5. How Node autoprovisioning - NAP (Karpenter) works and its CRDs

A **NodePool** in NAP defines constraints for nodes and pod scheduling. It's customizable for specific requirements.

These requirements are combined with `pod.spec.affinity.nodeAffinity` rules.

```
apiVersion: karpenter.sh/v1beta1
kind: NodePool
metadata:
  name: nap-nodepool
spec:
  template:
    spec:
      nodeClassRef:
        name: default
      requirements:
      - key: kubernetes.io/arch
        operator: In #also supports NotIn,
Exists, DoesNotExist, Gt, and Lt
        values:
        - amd64
      - key: kubernetes.io/os
        operator: In
        values:
        - linux
      - key: karpenter.sh/capacity-type
        operator: In
        values:
        - on-demand
      - key: karpenter.azure.com/sku-family
        operator: In
        values:
        - D
  disruption:
    consolidationPolicy: WhenUnderutilized
    expireAfter: Never
  limits:
    cpu: "1000"
    memory: 1000Gi
  weight: 10
```

Selector	Description	Example
karpenter.azure.com/sku-family	VM SKU Family	D, F, L etc.
karpenter.azure.com/sku-name	Explicit SKU name	Standard_A1_v2
karpenter.azure.com/sku-version	SKU version (without "v", can use 1)	1 , 2
karpenter.sh/capacity-type	VM allocation type (Spot / On Demand)	spot or on-demand
karpenter.azure.com/sku-cpu	Number of CPUs in VM	16
karpenter.azure.com/sku-memory	Memory in VM in MiB	131072
karpenter.azure.com/sku-gpu-name	GPU name	A100
karpenter.azure.com/sku-gpu-manufacturer	GPU manufacturer	nvidia
karpenter.azure.com/sku-gpu-count	GPU count per VM	2
karpenter.azure.com/sku-networking-accelerated	Whether the VM has accelerated networking	[true, false]
karpenter.azure.com/sku-storage-premium-capable	Whether the VM supports Premium IO storage	[true, false]
karpenter.azure.com/sku-storage-ephemeralos-maxsize	Size limit for the Ephemeral OS disk in Gb	92
topology.kubernetes.io/zone	The Availability Zone(s)	[uksouth-1,uksouth-2,uksouth-3]
kubernetes.io/os	Operating System (Linux only during preview)	linux
kubernetes.io/arch	CPU architecture (AMD64 or ARM64)	[amd64, arm64]

Source: https://learn.microsoft.com/en-us/azure/aks/node-autoprovision

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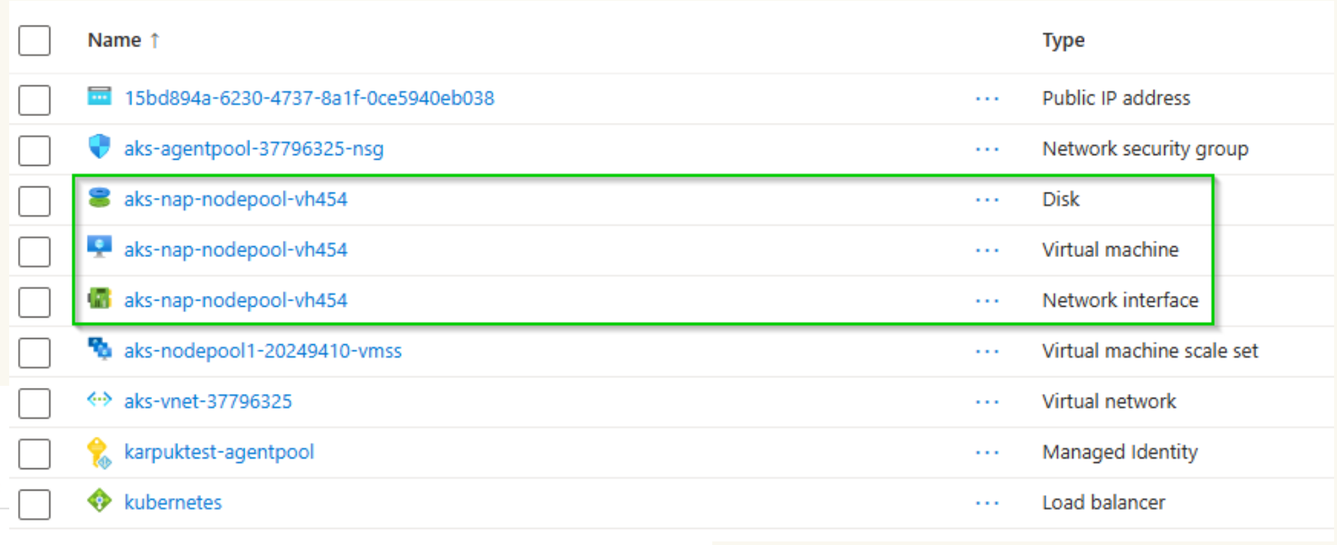
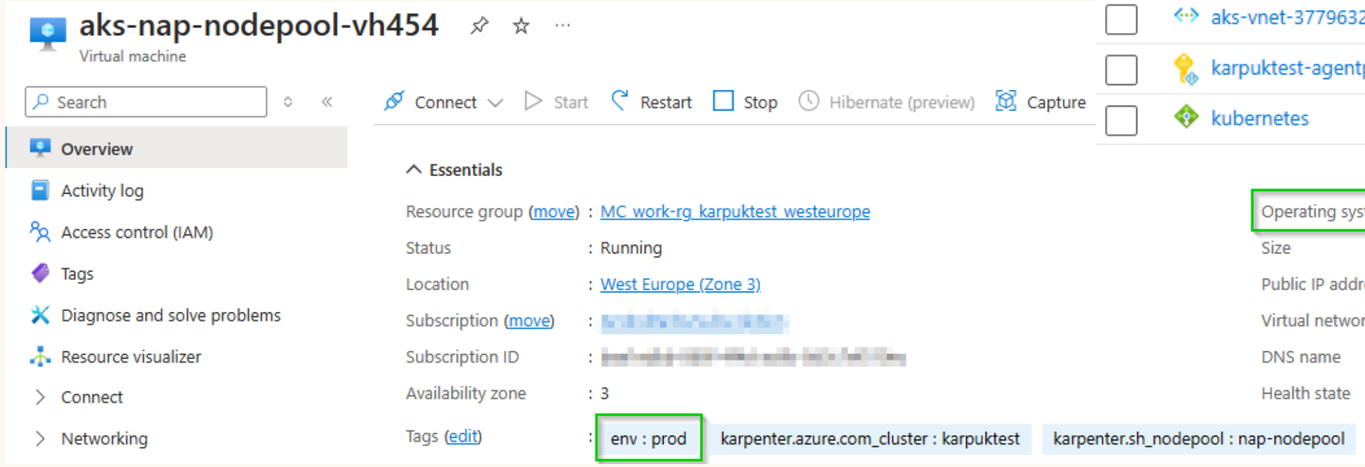
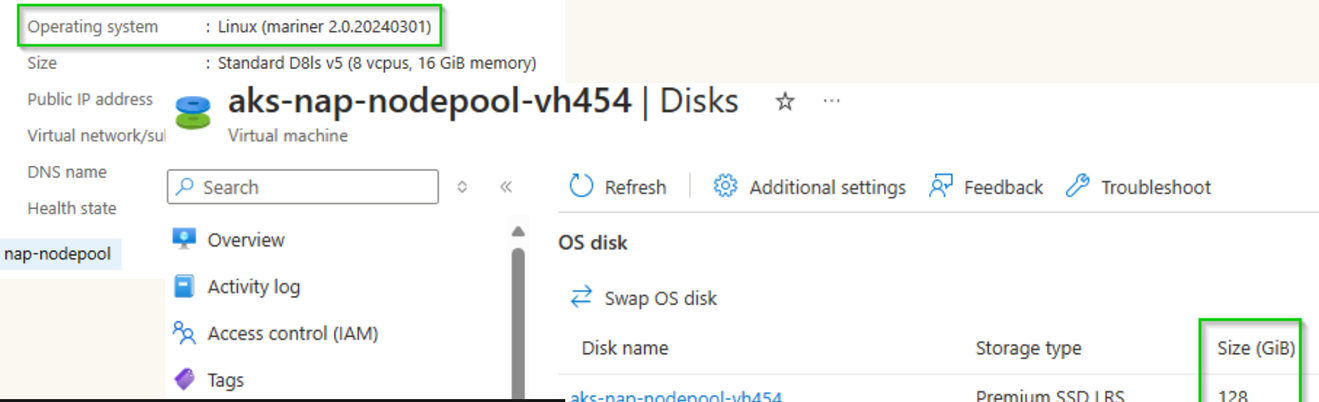
An AKSNodeClass in NAP is the top-level specification and fine-tunes specific VM-related settings. Each NodePool needs to reference an AKSNodeClass.

```
apiVersion: karpenter.azure.com/v1alpha2
kind: AKSNodeClass
metadata:
  name: nap-aksnodeclass
spec:
  imageFamily: AzureLinux
  imageVersion: 202404.01.0
  osDiskSizeGB: 128
  tags:
    env: prod
```








```
$k get node -o wide
NAME                                STATUS   ROLES   AGE     VERSION   INTERNAL-IP   EXTERNAL-IP   OS-IMAGE             KERNEL-VERSION      CONTAINER-RUNTIME
aks-nap-nodepool-vh454              Ready    agent   6m13s   v1.28.5   10.224.0.6    <none>        CBL-Mariner/Linux    5.15.148.2-2.cm2    containerd://1.6.26
aks-nodepool1-20249410-vmss000000   Ready    agent   15h     v1.28.5   10.224.0.5    <none>        Ubuntu 22.04.4 LTS   5.15.0-1059-azure   containerd://1.7.14-1
```

5. How Node autoprovisioning - NAP (Karpenter) works and its CRDs

A **NodeClaim** represents a claim for a specific node within the cluster.

It acts as an **intermediary between NAP (Karpenter) and the underlying cloud provider** (e.g., AWS, Azure).

When NAP (Karpenter) provisions a **new node**, it **creates a corresponding NodeClaim**.

```
apiVersion: karpenter.sh/v1beta1
kind: NodeClaim
metadata:
    name: nap-nodepool
spec:
  nodeClassRef:
    name: nap-aksnodeclass
  requirements:
  - key: kubernetes.io/arch
    operator: In
    values:
    - amd64
  - key: kubernetes.io/os
    operator: In
    values:
    - linux
  - key: karpenter.sh/capacity-type
    operator: In
    values:
    - on-demand
  - key: karpenter.azure.com/sku-family
    operator: In
    values:
    - D
  - key: karpenter.sh/nodepool
    operator: In
    values:
    - nap-nodepool
  - key: node.kubernetes.io/instance-type
    operator: In
    values:
    - Standard_D13_v2
    #list with other SKU sizes
  resources:
    requests:
      cpu: 5250m
      memory: 470Mi
      pods: "6"
status:
  allocatable:
    cpu: 7820m
    ephemeral-storage: 128G
    memory: 11743Mi
    pods: "110"
  capacity:
    cpu: "8"
    ephemeral-storage: 128G
    memory: 15155Mi
    pods: "110"
  nodeName: aks-nap-nodepool-vh454
```

```
$k get node,nodeclaim
NAME                                    STATUS   ROLES    AGE   VERSION
node/aks-nap-nodepool-vh454             Ready    agent    84m   v1.28.5
node/aks-nodepool1-20249410-vmss000000  Ready    agent    17h   v1.28.5

NAME                                        TYPE              ZONE          NODE                    READY   AGE
nodeclaim.karpenter.sh/nap-nodepool-vh454   Standard_D8ls_v5  westeurope-3  aks-nap-nodepool-vh454  True    85m
```