

# 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]

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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
```

<input type="checkbox"/>	Name ↑	Type
<input type="checkbox"/>	15bd894a-6230-4737-8a1f-0ce5940eb038	Public IP address
<input type="checkbox"/>	aks-agentpool-37796325-nsg	Network security group
<input type="checkbox"/>	aks-nap-nodepool-vh454	Disk
<input type="checkbox"/>	aks-nap-nodepool-vh454	Virtual machine
<input type="checkbox"/>	aks-nap-nodepool-vh454	Network interface
<input type="checkbox"/>	aks-nodepool1-20249410-vmss	Virtual machine scale set
<input type="checkbox"/>	aks-vnet-37796325	Virtual network
<input type="checkbox"/>	karpuktest-agentpool	Managed Identity
<input type="checkbox"/>	kubernetes	Load balancer

aks-nap-nodepool-vh454

Virtual machine

Search

Connect Start Restart Stop Hibernate (preview) Capture

Overview

Activity log

Access control (IAM)

Tags

Diagnose and solve problems

Resource visualizer

Connect

Networking

Essentials

Resource group (move) : MC\_work-rg\_karpuktest\_westeurope

Status : Running

Location : West Europe (Zone 3)

Subscription (move) :

Subscription ID :

Availability zone : 3

Tags (edit) : env : prod karpenter.azure.com\_cluster : karpuktest karpenter.sh\_nodepool : nap-nodepool

Operating system : Linux (mariner 2.0.20240301)

Size : Standard D8ls v5 (8 vcpus, 16 GiB memory)

Public IP address : aks-nap-nodepool-vh454

Virtual network/subnet : Virtual machine

DNS name :

Health state :

Search

Overview

Activity log

Access control (IAM)

Tags

aks-nap-nodepool-vh454 | Disks

Refresh Additional settings Feedback Troubleshoot

OS disk

Swap OS disk

Disk name	Storage type	Size (GiB)
aks-nap-nodepool-vh454	Premium SSD LRS	128

```
$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

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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

 aks-nap-nodepool-vh454

... Virtual machine