Cisco Elastic Services Controller 5.1 Administration Guide

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CONTENTS

About This Guide

This guide helps you to perform ESC administration related tasks such as basic configurations, monitoring the health of ESC, and viewing system logs.

- Audience, on page v

Audience

This guide is designed for network administrators responsible for provisioning, configuring, and monitoring VNFs. Cisco Elastic Services Controller (ESC) and its VNFs are deployed in a Virtual Infrastructure Manager (VIM). Currently OpenStack, VMware vCenter, VMware vCloud Director, CSP 2100 / 5000, and Amazon Web Services (AWS) are the supported VIMs. The administrator must be familiar with the VIM layer, vCenter, OpenStack and AWS resources, and the commands used.

Cisco ESC is targeted for Service Providers (SPs) and Large Enterprises. ESC helps SPs reduce cost of operating the networks by providing effective and optimal resource usage. For Large Enterprises, ESC automates provisioning, configuring and monitoring of network functions.

Terms and Definitions

The below table defines the terms used in this guide.

Table 1: Terms and Definitions

Terms	Definitions
AWS	Amazon Web Services (AWS) is a secure cloud services platform, offering compute, database storage, content delivery and other functionalities.
ESC	Elastic Services Controller (ESC) is a Virtual Network Function Manager (VNFM), performing lifecycle management of Virtual Network Functions.
ETSI	European Telecommunications Standards Institute (ETSI) is an independent standardization organization that has been instrumental in developing standards for information and communications technologies (ICT) within Europe.

Terms	Definitions
ETSI Deployment Flavour	A deployment flavour definition contains information about affinity relationships, scaling, min/max VDU instances, and other policies and constraints to be applied to the VNF instance. The deployment flavour defined in the VNF Descriptor (VNFD) must be selected by passing the *flavour_id* attribute in the InstantiateVNFRequest payload during the instantiate VNF LCM operation.
HA	ESC High Availability (HA) is a solution for preventing single points of ESC failure and achieving minimum ESC downtime.
KPI	Key Performance Indicator (KPI) measures performance management. KPIs specify what, how and when parameters are measured. KPI incorporates information about source, definitions, measures, calculations for specific parameters.
MSX	Cisco Managed Services Accelerator (MSX) is a service creation and delivery platform that enables fast deployment of cloud-based networking services for both Enterprises and Service Providers customers.
NFV	Network Function Virtualization (NFV) is the principle of separating network functions from the hardware they run on by using virtual hardware abstraction.
NFVO	NFV Orchestrator (NFVO) is a functional block that manages the Network Service (NS) lifecycle and coordinates the management of NS lifecycle, VNF lifecycle (supported by the VNFM) and NFVI resources (supported by the VIM) to ensure an optimized allocation of the necessary resources and connectivity.
NSO	Cisco Network Services Orchestrator (NSO) is an orchestrator for service activation which supports pure physical networks, hybrid networks (physical and virtual) and NFV use cases.
OpenStack Compute Flavor	Flavors define the compute, memory, and storage capacity of nova computing instances. A flavor is an available hardware configuration for a server. It defines the *size* of a virtual server that can be launched.
Service	A service consists of a single or multiple VNFs.
VDU	The Virtualisation Deployment Unit (VDU) is a construct that can be used in an information model, supporting the description of the deployment and operational behaviour of a subset of a VNF, or the entire VNF if it was not componentized in subsets.
VIM	The Virtualized Infrastructure Manager (VIM) adds a management layer for the data center hardware. Its northbound APIs are consumed by other layers to manage the physical and virtual resources for instantiation, termination, scale in and out procedures, and fault & performance alarms.
VM	A Virtual Machine (VM) is an operating system OS or an application installed on a software, which imitates a dedicated hardware. The end user has the same experience on a virtual machine as they would have on dedicated hardware.
VNF	A Virtual Network Function (VNF) consists of a single or a group of VMs with different software and processes that can be deployed on a Network Function Virtualization (NFV) Infrastructure.

Terms	Definitions
VNFC	A Virtual Network Function Component is (VNFC) a composite part of the VNF, synonymous with a VDU, which could be implemented as a VM or a container.
VNFM	Virtual Network Function Manager (VNFM) manages the life cycle of a VNF.

Related Documentation

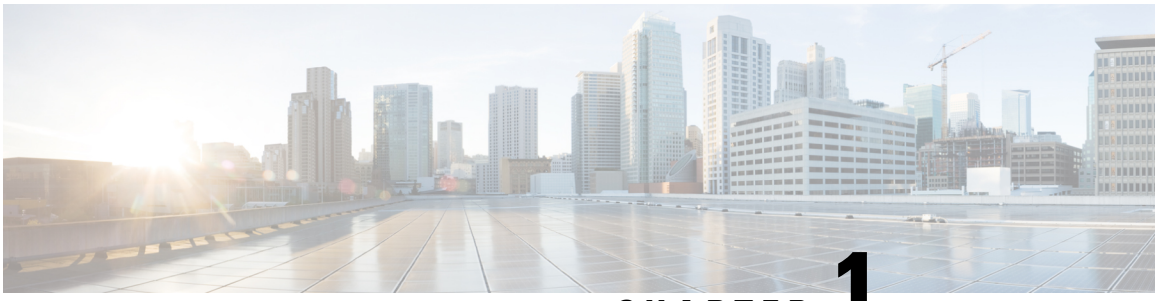
The Cisco ESC doc set comprises of the following guides to help you perform installation, configuration; the lifecycle management operations, healing, scaling, monitoring and maintenance of the VNFs using different APIs.

Guide	Information Provided in This Guide
Cisco Elastic Services Controller Release Notes	Includes new features and bugs, known issues.
Cisco Elastic Services Controller Install and Upgrade Guide	Includes procedure for new installation and upgrade scenarios, pre and post installation tasks, and procedure for ESC High Availability (HA) deployment.
Cisco Elastic Services Controller User Guide	Includes lifecycle management operations, monitoring, healing and scaling of the VNFs.
Cisco Elastic Services Controller ETSI NFV MANO User Guide	Includes lifecycle management operations, monitoring, healing and scaling of the VNFs using the ETSI APIs.
Cisco Elastic Services Controller Administration Guide	Includes maintenance, monitoring the health of ESC, and information on system logs generated by ESC.
Cisco Elastic Services Controller NETCONF API Guide	Information on the Cisco Elastic Services Controller NETCONF northbound API, and how to use them.
Cisco Elastic Services Controller REST API Guide	Information on the Cisco Elastic Services Controller RESTful northbound API, and how to use them.
Cisco Elastic Services Controller ETSI REST API Guide	Includes information on the Cisco Elastic Services Controller ETSI APIs, and how to use them.
Cisco Elastic Services Controller Deployment Attributes	Includes information about deployment attributes used in a deployment datamodel.
Cisco Elastic Services Controller Open Source	Includes information on licenses and notices for open source software used in Cisco Elastic Services Controller.

Obtaining Documentation Request

For information on obtaining documentation, using the Cisco Bug Search Tool (BST), submitting a service request, and gathering additional information, see *What's New in Cisco Product Documentation*, at: http://www.cisco.com/c/en/us/td/docs/general/whatsnew/whatsnew.html.

Subscribe to *What's New in Cisco Product Documentation*, which lists all new and revised Cisco technical documentation, as an RSS feed and deliver content directly to your desktop using a reader application. The RSS feeds are a free service.



CHAPTER 1

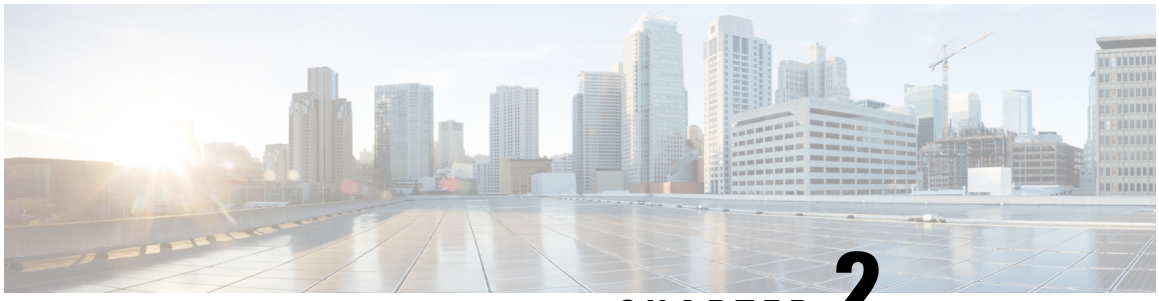
Elastic Services Controller Overview

Elastic Services Controller Overview

Cisco Elastic Services Controller (ESC) is a Virtual Network Functions Manager (VNFM) managing the lifecycle of Virtual Network Functions (VNFs). ESC provides agentless and multi vendor VNF management by provisioning the virtual services. ESC monitors the health of VNFs , promotes agility, flexibility, and programmability in Network Function Virtualization (NFV) environments. It provides the flexibility to define rules for monitoring and associate actions that are triggered based on the outcome of these rules. Based on the monitoring results, ESC performs scale in or scale out operations on the VNFs. In the event of a VM failure ESC also supports automatic VM recovery.

ESC fully integrates with Cisco and other third party applications. As a standalone product, the ESC can be deployed as a VNF Manager. ESC integrates with Cisco Network Services Orchestrator (NSO) to provide VNF management along with orchestration. ESC as a VNF Manager targets the virtual managed services and all service provider NFV deployments such as virtual packet core, virtual load balancers, virtual security services and so on. Complex services include multiple VMs that are orchestrated as a single service with dependencies between them.

Elastic Services Controller Overview



CHAPTER 2

Configuring Interfaces

Interface Configurations

The Interface configuration allows to choose various configuration for the interface including network, subnet, ip address, mac address, vim interface name, model, and so on.

This section describes these basic and advance interface configurations for Elastic Services Controller (ESC) and procedures to configure these.

Basic Interface Configurations

In ESC Datamodel, Interface refers to the VNIC attached to the VM. We can add one or more Interface under a VM Group. The interface section will have details to configure the VNIC.

This section describes basic interface configurations for Elastic Services Controller (ESC).

Configuring Basic Interface Settings

This section describes basic interface configurations, such as:

- Network
- Subnet
- IP address
- MAC address
- VIM interface name, and so on for Elastic Services Controller (ESC).

Configuring an Interface Name

To configure VIM interface name, specify attribute `<vm_interface_name>` for an interface in the Deployment XML file. Use `<vm_interface_name>` to use a specific name when generating an interface name. If these attribute is not specified, ESC will auto-generate an interface name, which is a combination of the

deployment_name, group_name, and a random UUID string. For example: my-deployment-na_my-gro_0_8053d7gf-hyt33-4676-h9d4-9j4a5599472t.

Note This feature is currently supported only on OpenStack.

If the VM group is elastic and a `vim_interface_name` has been specified, a numeric index is added after the interface name for the second interface name onwards (the first one remains unchanged). For example, if the specified interface name is set as `<vim_interface_name>interface_1</vim_interface_name>` and scaling is set to 3, three VMs are created with three different interface name, interface_1, interface_1_1, and interface_1_2. If a VM group only has a single VM, then there is no "_<index>" appended to the custom interface name. A single deployment can contain multiple VM groups, and each individual VM group can specify a different `vim_interface_name` value, if required. For example, a deployment could have two VM groups: the first group specifies a `vim_interface_name` and all VMs have their names generated as described above. The second VM group does not specify a `vim_interface_name`, therefore all VM names created from this group are auto generated. The same interface name can be used in separate interface sections within the same VM group, or in separate VM groups within a deployment, or in different deployments if required.

If attributes `<vim_interface_name>` or `<port>` are used for the same interface, the `vim_interface_name` value will be ignored and the value in the `port` attribute will be used.

```
<esc_datamodel xmlns="https://www.cisco.com/esc/esc"> <tenants><tenant>
<name>Admin</name>
<deployments>
<deployment>
<deployment_name>NwDepModel_nosvc</deployment_name>
<interface>
<nicid>0</nicid>
<vim_interface_name>interface_1</vim_interface_name>
<network>my-network</network>
</interface>
```

Note You can use a maximum of 61 characters for an interface name should not contain special characters and can only contain alphanumeric characters and "_" and "-". The following are some output samples with the custom port name. If the `vim_interface_name` was set during the deployment, the same value will be shown in the output. If this value was not set during the deployment, ESC will auto-generate the port name.

- Below is an example of the output operational data fetched using the esc_nc_cli script after adding a custom interface name. A new element called `vim_interface_name` will be shown under the interface element.

```
[admin@esc-3-1-xxx]$ esc_nc_cli get esc_datamodel/opdata
<?xml version="1.0" encoding="UTF-8"?>
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
. . .
    <interface>
        <nicid>0</nicid>
        <type>virtual</type>
        <port_id>e4111069-5d00-493b-8ea9-1a2ca134b5c8</port_id>
        <vim_interface_name>interface_1</vim_interface_name>      <!-- NEW IN OUTPUT
-->
        <network>c7fafeca-aa53-4349-9b60-1f4b92605420</network>
        <subnet>255.255.255.0</subnet>
```

```
        <ip_address>192.168.2.1</ip_address>
        <mac_address>fa:16:3e:d7:5e:da</mac_address>
        <netmask>255.255.240.0</netmask>
        <gateway>192.168.2.255</gateway>
    </interface>
```

- Below is an example output operational data fetched using a REST API.

```
GET http://localhost:8080/ESCManager/v0/deployments/example-deployment-123
| xmllint --format -
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<deployments>
. . .
    <interface>
        <network_uuid>c7fafeca-aa53-4349-9b60-1f4b92605420</network_uuid>
        <gateway>172.16.0.1</gateway>
        <ip_address>172.16.12.251</ip_address>
        <mac_address>fa:16:3e:30:0c:99</mac_address>
        <netmask>255.255.240.0</netmask>
        <nic_id>0</nic_id>
        <port_forwarding/>
        <port_uuid>1773cdbf-fe5f-4af1-adff-3a9c1dd1c47d</port_uuid>
       <vim_interface_name>interface_1</vim_interface_name>         <!-- NEW IN OUTPUT
 -->
        <security_groups/>
        <subnet_uuid>7b2ce63b-eb20-4ff8-8d49-e46ee8dde0f5</subnet_uuid>
        <type>virtual</type>
    </interface>
```

In all the above scenarios, if `vim_interface_name` is not specified in the deployment.xml, the output will still contain this element, however with an internally generated interface name. For example:

```
<vim_interface_name>vm-name-deployme_Grp1_1_0f24cd7e-cae7-402e-819a-5c84087103ba</vim_interface_name>
```

Assigning the MAC Address

ESC deployment on VMware vCenter supports assigning MAC address using the MAC address range, or MAC address list from the MAC address pool to deploy VMs to the network.

You can assign MAC address in the following ways:

Using the Interface

```
<interfaces>
    <interface>
 <nicid>1</nicid>
 <network>MANAGEMENT_NETWORK</network>
 <ip_address>172.16.0.11</ip_address>
 <mac_address>fa:16:3e:73:19:a0</mac_address>
    </interface>
</interfaces>
```

During scaling, you can assign the MAC address list or MAC address range from the MAC address pool.

```
<scaling>
 <min_active>2</min_active>
 <max_active>2</max_active>
 <elastic>true</elastic>
 <static_ip_address_pool>
  <network>MANAGEMENT_NETWORK</network>
  <ip_address>172.16.0.11</ip_address>
  <ip_address>172.16.0.12</ip_address>
  <ip_address>172.16.0.13</ip_address>
```

```
 </static_ip_address_pool>
 <static_mac_address_pool>
  <network>MANAGEMENT_NETWORK</network>
  <mac_address>fa:16:3e:73:19:a0</mac_address>
  <mac_address>fa:16:3e:73:19:a1</mac_address>
  <mac_address>fa:16:3e:73:19:a2</mac_address>
 </static_mac_address_pool>
</scaling>
```

Assign MAC address using MAC address range.

```
<scaling>
 <min_active>2</min_active>
 <max_active>2</max_active>
 <elastic>true</elastic>
 <static_ip_address_pool>
  <network>MANAGEMENT_NETWORK</network>
  <ip_address_range>
   <start>172.16.0.25</start>
   <end>172.16.0.27</end>
  </ip_address_range>
 </static_ip_address_pool>
 <static_mac_address_pool>
  <network>MANAGEMENT_NETWORK</network>
  <mac_address_range>
   <start>fa:16:3e:73:19:b0</start>
   <end>fa:16:3e:73:19:b2</end>
  </mac_address_range>
 </static_mac_address_pool>
</scaling>
```

Note You cannot change the MAC or IP pool in an existing deployment, or during scaling (when min and max value are greater than 1) of VM instances in a service update.

In VMware vCenter, while assigning the MAC address, the server might override the specified value for "Generated" or "Assigned" if it does not fall in the right ranges or is determined to be a duplicate. Because of this, if ESC is unable to assign the MAC address the deployment fails.

Configuring Subnet for an Interface

Subnets can be passed through the datamodel. Subnet within interfaces can be specified in the Interface section of the Deployment XML file. If there is no subnet specified in the datamodel, ESC will let OpenStack select the subnet for interface creation and will use the subnet from the port created by OpenStack.

```
<interface>
   <nicid>0</nicid>
   <network>my-network</network>
  <subnet>my-subnet</subnet>
    </interface>
```

The `no_gateway` attribute allows ESC to create a subnet with the gateway disabled. In the example below, the `no_gateway` attribute is set to true to create a subnet without gateway.

```
<networks>
<network>
<name>mgmt-net</name>
<subnet>
<name>mgmt-net-subnet</name>
```

```
<ipversion>ipv4</ipversion>
<dhcp>false</dhcp>
<address>172.16.0.0</address>
<no_gateway>true</no_gateway><!-- DISABLE GATEWAY -->
<gateway>172.16.0.1</gateway>
<netmask>255.255.255.0</netmask>
</subnet>
</network>
</networks>
```

Configuring an Out-of-Band Port

ESC also allows you to attach an out-of-band port to a VNF. To do this, pass the UUID or the name of the port in the deployment request file while initiating a service request. For more information, see, Out-of-band Volumes section in the Cisco Elastic Services Controller User Guide.

Note While undeploying or restoring a VNF, the ports attached to that VNF will only be detached and not deleted. ESC does not allow scaling while using out-of-band port for a VM group. You can configure only one instance of VM for the VM group.Updating the scaling value for a VM group, while using the out-of-band port is not allowd during a deployment update.

```
<esc_datamodel xmlns="https://www.cisco.com/esc/esc">
    <name>tenant</name>
    <deployments>
        <deployment>
            <name>depz</name>
            <vm_group>
                <name>g1</name>
                <image>Automation-Cirros-Image</image>
                <flavor>Automation-Cirros-Flavor</flavor>
                <bootup_time>100</bootup_time>
                <reboot_time>30</reboot_time>
                <recovery_wait_time>10</recovery_wait_time>
                <interfaces>
                    <interface>
                        <nicid>0</nicid>
                        <port>057a1c22-722e-44da-845b-a193e02807f7</port>
                        <network>my-network</network>
                    </interface>
                </interfaces>
            </vm_group>
        </deployment>
    </deployments>
</esc_datamodel>
```

Dual Stack Support

A dual stack network allows you to assign multiple IP addresses. These multiple IP addresses can be assigned on different subnets to a given interface within a VNF deployment using ESC.

ESC supports the following for dual stack:

- Configuring the network and list of subnet
- Configuring the network and list of subnet and ip address
- Configuring the network and list of ip address (no subnet)

- Specifying the network and list of subnet/ip (same subnet but different ip)

Note Currently, ESC supports dual stack only on OpenStack. ESC supports end-to-end IPv6 for OpenStack deployments.

A new container element named addresses is added to the Interface. This container holds a list of address elements. An address element must have an address_id (key). The subnet and fixed-ip address fields are optional, but you must specify either one.

The container address is as follows:

```
container addresses {
  list address {
    key "address_id";
    leaf address_id {
      description "Id for the address in address list.";
      type uint16;
      mandatory true;
    }
    leaf subnet {
      description "Subnet name or uuid for allocating IP to this port";
      type types:escnetname;
    }
    leaf ip_address {
      description "Static IP address for this specific subnet";
      type types:escipaddr;
      must "../../../../../scaling/max_active = 1"
      {
         error-message "Only single VM per group supported with multiple address option.";
      }
    }
  }
}
```

Dual stack now supports KPI monitoring. A new child element address_id has been added to the metric_collector element. This accepts a value which points to an address within the specified nicid to be used for KPI monitoring. That is, it allows one of the addresses defined beneath an interface to be used for KPI monitoring.

```
…
    <interface>
        <nicid>1</nicid>
        <network>demo-net</network>
        <addresses>
            <address>
                <address_id>0</address_id>
                <subnet>demo-subnet</subnet>
            </address>
        </addresses>
    </interface>
 <kpi_data>
              <kpi>
                <event_name>VM_ALIVE</event_name>
                <metric_value>1</metric_value>
                <metric_cond>GT</metric_cond>
                <metric_type>UINT32</metric_type>
           <metric_occurrences_true>5</metric_occurrences_true>
                <metric_occurrences_false>5</metric_occurrences_false>
               <metric_collector>
```

```
                    <type>ICMPPing</type>
                    <nicid>1</nicid>
                    <address_id>0</address_id>
                    <poll_frequency>10</poll_frequency>
                    <polling_unit>seconds</polling_unit>
                   <continuous_alarm>false</continuous_alarm>
                  </metric_collector>
                </kpi>
              </kpi_data>
...
```

Note The address_id under the metric_collector element must be the same as one of the address_id beneath the interface.

Dual stack interfaces can now be used in day-0 variable substitution. This means the ability to substitute the values from the multiple addresses defined under a single interface. Day 0 configuration is defined in the datamodel under the config_data tag.

In case of dual stack with multiple IP addresses, the variables are in the form NICID_<n>_<a>_<PROPERTY> where:

- <n> is the nicid for the interface.
- <a> is the address_id of an address within that interface.

The list of possible day-0 substitution variables from dual stack is:

NICID_n_a_IP_ALLOCATION_TYPE	string containing FIXED | DHCP	ipv4 or ipv6
NICID_n_a_IP_ADDRESS	IP address	ipv4 or ipv6
NICID_n_a_GATEWAY	Gateway address	ipv4 or ipv6
NICID_n_a_CIDR_ADDRESS	CIDR prefix address	ipv4 or ipv6
NICID_n_a_CIDR_PREFIX	Integer with CIDR prefix-length	ipv4 or ipv6
NICID_n_a_NETMASK	If an ipv4 CIDR address and prefix are present, ESC will automatically calculate and populate the netmask variable. This is not substituted in the case of an IPv6 address and should not be used.	ipv4 only

For information on day-0 confirguration for single IP address, see Day Zero Configuration chapter in the Cisco Elastic Services Controller User Guide.

The template file defined in the config_data with day-0 configurations is as follows:

```
NICID_0_NETWORK_ID=${NICID_0_NETWORK_ID}
NICID_0_MAC_ADDRESS=${NICID_0_MAC_ADDRESS}

NICID_0_0_IP_ALLOCATION_TYPE=${NICID_0_0_IP_ALLOCATION_TYPE}
NICID_0_0_IP_ADDRESS=${NICID_0_0_IP_ADDRESS}
NICID_0_0_GATEWAY=${NICID_0_0_GATEWAY}
NICID_0_0_CIDR_ADDRESS=${NICID_0_0_CIDR_ADDRESS}
NICID_0_0_CIDR_PREFIX=${NICID_0_0_CIDR_PREFIX}
```

```
NICID_0_0_NETMASK=${NICID_0_0_NETMASK}

NICID_0_1_IP_ALLOCATION_TYPE=${NICID_0_1_IP_ALLOCATION_TYPE}
NICID_0_1_IP_ADDRESS=${NICID_0_1_IP_ADDRESS}
NICID_0_1_GATEWAY=${NICID_0_1_GATEWAY}
NICID_0_1_CIDR_ADDRESS=${NICID_0_1_CIDR_ADDRESS}
NICID_0_1_CIDR_PREFIX=${NICID_0_1_CIDR_PREFIX}
```

The datamodel is as follows:

```
<?xml version="1.0" encoding="ASCII"?>
<esc_datamodel xmlns="https://www.cisco.com/esc/esc">
  <tenants>
    <tenant>
      <name>dep-tenant</name>
      <deployments>
        <deployment>
          <name>cirros-dep</name>
          <vm_group>
            <name>Grp1</name>
            <bootup_time>600</bootup_time>
            <recovery_wait_time>30</recovery_wait_time>
            <flavor>Automation-Cirros-Flavor</flavor>
            <image>Automation-Cirros-Image</image>
           <interfaces>
              <interface>
                <!-- No dual stack support on mgmt interface in ESC 4.1 -->
                <nicid>0</nicid>
                <network>my-network</network>
              </interface>
              <interface>
                <nicid>1</nicid>
                <network>ent-network1</network>
                <addresses>
                  <address>
                    <!-- IPv4 Dynamic -->
                    <address_id>0</address_id>
                    <subnet>v4-subnet_A</subnet>
                  </address>
                  <address>
                    <!-- IPv6 Dynamic -->
                    <address_id>1</address_id>
                    <subnet>v6-subnet_B</subnet>
                  </address>
                </addresses>
              </interface>
              <interface>
                <nicid>2</nicid>
                <network>ent-network2</network>
                <addresses>
                  <address>
                    <!-- IPv4 Static -->
                    <address_id>0</address_id>
                    <subnet>v4-subnet_C</subnet>
                    <ip_address>172.16.87.8</ip_address>
                  </address>
                  <address>
                    <!-- IPv6 Static -->
                    <address_id>1</address_id>
                    <subnet>v6-subnet_D</subnet>
                    <ip_address>fd07::110</ip_address>
                  </address>
                </addresses>
              </interface>
```

```
                <interface>
                  <nicid>3</nicid>
                  <network>ent-network3</network>
                  <addresses>
                    <address>
                      <!--  Only ip config -  ipv6 but no subnet  -->
                      <address_id>0</address_id>
                      <ip_address>fd07::110</ip_address>
                    </address>
                    <address>
                      <!--  Only ip config - ipv4 but no subnet  -->
                      <address_id>1</address_id>
                      <ip_address>172.16.88.9</ip_address>
                    </address>
                  </addresses>
                </interface>
                <interface>
                  <nicid>4</nicid>
                  <network>ent-network4</network>
                  <addresses>
                    <address>
                      <!-- ipv4 same subnet as address_id 6 -->
                      <address_id>0</address_id>      //
                      <subnet>v4-subnet_F</subnet>
                      <ip_address>172.16.86.10</ip_address>
                    </address>
                    <address>
                      <!-- ipv4 same subnet as id 5 -->
                      <address_id>1</address_id>
                      <subnet>v4-subnet_F</subnet>
                      <ip_address>172.16.86.11</ip_address>
                    </address>
                  </addresses>
                </interface>
              </interfaces>
              <kpi_data>
...
```

After successful deployment using multiple IPs, ESC provides a list of addresses as notification, or opdata.

A list of multiple <address> elements under the parent <interface> element containing the following:

- **address_id**—the address id specified in the input XML
- **subnet element**—subnet name or uuid
- **ip_address element**—the port's assigned IP on that subnet
- **prefix**—the subnet CIDR prefix
- **gateway**—the subnet gateway address
- ESC Static IP support

Notification:

```
                  <vm_id>1834124d-b70b-41b9-9e53-fb55d7c901f0</vm_id>
                  <name>jenkins-gr_g1_0_e8bc9a81-4b9a-437a-807a-f1a9bbc2ea3e</name>

<generated_name>jenkins-gr_g1_0_e8bc9a81-4b9a-437a-807a-f1a9bbc2ea3e</generated_name>
                <host_id>dc380f1721255e2a7ea15932c1a7abc681816642f75276c166b4fe50</host_id>

                  <hostname>my-server</hostname>
```

```
                    <interfaces>
                      <interface>
                        <nicid>0</nicid>
                        <type>virtual</type>

<vim_interface_name>jenkins-gr_g1_0_e8bc9a81-4b9a-437a-807a-f1a9bbc2ea3e</vim_interface_name>

                        <port_id>4d57d4a5-3150-455a-ad39-c32fffbb10b1</port_id>
                        <mac_address>fa:16:3e:d2:50:a5</mac_address>
                        <network>45638651-2e92-45fb-96ce-9efdd9ea343e</network>
                        <address>
                          <address_id>0<address_id>
                          <subnet>6ac36430-4f58-454b-9dc1-82f7a796e2ff</subnet>
                          <ip_address>172.16.0.22</ip_address>
                          <prefix>24</prefix>
                          <gateway>172.16.0.1</gateway>
                        </address>
                        <address>
                          <address_id>1<address_id>
                          <subnet>8dd9f501-19d4-4782-8335-9aa9fbd4dab9</subnet>
                          <ip_address>2002:dc7::4</ip_address>
                          <prefix>48</prefix>
                          <gateway>2002:dc7::1</gateway>
                        </address>
                        <address>
                          <address_id>2<address_id>
                          <subnet>a234501-19d4-4782-8335-9aa9fbd4caf6</subnet>
                          <ip_address>172.16.87.8</ip_address>
                          <prefix>20</prefix>
                          <gateway>172.16.87.1</gateway>
                        </address>
                      </interface>
```

Sample opdata:

```
  <interfaces>
   <interface>
      <nicid>0</nicid>
      <type>virtual</type>

<vim_interface_name>jenkins-gr_g1_0_e8bc9a81-4b9a-437a-807a-f1a9bbc2ea3e</vim_interface_name>

      <port_id>4d57d4a5-3150-455a-ad39-c32fffbb10b1</port_id>
      <mac_address>fa:16:3e:d2:50:a5</mac_address>
      <network>45638651-2e92-45fb-96ce-9efdd9ea343e</network>
      <address>
         <address_id>0</address_id>
         <subnet>6ac36430-4f58-454b-9dc1-82f7a796e2ff</subnet>
         <ip_address>172.16.0.22</ip_address>
         <prefix>24</prefix>
         <gateway>172.16.0.1</gateway>
      </address>
      <address>
         <address_id>1</address_id>
         <subnet>8dd9f501-19d4-4782-8335-9aa9fbd4dab9</subnet>
         <ip_address>2002:dc7::4</ip_address>
         <prefix>48</prefix>
         <gateway>2002:dc7::1</gateway>
      </address>
   </interface>
</interfaces>
```

You can also see that the day-0 substitution values are replaced in the output data. Sample output data with the values populated in the day-0 configuration is as follows:

```
NICID_0_NETWORK_ID=45638651-2e92-45fb-96ce-9efdd9ea343e
NICID_0_MAC_ADDRESS=fa:16:3e:d2:50:a5

NICID_0_0_IP_ALLOCATION_TYPE=DHCP
NICID_0_0_IP_ADDRESS=172.16.0.22
NICID_0_0_GATEWAY=172.16.0.1
NICID_0_0_CIDR_ADDRESS=172.16.0.0
NICID_0_0_CIDR_PREFIX=24
NICID_0_0_NETMASK=255.255.255.0

NICID_0_1_IP_ALLOCATION_TYPE=DHCP
NICID_0_1_IP_ADDRESS=2002:dc7::4
NICID_0_1_GATEWAY=2002:dc7::1
NICID_0_1_CIDR_ADDRESS=2002:dc7::/48
NICID_0_1_CIDR_PREFIX=48
```

Dual Stack with Static IP Support

ESC supports dual stack with static IP support. As part of the initial configuration the user can provide the subnet and IP to be configured.

Note ESC supports static IP only when the scaling is false or minimum /maximum =1.

When you create a VM with out-of-band network, and specify a list of subnets with static IP (the network has multiple subnets), then ESC applies both subnet and the corresponding static IP.

In the example below, two subnets (ipv4 and ipv6) are added to a single interface.

```
  <?xml version="1.0" encoding="ASCII"?>
<esc_datamodel xmlns="https://www.cisco.com/esc/esc">
  <tenants>
    <tenant>
      <name>dep-tenant</name>
      <deployments>
        <deployment>
          <name>cirros-dep</name>
          <vm_group>
            <name>Grp1</name>
            <bootup_time>600</bootup_time>
            <recovery_wait_time>30</recovery_wait_time>
            <flavor>Automation-Cirros-Flavor</flavor>
            <image>Automation-Cirros-Image</image>
            <interfaces>
              <interface>
                <nicid>0</nicid>
                <network>ent-network2</network>
                <addresses>
                  <address>
                    <!-- IPv4 Static -->
                    <address_id>0</address_id>
                    <subnet>v4-subnet_C</subnet>
                    <ip_address>172.16.87.8</ip_address>
                  </address>
                  <address>
                    <!-- IPv6 Static -->
                    <address_id>1</address_id>
```

```
            <subnet>v6-subnet_D</subnet>
            <ip_address>fd07::110</ip_address>
          </address>
        </addresses>
      </interface>
    </interfaces>
  <kpi_data>
```

For information on deploying VNFs, see Deploying Virtual Network Functions on OpenStack.

Advanced Interface Configurations

This section describes several interface configurations for Elastic Services Controller (ESC) and the procedure to configure the hardware interfaces.

For information on basic interface settings, see Basic Interface Configurations.

Configuring Advance Interface Settings

Configuring SR-IOV in ESC

Single Root I/O Virtualization (SR-IOV) allows multiple VMs running a variety of guest operating systems to share a single PCIe network adapter within a host server. It also allows a VM to move data directly to and from the network adapter, bypassing the hypervisor for increased network throughput and lower server CPU burden.

Configuring SR-IOV in ESC for OpenStack

Before you configure SR-IOV in ESC for OpenStack, configure the hardware and OpenStack with the correct parameters.

To enable SR-IOV in ESC for OpenStack, specify the interface `type` as `direct`. The following snippet shows a sample datamodel:

```
<interfaces>
 <interface>
  <nicid>0</nicid>
  <network>my-network</network>
  <type>direct</type>
  </interface>
</interfaces>
...
```

Configuring SR-IOV in ESC for VMware

Before you configure SR-IOV in ESC for VMware, consider the following:

- Enable SR-IOV Physical Functions on desired ESXi hosts. For more information, see VMware documentation.
- Consider the following important points before enabling SR-IOV:
  - Review the list of physical network adaptors that VMware supports for SR-IOV. See VMware documentation.
  - Review the list of VM features that are not supported on a VM with SR-IOV configured. See VMware documentation.

- In a cluster deployment (defined by "zone" in the datamodel) with SR-IOV, make sure that each ESXi host has identical Physical Functions enabled for SR-IOV selection. For example, if a VM is going to use vmnic7 as the Physical Function, make sure that each host has vmnic7 and SR-IOV status for each vmnic7 is enabled.

  To enable SR-IOV in ESC for VMware, specify interface`<type>` as `direct` and also extension `<name>` as `sriov_pf_selection` in the deployment datamodel. Interface Type `direct`indicates an SR-IOV device and extension name `sriov_pf_selection` indicates the physical function. The following snippet shows a sample datamodel:

```
<vm_group>
...
<interface>
  <nicid>2</nicid>
  <network>MgtNetwork</network>
  <type>direct</type>
</interface>
<interface>
  <nicid>3</nicid>
  <network>MgtNetwork</network>
  <type>direct</type>
</interface>
...
<extensions>
 <extension>
 <name>sriov_pf_selection</name>
 <properties>
 <property>
 <name>nicid-2</name>
 <value>vmnic1,vmnic2</value>
 </property>
 <property>
 <name>nicid-3</name>
 <value>vmnic3,vmnic4</value>
 </property>
 </properties>
 </extension>
 </extensions>
</vm_group>
```

Configuring Allowed Address Pair

Cisco Elastic Services Controller allows you to specify the address pairs in the deployment datamodel to pass through a specified port regardless of the subnet associated with the network.

The address pair is configured in the following ways:

- List of Network—When a list of network is provided on a particular interface, ESC will get the subnet details from the OpenStack for these networks and add them to the corresponding port or interface. The following example explains how to configure address pairs as a list of network:

```
<interface>
                  <nicid>1</nicid>
                  <network>network1</network>
                  <allowed_address_pairs>
                    <network>
                        <name>bb8c5cfb-921c-46ea-a95d-59feda61cac1</name>
                    </network>
                    <network>
                        <name>6ae017d0-50c3-4225-be10-30e4e5c5e8e3</name>
```

```
        </network>
      </allowed_address_pairs>
    </interface>
  </interfaces>
```

- List of Address— When a list of address is provided, ESC will add these addresses to the corresponding interface. The following example explains how to configure address pairs as a list of address:

```
<interface>
        <nicid>0</nicid>
        <network>esc-net</network>
        <allowed_address_pairs>
         <address>
          <ip_address>10.10.10.10</ip_address>
          <netmask>255.255.255.0</netmask>
         </address>
         <address>
          <ip_address>10.10.20.10</ip_address>
          <netmask>255.255.255.0</netmask>
         </address>
        </allowed_address_pairs>
      </interface>
```

Configuring Security Group Rules

Cisco Elastic Services Controller (ESC) allows you to associate security group rules to the deployed instances on OpenStack. These security group rules are configured by specifying the necessary parameters in the deployment datamodel. In addition to configuring security group rules, if any VNF instance fails, ESC recovers the instance and applies the security group rules for the redeployed VNF.

To configure security group rules, do the following:

Before you begin

- Make sure you have created a tenant through ESC.
- Make sure you have security groups created.
- Make sure you have the security group name or UUID.

Step 1 Log in to the ESC VM as a root user.

Step 2 Run the following command to check the UUIDs of a given security group:

```
nova --os-tenant-name <NameOfTheTenant> secgroup-list
```

Step 3 Pass the following arguments in the deployment data model:

```
<interfaces>
 <interface>
  <nicid>0</nicid>
  <network>my-network</network><!-- depends on network name -->
  <security_groups>
  <security_group>0c703474-2692-4e84-94b9-c29e439848b8</security_group>
  <security_group>bbcdbc62-a0de-4475-b258-740bfd33861b</security_group>
  </security_groups>
</interface>
<interface>
```

```
 <nicid>1</nicid>
 <network>sample_VmGrpNet</network><!--depends on network name  -->
 <security_groups>
 <security_group>sample_test_SQL</security_group>
 </security_groups>
</interface>
```

Step 4 Run the following command to verify whether the security groups are associated with the VM instance:

```
nova --os-tenant-name <NameOfTenant> show <NameOfVMinstance>
```

Hardware Acceleration Support (OpenStack Only)

You can configure hardware acceleration features on OpenStack using the *flavor data model*. The following hardware acceleration features can be configured:

- **vCPU Pinning**—enables binding and unbinding of a process to a vCPU (Virtual Central Processing Unit) or a range of CPUs, so that the process executes only on the designated CPU or CPUs rather than any CPU.
- **OpenStack performance optimization for large pages and non-uniform memory access (NUMA)**—enables improvement of system performance for large pages and NUMA i.e., system's ability to accept higher load and modify the system to handle a higher load.
- **OpenStack support for PCIe Passthrough interface**—enables assigning a PCI device to an instance on OpenStack.

The following example explains how to configure hardware acceleration features using *flavor data model*:

```
$ cat fl.xml
<?xml version='1.0' encoding='ASCII'?>
<esc_datamodel xmlns="http://www.cisco.com/esc/esc">
  <flavors>
    <flavor>
      <name>testfl6</name>
      <vcpus>1</vcpus>
      <memory_mb>2048</memory_mb>
      <root_disk_mb>10240</root_disk_mb>
      <ephemeral_disk_mb>0</ephemeral_disk_mb>
      <swap_disk_mb>0</swap_disk_mb>
      <properties>
        <property>
          <name>pci_passthrough:alias</name>
          <value>nic1g:1</value>
        </property>
      </properties>
    </flavor>
  </flavors>
</esc_datamodel>
$ /opt/cisco/esc/esc-confd/esc-cli/esc_nc_cli edit-config ./fl.xml
```

Creating Additional Parameters for VMware vSphere NUMA Attributes

ESC enhances NUMA for VMware vSphere by adding additional configuration parameters.

This enhancement adds the additional or advanced configuration for VMware vSphere as a prefix to pass configuration parameters instead of passing these values through the day-0 configuration files.

Prefix: `extConfigParam`

Example:

```
<configuration>
    <dst>extConfigParam:mgmt-ipv4-addr</dst>
    <data>$NICID_1_IP_ADDRESS/16</data>
</configuration>
```

The additional configuration helps to minimize the data model changes, and restrict configuration changes to the VIM layer.

Configuring PCI or PCIe Device Passthrough on VMware vCenter

ESC supports VMware vCenter PCI or PCIe device passthrough (VMDirectPath I/O). This enables VM access to physical PCI functions on platforms with an I/O memory management unit.

Before You Begin

For the PCI / PCIe devices of a host VM to enable passthrough, the vSphere administrator must mark these devices in the vCenter.

Note You must reboot the host after PCI settings. Put the host to maintenance mode, power off or migrate all VMs to other hosts.

To specify PCI device passthrough request in ESC deployments include the <type> attribute with value set to ***passthru***. The data model is as follows:

```
<tenants>
  <tenant>
   <name>admin</name>
   <deployments>
    <deployment>
     <name>test</name>

     <vm_group>
      <name>test-g1</name>
      <image>uLinux</image>
      <bootup_time>300</bootup_time>
      <recovery_wait_time>10</recovery_wait_time>
      <interfaces>
       <interface>
        <nicid>1</nicid>
        <network>MgtNetwork</network>
        <ip_address>192.168.0.102</ip_address>
       </interface>
       <interface>
        <nicid>2</nicid>
        <network>VM Network</network>
        <type>passthru</type>
        <ip_address>172.16.0.0</ip_address>
       </interface>
       <interface>
        <nicid>3</nicid>
        <network>VM Network</network>
```

```
    <type>passthru</type>
    <ip_address>192.168.46.117</ip_address>
   </interface>
  </interfaces>
```

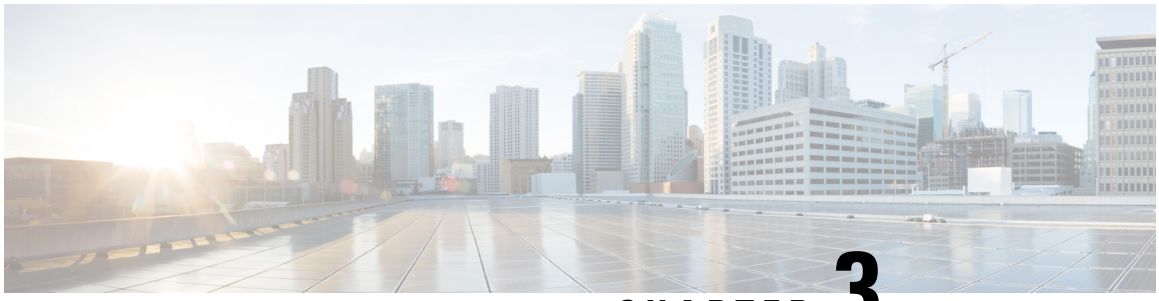
After successful deployment, the ***passthru*** value is set in the interface section of the notification as well as in the operational data.

Auto Selecting PCI or PCIe PassThrough Device

ESC needs one or more PCI or PCIe passthrough devices to be attached to each deployment without a particular PCI ID. ESC first selects a host. ESC selects the next available PCI or PCIe passthrough enabled device and attaches it during the deployment. If there is no PCI or PCIe passthrough enabled device available, ESC fails the deployment. The vSphere administrator has to ensure all computing-host within the target computing-cluster have enough number of PCI or PCIe passthrough enabled devices.

Note

- PCI or PCIe passthrough is not considered by ESC placement algorithm. For example, ESC does not select a host because it has available resources to complete the PCI or PCIe passthrough requests.
- ESC selects the PCI or PCIe passthrough device randomly. ESC does not consider the type or specification of the device. It selects the next available PCI or PCIe device from the list.
- Recovery fails if the VNF is recovered to a computing-host that ESC has selected based on the ESC placement algorithm, and if that computing-host does not have any PCI or PCIe passthrough enabled devices available.
- DRS must be turned off for the passthrough to work.



CHAPTER 3

Monitoring ESC Health

You can monitor the health of ESC and its services, using one of the following:

- Monitoring Health API
- SNMP Trap

Monitoring the Health of ESC Using REST API

ESC provides REST API for any third party software to monitor the health of ESC and its services. Using the API, the third party software can query the health condition of ESC periodically to check whether ESC is in service. In response to the query, API provides status code and messages, see Table 2: ESC Health API Status Code and Messages , on page 22 for details. In an HA setup the virtual IP (VIP) must be used as the monitoring IP. The return value provides the overall condition of the ESC HA pairs. See the Table 3: Health API Status Messages for Standalone ESC and HA, on page 23 for details.

The REST API to monitor the health of ESC is as follows:

```
GET to https://<esc_vm_ip>:60000/esc/health
```

Note The monitoring health API is secured using the existing REST basic HTTP authentication. The user can retrieve the report by using the ESC REST API credentials.

The monitoring health API response with error conditions is as follows:

```
<?xml version="1.0" encoding="UTF-8" ?>
<esc_health_report>
<status_code>{error status code}</status_code>
<message>{error message}</message>
</esc_health_report>
```

XML and JSON responses are also supported for the monitoring health API.

If the API response is successful, an additional field called *stage* is introduced.

```
<?xml version="1.0" encoding="UTF-8" ?>
```

```
<esc_health_report>
<status_code>{success status code}</status_code>
<stage>{Either INIT or READY}</stage>
<message>{success message}</message>
</esc_health_report>
```

The stage field has INIT or READY parameters.

INIT: The INIT parameter is the initial stage, where ESC accepts *pre-provisioning* requests such as configuring the config parameters or registering a vim connector.

READY: ESC is ready for any kind of *provisioning* requests such as deploying, undeploying and so on with this parameter.

The status code and messages below provide the health condition of ESC. The status codes with 2000 series imply that the ESC is operational. The status codes with 5000 series imply that at least one ESC component is not in service.

Note The ESC Health API does not check the VIM status because of multi VIM deployment introduced in ESC Release 3.0.

Table 2: ESC Health API Status Code and Messages

Status Code	Message
2000	ESC services are running.
2010	ESC services are running, but ESC High Availability node is not reachable.
2020	ESC services are running. One or more VIM services (for example, keystone and nova) not reachable. **Note** Not supported from ESC Release 3.0.
2030	ESC services are running, but VIM credentials are not provided. **Note** Not supported from ESC Release 3.0.
2040	ESC services running. VIM is configured, ESC initializing connection to VIM.
2100	ESC services are running, but ESC High-Availability node is not reachable. One or more VIM services (for example, nova) are not reachable. **Note** Not supported from ESC Release 3.0.
5010	ESC service, ESC_MANAGER is not running.
5020	ESC service, CONFD is not running.
5030	ESC service, MONA is not running.
5040	ESC service, VIM_MANAGER is not running.

Status Code	Message
5090	More than one ESC service (for example, confd and mona) are not running.

Note ESC HA mode refers to ESC HA in DRBD setup only. For more information on the ESC HA setup, see the Cisco Elastic Services Controller Install Guide.

The table below describes the status message for standalone ESC and HA with success and failure scenarios. For more information on ESC standalone and HA setup, see the Cisco Elastic Services Controller Install Guide.

Table 3: Health API Status Messages for Standalone ESC and HA

	Success	Partial Success	Failure
Standalone ESC	The response is collected from the monitoring health API and the status code is 2000.	NA	• Monitor cannot get the response from the monitoring health API. • The response is collected from the monitoring health API and the status code returned is in the 5000 series.

	Success	Partial Success	Failure
ESC in HA (Active-Standby)	The response is collected from the monitoring health API and the status code is 2000.	The response is collected from the monitoring health API and the status code is 2010. This indicates that the ESC standby node cannot connect to ESC master node in ESC HA. However, this does not impact the ESC service to northbound.	• The monitor cannot get the response from the monitoring health API for more than two minutes. **Note** ESC monitoring health API may not be available for a certain period during the HA switchover period. The monitoring software must set a proper threshold to report service failure in this scenario. • The response is collected from the monitoring health API and the status code returned is in the 5000 series.

Monitoring the Health of ESC Using SNMP Trap Notifications

You can also configure notifications on the health of various ESC components via SNMP traps using an SNMP Agent. This Agent is installed as part of the standard ESC installation and supports the SNMP version 2c protocol. The SNMP traps currently support only the state of the ESC product and not of the VNFs managed by ESC. This section describes the steps required to configure the ESC SNMP agent and also cover the events that will be triggered as part of the notifications.

Before you begin

- Ensure the **CISCO-ESC-MIB** and **CISCO-SMI MIB** files are available on your system. These are located in the /opt/cisco/esc/snmp/mibs directory. Download these to your SNMP Manager machine and place them in the $HOME/.snmp/mibs directory.
- Configure SNMP Agent. There are three methods to configure SNMP agent. These methods are discussed in detail in the section below.

Configuring SNMP Agent

In order to receive the SNMP traps, configure the SNMP Agent parameters. The agent can be configured using three different methods described in this section. The best or most applicable method to use depends on your use case.

Procedure

- **Configuring SNMP Agent during the installation of ESC via BootVM**: While installing ESC, use the following additional parameters to configure SNMP agent:

```
% bootvm.py <esc_vm_name> --image <image-name> --net <net-name> --enable-http-rest
--ignore-ssl-errors
--managers "udp:ipv4/port" or "udp:[ipv6]/port"
```

- **Configuring via ESCADM**: Using the escadm tool, you can modify the SNMP agent configuration parameters such as managers and ignoreSslErrors properties.

```
sudo escadm snmp set --ignore_ssl_errors=true --managers="udp:ipv4/port" or
"udp:[ipv6]/port"
```

- **Updating the configuration file**: The configuration is in the file /opt/cisco/esc/esc_database/snmp.conf. This file is in JSON format. Following is an example:

```
{"sysDescr": "ESC SNMP Agent",
    "listeningPort": "2001",
    "managers": [
        "udp:[ipv4]/port",
        "udp:[ipv6]/port"
    ],
    "ignoreSslErrors": "yes",
    "logLevel": "INFO",
    "sysLocation": "Unspecified",
    "sysName": "system name",
    "pollSeconds": "15",
    "listeningAddress": "0.0.0.0",
    "healthUrl": "https://<esc_vm_ip>:60000/esc/health",
    "sysContact": "root@localhost"}
```

The table below describes the properties that can be configured.

Note Using bootvm and escadm tool, you can only configure ignoreSslErrors and Managers parameters.

Table 4: Agent Configuration Parameters

Variable	Description
listeningAddress	Specify the network interface to listen on. 0.0.0.0 means all interfaces.
listeningPort	Specify the UDP port to listen on
ignoreSslErrors	Specify as no if you want the certificates to be validated for SSL connections. For untrusted self-signed certificates, set to yes.
healthUrl	Specify the URL of the Health Monitor API. **Note** The Agent may be used outside the ESC machine, such as a laptop with a Java-8 installed. In that case, the health URL should point to the ESC machine, and provide an ESC username/password (authUser/authPass) to authenticate with the ESC Monitor.
authUser	Specify the HTTP-BASIC username for the Health Monitor API. Use this parameter only if the agent is external to the ESC machine.
authPass	Specify the HTTP-BASIC password for the Health Monitor API. Use this parameter only if the agent is external to the ESC machine.
managers	Specify an array of strings in "udp:ipv4/port" or "udp:[ipv6]/port" format of where SNMP traps are to be delivered to. If these are changed when the Agent is running, the configuration is reloaded and the new managers used for future traps.
pollSeconds	This parameter is used by the scheduler. Use this paramter to specify the number of seconds between polls to the Health Monitor API.
logLevel	Specify the levels as INFO, ERROR, WARN, DEBUG, TRACE, ALL and OFF. This parameter can only be changed at runtime.
sysName	(SNMPv2-MIB) Optional value indicating the name of this node. The hostname is used by default.
sysDescr	(SNMPv2-MIB) Optional value describing this agent.
sysLocation	(SNMPv2-MIB) Optional value giving the physical location of this node.
sysContact	(SNMPv2-MIB) Optional value giving a contact name and/or email address for enquiries regarding this node

Defining ESC SNMP MIBs

The following table describes the content of ESC MIB. These values are configurable in snmp.conf file.

Variable	Simple IOD	Description
sysName	SNMPv2-MIB::sysName.0	Specify the name of the ESC machine. The host name is taken by default.
sysDescr	SNMPv2-MIB::sysDescr.0	Specify the name of the SNMP Agent.
sysLocation	SNMPv2-MIB::sysLocation.0	Specify where the ESC machine is located.
sysContact	SNMPv2-MIB::sysContact.0	Specify the Admin contact.

Enabling SNMP Trap Notifications

Use the escadm tool to start the SNMP services.

```
sudo escadm snmp start
```

You can also use esadm tool to stop, get the status, and modify the configurations of the SNMP agent.

```
sudo escadm snmp stop
sudo escadm snmp status
sudo escadm snmp restart
```

Managing SNMP Traps in ESC

This section covers:

- Understanding the SNMP Notification Types in ESC.
- Receiving SNMP Trap Message Directly From the Network
- Managing Trap Endpoints (SNMP Managers)
- Managing ESC SNMP in an HA Environment
- Managing Self-Signed Certificates in ESC

Procedure

- **Understanding the SNMP Notification Types in ESC:** The following table lists all the events supported by this version of the SNMP agent. These status codes and messages will be returned via a SNMP trap to a registered manager only when there is a change of state of ESC. The status codes with 2000 series imply that the ESC is operational. The status codes with 5000 series imply that at least one ESC component is not in service. For more details on status codes with 2000 series and 5000 series, see section, *Monitoring ESC Health Using REST API*.

Status Code	SNMP Agent-specific Message
5100	An HTTP error was received when using the ESC Monitor API
5101	The ESC Monitor replied, but the data could not be understood.
5102	The Agent could not create a network connection to the ESC Monitor API.
5199	An unhandled error occurred (details will be included in the message).
5200	In an HA environment when there are changes to the HA master node the agent will send this notification

- **Receiving SNMP trap messages directly from the network**: Directly receive SNMP trap messages from the network, by using basic SNMP UNIX tools such as, snmpget snmpwalk and snmptrapd. An example usage:

```
snmptrapd -m ALL -f -Lo -c snmptrapd.conf <port>
```

This will start an SNMP trap daemon on port 12113. Make sure the Cisco and ESC MIB's are present in ~/.snmp/mibs. The referenced snmptrapd.conf looks like this:

```
disableAuthorization yes
authCommunity   log,execute,net public
# traphandle default /Users/ahanniga/bin/notify.sh esc

createUser myuser MD5 mypassword DES myotherpassword

format2 %V\n% Agent Address: %A \n Agent Hostname: %B \n Enterprise OID: %N \n Trap
Sub-Type: %q \n Community/Infosec Context: %P \n Uptime: %T \n PDU Attribute/Value Pair
 Array:\n%v \n -------------- \n
```

The trap will contain two entries: statusCode and statusMessage. The trap will be sent when the status changes

```
DISMAN-EVENT-MIB::sysUpTimeInstance = Timeticks: (3971) 0:00:39.71
SNMPv2-MIB::snmpTrapOID.0 = OID: CISCO-ESC-MIB::statusNotif
SNMPv2-MIB::sysDescr.0 = STRING: ESC SNMP Server
CISCO-ESC-MIB::escStatusCode.0 = STRING: "2000"
CISCO-ESC-MIB::escStatusMessage.0 = STRING: "ESC services are running."
```

- **Managing Trap Endpoints (SNMP Managers)**: The SNMP Agent monitors its configuration file for changes and reloads when a change is made. Add or remove manager endpoints to the configuration file and the new configuration will be used in future traps.
- **Managing ESC SNMP Agent in an HA Environment**: Two or more ESC nodes can be deployed in a HA configuration and the SNMP agent does support this configuration. However, consider the following points in an HA deployment:
  - Only one ESC node (the master node) can send SNMP traps
  - The SNMP Agent must be up if the backup node becomes the master.

- Any changes made to the master configuration must also be applied on backup nodes.
- If a node becomes the master node due to failover, this will generate a trap.

- **Managing Self-Signed Certificates**: When ESC is deployed and the SNMP agent uses ESC Health APIs, it is recommended that a root trusted certificate is installed on the server. If the environment is a known and trusted one then it is possible to ignore these errors using the configuration parameter "ignoreSslErrors". However, if you did want to keep this setting to its more secure default it is possible to install a self-signed certificate by importing the ESC certificate into the JVM trust store. The following section describes the procedure to do so.

  a) Add esc as an alternative name for localhost. In the file "/etc/hosts:" add the following (or ensure that "esc" is added to the end):

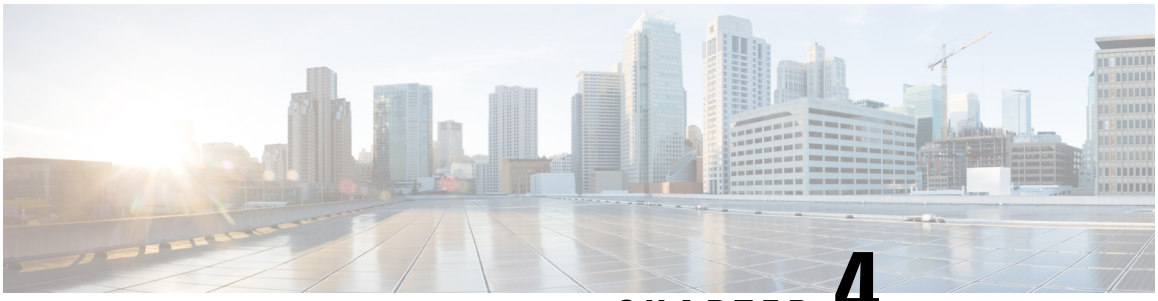
  ```
  127.0.0.1   localhost localhost.localdomain localhost4 localhost4.localdomain4 esc
  ```

  b) In the SNMP Agent configuration file "/opt/cisco/esc/esc_database/snmp.conf" the healthUrl must point to esc.

  ```
  "healthUrl": "https://esc:60000:/esc/health"
  ```

  c) Import the certificate into the truststore. Following is an example of importing the certificate, assuming $JAVA_HOME is/usr/lib/jvm/jre-1.8.0-openjdk.x86_64:

  ```
  cd /opt/cisco/esc/esc-config
  sudo openssl x509 -inform PEM -in server.pem -outform DER -out server.cer
  sudo keytool -importcert -alias esc -keystore $JAVA_HOME/lib/security/cacerts
  -storepass changeit -file server.cer
  ```



CHAPTER 4

ESC System Logs

Viewing ESC Log Messages

Log messages are created for ESC events throughout the VNF lifecycle. These can be external messages, messages from ESC to other external systems, error messages, warnings, events, failures and so on. The log file can be found at `/var/log/esc/escmanager_tagged.log`.

The log message format is as follows:

```
date=<time-date>] [loglevel=<loglevel>] [tid=<transactionid>] [cl=<classifications>]
[tags=<tags>] [msg=<message>
```

Sample log is as follows:

```
date=15:43:58,46022-Nov-2016]
[loglevel=ERROR ] [tid=0793b5c9-8255-47f3-81e6-fbb59f6571f7] [cl=OS ]
[tags=wf:create_vm,eventType:VM_DEPLOY_EVENT,tenant:CSCvd94541,depName:test-dep,vmGrpName:test-VNF,
vmName:test-dep_test_0_dc3f406c-05ca-43b3-af21-0841e3b029a0]
[tags=wf:create_vm,eventType:VM_DEPLOY_EVENT,tenant:test,depName:test-dep,vmGrpName:test-VNF,
vmName:test-dep_test_0_dc3f406c-05ca-43b3-af21-0841e3b029a0] [msg=sleepingfor5seconds
to allow vm to become ACTIVE instance id:
162344f7-78f9-4e45-9f23-34cf87377fa7
name:test-dep_test_0_dc3f406c-05ca-43b3-af21-0841e3b029a0
```

When a request is received, a RequestDetails object is created which autogenerates a unique transaction id. This value is carried forward across all threads. Classifications and tags are optional. These are prefixes added to the log messages to enhance readability, and help in debugging. With classifications and tags, the log messages can be easily parsed and filtered by the log analysis tools.

The following classifications are supported:

NBI	"com.cisco.esc.rest""com.cisco.esc.filter"(North Bound Interface - Clientinterface)
SBI	"com.cisco.esc.rest"- source is a callback handler or"EventsResource"(South Bound Interface - i.e. between ESC and the VIM)
SM	"com.cisco.esc.statemachines". stands for StateMachine. This classification indicates logs in the StateMachine category.

MONITORING	"com.cisco.esc.monitoring""com.cisco.esc.paadaptor"(MONA related logs)
DYNAMIC_MAPPING	"com.cisco.esc.dynamicmapping""com.cisco.esc.db.dynamicmapping"(MONA related logs)
CONFD	"com.cisco.esc.confd"
CONFD_NOTIFICATION	"com.cisco.esc.confd.notif""com.cisco.esc.confd.ConfdNBIAdapter"
OS	"com.cisco.esc.vim.openstack"
LIBVIRT	"com.cisco.esc.vim.vagrant
VIM	"com.cisco.esc.vim"
REST_EVENT	"ESCManager_Event""com.cisco.esc.util.RestUtils". indicates REST notifications in logs.
WD	"com.cisco.esc.watchdog"
DM	"com.cisco.esc.datamodel""com.cisco.esc.jaxb.parameters"(Datamodel and resource objects)
DB	"com.cisco.esc.db"(Database related logs)
GW	"com.cisco.esc.gateway"
LC	"com.cisco.esc.ESCManager"(Start up related logs)
SEC	"com.cisco.esc.jaas"
MOCONFIG	"com.cisco.esc.moconfig"(MOCONFIG object related logs --this is internal for ESC developers)
POLICY	"com.cisco.esc.policy"(Service/VM Policy related logs)
TP	"com.cisco.esc.threadpool"
ESC	"com.cisco.esc" Any other packages not mentioned above

The following tags are supported:

- **Workflow [wf:]**—Generated using action and resource from RequestDetails object. Example "wf:create_network"
- **Event type [eventType:]**—Event that triggered the current action. Example: "eventType:VM_DEPLOY_EVENT"
- **Resource based**—These values are generated based on the type of parameter used by the event. The hierarchy, that is, the tenant, the vm group and so on is added to the log.

Tenant	[tenant:<tenant name>]
Network	[tenant:<tenant id>, network:<network name>] **Note** The tenant appears only if applicable.

Subnet	[tenant:<tenant name or id>, network:<network name or id>, subnet:<subnet name>] **Note** The tenant appears only if applicable.
User	[tenant:<tenant name>, user:<user name or id>] **Note** The tenant appears only if applicable.
Image	[image:<image name>]
Flavor	[flavor:<flavor name>]
Deployment	[tenant:<tenant name or id>, depName:<deployment name>]
DeploymentDetails	[tenant:<tenant name or id>, depName:<deployment name>, vmGroup:<vm group name>, vmName:<vm name>]
Switch	[tenant:<tenant name or id>, switch:<switch name>]
Volume	[volume:<volume name>]
Service	[svcName:<Service Registration name>]

Further, ESC logs can also be forwarded to an rsyslog server for further analysis and log management.

Filtering Logs Using Confd APIs

You can query and retrieve logs (for example, deployment logs, or error logs) in ESC using log filters introduced in the confd APIs. New filters for Tenant, Deployment Name, and VM Name are introduced. This enables you to query the ESC logs further for most recent error logs using the log filters in Confd APIs. You can also retrieve ESC logs related to the communication between ESC and the OS (by setting the classification tag to "OS").

The log format to retrieve confd API logs:

```
date=<time-date>] [loglevel=<loglevel>] [tid=<transactionid>] [cl=<classifications>]
[tags=<tags>] [msg=<message>
```

The sample log is as follows:

```
date=15:43:58,46022-Nov-2016] [loglevel=ERROR ] [tid=0793b5c9-8255-47f3-81e6-fbb59f6571f7]
 [cl=OS ]
[tags=wf:create_vm,eventType:VM_DEPLOY_EVENT,tenant:test,depName:test-dep,vmGrpName:test-VNF,
vmName:test-dep_test_0_dc3f406c-05ca-43b3-af21-0841e3b029a0]
[msg=sleepingfor5seconds to allow vm to become ACTIVE instance id:
162344f7-78f9-4e45-9f23-34cf87377fa7 name:test-dep_test_0_dc3f406c-05ca-43b3-af21-0841e3b029a0
```

The parameters for log level, classification and tags are dependent on each other to retrieve the logs. You can successfully retrieve the logs with the following combination.

- log_level=ERROR, classifications=OS, tags=(depName:test-dep)
- log_level=ERROR, classifications=OS, tags=(tenant: test)

The log filter returns a value when all the following conditions are met:

- Log level
- Classifications (if provided)

- Tags (if provided)

Note If there are more than one classification listed, it has to match at least one of the classifications. The same applies to the tags as well.

For example, the following log filter criteria does not return the log sample mentioned earlier:

```
log_level=ERROR, classifications=VIM, tags=(depName:test-dep)
```

It does not return any value though the log level and tags match, the classification VIM does not match.

The data model is as follows:

```
rpc filterLog {
    description "Query and filter escmanager logs using given parameters";
    tailf:actionpoint escrpc;
    input {
      leaf log_level {
        mandatory false;
        description "One of DEBUG / INFO / WARNING / ERROR / TRACE / FATAL. Results will
include all logs at and
                     above the level specified";
        type types:log_level_types;
        default ERROR;
      }
      leaf log_count {
        mandatory false;
        description "Number of logs to return";
        type uint32;
        default 10;
      }
      container classifications {
        leaf-list classification {
         description "Classification values to be used for the log filtering.  For example:
 'OS', 'SM'.
                      Logs containing any of the provided classification values will be
returned.";
          type types:log_classification_types;
        }
      }
      container tags {
        list tag {
          key "name";
          leaf name {
            mandatory true;
            description "Tag name to be used for the log filtering.  For example: 'tenant',
 'depName'.
                         Logs containing any of the provided tag name plus the tag values
will be returned.";
            type types:log_tag_types;
          }
          leaf value {
            mandatory true;
            description "Tag value pairs to be used for the log filtering.  For example:
'adminTenant', 'CSRDeployment'";
            type string;
          }
        }
      }
    }
    output {
```

```
    container filterLogResults {
      leaf log_level {
        description "Log level used to filter for the logs.";
        type types:log_level_types;
      }
      list logs {
        container classifications {
          leaf-list classification {
            description "Classifications used to filter for the logs.";
            type types:log_classification_types;
          }
        }
        container tags {
          list tag {
            key "name";
            leaf name {
              mandatory true;
              description "Tag name used to filter for the logs.";
              type types:log_tag_types;
            }
            leaf value {
              mandatory true;
              description "Tag value used to filter for the logs.";
              type string;
            }
          }
        }
        leaf log_date_time {
          description "Timestamp of the log.";
          type string;
        }
        leaf log_message {
          description "The log message.";
          type string;
        }
      }
    }
  }
}
```

You can query for the confd API logs through the netconf console or esc_nc_cli

- Through the netconf-console, run the following query:

  ```
  /opt/cisco/esc/confd/bin/netconf-console --port=830 --host=127.0.0.1 --user=admin
  --privKeyFile=/home/admin/.ssh/confd_id_dsa --privKeyType=dsa --rpc=log.xml
  ```

- Using the esc_nc_cli, run the following query:

  ```
  ./esc_nc_cli filter-log log.xml
  ```

  The sample log.xml is as follows:

  ```
  <filterLog xmlns="https://www.cisco.com/esc/esc">
    <log_level>INFO</log_level>
    <log_count>1</log_count>
    <classifications>
      <classification>OS</classification>
      <classification>SM</classification>
    </classifications>
    <tags>
      <tag>
        <name>depName</name>
        <value>CSR_ap1</value>
      </tag>
  ```

```
    <tag>
      <name>tenant</name>
      <value>admin</value>
    </tag>
  </tags>
</filterLog>
```

The response is as follows:

```
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="1">
  <filterLogResults xmlns="https://www.cisco.com/esc/esc">
    <log_level>INFO</log_level>
    <logs>
      <classifications>
        <classification>OS</classification>
        <classification>SM</classification>
      </classifications>
      <tags>
        <tag>
          <name>depName</name>
          <value>CSR_ap1</value>
        </tag>
        <tag>
          <name>tenant</name>
          <value>admin</value>
        </tag>
      </tags>
      <log_date_time>13:06:07,575 31-Oct-2016</log_date_time>
      <log_message> No pending work flow to start.</log_message>
    </logs>
  </filterLogResults>
</rpc-reply>
```

Note The logging API responses are in XML format. If the log messages contain any XML characters, then the characters will be escaped so not to break the XML conformance.

Viewing ESC Log Files

You can find the logs of various ESC components here:

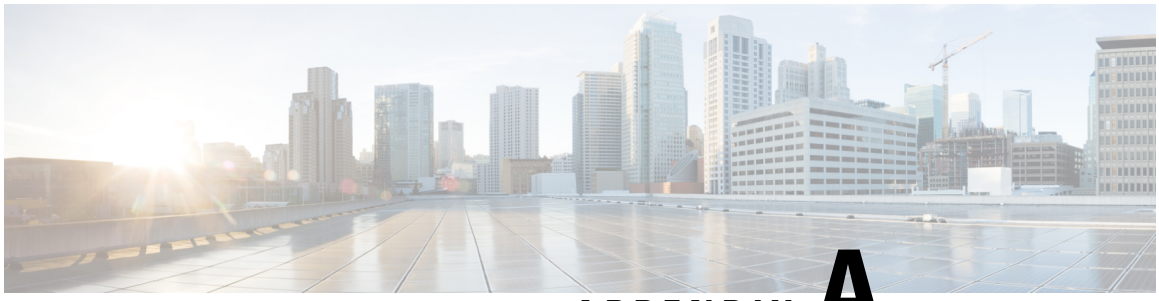
File	Component	Description	Rotation Size	Number of backup files	Active/Active deployment
/var/log/esc/escmanager.log	ESCManager	This contains logs of the ESC Manager which includes workflow, request and persistence.	150 MB	10	Available

File	Component	Description	Rotation Size	Number of backup files	Active/Active deployment
/var/log/esc/escmanager_tagged.log	ESCManager	This is the same as escmanager.log but with a format that is easier to read for netconf logging API but can be used by other parsers if needed.	150 MB	10	Available
/var/log/esc/yangesc.log	ESCManager	This contains logs related to netconf request and notifications	150 MB	10	Available
/var/log/esc/error_escmanager.log	ESCManager	All error log entries.	150 MB	10	Available
/var/log/esc/event_escmanager.log	ESCManager		150 MB	10	Available
/var/log/esc/trace/event_escmanager.log	ESCManager		150 MB	10	Available
/var/log/esc/trace/escdatabase.log	ESCManager	Database related log entries			Available
/var/log/esc/trace/debug_yangesc.log	ESCManager		51 MB	2	Available
/var/log/esc/trace/esc_rest.log	ESCManager		150 MB	10	Available
/var/log/esc/mona/mona.log	MONA		150 MB	10	Available
/var/log/esc/mona/actions_mona.log	MONA		150 MB	10	Available
/var/log/esc/mona/rules_mona.log	MONA		150 MB	10	Available
/var/log/esc/vimmanager/vimmanager.log	VIM Manager Service	A detailed VIM manager log.	150 MB	10	Available

File	Component	Description	Rotation Size	Number of backup files	Active/Active deployment
/var/log/esc/vimmanager/operations_vimmanager.log	VIM Manager Service	A simplified log which only lists the VIM Manager operations been processed.	150 MB	10	Available
/var/log/esc/trace/vimmanager/vim_vimmanager.log	VIM Manager Service	Raw HTTP request/response (including header) between VIM Manager and VIM. Note, for OpenStrack to track this log, log level has to set to DEBUG for VIM. Manager.	150 MB	10	Available
/var/log/esc/<timestamp>-esc-portal-be.log	ESC UI		10 MB	4	Available
/var/log/esc/confd/audit.log	confd		10 MB	4	Available
/var/log/esc/confd/browser.log	confd		10 MB	4	Available
/var/log/esc/confd/confd.log	confd		10 MB	4	Available
/var/log/esc/confd/devel.log	confd		10 MB	4	Available
/var/log/esc/confd/netconf.log	confd		10 MB	4	Available
/var/log/esc/confd/netconf.trace	confd		10 MB	4	Available
/var/log/esc/confd/global.data			Not rotated		Available
/var/log/esc/esc_monitor.log	ESC INFRA or HA		10 MB	4	Not available
/var/log/esc/esc_monitor_output.log	ESC INFRA or HA		10 MB	4	Not available

File	Component	Description	Rotation Size	Number of backup files	Active/Active deployment
/var/log/esc/esc_confd.log	ESC INFRA or HA		10 MB	4	Not available
/var/log/esc/pgstartup.log	ESC INFRA or HA		10 MB	4	Not available
/var/log/esc/spy.log	ESC INFRA or HA		No logs (size 0)	No ESC generated logs.	Not available
/var/log/esc/catalina.out	Tomcat		Not rotated	No ESC generated logs. Only Error.	Available
/var/log/esc/esc_dbtool.log	DB tool		Not rotated		Available
/var/log/esc/snmp/snmp.log	SNMP Agent		Not rotated		Not available
/var/log/esc/etsi-vnfm/etsi-vnfm.log	ETSI-Service	This is the main log file for ETSI processing, including requests, response, payloads and general logging information where appropriate.	150MB	10	Available
/var/log/esc/etsi-vnfm/events-etsi-vnfm.log	ETSI-Service	Logs only API requests, both entering and leaving.	150MB	10	Available
/var/log/esc/etsi-vnfm/event-details-etsi-vnfm.log	ETSI-Service	Logs both the API requests (entering and leaving) along with the actual JSON payloads.	150MB	10	Available

File	Component	Description	Rotation Size	Number of backup files	Active/Active deployment
/var/log/esc/escadm.log	Escadm service	Logs to capture both manual and automated messages and errors from escadm.py. This log is useful to track startup and configuration changes to ESC.	10 MB	4	Available
/var/log/esc/elector-<pid>	Elector service	Log entries records leadership decisions.	Not rotated		Available for Active/Active only
/var/log/esc/consul_agent-<timestamp>	Consul agent	Log entries recording ESC Consul agent with Consul server.	Not rotated		Available for Active/Active only



APPENDIX A

ESC Error Conditions

Error Conditions for ESC Operations

Error Conditions for ESC Operations

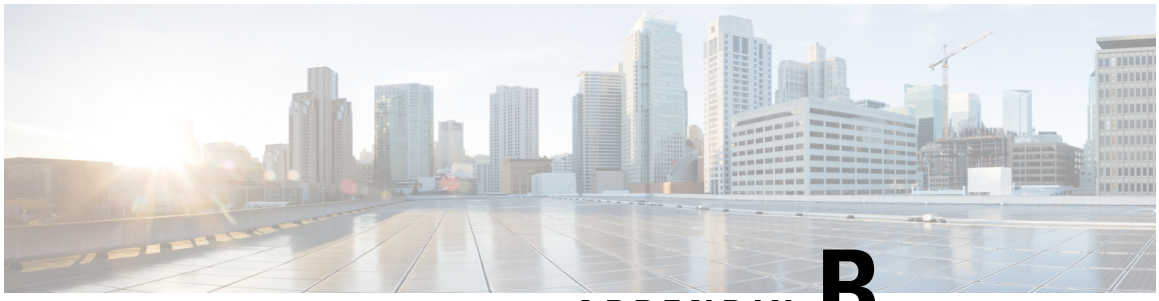
If an operation fails in ESC, the user must cancel that operation. ESC will not rollback automatically to cancel any operations. The table below shows the error condition, and recovery details.

Notifications or Logging details for Error Conditions

Typically, for all error conditions, an error notification of the failed request will be sent to the NB client (ESC User) through callback if using REST interface, or through netconf notification if using NETCONF interface. An error log will be generated and sent to syslog, if syslog is configured.

Error Condition	Recovery
Failed create tenant request	NB client (ESC User) has to send in a delete tenant request before attempting to send in the same create tenant request.
Failed create network request	NB client (ESC User) has to send in a delete network request before attempting to send in the same create network request.
Failed create subnet request	NB client (ESC User) has to send in a delete subnet request before attempting to send in the same create subnet request.
Failed deployment request	NB client (ESC User) has to send in an undeploy request before attempting to send in the same deploy request If a deployment fails, ESC updates information in its database (with error state) until it receives an undeployment request. The undeployment will remove objects that are in error states.

Error Condition	Recovery
Failed Recovery	The existing deployment is not usable anymore. NB client (ESC User) has to send in an undeploy request then the same deploy request.
Failed Scale Out/In	No action required. The existing deployment is still functional. If at a later stage an undeploy was triggered, it will clean up any VMs that were affected part of the failed scale out and scale in.
Failed Service Update	No action required. The existing deployment is still functional. Any retries of that update will not be honored. If at a later stage an undeploy was triggered, it will clean up any created VMs part of the failed update.
Failed VM Operations (Start, Stop, Reboot, Enable Monitor, Disable Monitor)	No action required. The existing deployment is still functional. NB client (ESC User) can retry the failed operation.
Failed VNF/Service Operations (Start, Stop, Reboot, Enable Monitor, Disable Monitor)	No action required. The existing deployment is still functional. NB client (ESC User) can retry the failed operation.
Failed delete tenant request	Possibility of leaking resource in VIM. Manual intervention might be needed to clean up leaking resources on VIM.
Failed delete network request	Possibility of leaking resource in VIM. Manual intervention might be needed to clean up leaking resources on VIM.
Failed delete subnet request	Possibility of leaking resource in VIM. Manual intervention might be needed to clean up leaking resources on VIM.
Failed undeployment request	Possibility of leaking resource in VIM. Manual intervention might be needed to clean up leaking resources on VIM



APPENDIX B

Before Contacting Tech Support

At some point, you might need to contact your technical support representative or Cisco TAC for some additional assistance. This section outlines the steps that you should perform before you contact your next level of support in order to reduce the amount of time spent resolving the issue.

Downloading Logs from the ESC

You can download log files from the ESC for troubleshooting.

To collect log files through CLI, use the following command:

```
sudo escadm log collect --output <output_directory>
```

To collect configuration data for VMs, use the following command,

```
esc_nc_cli get-config esc_datamodel > <file-name>
```

For example:

```
esc_nc_cli get-config esc_datamodel > /var/tmp/esc_datamodel.txt
```

For more information of the ESC system level configuration, see Downloading Logs from the ESC Portal section in the Cisco Elastic Services Controller User Guide.

Things To Do Before Calling TAC

Answer the following questions before you contact your technical support representative:

1. Collect the system information and configuration through CLI (system log files) and through GUI. For instructions, refer Downloading the log files.
2. If an error occurs in ESC, take a screen shot of the error. In Windows, press Alt+PrintScreento capture the active window, or press PrintScreen to capture the entire desktop. Paste the screenshot into a new Microsoft Paint (or similar program) session and save the file.
3. Capture the exact error codes that you see in the message logs from either ESC or the CLI.
4. Answer the following questions before you contact your technical support representative:

- Which ESC version, operating systems versions, and storage device firmware are in your network?
- Were any changes made to the environment (VLANs, upgrades, or adding modules) prior to or at the time of this event?
- Are there other similarly configured devices that could have this problem but do not?
- Where was this problematic device connected (which device and interface)?
- When did this problem first occur?
- When did this problem last occur?
- How often does this problem occur?
- Were any traces or debug output captured during the problem time?
- What troubleshooting steps have you attempted?

5. Answer the following questions if your problem is related to a software upgrade attempt:
   - What was the original Cisco ESC version?
   - What is the new Cisco ESC version?
   - Collect the output from the following command and forward them to your customer support representative:
     - `esc_nc_cli get-config esc_datamodel > <file-name>`
     - `esc_version`
     - `health.sh`
     - `escadm status`
     - `escadm vim show`