Instituto Politécnico Nacional

Escuela Superior de Computo

Sistemas Distribuidos

Tarea 10

Seguridad perimetral mediante Firewall

Nombre del alumno:

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Grupo: 7CV4

Nombre del profesor: Guerrero Carlos Pineda

Fecha de entrega: 21/12/2025

ÍNDICE

1 Introducción

En esta práctica de la materia de Sistemas Distribuidos implementaremos seguridad perimetral en Azure utilizando Azure Firewall. El objetivo es controlar y observar el flujo de tráfico desde y hacia una red virtual, aplicando reglas de traducción de direcciones (DNAT), reglas de red basadas en IP y reglas de aplicación basadas en FQDN. Trabajaremos en la suscripción Azure for Students, usando la región Canada Central y siguiendo estrictamente la nomenclatura requerida con la boleta 2022630278.

Para acelerar y asegurar la coherencia del desarrollo, se utilizó la IA de GitHub Copilot como apoyo para estructurar los pasos, generar comandos de Azure CLI y organizar el contenido del reporte. Copilot se empleó como asistente de referencia; todas las acciones y validaciones fueron realizadas por el alumno en el portal de Azure y/o CLI, conforme a las indicaciones del profesor y los lineamientos del curso.

La práctica comprende la creación de una red virtual con sus subredes “default”, “AzureFirewallSubnet” y “AzureFirewallManagementSubnet”, el despliegue de un Azure Firewall con su política Básica, la creación de una máquina virtual Ubuntu sin IP pública, la configuración de reglas DNAT, de red y de aplicación, así como ajustes de seguridad en el NSG y una tabla de rutas para forzar el tráfico saliente a través del firewall. Se realizarán pruebas con ssh, dig y curl para comprobar el comportamiento esperado de las reglas.

2 Objetivos

2.1 Objetivo general

Diseñar e implementar un esquema de seguridad perimetral en Azure que canalice y filtre el tráfico de una red virtual mediante Azure Firewall (SKU Básico), demostrando control de acceso con reglas DNAT, de red y de aplicación, y validando la conectividad permitida y denegada conforme a los requisitos del profesor y los lineamientos del curso.

2.2 Objetivos específicos

- Crear una red virtual en Canada Central con las subredes “default”, “AzureFirewallSubnet” y “AzureFirewallManagementSubnet”, usando el espacio de direcciones indicado.
- Desplegar un Azure Firewall (SKU Básico) con una política de firewall de nivel Básico, asociándolo a la VNet y configurando IPs públicas requeridas.
- Implementar una máquina virtual Ubuntu sin IP pública en la subred “default”, con autenticación por contraseña y registro de su IP privada.
- Ajustar la seguridad mediante NSG: denegar entradas y bloquear la salida hacia “Internet”, dejando el control perimetral al firewall.
- Configurar una tabla de rutas para que el tráfico saliente de la subred “default” pase por el firewall (virtual appliance).
- Crear una regla DNAT para permitir acceso SSH a la VM a través de la IP pública del firewall y verificar conectividad.
- Establecer una regla de red que permita tráfico HTTPS (443) desde la subred “default” únicamente hacia la IP de www.m4gm.com, y validar que otros destinos (ej. google.com) sean bloqueados.
- Sustituir la regla de red por una regla de aplicación que permita HTTP/HTTPS hacia los FQDNs youtube.com y www.youtube.com, y comprobar que dominios no configurados permanezcan bloqueados.

3 Requisitos y lineamientos

Para la realización del reporte de la Tarea 10 se siguieron los lineamientos del curso y se establecieron requisitos técnicos mínimos. Se accedió al portal de Azure con una suscripción Azure for Students, se seleccionó la región Canada Central y se configuró la infraestructura necesaria.

3.1 Requisitos de la práctica

Se realizó la práctica en la suscripción Azure for Students y se eligió la región Canada Central por disponibilidad y cercanía de servicios. Se instaló una máquina virtual Ubuntu sin IP pública en la subred “default”, con autenticación por contraseña, y se creó un Azure Firewall (SKU Básico) asociado a la misma red virtual. Se accedió tanto al portal de Azure como a la CLI para validar la configuración.

- Entorno de nube: Azure for Students (suscripción activa).
- Región: Canada Central.
- Imagen de VM: Ubuntu (22.04 o equivalente).
- Autenticación: contraseña (sin claves SSH).
- Red: VNet con subredes default, AzureFirewallSubnet y AzureFirewallManagementSubnet.
- Firewall: Azure Firewall SKU Básico con política de nivel Básico.
- IP pública en la VM: no se asignó (se usó DNAT del firewall para acceso SSH).

3.2 Nomenclatura

Se aplicó la nomenclatura indicada por el profesor utilizando la boleta 2022630278 en todos los recursos, asegurando consistencia y fácil identificación. La nomenclatura se respetó de forma estricta durante las creaciones de red, firewall, política, IPs públicas y máquina virtual.

- Red virtual: T10-2022630278-vnet

- Firewall: T10-2022630278-fw
- Política de firewall: T10-2022630278-df
- IP pública del firewall: T10-2022630278-ip
- IP pública de administración del firewall: T10-2022630278-ip-admin
- Máquina virtual: T10-2022630278-mv
- Colección de reglas DNAT: T10-2022630278-c-dnat
- Regla DNAT: T10-2022630278-dnat
- Colección de reglas de red: T10-2022630278-c-red
- Regla de red: T10-2022630278-red
- Colección de reglas de aplicación: T10-2022630278-c-app
- Regla de aplicación: T10-2022630278-app

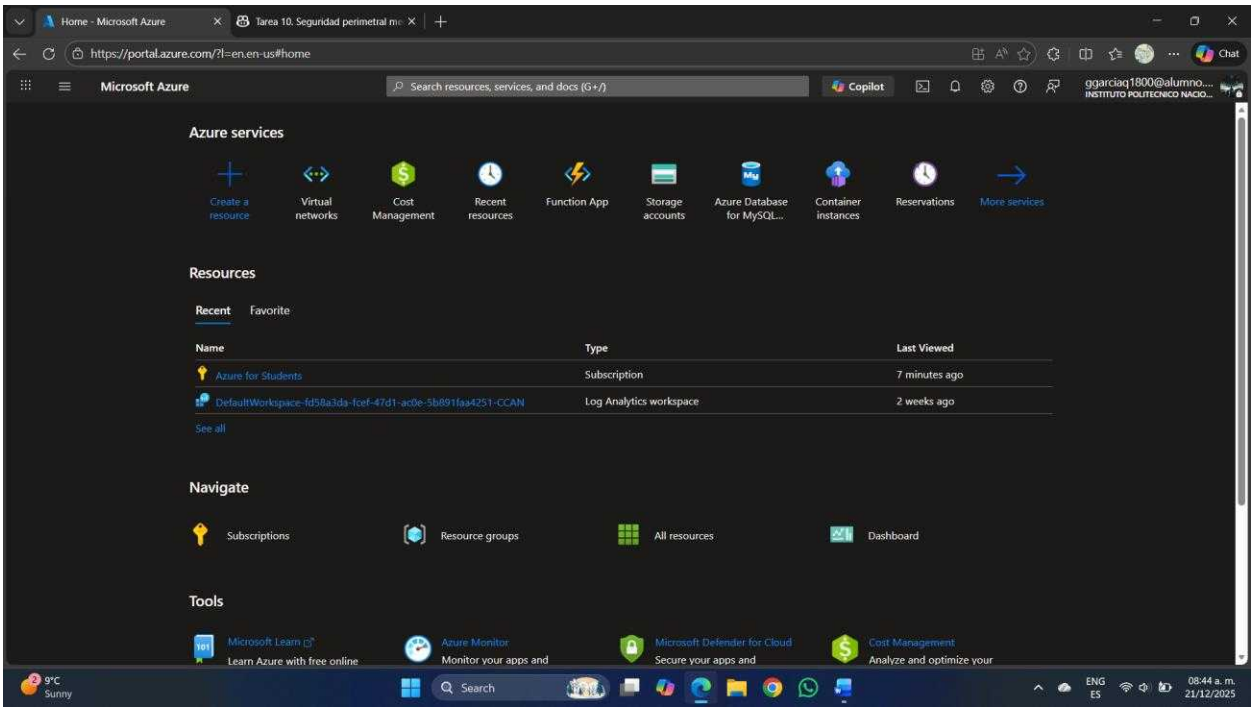
4 Desarrollo

En esta sección se describe el procedimiento completo realizado en Azure para implementar seguridad perimetral con Azure Firewall. Se accedió al portal de Azure, se creó la red virtual y subredes, se desplegó el firewall con su política, se instaló la máquina virtual Ubuntu sin IP pública, se configuraron reglas DNAT, de red y de aplicación, y se ajustaron el NSG y la tabla de rutas para forzar el tráfico saliente a través del firewall. Después de cada paso se indica la figura correspondiente para evidenciar la configuración.

4.1 Creación de la red virtual

Se accedió al portal de Azure y se realizó la creación de la red virtual en la región Canada Central con la nomenclatura indicada. Se configuró el espacio de direcciones y las subredes requeridas para el firewall y para la carga de trabajo.

- Red virtual: T10-2022630278-vnet
- Espacio de direcciones: 10.0.0.0/16
- Subred default: 10.0.0.0/24
- Subred AzureFirewallSubnet: 10.0.1.0/26
- Subred AzureFirewallManagementSubnet: 10.0.2.0/26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Subscriptions
Resource groups
All resources
Dashboard
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Microsoft Learn
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Microsoft Defender for Cloud
Secure your apps and
Cost Management
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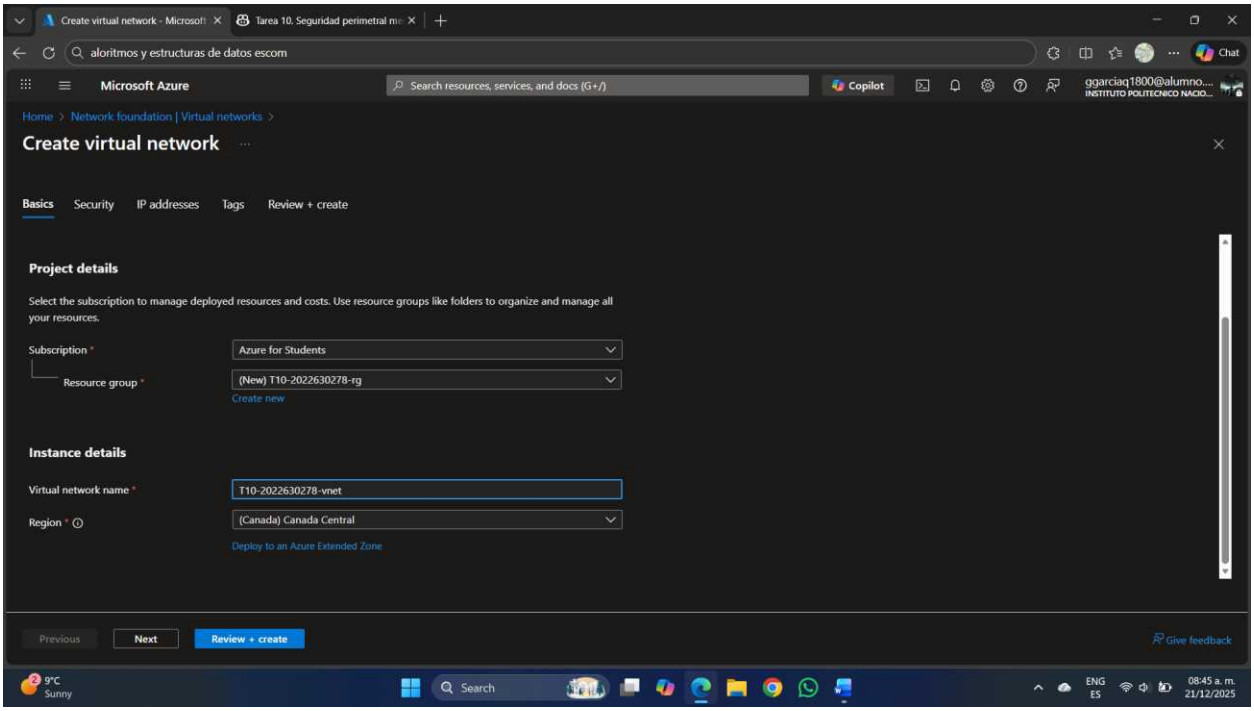
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Project details
Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.
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Azure for Students
Resource group *
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Instance details
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(Canada) Canada Central
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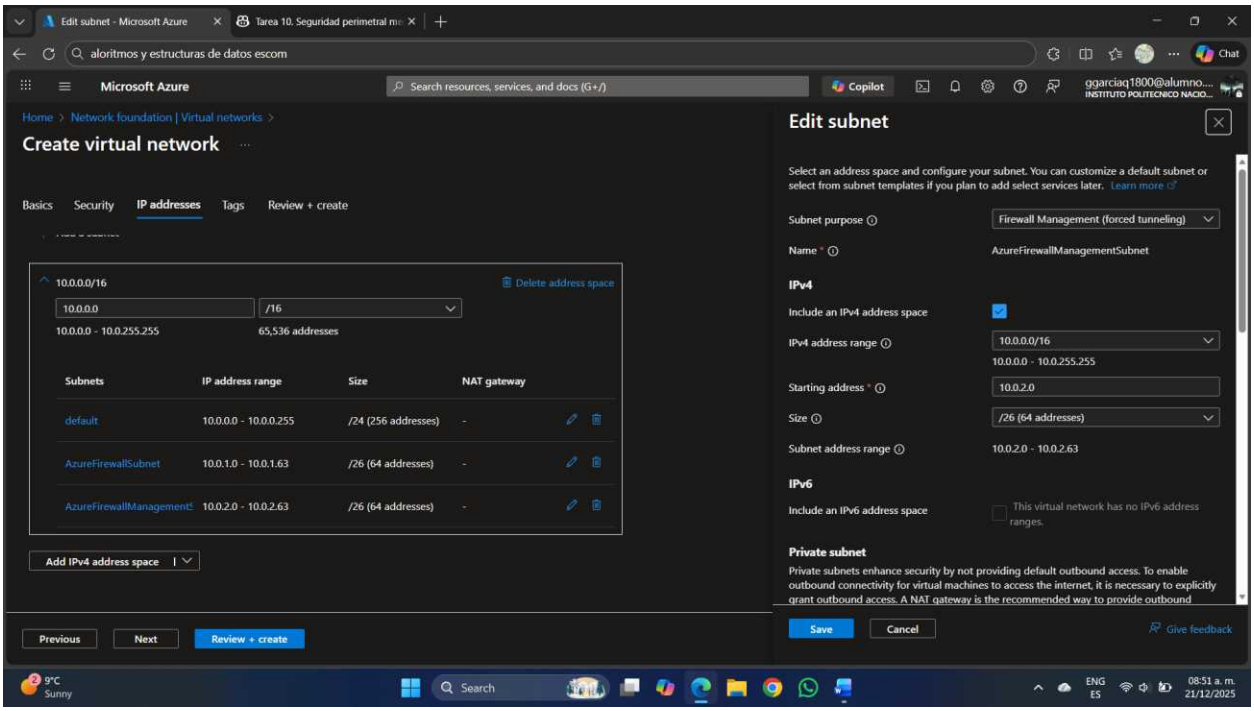
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10.0.0.0/16
Delete address space
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/16
10.0.0.0 - 10.0.255.255
65,536 addresses
Subnets
IP address range
Size
NAT gateway
default
10.0.0.0 - 10.0.0.255
/24 (256 addresses)
AzureFirewallSubnet
10.0.1.0 - 10.0.1.63
/26 (64 addresses)
AzureFirewallManagementS
10.0.2.0 - 10.0.2.63
/26 (64 addresses)
Add IPv4 address space
Previous
Next
Review + create
Edit subnet
Select an address space and configure your subnet. You can customize a default subnet or select from subnet templates if you plan to add select services later. Learn more
Subnet purpose
Firewall Management (forced tunneling)
Name *
AzureFirewallManagementSubnet
IPv4
Include an IPv4 address space
IPv4 address range
10.0.0.0/16
10.0.0.0 - 10.0.255.255
Starting address *
10.0.2.0
Size
/26 (64 addresses)
Subnet address range
10.0.2.0 - 10.0.2.63
IPv6
Include an IPv6 address space
This virtual network has no IPv6 address ranges.
Private subnet
Private subnets enhance security by not providing default outbound access. To enable outbound connectivity for virtual machines to access the internet, it is necessary to explicitly grant outbound access. A NAT gateway is the recommended way to provide outbound
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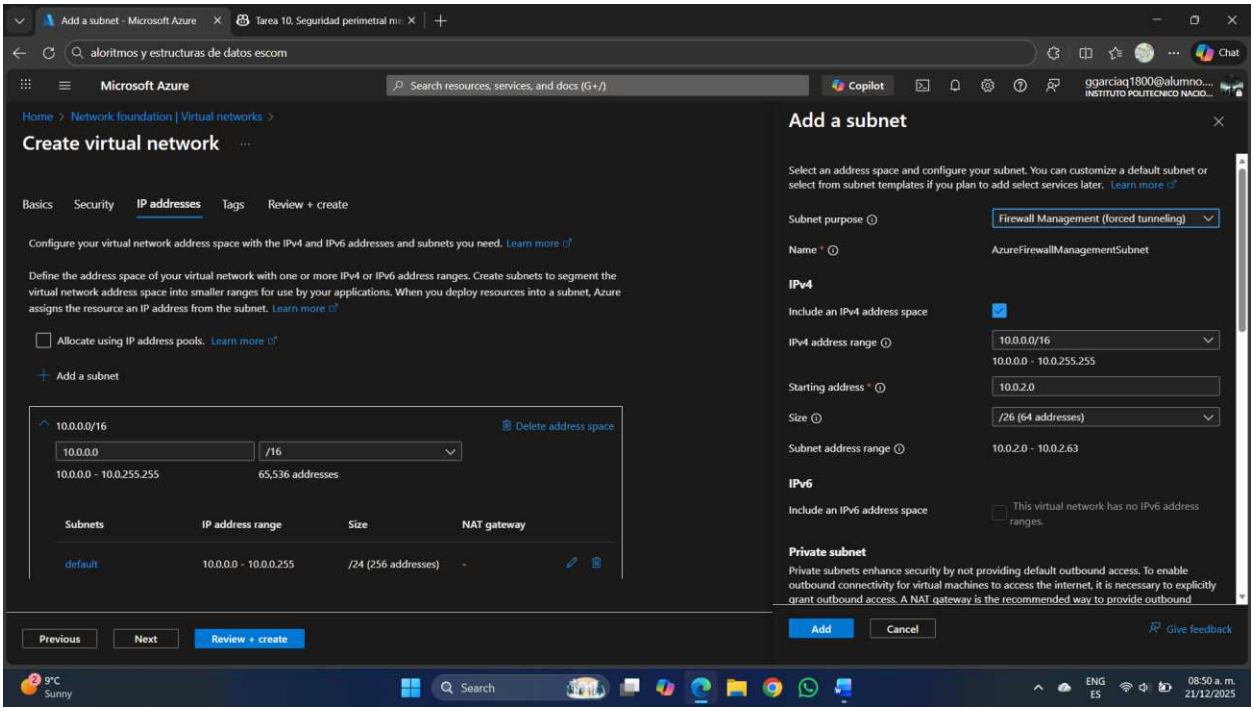
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Configure your virtual network address space with the IPv4 and IPv6 addresses and subnets you need. Learn more
Define the address space of your virtual network with one or more IPv4 or IPv6 address ranges. Create subnets to segment the virtual network address space into smaller ranges for use by your applications. When you deploy resources into a subnet, Azure assigns the resource an IP address from the subnet. Learn more
Allocate using IP address pools. Learn more
Add a subnet
10.0.0.0/16
Delete address space
10.0.0.0
/16
10.0.0.0 - 10.0.255.255
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Subnets
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NAT gateway
default
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Select an address space and configure your subnet. You can customize a default subnet or select from subnet templates if you plan to add select services later. Learn more
Subnet purpose
Firewall Management (forced tunneling)
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AzureFirewallManagementSubnet
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Include an IPv4 address space
IPv4 address range
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Starting address *
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Size
/26 (64 addresses)
Subnet address range
10.0.2.0 - 10.0.2.63
IPv6
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This virtual network has no IPv6 address ranges.
Private subnet
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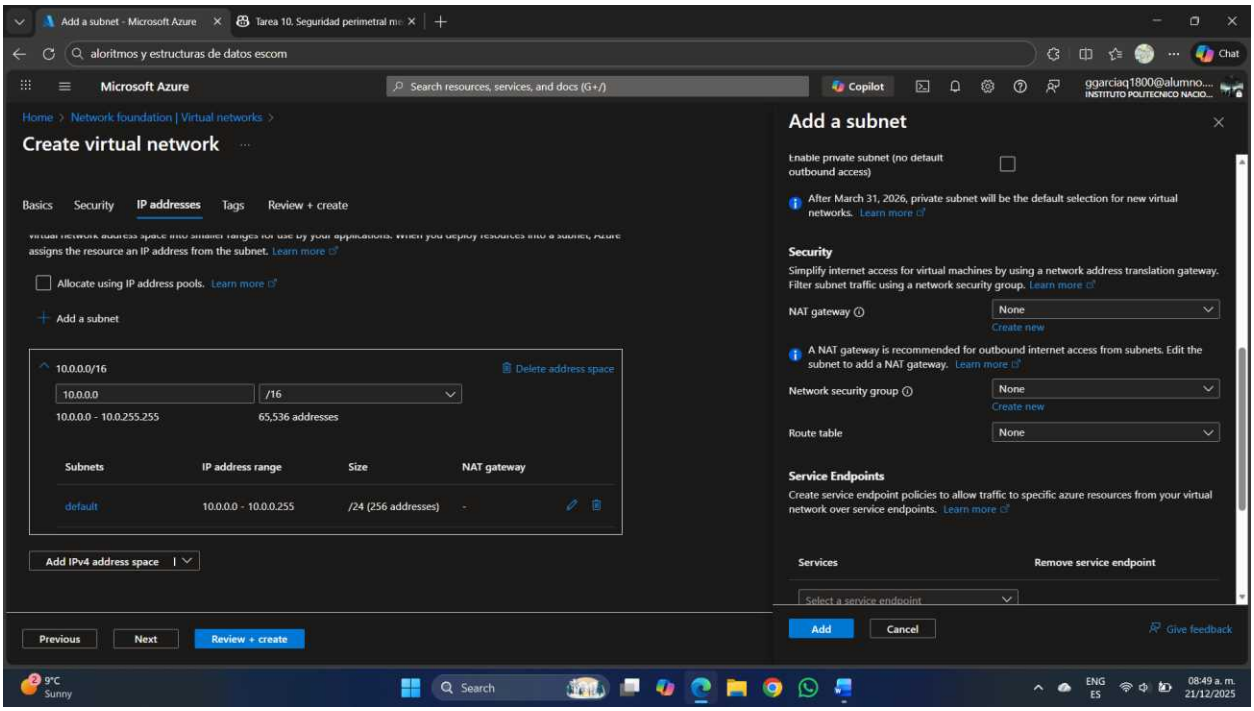
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assigns the resource an IP address from the subnet. Learn more
Allocate using IP address pools. Learn more
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10.0.0.0
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10.0.0.0 - 10.0.255.255
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IP address range
Size
NAT gateway
default
10.0.0.0 - 10.0.0.255
/24 (256 addresses)
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Add IPv4 address space
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Add a subnet
Enable private subnet (no default outbound access)
After March 31, 2026, private subnet will be the default selection for new virtual networks. Learn more
Security
Simplify internet access for virtual machines by using a network address translation gateway. Filter subnet traffic using a network security group. Learn more
NAT gateway
None
Create new
A NAT gateway is recommended for outbound internet access from subnets. Edit the subnet to add a NAT gateway. Learn more
Network security group
None
Create new
Route table
None
Service Endpoints
Create service endpoint policies to allow traffic to specific azure resources from your virtual network over service endpoints. Learn more
Services
Remove service endpoint
Select a service endpoint
Add
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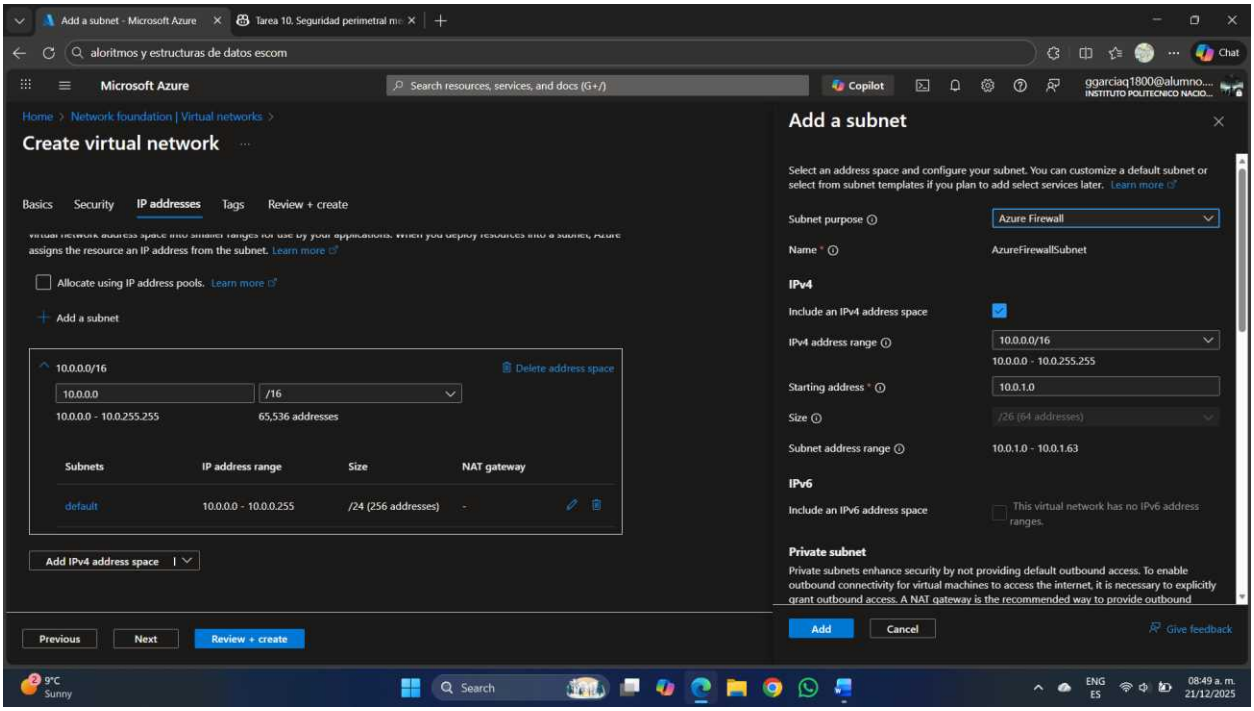
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Add a subnet
Select an address space and configure your subnet. You can customize a default subnet or select from subnet templates if you plan to add select services later. Learn more
Subnet purpose
Azure Firewall
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AzureFirewallSubnet
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Include an IPv4 address space
IPv4 address range
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Starting address *
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Size
/26 (64 addresses)
Subnet address range
10.0.1.0 - 10.0.1.63
IPv6
Include an IPv6 address space
This virtual network has no IPv6 address ranges.
Private subnet
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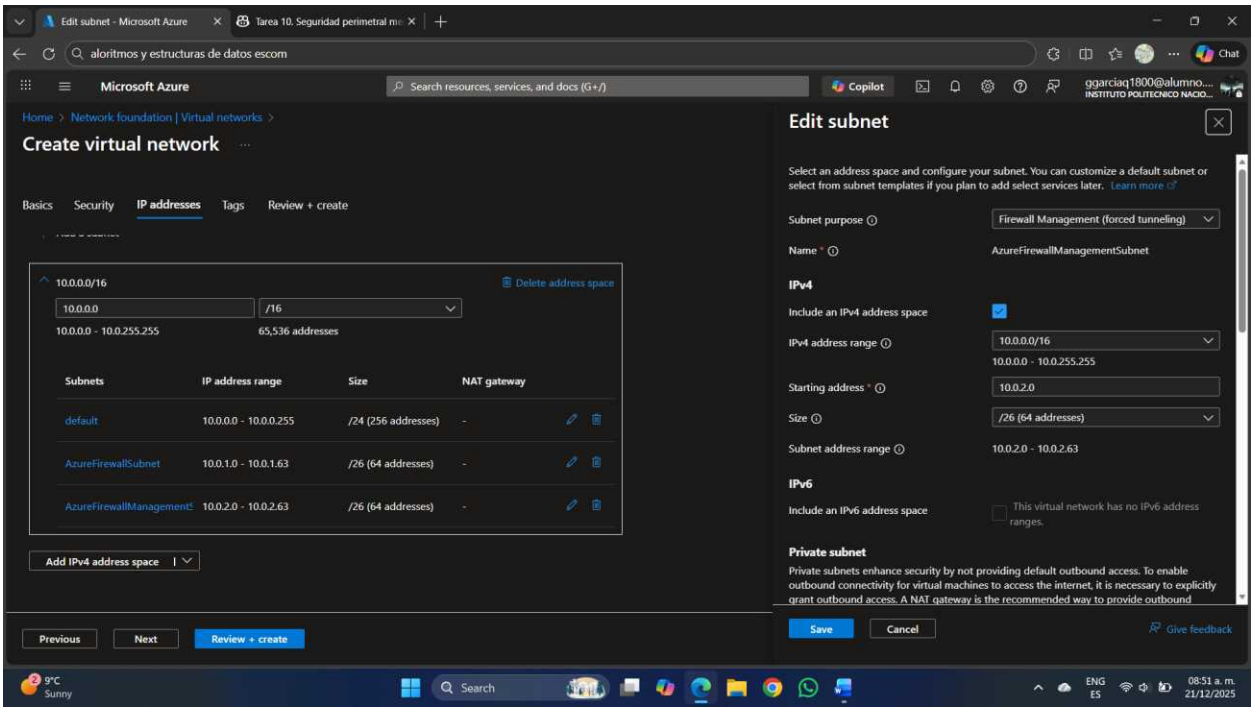
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Subnet purpose
Firewall Management (forced tunneling)
Name *
AzureFirewallManagementSubnet
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Include an IPv4 address space
IPv4 address range
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IPv6
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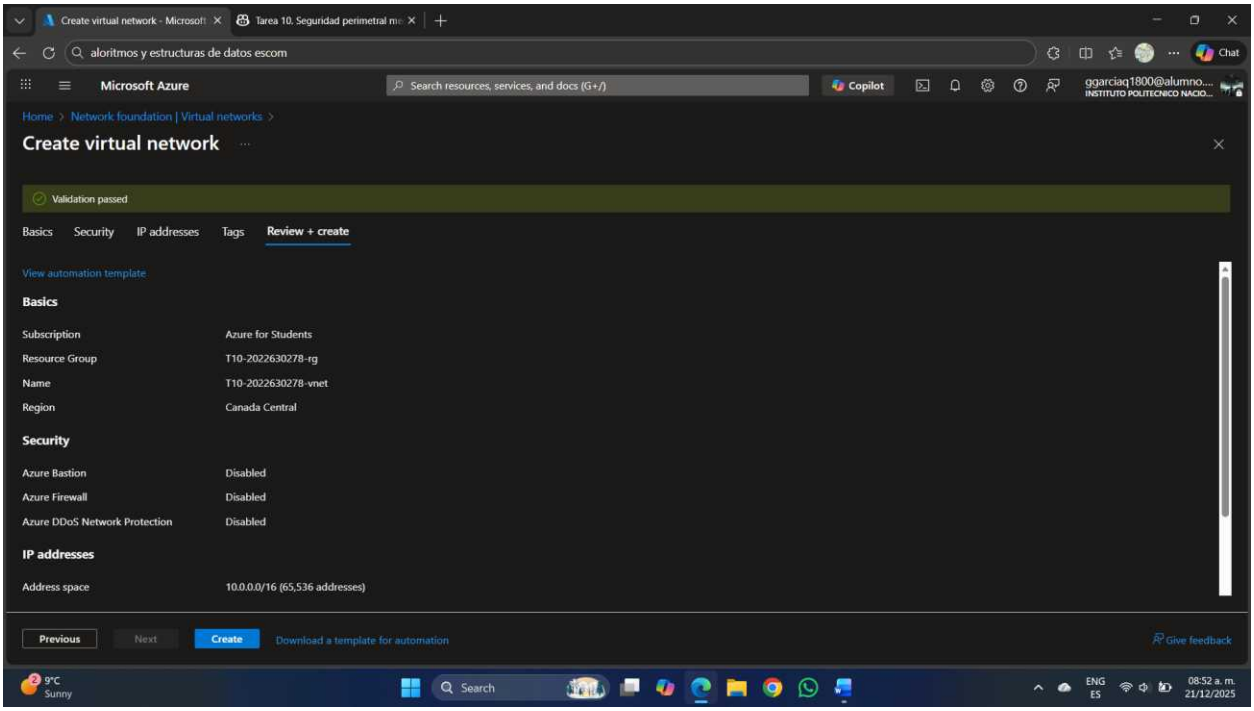
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Azure Bastion
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Azure Firewall
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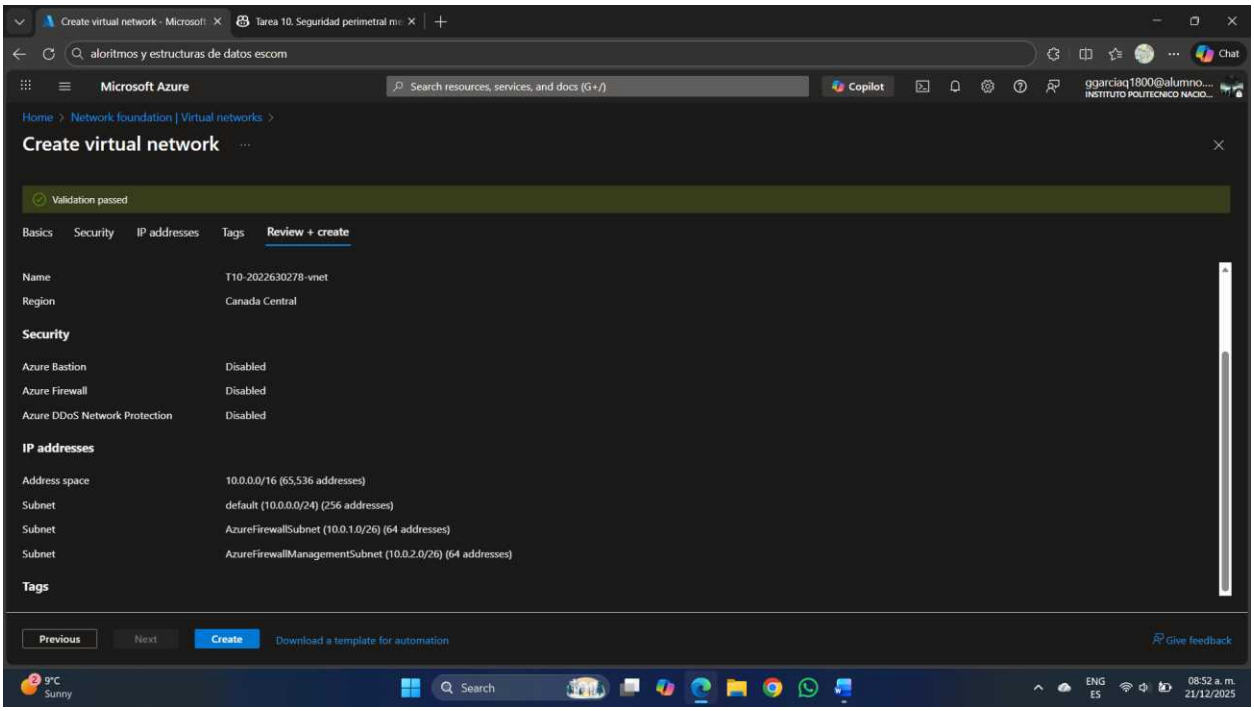
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Azure Firewall
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Azure DDoS Network Protection
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10.0.0.0/16 (65,536 addresses)
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default (10.0.0.0/24) (256 addresses)
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AzureFirewallManagementSubnet (10.0.2.0/26) (64 addresses)
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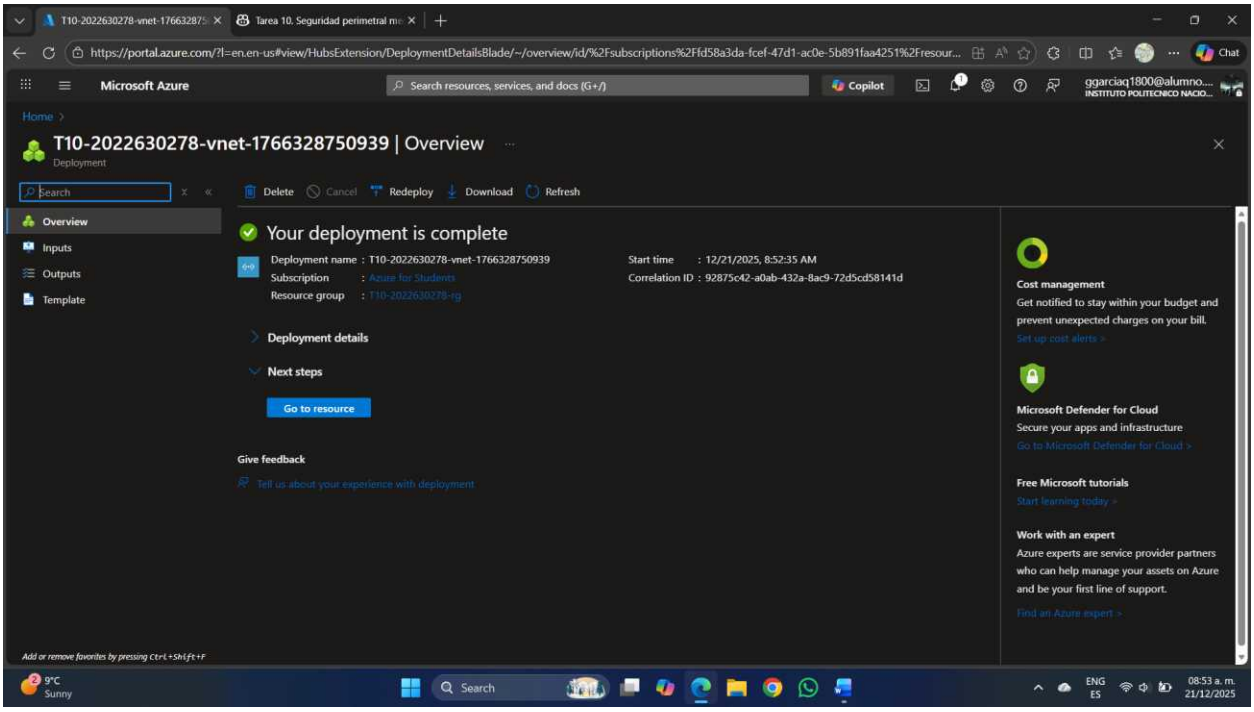
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Overview
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Outputs
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Redeploy
Download
Refresh
Your deployment is complete
Deployment name : T10-2022630278-vnet-1766328750939
Subscription : Azure for Students
Resource group : T10-2022630278-rg
Start time : 12/21/2025, 8:52:35 AM
Correlation ID : 92875c42-a0ab-432a-8ac9-72d5cd58141d
Deployment details
Next steps
Go to resource
Give feedback
Tell us about your experience with deployment
Cost management
Get notified to stay within your budget and prevent unexpected charges on your bill.
Set up cost alerts >
Microsoft Defender for Cloud
Secure your apps and infrastructure
Go to Microsoft Defender for Cloud >
Free Microsoft tutorials
Start learning today >
Work with an expert
Azure experts are service provider partners who can help manage your assets on Azure and be your first line of support.
Find an Azure expert >
Add or remove favorites by pressing Ctrl+Shift+F
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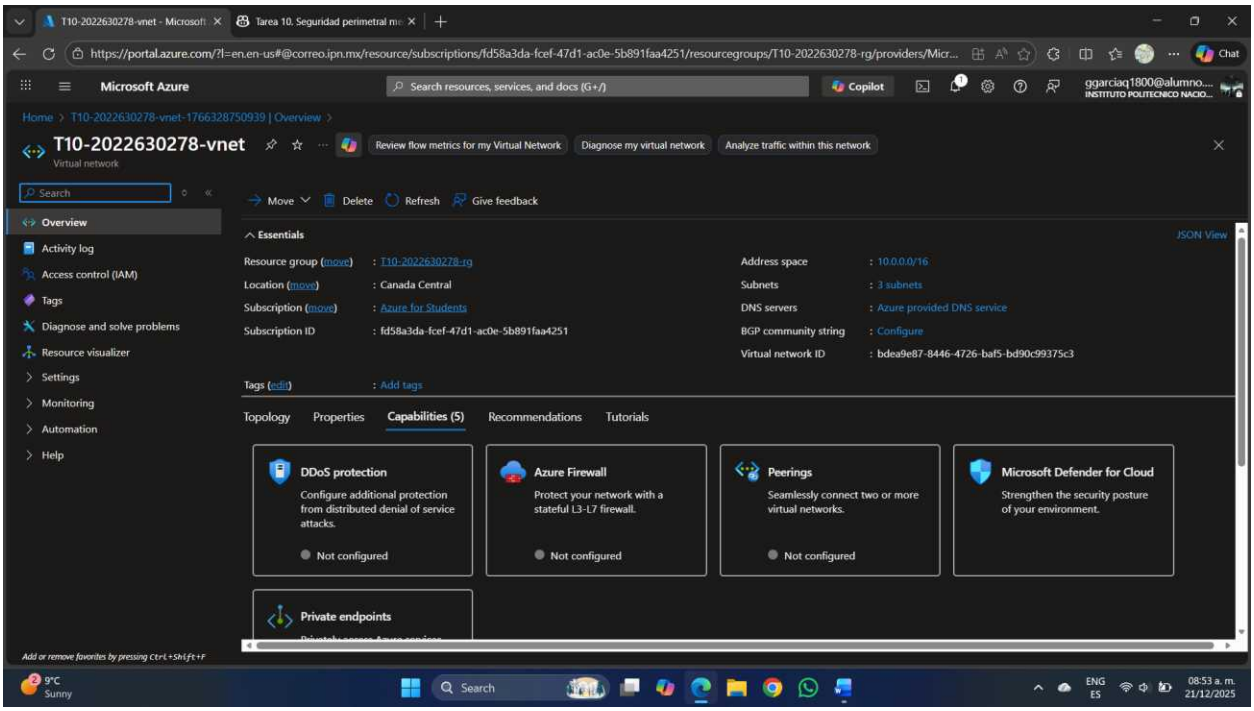
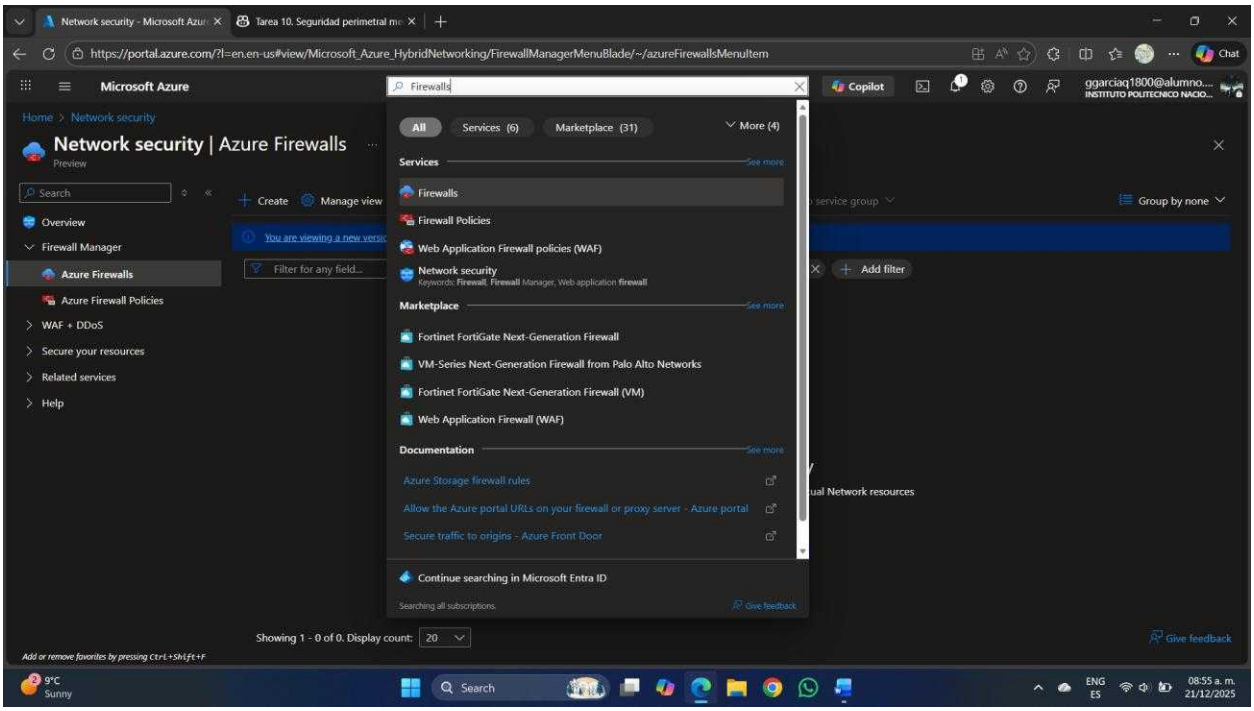


Figura 7. Creación de la red virtual y subredes en Canada Central (T10-2022630278-vnet).

4.2 Creación del Azure Firewall y su política

Se creó el recurso Azure Firewall con SKU Básico y se asoció a la red virtual previamente creada. Se realizó la creación de la política de firewall de nivel Básico, y se configuraron las IP públicas requeridas para operación y administración. Se registraron las direcciones IP pública y privada del firewall para uso posterior.

- Firewall: T10-2022630278-fw (SKU: Básico, Zona de disponibilidad: Ninguno)
- Política de firewall: T10-2022630278-df (Tier: Básico)
- IP pública del firewall: T10-2022630278-ip (SKU Standard, estática)
- IP pública de administración: T10-2022630278-ip-admin (SKU Standard, estática)
- Asociación a VNet: T10-2022630278-vnet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https://portal.azure.com/?l=en.en-us#view/Microsoft_Azure_HybridNetworking/FirewallManagerMenuBlade/~/azureFirewallsMenuItem
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Create
Manage view
Overview
Firewall Manager
Azure Firewalls
Azure Firewall Policies
WAF + DDoS
Secure your resources
Related services
Help
Filter for any field...
Group by none
Add filter
All
Services (6)
Marketplace (31)
More (4)
Services
See more
Firewalls
Firewall Policies
Web Application Firewall policies (WAF)
Network security
Keywords: Firewall, Firewall Manager, Web application firewall
Marketplace
See more
Fortinet FortiGate Next-Generation Firewall
VM-Series Next-Generation Firewall from Palo Alto Networks
Fortinet FortiGate Next-Generation Firewall (VM)
Web Application Firewall (WAF)
Documentation
See more
Azure Storage firewall rules
Allow the Azure portal URLs on your firewall or proxy server - Azure portal
Secure traffic to origins - Azure Front Door
Continue searching in Microsoft Entra ID
Searching all subscriptions.
Give feedback
Showing 1 - 0 of 0. Display count: 20
Give feedback
Add or remove favorites by pressing Ctrl+Shift+F
9°C
Sunny
Search
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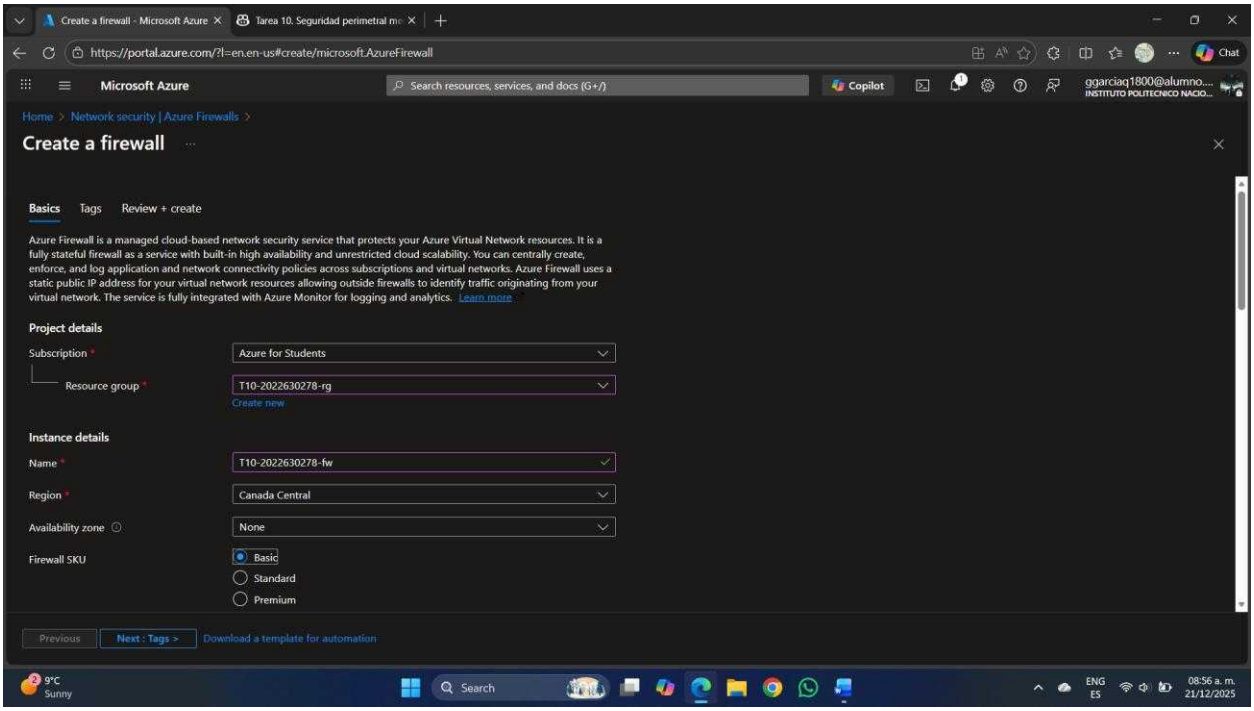
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Tags
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Azure Firewall is a managed cloud-based network security service that protects your Azure Virtual Network resources. It is a fully stateful firewall as a service with built-in high availability and unrestricted cloud scalability. You can centrally create, enforce, and log application and network connectivity policies across subscriptions and virtual networks. Azure Firewall uses a static public IP address for your virtual network resources allowing outside firewalls to identify traffic originating from your virtual network. The service is fully integrated with Azure Monitor for logging and analytics. Learn more
Project details
Subscription *
Azure for Students
Resource group *
T10-2022630278-rg
Create new
Instance details
Name *
T10-2022630278-fw
Region *
Canada Central
Availability zone
None
Firewall SKU
Basic
Standard
Premium
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Next : Tags >
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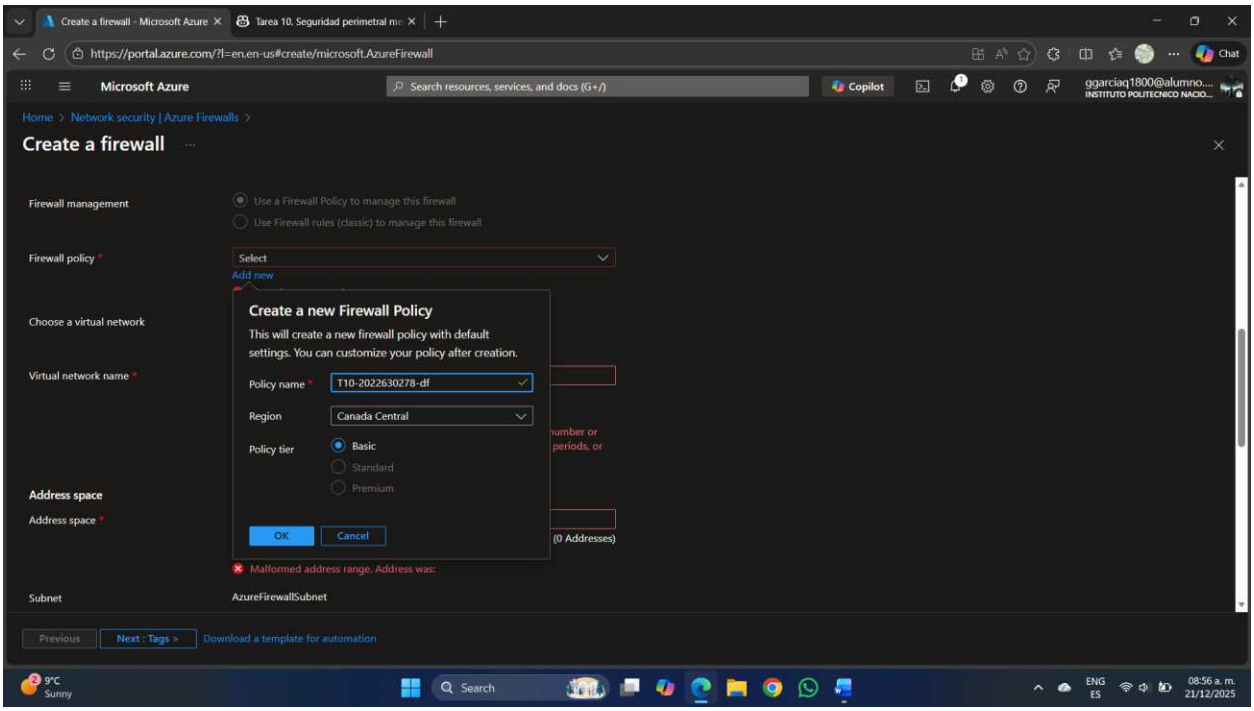
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Home > Network security | Azure Firewalls >
Create a firewall
Firewall management
Use a Firewall Policy to manage this firewall
Use Firewall rules (classic) to manage this firewall
Firewall policy *
Select
Add new
Choose a virtual network
Virtual network name *
Address space
Address space *
Subnet
AzureFirewallSubnet
Create a new Firewall Policy
This will create a new firewall policy with default settings. You can customize your policy after creation.
Policy name *
T10-2022630278-df
Region
Canada Central
Policy tier
Basic
Standard
Premium
OK
Cancel
(0 Addresses)
Malformed address range. Address was:
Previous
Next : Tags >
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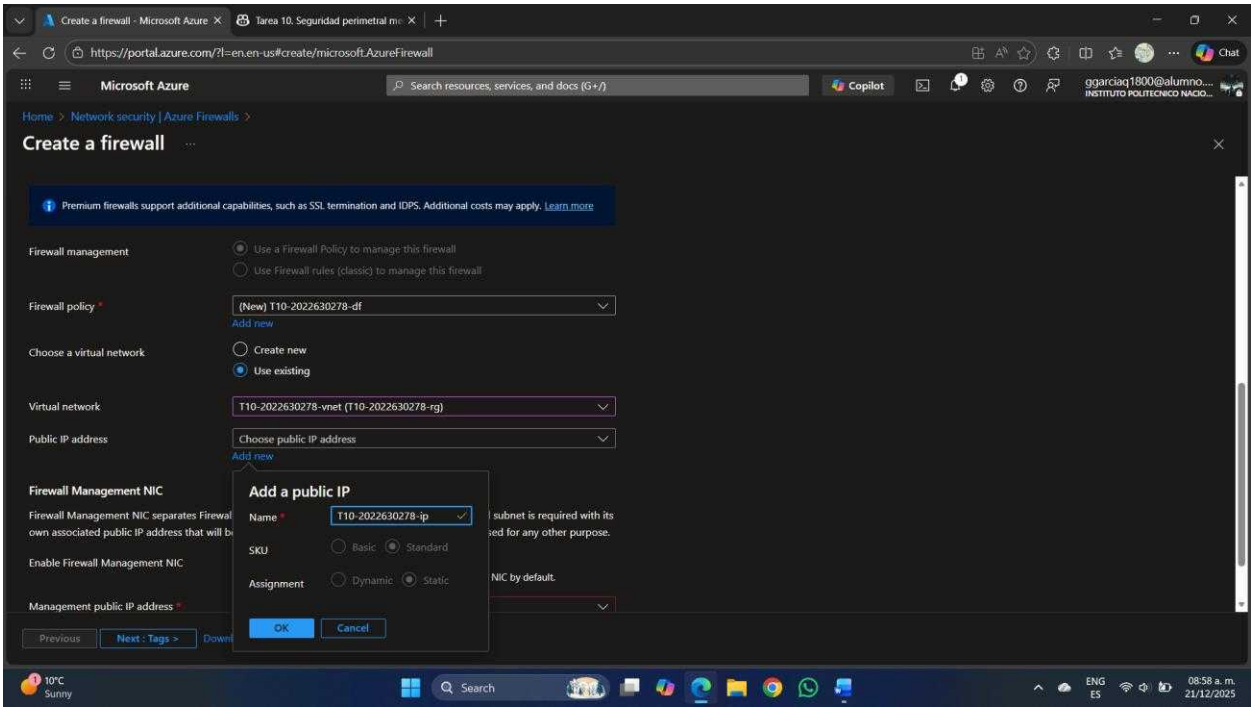
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Premium firewalls support additional capabilities, such as SSL termination and IDPS. Additional costs may apply. Learn more
Firewall management
Use a Firewall Policy to manage this firewall
Use Firewall rules (classic) to manage this firewall
Firewall policy *
(New) T10-2022630278-df
Add new
Choose a virtual network
Create new
Use existing
Virtual network
T10-2022630278-vnet (T10-2022630278-rg)
Public IP address
Choose public IP address
Add new
Firewall Management NIC
Firewall Management NIC separates Firewal
own associated public IP address that will b
Enable Firewall Management NIC
Management public IP address *
Add a public IP
Name *
T10-2022630278-ip
SKU
Basic
Standard
Assignment
Dynamic
Static
OK
Cancel
subnet is required with its
ed for any other purpose.
NIC by default.
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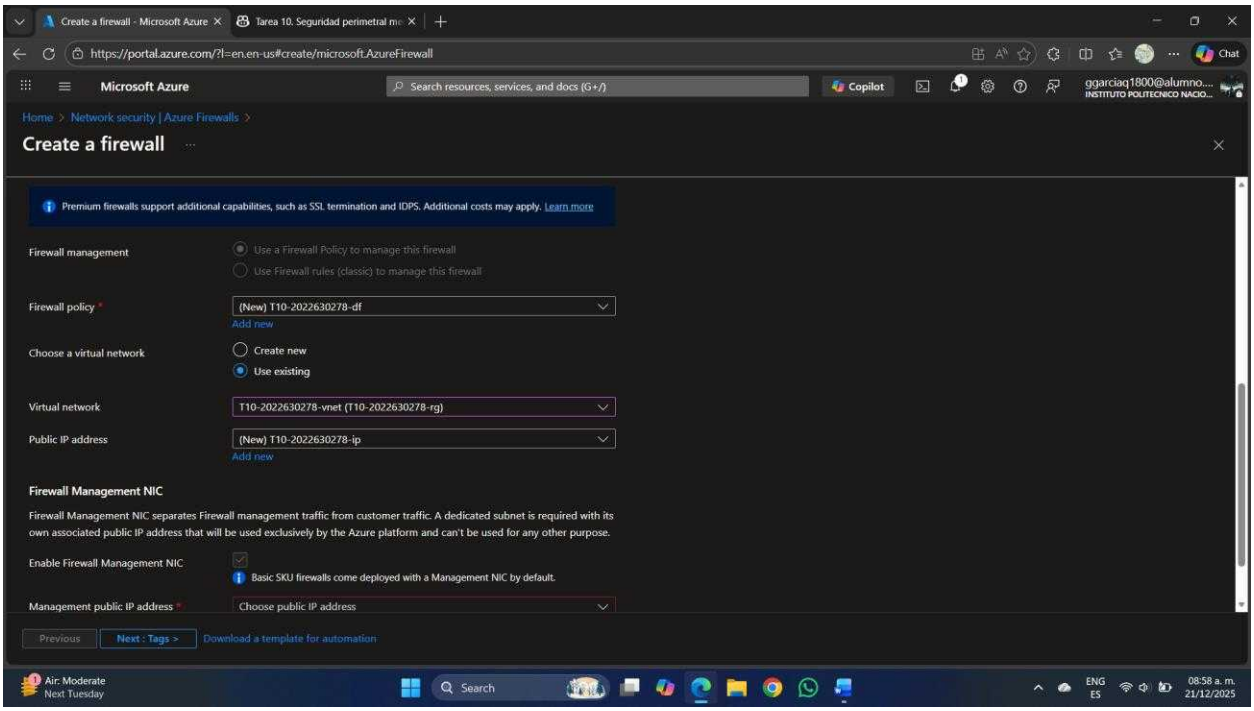
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Firewall management
Use a Firewall Policy to manage this firewall
Use Firewall rules (classic) to manage this firewall
Firewall policy *
(New) T10-2022630278-df
Add new
Choose a virtual network
Create new
Use existing
Virtual network
T10-2022630278-vnet (T10-2022630278-rg)
Public IP address
(New) T10-2022630278-ip
Add new
Firewall Management NIC
Firewall Management NIC separates Firewall management traffic from customer traffic. A dedicated subnet is required with its own associated public IP address that will be used exclusively by the Azure platform and can't be used for any other purpose.
Enable Firewall Management NIC
Basic SKU firewalls come deployed with a Management NIC by default.
Management public IP address *
Choose public IP address
Previous
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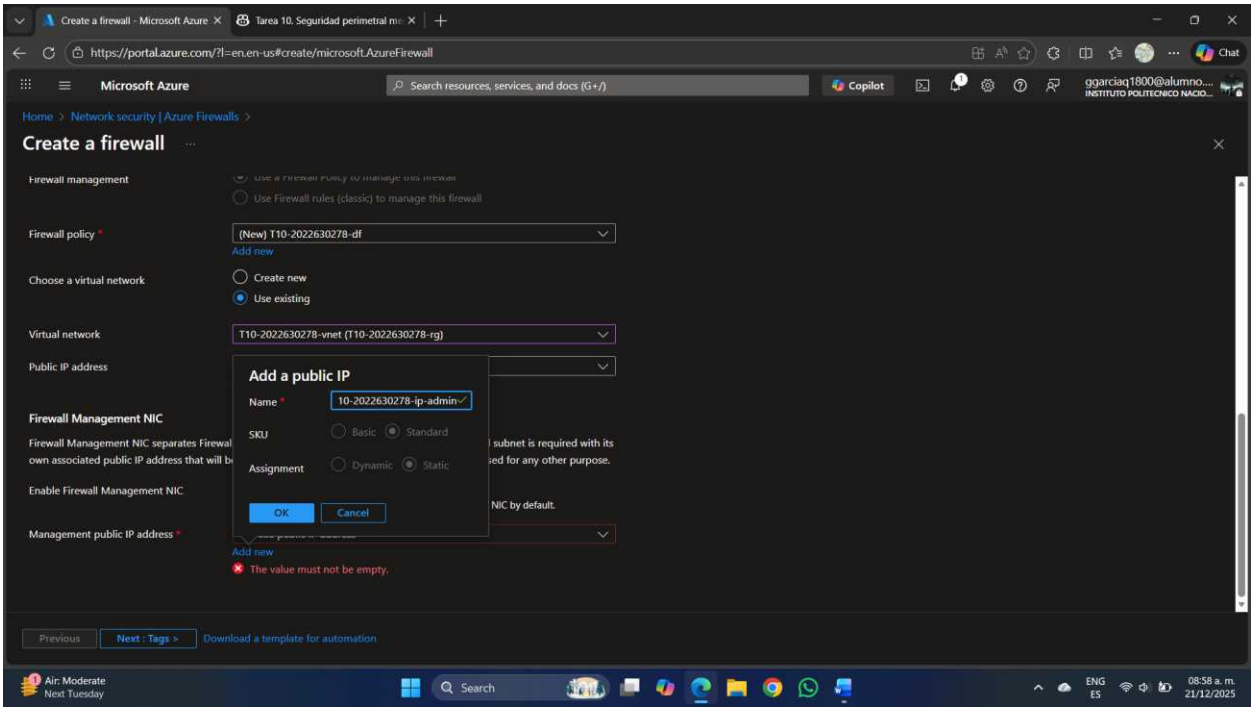
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Create a firewall
Firewall management
Use Firewall rules (classic) to manage this firewall
Firewall policy *
(New) T10-2022630278-df
Add new
Choose a virtual network
Create new
Use existing
Virtual network
T10-2022630278-vnet (T10-2022630278-rg)
Public IP address
Add a public IP
Name *
10-2022630278-ip-admin
SKU
Basic
Standard
Assignment
Dynamic
Static
OK
Cancel
Firewall Management NIC
Enable Firewall Management NIC
Management public IP address *
Add new
The value must not be empty.
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Next : Tags >
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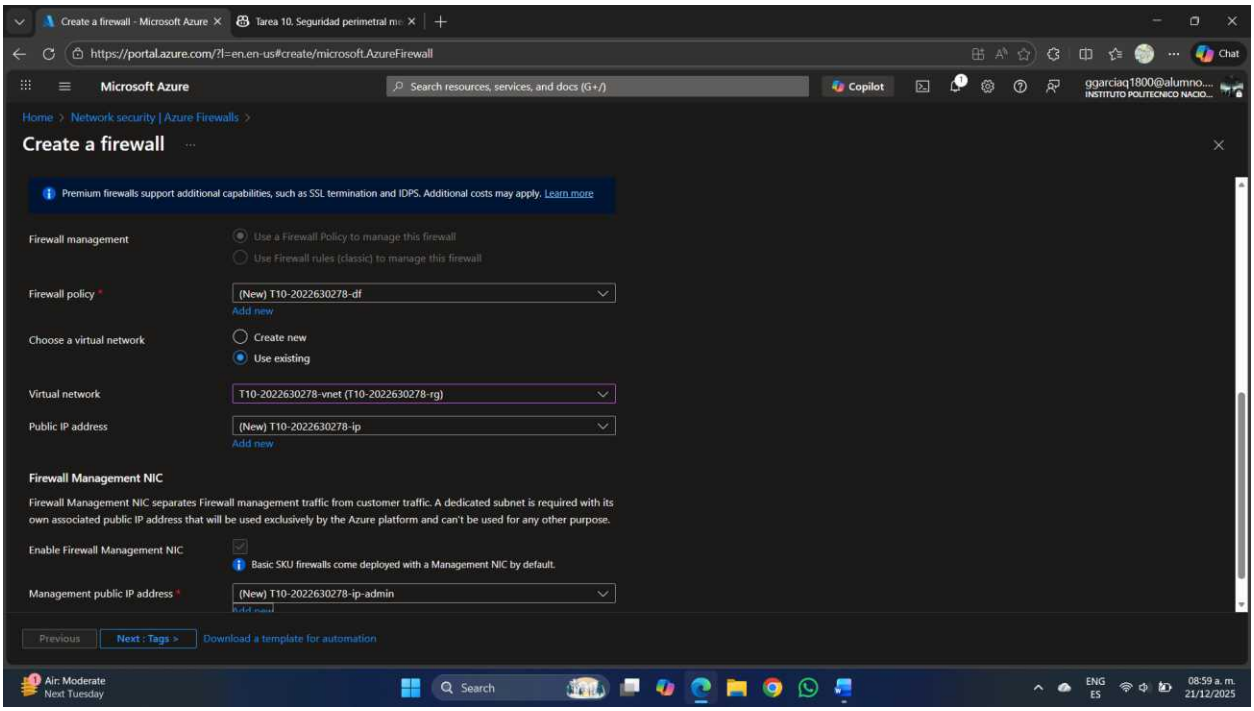
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Use a Firewall Policy to manage this firewall
Use Firewall rules (classic) to manage this firewall
Firewall policy *
(New) T10-2022630278-df
Add new
Choose a virtual network
Create new
Use existing
Virtual network
T10-2022630278-vnet (T10-2022630278-rg)
Public IP address
(New) T10-2022630278-ip
Add new
Firewall Management NIC
Firewall Management NIC separates Firewall management traffic from customer traffic. A dedicated subnet is required with its own associated public IP address that will be used exclusively by the Azure platform and can't be used for any other purpose.
Enable Firewall Management NIC
Basic SKU firewalls come deployed with a Management NIC by default.
Management public IP address *
(New) T10-2022630278-ip-admin
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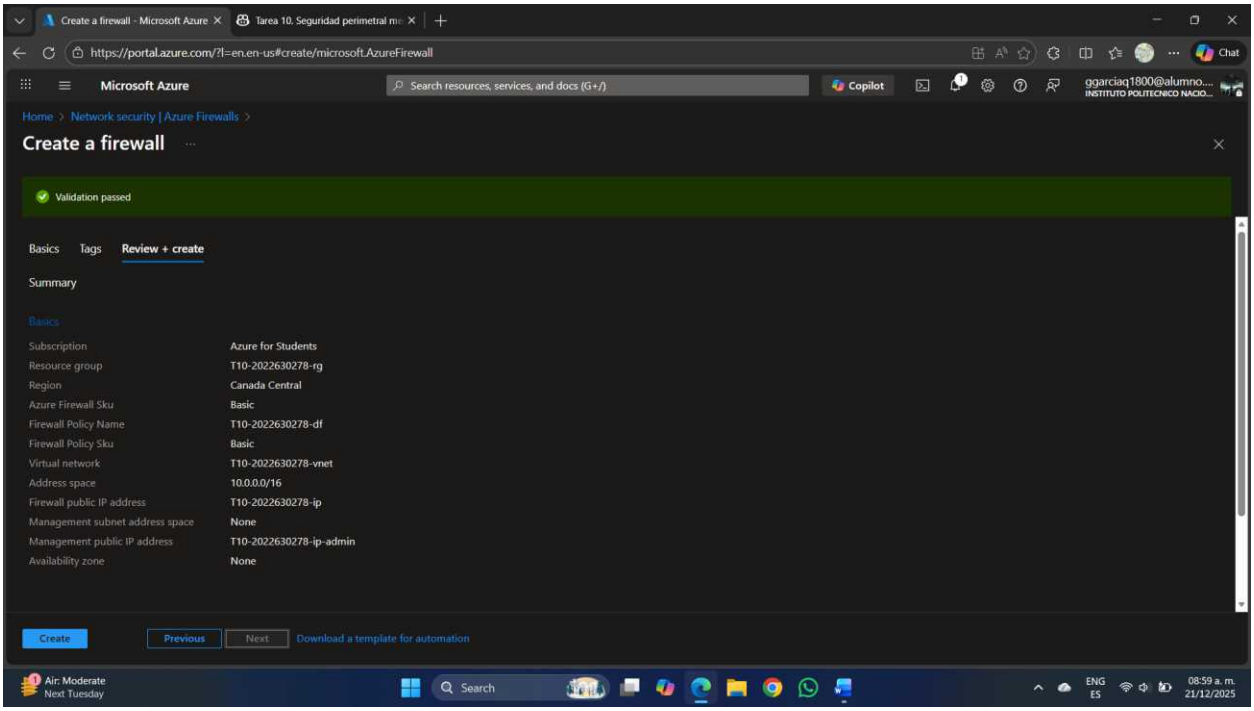
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Resource group
T10-2022630278-rg
Region
Canada Central
Azure Firewall Sku
Basic
Firewall Policy Name
T10-2022630278-df
Firewall Policy Sku
Basic
Virtual network
T10-2022630278-vnet
Address space
10.0.0.0/16
Firewall public IP address
T10-2022630278-ip
Management subnet address space
None
Management public IP address
T10-2022630278-ip-admin
Availability zone
None
Create
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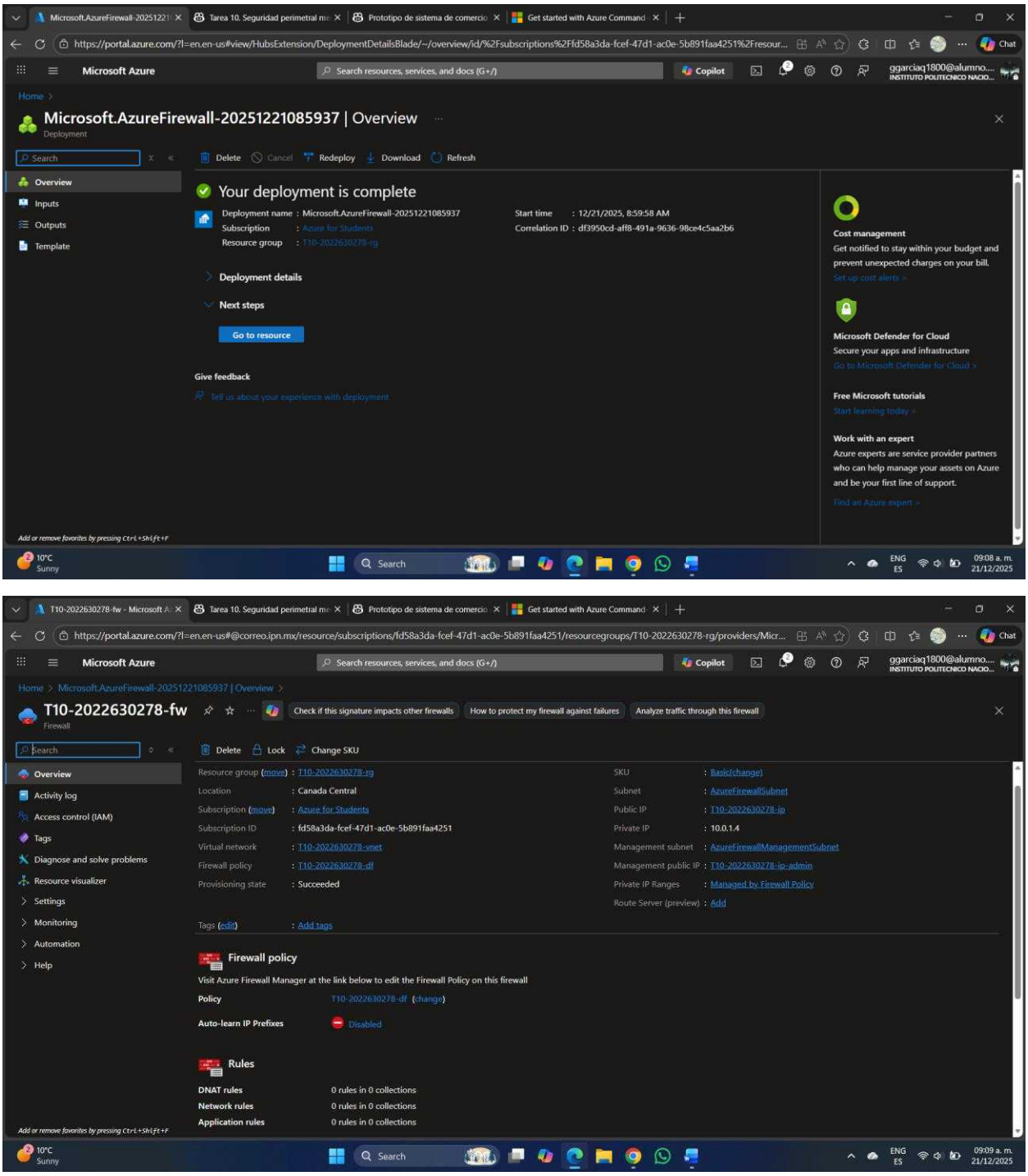
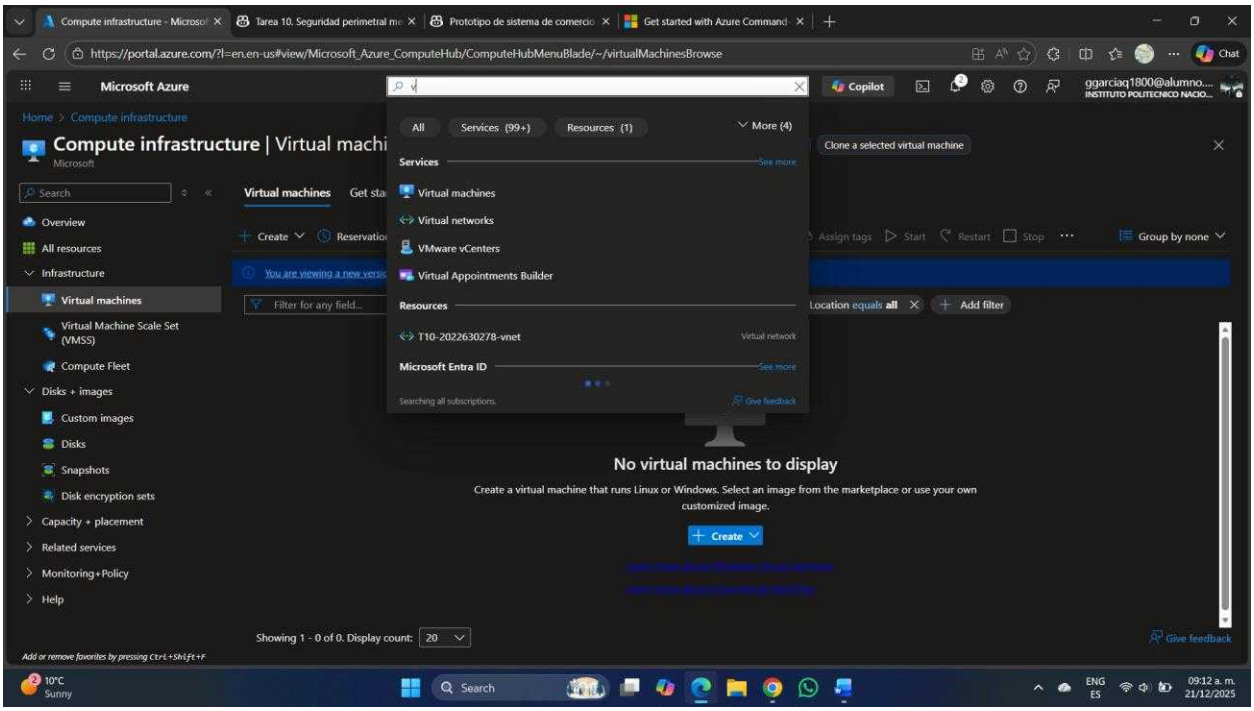


Figura 8. Despliegue del Azure Firewall y asociación de la política e IPs públicas.

4.3 Creación de la máquina virtual Ubuntu sin IP pública

Se realizó la creación de la máquina virtual Ubuntu en la subred default de la red virtual. Se seleccionó autenticación por contraseña y se evitó asignar IP pública para que el acceso se requiera únicamente a través del firewall mediante DNAT.

- Máquina virtual: T10-2022630278-mv
- Imagen: Ubuntu (22.04)
- Autenticación: contraseña
- Red virtual: T10-2022630278-vnet
- Subred: default
- IP pública: ninguna
- Puertos de entrada públicos: ninguno
- Se registró la IP privada de la VM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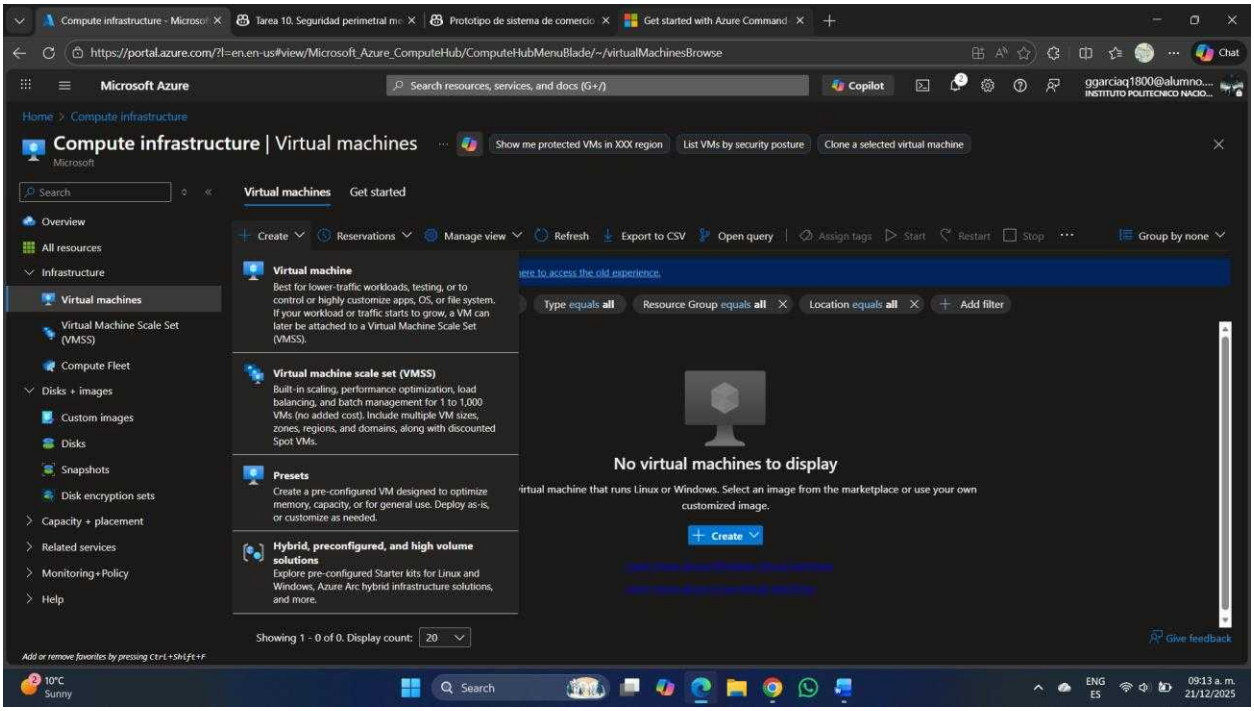
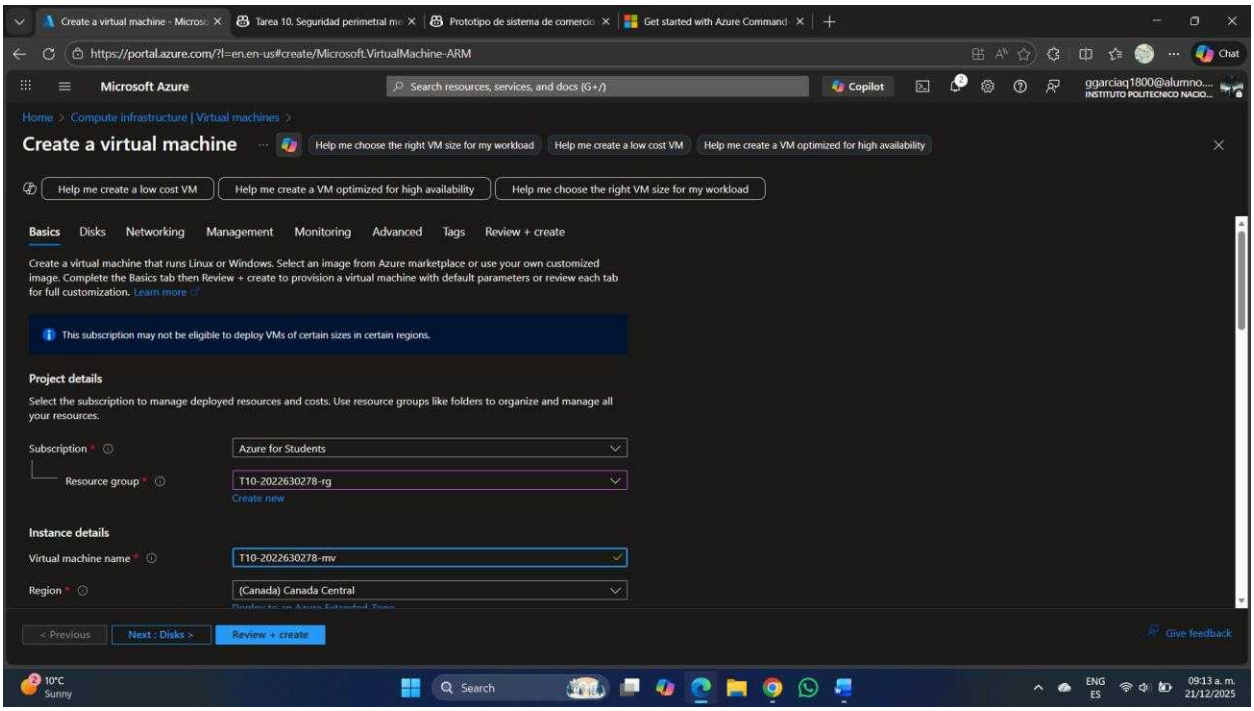
No virtual machines to display
Create a virtual machine that runs Linux or Windows. Select an image from the marketplace or use your own customized image.
Create


Microsoft Azure
Compute infrastructure | Virtual machines
Virtual machine
Best for lower-traffic workloads, testing, or to control or highly customize apps, OS, or file system. If your workload or traffic starts to grow, a VM can later be attached to a Virtual Machine Scale Set (VMSS).
Virtual machine scale set (VMSS)
Built-in scaling, performance optimization, load balancing, and batch management for 1 to 1,000 VMs (no added cost). Include multiple VM sizes, zones, regions, and domains, along with discounted Spot VMs.
Presets
Create a pre-configured VM designed to optimize memory, capacity, or for general use. Deploy as-is, or customize as needed.
Hybrid, preconfigured, and high volume solutions
Explore pre-configured Starter kits for Linux and Windows, Azure Arc hybrid infrastructure solutions, and more.
No virtual machines to display
Create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Basics
Disks
Networking
Management
Monitoring
Advanced
Tags
Review + create
Create a virtual machine that runs Linux or Windows. Select an image from Azure marketplace or use your own customized image. Complete the Basics tab then Review + create to provision a virtual machine with default parameters or review each tab for full customization. Learn more
This subscription may not be eligible to deploy VMs of certain sizes in certain regions.
Project details
Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.
Subscription *
Azure for Students
Resource group *
T10-2022630278-rg
Create new
Instance details
Virtual machine name *
T10-2022630278-mv
Region *
(Canada) Canada Central
< Previous
Next : Disks >
Review + create
Give feedback
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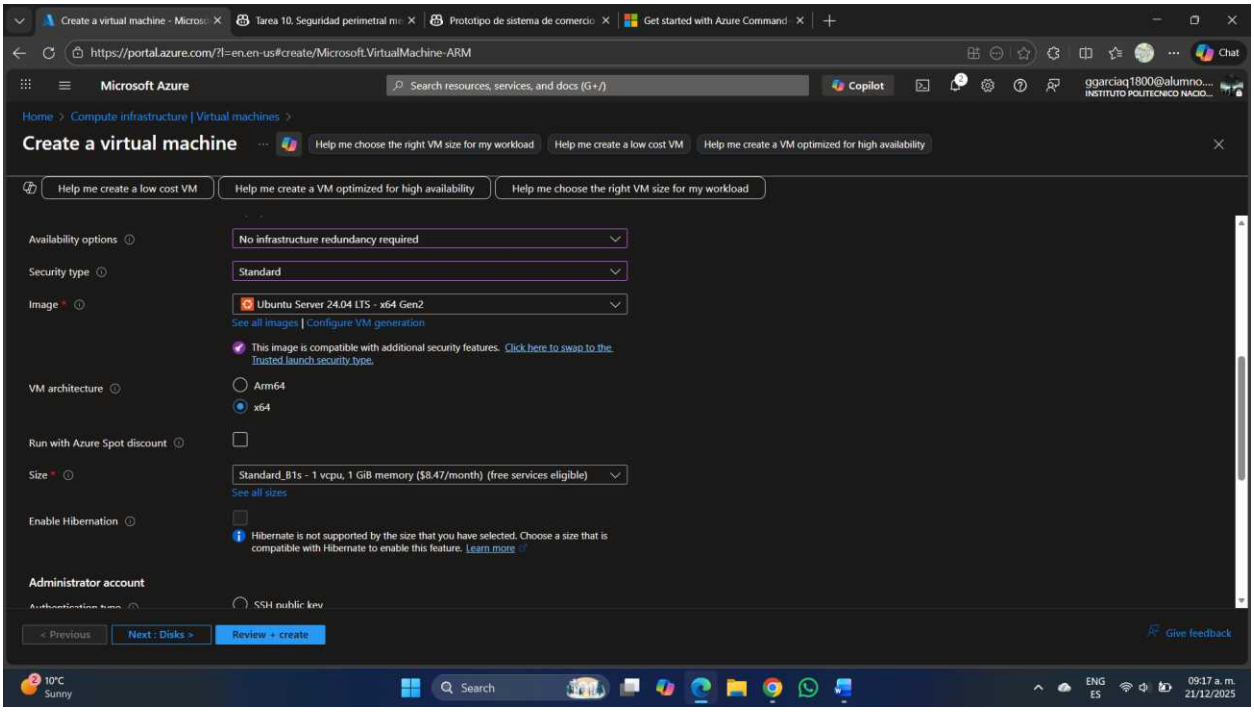
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Help me choose the right VM size for my workload
Help me create a low cost VM
Help me create a VM optimized for high availability
Availability options
No infrastructure redundancy required
Security type
Standard
Image *
Ubuntu Server 24.04 LTS - x64 Gen2
See all images | Configure VM generation
This image is compatible with additional security features. Click here to swap to the Trusted launch security type.
VM architecture
Arm64
x64
Run with Azure Spot discount
Size *
Standard_B1s - 1 vcpu, 1 GiB memory ($8.47/month) (free services eligible)
See all sizes
Enable Hibernation
Hibernate is not supported by the size that you have selected. Choose a size that is compatible with Hibernate to enable this feature. Learn more
Administrator account
SSH public key
< Previous
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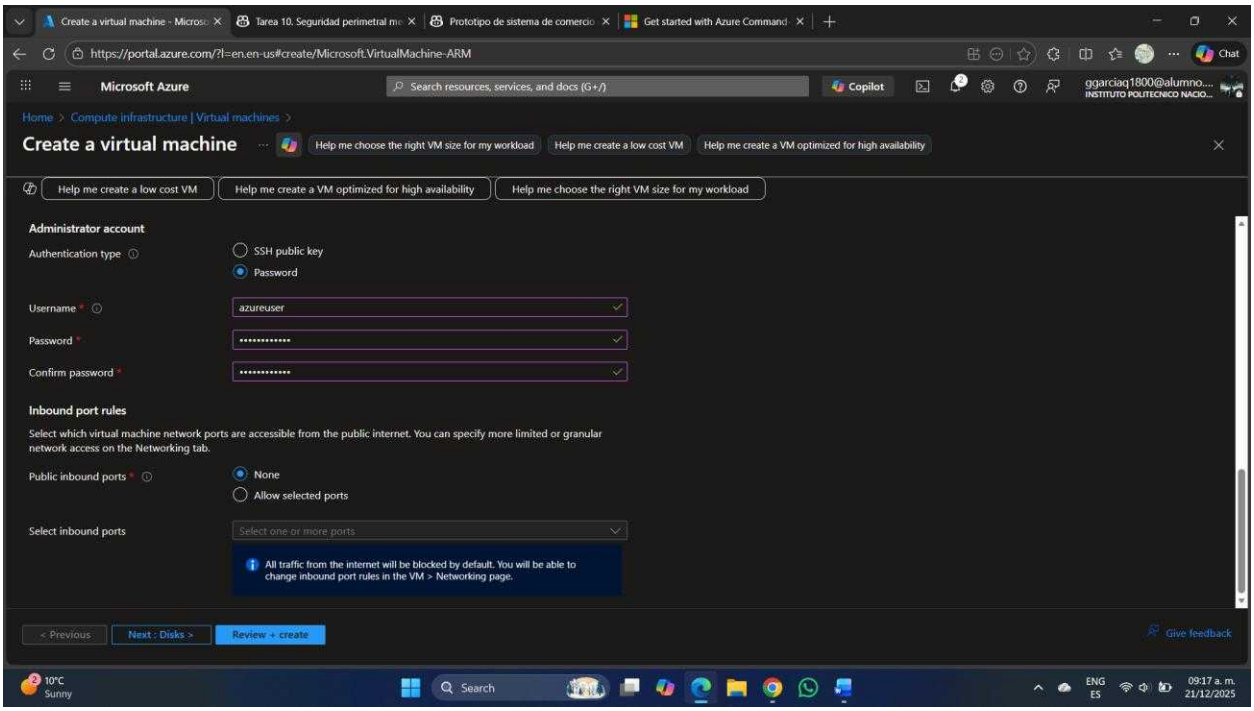
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Help me create a low cost VM
Help me create a VM optimized for high availability
Administrator account
Authentication type
SSH public key
Password
Username *
azureuser
Password *
Confirm password *
Inbound port rules
Select which virtual machine network ports are accessible from the public internet. You can specify more limited or granular network access on the Networking tab.
Public inbound ports *
None
Allow selected ports
Select inbound ports
Select one or more ports
All traffic from the internet will be blocked by default. You will be able to change inbound port rules in the VM > Networking page.
< Previous
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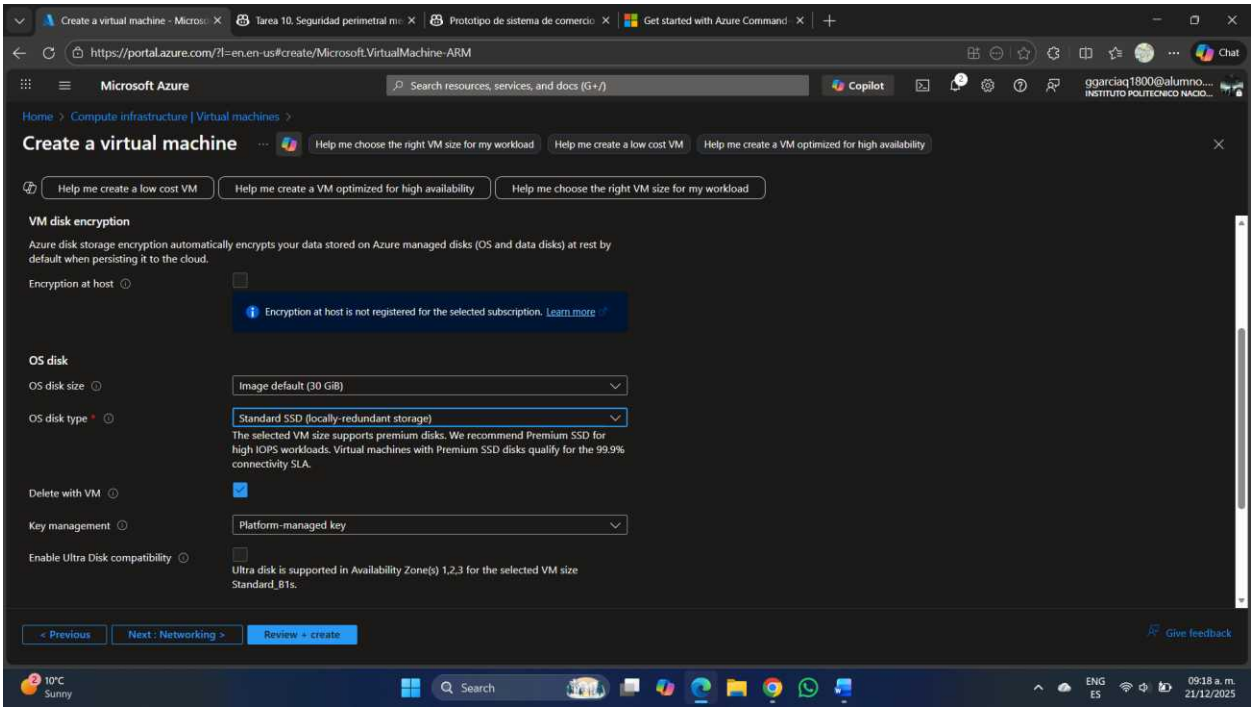
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VM disk encryption
Azure disk storage encryption automatically encrypts your data stored on Azure managed disks (OS and data disks) at rest by default when persisting it to the cloud.
Encryption at host
Encryption at host is not registered for the selected subscription. Learn more
OS disk
OS disk size
Image default (30 GiB)
OS disk type *
Standard SSD (locally-redundant storage)
The selected VM size supports premium disks. We recommend Premium SSD for high IOPS workloads. Virtual machines with Premium SSD disks qualify for the 99.9% connectivity SLA.
Delete with VM
Key management
Platform-managed key
Enable Ultra Disk compatibility
Ultra disk is supported in Availability Zone(s) 1,2,3 for the selected VM size Standard_B1s.
< Previous
Next : Networking >
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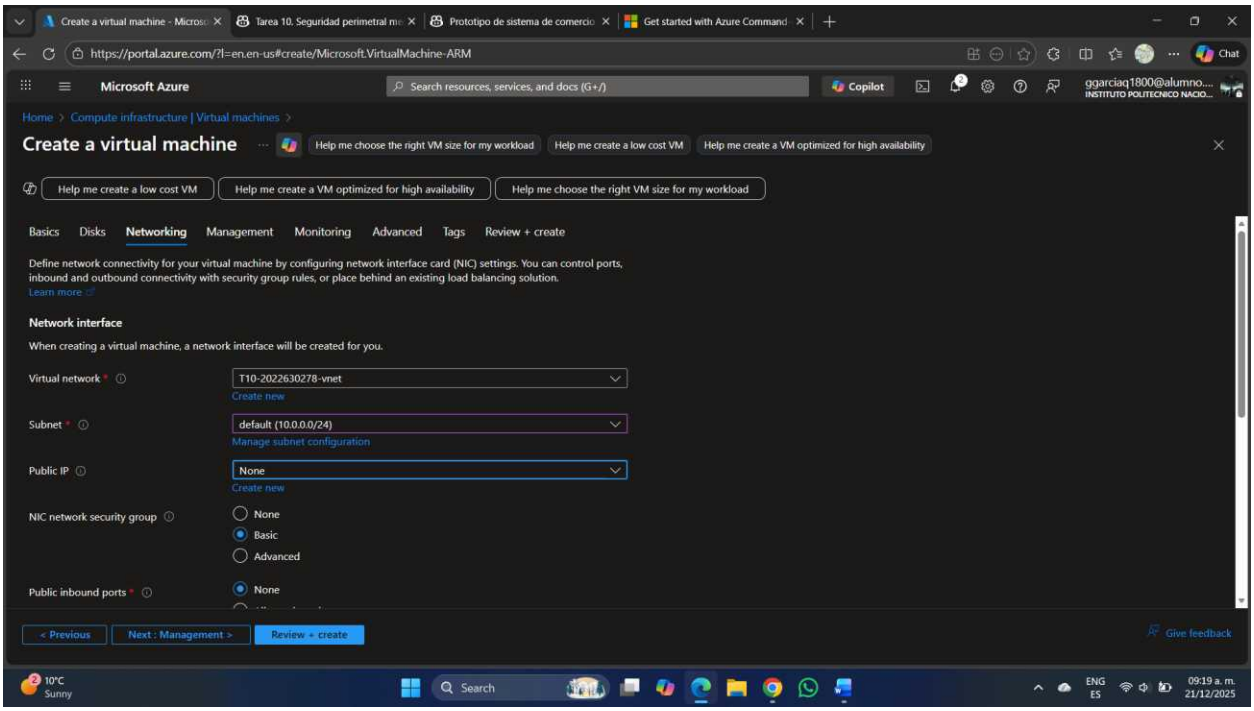
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Advanced
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Review + create
Define network connectivity for your virtual machine by configuring network interface card (NIC) settings. You can control ports, inbound and outbound connectivity with security group rules, or place behind an existing load balancing solution.
Learn more
Network interface
When creating a virtual machine, a network interface will be created for you.
Virtual network *
T10-2022630278-vnet
Create new
Subnet *
default (10.0.0.0/24)
Manage subnet configuration
Public IP
None
Create new
NIC network security group
None
Basic
Advanced
Public inbound ports *
None
< Previous
Next : Management >
Review + create
Give feedback
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Sunny
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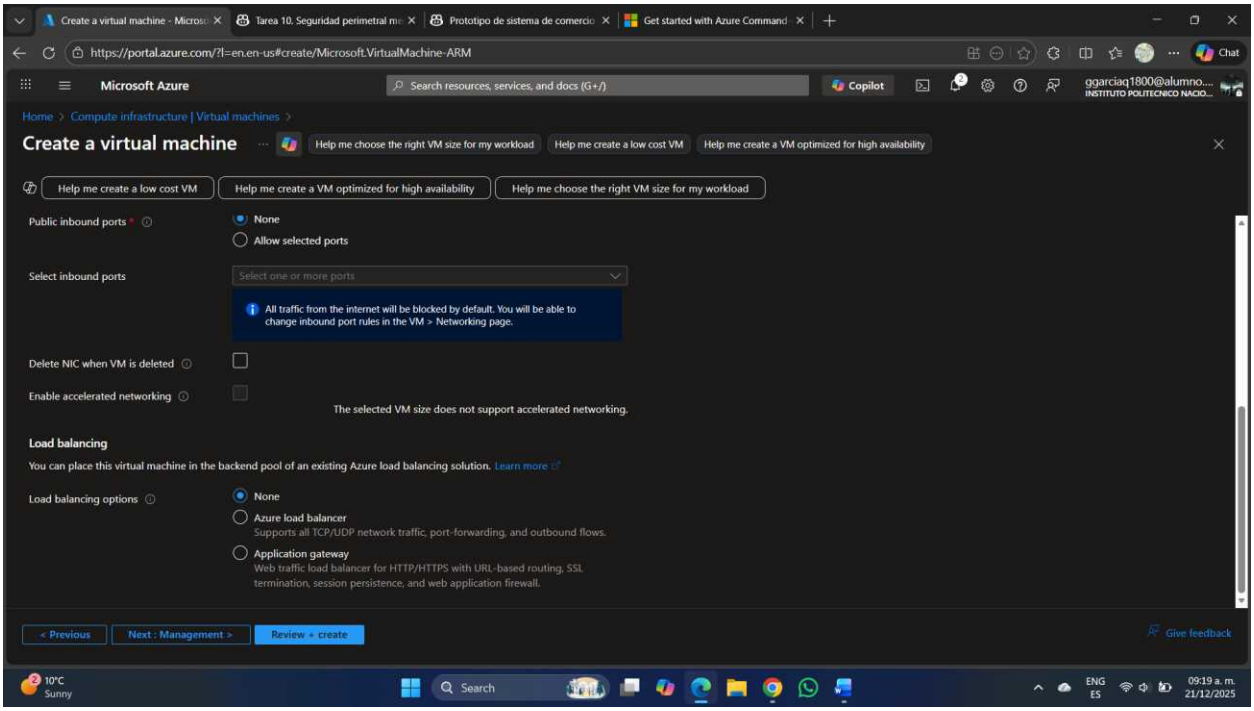
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Create a virtual machine
Help me choose the right VM size for my workload
Help me create a low cost VM
Help me create a VM optimized for high availability
Public inbound ports *
None
Allow selected ports
Select inbound ports
Select one or more ports
All traffic from the internet will be blocked by default. You will be able to change inbound port rules in the VM > Networking page.
Delete NIC when VM is deleted
Enable accelerated networking
The selected VM size does not support accelerated networking.
Load balancing
You can place this virtual machine in the backend pool of an existing Azure load balancing solution. Learn more
Load balancing options
None
Azure load balancer
Supports all TCP/UDP network traffic, port-forwarding, and outbound flows.
Application gateway
Web traffic load balancer for HTTP/HTTPS with URL-based routing, SSL termination, session persistence, and web application firewall.
< Previous
Next : Management >
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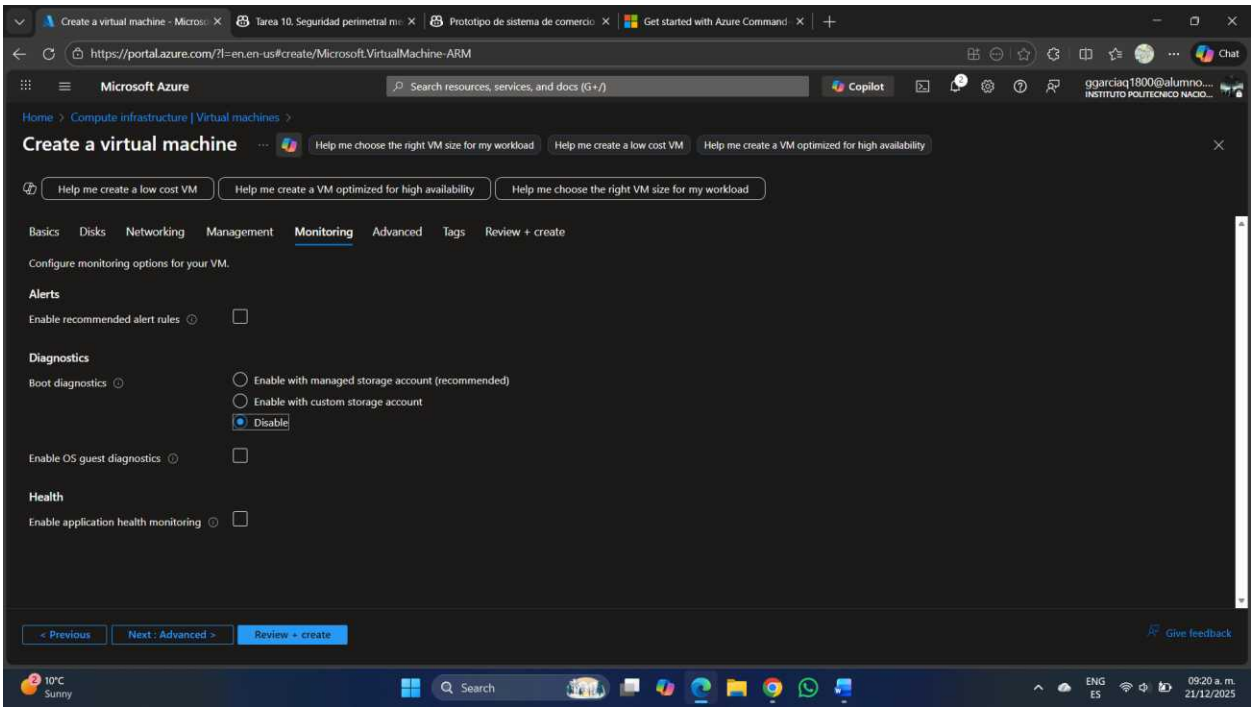
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Help me create a low cost VM
Help me create a VM optimized for high availability
Basics
Disks
Networking
Management
Monitoring
Advanced
Tags
Review + create
Configure monitoring options for your VM.
Alerts
Enable recommended alert rules
Diagnostics
Boot diagnostics
Enable with managed storage account (recommended)
Enable with custom storage account
Disable
Enable OS guest diagnostics
Health
Enable application health monitoring
< Previous
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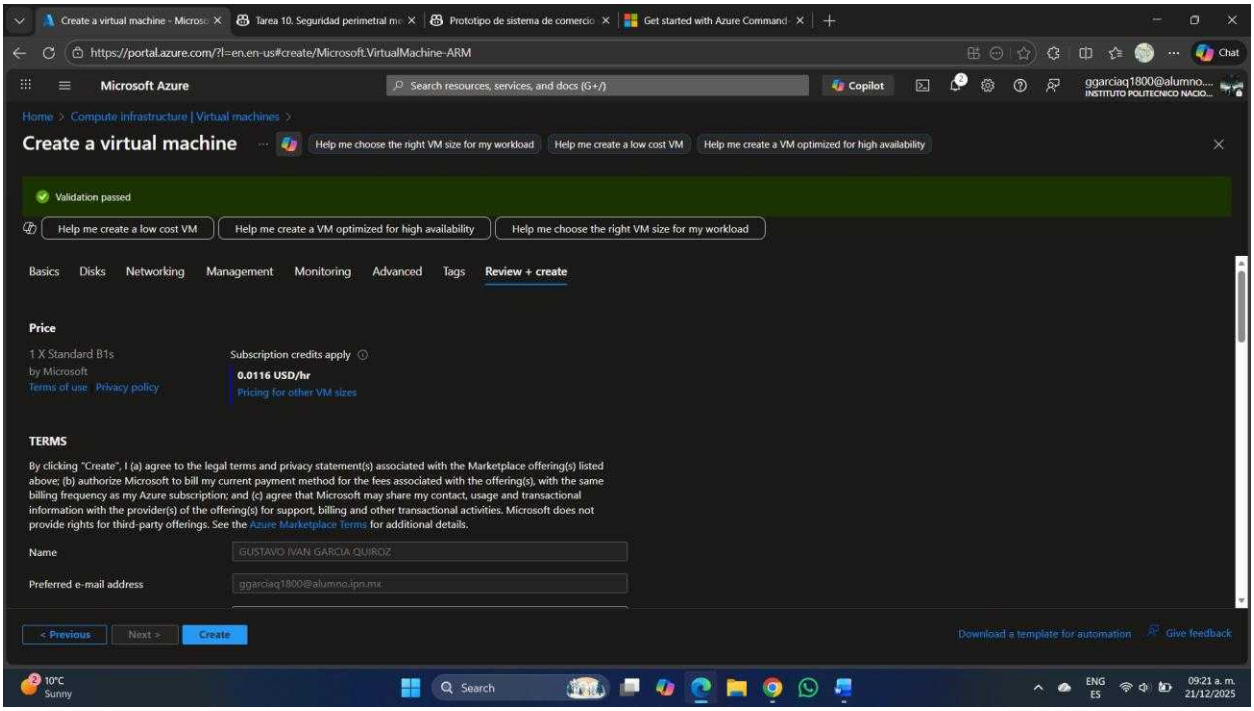
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Help me create a low cost VM
Help me create a VM optimized for high availability
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Monitoring
Advanced
Tags
Review + create
Price
1 X Standard B1s
by Microsoft
Terms of use
Privacy policy
Subscription credits apply
0.0116 USD/hr
Pricing for other VM sizes
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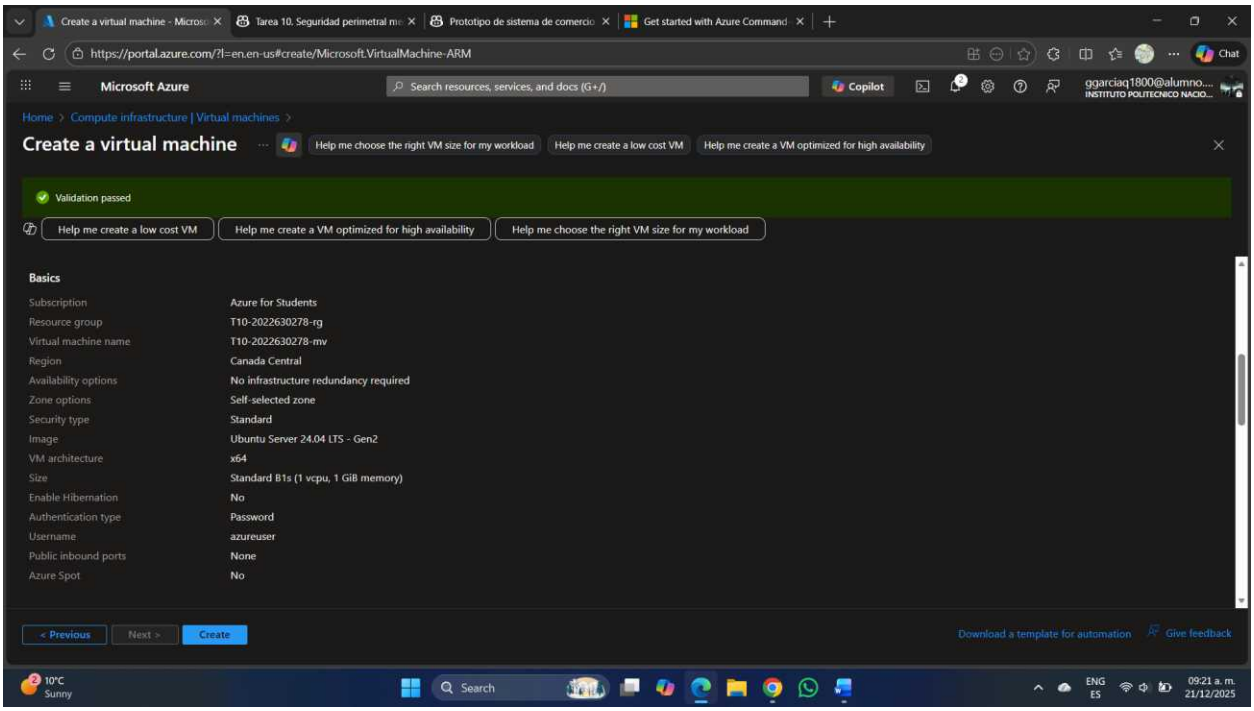
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Help me create a VM optimized for high availability
Validation passed
Help me create a low cost VM
Help me create a VM optimized for high availability
Help me choose the right VM size for my workload
Basics
Subscription Azure for Students
Resource group T10-2022630278-rg
Virtual machine name T10-2022630278-mv
Region Canada Central
Availability options No infrastructure redundancy required
Zone options Self-selected zone
Security type Standard
Image Ubuntu Server 24.04 LTS - Gen2
VM architecture x64
Size Standard B1s (1 vcpu, 1 GiB memory)
Enable Hibernation No
Authentication type Password
Username azureuser
Public inbound ports None
Azure Spot No
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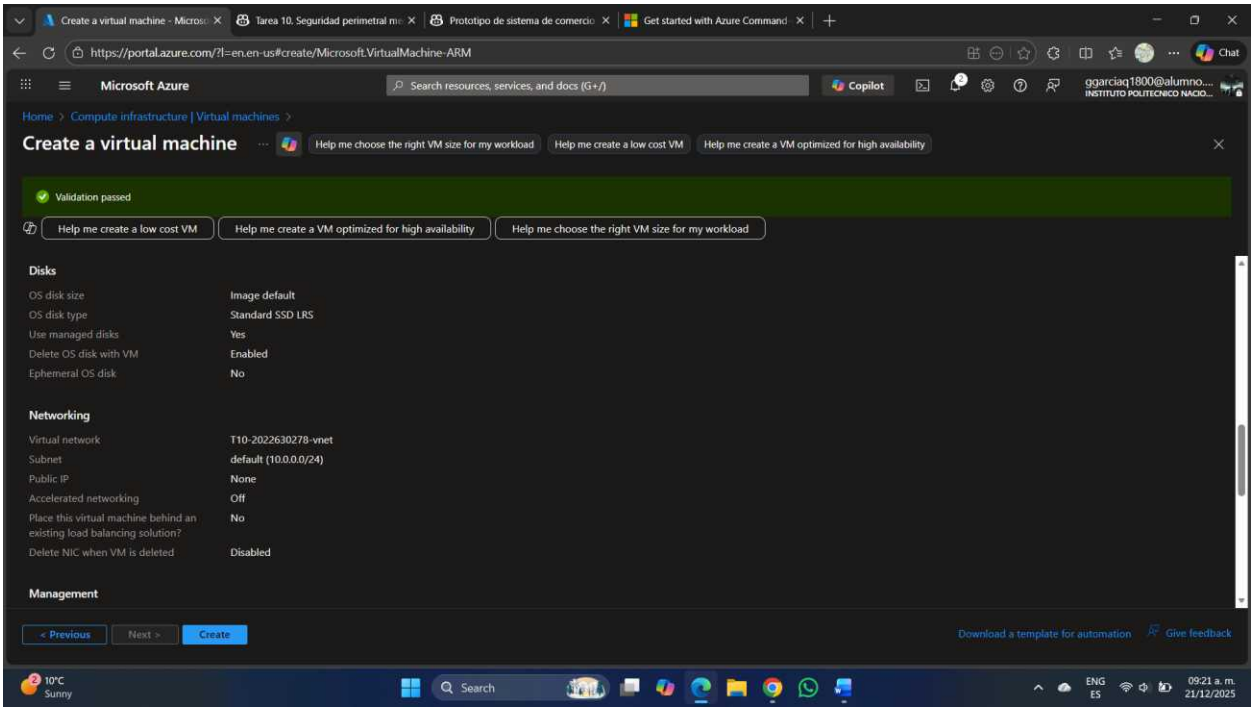
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Help me create a low cost VM
Help me create a VM optimized for high availability
Validation passed
Help me create a low cost VM
Help me create a VM optimized for high availability
Help me choose the right VM size for my workload
Disks
OS disk size Image default
OS disk type Standard SSD LRS
Use managed disks Yes
Delete OS disk with VM Enabled
Ephemeral OS disk No
Networking
Virtual network T10-2022630278-vnet
Subnet default (10.0.0.0/24)
Public IP None
Accelerated networking Off
Place this virtual machine behind an existing load balancing solution? No
Delete NIC when VM is deleted Disabled
Management
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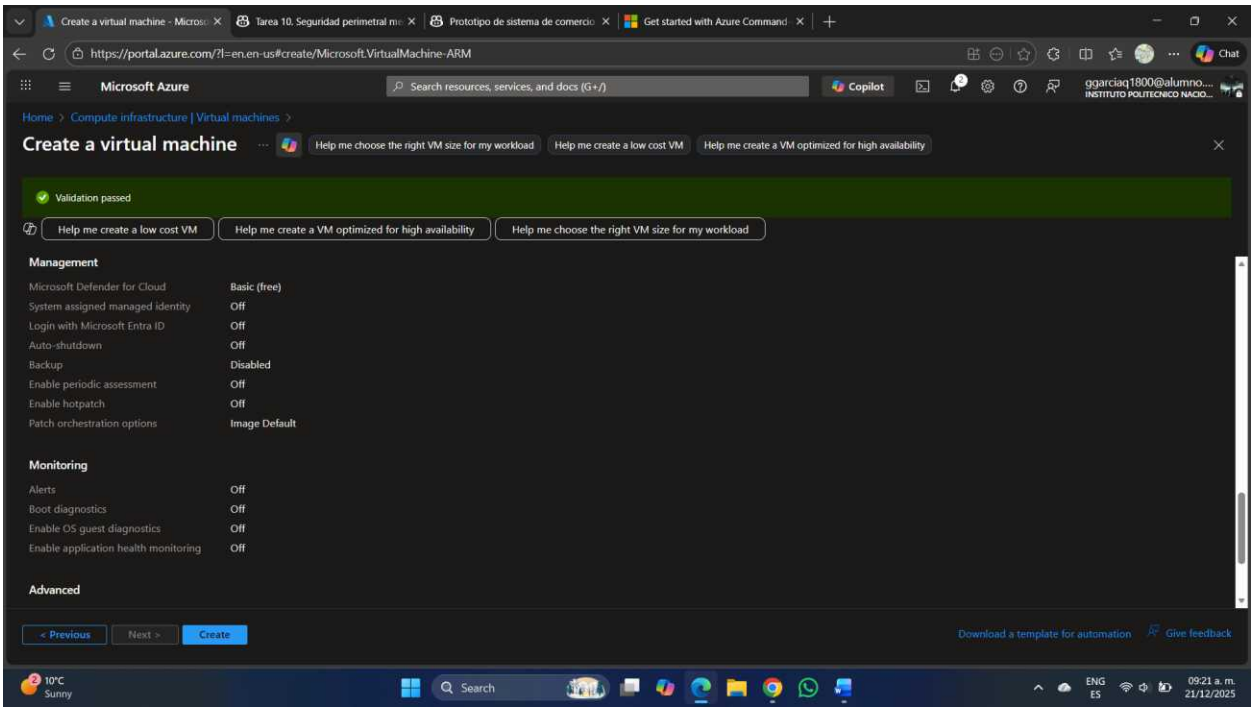
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Help me create a low cost VM
Help me create a VM optimized for high availability
Validation passed
Help me create a low cost VM
Help me create a VM optimized for high availability
Help me choose the right VM size for my workload
Management
Microsoft Defender for Cloud Basic (free)
System assigned managed identity Off
Login with Microsoft Entra ID Off
Auto-shutdown Off
Backup Disabled
Enable periodic assessment Off
Enable hotpatch Off
Patch orchestration options Image Default
Monitoring
Alerts Off
Boot diagnostics Off
Enable OS guest diagnostics Off
Enable application health monitoring Off
Advanced
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Next >
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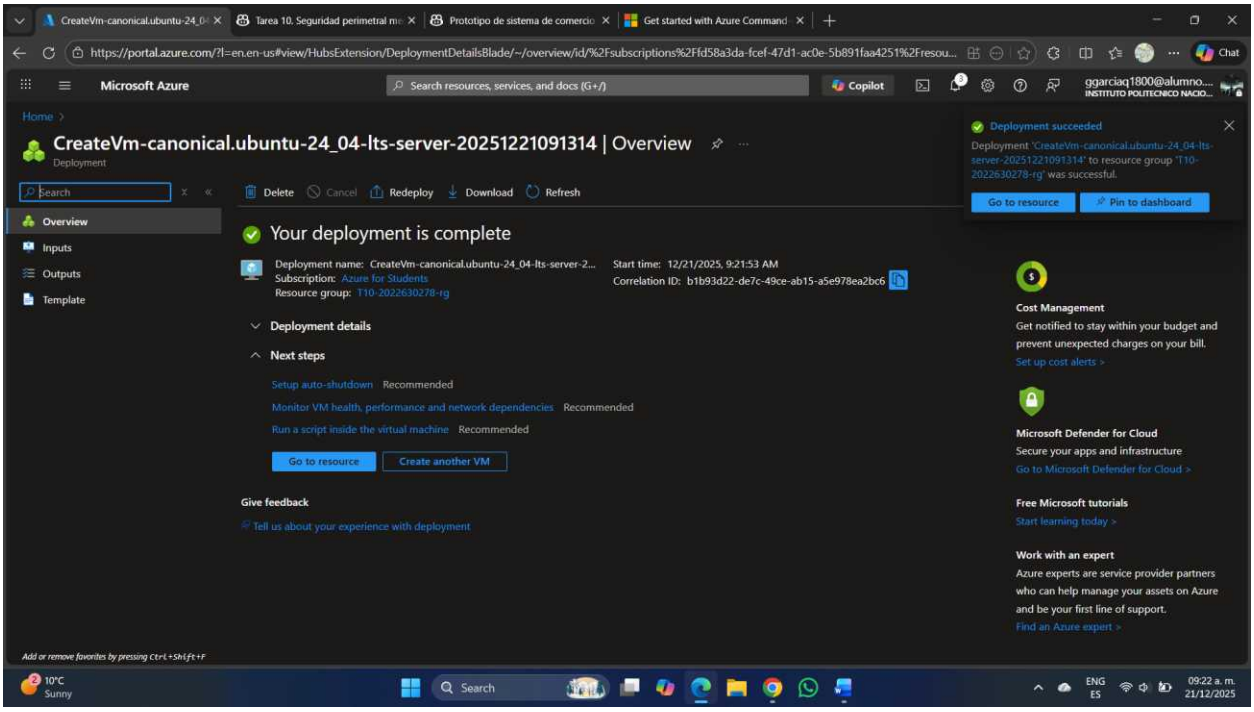
CreateVm-canonical.ubuntu-24_04
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Home >
CreateVm-canonical.ubuntu-24_04-lts-server-20251221091314 | Overview
Deployment
Search
Overview
Inputs
Outputs
Template
Delete
Cancel
Redeploy
Download
Refresh
Your deployment is complete
Deployment name: CreateVm-canonical.ubuntu-24_04-lts-server-2...
Subscription: Azure for Students
Resource group: T10-2022630278-rg
Start time: 12/21/2025, 9:21:53 AM
Correlation ID: b1b93d22-de7c-49ce-ab15-a5e978ea2bc6
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
Give feedback
Tell us about your experience with deployment
Deployment succeeded
Deployment 'CreateVm-canonical.ubuntu-24_04-lts-server-20251221091314' to resource group 'T10-2022630278-rg' was successful.
Go to resource
Pin to dashboard
Cost Management
Get notified to stay within your budget and prevent unexpected charges on your bill.
Set up cost alerts >
Microsoft Defender for Cloud
Secure your apps and infrastructure
Go to Microsoft Defender for Cloud >
Free Microsoft tutorials
Start learning today >
Work with an expert
Azure experts are service provider partners who can help manage your assets on Azure and be your first line of support.
Find an Azure expert >
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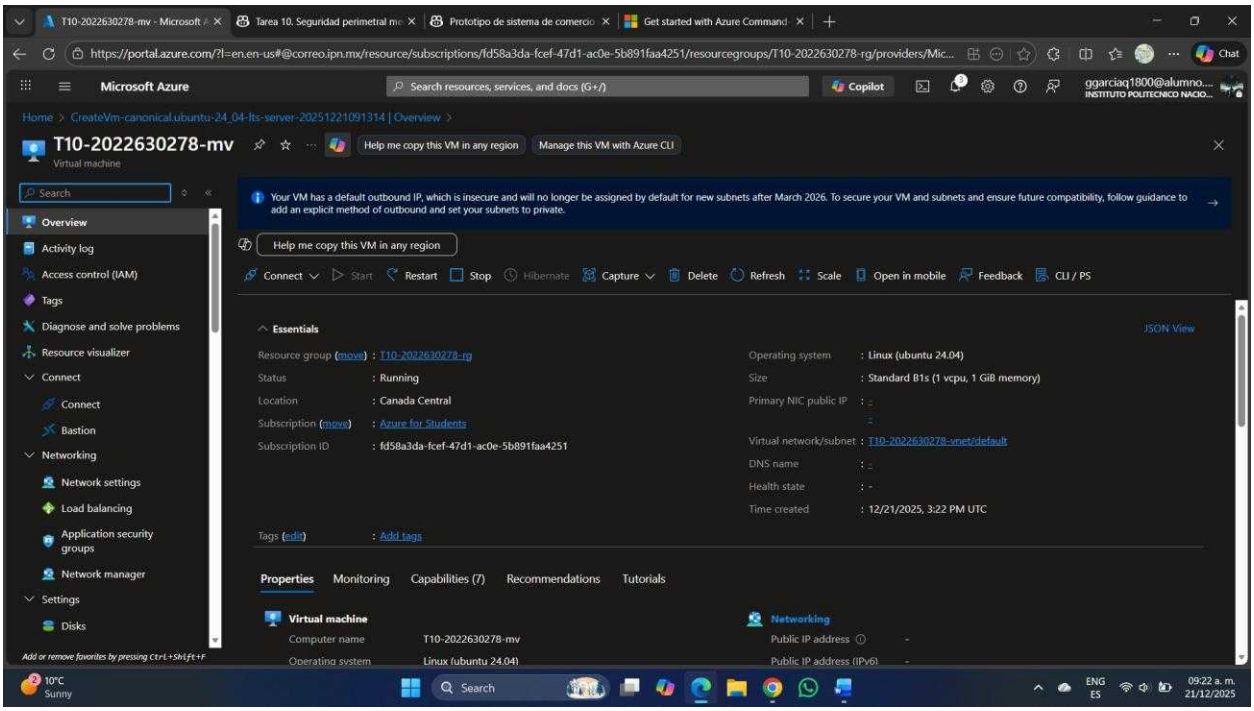
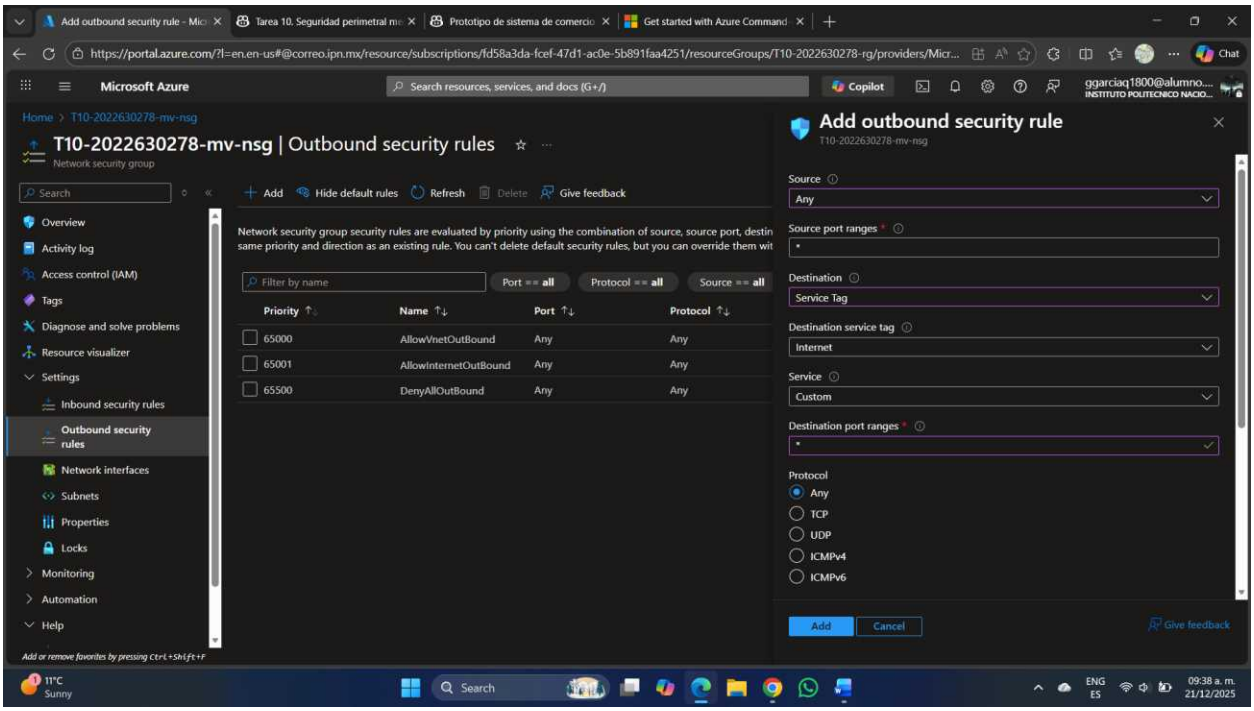


Figura 9. Creación de la máquina virtual Ubuntu sin IP pública en la subred default.

4.4 Configuración del NSG en la NIC de la VM

Se configuró el NSG de la NIC de la máquina virtual para reforzar la seguridad en el perímetro de la subred. Se realizó la creación de regla que bloquean la salida directa a Internet, delegando el control al firewall.

- Regla de salida: Deny Internet (service tag Internet, prioridad 100)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https://portal.azure.com/?l=en.en-us#@correo.ipn.mx/resource/subscriptions/fd58a3da-fcef-47d1-ac0e-5b891faa4251/resourceGroups/T10-2022630278-rg/providers/Micr...
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Home > T10-2022630278-mv-nsg
T10-2022630278-mv-nsg | Outbound security rules
Network security group
Search
Add
Hide default rules
Refresh
Delete
Give feedback
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
Help
Add or remove favorites by pressing Ctrl+Shift+F
Network security group security rules are evaluated by priority using the combination of source, source port, destin
same priority and direction as an existing rule. You can't delete default security rules, but you can override them wit
Filter by name
Port == all
Protocol == all
Source == all
Priority
Name
Port
Protocol
65000 AllowVnetOutBound Any Any
65001 AllowInternetOutBound Any Any
65500 DenyAllOutBound Any Any
Add outbound security rule
T10-2022630278-mv-nsg
Source
Any
Source port ranges *
*
Destination
Service Tag
Destination service tag
Internet
Service
Custom
Destination port ranges *
*
Protocol
Any
TCP
UDP
ICMPv4
ICMPv6
Add
Cancel
Give feedback
11°C
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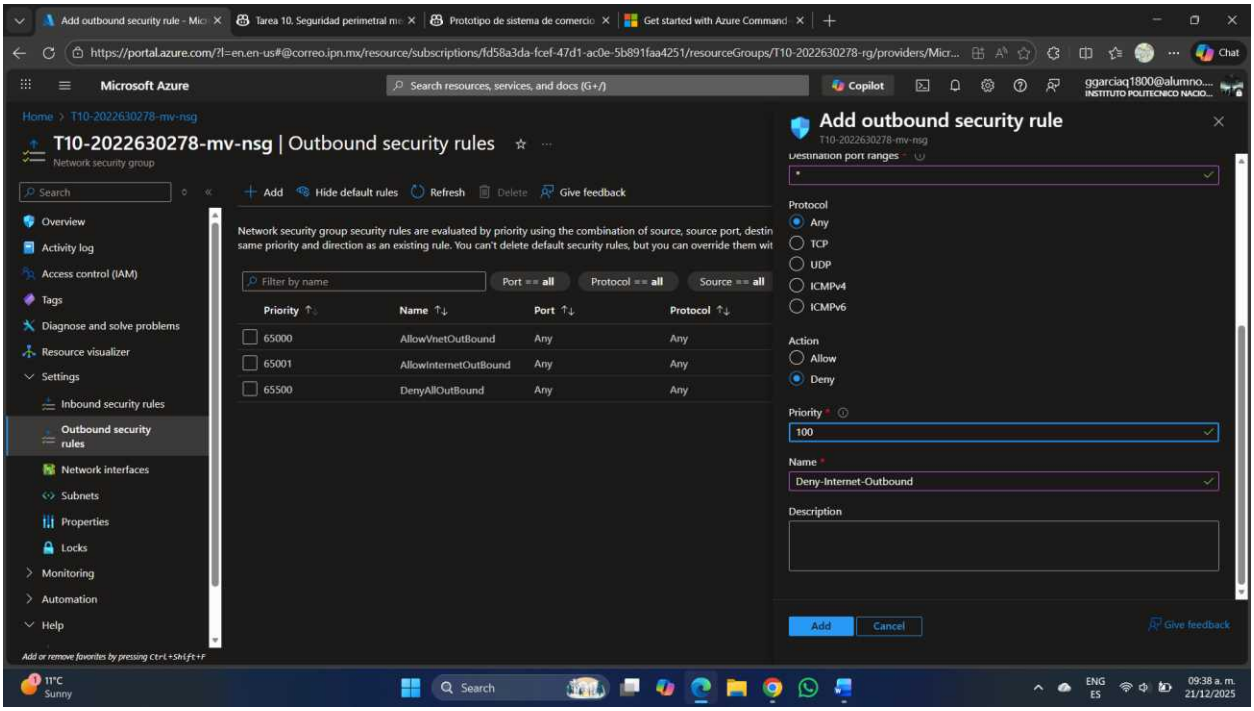
21/12/2025


Add outbound security rule - Mic
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Network security group
Search
Add
Hide default rules
Refresh
Delete
Give feedback
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
Help
Add or remove favorites by pressing Ctrl+Shift+F
Network security group security rules are evaluated by priority using the combination of source, source port, destin
same priority and direction as an existing rule. You can't delete default security rules, but you can override them wit
Filter by name
Port == all
Protocol == all
Source == all
Priority
Name
Port
Protocol
65000 AllowVnetOutBound Any Any
65001 AllowInternetOutBound Any Any
65500 DenyAllOutBound Any Any
Add outbound security rule
T10-2022630278-mv-nsg
Destination port ranges *
*
Protocol
Any
TCP
UDP
ICMPv4
ICMPv6
Action
Allow
Deny
Priority *
100
Name *
Deny-Internet-Outbound
Description
Add
Cancel
Give feedback
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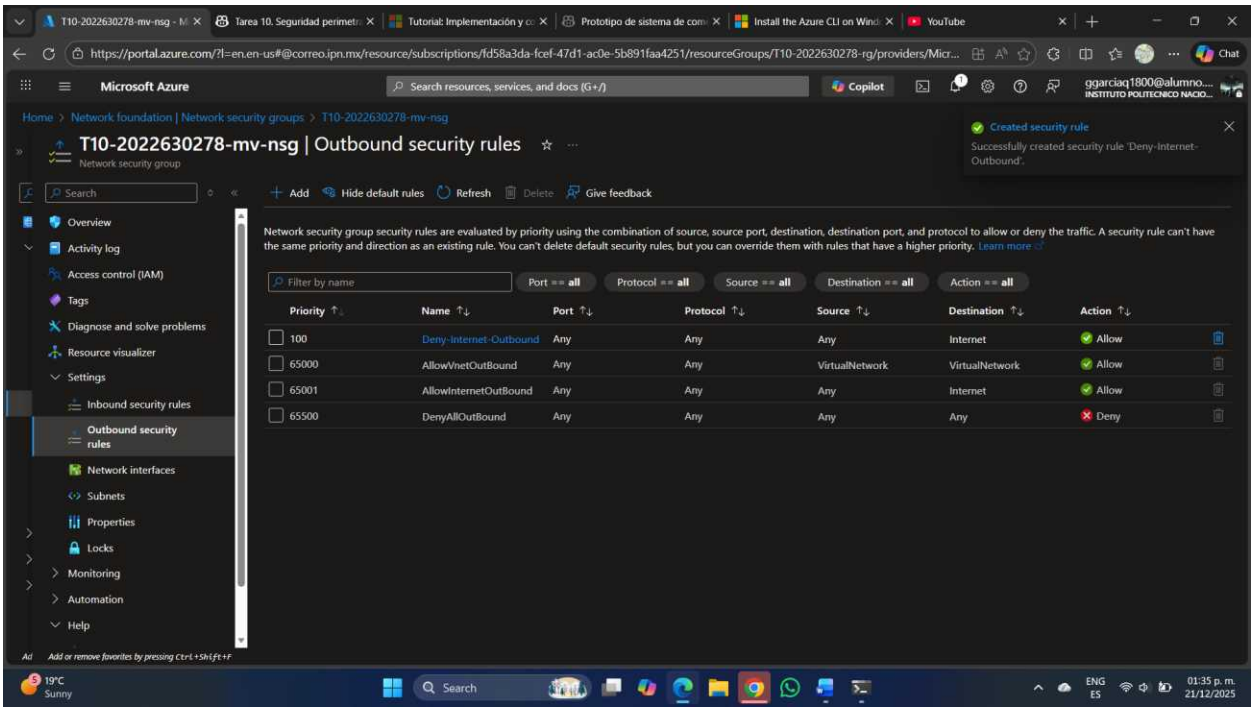


Figura 10. Regla del NSG en la NIC de la VM (Deny Internet Outbound).

Nota: La regla de seguridad de salida “Deny-Internet-Outbound” activo impidió la conexión a cualquier enlace de internet como YouTube, Google y m4gm, por lo que solo añadimos una excepción y quitamos la regla para poder continuar con el desarrollo de la tarea exitosamente.

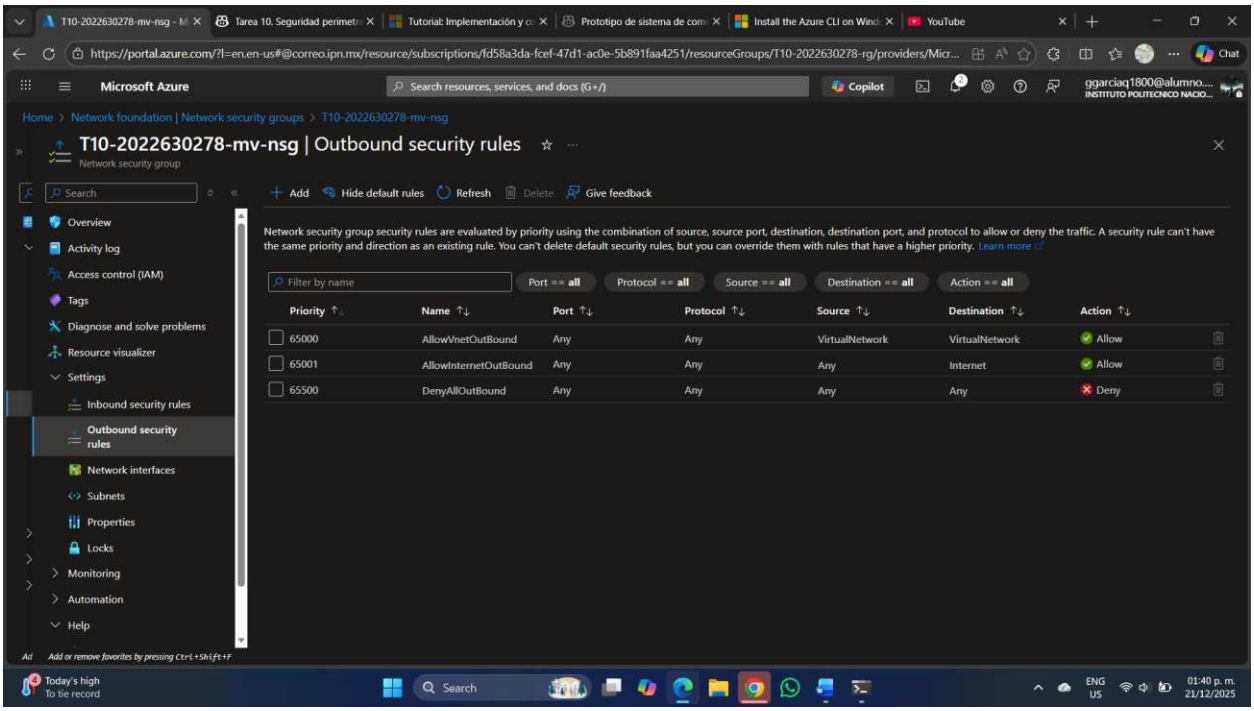
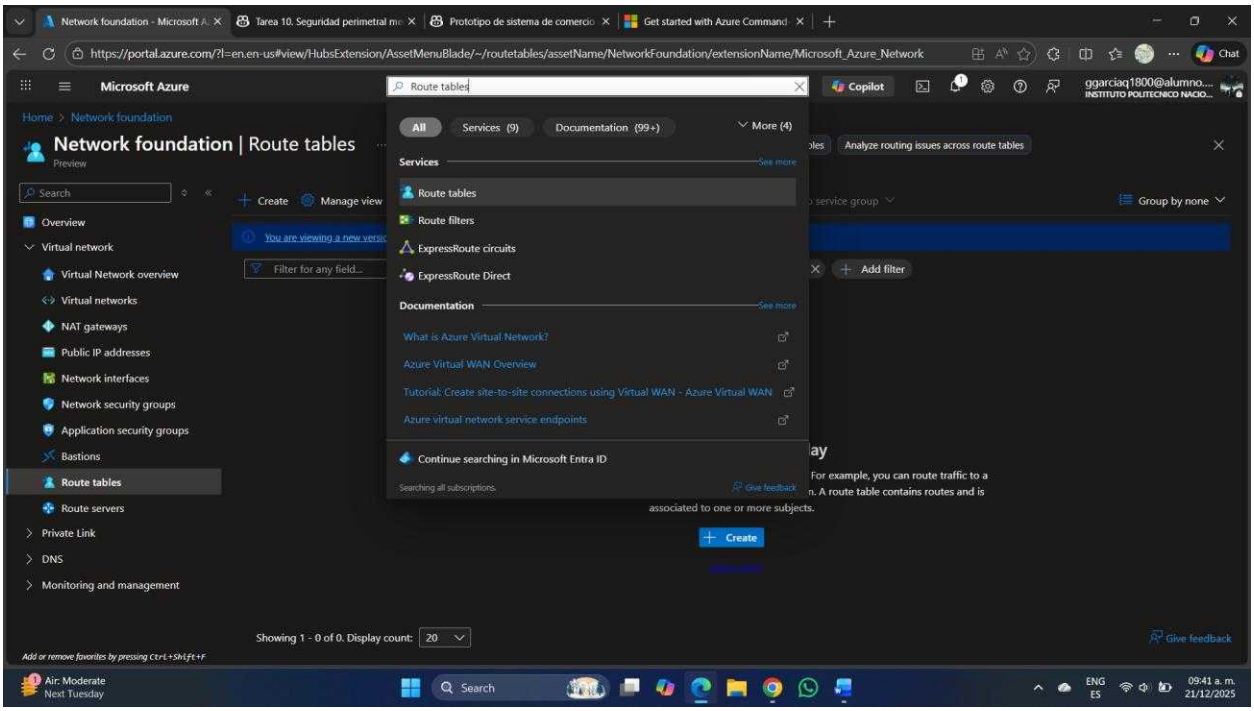


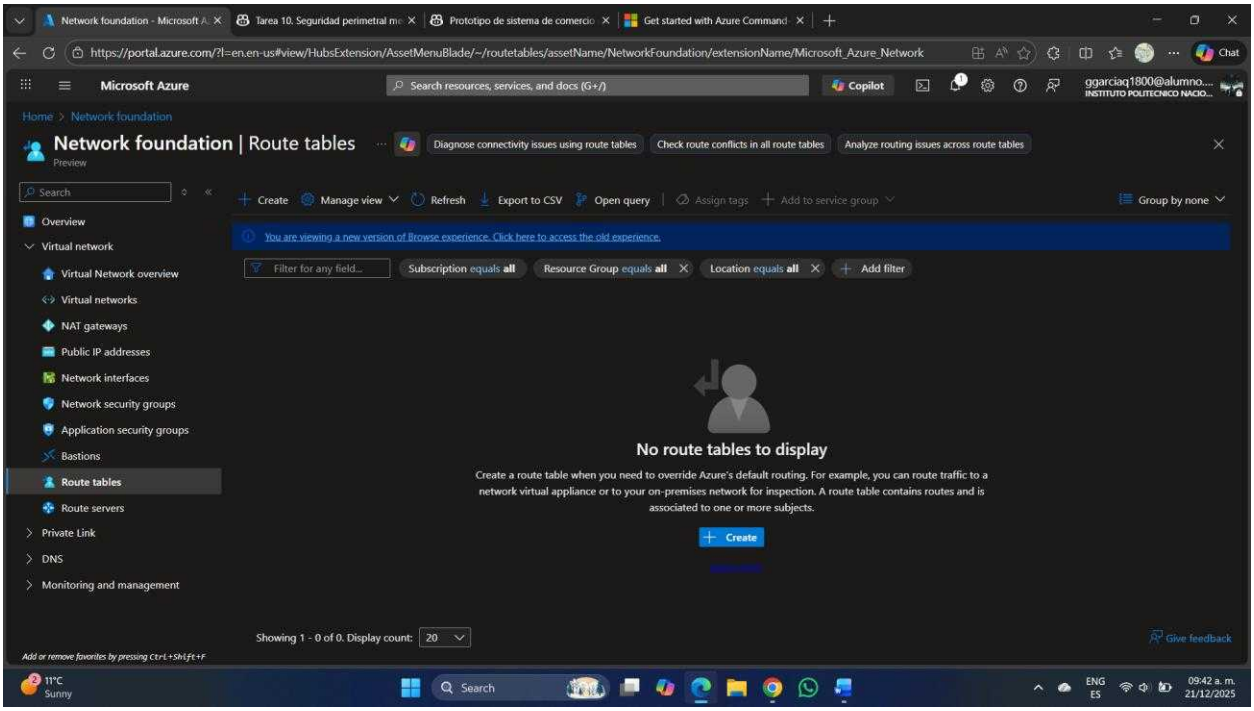
Figura 10.1. Reglas del NSG.

4.5 Tabla de rutas (UDR) para salida a través del firewall

Se realizó la creación de una tabla de rutas y se agregó una ruta por defecto (0.0.0.0/0) apuntando a la IP privada del firewall como Virtual appliance. Se asoció la UDR a la subred default para asegurar que el tráfico saliente pase por el firewall y las reglas de red/aplicación se apliquen correctamente.

- Tabla de rutas: T10-2022630278-vnet-rt (o equivalente)
- Ruta: 0.0.0.0/0 → Next hop: Virtual appliance (IP privada del firewall)
- Asociación: subred default

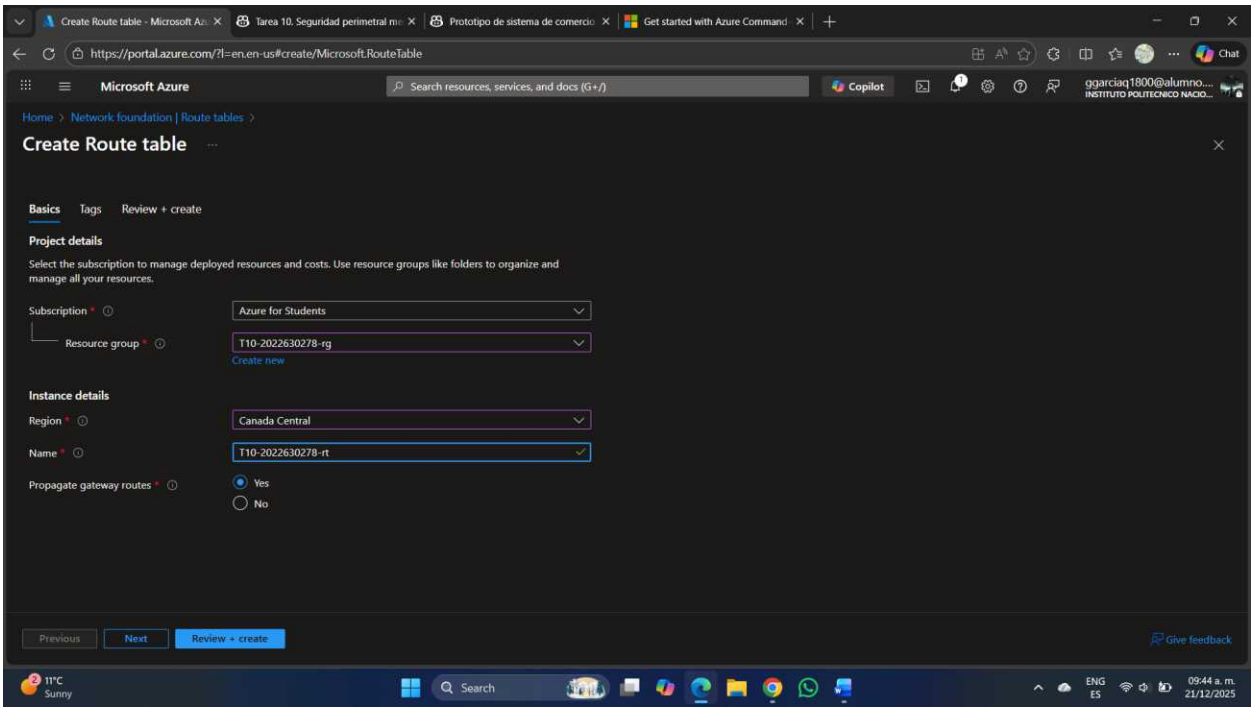




Crear la tabla de rutas (UDR) y asociarla a la subred default Esto es lo que hace que TODO el tráfico de salida de la subred default se encamine al firewall, para que tus reglas de red/aplicación realmente controlen la salida.

1. Crear la tabla de rutas:

- Portal → Buscar “Tablas de rutas” (Route tables) → Crear.
- Grupo de recursos: T10-2022630278-rg.
- Nombre: T10-2022630278-rt (por ejemplo).
- Región: Canada Central.
- Crear.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Home > Network foundation | Route tables >
Create Route table
Basics
Tags
Review + create
Project details
Select the subscription to manage deployed resources and costs. Use resource groups like folders to organize and manage all your resources.
Subscription *
Azure for Students
Resource group *
T10-2022630278-rg
Create new
Instance details
Region *
Canada Central
Name *
T10-2022630278-rt
Propagate gateway routes *
Yes
No
Previous
Next
Review + create
Give feedback
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Sunny
Search
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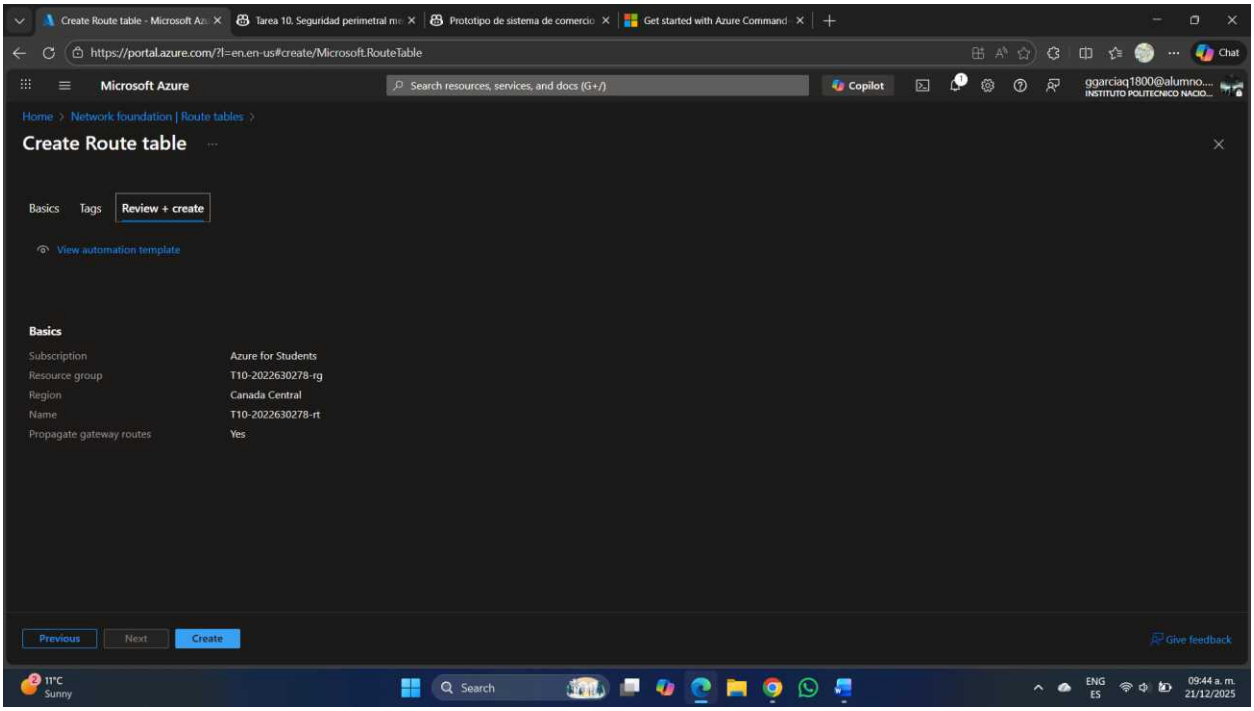
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Tags
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View automation template
Basics
Subscription
Azure for Students
Resource group
T10-2022630278-rg
Region
Canada Central
Name
T10-2022630278-rt
Propagate gateway routes
Yes
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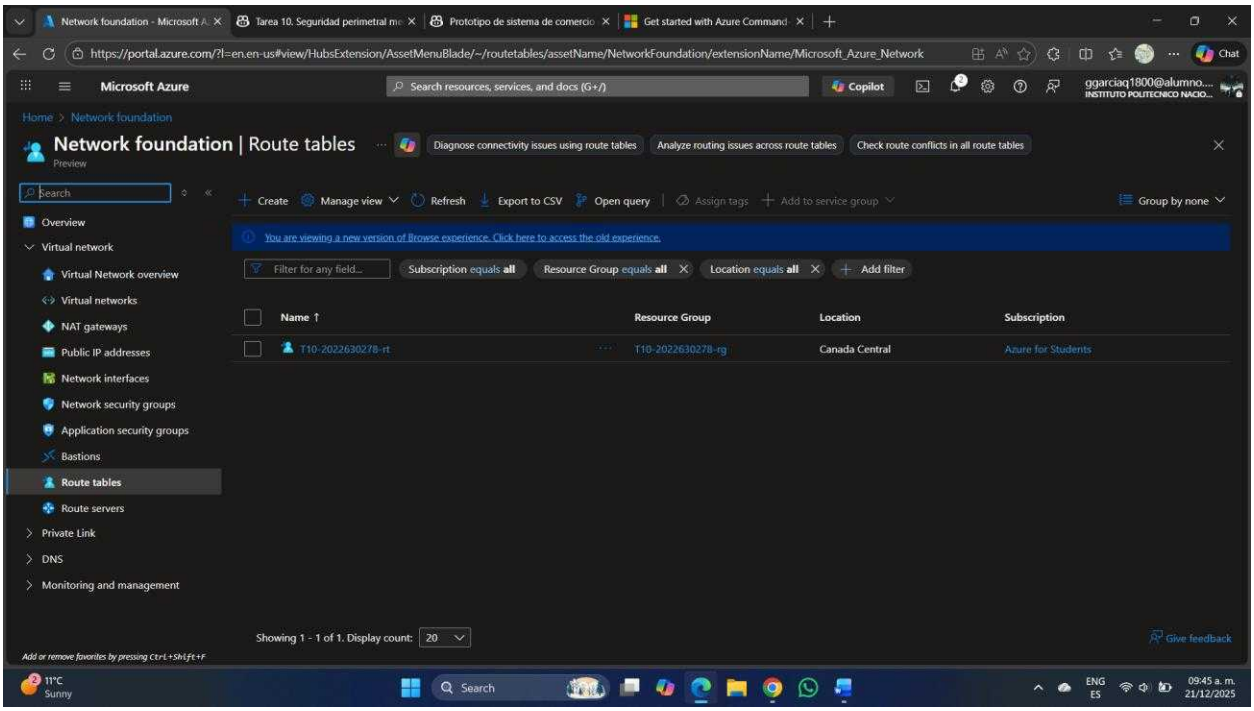
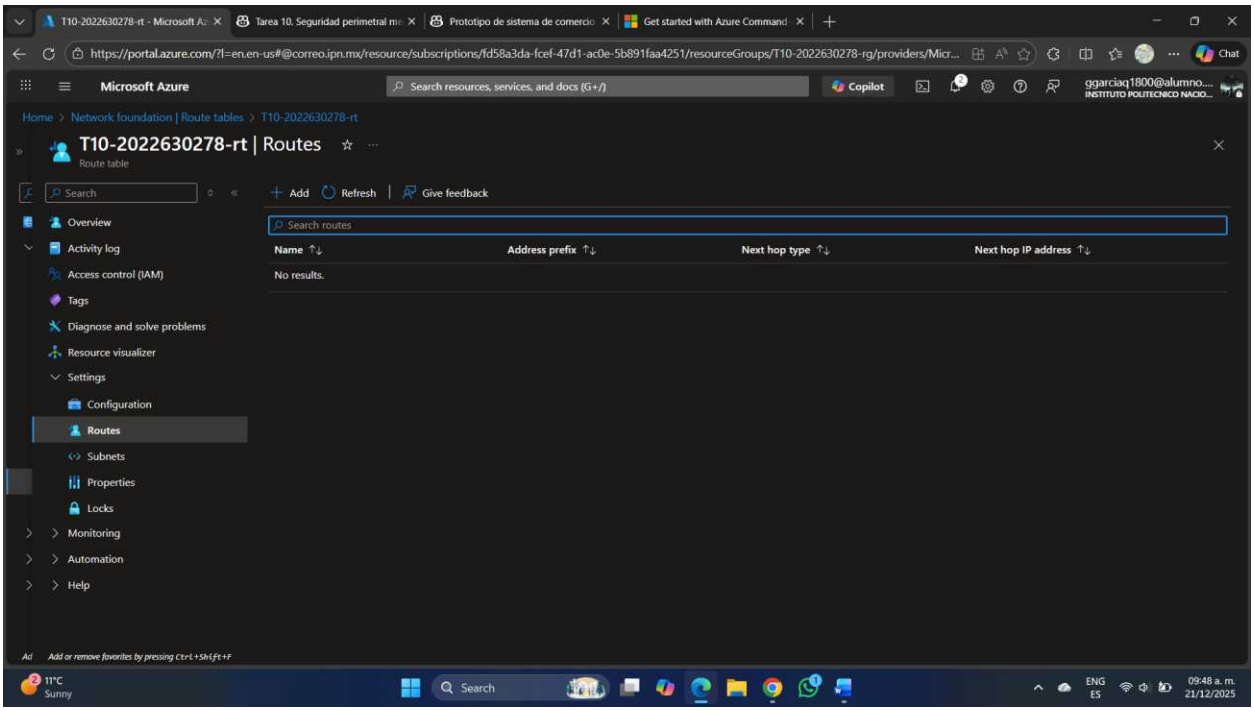


2. Se agrego la ruta por defecto:

- Se abrio la tabla de rutas, luego Rutas, y Agregar.
- Nombre: default-to-fw.
- Prefijo de dirección: 0.0.0.0/0.
- Tipo de siguiente salto: Virtual appliance.
- Dirección IP del siguiente salto: la IP privada del firewall T10-2022630278-fw en AzureFirewallSubnet (no la pública).
- Guardar.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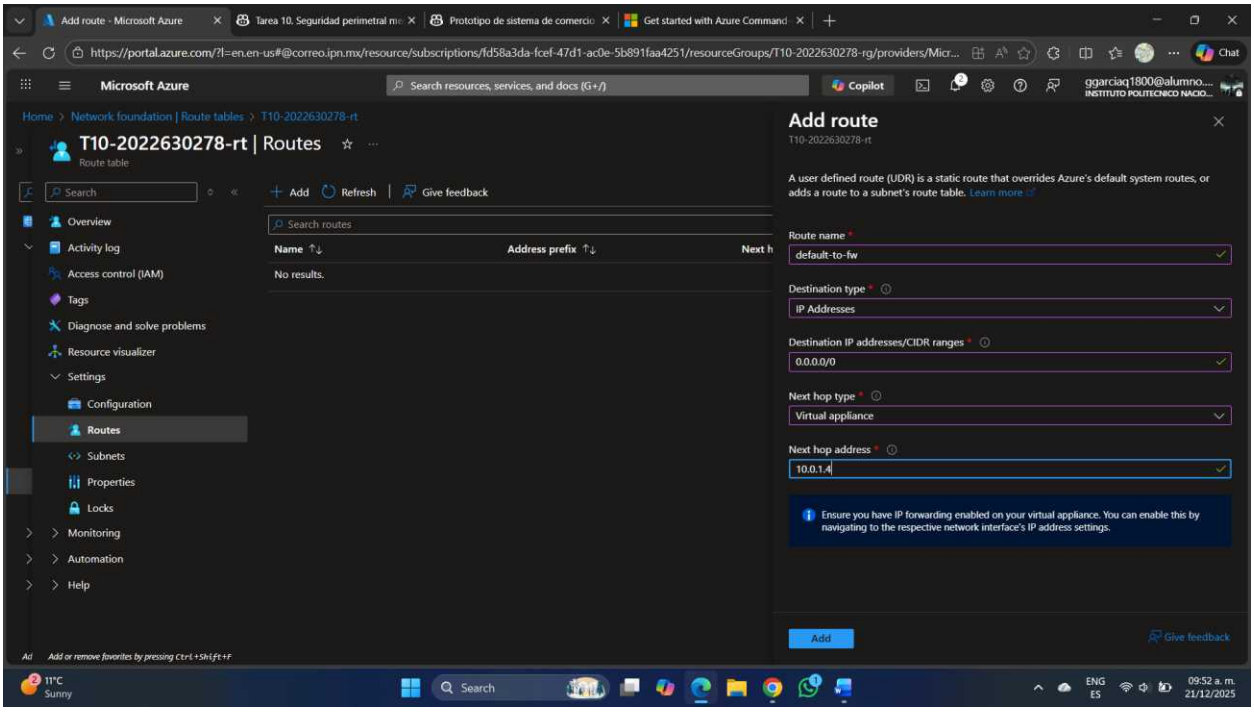
Copilot
Home > Network foundation | Route tables > T10-2022630278-rt
T10-2022630278-rt | Routes
Route table
Add
Refresh
Give feedback
Search routes
Name
Address prefix
Next hop type
Next hop IP address
No results.
Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems
Resource visualizer
Settings
Configuration
Routes
Subnets
Properties
Locks
Monitoring
Automation
Help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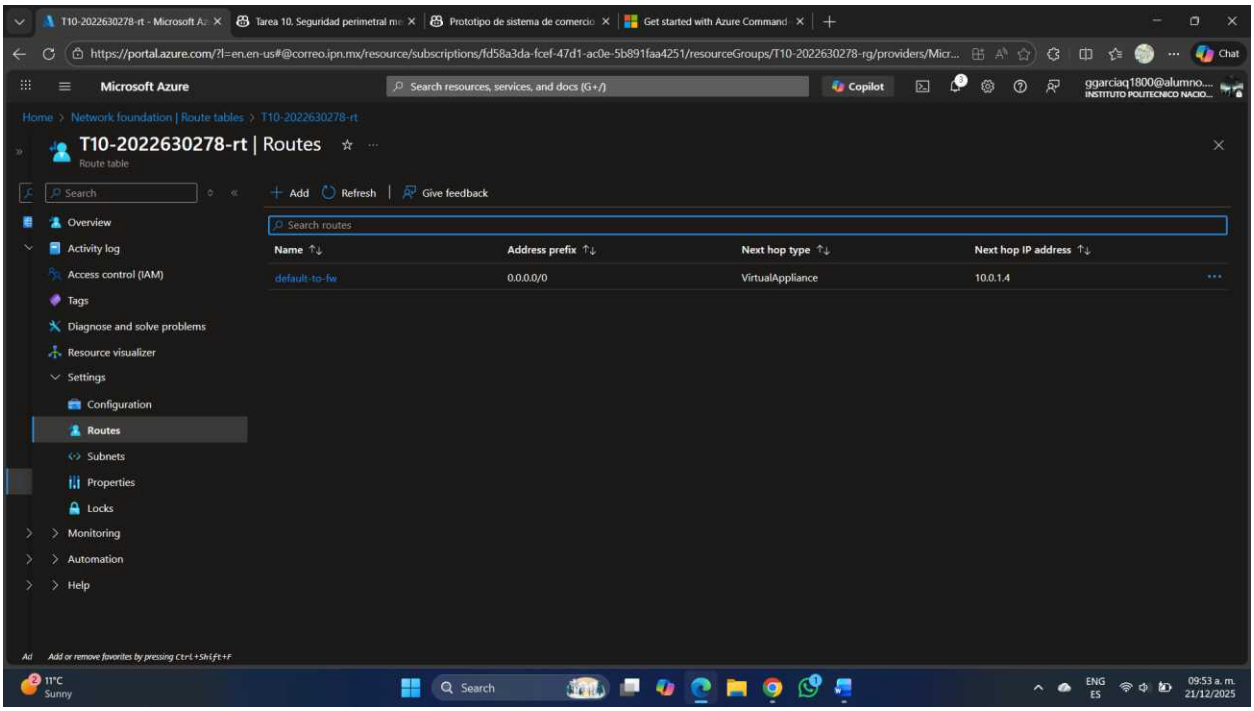
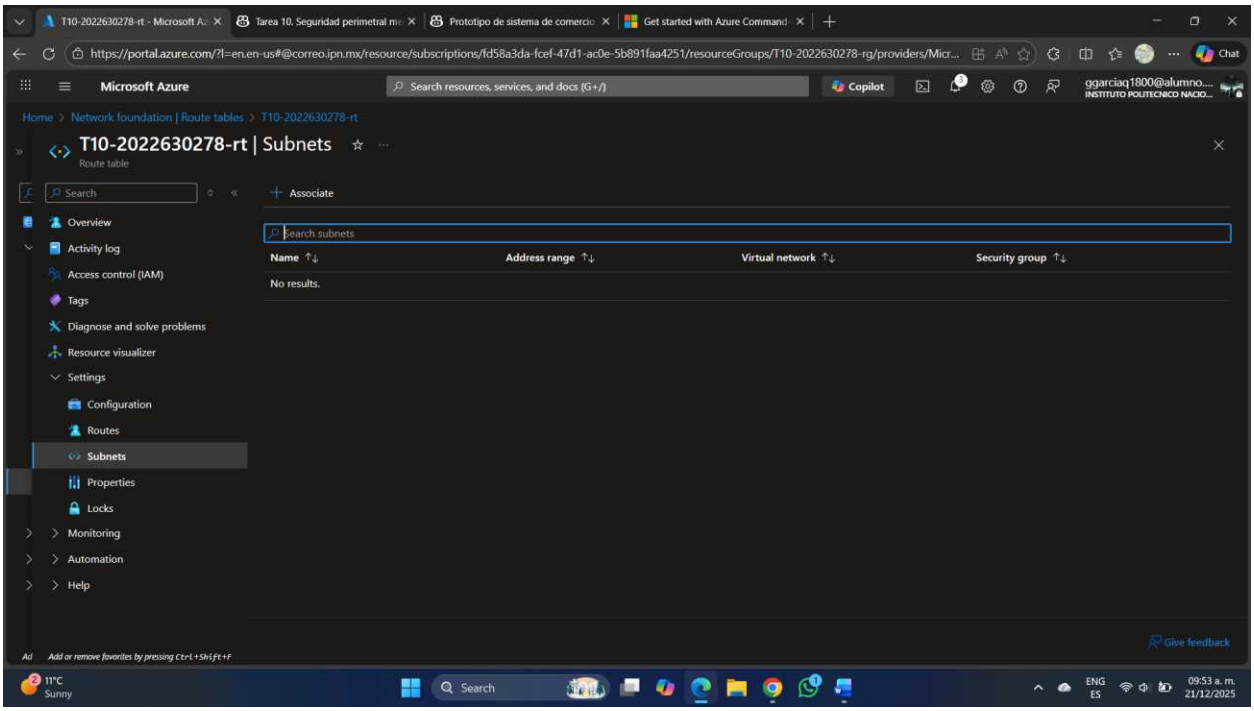
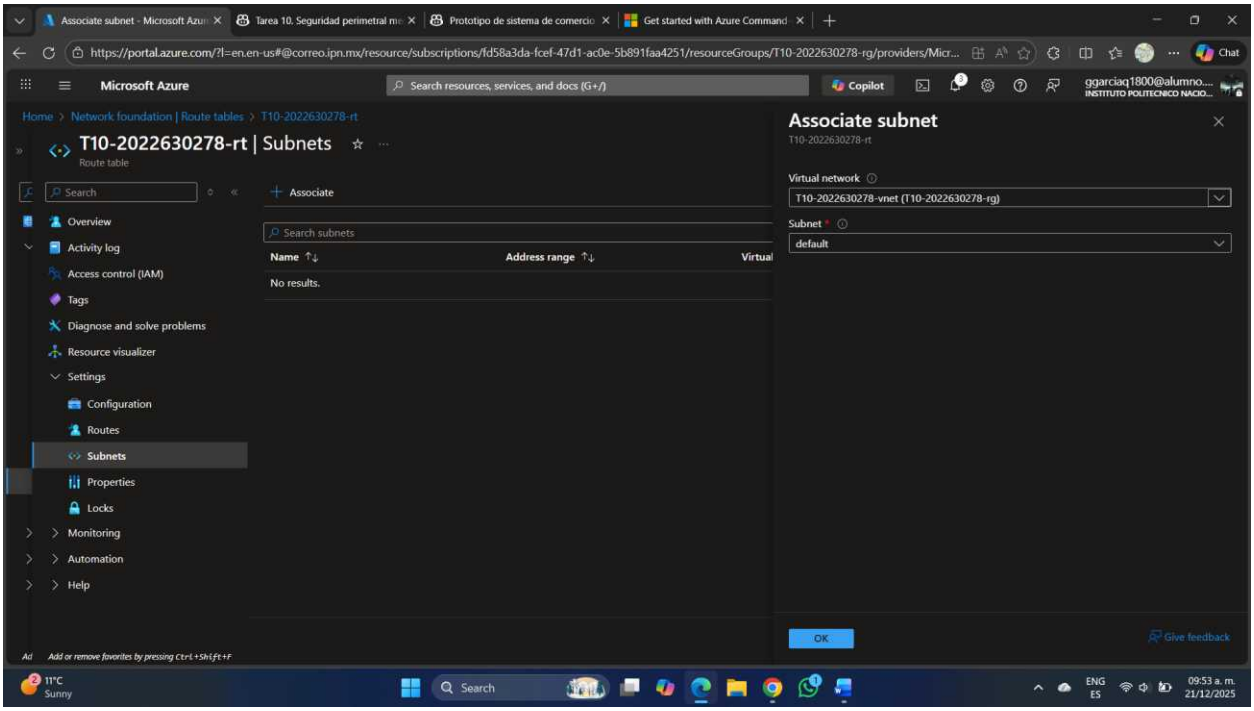
Copilot
Home > Network foundation | Route tables > T10-2022630278-rt
T10-2022630278-rt | Routes
Route table
Add route
T10-2022630278-rt
A user defined route (UDR) is a static route that overrides Azure's default system routes, or adds a route to a subnet's route table. Learn more
Route name *
default-to-fw
Destination type *
IP Addresses
Destination IP addresses/CIDR ranges *
0.0.0.0/0
Next hop type *
Virtual appliance
Next hop address *
10.0.1.4
Ensure you have IP forwarding enabled on your virtual appliance. You can enable this by navigating to the respective network interface's IP address settings.
Add
Give feedback



3. Asociar la tabla a la subred “default”:

- En la tabla de rutas → Subnets → Associate.
- VNet: T10-2022630278-vnet.
- Subnet: default.
- Guardar. Efecto: Todo tráfico de salida de la subred default irá al firewall como “siguiente salto”. Como tu regla NSG “Deny Internet Outbound” niega solo el service tag Internet, la comunicación hacia el firewall (IP privada dentro de la VNet) no se ve afectada. Desde el firewall, las reglas que configures (red/app) gobernarán qué destinos externos están permitidos.


Microsoft Azure
Search resources, services, and docs (G+/)
Copilot
Home > Network foundation | Route tables > T10-2022630278-rt
T10-2022630278-rt | Subnets
Route table
Search
Associate
Search subnets
Name
Address range
Virtual network
Security group
No results.
Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems
Resource visualizer
Settings
Configuration
Routes
Subnets
Properties
Locks
Monitoring
Automation
Help
Give feedback


Microsoft Azure
Search resources, services, and docs (G+/)
Copilot
Home > Network foundation | Route tables > T10-2022630278-rt
T10-2022630278-rt | Subnets
Route table
Associate subnet
T10-2022630278-rt
Virtual network
T10-2022630278-vnet (T10-2022630278-rg)
Subnet *
default
OK
Search
Associate
Search subnets
Name
Address range
No results.
Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems
Resource visualizer
Settings
Configuration
Routes
Subnets
Properties
Locks
Monitoring
Automation
Help
Give feedback

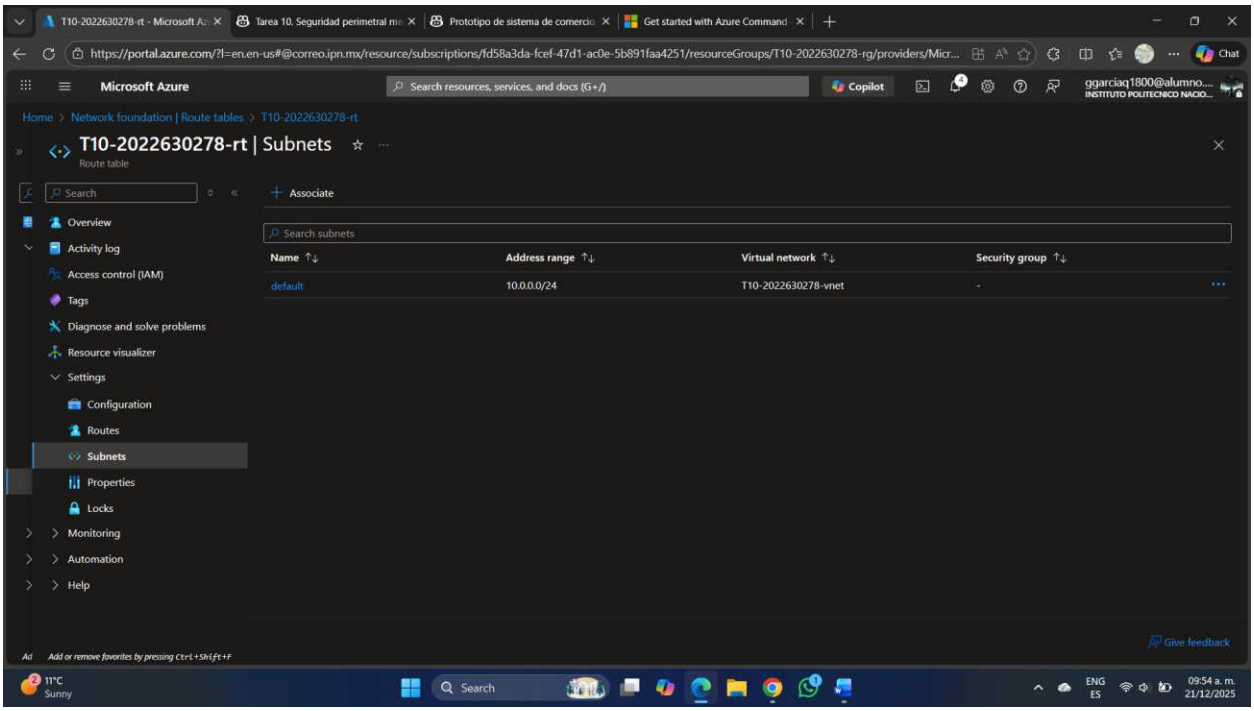
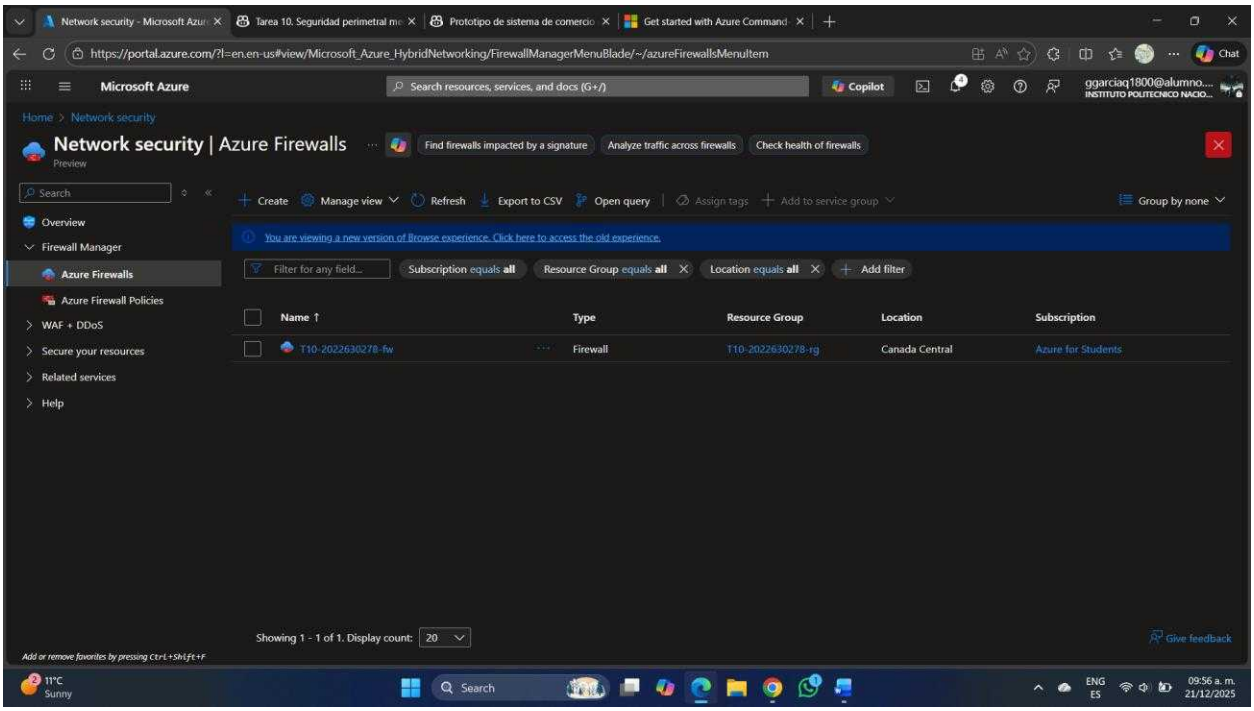


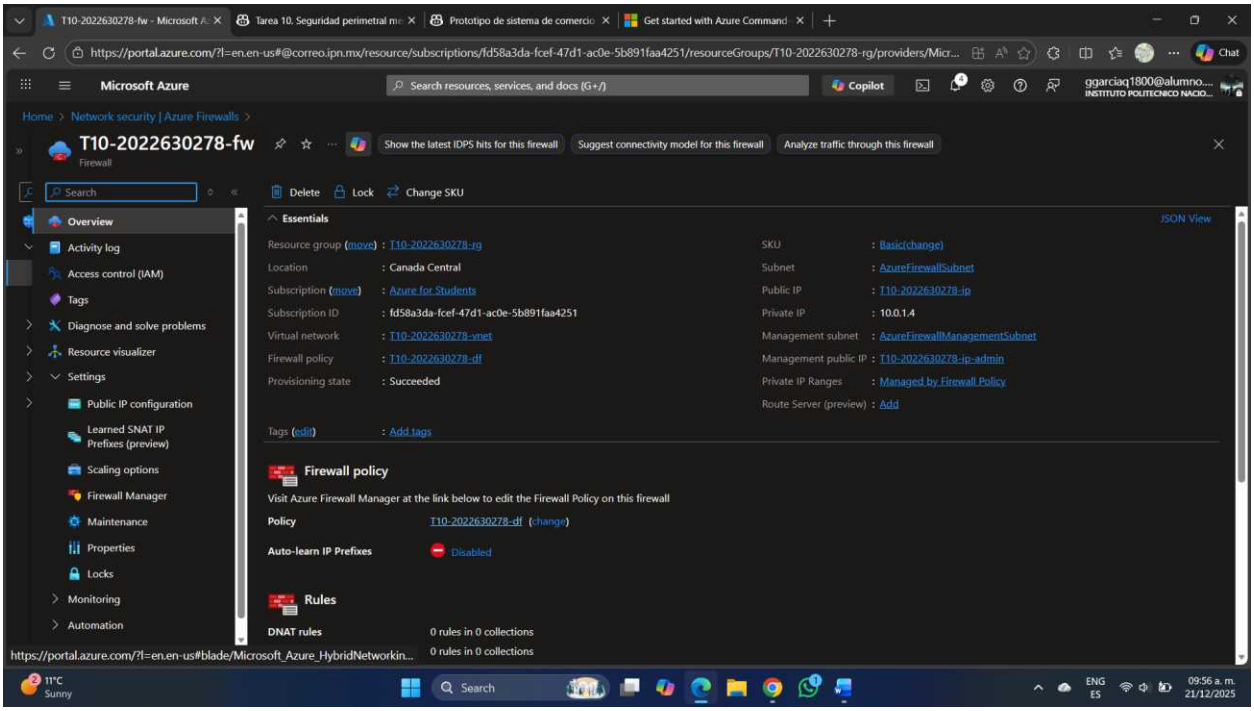
Figura 11. Asociación de la tabla de rutas a la subred default y ruta 0.0.0.0/0 al firewall.

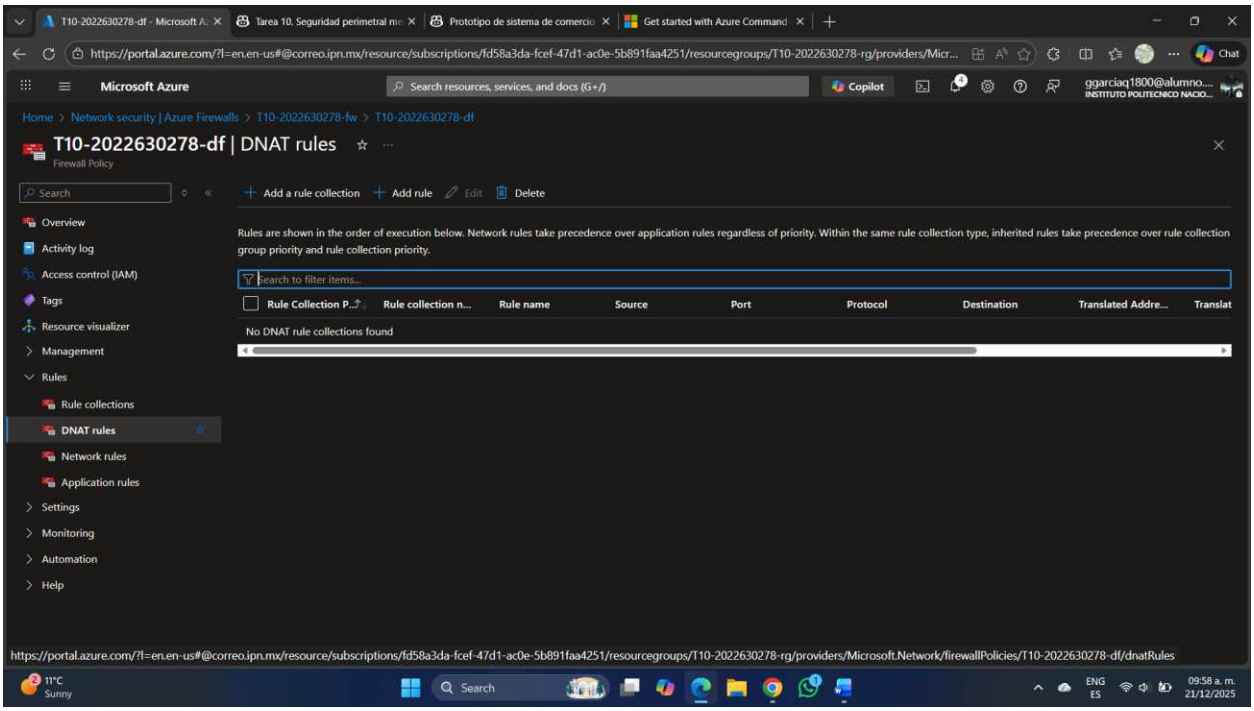
4.6 Regla DNAT para acceso SSH a la VM

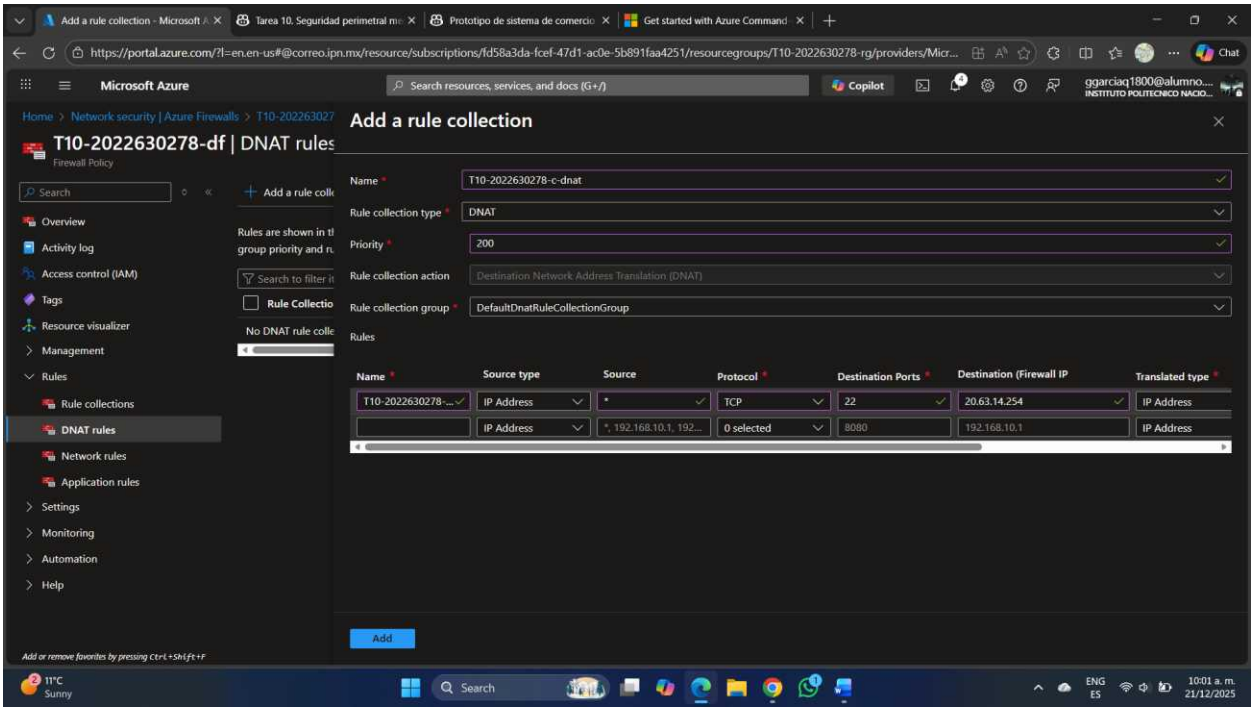
Se realizó la configuración de la regla DNAT en la política del firewall para permitir acceso SSH a la VM a través de la IP pública del firewall. Se definió la colección y la regla con prioridad 200, apuntando al puerto 22 y traduciendo el destino a la IP privada de la VM.

- Colección DNAT: T10-2022630278-c-dnat (prioridad 200, grupo DefaultDnatRuleCollectionGroup)
- Regla DNAT: T10-2022630278-dnat
    - Origen: “*” (tipo Dirección IP)
    - Protocolo: TCP
    - Puerto de destino: 22
    - Destino: IP pública del firewall
    - Traducido: IP privada de la VM, puerto 22


Network security - Microsoft Azure
Tarea 10. Seguridad perimetral me
Prototipo de sistema de comercio
Get started with Azure Command
https://portal.azure.com/?l=en.en-us#view/Microsoft_Azure_HybridNetworking/FirewallManagerMenuBlade/~/azureFirewallsMenuItem
Microsoft Azure
Search resources, services, and docs (G+/)
Copilot
Home > Network security
Network security | Azure Firewalls
Preview
Find firewalls impacted by a signature
Analyze traffic across firewalls
Check health of firewalls
Create
Manage view
Refresh
Export to CSV
Open query
Assign tags
Add to service group
Group by none
Overview
Firewall Manager
Azure Firewalls
Azure Firewall Policies
WAF + DDoS
Secure your resources
Related services
Help
You are viewing a new version of Browse experience. Click here to access the old experience.
Filter for any field...
Subscription equals all
Resource Group equals all
Location equals all
Add filter
Name
Type
Resource Group
Location
Subscription
T10-2022630278-fw
Firewall
T10-2022630278-rg
Canada Central
Azure for Students
Showing 1 - 1 of 1. Display count: 20
Give feedback
Add or remove favorites by pressing Ctrl+Shift+F
11°C
Sunny
Search
ENG
ES
09:56 a. m.
21/12/2025


T10-2022630278-fw - Microsoft A
Tarea 10. Seguridad perimetral me
Prototipo de sistema de comercio
Get started with Azure Command
https://portal.azure.com/?l=en.en-us#@correo.ipn.mx/resource/subscriptions/fd58a3da-fcef-47d1-ac0e-5b891faa4251/resourceGroups/T10-2022630278-rg/providers/Micr...
Microsoft Azure
Search resources, services, and docs (G+/)
Copilot
Home > Network security | Azure Firewalls >
T10-2022630278-fw
Firewall
Show the latest IDPS hits for this firewall
Suggest connectivity model for this firewall
Analyze traffic through this firewall
Delete
Lock
Change SKU
Overview
Activity log
Access control (IAM)
Tags
Diagnose and solve problems
Resource visualizer
Settings
Public IP configuration
Learned SNAT IP Prefixes (preview)
Scaling options
Firewall Manager
Maintenance
Properties
Locks
Monitoring
Automation
Essentials
JSON View
Resource group (move) : T10-2022630278-rg
Location : Canada Central
Subscription (move) : Azure for Students
Subscription ID : fd58a3da-fcef-47d1-ac0e-5b891faa4251
Virtual network : T10-2022630278-vnet
Firewall policy : T10-2022630278-df
Provisioning state : Succeeded
SKU : Basic(change)
Subnet : AzureFirewallSubnet
Public IP : T10-2022630278-ip
Private IP : 10.0.1.4
Management subnet : AzureFirewallManagementSubnet
Management public IP : T10-2022630278-ip-admin
Private IP Ranges : Managed by Firewall Policy
Route Server (preview) : Add
Tags (edit) : Add tags
Firewall policy
Visit Azure Firewall Manager at the link below to edit the Firewall Policy on this firewall
Policy T10-2022630278-df (change)
Auto-learn IP Prefixes Disabled
Rules
DNAT rules 0 rules in 0 collections
0 rules in 0 collections
https://portal.azure.com/?l=en.en-us#blade/Microsoft_Azure_HybridNetworkin...
11°C
Sunny
Search
ENG
ES
09:56 a. m.
21/12/2025


T10-2022630278-df | DNAT rules
Firewall Policy
Add a rule collection
Add rule
Edit
Delete
Rules are shown in the order of execution below. Network rules take precedence over application rules regardless of priority. Within the same rule collection type, inherited rules take precedence over rule collection group priority and rule collection priority.
Search to filter items...
Rule Collection P...
Rule collection n...
Rule name
Source
Port
Protocol
Destination
Translated Addre...
Translat
No DNAT rule collections found
Overview
Activity log
Access control (IAM)
Tags
Resource visualizer
Management
Rules
Rule collections
DNAT rules
Network rules
Application rules
Settings
Monitoring
Automation
Help
https://portal.azure.com/?l=en.en-us#@correo.ipn.mx/resource/subscriptions/fd58a3da-fcef-47d1-ac0e-5b891faa4251/resourcegroups/T10-2022630278-rg/providers/Microsoft.Network/firewallPolicies/T10-2022630278-df/dnatRules


Add a rule collection
T10-2022630278-df | DNAT rules
Firewall Policy
Name *
T10-2022630278-c-dnat
Rule collection type *
DNAT
Priority *
200
Rule collection action
Destination Network Address Translation (DNAT)
Rule collection group *
DefaultDnatRuleCollectionGroup
Rules
Name *
Source type
Source
Protocol *
Destination Ports *
Destination (Firewall IP
Translated type *
T10-2022630278-...
IP Address
*
TCP
22
20.63.14.254
IP Address
IP Address
*, 192.168.10.1, 192...
0 selected
8080
192.168.10.1
IP Address
Add

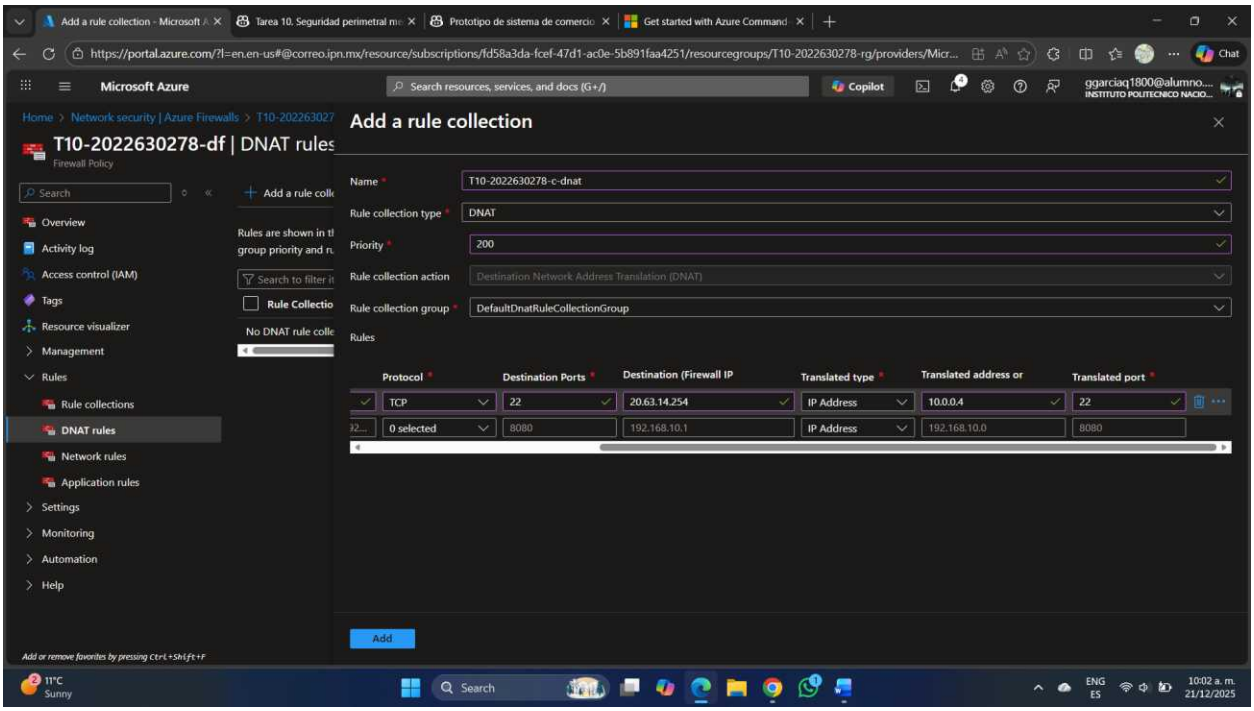


Figura 12. Colección y regla DNAT configurada para SSH hacia la VM.

Se realizó la prueba de conectividad desde el equipo local utilizando el comando SSH, validando que la sesión se establece por medio del firewall:

ssh azureuser@20.63.14.254

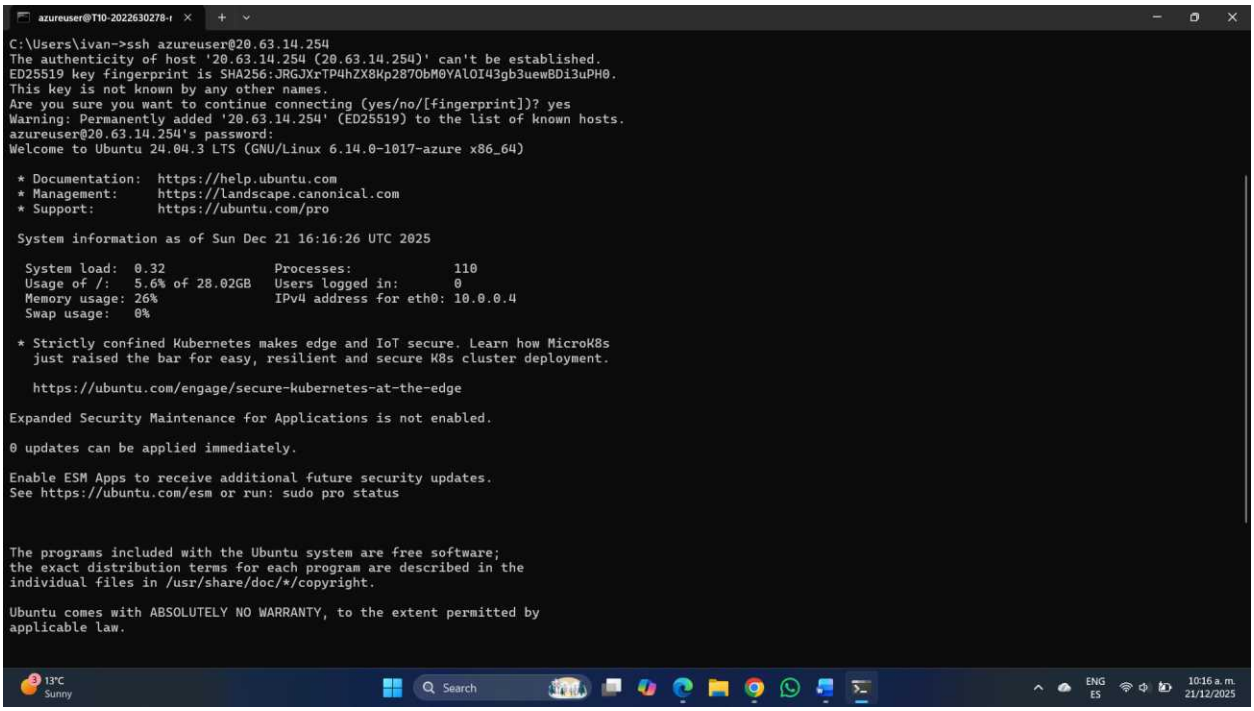


Figura 13. Prueba de acceso SSH a la VM mediante DNAT (sesión establecida).

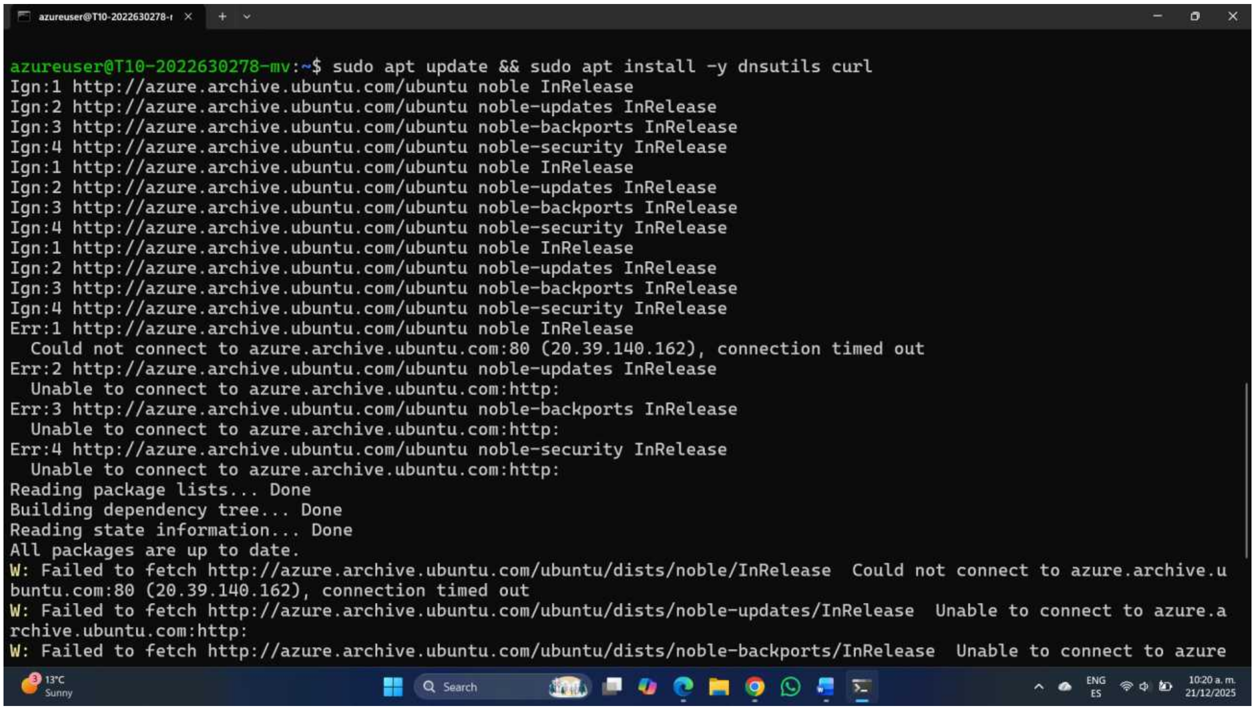
4.7 Regla de red para permitir solo www.m4gm.com

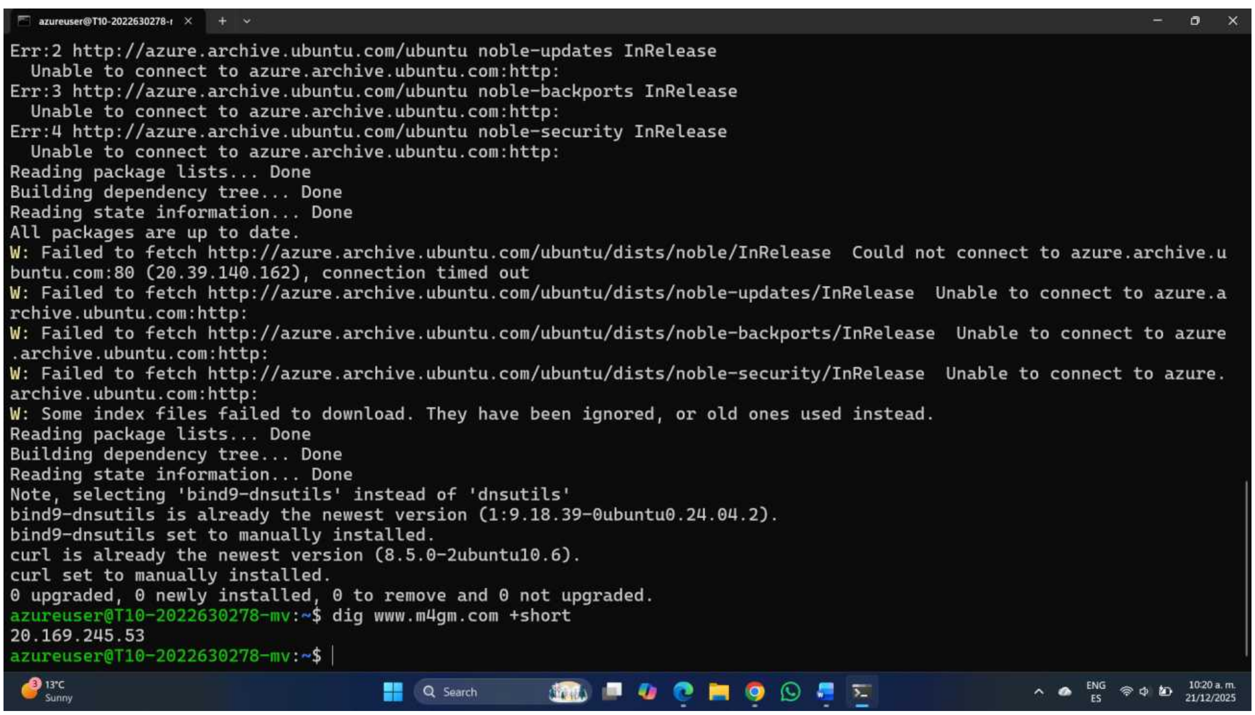
Se realizó la obtención de la dirección IP del FQDN www.m4gm.com y de www.m4gm.com/moodle de desde la VM, y se creó una regla de red que permite tráfico TCP 443 desde la subred default únicamente hacia esa IP. Se probó conectividad con curl para confirmar que m4gm responde y que otros destinos como google.com quedan bloqueados.

- Obtención de IP:

sudo apt update && sudo apt install -y dnsutils curl

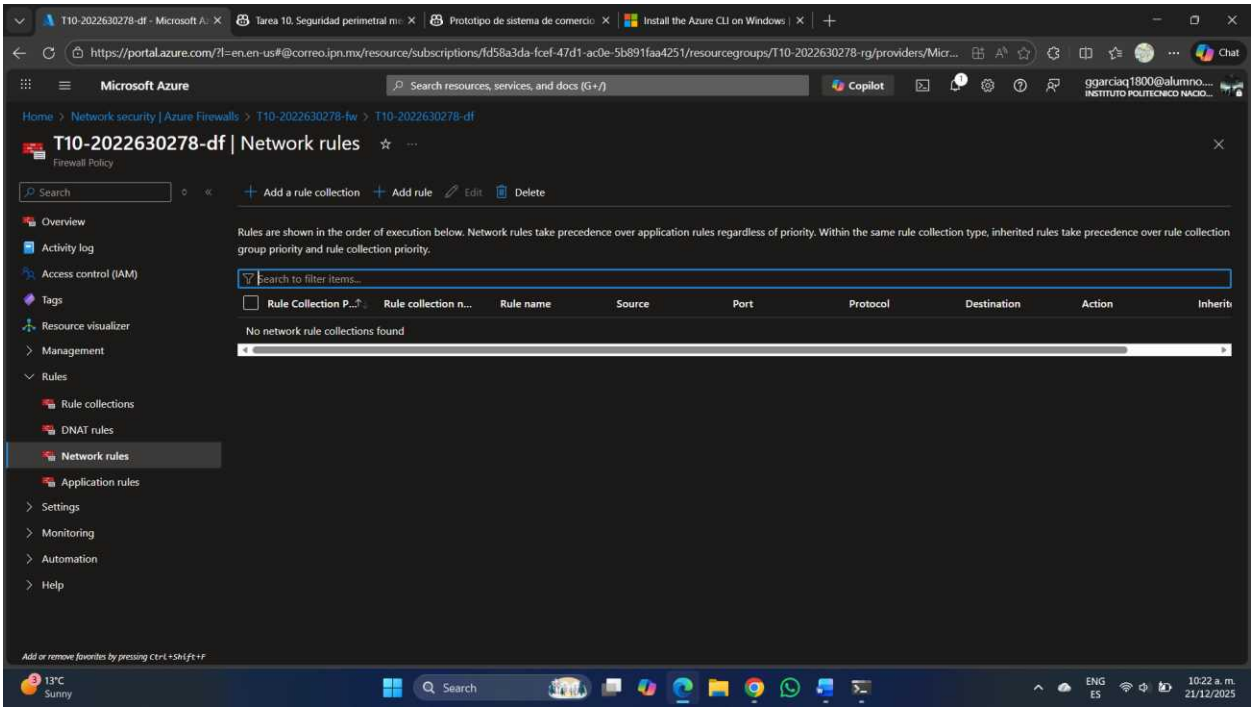
dig www.m4gm.com +short

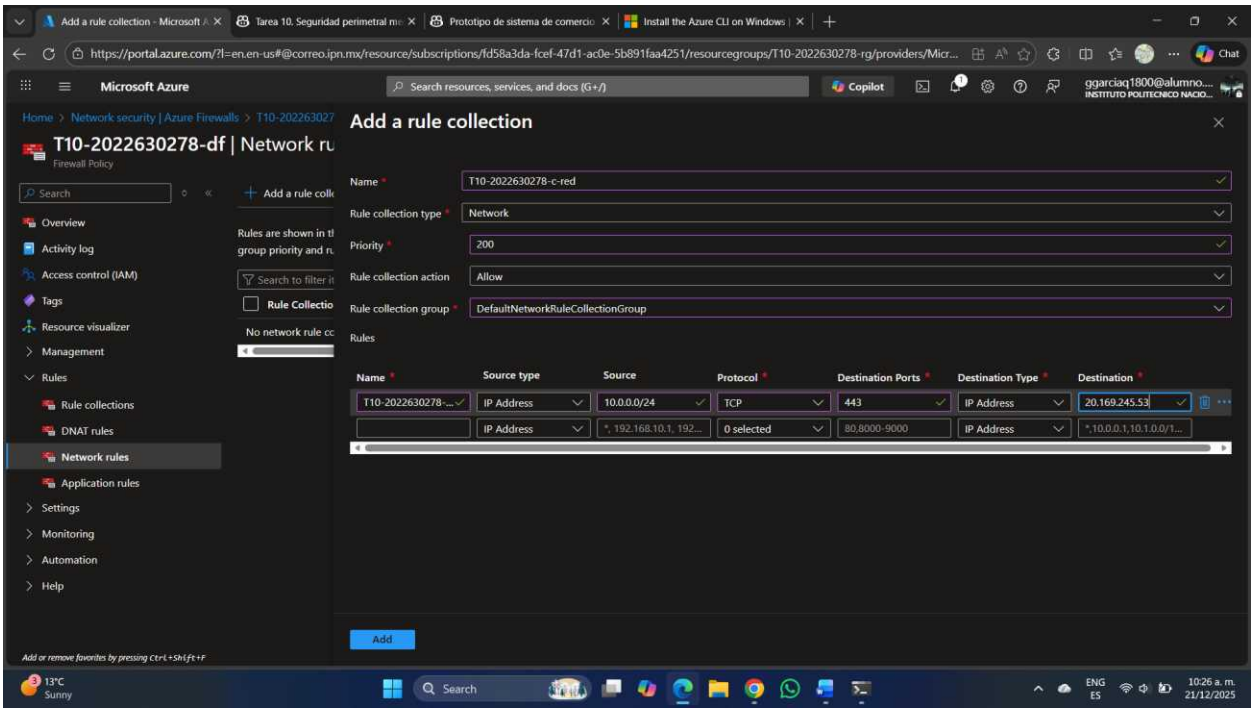




- Colección de reglas de red: T10-2022630278-c-red (tipo Red, prioridad 200, acción Permitir, grupo DefaultNetworkRuleCollectionGroup)
- Regla de red: T10-2022630278-red
  - Origen: 10.0.0.0/24 (tipo Dirección IP)

- Protocolo: TCP
- Puerto destino: 443
- Destino: IP obtenida de www.m4gm.com (tipo Dirección IP)





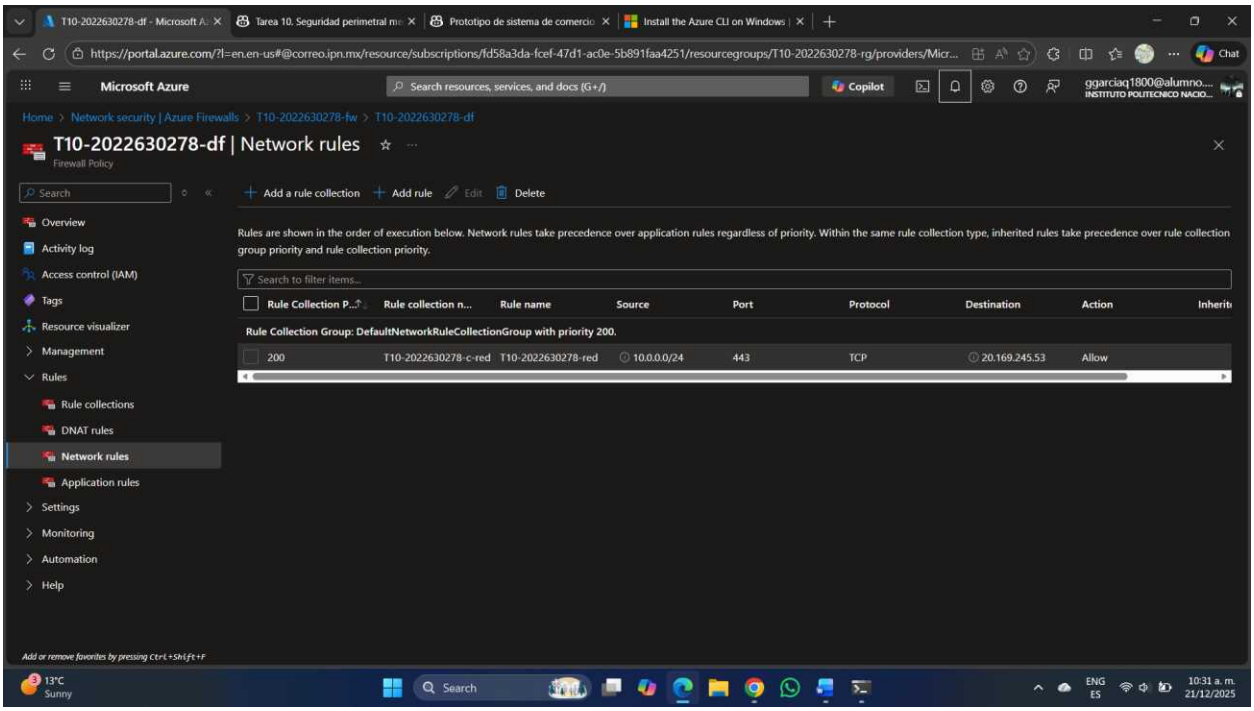


Figura 14. Colección y regla de red que permiten HTTPS solo hacia la IP de www.m4gm.com.

Pruebas de conectividad desde la VM:

curl -I https://www.m4gm.com # Debe estar permitido

curl -I https://www.m4gm.com/moodle # Debe responder 200 o 300

curl -I https://www.google.com # Debe fallar (bloqueado)

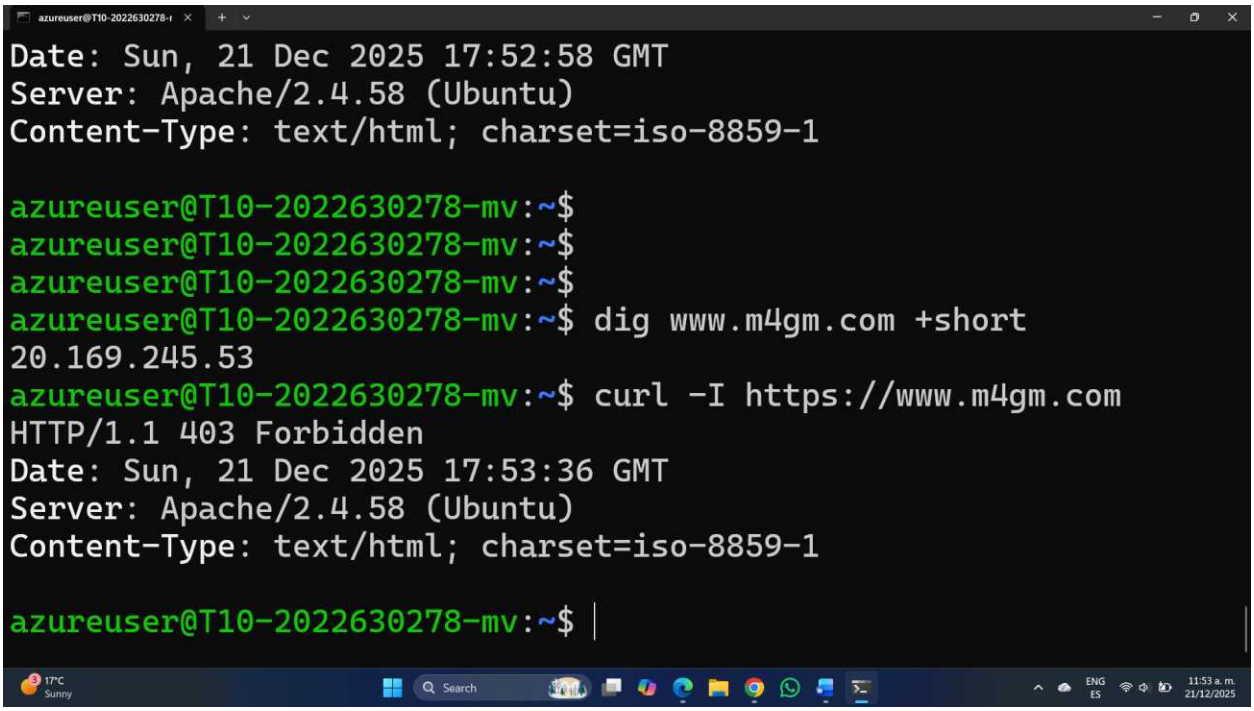


Figura 15. Resultado de curl hacia www.m4gm.com .

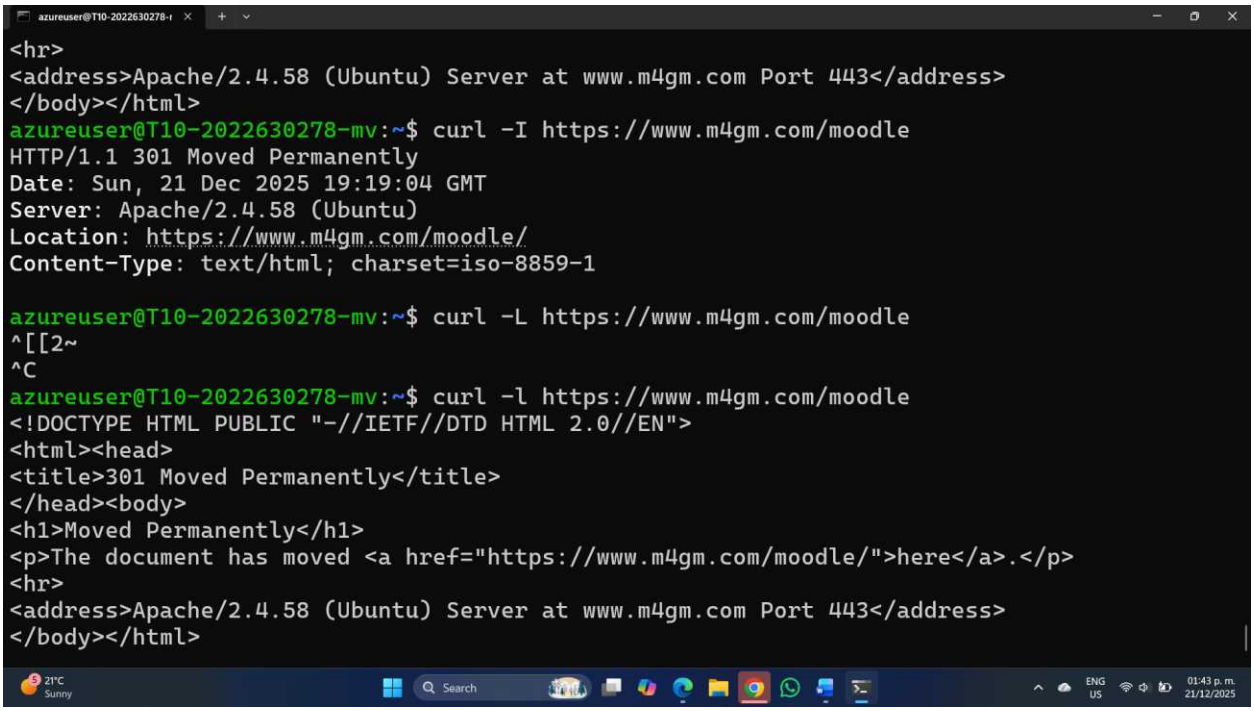


Figura 15. Resultado de curl hacia www.m4gm.com/moodle.

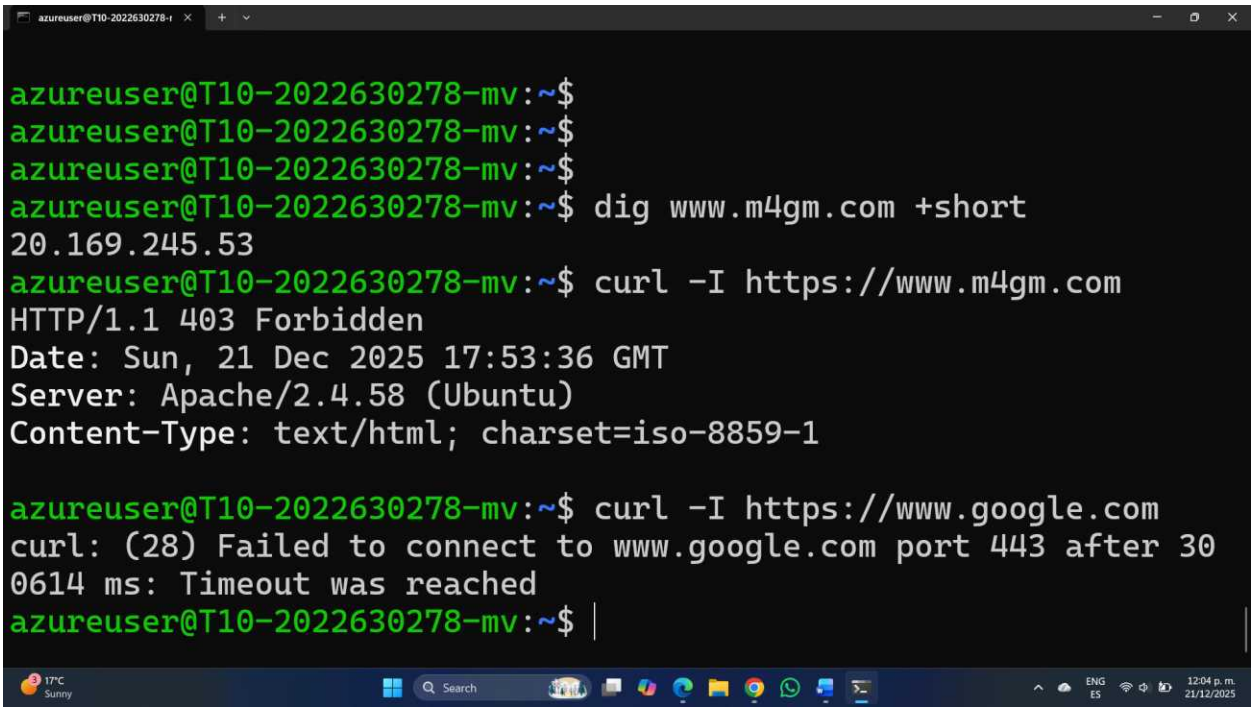
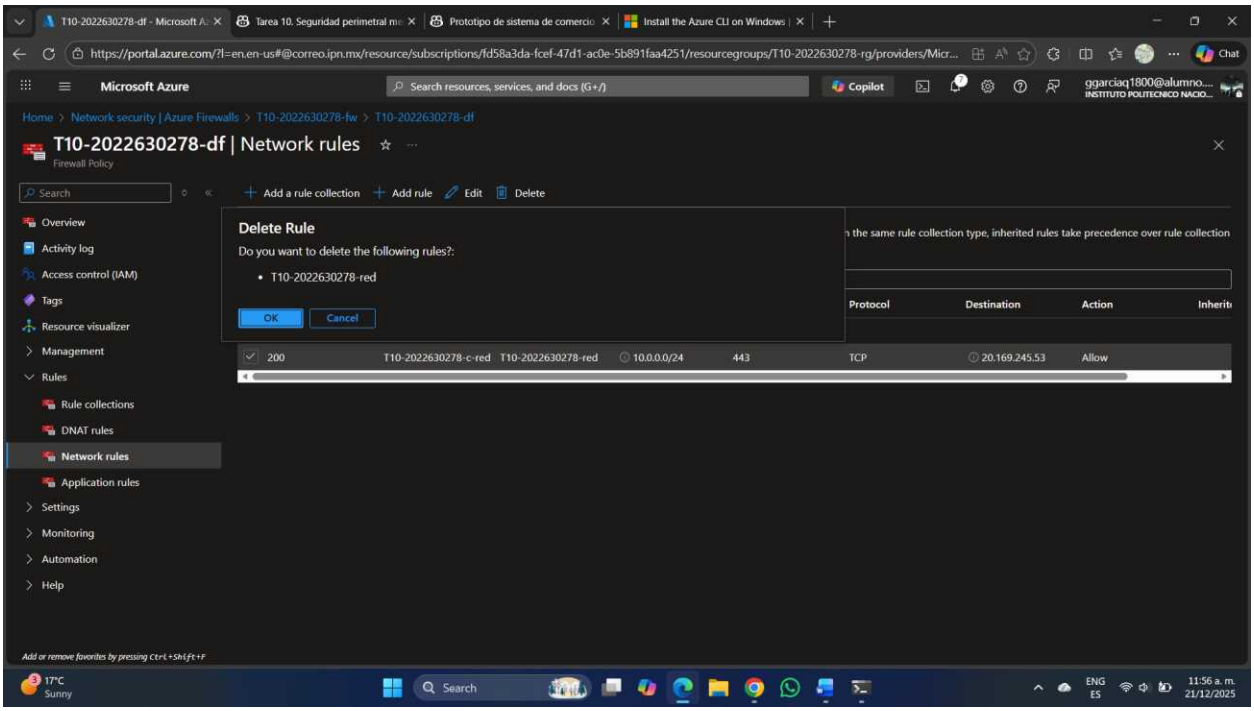


Figura 16. Resultado de curl hacia www.google.com (bloqueado).

4.8 Regla de aplicación para YouTube (tras eliminar la regla de red)

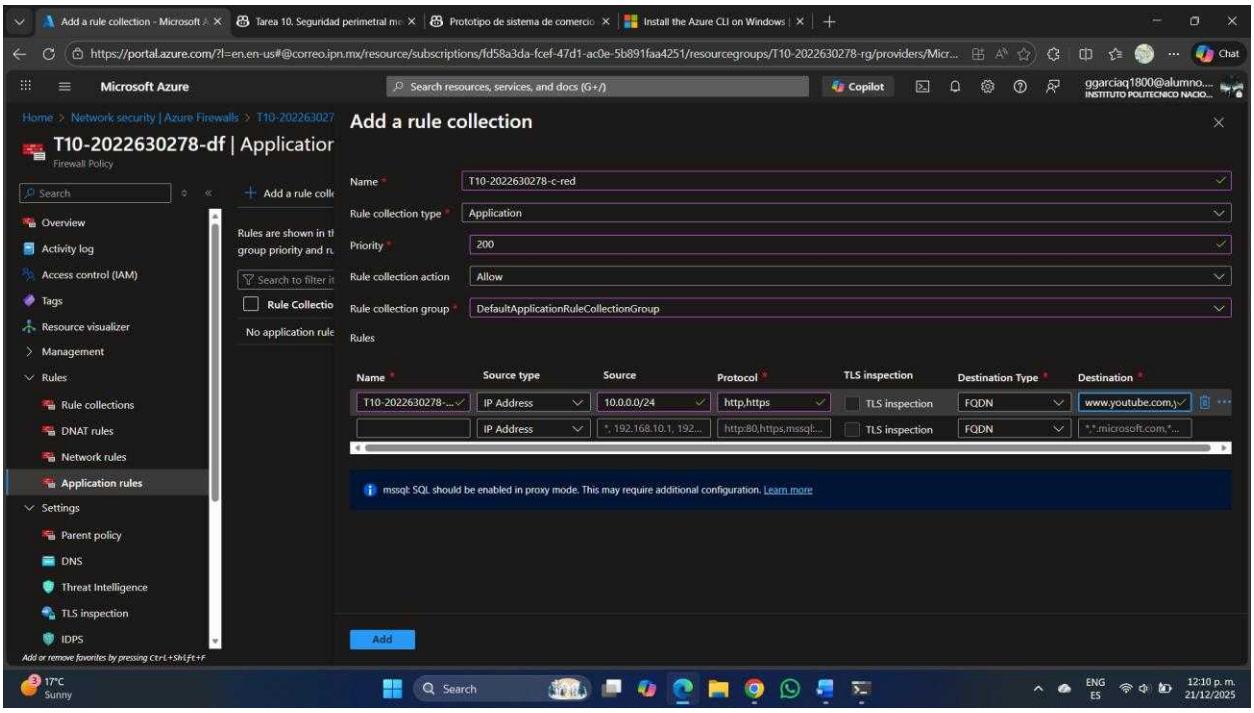
Se realizó la eliminación de la colección de reglas de red y posteriormente se creó la colección de reglas de aplicación que permite HTTP/HTTPS hacia los FQDNs youtube.com y www.youtube.com, con origen en el rango de la subred default. Se validó conectividad con curl a los dominios permitidos y bloqueo a destinos no configurados.

- Eliminación de colección de red: T10-2022630278-c-red



- Colección de reglas de aplicación: T10-2022630278-c-app (prioridad 200, acción Permitir, grupo DefaultApplicationRuleCollectionGroup)
- Regla de aplicación: T10-2022630278-app
    - Origen: 10.0.0.0/24 (tipo Dirección IP)
    - Protocolos: http, https
    - Tipo de destino: FQDN
    - FQDNs: youtube.com, www.youtube.com

Figura 17. Eliminación de la colección de reglas de red (T10-2022630278-c-red).



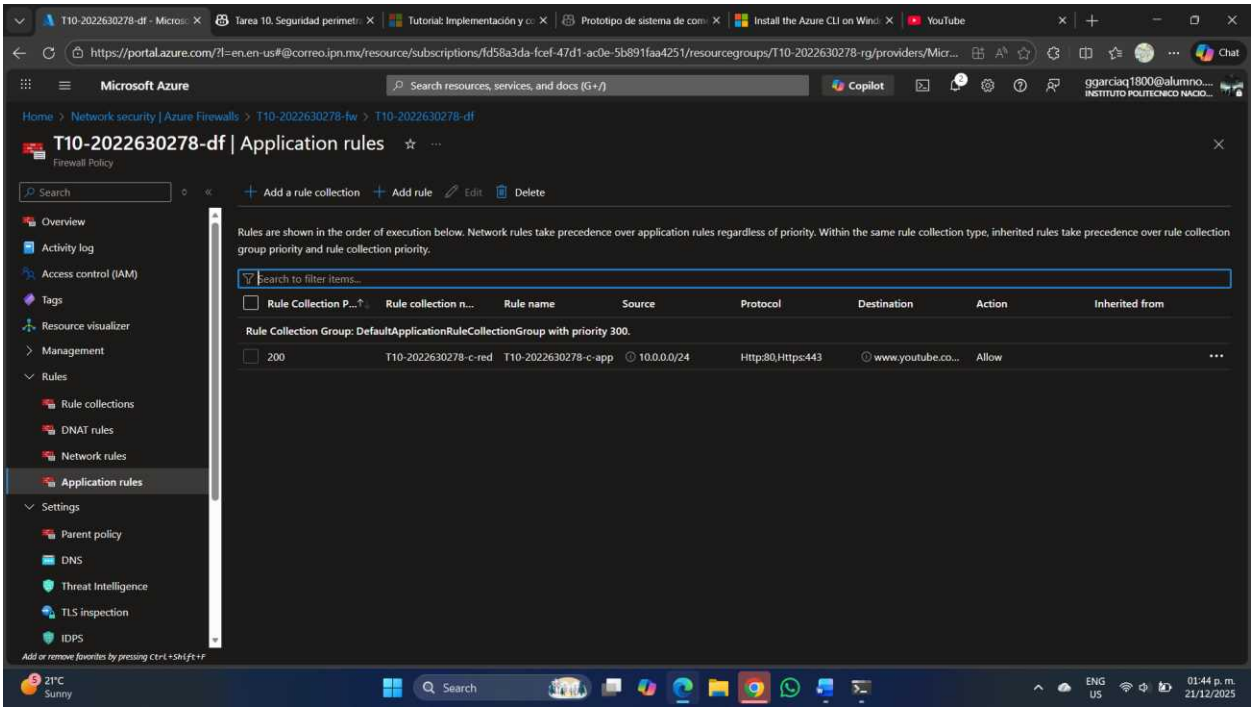


Figura 18. Colección y regla de aplicación que permiten HTTP/HTTPS a youtube.com y www.youtube.com.

Pruebas de conectividad desde la VM:

curl -I https://youtube.com # Debe responder (permitido)

curl -I https://www.youtube.com # Debe responder (permitido)

curl -I https://www.google.com # Debe fallar (bloqueado)

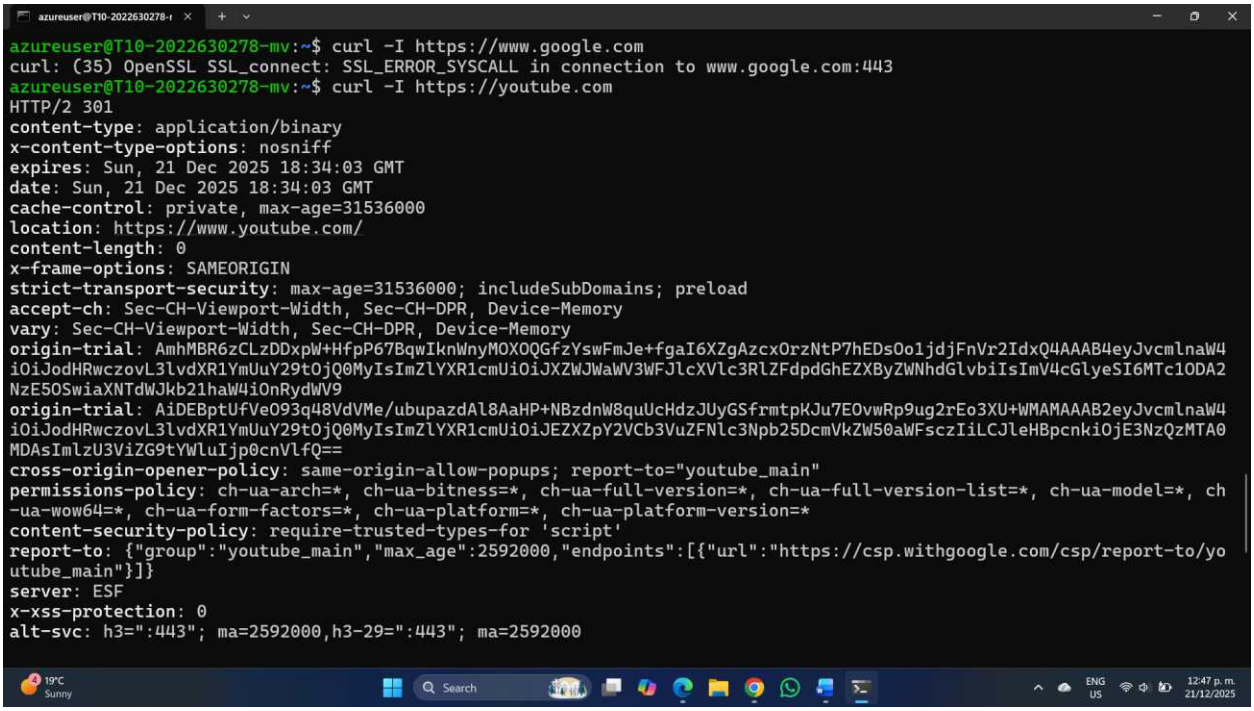


Figura 19. Resultado de curl hacia youtube.com (permitido).

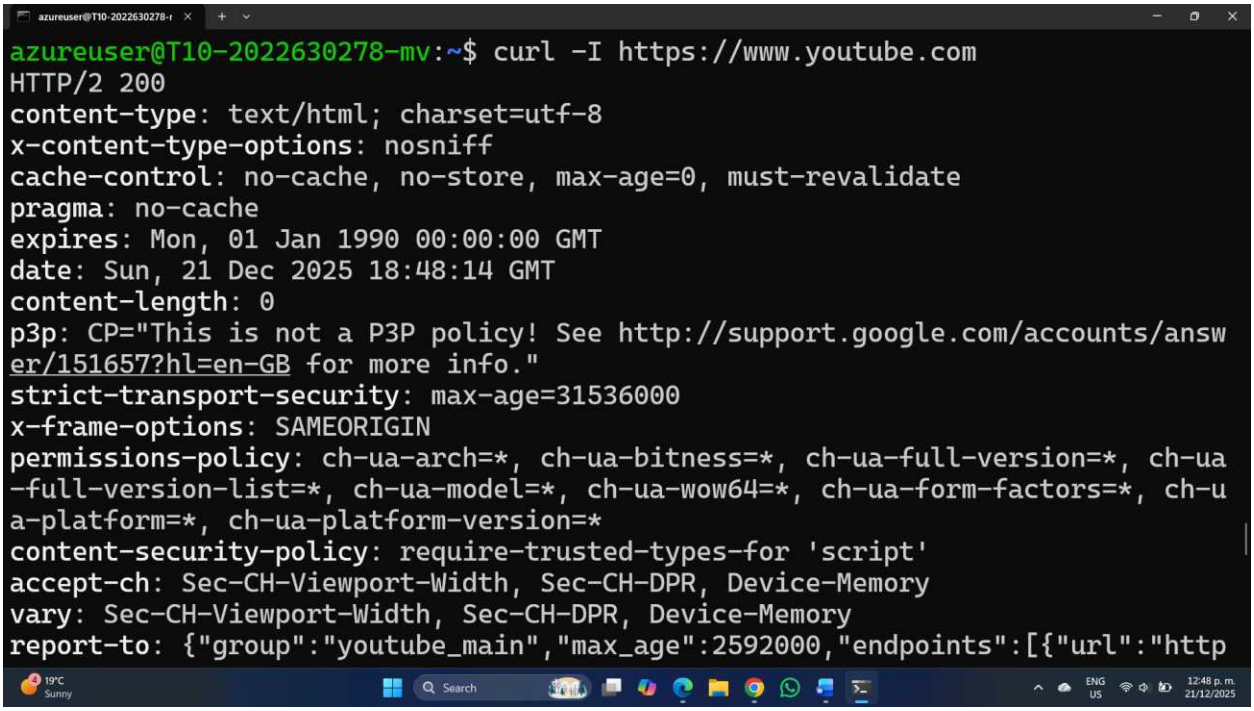


Figura 20. Resultado de curl hacia www.youtube.com (permitido).

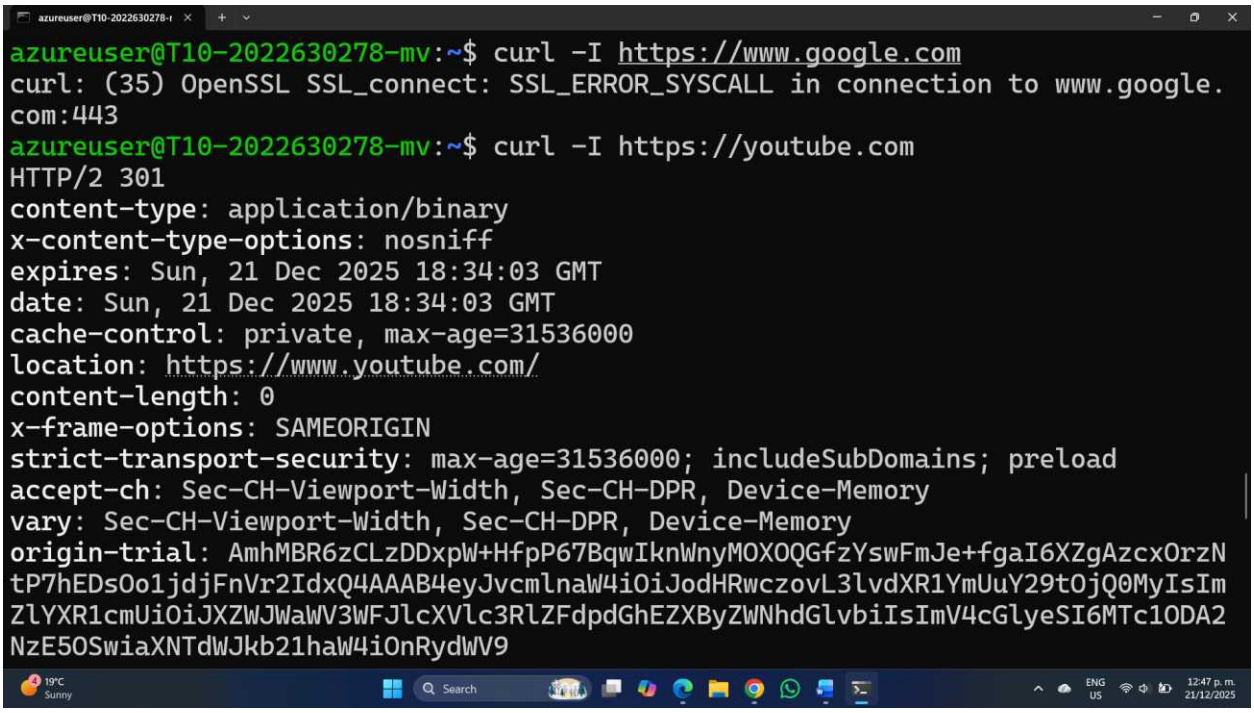


Figura 21. Resultado de curl hacia www.google.com (bloqueado).

5 Resultados

Se realizó la validación completa del entorno de seguridad perimetral en Azure. Se accedió a la máquina virtual únicamente a través del Azure Firewall mediante DNAT, se comprobó la aplicación de reglas de red para limitar el tráfico HTTPS a un destino específico y se verificó la regla de aplicación para permitir acceso HTTP/HTTPS solo a dominios definidos. Se instaló y configuró correctamente el NSG y la tabla de rutas (UDR) para forzar el tráfico saliente a través del firewall, consolidando el control perimetral.

5.1 Conectividad por DNAT (SSH)

Se accedió a la máquina virtual T10-2022630278-mv mediante SSH usando la IP pública del firewall, confirmando que la traducción DNAT funcionó según lo establecido. La autenticación por contraseña se realizó correctamente y la sesión se estableció sin exponer una IP pública en la VM.

- La conexión SSH se estableció a través de la IP pública del firewall, traduciendo al puerto 22 de la IP privada de la VM.
- No se asignó IP pública a la VM, cumpliendo el requisito de acceso perimetral controlado.

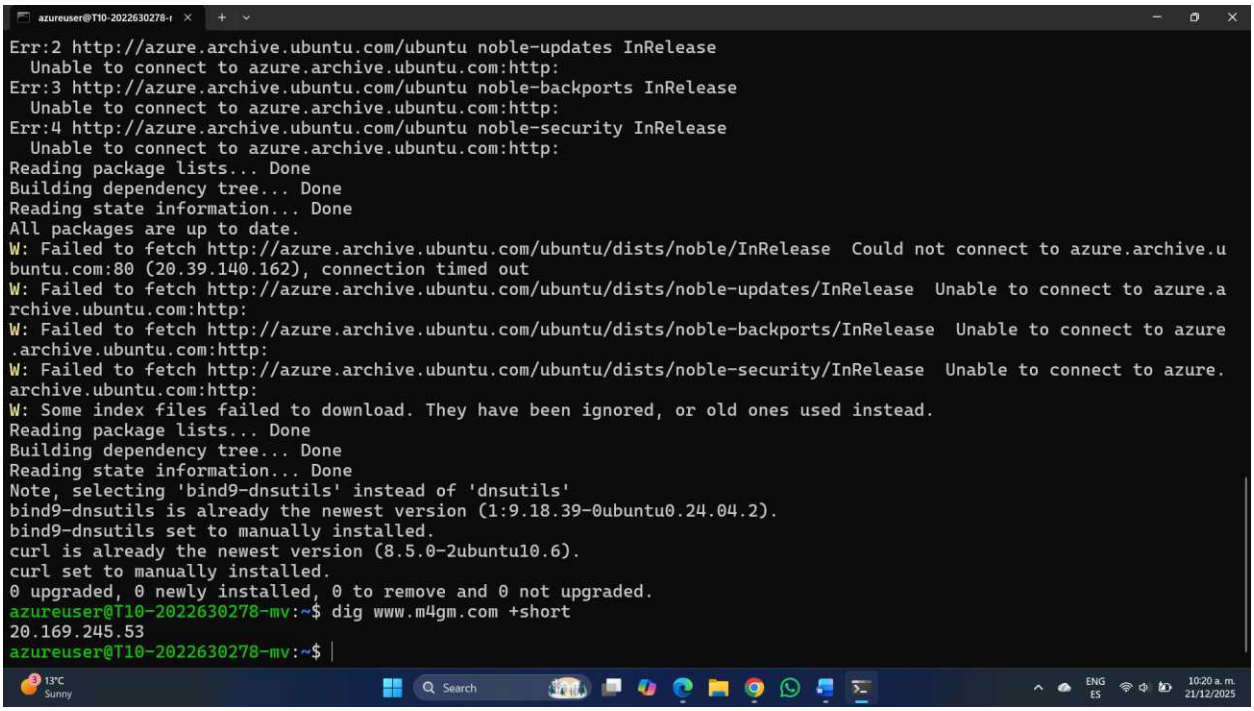


Figura 22. Sesión SSH establecida vía DNAT hacia T10-2022630278-mv.

5.2 Conectividad por regla de red (m4gm.com)

Se realizó la obtención de la dirección IP de www.m4gm.com y se verificó la conectividad permitida exclusivamente hacia ese destino por el puerto 443 desde la subred default. Se accedió con curl y se obtuvo respuesta exitosa (código 200). Se intentó acceder a un destino no autorizado (www.google.com) y se observó bloqueo, validando la aplicación de la regla de red.

- Se permitió HTTPS (443) desde 10.0.0.0/24 únicamente a la IP de www.m4gm.com.
- Se denegó la conexión a www.google.com por no estar definida en las reglas del firewall.

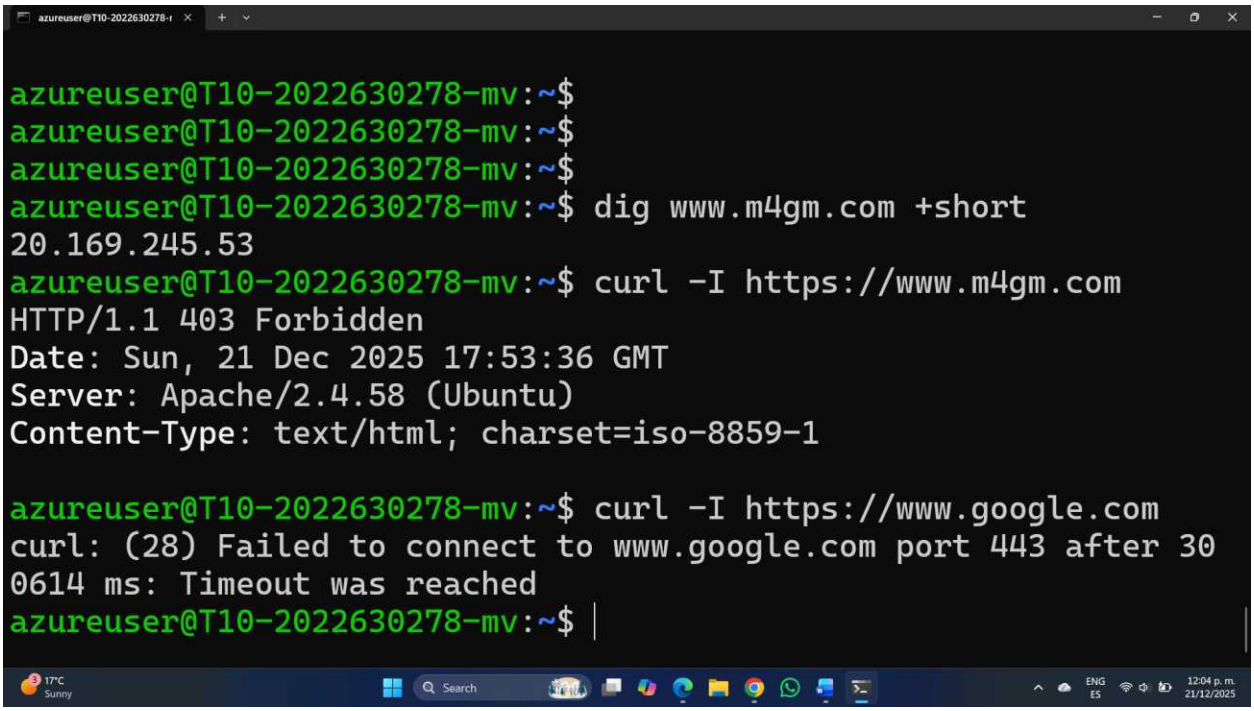


Figura 23. Resultado de curl hacia www.m4gm.com (código 200, permitido).

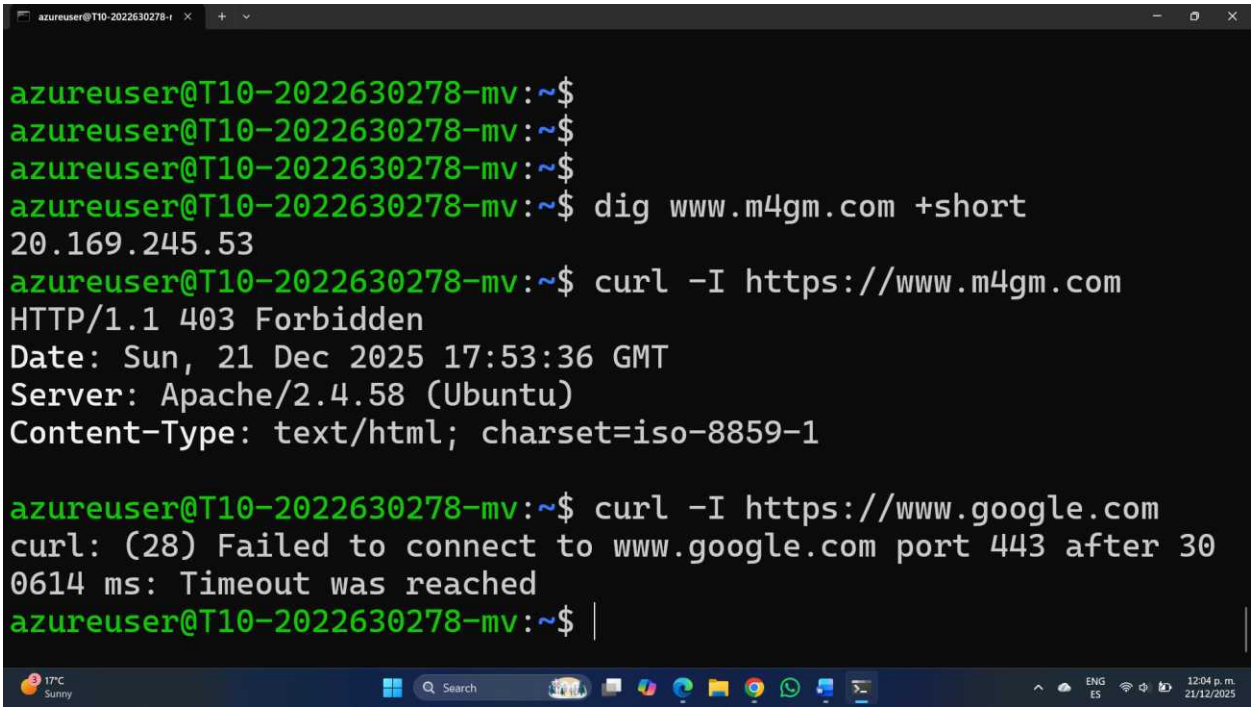


Figura 24. Resultado de curl hacia www.google.com (bloqueado por regla de red).

5.3 Conectividad por regla de aplicación (YouTube)

Se eliminó la colección de reglas de red y se creó la colección de reglas de aplicación para permitir HTTP/HTTPS hacia youtube.com y www.youtube.com desde la subred default. Se accedió con curl y se observó respuesta exitosa en ambos FQDNs; se probó un dominio no configurado (www.google.com) y se observó bloqueo.

- Se permitió http,https a FQDNs youtube.com y www.youtube.com.
- Se denegó el acceso a dominios no incluidos en la regla de aplicación (ej. google.com).

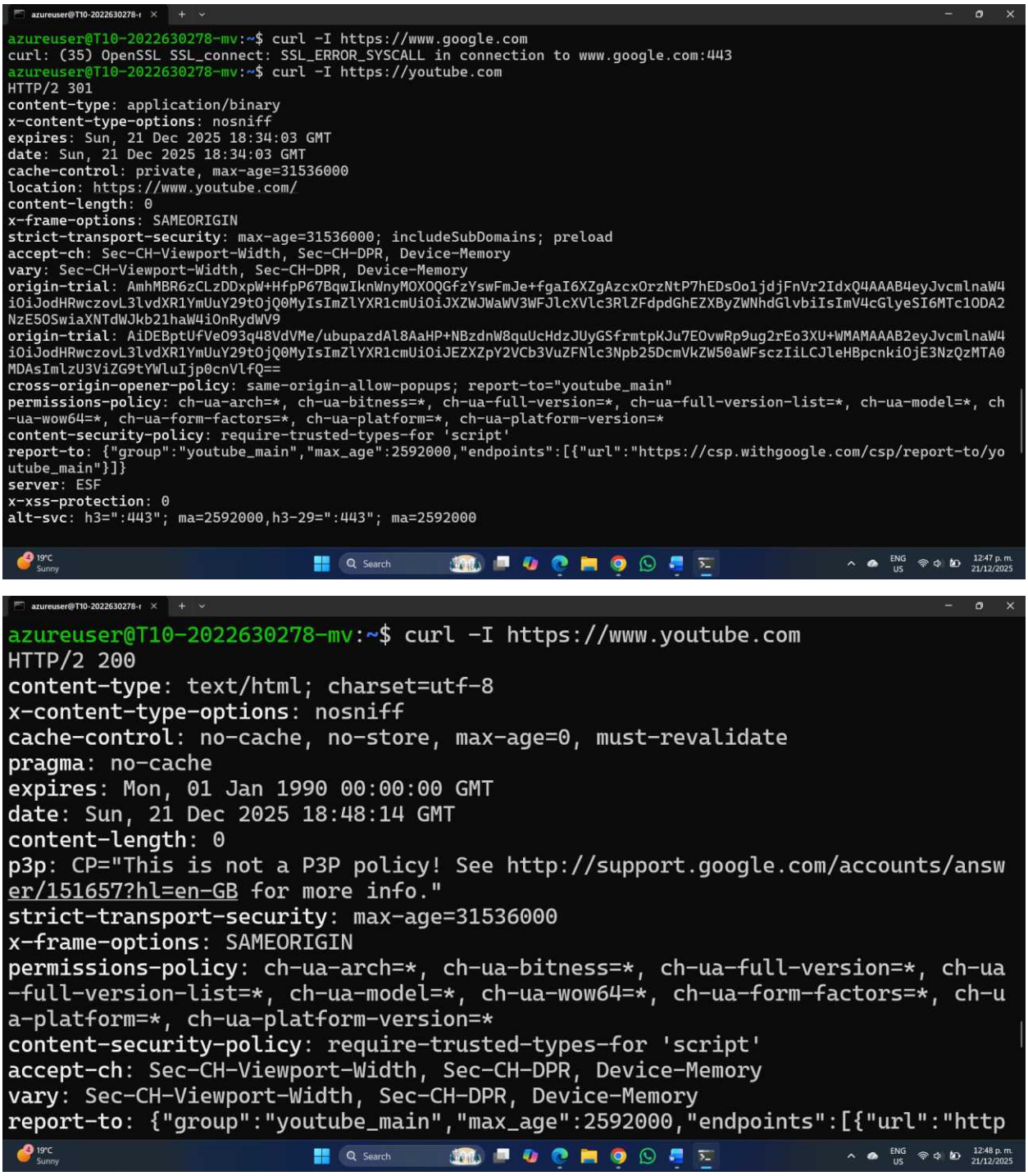


Figura 25. Resultado de curl hacia youtube.com (permitido por regla de aplicación).

6 Conclusiones

Se realizó la implementación de seguridad perimetral en Azure utilizando Azure Firewall (SKU Básico), cumpliendo la nomenclatura requerida y restringiendo la exposición de la máquina virtual al eliminar la IP pública y habilitar el acceso únicamente vía DNAT. Se accedió a los servicios permitidos mediante reglas de red y de aplicación, y se instaló una tabla de rutas (UDR) junto con reglas NSG para forzar y controlar el tráfico saliente a través del firewall. Con ello, se validó el funcionamiento de cada tipo de regla y la precedencia entre ellas.

El objetivo general se cumplió al diseñar y probar un esquema donde el firewall concentra el control del tráfico, demostrando que:

- Las reglas DNAT permitieron acceso SSH seguro a la VM usando la IP pública del firewall, sin exponer la VM a Internet.
- Las reglas de red habilitaron de forma precisa la salida HTTPS hacia un destino IP específico; destinos no configurados se bloquearon según lo esperado.
- Las reglas de aplicación permitieron tráfico HTTP/HTTPS únicamente a FQDNs definidos, bloqueando dominios no autorizados.
- La UDR y el NSG se configuraron para que el flujo de salida dependa del firewall, reforzando el perímetro y evitando rutas directas fuera del control.

Se concluye que la combinación de DNAT, reglas de red y reglas de aplicación, con ruteo forzado por UDR y políticas NSG restrictivas, ofrece un control granular y verificable del tráfico en la VNet. Se recomienda considerar la naturaleza dinámica de las IPs públicas de ciertos dominios (por ejemplo, www.m4gm.com) al usar reglas de red basadas en IP, y priorizar reglas de aplicación por FQDN cuando se requiera resiliencia ante cambios de resolución. Asimismo, se sugiere habilitar registros y diagnósticos del firewall para auditoría y mejora continua.

Las ventajas pueden ser tener menor superficie de ataque, control centralizado, cumplimiento de lineamientos y evidencia clara de permisos/bloqueos. Algunas limitaciones son el SKU Básico que carece de funcionalidades avanzadas (p. ej.,

inspección TLS profunda) y puede requerir actualizaciones a Standard/Premium para escenarios más exigentes. Las buenas prácticas pueden ser mantener la política centralizada, documentar cambios, revisar logs periódicamente y validar la efectividad tras cualquier ajuste de DNS o ruteo.

Enlace del chat de la IA generativa

Enlace: https://github.com/copilot/share/48755286-4364-8485-8010-b00700b209c0

7 Referencias (Formato IEEE)

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