



Managing VNF Lifecycle Operations

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Managing the VNF Lifecycle

The NFVO communicates with ESC using the ETSI MANO API for lifecycle management of a VNF. A configuration template, the Virtual Network Function Descriptor (VNFD) file describes the deployment parameters and operational behaviors of a VNF type. The VNFD is used in the process of deploying a VNF and managing the lifecycle of a VNF instance.

The lifecycle operations of a VNF instance is as follows:

1. **Create a VNF Identifier**—ESC generates a new VNF Instance Id (a universally unique identifier) that is subsequently used as a handle to reference the instance upon which to execute further operations.
2. **Instantiate / Deploy VNF**—As part of VNF instantiation, ESC instantiates a new VNF instance in the VIM. ESC receives a request to instantiate a VNF instance from NFVO. The instantiate request contains resource requirements, networking and other service operational behaviors. All these requirements along with the VNFD and the grant information provides all the necessary information to instantiate the VNF.
3. **Operate VNF**—ESC allows you to start and stop a VNF instance. The resources are not released or changed, but the VNF instance in the VIM is toggled between these two states.
4. **Query VNF**—To query one or more VNF instances known to ESC. This is a specific REST end point that can be filtered to find specific instances. The instances can be filtered using the VNF Instance Id.

Also, a separate REST end point allows the NFVO to query the status of one or more lifecycle operation occurrences associated with a VNF. The lifecycle operations can be filtered using a specific occurrence identifier.

5. **Modify VNF**—ESC allows you to modify the properties of a single VNF instance. The instantiated VNF is updated, and the lifecycle management operation occurrence sends notification to the NFVO about the status of the VNF.
6. **Scale and Scale to Level VNF**—ESC allows you to scale VNFs in two ways. You can scale a VNF incrementally, or to a specific level.
7. **Heal VNF**—ESC heals the VNF when there is a failure.

8. **Terminate / Undeploy VNF**—To terminate the VNF instance in the VIM. The resources themselves remain reserved for the VNF instance, however the VNF itself is undeployed.
9. **Delete VNF Identifier**—The resources are fully released in the VIM and in ESC and the associated VNF instance identifier is also released.

For VNF lifecycle operations using REST and NETCONF APIs, see [Configuring Deployment Parameters in the Cisco Elastic Services Controller User Guide](#).

The ESC health monitor API can determine the connectivity of ESC to the NFVO and send appropriate status notifications. For more details, see *Monitoring ESC Health* in the [Cisco Elastic Services Controller Administration Guide](#).

VNF Lifecycle Operations

VNFM Prerequisites

The following prerequisites must be met for VNF lifecycle operations:

- The resource definitions must be created out of band and must be available before VNF instantiation.
- There are two options with regards to connecting to the VIM. The VIM Connector specifies how ESC connects to the VIM and may be created and validated in advance of deploying a VNF (and identified by name) or created as part of the request if new `vimConnectionInfo` is supplied. See [VIM Connectors Overview](#).

NFVO Prerequisites

- The VNF to be instantiated has to be onboarded to the NFVO within an ETSI compliant VNF package.
 - The NFVO must provide ETSI compliant VNF Packages to ESC.
 - The VNF package must contain a VNF Descriptor (VNFD) file.

The NFVO must support the `/vnf_packages` API to allow access to the package artifacts. See chapter 10 in the *ETSI GS NFV-SOL 003* specification on the ETSI website for details.

- Update the properties file, *etsi-production.properties* under: `/opt/cisco/esc/esc_database/`. The properties file provides details about the NFVO to ESC.

The single property `nfvo.apiRoot` allows specification of the NFVO host and port. For example, `nfvo.apiRoot=localhost:8280`.



Note The initial implementation of the ETSI MANO API supports only a single VIM. The tenant/project is currently specified using the `resourceGroupId`.

For notes on ESC in HA mode, enabled with ETSI service, see the [Cisco Elastic Services Controller Install and Upgrade Guide](#).

Deployment Request

The deployment request includes the following tasks:

The VNFD provides a description of the following constructs (see *ETSI GS NFV-SOL 001* specification on the ETSI website for details)

- The deployment level configuration such as deployment flavours and external connections
- The VDU configuration, including any applicable images (Compute)
- The internal connection points (VduCp)
- Any volumes to be created, including any applicable images (VirtualBlockStorage)
- The internal virtual links (VnfVirtualLink)
- Policies and groups for placement, scaling and security

The InstantiateVnfRequest:

- The chosen deployment flavour
- The VIM connection details (vimConnectionInfo - Or-Vnfm only)
- Any external networks to which to connect the external connection points (extVirtualLinks)
- Any external networks that may be bound to for internal virtual links (extManagedVirtualLinks)
- A list of key-value pairs to provide deployment specific variables for the deployment (additionalParams)

The Grant from the NFVO (see *ETSI GS NFV-SOL 003* specification on the ETSI website for details):

- Approved and/or updated resources to be added, updated or removed (UUIDs)
- Confirmed placement information

Creating the VNF Identifier

Creating the VNF Identifier is the first request for any VNF instance. This identifier is used for all further LCM operations executed by the ETSI API. Resources are neither created nor reserved at this stage.

ESC sends a POST request to create VNF instances:

Method Type:

POST

VNFM Endpoint:

/vnf_instances/

HTTP Request Headers:

Content-Type:application/json

Request Payload (ETSI data structure: CreateVnfRequest):

```
{
  "vnfInstanceName": "Test-VNf-Instance",
  "vnfdId": "vnfd-88c6a03e-019f-4525-ae63-de58ee89db74"
}
```

Response Headers:

HTTP/1.1 201

```

X-Content-Type-Options: nosniff
X-XSS-Protection: 1; mode=block
Cache-Control: no-cache, no-store, max-age=0, must-revalidate
Pragma: no-cache
Expires: 0
X-Frame-Options: DENY
Strict-Transport-Security: max-age=31536000 ; includeSubDomains
X-Application-Context: application:8250
Accept-Ranges: none
Location: http://localhost:8250/vnflcm/v1/vnf_instances/14924fca-fb10-45da-bcf5-59c581d675d8
Content-Type: application/json;charset=UTF-8
Transfer-Encoding: chunked
Date: Thu, 04 Jan 2018 12:18:13 GMT

```

Response Body (ETSI Data structure:VnfInstance)

```

{
  "id": "14924fca-fb10-45da-bcf5-59c581d675d8",
  "instantiationState": "NOT_INSTANTIATED",
  "onboardedVnfPkgInfoId": "vnfpkg-bb5601ef-cae8-4141-ba4f-e96b6cad0f74",
  "vnfInstanceName": "Test-Vnf-Instance",
  "vnfProductName": "vnfd-1VDU",
  "vnfProvider": "Cisco",
  "vnfSoftwareVersion": "1.1",
  "vnfdId": "vnfd-88c6a03e-019f-4525-ae63-de58ee89db74",
  "vnfdVersion": "1.3",
  "_links": {
    "instantiate": {
      "href":
"http://localhost:8250/vnflcm/v1/vnf_instances/14924fca-fb10-45da-bcf5-59c581d675d8/instantiate"
    },
    "self": {
      "href":
"http://localhost:8250/vnflcm/v1/vnf_instances/14924fca-fb10-45da-bcf5-59c581d675d8"
    }
  }
}

```

For instantiating VNFs, see [Instantiating Virtual Network Functions, on page 4](#).

Instantiating Virtual Network Functions

The instantiation request triggers several message exchanges, which allow the call flow to deploy a VNF instance. The resources for the VNF are only allocated when the VNF instance is instantiated. The request requires the VNF instance identifier, returned by the Create VNF request to be encoded into the URL to which the request is posted.

The instantiation sub-tasks within the flow include:

1. Retrieving the VNF Descriptor (VNFD) template from the NFVO.
2. Requesting permission from the NFVO (bi-directional Grant flow). For more information see, [Requesting Permission via Grant](#).

Example for *SOL003*:

Method type:

```
POST
```

VNFM Endpoint:

```
/vnf_instances/{vnfInstanceId}/instantiate
```

HTTP Request Header:

```
Content-Type:application/json
```

Request Payload (ETSI data structure: InstantiateVnfRequest)

```
{
  "flavourId": "default",
  "extVirtualLinks": [
    {
      "id": "extVL-dbf477ad-199a-47ff-939a-cb0101c92585",
      "resourceId": "ext-net",
      "extCps": [
        {
          "cpdId": "ecp_1_vdu_node_1",
          "cpConfig": [
            {
              "cpProtocolData": [
                {
                  "layerProtocol": "IP_OVER_ETHERNET",
                  "ipOverEthernet": {
                    "ipAddresses": [
                      {
                        "numDynamicAddresses": "1",
                        "subnetId": "23bb3-742aa-8213eb-dded2"
                        "type": "IPV4"
                      }
                    ]
                  }
                }
              ]
            }
          ]
        }
      ]
    }
  ],
  "extManagedVirtualLinks": [
    {
      "id": "my-network",
      "resourceId": "93fb90ae-0ec1-4a6e-8700-bf109a0f4fba",
      "virtualLinkDescId": "VLD1"
    }
  ],
  "vimConnectionInfo": [
    {
      "accessInfo": {
        "password": "*****",
        "username": "admin",
        "vim_project": "tenantName"
      },
      "extra": {
        "name": "esc"
      },
      "id": "default_openstack_vim",
      "interfaceInfo": {
        "baseUrl": "http://localhost:8080"
      },
      "vimId": "default_openstack_vim",
      "vimType": "OPENSTACK"
    }
  ]
  "additionalParams": {
    "CPUS": 2,

```

```

    "MEM_SIZE": "512 MB",
    "VIM_FLAVOR": "Automation-Cirros-Flavor",
    "BOOTUP_TIME": "1800"
  }
}

```

The *flavourId* value must be the same as a single *flavour_id* specified in the VNFD.

The previous example also includes an external connection point with a subnet defined. The IP addresses are allocated from that subnet. For information on fixed IP or MAC addresses, see [Scaling Virtual Network Functions Using ETSI API](#).



Note The Grant response from the NFVO provides the *vimConnectionInfo*. It is not provided in the *SOL002* payload. This is required in some cases since the *SOL002* payloads do not include the *vimConnectionInfo* information.

You can customize the VNF before instantiation by adding variables to the VNFD template. The values that map to those variables are supplied in the *additionalParams* field of the LCM request. The variables are key-value pairs, where the value can be either a list, string, numeric or boolean.

When the VNFD is retrieved by the VNFM, the *additionalParams* variables are merged into the VNF instance data from the original request received to form instance-specific data.

The list of parameters supplied is driven by the contents of the VNFD; the *additionalParams* specified in the request are used by the VNFD using the *get_input* TOSCA method within the VNFD. For example, the *cpus*, and *mem_size* variables are merged with the placeholders within the VNFD. For example:

```

tosca_definitions_version: tosca_simple_yaml_1_2

imports:
  - cisco_nfv_sol001_types.yaml
  - etsi_nfv_sol001_vnfd_2_7_1_types.yaml

metadata:
  template_name: Example
  template_author: Cisco Systems
  template_version: '1.0'

topology_template:
  inputs:

    CPUS:
      description: Number of CPUs
      type: string
      default: "2"
    MEM_SIZE:
      description: Memory size
      type: string
      default: "512 MB"
    VIM_FLAVOR:
      description: VIM Flavor
      type: string
      default: "Automation-Cirros-Flavour"
    BOOTUP_TIME:
      description: Time taken to boot the VNF
      type: string
      default: "1800"

  substitution_mappings:
    node_type: cisco.1VDU.1_0.1_0
    requirements:
      - virtual_link: [ node_1_nic0, virtual_link ]

```

```

node_templates:

  vdul:
    type: toasca.nodes.nfv.Vdu.Compute
    properties:
      name: vdul
      description: Example
      configurable_properties:
        additional_vnfc_configurable_properties:
          vim_flavor: { get_input: VIM_FLAVOR }
          bootup_time: { get_input: BOOTUP_TIME }
          ...
      vdu_profile:
        min_number_of_instances: 1
        max_number_of_instances: 1
    capabilities:
      virtual_compute:
        properties:
          virtual_cpu:
            num_virtual_cpu: { get_input: CPUS }
          virtual_memory:
            virtual_mem_size: { get_input: MEM_SIZE }

  node_1_nic0:
    type: toasca.nodes.nfv.VduCp
    properties:
      order: 0
      layer_protocols: [ ipv4 ]
      protocol:
        - associated_layer_protocol: ipv4
      trunk_mode: false
      virtual_network_interface_requirements:
        - support_mandatory: true
          network_interface_requirements:
            management: "false"
            name_override: { get_input: SRIOV_A_INT_NAME }
            iface_type: "direct"
    requirements:
      - virtual_binding: vdu_1

```

If a modification request with new *additionalParams* variables is submitted for the same VNF instance, then the new variables overwrites the existing values for those keys. The VNFM uses the new variables for deployment.

Although internal links are designed to be ephemeral, in some deployment scenarios they can be bound to external links that outlive the VNF. Consider the following example VNFD fragment:

```

automation_net:
  type: toasca.nodes.nfv.VnfVirtualLink
  properties:
    connectivity_type:
      layer_protocols: [ ipv4 ]
    description: Internal Network VL
  vl_profile:
    max_bitrate_requirements:
      root: 10000
    min_bitrate_requirements:
      root: 0
  virtual_link_protocol_data:
    - associated_layer_protocol: ipv4
      l3_protocol_data:
        ip_version: ipv4

```

```
cidr: 1.180.10.0/29
dhcp_enabled: true
```

To specify an external virtual link to be used in place of `automation_net` in the VNF deployment, the following data structure is used as part of the instantiation request:

```
...
"extManagedVirtualLinks": [
  {
    "id": "net-5ddc8435-9d85-4560-8b95-bfcd3369c5c2",
    "resourceId": "esc-net2",
    "vimConnectionId": "default_openstack_vim",
    "virtualLinkDescId": "automation_net"
  }
],
...
```

Although the ETSI specifications only support the concept of ephemeral volumes, many vendors require the specification of a persistent volume and so Cisco has implemented an extension to support this. The VIM resource Id of the persistent volume can be supplied as an *additionalParams* key (that matches the `get_input` in the VNFD) and replace a volume in the VNFD using an optional property, as per the following example:

```
example-volume:
  type: toasca.nodes.nfv.Vdu.VirtualBlockStorage
  properties:
    virtual_block_storage_data:
      size_of_storage: 200 GB
    vdu_storage_requirements:
      resource_id: { get_input: EX_VOL_UUID }
      vol_id: "0"
      bus: ide
      type: LUKS
```

Requesting Permission via Grant

The ETSI API requests permission from the NFVO to complete lifecycle management operations for the VNF instance resources and gets resource Ids for any resources pre-provisioned. Following is an example of GrantRequest:

```
{
  "flavourId": "default",
  "instantiationLevelId": "default",
  "isAutomaticInvocation": false,
  "operation": "INSTANTIATE",
  "vnfInstanceId": "e426a94e-7963-430c-96ee-778dde5bd021",
  "vnfLc mOpOccId": "06fe989b-7b0b-40dc-afb3-de26c18651ae",
  "vnfdId": "6940B47B-B0D0-48CB-8920-86BC23F91B16",
  "addResources":
  [
    {
      "id": "res-1abb1609-a1f3-418a- a7a0-2692a5e53311",
      "resourceTemplateId": "vdu1",
      "type": "COMPUTE",
      "vduId": "vdu1"
    },
    {
      "id": "res-c5ece35c-89e3-4d29-b594-ee9f6591f061",
      "resourceTemplateId": "node_1_nic0",
      "type": "LINKPORT",
      "vduId": "vdu1"
    }
  ],
}
```



```

    {
      "id": "res-e88d8461-5f5a-4dba-af14-def82ce894e5",
      "resourceTemplateId": "automation_net",
      "type": "VL"
    }
  ],
  "_links":
  {
    "vnfInstance":
    {
      "href": "https://172.16
.255.8:8251/vnflcm/v1/vnf_instances/14924fca-fb10-45da-bcf5-59c581d675d8"
    },
    "vnfLcmOpOcc":
    {
      "href":
"https://172.16.255.8:8251/vnflcm/v1/vnf_lcm_op_occs/457736f0-c877-4e07-8055-39dd406c616b"
    }
  }
}

```

The corresponding grant returned may look like the following:

```

{
  "id": "grant-0b7d3420-e6ee-4037-b116-18808dea4e2a",
  "vnfInstanceId": "14924fca-fb10-45da-bcf5-59c581d675d8",
  "vnfLcmOpOccId": "457736f0-c877-4e07-8055-39dd406c616b",
  "addResources": [
    {
      "resourceDefinitionId": "res-1abb1609-a1f3-418a-a7a0-2692a5e53311",
      "vimConnectionId": "esc-005e4412-e056-43a9-8bc0-d6699c968a3c"
    },
    {
      "resourceDefinitionId": "res-c5ece35c-89e3-4d29-b594-ee9f6591f061",
      "vimConnectionId": "esc-005e4412-e056-43a9-8bc0-d6699c968a3c"
    },
    {
      "resourceDefinitionId": "res-e88d8461-5f5a-4dba-af14-def82ce894e5",
      "vimConnectionId": "esc-005e4412-e056-43a9-8bc0-d6699c968a3c"
    }
  ],
  "vimAssets": {
    "computeResourceFlavours": [
      {
        "vimConnectionId": "esc-005e4412-e056-43a9-8bc0-d6699c968a3c",
        "vimFlavourId": "Automation-Cirros-Flavor",
        "vnfdVirtualComputeDescId": "vdul"
      }
    ],
    "softwareImages": [
      {
        "vimConnectionId": "esc-005e4412-e056-43a9-8bc0-d6699c968a3c",
        "vimSoftwareImageId": "Automation-Cirros-DHCP-2-IF",
        "vnfdSoftwareImageId": "vdul"
      }
    ]
  },
  "vimConnections": [
    {
      "id": "esc-005e4412-e056-43a9-8bc0-d6699c968a3c",
      "vimId": "default_openstack_vim",
      "vimType": "OPENSTACK",
      "accessInfo": {
        "vim_project": "admin"
      }
    }
  ]
}

```

```

    }
  ],
  "zones": [
    {
      "id": "zone-c9f79460-7a23-43e4-bb6d-0683e2cdb3d4",
      "vimConnectionId": "default_openstack_vim",
      "zoneId": "default"
    },
    {
      "id": "zone-4039855e-a2cb-48f8-996d-b328cdf9889a",
      "vimConnectionId": "default_openstack_vim",
      "zoneId": "nova"
    }
  ],
  "_links": {
    "self": {
      "href":
"http://localhost:8280/grant/v1/grants/grant-0b7d3420-e6ee-4037-b116-18808dea4e2a"
    },
    "vnfInstance": {
      "href": "https://172.16
.255.8:8251/vnflcm/v1/vnf_instances/14924fca-fb10-45da-bcf5-59c581d675d8"
    },
    "vnfLcmOpOcc": {
      "href":
"https://172.16.255.8:8251/vnflcm/v1/vnf_lcm_op_occs/457736f0-c877-4e07-8055-39dd406c616b"
    }
  }
}

```

The grant request is accepted only if all the requested resources have been granted, else the grant is rejected.

Querying Virtual Network Functions

Querying VNFs does not affect the state of any VNF instance. This operation simply queries ESC for all the VNF instances it knows about, or a specific VNF instance.

Method Type:

GET

VNFM Endpoint:

/vnf_instances/vnf_instances/{vnfInstanceId}

HTTP Request Header:

Content-Type: application/json

Request Payload:

not applicable.

Response Headers:

```

< HTTP/1.1 200
HTTP/1.1 200
< X-Content-Type-Options: nosniff
X-Content-Type-Options: nosniff
< X-XSS-Protection: 1; mode=block
X-XSS-Protection: 1; mode=block
< Cache-Control: no-cache, no-store, max-age=0, must-revalidate
Cache-Control: no-cache, no-store, max-age=0, must-revalidate
< Pragma: no-cache

```

```

Pragma: no-cache
< Expires: 0
Expires: 0
< X-Frame-Options: DENY
X-Frame-Options: DENY
< Strict-Transport-Security: max-age=31536000 ; includeSubDomains
Strict-Transport-Security: max-age=31536000 ; includeSubDomains
< X-Application-Context: application:8250
X-Application-Context: application:8250
< Accept-Ranges: none
Accept-Ranges: none
< ETag: "2"
ETag: "2"
< Content-Type: application/json;charset=UTF-8
Content-Type: application/json;charset=UTF-8
< Transfer-Encoding: chunked
Transfer-Encoding: chunked
< Date: Thu, 04 Jan 2018 12:25:32 GMT
Date: Thu, 04 Jan 2018 12:25:32 GMT

```

Response Body for a single VNF Instance (ETSI Data structure:VnfInstance)



Note The ETag response header is only returned for a single VNF query (that is, one with the VNF Instance ID specified). The ETag value is conditionally used during any subsequent VNF modify operations.

```

{
  "_links": {
    "instantiate": {
      "href":
"http://localhost:8250/vnflcm/v1/vnf_instances/14924fca-fb10-45da-bcf5-59c581d675d8/instantiate"
    },
    "self": {
      "href":
"http://localhost:8250/vnflcm/v1/vnf_instances/14924fca-fb10-45da-bcf5-59c581d675d8"
    }
  },
  "id": "14924fca-fb10-45da-bcf5-59c581d675d8",
  "instantiationState": "NOT_INSTANTIATED",
  "onboardedVnfPkgInfoId": "vnfpkg-bb5601ef-cae8-4141-ba4f-e96b6cad0f74",
  "vnfInstanceName": "Test-VNf-Instance",
  "vnfProductName": "vnfd-1VDU",
  "vnfProvider": "Cisco",
  "vnfSoftwareVersion": "1.1",
  "vnfdId": "vnfd-88c6a03e-019f-4525-ae63-de58ee89db74",
  "vnfdVersion": "2.1"
}

```

The query VNF operation output shows the instantiated state of the VNF. The *InstantiatedVnfInfo* element shows the VIM resource information for all the VNFs.

For example:

```

{
  "instantiatedVnfInfo": {
    "extCpInfo": [
      {
        "cpProtocolInfo": [
          {
            "ipOverEthernet": {

```

```

        "ipAddresses": [
          {
            "addresses": [
              "172.16.235.19"
            ],
            "isDynamic": false,
            "type": "IPV4"
          }
        ],
        "macAddress": "fa:16:3e:4b:f8:03"
      },
      "layerProtocol": "IP_OVER_ETHERNET"
    }
  ],
  "cpdId": "anECP",
  "id": "extCp-4143f7d4-f581-45fc-a730-568435dfdb4f"
}
],
"extManagedVirtualLinkInfo": [
  {
    "id": "net-d39bc4de-285c-4056-8113-24eccf821ebc",
    "networkResource": {
      "resourceId": "my-network",
      "vimConnectionId": "esc-b616e5be-58ce-4cfc-8eee-e18783c5ae5d"
    },
    "vnfLinkPorts": [
      {
        "cpInstanceId": "vnfcCp-9b24c9e0-1b28-4aba-a9df-9bfc786bfaed",
        "id": "vnfLP-9b24c9e0-1b28-4aba-a9df-9bfc786bfaed",
        "resourceHandle": {
          "resourceId": "926b7748-61d9-4295-b9ff-77fceb05589a",
          "vimConnectionId": "esc-b616e5be-58ce-4cfc-8eee-e18783c5ae5d"
        }
      }
    ],
    "vnfVirtualLinkDescId": "my-network"
  }
],
"extVirtualLinkInfo": [
  {
    "extLinkPorts": [
      {
        "cpInstanceId": "extCp-4143f7d4-f581-45fc-a730-568435dfdb4f",
        "id": "extLP-4143f7d4-f581-45fc-a730-568435dfdb4f",
        "resourceHandle": {
          "resourceId": "d6a4c231-e77c-4dlf-a6e2-d3f463c4ff72",
          "vimConnectionId": "default_openstack_vim"
        }
      }
    ],
    "id": "extVL-b9bd55a9-4bd9-4ad8-bf67-bale7b82aca6",
    "resourceHandle": {
      "resourceId": "anECP",
      "vimConnectionId": "esc-b616e5be-58ce-4cfc-8eee-e18783c5ae5d"
    }
  }
],
"flavourId": "bronze",
"scaleStatus": [
  {
    "aspectId": "default_scaling_aspect",
    "scaleLevel": 1
  }
],

```

```

"vnfState": "STARTED",
"vnfcResourceInfo": [
  {
    "computeResource": {
      "resourceId": "a21f0b15-ec4b-4968-adce-1ccfad118caa",
      "vimConnectionId": "default_openstack_vim"
    },
    "id": "res-89a669bb-fef4-4099-b9fe-c8d2e465541b",
    "vduId": "vdu_node_1",
    "vnfcCpInfo": [
      {
        "cpProtocolInfo": [
          {
            "ipOverEthernet": {
              "ipAddresses": [
                {
                  "addresses": [
                    "172.16.235.19"
                  ],
                  "isDynamic": false,
                  "type": "IPV4"
                }
              ],
              "macAddress": "fa:16:3e:4b:f8:03"
            },
            "layerProtocol": "IP_OVER_ETHERNET"
          }
        ],
        "cpdId": "node_1_nic0",
        "id": "vnfcCp-c09d5cf2-8727-400e-8845-c4d5cb479db8",
        "vnfExtCpId": "extCp-4143f7d4-f581-45fc-a730-568435dfdb4f"
      },
      {
        "cpProtocolInfo": [
          {
            "ipOverEthernet": {
              "ipAddresses": [
                {
                  "addresses": [
                    "172.16.235.16"
                  ],
                  "isDynamic": false,
                  "type": "IPV4"
                }
              ],
              "macAddress": "fa:16:3e:94:b3:91"
            },
            "layerProtocol": "IP_OVER_ETHERNET"
          }
        ],
        "cpdId": "node_1_nic1",
        "id": "vnfcCp-9b24c9e0-1b28-4aba-a9df-9bfc786bfaed"
      }
    ]
  }
]
}

```

Selecting Attributes for VNF Query

You can select the attributes to appear in the VNF Query response using the attribute selector. You can mark the attributes for including or excluding from a query. You can exclude some of the attributes that are not

required, for example attributes with a lower bound of zero on their cardinality (e.g. 0..1, 0..N) and that are not mandatory (subject to certain conditions).

By selecting only the necessary attributes in the query reduces the amount of data exchanged over the interface and processed by the API consumer application.

The table lists the URI query parameters for selecting attributes for the GET Request.

Table 1: Selecting Attributes for GET Request

Parameter	Definition
all_fields	<p>Requests all complex attributes included in the response, including those suppressed by <code>exclude_default</code>. It is opposite to the <code>exclude_default</code> parameter. The API producer supports the <code>all_fields</code> parameter for certain resources.</p> <p>Note The complex attributes are structured attributes or arrays.</p>
fields	<p>Requests to include only the listed complex attributes in the response.</p> <p>The parameter is formatted as a list of attribute names. An attribute name can either be the name of an attribute, or a path consisting of the names of multiple attributes with parent-child relationship, separated by "/". The attribute names in the list can be separated by comma (","). The valid attribute names for a particular GET request are the names of all complex attributes in the expected response that have a lower cardinality bound of 0 and that are not conditionally mandatory.</p> <p>The API producer supports the <code>fields</code> parameter for certain resources. The details are defined in the clauses specifying the actual resources.</p> <p>The "/" and "~" characters in attribute names in an attribute selector will be escaped according to the IETF standards.</p> <p>The "," character in attribute names in an attribute selector will be escaped by replacing it with "~a".</p> <p>Further, percent-encoding applies to the characters that are not allowed in a URI query part according to the IETF standards.</p>
exclude_fields	<p>Requests to exclude the listed complex attributes from the response. For the format, eligible attributes and support by the API producer, the provisions defined for the "fields" parameter will apply.</p>

Parameter	Definition
exclude_default	<p>Requests to exclude a default set of complex attributes from the response. Not every resource has a default set. Only complex attributes with a lower cardinality bound of zero that are not conditionally mandatory can be included in the set.</p> <p>The API producer supports this parameter for certain resources.</p> <p>The exclude_default parameter is a flag and has no value.</p> <p>If a resource supports attribute selector, and none of the attribute selector parameters is specified in a GET request, then the exclude_default parameter becomes the default. To emulate the original behaviour of GET Request, you can either supply the all_fields flag or set the ETSI property attribute.selector.default.all_fields to true which changes the behaviour, when no attribute selectors are provided, to all_fields.</p>

The GET Response validates the parameter combinations in the GET Request. The table defines the valid parameter combinations.

Table 2: Parameter combinations for Get Response

Parameter Combination	GET Response
(none)	Includes same as exclude_default.
all_fields	Includes all the attributes.
fields=<list>	Includes all the attributes except all complex attributes with minimum cardinality of zero that are not conditionally mandatory, and that are not provided in <list>.
exclude_fields=<list>	Includes all attributes except those complex attributes with a minimum cardinality of zero that are not conditionally mandatory, and that are provided in <list>.
exclude_default	Includes all attributes except those complex attributes with a minimum cardinality of zero that are not conditionally mandatory, and that are part of the <i>default exclude set</i> defined in the present document for the particular resource.
exclude_default and fields=<list>	Includes all attributes except those complex attributes with a minimum cardinality of zero that are not conditionally mandatory and that are part of the <i>default exclude set</i> defined in the present document for the particular resource, but that are not part of <list>.

The GET Request for resources such as VNF Instances, VNF LCM Operation Occurrences, and PM Jobs supports the selection of attributes.

Table 3: Resources supporting the selection of attributes

Name	Cardinality	Description
VNF Instances		
exclude_default	0..1	<p>Indicates to exclude the following complex attributes from the response.</p> <p>The following attributes are excluded from the VnfInstance structure in the response body if this parameter is provided, or none of the parameters (all_fields, fields, exclude_fields, exclude_default) are provided:</p> <ul style="list-style-type: none"> • vnfConfigurableProperties • vimConnectionInfo • instantiatedVnfInfo • metadata • extension
VNF LCM operation occurrences		
exclude_default	0..1	<p>The following attributes are excluded from the VnfLcmOpOcc structure in the response body if this parameter is provided, or none of the parameters (all_fields, fields, exclude_fields, exclude_default) are provided:</p> <ul style="list-style-type: none"> • operationParams • error • resourceChanges • changedInfo • changedExtConnectivity
PM Jobs		

Name	Cardinality	Description
exclude_default	0..1	The following attributes are excluded from the PmJob structure in the response body if this parameter is provided, or none of the parameters (all_fields, fields, exclude_fields, exclude_default) are provided: <ul style="list-style-type: none"> • Reports

For information on VNF lifecycle operations, see [VNF Lifecycle Operations, on page 2](#).

Modifying Virtual Network Functions

You can modify or update the properties of a VNF instance, which is in the NOT_INSTANTIATED state, using the modify VNF lifecycle operation. ESC receives a PATCH request from NFVO to modify a single VNF instance.

A JSON merge algorithm is applied from the input payload against the stored data to modify the VNF instance.



Note Modifying VNF operation updates only the properties, but not the functionality of the VNF. The modify operation is only valid on a VNF instance resource that is NOT_INSTANTIATED.

The following properties of an existing VNF instance can be modified:

- vnfInstanceName
- vnfInstanceDescription
- onboardedVnfPkgInfoId (null value is not allowed)
- vnfConfigurableProperties
- metadata
- extensions
- vimConnectionInfo

Method Type

PATCH

VNFM Endpoint

/vnf_instances/{vnfInstanceId}

HTTP Request Header

Content-Type: application/merge-patch+json
If-Match: ETag value



Note The ETag, if specified, is validated against the ETag value stored against the VNF instance resource. If the values do not match, the modify request will be rejected.

Request Payload (ETSI data structure: VnfInfoModifications)

```
{
  "vnfInstanceName": "My NEW VNF Instance Name",
  "vnfInstanceDescription": "My NEW VNF Instance Description",
  "vnfPkgId": "pkg-xyzy-123",
  "vnfConfigurableProperties": {
    "isAutoscaleEnabled": "true"
  },
  "metadata": {
    "serialRange": "ab123-cc331",
    "manufacturer": "Cisco"
  },
  "extensions": {
    "testAccess": "false",
    "ipv6Interface": "false"
  },
  "vimConnectionInfo": [
    {
      "id": "vcil",
      "vimType": "openstack",
      "interfaceInfo": {
        "uri": "http://172.16.14.27:35357/v3"
      },
      "accessInfo": {
        "domainName": "default",
        "projectName": "admin",
        "userName": "default"
      }
    }
  ]
}
```



Note The Grant response from the NFVO provides the vimConnectionInfo instead of the *SOL002* payload. The *SOL002* request contains some attributes that affect the VNF resource at a finer VNFC-level such as vnfInfoModifications. See *SOL002* on the *ETSI website* for more details.

Response Header:

not applicable.

Response Body:

not applicable.

When the PATCH operation is complete, the VNF instance is modified, and the details are sent to the NFVO through the notification.

Operating Virtual Network Functions

You can start or stop a VNF instance using the operate lifecycle management operation. The VNF instance can be stopped gracefully or forcefully.



Note The OpenStack API supports only forceful stop.

The *changeStateTo* field must have the value STARTED or STOPPED in the request payload, to start or stop a VNF instance.

Permission is also required from the NFVO (bi-directional Grant flow) for this operation. See Requesting Grant Permission for more information.

Method Type:

POST

VNFM Endpoint:

/vnf_instances/{vnfInstanceId}/operate

HTTP Request Headers:

Content-Type:application/json

Response Headers:

```
HTTP/1.1 202
X-Content-Type-Options: nosniff
X-XSS-Protection: 1; mode=block
Cache-Control: no-cache, no-store, max-age=0, must-revalidate
Pragma: no-cache
Expires: 0
X-Frame-Options: TEST
Strict-Transport-Security: max-age=31536000 ; includeSubDomains
X-Application-Context: application:8250
Accept-Ranges: none
Location: http://localhost:8250/vnflcm/v1/vnf_lcm_op_occs/e775aad5-8683-4450-b260-43656b6b13e9
Content-Length: 0
Date: Thu, 04 Jan 2018 12:40:27 GMT
```

Response Body:

not applicable.

Terminating Virtual Network Functions

The terminating VNF request terminates a VNF instance. The resources are deallocated but remain reserved for this instance until it is deleted. Permission is required from the NFVO (bi-directional Grant flow) for this operation. The VNF instance can be decommissioned gracefully or forcefully.



Note The OpenStack API supports only forceful termination.

As per the Instantiate VNF Request, the terminate VNF request requires the VNF instance identifier encoded into the URL to which the request is posted.

Method Type:

POST

VNFM Endpoint:

```
/vnf_instances/{vnfInstanceId}/terminate
```

HTTP Request Headers:

```
Content-Type:application/json
```

Request Payload (ETSI data structure: TerminateVnfRequest)

```
{
  "terminationType":"FORCEFUL",
}
```

Response Headers:

```
HTTP/1.1 202
X-Content-Type-Options: nosniff
X-XSS-Protection: 1; mode=block
Cache-Control: no-cache, no-store, max-age=0, must-revalidate
Pragma: no-cache
Expires: 0
X-Frame-Options: TEST
Strict-Transport-Security: max-age=31536000 ; includeSubDomains
X-Application-Context: application:8250
Accept-Ranges: none
Location: http://localhost:8250/vnflcm/v1/vnf_lcm_op_occs/dae25dbc-fcde-4ff9-8fd6-31797d19dbc1
Content-Length: 0
Date: Thu, 04 Jan 2018 12:45:59 GMT
```

Response Body:

```
not applicable.
```

Deleting Virtual Network Function Resource Identifier

Deleting VNF operation releases the VIM resources reserved for the VNF instance as well as deletes the VNF instance identifier. Upon deletion, the VNF instance identifier is no longer available. So, no further lifecycle management operations are possible using this identifier.

Method Type:

```
DELETE
```

VNFM Endpoint:

```
/vnf_instances/{vnfInstanceId}
```

HTTP Request Headers:

```
Content-Type:application/json
```

Request Payload:

```
not applicable.
```

Response Headers:

```
HTTP/1.1 204
X-Content-Type-Options: nosniff
X-XSS-Protection: 1; mode=block
Cache-Control: no-cache, no-store, max-age=0, must-revalidate
Pragma: no-cache
Expires: 0
X-Frame-Options: TEST
```

```
Strict-Transport-Security: max-age=31536000 ; includeSubDomains  
X-Application-Context: application:8250  
Accept-Ranges: none  
Date: Thu, 04 Jan 2018 12:48:59 GMT
```

Response Body:

not applicable.

