test connectivity, and peer two VNets to demonstrate cross-network communication.

### 6.1 Step 1: Create Resource Group

- Azure Portal → Search "Resource groups"
- Click + Create
- Resource Group Name: RG-Network-Demo
- Region: Central India
- Click Review + Create → Create



The screenshot shows the 'Create a resource group' page in the Azure Portal, specifically the 'Review + create' tab. The page header includes the Microsoft Azure logo, a search bar, and user information (H97820@gmail.com). The breadcrumb trail is 'Home > Resource groups >'. The page title is 'Create a resource group'. Below the title, there are tabs for 'Basics', 'Tags', and 'Review + create', with 'Review + create' being the active tab. An 'Automation Link' is visible. Under the 'Basics' section, the following details are shown: Subscription (Azure for Students), Resource group name (RG-Network-Demo), and Region (Central India). Under the 'Tags' section, the value is 'None'. At the bottom, there are three buttons: 'Previous', 'Next', and 'Create'.

Basics	
Subscription	Azure for Students
Resource group name	RG-Network-Demo
Region	Central India

Tags	
Tags	None

Previous Next Create

## 6.2 Step 2: Create First VNet and Subnets

- Azure Portal → "Virtual Networks" → + Create
- Name: VNet-Demo1
- Region: Central India
- Address space: 10.1.0.0/16
- Add Subnet 1: Subnet-Win → 10.1.1.0/24
- Add Subnet 2: Subnet-Linux → 10.1.2.0/24
- Click Review + Create → Create

The screenshot displays the Microsoft Azure portal interface. At the top, the navigation bar includes the Microsoft Azure logo, a search bar, and user information. The main content area shows the 'VNet-Demo1-1749920725181' deployment overview. A green checkmark indicates that the deployment is complete. Below this, deployment details are listed, including the deployment name, subscription, resource group, start time, and correlation ID. A 'Go to resource' button is visible. The left sidebar contains navigation links for Overview, Inputs, Outputs, and Template. The right sidebar features recommendations for Cost management, Microsoft Defender for Cloud, and Free Microsoft tutorials. At the bottom left, a note mentions adding or removing favorites by pressing Ctrl+Shift+F.

Microsoft Azure

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VNet-Demo1-1749920725181 | Overview

Deployment

Search

Delete Cancel Redeploy Download Refresh

Overview

Inputs

Outputs

Template

✓ Your deployment is complete

Deployment name : VNet-Demo1-1749920725181

Subscription : Azure for Students

Resource group : RG-Network-Demo

Start time : 6/14/2025, 10:36:27 PM

Correlation ID : 7b6a16d7-b5a3-402a-abe6-f5112362fdd9

> Deployment details

✓ Next steps

Go to resource

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## 6.3 Step 3: Deploy Windows VM

- Azure Portal → "Virtual Machines" → + Create
- Name: WinVM
- Image: Windows Server 2022
- Region: Central India
- VNet: VNet-Demo1, Subnet: Subnet-Win
- Public IP: Enabled
- Inbound port: Allow RDP (3389)
- Set admin credentials
- Availability Zone: Set to Zone 2 if Zone 1 is not available
- Click Review + Create → Create

The screenshot shows the Microsoft Azure portal interface. At the top, there's a navigation bar with the Microsoft Azure logo, a search bar, and user information. Below the navigation bar, the main content area displays the deployment progress for a resource named "CreateVm-MicrosoftWindowsServer.WindowsServer-202-20250614225322". The deployment is in progress, as indicated by the "Deployment is in progress" status. The deployment details table shows the following resources and their statuses:

Resource	Type	Status	Operation details
WinVM	Microsoft.Compute/virtualMachines	Created	<a href="#">Operation details</a>
winvm187_z2	Microsoft.Network/networkInterfa...	Created	<a href="#">Operation details</a>
WinVM-nsg	Microsoft.Network/networkSecuri...	OK	<a href="#">Operation details</a>
WinVM-ip	Microsoft.Network/publicIpAddre...	OK	<a href="#">Operation details</a>

On the right side of the deployment details, there are several informational panels: "Microsoft Defender for Cloud" (Secure your apps and infrastructure), "Free Microsoft tutorials" (Start learning today >), and "Work with an expert" (Find an Azure expert >).



## 6.4 Step 4: Deploy Linux VM

- Name: LinuxVM
- Image: Ubuntu 22.04 LTS
- Region: Central India
- VNet: VNet-Demo1, Subnet: Subnet-Linux
- Public IP: Enabled
- Inbound port: Allow SSH (22)
- Use SSH key or password
- Availability Zone: Set to Zone 2
- Click Review + Create → Create

The screenshot displays the Microsoft Azure portal interface. At the top, the navigation bar includes the 'Microsoft Azure' logo, a search bar, and user information for 'H97820@gmail.com'. The main content area shows a deployment overview for 'CreateVm-MicrosoftWindowsServer.WindowsServer-202-20250614225322'. A green checkmark indicates 'Your deployment is complete'. Below this, deployment details are listed: 'Deployment name: CreateVm-MicrosoftWindowsServer.WindowsSe...', 'Subscription: Azure for Students', and 'Resource group: RG-Network-Demo'. The 'Next steps' section includes links for 'Setup auto-shutdown', 'Monitor VM health, performance and network dependencies', and 'Run a script inside the virtual machine'. On the right sidebar, there are links for 'Cost Management', 'Microsoft Defender for Cloud', 'Free Microsoft tutorials', and 'Work with an expert'. The footer contains a note about adding or removing favorites.

portal.azure.com/?Microsoft\_Azure\_Education\_correlationId=51ca535b-b62e-4b09-be00-3c521db4e0a08Microsoft\_Azure\_Education\_newA4E=true&Microsoft\_Azure\_Education\_asoSubGuid=...

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Deployment

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Overview

Inputs

Outputs

Template

✓ Your deployment is complete

Deployment name: CreateVm-MicrosoftWindowsServer.WindowsSe... Start time: 6/14/2025, 10:59:18 PM

Subscription: Azure for Students Correlation ID: 864ef413-7774-4750-aea4-6128a29b6572

Resource group: RG-Network-Demo

Deployment details

Next steps

Setup auto-shutdown Recommended

Monitor VM health, performance and network dependencies Recommended

Run a script inside the virtual machine Recommended

Go to resource Create another VM

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## 6.5 Step 5: Enable Ping (ICMP) Between VMs

- Go to NSG linked with each VM NIC or subnet
- Add Inbound Rule:
  - Source: Any
  - Protocol: ICMP
  - Action: Allow
  - Priority: 100
  - Name: AllowPing
- Connect to VMs:
  - RDP into WinVM → Open Command Prompt → ping <LinuxVM Private IP>
  - SSH into LinuxVM → Run ping <WinVM Private IP>

If replies are received, VMs can communicate.

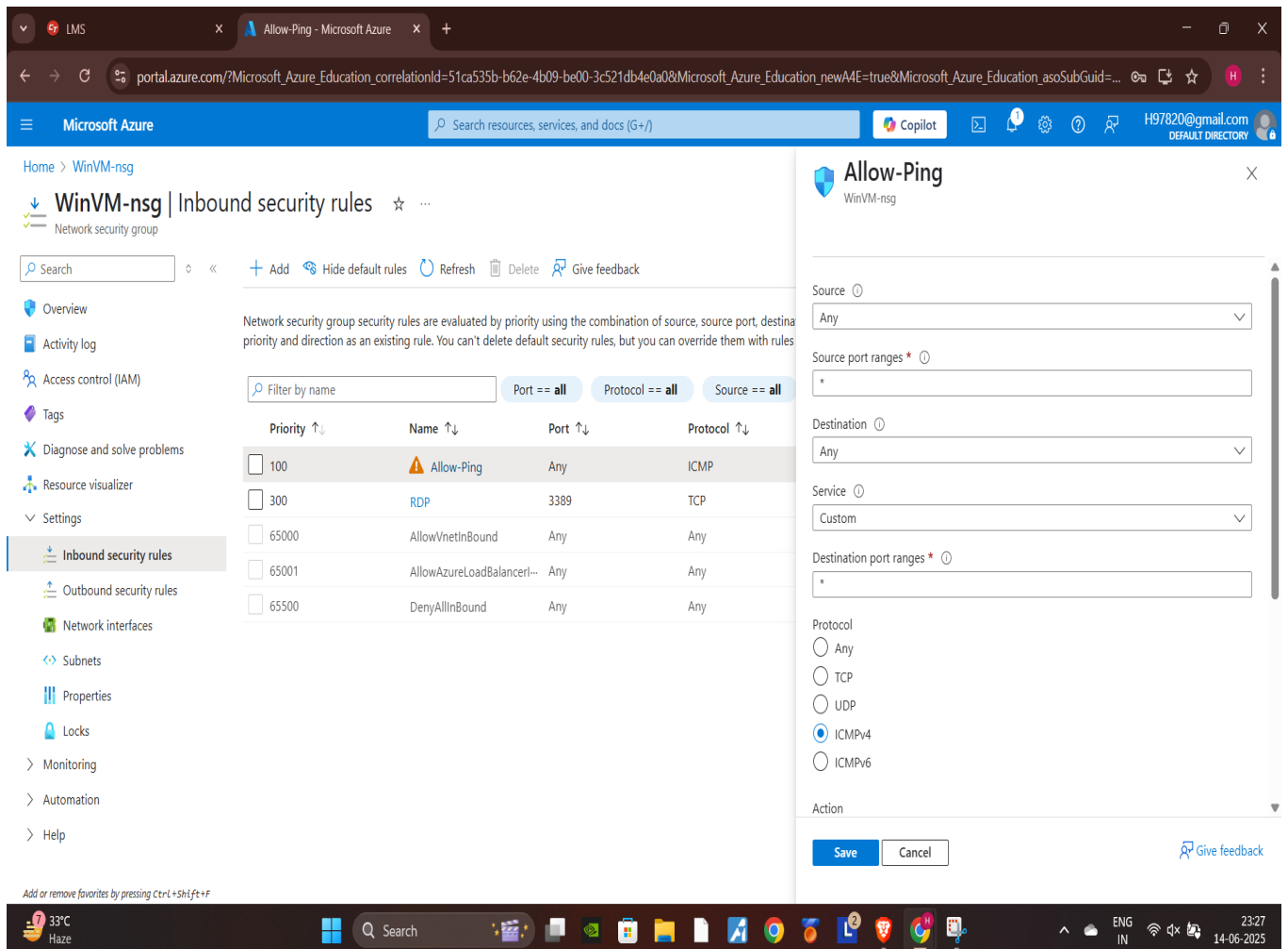
The screenshot shows the Microsoft Azure portal interface. The browser address bar displays a URL from portal.azure.com. The page title is 'winvm187\_z2' under the 'Network Interface' section. The left sidebar contains navigation links: Overview, Activity log, Access control (IAM), Tags, Resource visualizer, Settings, Monitoring, Automation, and Help. The main content area is divided into 'Essentials' and 'Properties' tabs. The 'Essentials' tab is active, showing a table of configuration details:

Property	Value
Resource group	RG-Network-Demo
Location	Central India
Subscription	Azure for Students
Subscription ID	569991b8-df2c-4e5e-a23a-753c630a3795
Accelerated networking	Enabled
Virtual network/subnet	VNet-Demo1/Subnet-Windows
Tags	Add tags
Private IPv4 address	10.0.1.4
Public IPv4 address	20.193.154.79 (WinVM-ip)
Private IPv6 address	-
Public IPv6 address	-
Attached to	WinVM (Virtual machine) WinVM-nsg (Network security group)
Type	Regular

Below the table, there is a 'Get started' section with the heading 'Enable Azure resources to communicate with each other'. It includes a sub-heading 'A network interface allows Azure resources to communicate with the internet, and on-premises resources.' and a 'Learn more' link. At the bottom, there are three cards: 'Configure your IPs', 'Choose DNS server', and 'Select network security group'.

## 6.6 Step 6: Create Second VNet (VNet-Demo2)

- Go to "Virtual Networks" → + Create
- Name: VNet-Demo2
- Region: Central India (or another)
- Address space: 10.2.0.0/16
- Subnet: Subnet-Peer → 10.2.1.0/24
- Click Review + Create → Create



The screenshot displays the Microsoft Azure portal interface. The main content area shows the 'WinVM-nsg' inbound security rules configuration. The 'Allow-Ping' rule is selected, and its configuration is shown in a pane on the right. The rule is configured to allow ICMP traffic from any source to any destination. The configuration pane on the right shows the following settings:

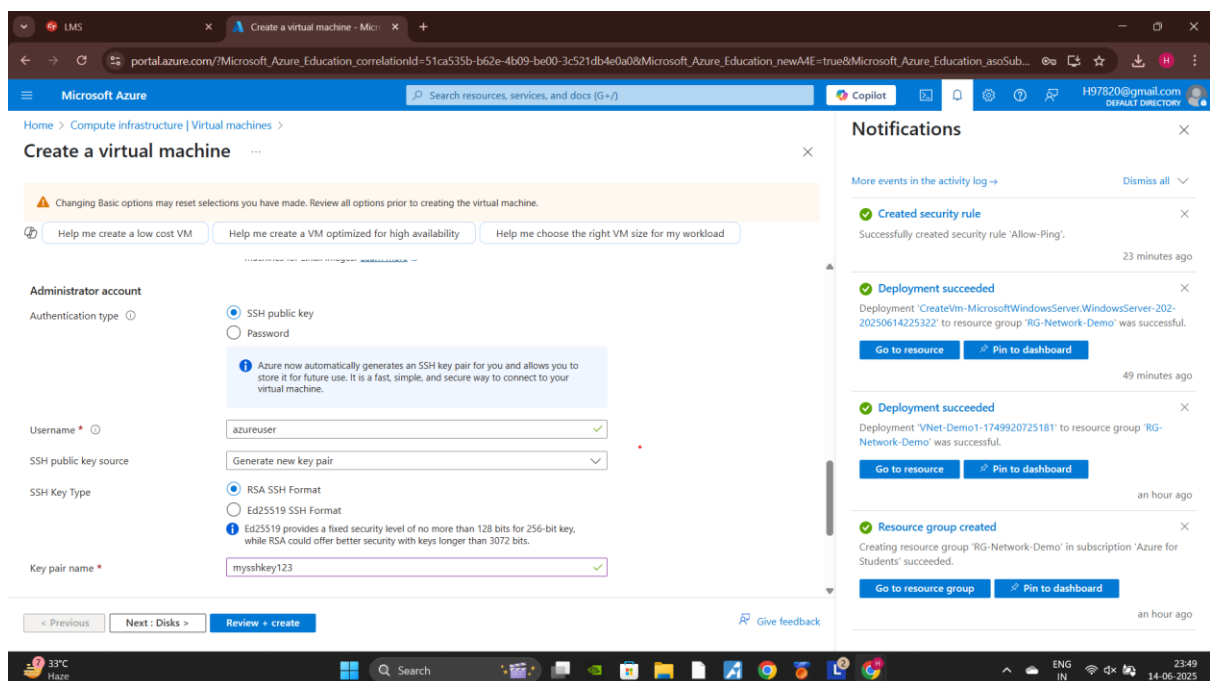
- Source: Any
- Source port ranges: \*
- Destination: Any
- Service: Custom
- Destination port ranges: \*
- Protocol: ICMPv4
- Action: Save/Cancel

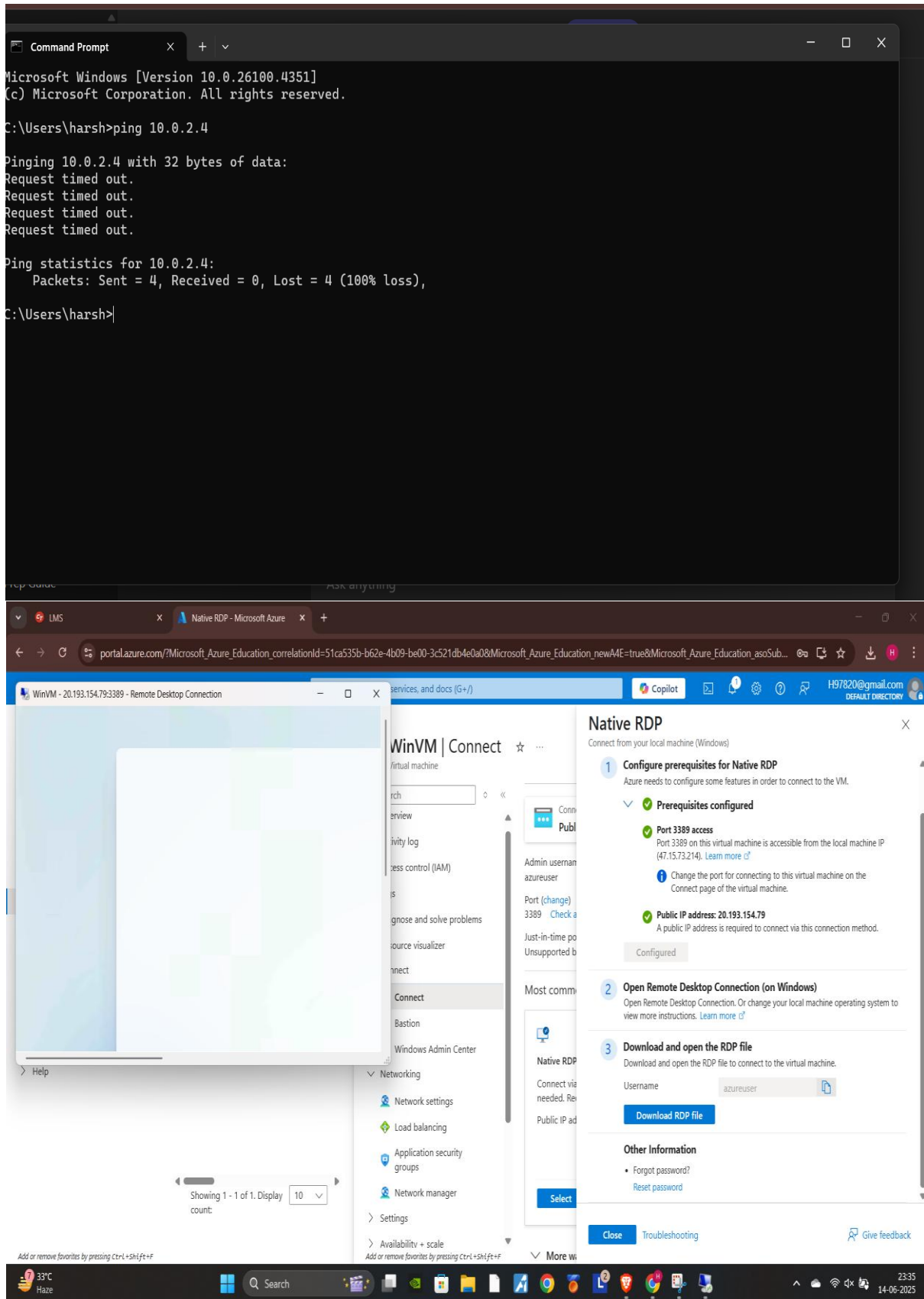
The left sidebar shows the navigation menu with options like Overview, Activity log, Access control (IAM), Tags, Diagnose and solve problems, Resource visualizer, Settings, Inbound security rules, Outbound security rules, Network interfaces, Subnets, Properties, Locks, Monitoring, Automation, and Help.

## 6.7 Step 7: VNet Peering Between VNet-Demo1 and VNet-Demo2

1. Go to VNet-Demo1 → Peerings → + Add
  - Name: peer-to-VNet2
  - Remote VNet: VNet-Demo2
  - Allow traffic in both directions: Yes
2. Go to VNet-Demo2 → Peerings → + Add
  - Name: peer-to-VNet1
  - Remote VNet: VNet-Demo1
  - Allow traffic in both directions: Yes

VMs in both VNets can now communicate via private IPs (check ICMP rules in NSGs).





## 8. Conclusion

This document demonstrates the step-by-step process of:

- Defining CIDR ranges in VNets and Subnets
- Creating logically segmented subnets
- Deploying Windows and Linux VMs
- Enabling communication within a VNet
- Establishing secure VNet Peering across networks

The implementation ensures secure and scalable network communication architecture on Azure.

## 9. Extended R&D: CIDR and Peering Concepts in Practice

- CIDR is essential for efficient IP allocation in cloud networking. Larger CIDR blocks (e.g., /16) are allocated to VNets to allow further subnetting as needs grow.
  - Subnetting strategies differ for production vs. dev/test environments.
  - Peering reduces the need for VPN gateways when VNets are within the same tenant.
  - Azure recommends peering instead of routing through a hub VNet unless using NVAs (network virtual appliances).
  - IP overlap issues are common in large environments—always design IP plans before creating VNets.
-