

Proof Document

```
resource "azurerm_network_security_rule" "ssh" {
    source_address_prefixes = ["85.12.154.27/32"]
}

azurerm_subnet.main: Refreshing state... [id=/subscriptions/5ed9512a-7969-40e7-bf64-d2143f0ae1fa/resourceGroups/cherouf_group/providers/Microsoft.Network/virtualNetworks/vm-vnet/subnets/vm-subnet]

azurerm_network_interface.main: Refreshing state... [id=/subscriptions/5ed9512a-7969-40e7-bf64-d2143f0ae1fa/resourceGroups/cherouf_group/providers/Microsoft.Network/networkInterfaces/vm-nic]

azurerm_network_interface_security_group_association.main: Refreshing state... [id=/subscriptions/5ed9512a-7969-40e7-bf64-d2143f0ae1fa/resourceGroups/cherouf_group/providers/Microsoft.Network/networkInterfaces/vm-nic]/subscriptions/5ed9512a-7969-40e7-bf64-d2143f0ae1fa/resourceGroups/cherouf_group/providers/Microsoft.NetworkSecurityGroups/vm-nsg]

azurerm_linux_virtual_machine.main: Refreshing state... [id=/subscriptions/5ed9512a-7969-40e7-bf64-d2143f0ae1fa/resourceGroups/cherouf_group/providers/Microsoft.Compute/virtualMachines/super-vm]

No changes. Your infrastructure matches the configuration.

Terraform has compared your real infrastructure against your configuration and found no differences, so no changes are needed.

Apply complete! Resources: 0 added, 0 changed, 0 destroyed.
```

Name	Access	Dir	Prio	Proto	Src	DestPort
securityRules/allow-ssh	Allow	Inbound	1000	Tcp	85.12.154.27/32	22-22
defaultSecurityRules/AllowVnetInBound	Allow	Inbound	65000	All	VirtualNetwork	0-65535
defaultSecurityRules/AllowAzureLoadBalancerInBound	Allow	Inbound	65001	All	AzureLoadBalancer	0-65535
defaultSecurityRules/DenyAllInBound	Deny	Inbound	65500	All	0.0.0.0/0	0-65535
defaultSecurityRules/AllowVnetOutBound	Allow	Outbound	65000	All	VirtualNetwork	0-65535
defaultSecurityRules/AllowInternetOutBound	Allow	Outbound	65001	All	0.0.0.0/0	0-65535
defaultSecurityRules/DenyAllOutBound	Deny	Outbound	65500	All	0.0.0.0/0	0-65535

```
tf-azure-2
variables.tf
main.tf
main.tf
57 resource "azurerm_linux_virtual_machine" "main" {
79   source_image_reference {
      id          = "/subscriptions/5ed9512a-7969-40e7-bf64-d2143f0ae1fa/resourceGroups/cherouf_group/providers/Microsoft.Network/publicIPAddresses/vm-ip"
      name        = "vm-ip"
      tags        = {}
    }
    # (12 unchanged attributes hidden)
}

Plan: 0 to add, 1 to change, 0 to destroy.
azurerm_public_ip.main: Modifying... [id=/subscriptions/5ed9512a-7969-40e7-bf64-d2143f0ae1fa/resourceGroups/cherouf_group/providers/Microsoft.Network/publicIPAddresses/vm-ip]
azurerm_public_ip.main: Modifications complete after 6s [id=/subscriptions/5ed9512a-7969-40e7-bf64-d2143f0ae1fa/resourceGroups/cherouf_group/providers/Microsoft.Network/publicIPAddresses/vm-ip]

Apply complete! Resources: 0 added, 1 changed, 0 destroyed.
PS C:\Users\chero\OneDrive\Bureau\tf-azure-2> az network public-ip show -g cherouf_group -n vm-ip
>> --query "{ip: ipAddress, fqdn: dnsSettings.fqdn}" -o table
Ip Fqdn
4.178.183.115 cherouf-supervm-01.francecentral.cloudapp.azure.com
PS C:\Users\chero\OneDrive\Bureau\tf-azure-2>
```

```
tf-azure-2
variables.tf
main.tf
main.tf
System load: 0.0 Processes: 105
Usage of /: 5.7% of 28.89GB Users logged in: 0
Memory usage: 28% IPv4 address for eth0: 10.0.1.4
Swap usage: 0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

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

The list of available updates is more than a week old.
To check for new updates run: sudo apt update
New release '24.04.3 LTS' available.
Run 'do-release-upgrade' to upgrade to it.

Last login: Sat Sep 13 07:39:32 2025 from 85.12.154.27
cherouf-cli@super-vm:~$
```

Étape C — Mini explication “comment ça s’authentifie ?”

- azcopy login --identity utilise l'identité managée de ta VM.
- Sur Azure, chaque VM peut avoir une Managed Identity (service principal géré).
- AzCopy demande un token OAuth2 auprès d'Azure AD via l'IMDS (Instance Metadata Service) exposé à l'IP 169.254.169.254.
- La ressource ciblée est https://storage.azure.com/.
- Azure AD renvoie un JWT (Bearer token) que AzCopy met dans l'en-tête Authorization: Bearer <token> pour appeler le service de Blob Storage.
- L'accès est autorisé si l'identité de la VM a le rôle **Storage Blob Data Contributor** sur le scope du Storage Account/Container.

```
>> terraform state show azurerm_storage_container.main | Select-String "name"

    name          = "cheroufsabackup01"
  resource_group_name = "cherouf_group"
      name          = "backups"
storage_account_name      = "cheroufsabackup01"

PS C:\Users\chero\OneDrive\Bureau\tf-azure-2> az storage account list -g cherouf_group -o
  table
>> az storage container list --account-name cheroufsabackup01 -o table
AccessTier  AllowBlobPublicAccess  AllowCrossTenantReplication  AllowSharedKeyAcces
s  CreationTime  DefaultToOAuthAuthentication  DnsEndpointType
EnableHttpsTrafficOnly  EnableNfsV3  IsHnsEnabled  IsLocalUserEnabled  IsSftpEna
bled  Kind  Location  MinimumTlsVersion  Name  PrimaryLocation
ProvisioningState  PublicNetworkAccess  ResourceGroup  StatusOfPrimary
-----
-----
```

Hot	True	True	True	True	Standard
2025-09-13T08:32:36.606Z	2025-09-13T08:32:36.606Z	2025-09-13T08:32:36.606Z	2025-09-13T08:32:36.606Z	2025-09-13T08:32:36.606Z	2025-09-13T08:32:36.606Z
True	False	False	True	False	
StorageV2	francecentral	TLS1_2	cheroufsabackup01	francecentral	
Succeeded	Enabled		cherouf_group	available	

PROBLÈMES SORTIE CONSOLE DE DÉBOGAGE TERMINAL ...

ssh └── ... └── ×

```
Job 76426e9d-b194-4d49-54e8-5d9bc7db6b3f summary
Elapsed Time (Minutes): 0.0335
Number of File Transfers: 1
Number of Folder Property Transfers: 0
Number of Symlink Transfers: 0
Total Number of Transfers: 1
Number of File Transfers Completed: 1
Number of Folder Transfers Completed: 0
Number of File Transfers Failed: 0
Number of Folder Transfers Failed: 0
Number of File Transfers Skipped: 0
Number of Folder Transfers Skipped: 0
Number of Symbolic Links Skipped: 0
Number of Hardlinks Converted: 0
Number of Special Files Skipped: 0
Total Number of Bytes Transferred: 52
Final Job Status: Completed

hello from vm super-vm Sat Sep 13 09:03:25 UTC 2025
cherouf-cli@super-vm:~$
```

```
PS C:\Users\chero\OneDrive\Bureau\tf-azure-2> az monitor metrics alert list -g cherouf_group -o table
AutoMitigate      Description          Enabled   EvaluationFrequency  Location
Name             ResourceGroup        Severity  TargetResourceRegion TargetResource
Type     WindowSize
-----  -----
-----  -----
-----  -----
-----  -----
True      Alerte si CPU > 70%       True      PT1M                global
cpu-alert-super-vm cherouf_group    2
PT5M
True      Alerte si RAM dispo < 512Mo True      PT1M                global
ram-alert-super-vm cherouf_group   2
PT5M
PS C:\Users\chero\OneDrive\Bureau\tf-azure-2>
```

11:21



16

◀ Instagram



Microsoft Azure
À Vous

11:20

...



⚠ Your Azure Monitor alert was triggered

Azure monitor alert rule ram-alert-super-vm
was triggered for super-vm at September 13,
2025 9:20 UTC.

Alert rule description

Alerte si RAM dispo < 512Mo

Rule ID

/subscriptions/5ed9512a-7969-40e7-bf64-d21
43f0ae1fa/resourceGroups/cherouf_group/pro
viders/Microsoft.Insights/metricAlerts/ram-aler
t

```

PS C:\Users\chero\OneDrive\Bureau\tf-azure-2> az monitor activity-log list --status Failed
--status Succeeded -o table
+-----+-----+-----+-----+-----+
| Caller          | CorrelationId | Description | EventData |
| aId             | EventTimestamp | Level       | OperationId |
| ResourceGroup   | ResourceGroupName | ResourceId |
+-----+-----+-----+-----+
| TenantId | SubmissionTimestamp | SubscriptionId |
+-----+-----+-----+
mohamed.bouarioua@efrei.net 42abc209-49a3-31f6-57e1-dc3dd03c687d 43e55c85
-112d-4186-b827-73eb62378859 2025-09-13T09:19:39.8598918Z Informational 59f35f6e-524b-4
c0e-8c3f-2735e2de6db6 cherouf_group cherouf_group /subscriptions/5ed9512a-7969-
40e7-bf64-d2143f0ae1fa/resourcegroups/cherouf_group/providers/Microsoft.Insights/metricale
rts/ram-alert-super-vm 2025-09-13T09:20:57Z Sed9512a-7969-40e7-bf64-d2143f0ae1fa
413600cf-bd4e-4c7c-8a61-69e73cd7f31
mohamed.bouarioua@efrei.net 42abc209-49a3-31f6-57e1-dc3dd03c687d 96ce9b9a
-99a9-48b6-b852-048eafa6f7cd 2025-09-13T09:19:37.0521131Z Informational 89b7bac6-c713-4
210-ba25-8ba8eb99bd9a cherouf_group cherouf_group /subscriptions/5ed9512a-7969-

```

SSH and PowerShell tabs are visible in the top right.

The code editor shows several Terraform files:

- `variables.tf`
- `keyvault.tf`
- `terraform.tfstate`
- `terraform.tfvars` (active tab)
- `monitoring.tf`
- `main.tf`
- `storage.tf`

The `terraform.tfvars` file contains:

```

storage_container_name = "backups"
alert_email_address = "mohamed.bouarioua@efrei.net"
key_vault_name = "cheroufvault01"

```

The `main.tf` file shows a resource block for a key vault:

```

"attributes": {
  "created": "2025-09-13T09:52:17+00:00",
  "enabled": true,
  "expires": null,
  "notBefore": null,
  "recoverableDays": 7,
  "recoveryLevel": "CustomizedRecoverable+Purgeable",
  "updated": "2025-09-13T09:52:17+00:00"
},
"id": "https://cheroufvault01.vault.azure.net/secrets/app-secret/5a075d1cd014469ba5c070ff93033121",
"kid": null,
"managed": null,
"name": "app-secret",
"tags": {},
"value": "buYHFypD@00ggZcV"
}
buYHFypD@00ggZcV

```

The terminal pane at the bottom shows the command being run:

```

PS C:\Users\chero\OneDrive\Bureau\tf-azure-2>

```