Installing Packer and Running Packer

1. Prerequisites

- Azure Subscription: You will need an Azure subscription with permissions to create resources.
- Packer:
- The machine that running Ubuntu 22.04 with sudo or root privileges
- Internet connection

2. Setup environment

2.1 Install prerequisites package

Please run the command below to install an nessessary packages:

```
apt update
apt install wget unzip -y
```

2.2 Install Azure CLI

This script runs all installation commands in one step. This script is downloaded via curl and piped directly to bash to install the CLI.

```
curl -sL https://aka.ms/InstallAzureCLIDeb | sudo bash
```

Set default subscription

After you sign in, CLI commands are run against your default subscription. If you have multiple subscriptions, change your default subscription using `az account set --subscription`

```
az account set --subscription "<subscription ID or name>"
```

Log in to Azure with the command:

```
az login
```

This will open a browser window where you can log in to your Azure account.

Next, we need create Azure credentinal that will be used by Packer Run command below to create new service principal:

```
az ad sp create-for-rbac --role="Contributor" --
scopes="/subscriptions/YOUR_SUBSCRIPTION_ID"
```

This will give you the following details:

- client_id
- client_secret
- tenant_id
- subscription_id

> Save these values; you'll need them later when configuring Packer.

2.3 Install Packer

To install the precompiled binary, download the appropriate package for your system.

```
wget -O- https://apt.releases.hashicorp.com/gpg | sudo gpg --dearmor -o
/usr/share/keyrings/hashicorp-archive-keyring.gpg
echo "deb [signed-by=/usr/share/keyrings/hashicorp-archive-keyring.gpg]
https://apt.releases.hashicorp.com $(lsb_release -cs) main" | sudo tee
/etc/apt/sources.list.d/hashicorp.list
sudo apt update && sudo apt install packer
```

After installing Packer, verify the installation worked by opening a new command prompt or console, and checking that packer is available:

```
packer -h
```

The output look like:

```
    packer
    Usage: packer [--version] [--help] <command> [<args>]
    Available commands are:
    build           build image(s) from template
    console         creates a console for testing variable interpolation
    fix             fixes templates from old versions of packer
    fmt             Rewrites HCL2 config files to canonical format
    hcl2_upgrade    transform a JSON template into an HCL2 configuration
    init            Install missing plugins or upgrade plugins
    inspect         see components of a template
    validate        check that a template is valid
    version         Prints the Packer version
```

3. Create a Packer Template

3.1 What is a Packer Template?

A Packer template is a JSON file that defines how an image should be built. You'll write a template that defines the base image and hardening tasks.

3.2 Create the Packer Template

In this guide, we will use HCL syntax to create Packer template

Clone source code from github to server:

```
git clone <GIT_REPO_URL>
```

Folder structure as below:

This is a content of Packer template

```
packer {
  required_plugins {
    azure = {
      source  = "github.com/hashicorp/azure"
      version = "~> 1"
    }
  }
}

source "azure-arm" "openscap_hardening" {
  azure_tags = {
    dept    = "Security"
    project = "OpenSCAP-Remediation"
  }
  client_id                         = "client-id"
  client_secret                     = "client-secret"
  subscription_id                   = "subscription_id"
  tenant_id                         = "tenant_id"
  image_offer                       = "0001-com-ubuntu-server-jammy"
  image_publisher                   = "Canonical"
  image_sku                         = "22_04-lts-gen2"
  build_resource_group_name         = "cariad-dev-wp09-west-us-02"
  managed_image_name                = "wp09-ubuntu-22-04-template"
  managed_image_resource_group_name = "cariad-dev-wp09-west-us-02"
  os_type                           = "Linux"
  vm_size                           = "Standard_DS2_v2"
}


build {
```

```
  sources = ["source.azure-arm.openscap_hardening"]
  provisioner "shell" {
    inline          = ["sudo apt-get update", "sudo apt-get upgrade -y",
"sudo apt-get install unzip -y", "sudo apt-get install libopenscap8 -y"]
    max_retries       = 5
  }
  provisioner "shell" {
    execute_command = "chmod +x {{ .Path }}; {{ .Vars }} sudo -E sh '{{
.Path }}'"
    script          = "./setup.sh"
  }
  provisioner "file" {
    source      = "cloud-init.yaml"
    destination = "/tmp/cloud-init.yaml"
  }
  provisioner "shell" {
    inline = [
      "sudo mv /tmp/cloud-init.yaml
/etc/cloud/cloud.cfg.d/99_remove_waagent.cfg"
    ]
  }
  provisioner "file" {
    source      = "/tmp/reports/report-before.html"
    destination = "/tmp/report-before.html"
    direction   = "download"
  }
  provisioner "file" {
    source      = "/tmp/reports/report-after.html"
    destination = "/tmp/report-after.html"
    direction   = "download"
    max_retries = 5
  }
  provisioner "shell" {
    inline          = ["/usr/sbin/waagent -force -deprovision+user export
HISTSIZE=0 sync"]
  }

}
```

Explanation: This document outlines a Packer template used to create a custom hardened Ubuntu 22.04 virtual machine image following OpenSCAP remediation guidelines. The image is built using Packer with Azure as the infrastructure provider, and it includes multiple provisioning steps to install necessary packages and run custom shell scripts.

Packer Configuration

```
packer {
  required_plugins {
    azure = {
      source  = "github.com/hashicorp/azure"
```

```
      version = "~> 1"
    }
  }
}
```

Explanation:

- Packer Block: Defines the required Packer plugin for Azure (github.com/hashicorp/azure) to interact with Azure's ARM infrastructure.
- Version: Specifies that Packer should use version 1.x of the plugin.

Azure ARM Source Block

```
source "azure-arm" "openscap_hardening" {
  azure_tags = {
    dept    = "Security"
    project = "OpenSCAP-Remediation"
  }
  client_id                         = "client-id"
  client_secret                     = "client-secret"
  subscription_id                   = "subscription_id"
  tenant_id                         = "tenant_id"
  image_offer                       = "0001-com-ubuntu-server-jammy"
  image_publisher                   = "Canonical"
  image_sku                         = "22_04-lts-gen2"
  build_resource_group_name         = "cariad-dev-wp09-west-us-02"
  managed_image_name                = "wp09-ubuntu-22-04-template"
  managed_image_resource_group_name = "cariad-dev-wp09-west-us-02"
  os_type                           = "Linux"
  vm_size                           = "Standard_DS2_v2"
}
```

Explanation:

- Source Block: Defines the Azure resource that Packer will use to build the VM image.
- Azure Tags: Metadata tags that identify the department (`dept: Security`) and project (project: `OpenSCAP-Remediation`).
- Client ID, Secret, Subscription, Tenant: Azure authentication credentials. These should be securely provided as environment variables or secrets.
- Image Settings:
  - image_offer: The base Ubuntu image being used, i.e., Ubuntu Server Jammy (22.04).
  - image_publisher: Canonical, the publisher of the Ubuntu image.
  - image_sku: Specifies the exact SKU for Ubuntu 22.04 LTS with Generation 2 support.
- Resource Groups:
  - build_resource_group_name: Resource group where the build VM will reside.
  - managed_image_name: The name of the final custom image created after provisioning.

    - managed_image_resource_group_name: The resource group where the final image will be stored.
- VM Size: Defines the virtual machine size (`Standard_DS2_v2`), a general-purpose VM optimized for most workloads.
- os_type: Operating system type (`Linux`).

Build Block

```
build {
  sources = ["source.azure-arm.openscap_hardening"]
  provisioner "shell" {
    inline          = ["sudo apt-get update", "sudo apt-get upgrade -y",
"sudo apt-get install unzip -y", "sudo apt-get install libopenscap8 -y"]
    max_retries       = 5
  }
  provisioner "shell" {
    execute_command = "chmod +x {{ .Path }}; {{ .Vars }} sudo -E sh '{{
.Path }}'"
    script          = "./setup.sh"
  }
  provisioner "file" {
    source      = "cloud-init.yaml"
    destination = "/tmp/cloud-init.yaml"
  }
  provisioner "shell" {
    inline = [
      "sudo mv /tmp/cloud-init.yaml
/etc/cloud/cloud.cfg.d/99_remove_waagent.cfg"
    ]
  }
  provisioner "file" {
    source      = "/tmp/reports/report-before.html"
    destination = "/tmp/report-before.html"
    direction   = "download"
  }
  provisioner "file" {
    source      = "/tmp/reports/report-after.html"
    destination = "/tmp/report-after.html"
    direction   = "download"
    max_retries = 5
  }
  provisioner "shell" {
    inline          = ["/usr/sbin/waagent -force -deprovision+user export
HISTSIZE=0 sync"]
  }

}
```

Explanation:

- Build Block: Specifies the provisioning steps and image creation process.
- Sources: Refers to the source block defined earlier (`azure-arm.openscap_hardening`).

Provisioners:

- Shell Provisioner (APT updates):
  - Inline Command: Executes common Linux commands to update the system, upgrade all packages, and install unzip and libopenscap8.
  - max_retries: Specifies the number of retries in case of failure.
- Shell Provisioner (Custom Script):
  - Script: Runs a custom script (setup.sh), which is uploaded to the VM and executed with elevated permissions.
  - execute_command: Ensures the script is executable and runs with necessary privileges.
  - inline_shebang: Custom shell interpreter (/bin/sh -x) for verbose output.
- File Provisioners:
  - Before Remediation: Downloads the OpenSCAP scan report generated before remediation to the local machine (report-before.html).
  - After Remediation: Downloads the post-remediation OpenSCAP report (report-after.html).
  - Direction: download specifies that files are being pulled from the VM.

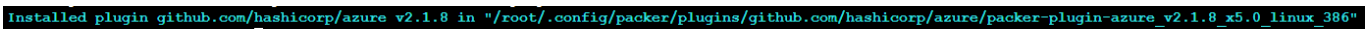
4.3 Provisioning Flow

1. System Update & OpenSCAP Installation:
   - The VM is updated, upgraded, and the OpenSCAP package is installed.
2. Custom Script Execution:
   - A custom hardening script (setup.sh) is executed to apply the desired system configurations.
3. File Transfers:
   - OpenSCAP reports are downloaded before and after the remediation process for auditing purposes.

5. Run Packer

Run following command to initialize Packer based o HCL template above

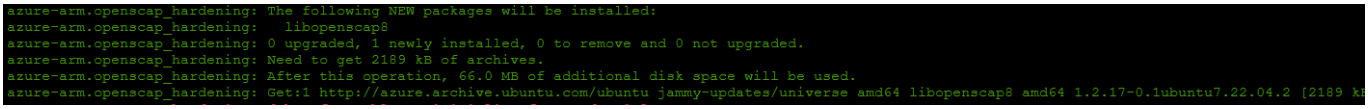
```
packer init ami-script.pkr.hcl
```



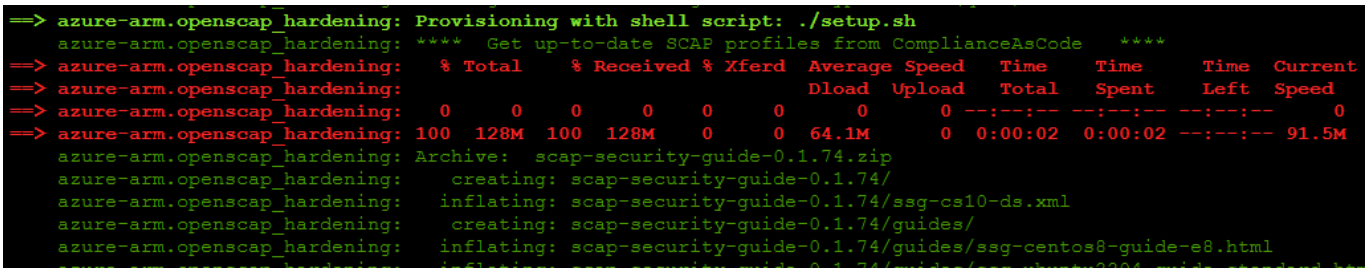
Next, Run Packer Build

```
packer build ami-script.pkr.hcl
```

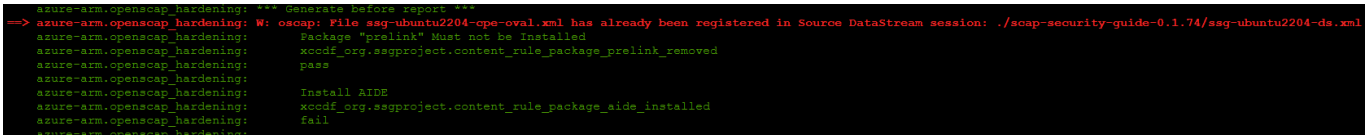
Install libopenscap8



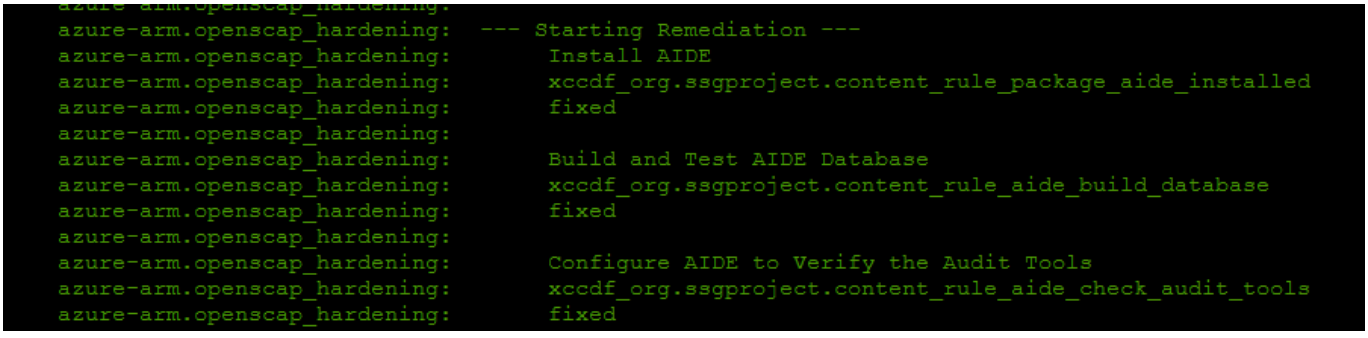
Start script, download and unzip OpenSCAP profile



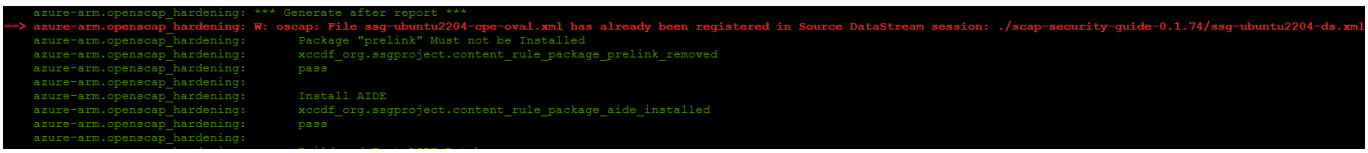
Create "report-before.html"



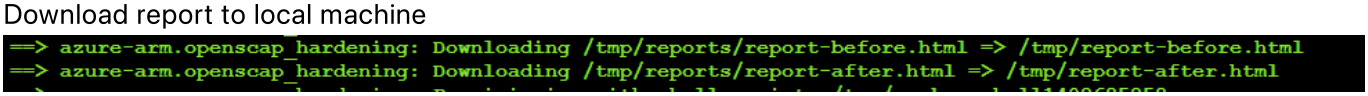
Starting remediation



Create "report-after.html"



Download report to local machine



Create Image

```
==> azure-arm.openscap_hardening: Querying the machine's properties ...
==> azure-arm.openscap_hardening:  -> ResourceGroupName : 'cariad-dev-wp09-west-us-02'
==> azure-arm.openscap_hardening:  -> ComputeName       : 'pkrvm2bb6wvdgo6'
==> azure-arm.openscap_hardening:  -> Managed OS Disk   : '/subscriptions/e5539e2d-86df-4147-a780-baa8cd7fb2d0/resourceGroups/cariad-dev-wp09-west-us-02/providers/Microsoft.Compute/disks/pkros2bb6wvdgo6'
==> azure-arm.openscap_hardening: Querying the machine's additional disks properties ...
==> azure-arm.openscap_hardening:  -> ResourceGroupName : 'cariad-dev-wp09-west-us-02'
==> azure-arm.openscap_hardening:  -> ComputeName       : 'pkrvm2bb6wvdgo6'
==> azure-arm.openscap_hardening: Powering off machine ...
==> azure-arm.openscap_hardening:  -> ResourceGroupName : 'cariad-dev-wp09-west-us-02'
==> azure-arm.openscap_hardening:  -> ComputeName       : 'pkrvm2bb6wvdgo6'
==> azure-arm.openscap_hardening:  -> Compute ResourceGroupName : 'cariad-dev-wp09-west-us-02'
==> azure-arm.openscap_hardening:  -> Compute Name              : 'pkrvm2bb6wvdgo6'
==> azure-arm.openscap_hardening:  -> Compute Location          : 'westus2'
==> azure-arm.openscap_hardening: Generalizing machine ...
==> azure-arm.openscap_hardening: Capturing image ...
==> azure-arm.openscap_hardening:  -> Image ResourceGroupName   : 'cariad-dev-wp09-west-us-02'
==> azure-arm.openscap_hardening:  -> Image Name                : 'wp09-ubuntu-22-04-template'
==> azure-arm.openscap_hardening:  -> Image Location            : 'westus2'
==> azure-arm.openscap_hardening:
```

Remove template object

```
==> azure-arm.openscap_hardening: Deleting Virtual Machine deployment and its attached resources...
==> azure-arm.openscap_hardening: Deleted -> pkrvm2bb6wvdgo6 : 'Microsoft.Compute/virtualMachines'
==> azure-arm.openscap_hardening: Deleted -> pkrni2bb6wvdgo6 : 'Microsoft.Network/networkInterfaces'
==> azure-arm.openscap_hardening: Deleted -> pkrip2bb6wvdgo6 : 'Microsoft.Network/publicIPAddresses'
==> azure-arm.openscap_hardening: Deleted -> pkrvn2bb6wvdgo6 : 'Microsoft.Network/virtualNetworks'
==> azure-arm.openscap_hardening: Deleted -> Microsoft.Compute/disks : '/subscriptions/e5539e2d-86df-4147-a780-baa8cd7fb2d0/resourceGroups/cariad-dev-wp09-west-us-02/providers/Microsoft.Compute/disks/pkros2bb6w
vdgo6'
==> azure-arm.openscap_hardening: Removing the created Deployment object: 'pkrdp2bb6wvdgo6'
==> azure-arm.openscap_hardening:
==> azure-arm.openscap_hardening: The resource group was not created by Packer, not deleting ...
Build 'azure-arm.openscap_hardening' finished after 17 minutes 15 seconds.

==> Wait completed after 17 minutes 15 seconds

==> Builds finished. The artifacts of successful builds are:
--> azure-arm.openscap_hardening: Azure.ResourceManagement.VMImage:
```

6. Verify The Report

6.1 Report Before Bardening

Evaluation Characteristics

Evaluation target	pkrvm2bb6wvdgo6
Benchmark URL	./scap-security-guide-0.1.74/ssg-ubuntu2204-ds.xml
Benchmark ID	xccdf_org.ssgproject.content_benchmark_UBUNTU_22-04
Profile ID	xccdf_org.ssgproject.content_profile_cis_level1_workstation
Started at	2024-09-23T02:54:32
Finished at	2024-09-23T02:55:20
Performed by	packer

CPE Platforms

- cpe:/o:canonical:ubuntu_linux:22.04::~~lts~~~

Addresses

- IPv4 127.0.0.1
- IPv4 10.0.0.4
- IPv6 0:0:0:0:0:0:0:1
- IPv6 fe80:0:0:0:222:48ff:fe7b:18c3
- MAC 00:00:00:00:00:00
- MAC 00:22:48:7B:18:C3

Compliance and Scoring

The target system did not satisfy the conditions of 100 rules! Please review rule results and consider applying remediation.

Rule results

131 passed | 100 failed | 7

Severity of failed rules

5 other | 5 low | 87 medium | 3 high

Score

Scoring system	Score	Maximum	Percent
urn:xccdf:scoring:default	63.984261	100.000000	63.98%

6.2 Report After Remediation

Evaluation Characteristics

Evaluation target	pkrvm2bb6wvdgo6
Benchmark URL	./scap-security-guide-0.1.74/ssg-ubuntu2204-ds.xml
Benchmark ID	xccdf_org.ssgproject.content_benchmark_UBUNTU_22-04
Profile ID	xccdf_org.ssgproject.content_profile_cis_level1_workstation
Started at	2024-09-23T03:06:16
Finished at	2024-09-23T03:06:40
Performed by	packer

CPE Platforms

- cpe:/o:canonical:ubuntu_linux:22.04::~~lts~~~~

Addresses

- IPv4 127.0.0.1
- IPv4 10.0.0.4
- IPv6 0:0:0:0:0:0:0:1
- IPv6 fe80:0:0:0:222:48ff:fe7b:18c3
- MAC 00:00:00:00:00:00
- MAC 00:22:48:7B:18:C3

Compliance and Scoring

The target system did not satisfy the conditions of 4 rules! Please review rule results and consider applying remediation.

Rule results

226 passed 4 4

Severity of failed rules

1 other | 1 low | 1 medium | 1 high

Score

Scoring system	Score	Maximum	Percent
urn:xccdf:scoring:default	90.409302	100.000000	90.41%

7. Verify a new hardening image on Azure

We provisioned new Azure VM from custome image. Then ssh into that server and check

7.1 Package is deinstalled

```
The following packages will be REMOVED:
  walinuxagent*
0 upgraded, 0 newly installed, 1 to remove and 0 not upgraded.
After this operation, 1212 kB disk space will be freed.
(Reading database ... 63652 files and directories currently installed.)
Removing walinuxagent (2.2.46-0ubuntu5.1) ...
(Reading database ... 63527 files and directories currently installed.)
Purging configuration files for walinuxagent (2.2.46-0ubuntu5.1) ...
```

```
azureuser@cariad-dev-wp09-boundary:~$ sudo apt list --installed | grep walinuxagent

WARNING: apt does not have a stable CLI interface. Use with caution in scripts.

azureuser@cariad-dev-wp09-boundary:~$
```

7.2 Systemd service unit-file not present

```
azureuser@cariad-dev-wp09-boundary:~$ sudo systemctl status walinuxagent
Unit walinuxagent.service could not be found.
azureuser@cariad-dev-wp09-boundary:~$
```