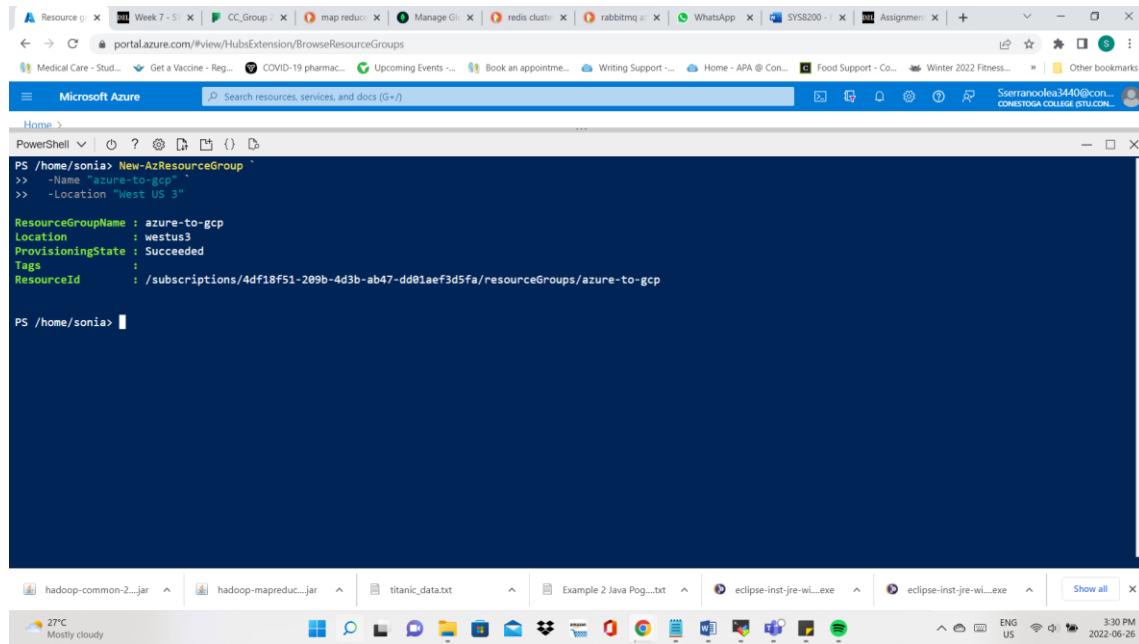


**Figure 1**

### Azure PowerShell



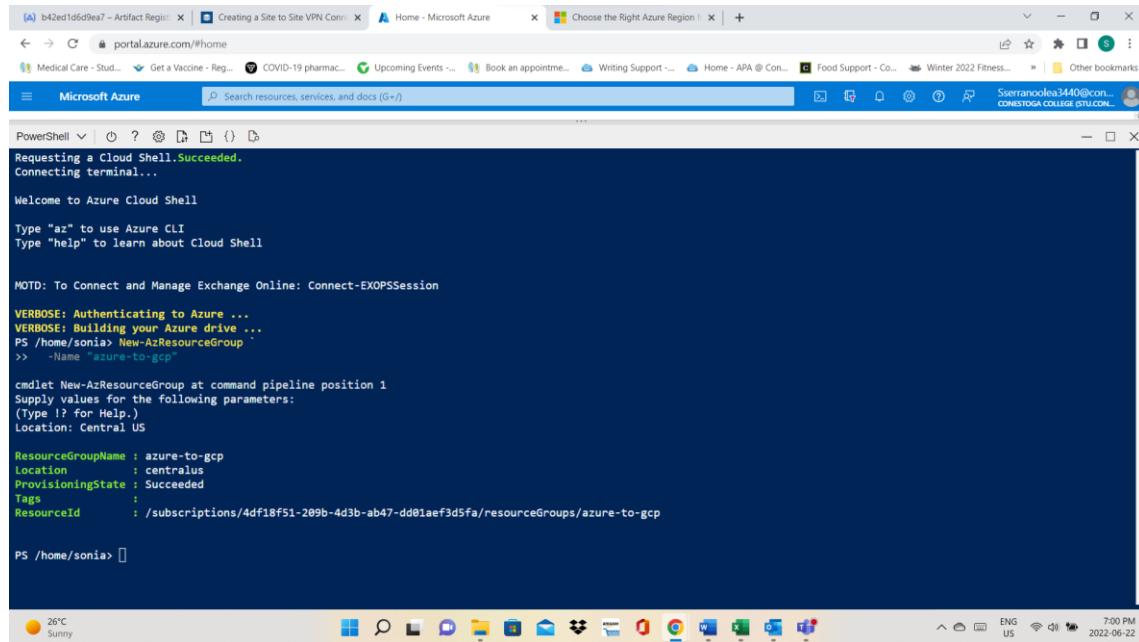
The screenshot shows a Microsoft Edge browser window with the Azure portal address bar. The main content area is a PowerShell session. The command `New-AzResourceGroup` is run with parameters: -Name "azure-to-gcp", -Location "West US 3". The output shows the new resource group details: ResourceGroupName: azure-to-gcp, Location: westus3, ProvisioningState: Succeeded, Tags: , ResourceId: /subscriptions/4df18f51-209b-4d3b-ab47-dd01aef3d5fa/resourceGroups/azure-to-gcp. Below the PowerShell window, the taskbar shows several open files like hadoop-common-2\_jar, titanic\_data.txt, Example 2 Java Pog...txt, eclipse-inst-jre-wi...exe, and eclipse-inst-jre-wi...exe. The system tray shows the date and time as 2022-06-26 3:30 PM.

```
PS /home/sonia> New-AzResourceGroup  
>> -Name "azure-to-gcp"  
>> -Location "West US 3"  
  
ResourceGroupName : azure-to-gcp  
Location : westus3  
ProvisioningState : Succeeded  
Tags :  
ResourceId : /subscriptions/4df18f51-209b-4d3b-ab47-dd01aef3d5fa/resourceGroups/azure-to-gcp  
  
PS /home/sonia>
```

Note: This screenshot shows the Azure PowerShell Console

**Figure 2**

### Creation of Azure resource group



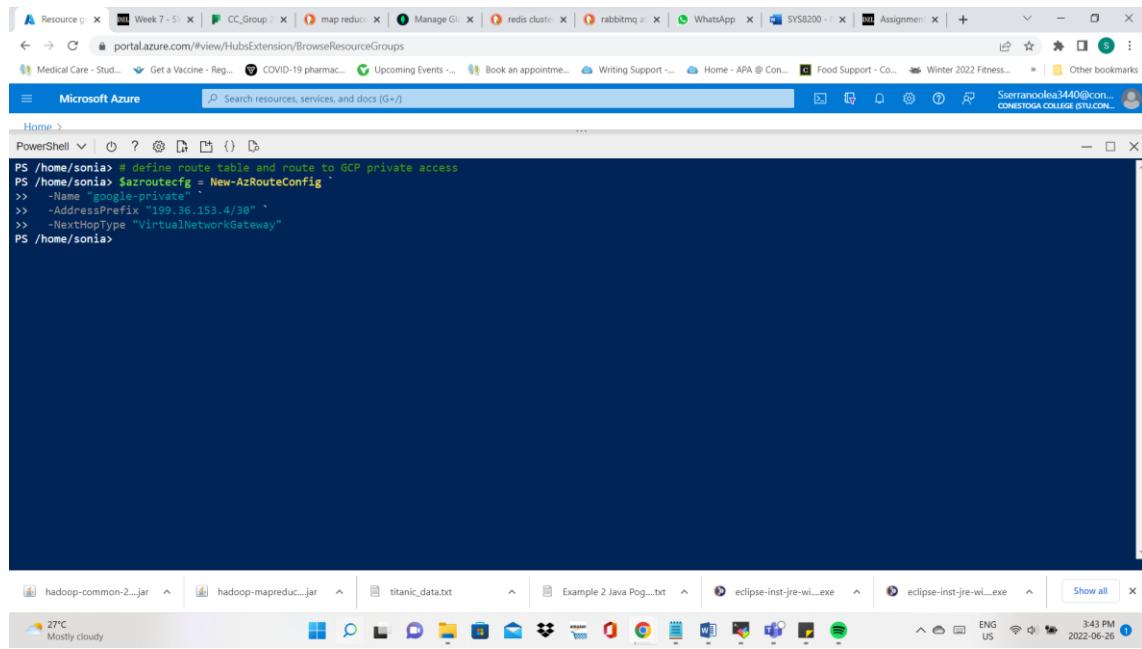
The screenshot shows a Microsoft Edge browser window with the Azure portal address bar. The main content area is a Cloud Shell session. It starts by requesting a Cloud Shell and connecting to it. Then, it displays the welcome message for the Azure Cloud Shell, which includes instructions to type "az" to use the Azure CLI and "help" to learn about Cloud Shell. It then shows the MOTD (Message of the Day) for connecting to Exchange Online. The user runs the command `New-AzResourceGroup` with parameters: -Name "azure-to-gcp", -Location "Central US". The output shows the new resource group details: ResourceGroupName: azure-to-gcp, Location: centralus, ProvisioningState: Succeeded, Tags: , ResourceId: /subscriptions/4df18f51-209b-4d3b-ab47-dd01aef3d5fa/resourceGroups/azure-to-gcp. Below the Cloud Shell window, the taskbar shows several open files like hadoop-common-2\_jar, titanic\_data.txt, Example 2 Java Pog...txt, eclipse-inst-jre-wi...exe, and eclipse-inst-jre-wi...exe. The system tray shows the date and time as 2022-06-22 7:00 PM.

```
Requesting a Cloud Shell.Succeeded.  
Connecting terminal...  
  
Welcome to Azure Cloud Shell  
  
Type "az" to use Azure CLI  
Type "help" to learn about Cloud Shell  
  
MOTD: To Connect and Manage Exchange Online: Connect-EXOPSSession  
  
VERBOSE: Authenticating to Azure ...  
VERBOSE: Building your Azure drive ...  
PS /home/sonia> New-AzResourceGroup  
>> -Name "azure-to-gcp"  
  
cmdlet New-AzResourceGroup at command pipeline position 1  
Supply values for the following parameters:  
(Type !? for Help.)  
Location: Central US  
  
ResourceGroupName : azure-to-gcp  
Location : centralus  
ProvisioningState : Succeeded  
Tags :  
ResourceId : /subscriptions/4df18f51-209b-4d3b-ab47-dd01aef3d5fa/resourceGroups/azure-to-gcp  
  
PS /home/sonia>
```

Note: This screenshot shows the creation of an Azure resource group in West US 3A

**Figure 3**

## Creation of route for a routing table



A screenshot of a Microsoft Azure PowerShell window. The title bar says "Microsoft Azure". The main area shows PowerShell commands being run:

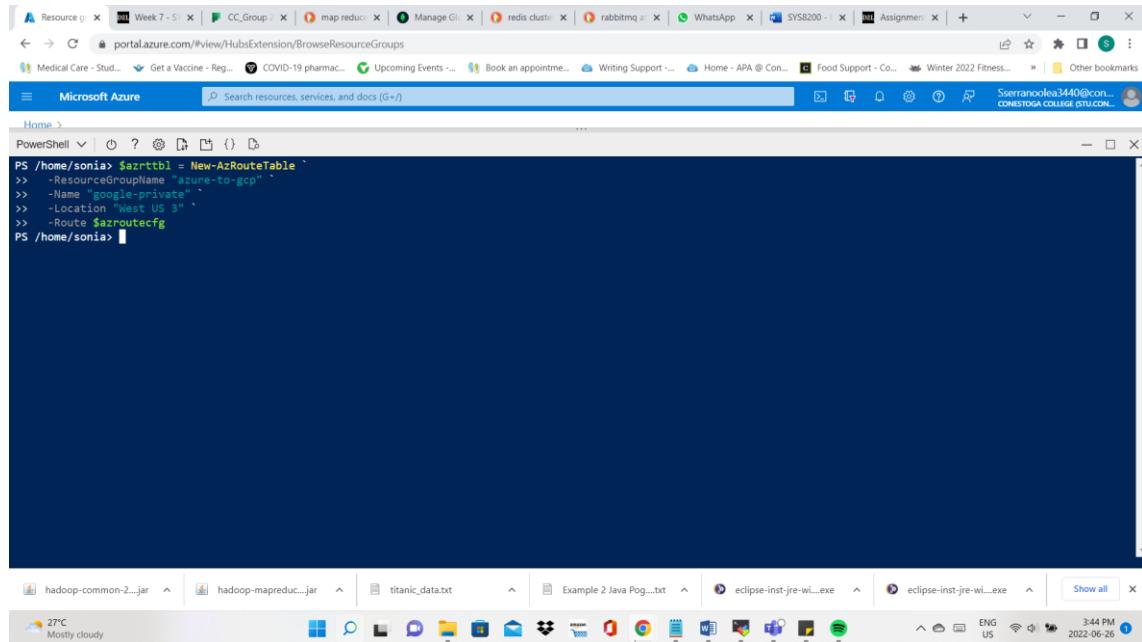
```
PS /home/sonia> # define route table and route to GCP private access
PS /home/sonia> $azroutecfg = New-AzRouteConfig
>> -Name "google-private"
>> -AddressPrefix "199.36.153.4/30"
>> -NextHopType "VirtualNetworkGateway"
PS /home/sonia>
```

The background of the window is dark blue.

Note: This screenshot shows the creation of a route for a routing table "google-private" with destination to Google APIs.

**Figure 4**

## Creation of route table



A screenshot of a Microsoft Azure PowerShell window. The title bar says "Microsoft Azure". The main area shows PowerShell commands being run:

```
PS /home/sonia> $azrttbl = New-AzRouteTable
>> -ResourceGroupName "azure-to-gcp"
>> -Name "google-private"
>> -Location "West US 3"
>> -Route $azroutecfg
PS /home/sonia>
```

The background of the window is dark blue.

Note: This screenshot shows the creation of a route table with the route \$azrouteconfig

**Figure 5**

## Creation of subnet for Virtual Network Gateway and host

The screenshot shows a Microsoft Azure PowerShell window titled "Microsoft Azure". The command being run is:

```
PS /home/sonia> $gatewaySubnet = New-AzVirtualNetworkSubnetConfig  
>> -Name "GatewaySubnet"  
>> -AddressPrefix "10.1.2.0/24"  
WARNING: Upcoming breaking changes in the cmdlet 'New-AzVirtualNetworkSubnetConfig':  
Update Property Name  
Cmdlet invocation changes:  
    Old Way : -ResourceId  
    New Way : -NatGatewayId  
Update Property Name  
Cmdlet invocation changes:  
    Old Way : -InputObject  
    New Way : -NatGateway  
Note : Go to https://aka.ms/azps-changewarnings for steps to suppress this breaking change warning, and other information on breaking changes in Azure PowerShell.  
PS /home/sonia> $defaultSubnet = New-AzVirtualNetworkSubnetConfig  
>> -Name "default"  
>> -AddressPrefix "10.1.1.0/24"  
>> -RouteTable $azrttbl  
WARNING: Upcoming breaking changes in the cmdlet 'New-AzVirtualNetworkSubnetConfig':  
Update Property Name  
Cmdlet invocation changes:  
    Old Way : -ResourceId  
    New Way : -NatGatewayId  
Update Property Name  
Cmdlet invocation changes:  
    Old Way : -InputObject  
    New Way : -NatGateway  
Note : Go to https://aka.ms/azps-changewarnings for steps to suppress this breaking change warning, and other information on breaking changes in Azure PowerShell.  
PS /home/sonia>
```

The PowerShell window is part of a larger Windows desktop environment. The taskbar at the bottom shows various open applications including a Java Pong game, Eclipse IDE, and several Microsoft Office apps. The system tray indicates it's 8:39 PM on June 22, 2022, with the weather showing 25°C and sunny.

Note: This screenshot shows the definition of a subnet for the site-to-site VPN connection and the subnet where the application will be hosted

**Figure 6**

## Creation of virtual network

The screenshot shows a Microsoft Azure PowerShell window titled "Microsoft Azure". The command being run is:

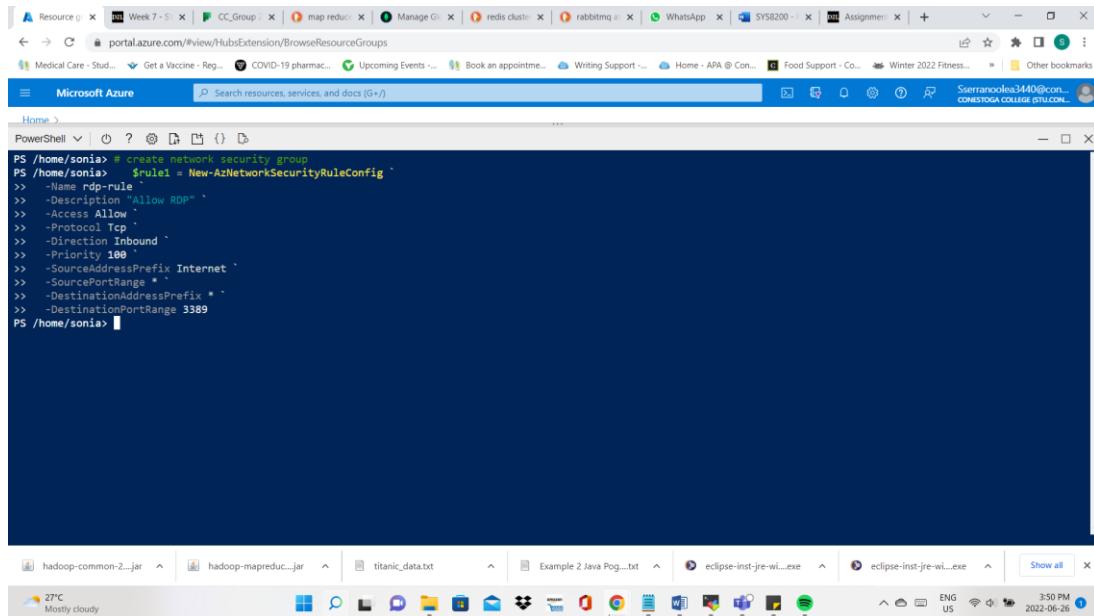
```
PS /home/sonia> $vnet = New-AzVirtualNetwork  
>> -Name "Azure-to-gcp-vnet"  
>> -ResourceGroupName "azure-to-gcp"  
>> -Location "West US 3"  
>> -AddressPrefix "10.1.0.0/16"  
>> -Subnet $gatewaySubnet,$defaultSubnet  
PS /home/sonia>
```

The PowerShell window is part of a larger Windows desktop environment. The taskbar at the bottom shows various open applications including a Java Pong game, Eclipse IDE, and several Microsoft Office apps. The system tray indicates it's 3:50 PM on June 26, 2022, with the weather showing 27°C and mostly cloudy.

Note: This screenshot shows the creation of the virtual network and a list of the subnets to associate with the virtual network.

**Figure 7**

### Creation of network security rules (RDP)



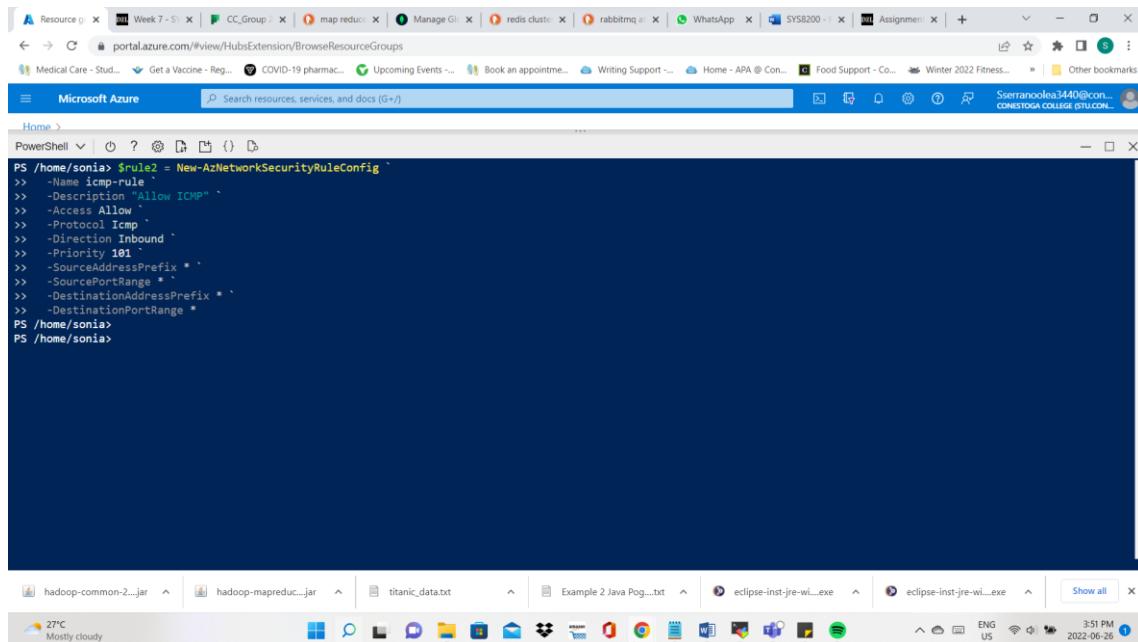
A screenshot of a Microsoft Azure PowerShell window. The command entered is:

```
PS /home/sonia> $rule1 = New-AzNetworkSecurityRuleConfig  
PS /home/sonia> $rule1 = New-AzNetworkSecurityRuleConfig  
>> -Name "rdp-rule"  
>> -Description "Allow RDP"  
>> -Access Allow  
>> -Protocol Tcp  
>> -Direction Inbound  
>> -Priority 100  
>> -SourceAddressPrefix Internet  
>> -SourcePortRange *  
>> -DestinationAddressPrefix *  
>> -DestinationPortRange 3389  
PS /home/sonia>
```

Note: This screenshot shows the creation of a rule to allow access from the Internet to port 3389 to test the private connection (RDP). This rule has the highest priority.

**Figure 8**

### Creation of network security rules (ICMP)



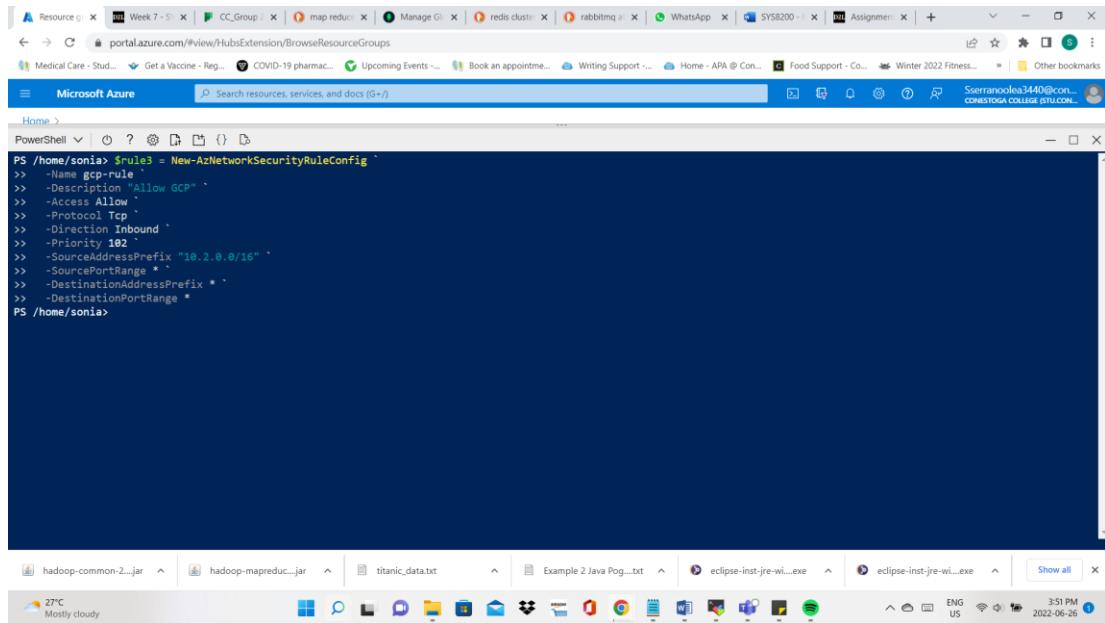
A screenshot of a Microsoft Azure PowerShell window. The command entered is:

```
PS /home/sonia> $rule2 = New-AzNetworkSecurityRuleConfig  
>> -Name icmp-rule  
>> -Description "Allow ICMP"  
>> -Access Allow  
>> -Protocol Icmp  
>> -Direction Inbound  
>> -Priority 101  
>> -SourceAddressPrefix *  
>> -SourcePortRange *  
>> -DestinationAddressPrefix *  
>> -DestinationPortRange *  
PS /home/sonia>  
PS /home/sonia>
```

Note: This screenshot shows the creation of a rule to allow ICMP (PING) traffic from any IP address. This rule has the second priority.

**Figure 9**

### Creation of network security rules (TCP) from Google VPC



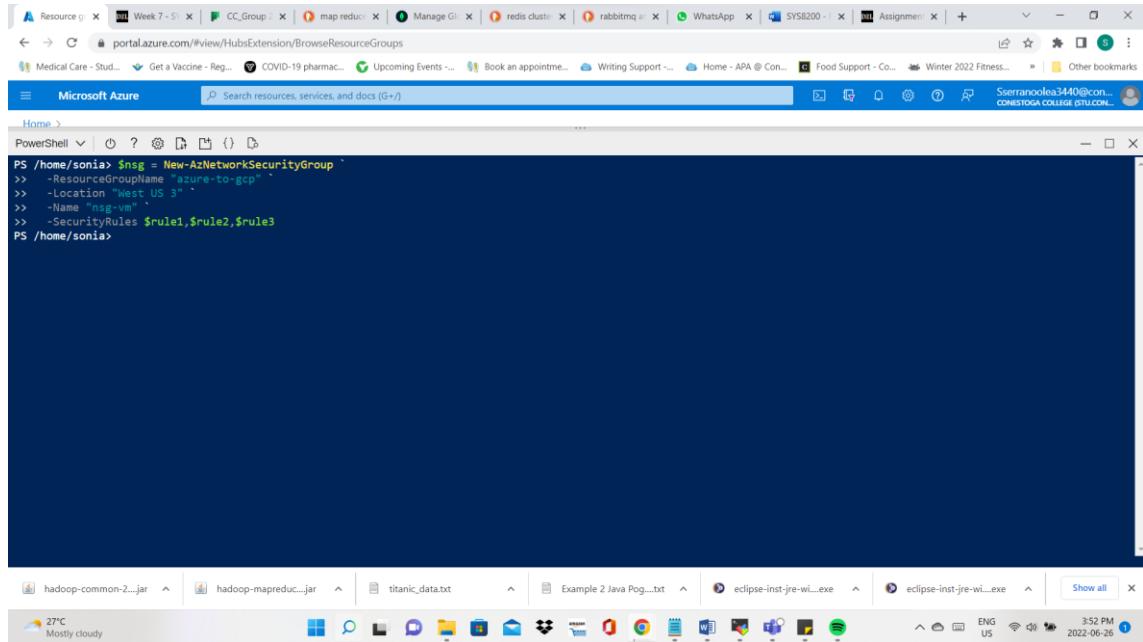
A screenshot of a Microsoft Azure PowerShell window. The title bar says "Microsoft Azure". The URL in the address bar is "portal.azure.com/#view/HubsExtension/BrowseResourceGroups". The PowerShell prompt is PS /home/sonia>. The command entered is:

```
PS /home/sonia> $rule3 = New-AzNetworkSecurityRuleConfig  
>> -Name gcp-rule  
>> -Description "Allow GCP"  
>> -Access Allow  
>> -Protocol Tcp  
>> -Direction Inbound  
>> -Priority 102  
>> -SourceAddressPrefix "10.2.0.0/16"  
>> -SourcePortRange *  
>> -DestinationAddressPrefix *  
>> -DestinationPortRange *
```

Note: This screenshot shows the creation of a rule to allow TCP traffic from Google VPC. This rule has the third priority.

**Figure 10**

### Creation of network security group



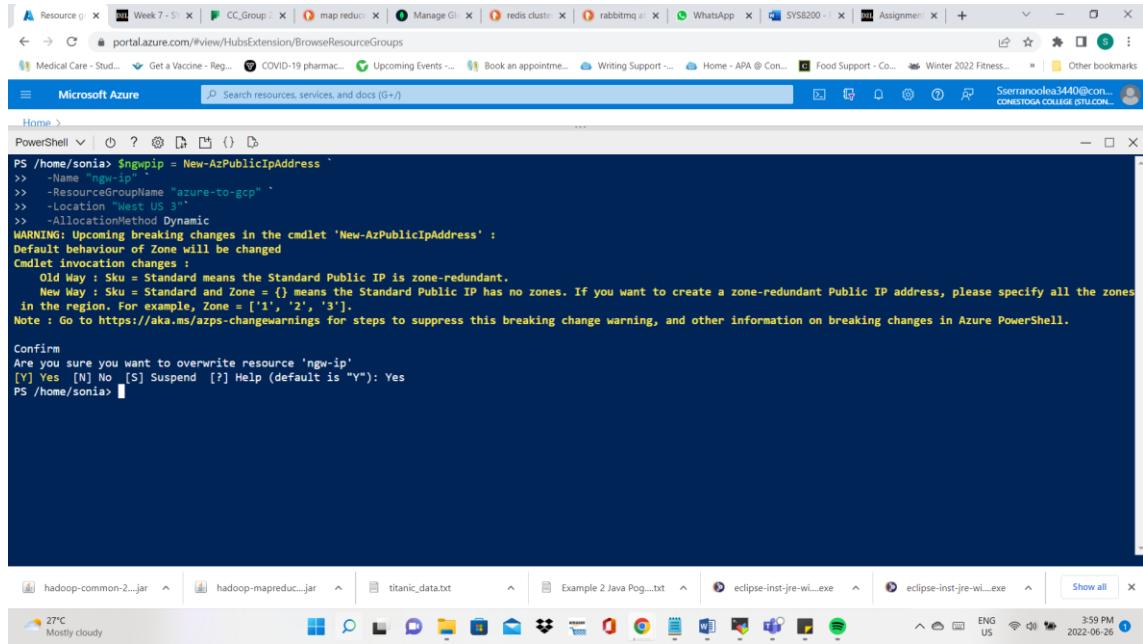
A screenshot of a Microsoft Azure PowerShell window. The title bar says "Microsoft Azure". The URL in the address bar is "portal.azure.com/#view/HubsExtension/BrowseResourceGroups". The PowerShell prompt is PS /home/sonia>. The command entered is:

```
PS /home/sonia> $nsg = New-AzNetworkSecurityGroup  
>> -ResourceGroupName "azure-to-gcp"  
>> -Location "West US 3"  
>> -Name "nsg-vm"  
>> -SecurityRules $rule1,$rule2,$rule3
```

Note: This screenshot shows the creation of a network security group to filter network traffic by applying the rules created in the previous steps.

**Figure 11**

### Creation of public Ips



A screenshot of a Microsoft Azure PowerShell window. The command being run is:

```
PS /home/sonia> $ngwip = New-AzPublicIpAddress `>> -Name "ngw-ip" `>> -ResourceGroupName "azure-to-gcp" `>> -Location "West US 3" `>> -AllocationMethod Dynamic
```

Output from the command:

```
WARNING: Upcoming breaking changes in the cmdlet 'New-AzPublicIpAddress' : Default behaviour of Zone will be changed Cmdlet invocation changes : Old Way : Sku = Standard means the Standard Public IP is zone-redundant. New Way : Sku = Standard and Zone = {} means the Standard Public IP has no zones. If you want to create a zone-redundant Public IP address, please specify all the zones in the region. For example, Zone = [1', '2', '3']. Note : Go to https://aka.ms/azps-changewarnings for steps to suppress this breaking change warning, and other information on breaking changes in Azure PowerShell.
```

Confirmation prompt:

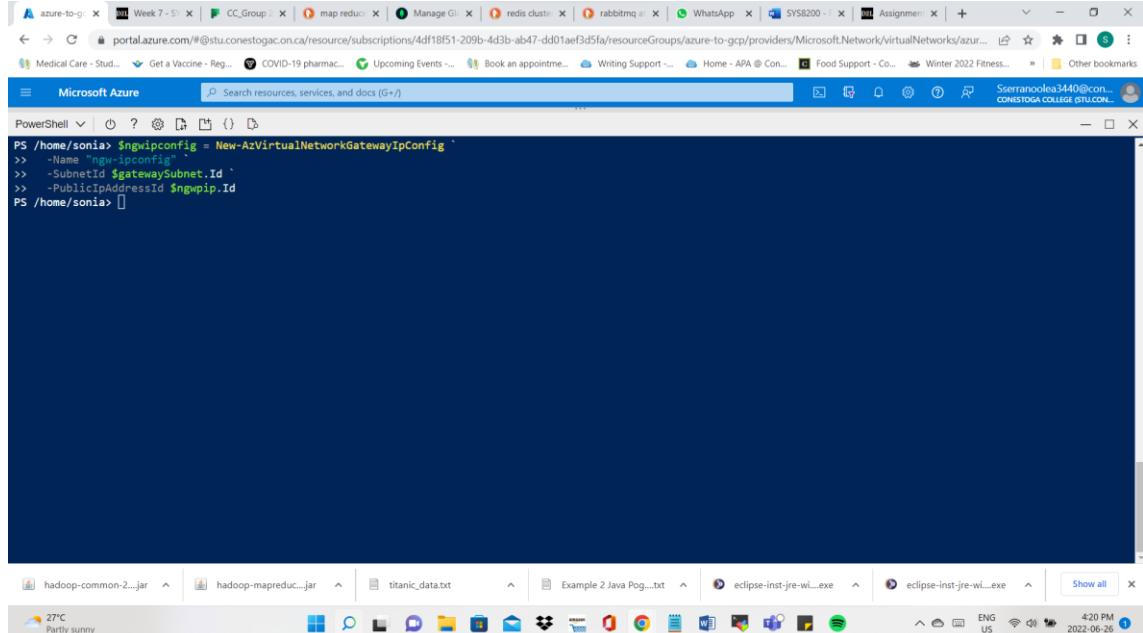
```
Confirm Are you sure you want to overwrite resource 'ngw-ip'? [Y] Yes [N] No [S] Suspend [?] Help (default is "Y"): Yes
```

The PowerShell window is part of a larger desktop environment with various icons and a taskbar at the bottom.

Note: This screenshot shows the creation of public Ips for the VPN and VM

**Figure 12**

### Create a virtual network gateway IP Configuration



A screenshot of a Microsoft Azure PowerShell window. The command being run is:

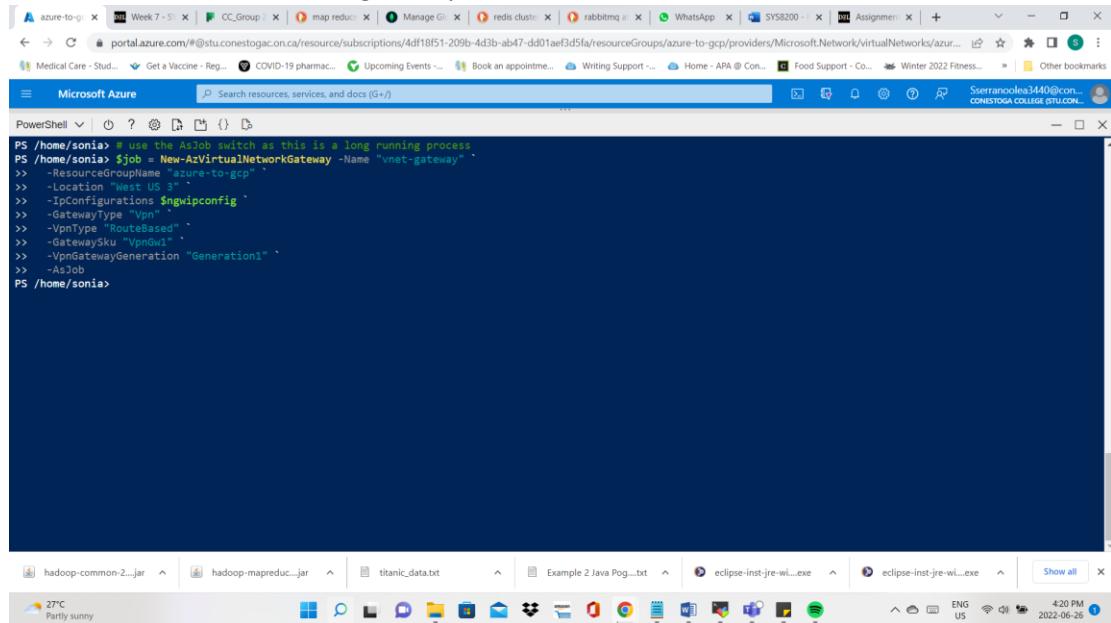
```
PS /home/sonia> $ngwipconfig = New-AzVirtualNetworkGatewayIpConfig `>> -Name "ngw-ipconfig" `>> -SubnetId $gatewaySubnet.Id `>> -PublicIpAddressId $ngwip.Id
```

The PowerShell window is part of a larger desktop environment with various icons and a taskbar at the bottom.

Note: This screenshot shows the creation of a Virtual Network Gateway configuration with the public IP created in the previous step based on the Gateway subnet ID

**Figure 13**

### Creation of a virtual network gateway

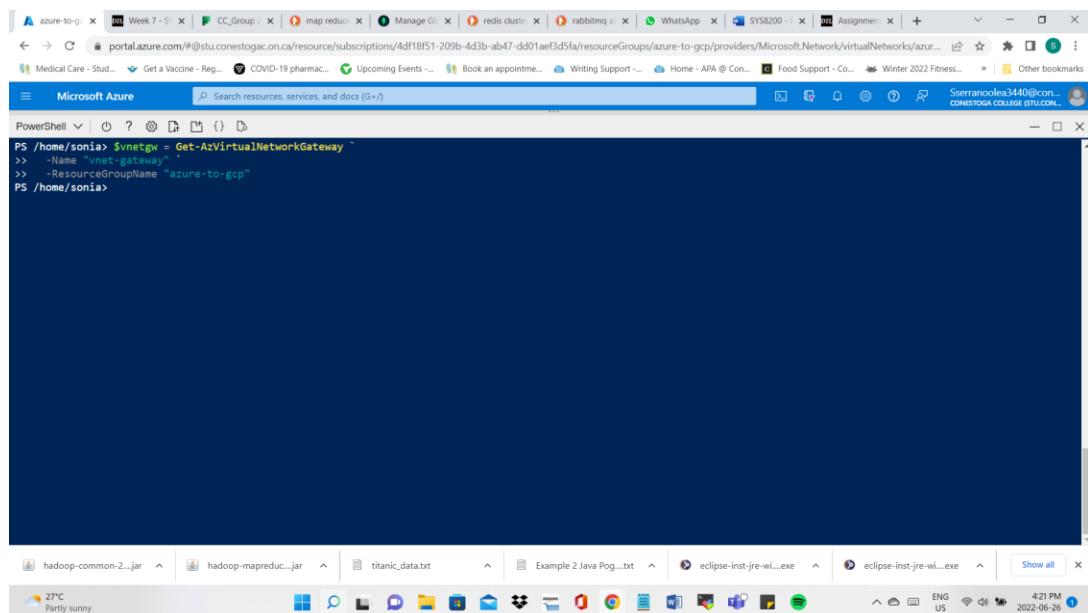


```
PS /home/sonia> # use the AsJob switch as this is a long running process
PS /home/sonia> $job = New-AzVirtualNetworkGateway -Name "vnet-gateway"
>> -ResourceGroupName "azure-to-gcp"
>> -Location "West US 3"
>> -IpConfigurations $ngwipconfig
>> -GatewayType "Vpn"
>> -VpnType "RouteBased"
>> -GatewaySku "VpnGw1"
>> -VpnGatewayGeneration "Generation1"
>> -AsJob
PS /home/sonia>
```

Note: This screenshot shows the creation of a virtual network gateway, type VPN, Generation1, and VpnGw1 that run in the background. This type allows a max 128 P2S and throughput benchmark of 650 Mbps. All Generation1 and Generation2 SKUs are recommended for production.

**Figure 14**

### Create Virtual Network Variable

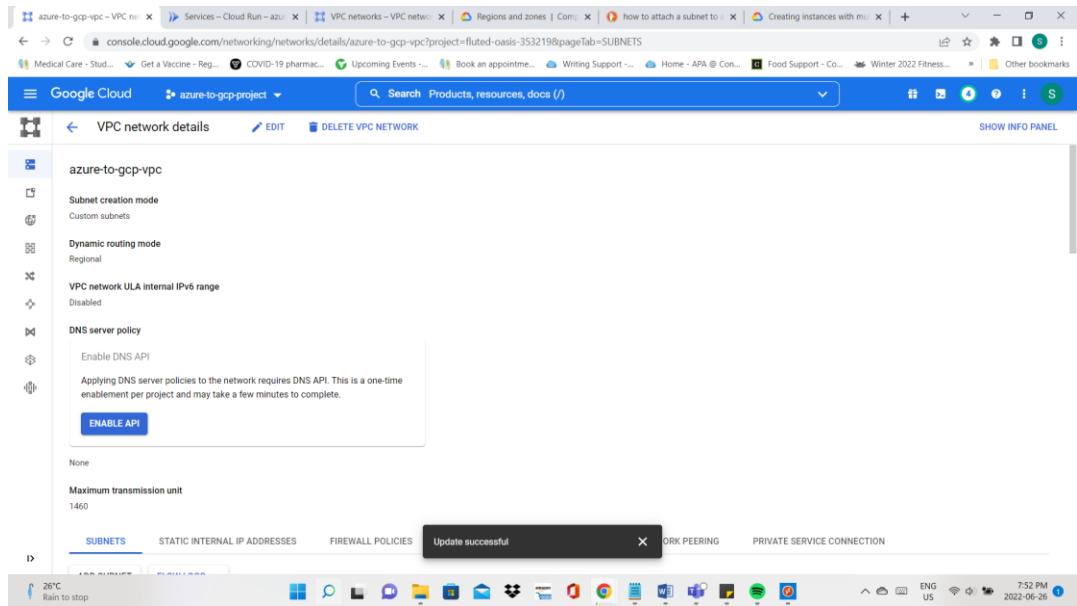


```
PS /home/sonia> $vnetgw = Get-AzVirtualNetworkGateway
>> -Name "vnet-gateway"
>> -ResourceGroupName "azure-to-gcp"
PS /home/sonia>
```

Note: This screenshot shows the creation of the virtual network gateway

**Figure 15**

### Creation of Google VPC



Note: This screenshot shows the creation of Google VPC "azure-to-gcp-vpc"

**Figure 16**

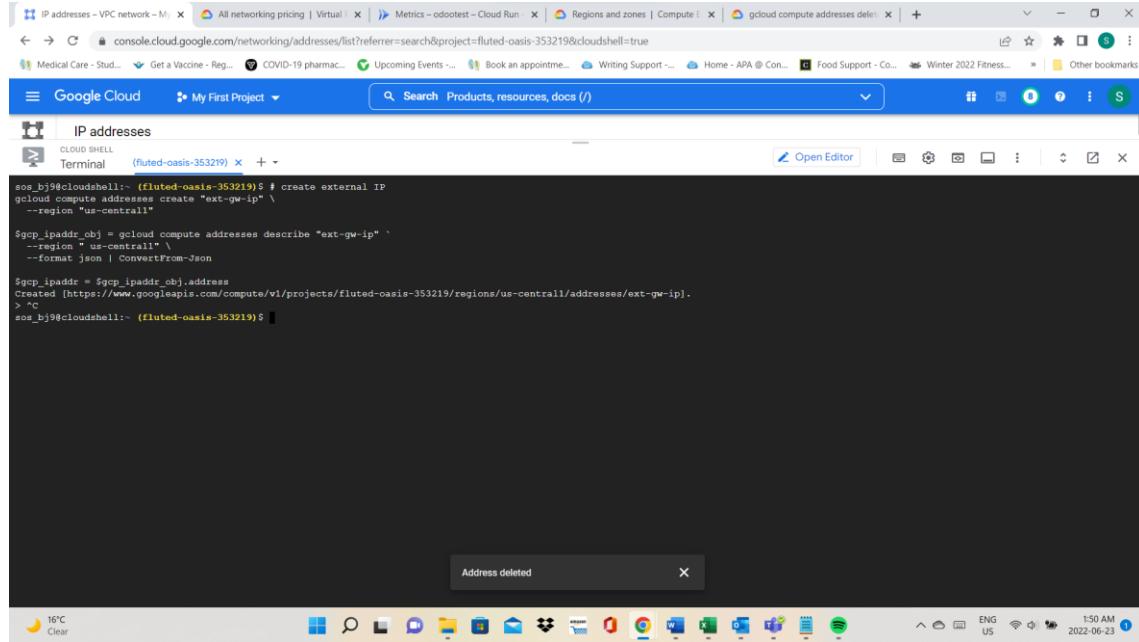
### Creation of VPC subnet

```
sos_bj9@cloudshell:~ (fluted-oasis-353219)$ gcloud compute networks subnets create "us-subnet" \
--network "azureto-gcp-vpc" \
--range "10.2.1.0/24" \
--region "us-central1" \
--enable-private-ip-google-access
Created [https://www.googleapis.com/compute/v1/projects/fluted-oasis-353219/regions/us-central1/subnetworks/us-subnet].
NAME: us-subnet
REGION: us-central1
NETWORK: azureto-gcp-vpc
RANGE: 10.2.1.0/24
STAGING_TYPE: STAGING_TYPE_ONLY
IPV4_ACCESS_TYPE: IPV4_ACCESS_TYPE_UNSPECIFIED
INTERNAL_IPV6_PREFIX: 10.2.1.0/24
EXTERNAL_IPV6_PREFIX: 2607:f8b0:400e::/32
sos_bj9@cloudshell:~ (fluted-oasis-353219)$
```

Note: This screenshot shows the creation of a subnet enabling Google Cloud APIs for instances without a public IP address.

**Figure 17**

## Create an external IP address for VPN Gateway



The screenshot shows a Google Cloud Terminal window titled "Terminal (fluted-oasis-353219)". The user is running a series of gcloud commands to create an external IP address:

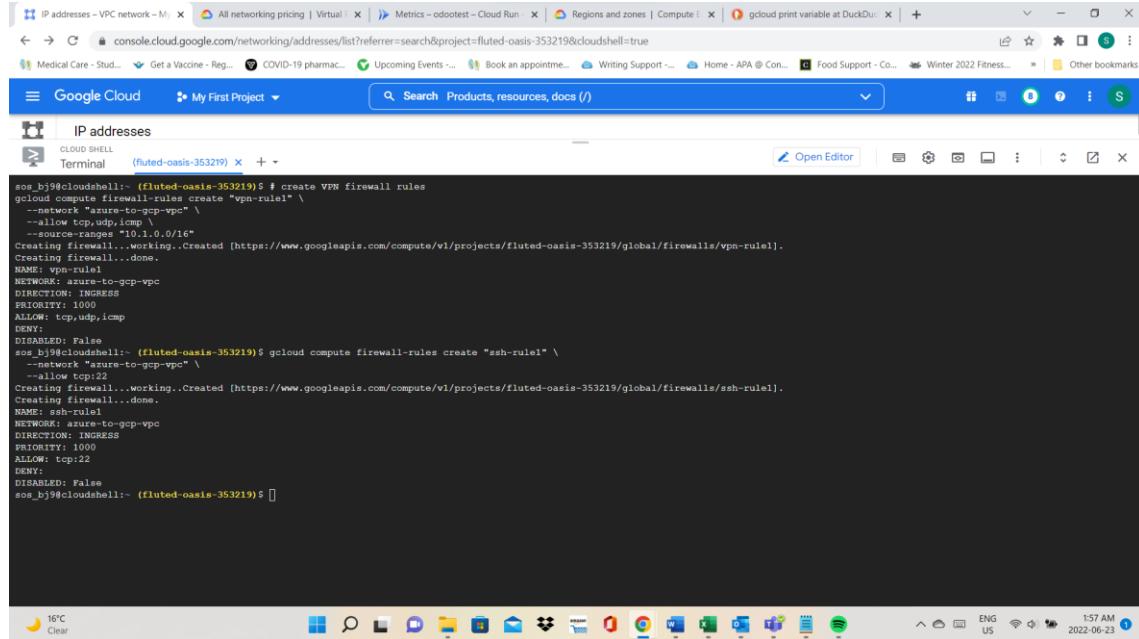
```
sos_bj9@cloudshell:~ (fluted-oasis-353219)$ # create external IP
gcloud compute addresses create "ext-gw-ip" \
--region "us-central1"
$gcp_ipaddr_obj = gcloud compute addresses describe "ext-gw-ip" \
--region "us-central1" \
--format json | ConvertFrom-Json
$gcp_ipaddr = $gcp_ipaddr_obj.address
Created [https://www.googleapis.com/compute/v1/projects/fluted-oasis-353219/regions/us-central1/addresses/ext-gw-ip].
> ^C
sos_bj9@cloudshell:~ (fluted-oasis-353219)$
```

A message box at the bottom of the terminal says "Address deleted". The system tray shows the date and time as 2022-06-23 1:50 AM.

Note: This screenshot shows the creation of an external IP for the interface with VPN Gateway

**Figure 18**

## Creation of firewall rules



The screenshot shows a Google Cloud Terminal window titled "Terminal (fluted-oasis-353219)". The user is creating two firewall rules using gcloud compute firewall-rules create:

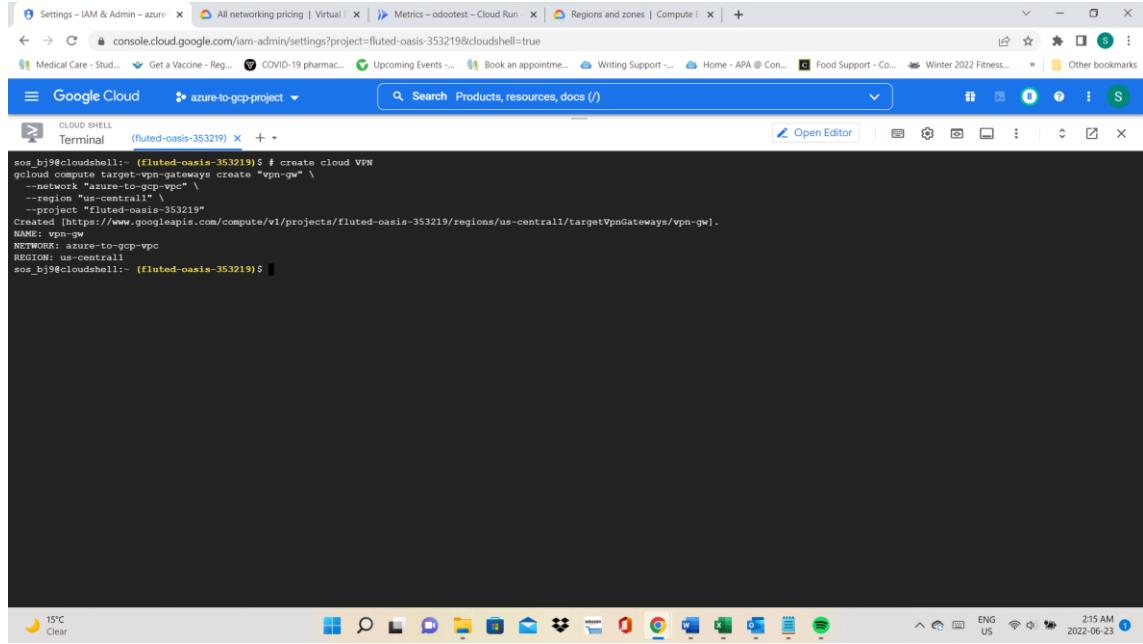
```
sos_bj9@cloudshell:~ (fluted-oasis-353219)$ # create VPN firewall rules
gcloud compute firewall-rules create "vpn-rule1" \
--network "azure-to-gcp-vpc" \
--allow tcp,udp,icmp \
--source-ranges "10.1.0.0/16"
Creating firewall...working..created [https://www.googleapis.com/compute/v1/projects/fluted-oasis-353219/global/firewalls/vpn-rule1].
Creating firewall...done.
NAME: vpn-rule1
NETWORK: azure-to-gcp-vpc
DIRECTION: INGRESS
PRIORITY: 1000
ALLOW: tcp,udp,icmp
DENY:
DISABLED: False
sos_bj9@cloudshell:~ (fluted-oasis-353219)$ gcloud compute firewall-rules create "ssh-rule1" \
--network "azure-to-gcp-vpc" \
--allow tcp:22
Creating firewall...working..created [https://www.googleapis.com/compute/v1/projects/fluted-oasis-353219/global/firewalls/ssh-rule1].
Creating firewall...done.
NAME: ssh-rule1
NETWORK: azure-to-gcp-vpc
DIRECTION: INGRESS
PRIORITY: 1000
ALLOW: tcp:22
DENY:
DISABLED: False
sos_bj9@cloudshell:~ (fluted-oasis-353219)$
```

The system tray shows the date and time as 2022-06-23 1:57 AM.

Note: This screenshot shows the firewall rules to allow Azure VPC traffic and SSH from the Internet.

**Figure 19**

## Creation of VPN



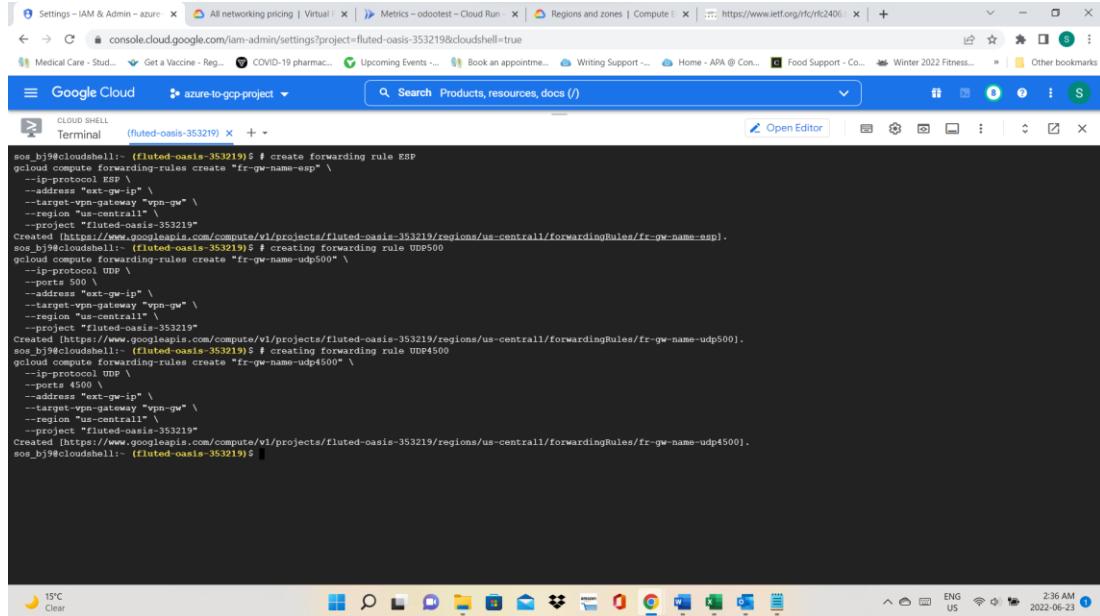
A screenshot of a Google Cloud Shell terminal window. The terminal shows the command `gcloud compute target-vpn-gateways create "vpn-gw" \` being run, followed by several lines of output describing the creation of a VPN gateway named 'vpn-gw' in the 'us-central1' region, project 'fluted-oasis-353219', and network 'azure-to-gcp-pvc'. The terminal window is part of a larger browser interface with multiple tabs open.

```
sos_bj98@cloudshell:~ (fluted-oasis-353219)$ # create cloud VPN
gcloud compute target-vpn-gateways create "vpn-gw" \
--network "azure-to-gcp-pvc" \
--region "us-central1" \
--project "fluted-oasis-353219"
Created (https://www.googleapis.com/compute/v1/projects/fluted-oasis-353219/regions/us-central1/targetVpnGateways vpn-gw).
NAME: vpn-gw
NETWORK: azure-to-gcp-pvc
REGION: us-central1
sos_bj98@cloudshell:~ (fluted-oasis-353219)$
```

Note: This screenshot shows the creation of a VPN Gateway for the Connection with Azure

**Figure 20**

## Creation of forwarding rules for vpn-gw



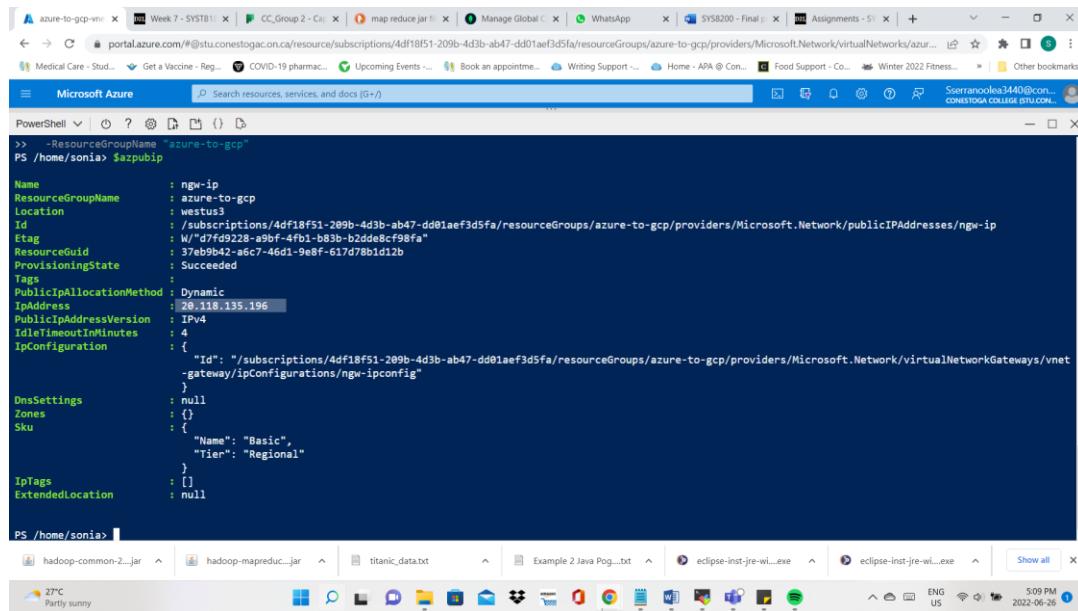
A screenshot of a Google Cloud Shell terminal window. The terminal shows the command `gcloud compute forwarding-rules create "fr-gw-name-esp" \` being run, followed by several lines of output creating three forwarding rules: 'fr-gw-name-esp' (ESP protocol), 'fr-gw-name-udp500' (UDP port 500), and 'fr-gw-name-udp4500' (UDP port 4500). The terminal window is part of a larger browser interface with multiple tabs open.

```
sos_bj98@cloudshell:~ (fluted-oasis-353219)$ # create forwarding rule ESP
gcloud compute forwarding-rules create "fr-gw-name-esp" \
--ip-protocol ESP \
--address "ext-gw-ip" \
--target-vpn-gateway "vpn-gw" \
--region "us-central1" \
--project "fluted-oasis-353219"
Created (https://www.googleapis.com/compute/v1/projects/fluted-oasis-353219/regions/us-central1/forwardingRules/fr-gw-name-esp).
sos_bj98@cloudshell:~ (fluted-oasis-353219)$ # creating forwarding rule UDP500
gcloud compute forwarding-rules create "fr-gw-name-udp500" \
--ip-protocol UDP \
--ports 500 \
--ports 500 \
--address "ext-gw-ip" \
--target-vpn-gateway "vpn-gw" \
--region "us-central1" \
--project "fluted-oasis-353219"
Created (https://www.googleapis.com/compute/v1/projects/fluted-oasis-353219/regions/us-central1/forwardingRules/fr-gw-name-udp500).
sos_bj98@cloudshell:~ (fluted-oasis-353219)$ # creating forwarding rule UDP4500
gcloud compute forwarding-rules create "fr-gw-name-udp4500" \
--ip-protocol UDP \
--ports 4500 \
--ports 4500 \
--address "ext-gw-ip" \
--target-vpn-gateway "vpn-gw" \
--region "us-central1" \
--project "fluted-oasis-353219"
Created (https://www.googleapis.com/compute/v1/projects/fluted-oasis-353219/regions/us-central1/forwardingRules/fr-gw-name-udp4500).
sos_bj98@cloudshell:~ (fluted-oasis-353219)$
```

Note: This screenshot shows the creation of forwarding rules to direct network traffic that receives vpn gateway. Acceptable values for --ports flag are: 500, 4500, also the Encapsulating Security Payload to provide confidentiality and data origin authentication.

**Figure 21**

## Azure Virtual Network Public IP Address



```
>>> -ResourceGroupName "azure-to-gcp"
PS /home/sonia> $azpubip

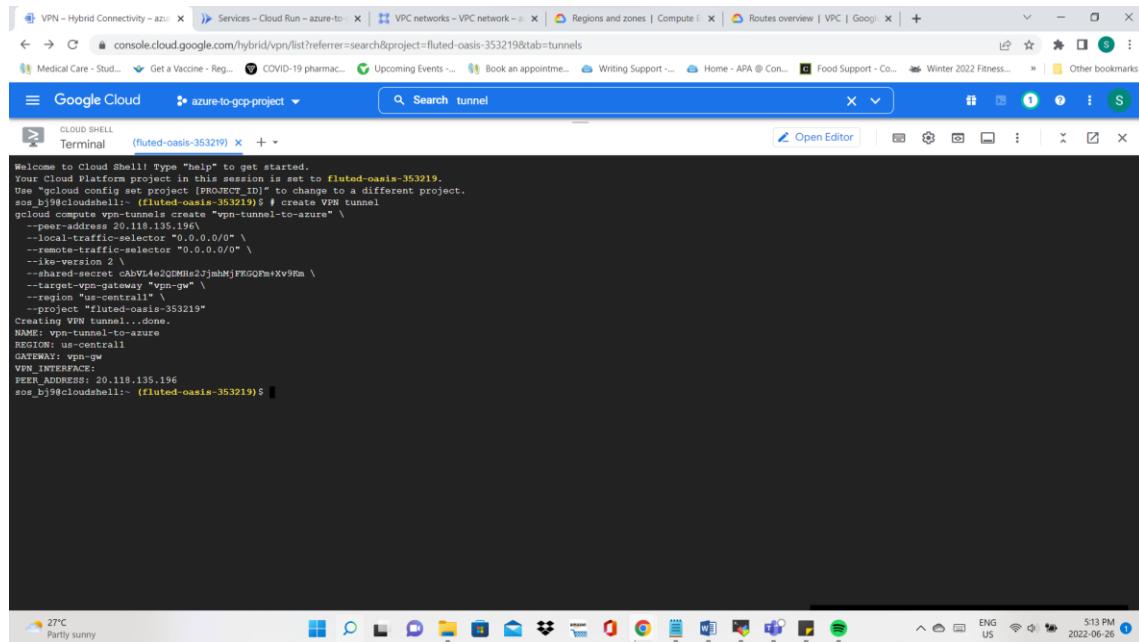
Name          : ngw-ip
ResourceGroupName : azure-to-gcp
location       : westus3
Id            : /subscriptions/4df18f51-209b-4d3b-ab47-dd01ae3d5fa/resourceGroups/azure-to-gcp/providers/Microsoft.Network/publicIPAddresses/ngw-ip
Etag          : W/"d7fd9228-a9bf-4fb1-b3b-b2de8c98fa"
ResourceGuid   : 37eb9042-a6c7-46d1-9e8f-617d78b1d12b
ProvisioningState : Succeeded
Tags          :
PublicIpAddressAllocationMethod : Dynamic
IpAddress      : 20.118.135.196
PublicIpAddressVersion : IPv4
IdleTimeoutInMinutes : 4
IpConfiguration : {
    "Id": "/subscriptions/4df18f51-209b-4d3b-ab47-dd01ae3d5fa/resourceGroups/azure-to-gcp/providers/Microsoft.Network/virtualNetworkGateways/vnet-gateway/ipConfigurations/ngw-ipconfig"
}
DnsSettings   : null
Zones          : {}
Sku           : {
    "Name": "Basic",
    "Tier": "Regional"
}
IpTags        : []
ExtendedLocation : null

PS /home/sonia>
```

Note: This screenshot shows the Azure Virtual Network Gateway Public IP Address that we will use to create the GCP Tunnel connection.

**Figure 22**

### Create a GCP VPN Tunnel



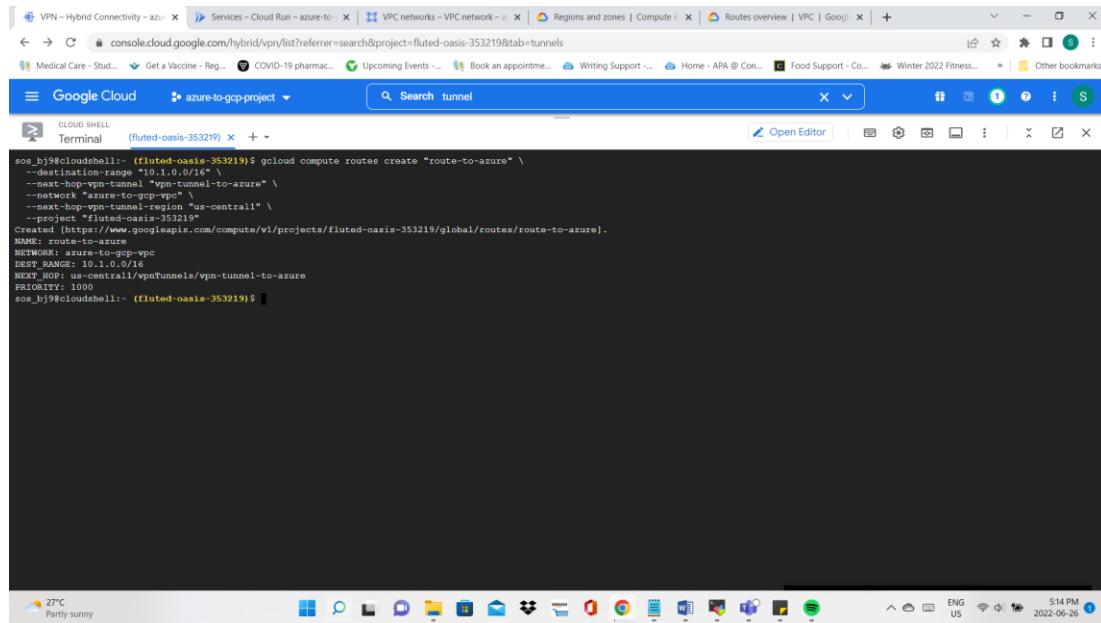
```
VPN - Hybrid Connectivity - azu... Services - Cloud Run - azure-to... VPC networks - VPC network - Regions and zones | Compute | Routes overview | VPC | Google Cloud
← → C console.cloud.google.com/hybrid/vpn/list?referrer=search&project=fluted-oasis-353219#tunnels
Medical Care - Stud... Get a Vaccine - Reg... COVID-19 pharmac... Upcoming Events - Book an appointme... Writing Support - Home - APA @ Con... Food Support - Co... Winter 2022 Fitness... Other bookmarks

Google Cloud
az: azure-to-gcp-project
Search tunnel
CLOUD SHELL Terminal (fluted-oasis-353219) + Open Editor
Welcome to Cloud Shell! Type "help" to get started.
Your Cloud Platform project in this session is set to fluted-oasis-353219.
Use "gcloud config set project [PROJECT_ID]" to change to a different project.
sos_bj9@fluted-oasis-353219:~$ # create VPN tunnel
gcloud compute vpn-tunnels create "vpn-tunnel-to-azure" \
--peer-address 20.118.135.196
--local-traffic-selector "0.0.0.0/0"
--remote-traffic-selector "0.0.0.0/0"
--ike-version 2
--shared-secret "cAbVL4e2QDMHs2JjmhMjFKGQFm+Xv9Km"
--target-gateway "vpn-gw"
--region "us-central1"
--project "fluted-oasis-353219"
Creating VPN tunnel...done.
NAME: vpn-tunnel-to-azure
REGION: us-central1
DISPLAY_NAME:
VPN_INTERFACE:
PEER_ADDRESS: 20.118.135.196
sos_bj9@fluted-oasis-353219:~$
```

Note: This screenshot shows the creation of the GCP VPN Tunnel, with internet key exchange protocol 2 (default), and a random generated pre-shared key  
cAbVL4e2QDMHs2JjmhMjFKGQFm+Xv9Km

**Figure 23**

### VPN Tunnel routes definition



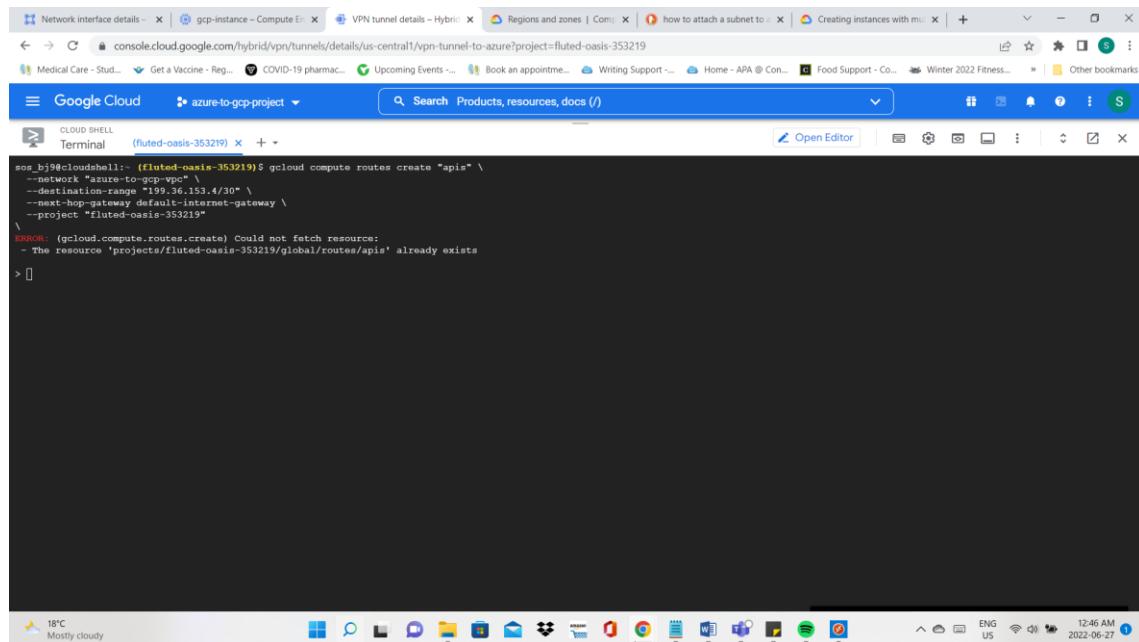
A screenshot of a Google Cloud Terminal window titled "azure-to-gcp-project". The terminal session is running on a Cloud Shell instance with the identifier "(fluted-oasis-353219)". The user is executing a command to create a global route named "route-to-azure". The command includes options for destination range ("10.1.0.0/16"), next-hop ("vpn-tunnel-to-azure"), network ("azure-to-gcp-vpc"), and project ("fluted-oasis-353219"). The output shows the creation of the route and its association with the VPN tunnel.

```
sos_bj@cloudshell:~ (fluted-oasis-353219)$ gcloud compute routes create "route-to-azure" \
--destination-range "10.1.0.0/16" \
--next-hop-vpn-tunnel "vpn-tunnel-to-azure" \
--network "azure-to-gcp-vpc" \
--next-hop-vpn-tunnel-region "us-central1" \
--project "fluted-oasis-353219"
Create https://compute.googleapis.com/compute/v1/projects/fluted-oasis-353219/global/routes/route-to-azure).
NAME: route-to-azure
NETWORK: azure-to-gcp-vpc
DEST_RANGE: 10.1.0.0/16
NEXT_HOP: us-central1/vpnTunnels/vpn-tunnel-to-azure
PRIORITY: 1000
sos_bj@cloudshell:~ (fluted-oasis-353219)$
```

Note: This screenshot shows the creation of the VPN tunnel routes to Azure (outgoing traffic)

**Figure 24**

### VPN Tunnel routes definition



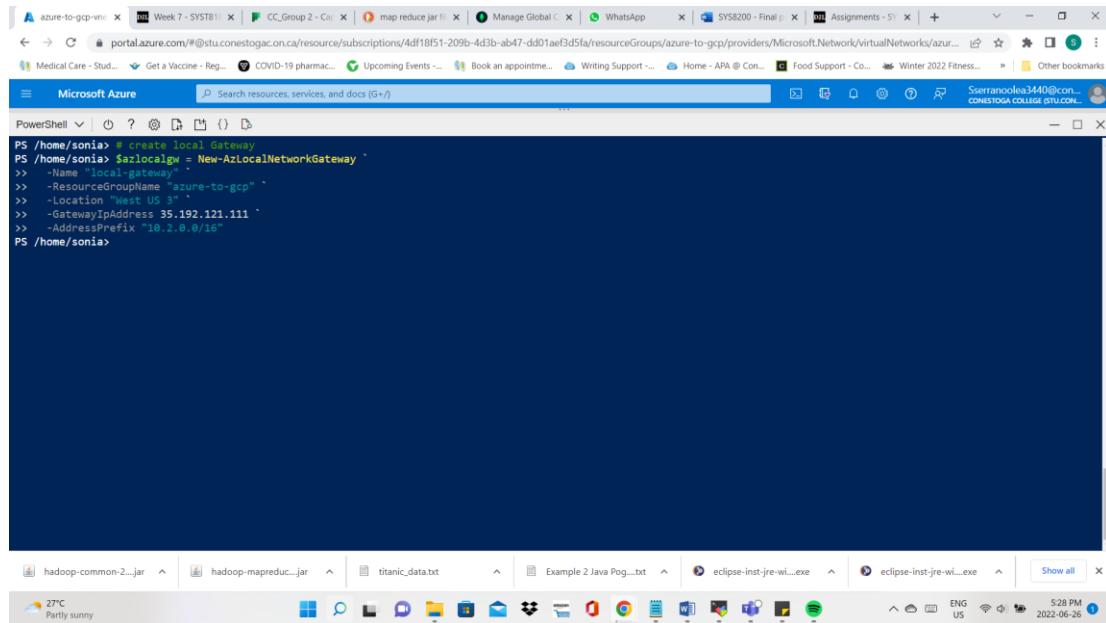
A screenshot of a Google Cloud Terminal window titled "azure-to-gcp-project". The terminal session is running on a Cloud Shell instance with the identifier "(fluted-oasis-353219)". The user is executing a command to create a global route named "apis" for Google APIs. The command specifies a destination range ("199.36.153.4/30") and uses the default internet gateway ("default-internet-gateway") as the next hop. The project is specified as "fluted-oasis-353219". The output shows an error message indicating that the resource already exists.

```
sos_bj@cloudshell:~ (fluted-oasis-353219)$ gcloud compute routes create "apis" \
--network "azure-to-gcp-vpc" \
--destination-range "199.36.153.4/30" \
--next-hop-gateway default-internet-gateway \
--project "fluted-oasis-353219"
ERROR: (gcloud.compute.routes.create) Could not fetch resource:
- The resource 'projects/fluted-oasis-353219/global/routes/apis' already exists
> [
```

Note: This screenshot shows the creation of the inbound traffic routes for the Google APIs. Google operates the default-internet-gateway that handles the packages

**Figure 25**

### Create Local Network Gateway in Azure

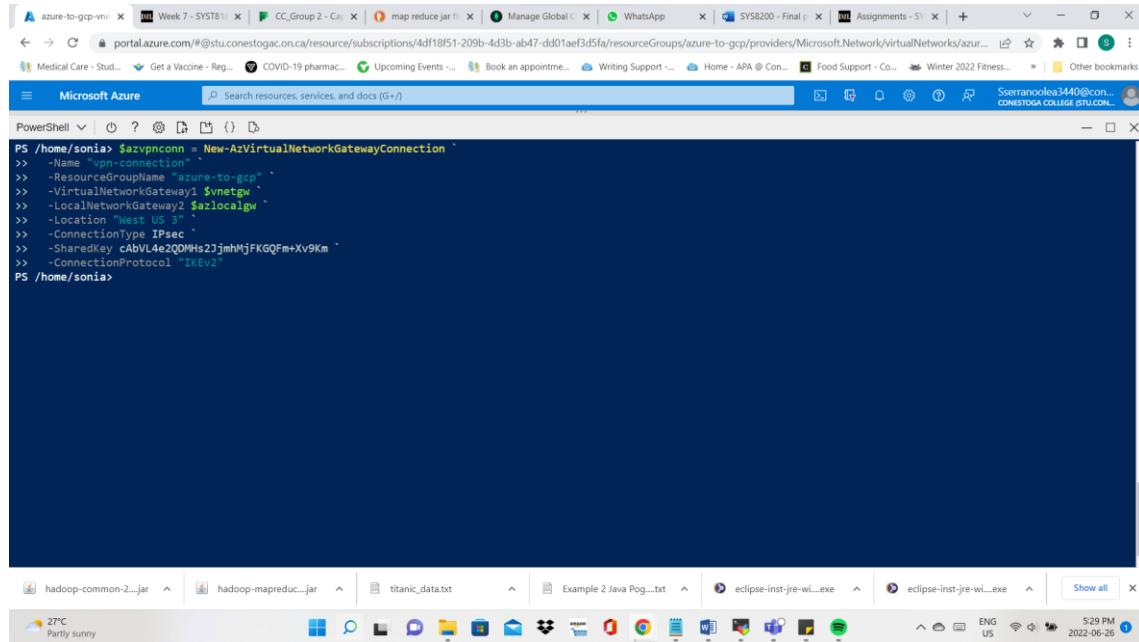


```
PS /home/sonia> $azlocalgw = New-AzLocalNetworkGateway `>> -Name "azlocalgw" `>> -ResourceGroupName "azure-to-gcp" `>> -Location "West US 3" `>> -GatewayIpAddress 35.192.121.111 `>> -AddressPrefix "10.2.0.0/16" `>> PS /home/sonia>
```

Note: This screenshot shows the creation of the Local Network Gateway in Azure that represents the GCP VPN gateway to setup the site-to-site VPN connection

**Figure 26**

### Create Azure VPN connection with Local Gateway

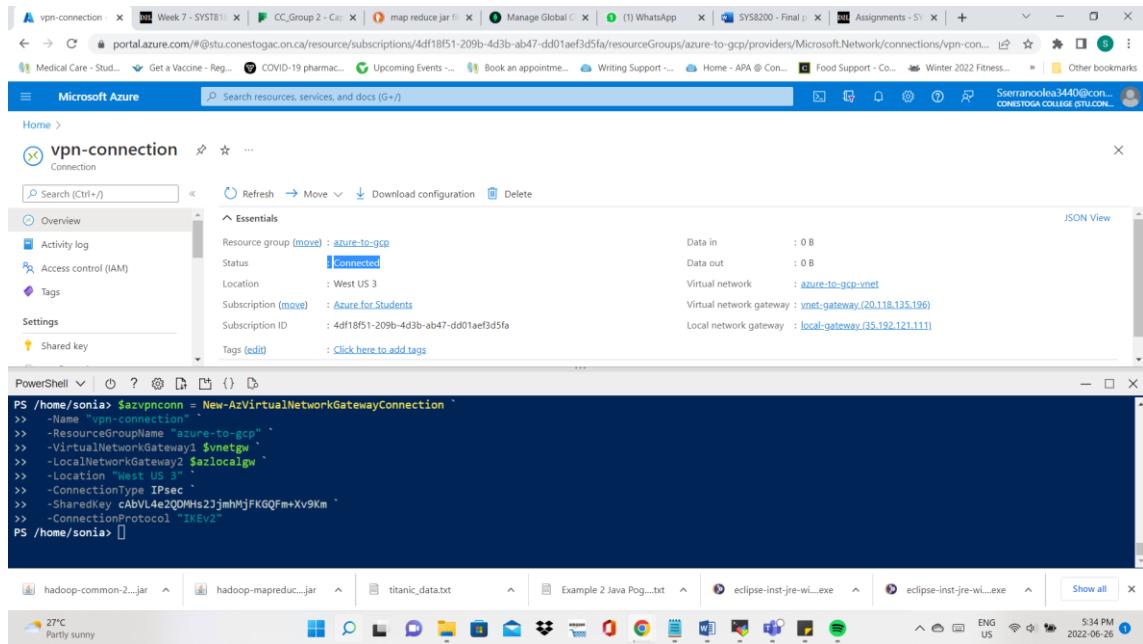


```
PS /home/sonia> $vpnconn = New-AzVirtualNetworkGatewayConnection `>> -Name "vpn-connection" `>> -ResourceGroupName "azure-to-gcp" `>> -VirtualNetworkGateway1 $vnetgw `>> -LocalNetworkGateway2 $azlocalgw `>> -Location "West US 3" `>> -ConnectionType IPsec `>> -SharedKey cbvL4e2QDHs2JjmhMjFKGQFm+Xv9Km `>> -ConnectionProtocol "IKEv2" `>> PS /home/sonia>
```

Note: This screenshot shows the creation of the connection in the azure side of Azure Virtual Network Gateway with the Local Network Gateway.

**Figure 27**

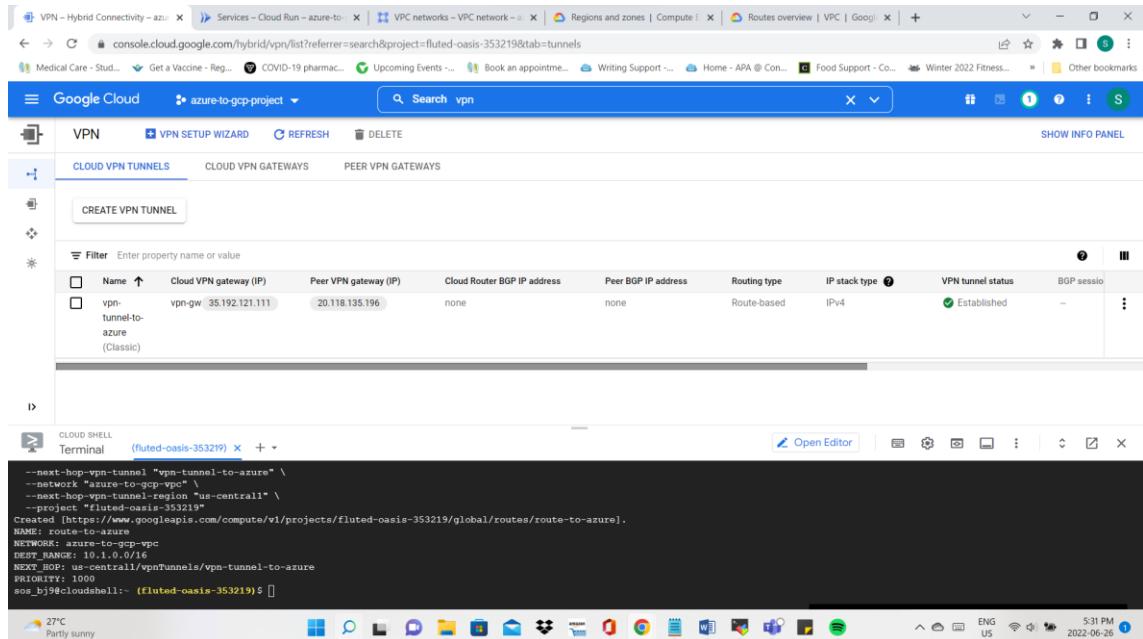
### Azure connection established



Note: This screenshot shows the Azure VPN connection established

**Figure 28**

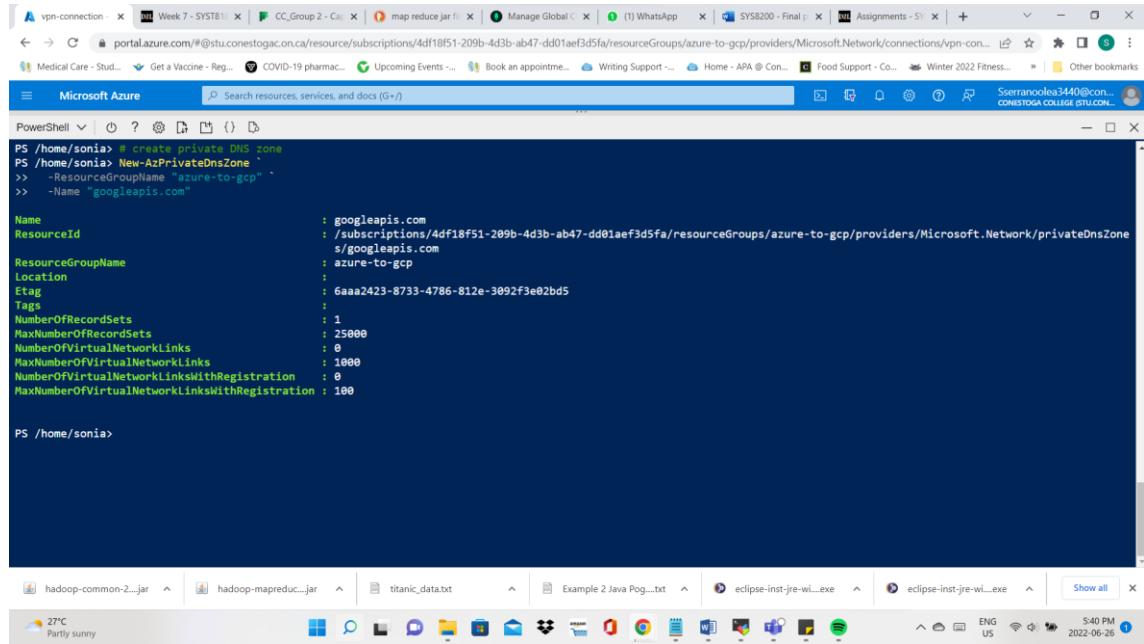
### Google connection established



Note: This screenshot shows the Google VPN connection established

**Figure 29**

## Create a private DNS Zone



```
PS /home/sonia> # create private DNS zone
PS /home/sonia> New-AzPrivateDnsZone
>> -ResourceGroupName "azure-to-gcp"
>> -Name "googleapis.com"

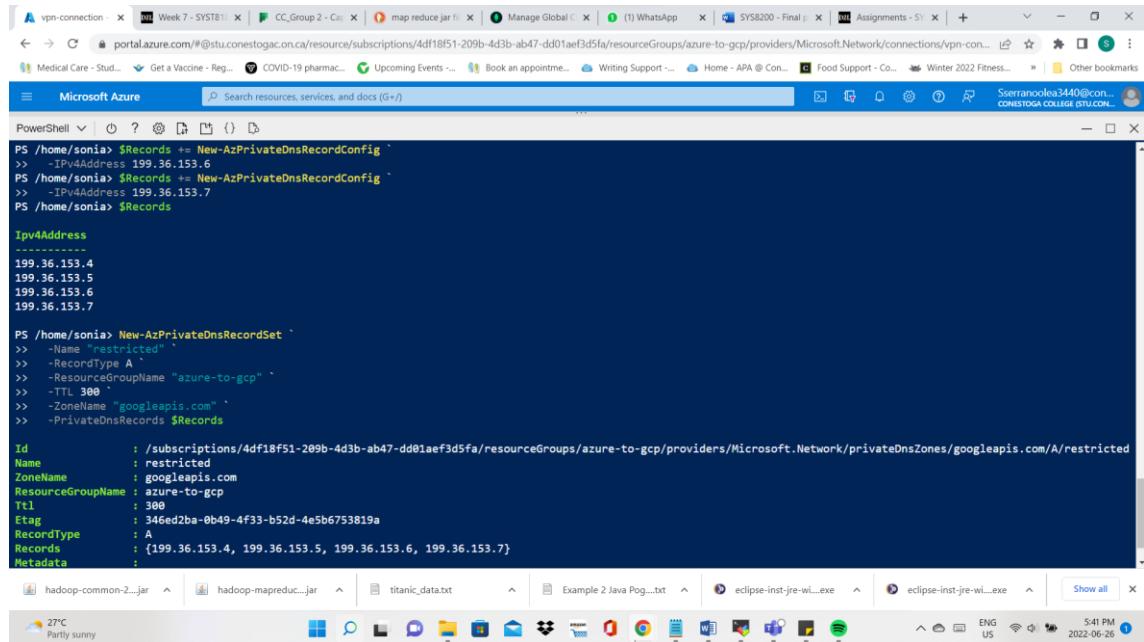
Name          : googleapis.com
ResourceId    : /subscriptions/4df18f51-209b-4d3b-ab47-dd01ae3d5fa/resourceGroups/azure-to-gcp/providers/Microsoft.Network/privateDnsZone
ResourceGroupName : azure-to-gcp
Location      :
Etag          :
Tags          :
NumberofRecordSets   : 1
MaxNumberofRecordSets : 25000
NumberofVirtualNetworkLinks : 0
MaxNumberofVirtualNetworkLinks : 1000
NumberofVirtualNetworkLinksWithRegistration : 0
MaxNumberofVirtualNetworkLinksWithRegistration : 100

PS /home/sonia>
```

Note: This screenshot shows the creation of a private DNS to resolve the googleapis.com domain

**Figure 30**

## Addition of records to the private DNS



```
PS /home/sonia> $Records += New-AzPrivateDnsRecordConfig
>> -IPv4Address 199.36.153.6
PS /home/sonia> $Records += New-AzPrivateDnsRecordConfig
>> -IPv4Address 199.36.153.7
PS /home/sonia> $Records

IPv4Address
-----
199.36.153.4
199.36.153.5
199.36.153.6
199.36.153.7

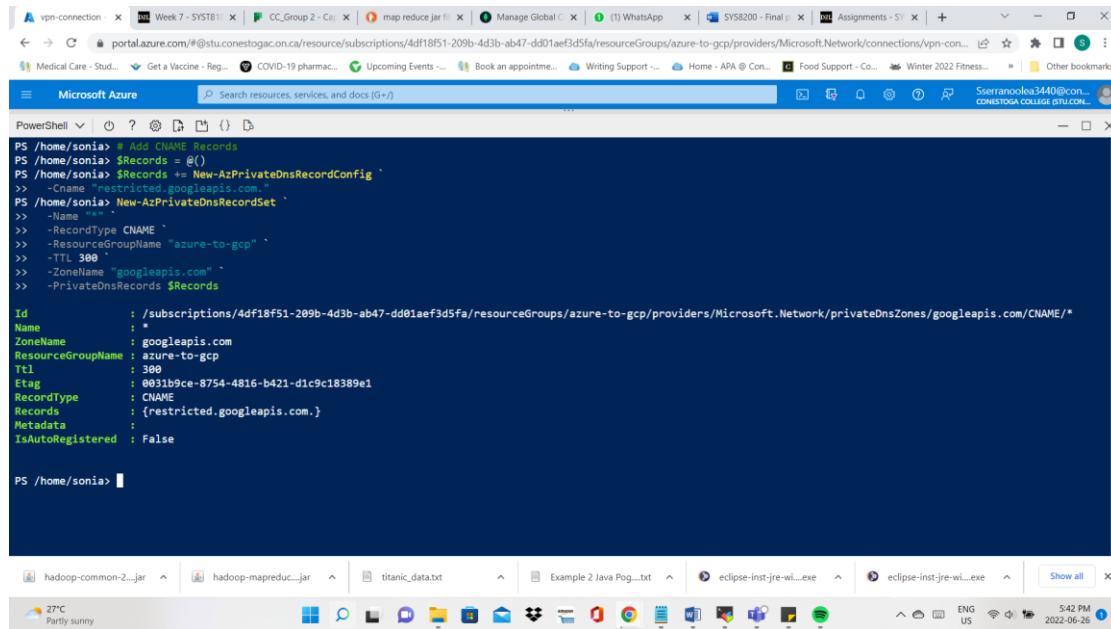
PS /home/sonia> New-AzPrivateDnsRecordSet
>> -Name "restricted"
>> -RecordType A
>> -ResourceGroupName "azure-to-gcp"
>> -TTL 300
>> -ZoneName "googleapis.com"
>> -PrivateDnsRecords $Records

Id          : /subscriptions/4df18f51-209b-4d3b-ab47-dd01ae3d5fa/resourceGroups/azure-to-gcp/providers/Microsoft.Network/privateDnsZones/googleapis.com/A/restricted
Name        : restricted
ZoneName    : googleapis.com
ResourceGroupName : azure-to-gcp
Ttl         : 300
Etag        :
RecordType : A
Records    : {199.36.153.4, 199.36.153.5, 199.36.153.6, 199.36.153.7}
Metadata   :
```

Note: This screenshot shows the creation of records into \$RECORDS array that the private DNS will resolve to redirect google API requests. An create a record set named restricted

**Figure 31**

### Add canonical name record



```
PS /home/sonia> # Add CNAME Records
PS /home/sonia> $Records = @()
PS /home/sonia> $Records += New-AzPrivateDnsRecordConfig `
>>   -Cname "restricted.googleapis.com"
PS /home/sonia> . New-AzPrivateDnsRecordSet
>>   -Name "restricted.googleapis.com"
>>   -RecordType CNAME
>>   -ResourceGroupName "azure-to-gcp"
>>   -Ttl 300
>>   -ZoneName "googleapis.com"
>>   -PrivateDnsRecords $Records

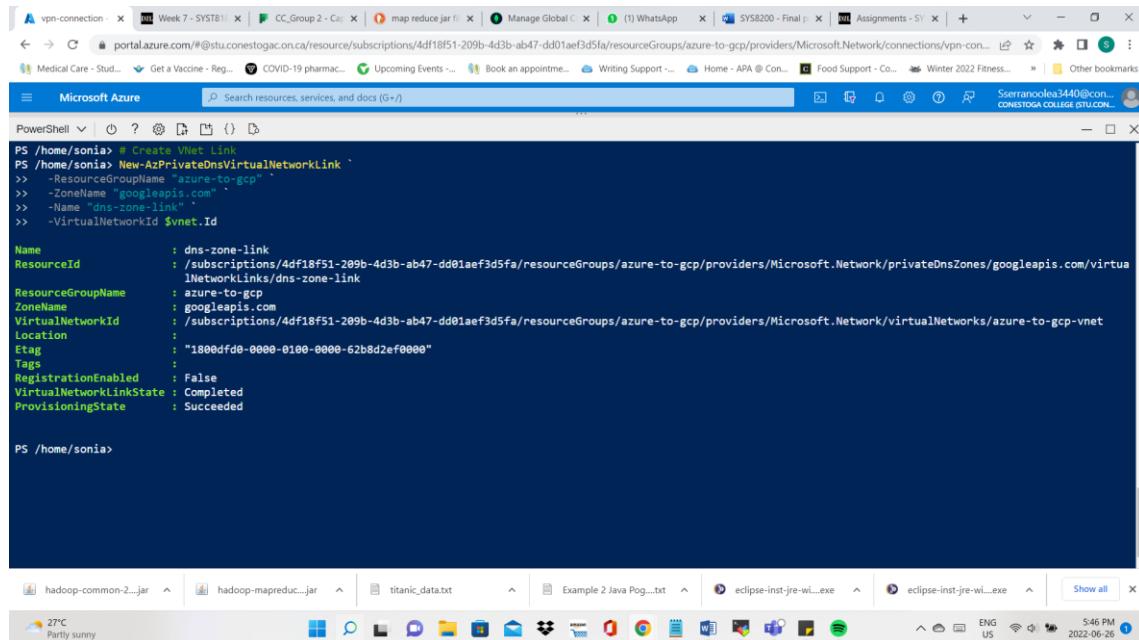
Id          : /subscriptions/4df18f51-209b-4d3b-ab47-dd01aeef3d5fa/resourceGroups/azure-to-gcp/providers/Microsoft.Network/privateDnsZones/googleapis.com/CNAME/
Name        :
ZoneName    : googleapis.com
ResourceGroupName : azure-to-gcp
Ttl         : 300
Etag        : 0031b9ce-8754-4816-b421-d1c9c18389e1
RecordType  : CNAME
Records     : {restricted.googleapis.com}
Metadata    :
IsAutoRegistered : False

PS /home/sonia>
```

Note: This screenshot shows the record set of CNAME type with alias "restricted.googleapis.com."

**Figure 32**

### Create Virtual Network Private Link



```
PS /home/sonia> # Create VNet Link
PS /home/sonia> New-AzPrivateDnsVirtualNetworkLink
>>   -ResourceGroupName "azure-to-gcp"
>>   -ZoneName "googleapis.com"
>>   -Name "dns-zone-link"
>>   -VirtualNetworkId $vnet.Id

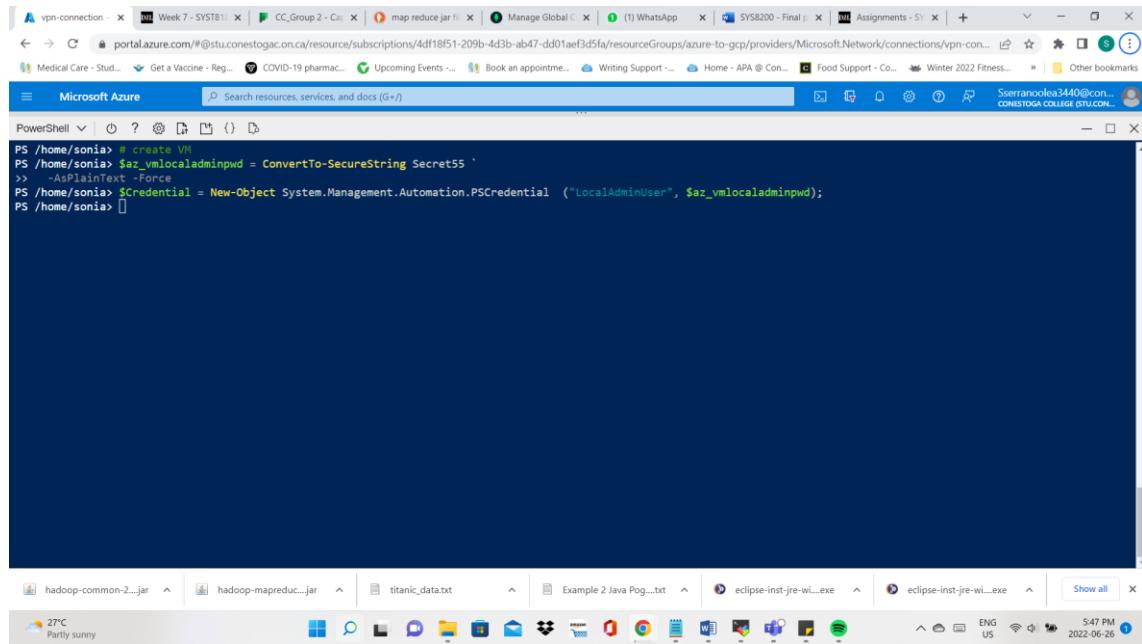
Name          : dns-zone-link
ResourceId    : /subscriptions/4df18f51-209b-4d3b-ab47-dd01aeef3d5fa/resourceGroups/azure-to-gcp/providers/Microsoft.Network/privateDnsZones/googleapis.com/virtualNetworkLinks/dns-zone-link
ResourceGroupName : azure-to-gcp
ZoneName      : googleapis.com
VirtualNetworkId : /subscriptions/4df18f51-209b-4d3b-ab47-dd01aeef3d5fa/resourceGroups/azure-to-gcp/providers/Microsoft.Network/virtualNetworks/azure-to-gcp-vnet
Location      :
Etag          : "1800dfd8-0000-0100-0000-62b8d2ef0000"
Tags          :
RegistrationEnabled : False
VirtualNetworkLinkState : Completed
ProvisioningState : Succeeded

PS /home/sonia>
```

Note: This screenshot links the private DNS with the Virtual Network

**Figure 33**

### Create credential objects (user and password)



A screenshot of a Microsoft Azure PowerShell window. The command entered is:

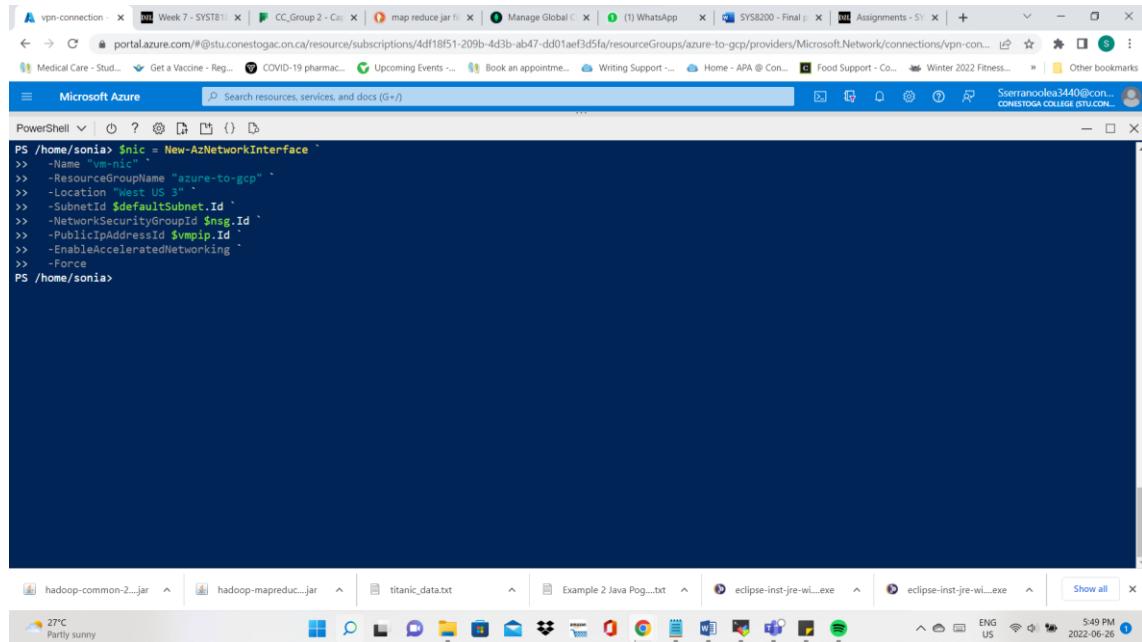
```
PS /home/sonia> # create VM
PS /home/sonia> $az_vmlocaladminpwd = ConvertTo-SecureString Secret55 ` 
>> -AsPlainText -Force
PS /home/sonia> $Credential = New-Object System.Management.Automation.PSCredential ("LocalAdminUser", $az_vmlocaladminpwd);
PS /home/sonia> [
```

The window also shows other tabs open, including 'Week 7 - SYST811', 'CC\_Group 2 - Cal...', 'map reduce jar...', 'Manage Global...', '(1) WhatsApp', 'SYS8200 - Final...', 'Assignments - SY...', and 'Other bookmarks'. The taskbar at the bottom shows various application icons like Eclipse, Java, and Microsoft Office.

Note: This screenshot shows the creation of a secure string password and a user LocalAdminUser

**Figure 34**

### Create credential objects (user and password)



A screenshot of a Microsoft Azure PowerShell window. The command entered is:

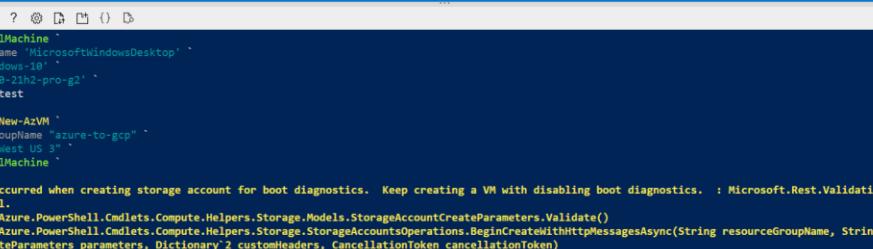
```
PS /home/sonia> $nic = New-AzNetworkInterface ` 
>> -Name "VM-nic" ` 
>> -ResourceGroupName "azure-to-gcp" ` 
>> -Location "West US 3" ` 
>> -SubnetId $defaultsSubnet.Id ` 
>> -NetworkSecurityGroupId $nsg.Id ` 
>> -PublicIpAddressId $vmip.Id ` 
>> -EnableAcceleratedNetworking ` 
>> -Force
PS /home/sonia>
```

The window also shows other tabs open, including 'Week 7 - SYST811', 'CC\_Group 2 - Cal...', 'map reduce jar...', 'Manage Global...', '(1) WhatsApp', 'SYS8200 - Final...', 'Assignments - SY...', and 'Other bookmarks'. The taskbar at the bottom shows various application icons like Eclipse, Java, and Microsoft Office.

Note: This screenshot shows the creation of the vnic for the virtual machine with the security group and ip previously created.

## Figure 35

## Creation of a windows-desktop machine in Azure



A screenshot of a Microsoft Azure PowerShell session. The session starts with creating a new storage account named 'az-to-gcp' in the West US region. Then, it creates a new VM named 'windows-desktop' with a Microsoft Windows Desktop publisher, version 10, and size 'Standard\_D2\_v2'. The session ends with a warning about boot diagnostics and a verbose message about performing a 'New' operation on the target.

```
>>> -VM $VirtualMachine
>>> -PublisherName "MicrosoftWindowsDesktop"
>>> -Offer Windows-10
>>> -Sku D2v2
>>> -Version latest
PS /home/sonia>
PS /home/sonia> New-AzVM `
>>> -ResourceGroupName "azure-to-gcp"
>>> -Location "West-US 3"
>>> -VM $VirtualMachine
>>> -Verbose
WARNING: Error occurred when creating storage account for boot diagnostics. Keep creating a VM with disabling boot diagnostics. : Microsoft.Rest.ValidationException: 'Kind
d' cannot be null.
   at Microsoft.Azure.PowerShell.Cmdlets.Compute.Helpers.Storage.Models.StorageAccountCreateParameters.Validate()
   at Microsoft.Azure.PowerShell.Cmdlets.Compute.Helpers.Storage.StorageAccountsOperations.BeginCreateWithHttpMessagesAsync(String resourceGroupName, String accountName, Storage
AccountCreateParameters parameters, Dictionary`2 customHeaders, CancellationToken cancellationToken)
   at Microsoft.Azure.PowerShell.Cmdlets.Compute.Helpers.Storage.StorageAccountsOperations.CreateWithHttpMessagesAsync(String resourceGroupName, String accountName, Storage
AccountCreateParameters parameters, Dictionary`2 customHeaders, CancellationToken cancellationToken)
   at Microsoft.Azure.PowerShell.Cmdlets.Compute.Helpers.Storage.StorageAccountsOperationsExtensions.CreateAsync(IStorageAccountsOperations operations, String resourceGroup
Name, String accountName, StorageAccountCreateParameters parameters, CancellationToken cancellationToken)
   at Microsoft.Azure.PowerShell.Cmdlets.Compute.Helpers.Storage.StorageAccountsOperationsExtensions.Create(IStorageAccountsOperations operations, String resourceGroupName,
String accountName, StorageAccountCreateParameters parameters)
   at Microsoft.Azure.Commands.Compute.NewAzureVMCommand.CreateStandardStorageAccount(StorageManagementClient client)
VERBOSE: Performing the operation "New" on target "windows-desktop".
RequestID IsSuccessStatusCode StatusCode ReasonPhrase
----->
True          OK      OK
PS /home/sonia>
```

Note: This screenshot shows the creation of a general-purpose Windows 10 pro VM with previously generated credentials and a network interface.

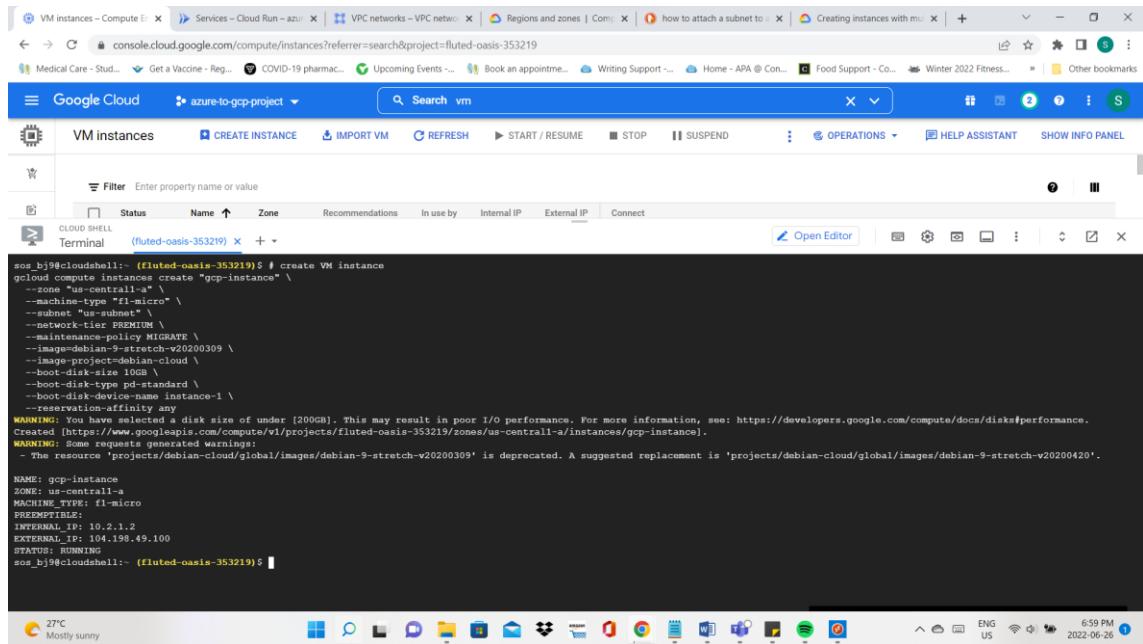
**Figure 36**

## VM Size

Note: This screenshot shows the list of Av2 Standard virtual machines

**Figure 37**

### Creation of a Linux machine in GCP



The screenshot shows a Google Cloud interface for managing VM instances. The terminal window displays the command used to create a VM instance named "gcp-instance". The command specifies parameters such as zone ("us-central1-a"), machine type ("f1-micro"), and image ("debian-cloud/debian-9-stretch-v20200309"). The terminal also shows system logs and warnings related to disk size and deprecated resources.

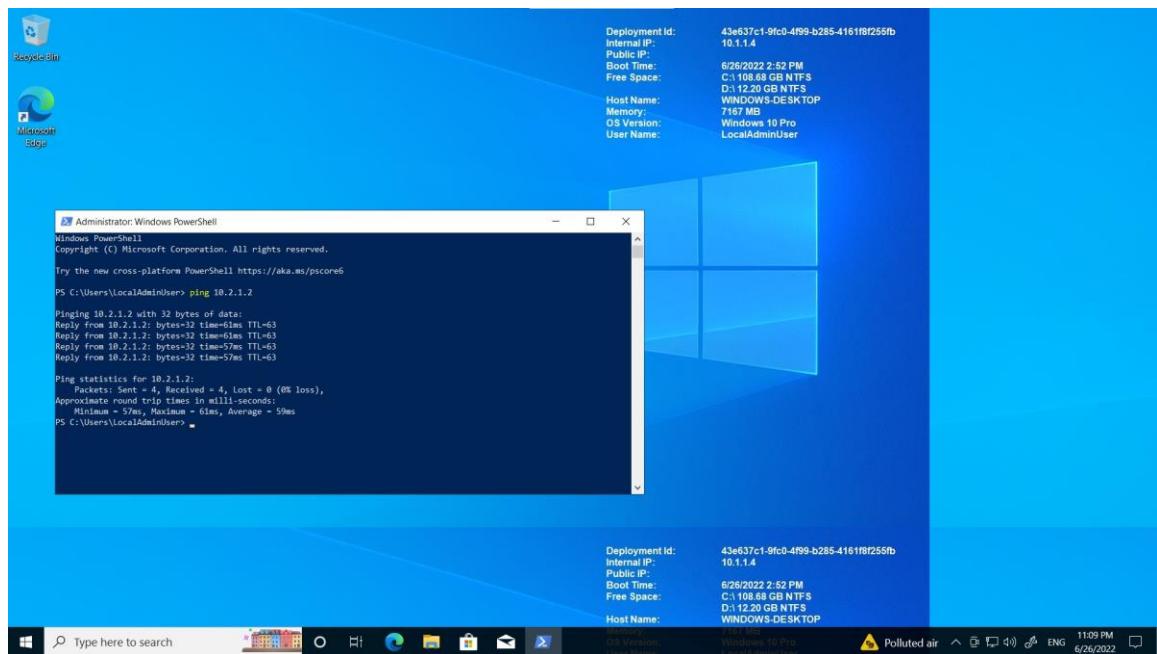
```
son_bj98@cloudshell:~ (fluted-oasis-353219)$ # create VM instance
gcloud compute instances create "gcp-instance" \
--zone "us-central1-a" \
--machine-type "f1-micro" \
--subnet "default" \
--preemptible \
--maintenance-policy MIGRATE \
--image "debian-9-stretch-v20200309" \
--image-project "debian-cloud" \
--boot-disk-size 10GB \
--boot-disk-type "pd-standard" \
--boot-disk-device-name "instance-1" \
--reservation-affinity any
WARNING: You have selected a disk size of under [200GB]. This may result in poor I/O performance. For more information, see: https://developers.google.com/compute/docs/disks#performance.
Created [https://www.googleapis.com/compute/v1/projects/fluted-oasis-353219/zones/us-central1-a/instances/gcp-instance].
WARNING: Some requests generated warnings:
- The resource 'projects/debian-cloud/global/images/debian-9-stretch-v20200309' is deprecated. A suggested replacement is 'projects/debian-cloud/global/images/debian-9-stretch-v20200420'.

NAME: gcp-instance
ZONE: us-central1-a
MACHINE_TYPE: f1-micro
PREEMPTIBLE:
INTERNAL_IP: 10.2.1.2
EXTERNAL_IP: 104.198.49.100
STATUS: RUNNING
son_bj98@cloudshell:~ (fluted-oasis-353219)$
```

Note: This screenshot shows of the creation of a VM f1-micro type. This shared-core is ideal for non-resource intensive apps

**Figure 38**

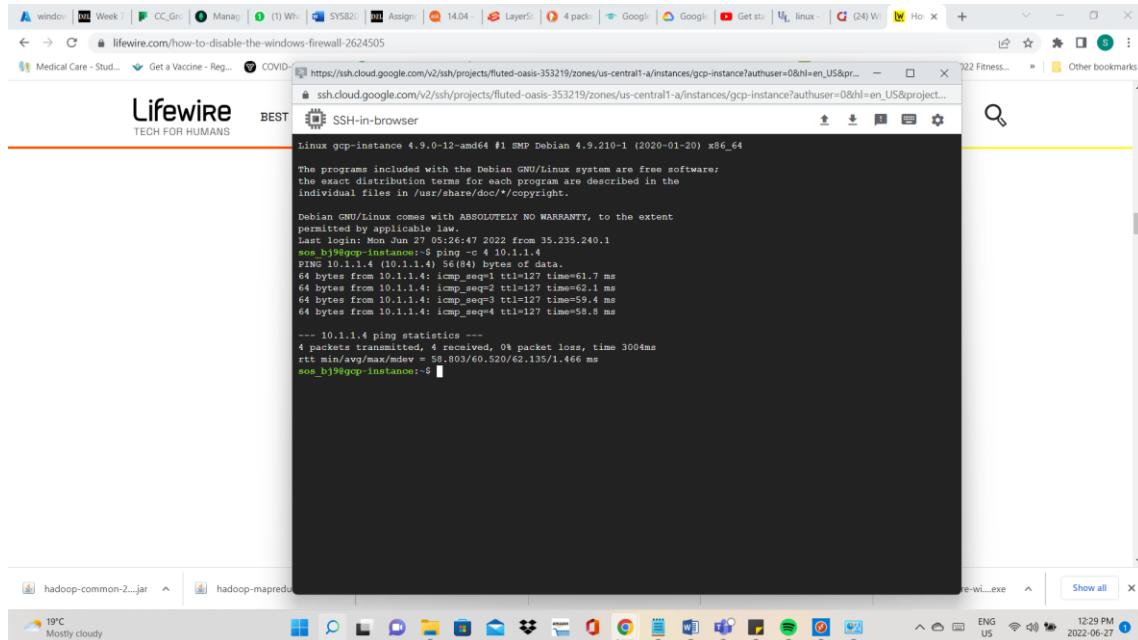
### Test Azure to GCP



Note: This screenshot shows the ping from Azure to GCP

**Figure 39**

### Test GCP to Azure



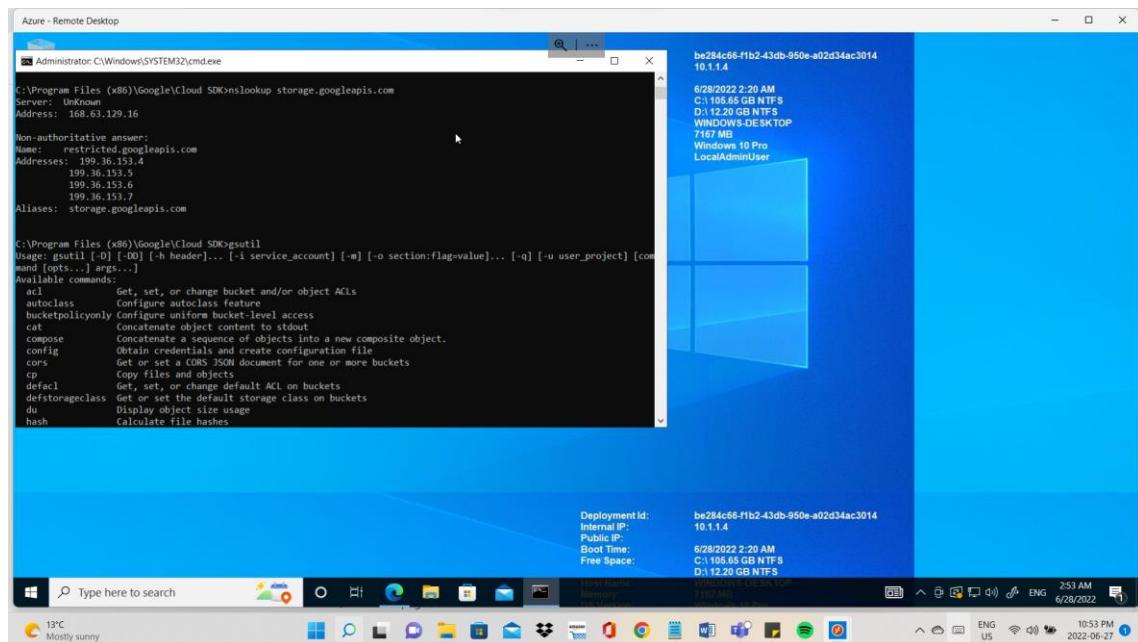
```
Linux gcp-instance 4.9.0-12-amd64 #1 SMP Debian 4.9.210-1 (2020-01-20) x86_64
The programs included with the Debian GNU/Linux system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Debian GNU/Linux comes with ABSOLUTELY NO WARRANTY, to the extent
permitted by applicable law.
Last login: Mon Jun 27 05:25:47 2022 from 35.235.240.1
root@ip-10-1-1-4:~$ ping -c 4 10.1.1.4
PING 10.1.1.4 (10.1.1.4) 56(84) bytes of data.
64 bytes from 10.1.1.4: icmp_seq=1 ttl=127 time=61.7 ms
64 bytes from 10.1.1.4: icmp_seq=2 ttl=127 time=62.1 ms
64 bytes from 10.1.1.4: icmp_seq=3 ttl=127 time=59.4 ms
64 bytes from 10.1.1.4: icmp_seq=4 ttl=127 time=58.8 ms
--- 10.1.1.4 ping statistics ---
4 packets transmitted, 4 received, 0% packet loss, time 3004ms
rtt min/avg/max/mdev = 58.803/60.520/62.135/1.466 ms
root@ip-10-1-1-4:~$
```

Note: This screenshot shows the ping from GCP to Azure

**Figure 40**

### Test GCP to Azure



```
C:\Program Files (x86)\Google\Cloud SDK\cmd\*nslookup storage.googleapis.com
Server: Unknown
Address: 168.63.129.16

Non-authoritative answer:
Name: restricted.googleapis.com
Addresses: 199.36.153.4
          199.36.153.6
          199.36.153.7
Aliases: storage.googleapis.com

C:\Program Files (x86)\Google\Cloud SDK\cmd\*gcloud
Usage: gcloud [-D] [-O] [-h header]... [-i service_account] [-m] [-o section:flag=value]... [-q] [-u user_project] [command [opts...] args...]
Available commands:
  acl      Get, set, or change bucket and/or object ACLs
  autoclass Configure autoclass feature
  bucketpolicyonly Configure bucket-level access
  cat      Concatenate objects and write to stdout
  compose  Concatenate a sequence of objects into a new composite object.
  config   Obtain credentials and create configuration file
  cors     Get or set a CORS JSON document for one or more buckets
  cp       Copy files and objects
  defacl   Get, set, or change default ACL on buckets
  defstorageclass Set or change default storage class on buckets
  du      Display object site usage
  hash    Calculate file hashes
```

Note: This screenshot shows the test to google APIs in the private DNS zone

