



## **Cisco Nexus 1000V InterCloud Port Profile Configuration Guide, Release 5.2(1)IC1(1.1)**

**First Published:** June 28, 2013

### **Americas Headquarters**

Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, CA 95134-1706  
USA  
<http://www.cisco.com>  
Tel: 408 526-4000  
800 553-NETS (6387)  
Fax: 408 527-0883

Text Part Number: OL-29148-01

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB's public domain version of the UNIX operating system. All rights reserved. Copyright © 1981, Regents of the University of California.

NOTWITHSTANDING ANY OTHER WARRANTY HEREIN, ALL DOCUMENT FILES AND SOFTWARE OF THESE SUPPLIERS ARE PROVIDED "AS IS" WITH ALL FAULTS. CISCO AND THE ABOVE-NAMED SUPPLIERS DISCLAIM ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NON-INFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: <http://www.cisco.com/go/trademarks>. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)

© Cisco Systems, Inc. All rights reserved.



## CONTENTS

---

### Preface

#### Preface v

Audience v

Document Conventions v

Related Documentation for Cisco Nexus 1000V InterCloud vii

Documentation Feedback vii

Obtaining Documentation and Submitting a Service Request viii

---

### CHAPTER 1

#### Overview 1

Information About Port Profiles and Port Groups 1

Information About Live Policy Changes 1

Information About Rollback to a Consistent Configuration 2

Information About Interface Quarantine 2

---

### CHAPTER 2

#### Creating Port Profiles 3

Information About Port Profiles 4

Information About Port Profile States 4

Information About vEthernet Port Binding 4

Guidelines and Limitations for Creating Port Profiles 5

Default Settings 5

Configuring Port Profiles 6

Creating a Port Profile 6

Configuring VMware Attributes 7

Port Mode Configuration 8

VLAN Ranges 8

Configuring a Trunk Port Profile 9

Configuring an Access Port Profile 10

Clearing a Port Management Policy 11

Port Binding for vEthernet Port Profiles Configuration 12

Configuring a Default Port Binding Type 12

Configuring Port Binding for a vEthernet Port Profile 14

Enabling a Port Profile 15

Removing a Port Profile 16

Feature History for Port Profiles 17

---

**CHAPTER 3**

**Configuring System Port Profiles 19**

Information About System Port Profiles 19

Guidelines and Limitations for System Port Profiles 19

Creating a System Port Profile 20

Modifying the System VLANs in a Trunk Mode Port Profile 22

    Converting a Port Profile to an Access Profile with a System VLAN 23

    Converting an Access Port Profile to a Trunk Port Profile 24

Modifying System VLANs in an Access Mode Port Profile 25

Feature History for System Port Profiles 26

---

**CHAPTER 4**

**Verifying the Port Profile Configuration 27**

Verifying the Port Profile Configuration 27

Feature History for Port Profile Verification 27

---

**APPENDIX A**

**Port Profile Configuration Limits 29**

Port Profile Configuration Limits 29



# Preface

---

This preface contains the following sections:

- [Audience, page v](#)
- [Document Conventions, page v](#)
- [Related Documentation for Cisco Nexus 1000V InterCloud, page vii](#)
- [Documentation Feedback , page vii](#)
- [Obtaining Documentation and Submitting a Service Request, page viii](#)

## Audience

This publication is for network administrators who configure and maintain Cisco Nexus devices.

This guide is for network and server administrators with the following experience and knowledge:

- An understanding of virtualization
- Using VMM software to create a virtual machine and configure a VMware vSwitch
- Ability to create an account on provider cloud such as Amazon Web Services (AWS).
- Knowledge of VMware vNetwork Distributed Switch is not required.

## Document Conventions

Command descriptions use the following conventions:

Convention	Description
<b>bold</b>	Bold text indicates the commands and keywords that you enter literally as shown.
<i>Italic</i>	Italic text indicates arguments for which the user supplies the values.
[x]	Square brackets enclose an optional element (keyword or argument).

Convention	Description
[x   y]	Square brackets enclosing keywords or arguments separated by a vertical bar indicate an optional choice.
{x   y}	Braces enclosing keywords or arguments separated by a vertical bar indicate a required choice.
[x {y   z}]	Nested set of square brackets or braces indicate optional or required choices within optional or required elements. Braces and a vertical bar within square brackets indicate a required choice within an optional element.
<i>variable</i>	Indicates a variable for which you supply values, in context where italics cannot be used.
string	A nonquoted set of characters. Do not use quotation marks around the string or the string will include the quotation marks.

Examples use the following conventions:

Convention	Description
<code>screen font</code>	Terminal sessions and information the switch displays are in screen font.
<b><code>boldface screen font</code></b>	Information you must enter is in boldface screen font.
<i><code>italic screen font</code></i>	Arguments for which you supply values are in italic screen font.
<>	Nonprinting characters, such as passwords, are in angle brackets.
[ ]	Default responses to system prompts are in square brackets.
!, #	An exclamation point (!) or a pound sign (#) at the beginning of a line of code indicates a comment line.

This document uses the following conventions:



**Note**

Means *reader take note*. Notes contain helpful suggestions or references to material not covered in the manual.



**Caution**

Means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

# Related Documentation for Cisco Nexus 1000V InterCloud

This section lists the documents used with the Cisco Nexus 1000V InterCloud and available on Cisco.com at the following URL:

[http://www.cisco.com/en/US/partner/products/ps12904/tsd\\_products\\_support\\_series\\_home.html](http://www.cisco.com/en/US/partner/products/ps12904/tsd_products_support_series_home.html)

## General Information

*Cisco Nexus 1000V InterCloud Release Notes*

## Install and Upgrade

*Cisco Nexus 1000V InterCloud Installation Guide*

## Configuration Guides

*Cisco Nexus 1000V InterCloud License Configuration Guide*

*Cisco Nexus 1000V InterCloud High Availability and Redundancy Configuration Guide*

*Cisco Nexus 1000V InterCloud Interface Configuration Guide*

*Cisco Nexus 1000V InterCloud Layer 2 Configuration Guide*

*Cisco Nexus 1000V InterCloud Port Profile Configuration Guide*

*Cisco Nexus 1000V InterCloud Security Configuration Guide*

*Cisco Nexus 1000V InterCloud System Management Configuration Guide*

## Reference Guides

*Cisco Nexus 1000V InterCloud Command Reference*

*Cisco Nexus 1000V InterCloud Verified Scalability Reference*

*Cisco Nexus 1000V MIB Quick Reference*

## Troubleshooting and Alerts

*Cisco Nexus 1000V Password Recovery Procedure*

## Cisco Nexus 1000V Documentation

*Cisco Nexus 1000V for VMware vSphere Documentation*

[http://www.cisco.com/en/US/products/ps9902/tsd\\_products\\_support\\_series\\_home.html](http://www.cisco.com/en/US/products/ps9902/tsd_products_support_series_home.html)

## Cisco Prime Network Services Controller Documentation

[http://www.cisco.com/en/US/products/ps13213/tsd\\_products\\_support\\_series\\_home.html](http://www.cisco.com/en/US/products/ps13213/tsd_products_support_series_home.html)

# Documentation Feedback

To provide technical feedback on this document, or to report an error or omission, please send your comments to [nexus1k-docfeedback@cisco.com](mailto:nexus1k-docfeedback@cisco.com). We appreciate your feedback.

# Obtaining Documentation and Submitting a Service Request

For information on obtaining documentation, submitting a service request, and gathering additional information, see the monthly *What's New in Cisco Product Documentation*, which also lists all new and revised Cisco technical documentation, at:

<http://www.cisco.com/en/US/docs/general/whatsnew/whatsnew.html>

Subscribe to the *What's New in Cisco Product Documentation* as a Really Simple Syndication (RSS) feed and set content to be delivered directly to your desktop using a reader application. The RSS feeds are a free service and Cisco currently supports RSS version 2.0.





## Overview

---

This chapter contains the following sections:

- [Information About Port Profiles and Port Groups, page 1](#)
- [Information About Live Policy Changes, page 1](#)
- [Information About Rollback to a Consistent Configuration, page 2](#)
- [Information About Interface Quarantine, page 2](#)

## Information About Port Profiles and Port Groups

A port profile is a collection of interface-level configuration commands that are combined to create a complete network policy.

A port group is a representation of a port profile on the server. Every port group on the server is associated with a port profile on the Cisco Nexus 1000V. Network administrators configure port profiles, and then server administrators can use the corresponding port groups on the server to assign ports to port profiles.

In the Server, a port profile is represented as a port group. You assign the vEthernet interfaces to a port group in to do the following:

- Define port configuration by policy.
- Apply a single policy across a large number of ports.

When a newly-provisioned virtual machine is powered on, a vEthernet interface is created on the Cisco Nexus 1000V for each of the virtual machine vNICs. The vEthernet inherits the definitions in the selected port profile.

## Information About Live Policy Changes

Port profiles are not static entities but dynamic policies that can change as network needs change. Changes to active port profiles are applied to each switch port that is using the profile. This simplifies the process of applying new network policies or changing an existing policy.

## Information About Rollback to a Consistent Configuration

When you update the configuration in a port profile, its member interfaces are also updated. If the configuration fails, the port profile and its member interfaces are rolled back to the last known good configuration for the port profile.

## Information About Interface Quarantine

Interfaces are sectioned off and shut down when a port profile configuration is in error. This is called Interface Quarantine.

When an interface is quarantined, it maintains its mapping to the port profile, and the port goes to the down status. The port goes to **NoPortProfile** state. If the port profile configuration is still in error, then the interface is again shut.

If you create a port profile with a command error, for example a private VLAN mapping error or service policy map error, then an attempt to apply this port profile to an interface shuts down the interface. The error is not copied to the interface and a system message is generated with details of the error. In this case, you must correct the error in the port profile, return the interface to service, and apply the corrected port profile to the interface.



## Creating Port Profiles

---

This chapter contains the following sections:

- [Information About Port Profiles, page 4](#)
- [Information About Port Profile States, page 4](#)
- [Information About vEthernet Port Binding, page 4](#)
- [Guidelines and Limitations for Creating Port Profiles, page 5](#)
- [Default Settings, page 5](#)
- [Configuring Port Profiles, page 6](#)
- [Creating a Port Profile, page 6](#)
- [Configuring VMware Attributes, page 7](#)
- [Port Mode Configuration, page 8](#)
- [VLAN Ranges, page 8](#)
- [Configuring a Trunk Port Profile, page 9](#)
- [Configuring an Access Port Profile, page 10](#)
- [Clearing a Port Management Policy, page 11](#)
- [Port Binding for vEthernet Port Profiles Configuration, page 12](#)
- [Configuring a Default Port Binding Type, page 12](#)
- [Configuring Port Binding for a vEthernet Port Profile, page 14](#)
- [Enabling a Port Profile, page 15](#)
- [Removing a Port Profile, page 16](#)
- [Feature History for Port Profiles, page 17](#)

## Information About Port Profiles

### Information About Port Profile States

The following table describes port profile behavior.

State	Behavior
Disabled (the default)	When disabled, a port profile behaves as follows: <ul style="list-style-type: none"> <li>• Its configuration is not applied to assigned ports.</li> </ul>
Enabled	When enabled, a port profile behaves as follows: <ul style="list-style-type: none"> <li>• Its configuration is applied to assigned ports.</li> </ul>

### Information About vEthernet Port Binding

You can configure either static, dynamic, or ephemeral port binding for vEthernet port profiles. The following table shows how this setting controls how ports are assigned in the VMware port group.

Type	Behavior
Static (the default)	A DVPortID is assigned from the port group pool when you first assign the port group to the port. The DVPortID persists for the life of the network adapter. The port group has a fixed number of ports.
Dynamic	<p><b>Please verify if the dynamic port profile is related to the vcenter server in the enterprise.</b></p> <p>A DVPortID is assigned to a virtual machine only when the virtual machine is powered on and its NIC is in a connected state. The DVPortID is freed when the virtual machine is powered off or the virtual machine's NIC is disconnected. Virtual machines connected to a port group configured with dynamic binding must be powered on and off through the VMware vCenter Server.</p> <p>Dynamic binding can be used in environments where you have more virtual machines than available ports, but do not plan to have a greater number of virtual machines active than you have available ports. For example, if you have 300 virtual machines and 100 ports, but will never have more than 90 virtual machines active at one time, then dynamic binding would be appropriate for your port group.</p>

Type	Behavior
Ephemeral	<p>A new DVPortID is assigned to the port every time the VM is powered on. The port keeps this same DVPortID while the VM is up. All available DVS ports are shared. Ports are not allocated from the port group pool.</p> <p><b>Note</b> If a system administrator changes the port profile assignment for an interface, any manual configuration on the interface is purged if either port profile is configured with ephemeral port binding. This purging of manual configurations occurs regardless of your auto purge setting.</p>

## Guidelines and Limitations for Creating Port Profiles

- Once a port profile is created, you cannot change the type.
- In an installation where multiple port profiles are active on the same VEM, it is recommended that they do not carry the same VLAN(s). The allowed VLAN list should be mutually exclusive. Overlapping VLANs can be configured but may cause duplicate packets to be received by virtual machines in the network.
- To maintain consistency between the port profile definition and what is applied to an interface, if a port profile modification is rejected by any port, the modification is rejected by the port profile too.
- If you create a port profile with a command error, for example a private VLAN mapping error or service policy map error, then an attempt to apply this port profile to an interface shuts down the interface. The error is not copied to the interface and a system message is generated with details of the error. In this case, you must correct the error in the port profile. Then return the interface to service and apply the corrected port profile using the following command sequence:

1 no shutdown

2 default shutdown

- Before configuring a port profile, the Cisco Nexus 1000V software must be initially configured.

## Default Settings

The following table lists the default settings in the port profile configuration.

Parameter	Default
capability l3control	No
description	-
administrative state	all ports disabled
switchport mode (access or trunk)	access

Parameter	Default
system vlan <i>vlan_list</i>	-
type	vethernet
access port vlan	VLAN 1
max-ports	32
min-ports	32
vEthernet port-bindings	Static

## Configuring Port Profiles

### Creating a Port Profile

#### Before You Begin

- You are logged in to the CLI in EXEC mode.
- You know whether the ports need to be initialized with system settings.
- You have identified the characteristics needed for this port profile.

#### Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile</b> [type <b>vethernet</b> ] <i>name</i>	Enters port profile configuration mode for the named port profile. If the port profile does not already exist, it is created using the following characteristics: <ul style="list-style-type: none"> <li>• <i>name</i>—The port profile name can be up to 80 characters and must be unique for each port profile on the Cisco Nexus 1000V.</li> <li>• <b>type</b>—(Optional) The port profile type is vEthernet.</li> </ul>
<b>Step 3</b>	switch(config-port-prof)# <b>description</b> <i>profile_description</i>	(Optional) Adds a description of up to 80 ASCII characters in length to the port profile.

	Command or Action	Purpose
<b>Step 4</b>	switch(config-port-prof)# <b>show port-profile</b> [brief   expand-interface   usage] [name profile-name]	(Optional) Displays the configuration for verification.
<b>Step 5</b>	switch(config-port-prof)# <b>copy running-config startup-config</b>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

## Configuring VMware Attributes

### Before You Begin

- You are logged in to the CLI in EXEC mode.
- You know if you will configure the VMware port group with the same name as the port profile or if you will specify an alternate name for the VMware port group.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile</b> [type vethernet] name	Enters port profile configuration mode for the named port profile. If the port profile does not already exist, it is created using the following characteristics: <ul style="list-style-type: none"> <li>• <b>name</b>—The port profile name can be up to 80 characters and must be unique for each port profile on the Cisco Nexus 1000V.</li> <li>• <b>type</b>—(Optional) The port profile type is vEthernet.</li> </ul>
<b>Step 3</b>	switch(config-port-prof)# <b>max-ports num</b>	Designates the maximum number of ports that can be assigned to this non-uplink port profile. The default is 32 ports.  When the specified maximum number of ports is reached, no more ports can be assigned.
<b>Step 4</b>	switch(config-port-prof)# <b>show port-profile</b> [brief   expand-interface   usage] [name profile-name]	(Optional) Displays the configuration for verification.

	Command or Action	Purpose
<b>Step 5</b>	<code>switch(config-port-prof)# copy running-config startup-config</code>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

## Port Mode Configuration

### VLAN Ranges

In accordance with the IEEE 802.1Q standard, up to 128 active VLANs are supported and the valid range for VLANs is 1-4094. The following table describes the available VLAN ranges and their use.

**Table 1: VLAN Ranges**

VLAN Numbers	Range	Usage
1	Normal	Cisco default. You can use this VLAN, but you cannot modify or delete it.
2-1005	Normal	You can create, use, modify, and delete these VLANs.
1006-4094	Extended	You can create, name, and use these VLANs. You cannot change the following parameters: <ul style="list-style-type: none"> <li>• State is always active.</li> <li>• VLAN is always enabled.</li> </ul> You cannot shut down these VLANs.
3968-4047 and 4094	Internally allocated	These 80 VLANs, plus VLAN 4094, are allocated for internal device use. You cannot create, delete, or modify any VLANs within the block reserved for internal use.



# Configuring a Trunk Port Profile

Use this procedure to configure a trunk port profile.

## Before You Begin

- You are logged in to the CLI in EXEC mode.
- You have already created the port profile.
- You know the needed VLAN configuration for this port profile and that it is to be used in trunk mode.
- A VLAN must already be created on the switch before you can assign it to a port profile.
- You know the supported VLAN ranges.

## Procedure

---

- Step 1** `switch# configure terminal`  
Enters global configuration mode.
- Step 2** `switch(config)# [no] vlan vlan-id`  
Creates or deletes, and saves in the running configuration, a VLAN or a range of VLANs.
- Step 3** `switch(config)# port-profile [type vethernet] name`  
Enters port profile configuration mode for the named port profile. If the port profile does not already exist, it is created using the following characteristics:
- *name*—The port profile name can be up to 80 characters and must be unique for each port profile on the Cisco Nexus 1000V.
  - *type*—(Optional) The port profile type is vEthernet.
- Step 4** `switch(config-port-prof)# switchport mode trunk`  
Designates that the interfaces are to be used as a trunking ports.
- A trunk port transmits untagged packets for the native VLAN and transmits encapsulated, tagged packets for all other VLANs.
- Step 5** `switch(config-port-prof)# switchport trunk allowed vlan {allowed-vlans | add add-vlans | except except-vlans | remove remove-vlans | all | none}`  
Designates the port profile as trunking and defines VLAN access to it as follows:
- *allowed-vlans*—Defines VLAN IDs that are allowed on the port.
  - **add**—Lists VLAN IDs to add to the list of those allowed on the port.
  - **except**—Lists VLAN IDs that are not allowed on the port.
  - **remove**—Lists VLAN IDs whose access is to be removed from the port.
  - **all**—Indicates that all VLAN IDs are allowed on the port, unless exceptions are also specified.
  - **none**—Indicates that no VLAN IDs are allowed on the port.

**Note** If you do not configure allowed VLANs, then the default VLAN 1 is used as the allowed VLAN.

- Step 6** `switch(config-port-prof)# no shutdown`  
Administratively enables all ports in the profile.
- Step 7** `switch(config-port-prof)# state enabled`  
Enables the port profile and applies its configuration to the assigned ports.
- Step 8** `switch(config-port-prof)# system vlan vlan-id`  
Adds system VLAN to this port profile.
- Step 9** `switch(config-port-prof)# publish port-profile <name>`  
Publishes port profile to Cisco Prime Network Services Controller.
- Step 10** (Optional) `switch(config-port-prof)# copy running-config startup-config`  
Saves the running configuration persistently through reboots and restarts by copying it to the startup configuration.

This example shows how to configure a trunk port profile.

```
switch# configure terminal
switch(config)# port-profile port-profile type vethernet Trunk_To_Cloud
switch(config-port-prof)# switchport mode trunk
switch(config-port-prof)# switchport trunk allowed vlan 72,2315-2350
switch(config-port-prof)# no shutdown
switch(config-port-prof)# state enabled
switch(config-port-prof)# max ports 64
switch(config-port-prof)# system vlan 72
switch(config-port-prof)# publish port-profile
switch(config-port-prof)#
```

## Configuring an Access Port Profile

An access port transmits packets on only one untagged VLAN. You can specify the VLAN, and it becomes the access VLAN. If you do not specify a VLAN for an access port, that interface carries traffic only on the default VLAN 1.

### Procedure

- Step 1** `switch# configure terminal`  
Enters global configuration mode.
- Step 2** `switch(config)# [no] vlan vlan-id`  
Creates or deletes, and saves in the running configuration, a VLAN or a range of VLANs.
- Step 3** `switch(config)# port-profile type vethernet name`  
Enters port profile configuration mode for the named port profile. If the port profile does not already exist, it is created using the following characteristics:
- *name*—The port profile name can be up to 80 characters and must be unique for each port profile on the Cisco Nexus 1000V.
  - *type*—(Optional) The port profile type is vEthernet.

- Step 4** switch(config-port-prof)# **switchport mode access**  
Sets port mode access.
- Step 5** switch(config-port-prof)# **switchport access vlan** [vlan-id-access]  
Assigns an access VLAN ID to this port profile.
- Note** An access port transmits packets on only one untagged VLAN. You can specify the VLAN, and it becomes the access VLAN. If you do not specify a VLAN for an access port, that interface carries traffic only on the default VLAN 1. If you do not specify a VLAN ID, then VLAN 1 is used automatically.
- Step 6** switch(config-port-prof)# **no shutdown**  
Administratively enables all ports in the profile.
- Step 7** switch(config-port-prof)# **state enabled**  
Enables the port profile and applies its configuration to the assigned ports.
- Step 8** switch(config-port-prof)# **system vlan** vlan-id  
Adds system VLAN to this port profile. Specify the VLAN as configured in step 5.
- Step 9** switch(config-port-prof)# **publish port-profile** <name>  
Publishes port profile to Cisco Prime Network Services Controller.
- Step 10** (Optional) switch(config-port-prof)# **copy running-config startup-config**  
Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

---

This example shows how to configure a port profile for InterCloud Switch management interface:

```
switch# configure terminal
switch(config)# port-profile type vethernet mgmt-access
switch(config-port-prof)# switchport mode access
switch(config-port-prof)# switchport access vlan 72
switch(config-port-prof)# no shutdown
switch(config-port-prof)# state enabled
switch(config-port-prof)# system vlan 72
switch(config-port-prof)# publish port-profile mgmt-access
switch(config-port-prof)#
```

## Clearing a Port Management Policy

You can use this procedure to remove either of the following port management policies from an existing port profile configuration:

- **shutdown**
- **switchport mode**




---

**Note** After removing the configuration for an attribute, the attribute does not appear in **show** command output.

---

### Before You Begin

- You are logged in to the CLI in EXEC mode.

**Procedure**

	<b>Command or Action</b>	<b>Purpose</b>
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile name</b>	Enters port profile configuration mode for the named port profile.
<b>Step 3</b>	<b>default {shutdown   switchport mode}</b>	Removes either the shutdown or the switchport mode configuration from the port profile. <ul style="list-style-type: none"> <li>• <b>shutdown</b>—Reverts port profile ports to the shutdown state.</li> <li>• <b>switchport mode</b>—Reverts port profile ports to switch access ports.</li> </ul>
<b>Step 4</b>	switch(config-port-prof)# <b>show port-profile [brief   expand-interface   usage] [name profile-name]</b>	(Optional) Displays the configuration for verification.
<b>Step 5</b>	switch(config-port-prof)# <b>copy running-config startup-config</b>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to change the administrative state of a port profile back to its default setting (all ports disabled):

```
switch# configure terminal
switch(config)# port-profile AccessProf
switch(config-port-prof)# default shutdown
switch(config-port-prof)# show port-profile name AccessProf
switch(config-port-prof)#
```

## Port Binding for vEthernet Port Profiles Configuration

### Configuring a Default Port Binding Type

You can use this procedure to configure the type of port binding (static, dynamic, or ephemeral) to apply by default to all new vEthernet port profiles.

#### Before You Begin

Before beginning this procedure, you must know or do the following:

- You are logged in to the CLI in EXEC mode.
- You know the type of port binding (static, dynamic, or ephemeral) you want to use as a default for all new vEthernet port profiles.

## Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile default</b> <b>port-binding {static [auto]</b> <b>dynamic [auto]  </b> <b>ephemeral}</b>	Configures a default port binding type to be applied automatically to all new vEthernet port profiles unless explicitly configured otherwise: <ul style="list-style-type: none"> <li>• <b>Static:</b> A DVPortID is assigned from the port group pool when you first assign the port group to the port. The DVPortID persists for the life of the network adapter. The port group has a fixed number of ports. If you include the <b>auto</b> option, Cisco Nexus 1000V creates port profiles with both min-ports and max-ports, which are initially inherited from the global defaults and can be redefined by the user at a later time. By configuring the binding type with the <b>auto</b> option, Cisco Nexus 1000V adjusts the number of ports per profile created at the vCenter server based on the usage of the port groups.</li> <li>• <b>Dynamic:</b> A DVPortID is assigned to a virtual machine only when the virtual machine is powered on and its NIC is in a connected state. The DVPortID is freed when the virtual machine is powered off or the virtual machine's NIC is disconnected. The <b>auto</b> option for dynamic binding works as described for static binding.</li> <li>• <b>Ephemeral:</b> A new DVPortID is assigned to the port every time the VM is powered on. The port keeps this same DVPortID while the VM is up. All available DVS ports are shared. Ports are not allocated from the port group pool.</li> </ul>
<b>Step 3</b>	switch(config-port-prof)# <b>show running-config</b>	(Optional) Displays the configuration for verification.
<b>Step 4</b>	switch(config-port-prof)# <b>copy running-config</b> <b>startup-config</b>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to configure the dynamic port binding type as the default for all new vEthernet port profiles created:

```
switch# configure terminal
switch(config)# port-profile default port-binding dynamic
switch(config-port-prof)#
```

# Configuring Port Binding for a vEthernet Port Profile

You can use this procedure to configure the type of port binding (static, dynamic, or ephemeral) for an existing vEthernet port profile.

## Before You Begin

- You are logged in to the CLI in EXEC mode.
- You have already created the vEthernet port profile.
- You know the type of port binding (static, dynamic, or ephemeral) you want to apply to this vEthernet port profile.

## Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile</b> [type { <b>vethernet</b> }] <i>profile-name</i>	Enters port profile configuration mode for the named vEthernet port profile.
<b>Step 3</b>	switch(config-port-prof)# <b>port-binding</b> { <b>static</b> [ <b>auto</b> ] <b>dynamic</b> [ <b>auto</b> ]   <b>ephemeral</b> }	<p>Configures a default port binding type to be applied automatically to all new vEthernet port profiles unless explicitly configured otherwise:</p> <ul style="list-style-type: none"> <li>• <b>Static:</b> <p>A DVPortID is assigned from the port group pool when you first assign the port group to the port. The DVPortID persists for the life of the network adapter. The port group has a fixed number of ports.</p> <ul style="list-style-type: none"> <li>◦ <b>auto:</b> Port profiles are created with both min-ports and max-ports, which are initially inherited from the global defaults and can be redefined by the user at a later time. By configuring the binding type with the <b>auto</b> option, the Cisco Nexus 1000V will adjust the number of ports per profile created at the vCenter server based on the usage of the port groups.</li> </ul> </li> <li>• <b>Dynamic:</b> <p>A DVPortID is assigned to a virtual machine only when the virtual machine is powered on and its NIC is in a connected state. The DVPortID is freed when the virtual machine is powered off or the virtual machine's NIC is disconnected.</p> <ul style="list-style-type: none"> <li>◦ See <b>auto</b> option above.</li> </ul> </li> <li>• <b>Ephemeral:</b></li> </ul>

	Command or Action	Purpose
		A new DVPortID is assigned to the port every time the VM is powered on. The port keeps this same DVPortID while the VM is up. All available DVS ports are shared. Ports are not allocated from the port group pool.
<b>Step 4</b>	switch(config-port-prof)# <b>show port-profile</b> [name <i>profile-name</i> ]	(Optional) Displays the configuration for verification.
<b>Step 5</b>	switch(config-port-prof)# <b>copy running-config</b> <b>startup-config</b>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to configure the dynamic port binding type for the existing port profile named target-pp.

```
switch# configure terminal
switch(config)# port-profile target-pp
switch(config-port-prof)# port-binding dynamic
switch(config-port-prof)#
```

## Enabling a Port Profile

### Before You Begin

- You are logged in to the CLI in EXEC mode.
- You have already created the port profile.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile</b> [type {vethernet}] <i>profile-name</i>	Enters port profile configuration mode for the named vEthernet port profile.
<b>Step 3</b>	switch(config-port-prof)# <b>state enabled</b>	Enables the port profile and applies its configuration to the assigned ports.
<b>Step 4</b>	switch(config-port-prof)# <b>publish</b> <b>port-profile</b> <name>	Publishes port profile to Cisco Prime Network Services Controller.
<b>Step 5</b>	switch(config-port-prof)# <b>show port-profile</b> [ <b>brief</b>   <b>expand-interface</b>   <b>usage</b> ] [name <i>profile-name</i> ]	Displays the configuration for verification.

	Command or Action	Purpose
<b>Step 6</b>	switch(config-port-prof)# <b>copy running-config startup-config</b>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to enable a port profile.

```
switch# configure terminal
switch(config)# port-profile AccessProf
switch(config-port-prof)# state enabled
switch(config-port-prof)# publish port-profile AccessProf
switch(config-port-prof)# show port-profile name AccessProf
switch(config-port-prof)#
```

## Removing a Port Profile

### Before You Begin

- You are logged in to the CLI in EXEC mode.
- If the port profile is inherited by another port profile, you need to remove the inheritance from the other port profile before removing this port profile. If you do not remove the inheritance first, the procedure fails.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>show port-profile virtual usage name</b> <i>profile_name</i>	(Optional) Verifies if active interfaces use this port profile. <b>Note</b> You cannot remove a port profile if there are active interfaces associated with it.
<b>Step 3</b>	switch(config)# <b>no port-profile</b> <i>profile_name</i>	Removes the port profile configuration and operational settings.
<b>Step 4</b>	switch(config)# <b>show port-profile</b> [ <b>name</b> <i>profile-name</i> ]	(Optional) Displays the configuration for verification.
<b>Step 5</b>	switch(config)# <b>copy running-config startup-config</b>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.



This example shows how to remove a port profile:

```
switch# configure terminal
switch(config)# no port-profile AccessProf
switch(config)# show port-profile name AccessProf
ERROR: port-profile AccessProf does not exist
switch(config)# copy running-config startup-config
switch(config)#
```

## Feature History for Port Profiles

Feature Name	Releases	Feature Information
Port Profiles	Release 5.2(1)IC1(1.1)	This feature was introduced.





# CHAPTER 3

## Configuring System Port Profiles

---

This chapter contains the following sections:

- [Information About System Port Profiles, page 19](#)
- [Guidelines and Limitations for System Port Profiles, page 19](#)
- [Creating a System Port Profile, page 20](#)
- [Modifying the System VLANs in a Trunk Mode Port Profile, page 22](#)
- [Modifying System VLANs in an Access Mode Port Profile, page 25](#)
- [Feature History for System Port Profiles, page 26](#)

### Information About System Port Profiles

System port profiles are designed to establish and protect those ports and VLANs which need to be configured before the VEM contacts the VSM.

For this reason, the following ports must use system VLANs:

- Management VLANs in the trunk port profile of the InterCloud Switch and InterCloud Extender
- Management VLAN in the access port profile of the InterCloud Switch's management interface.

### Guidelines and Limitations for System Port Profiles

- System VLANs must be used sparingly and only as described in the [Information About System Port Profiles, on page 19](#).
- You cannot delete a system VLAN when the port profile is in use.
- You can add or delete VLANs that are not system VLANs when the port profile is in use.
- System VLANs can be added to a port profile, even when the port profile is in use.

- You can only delete a system VLAN from a port profile after removing the port profile from service. This is to prevent accidentally deleting a critical VLAN, such as the management VLAN for a host, or the storage VLAN for the VSM.
- A system port profile cannot be converted to a port profile that is not a system port profile.
- The native VLAN on a system port profile can be a system VLAN but it does not have to be.
- When a system port profile is in use, you can change the native VLAN as follows:
  - From one VLAN that is not a system VLAN to another VLAN that is not a system VLAN.
  - From a VLAN that is not a system VLAN to a system VLAN
  - From one system VLAN to another system VLAN
- When a system port profile is in use, you cannot change the native VLAN from a system VLAN to a VLAN that is not a system VLAN.

## Creating a System Port Profile

Use this procedure to create a system port profile.

### Before You Begin

- You are logged in to the CLI in EXEC mode.
- You have configured the following:
  - Port admin status is active (no shutdown).
  - Port mode is access or trunk.
  - VLANs that are to be used as system VLANs already exist.
  - VLANs are configured as access VLANs or trunk-allowed VLANs.
- In an installation where multiple port profiles are active on the same VEM, it is recommended that they do not carry the same VLAN(s). The allowed VLAN list should be mutually exclusive. Overlapping VLANs can be configured but may cause duplicate packets to be received by virtual machines in the network.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile</b> [type { <b>vethernet</b> }] <i>name</i>	Enters port profile configuration mode for the named port profile. If the port profile does not already exist, it is created using the following characteristics: <ul style="list-style-type: none"> <li>• <i>name</i>—The port profile name can be up to 80 characters and must be unique for each port profile on the Cisco Nexus 1000V.</li> </ul>

	Command or Action	Purpose
		<ul style="list-style-type: none"> <li>• <b>type</b>—(Optional) The port profile type is vEthernet.</li> </ul>
<b>Step 3</b>	switch(config-port-prof)# <b>description</b> <i>profile-description</i>	(Optional) Adds a description of up to 80 ASCII characters in length to the port profile. This description is automatically pushed to vCenter Server.
<b>Step 4</b>	switch(config-port-prof)# <b>switchport mode trunk</b>	Designates that the interfaces are to be used as a trunking ports.  A trunk port transmits untagged packets for the native VLAN and transmits encapsulated, tagged packets for all other VLANs.
<b>Step 5</b>	switch(config-port-prof)# <b>switchport trunk allowed vlan</b> { <i>vlan-id-list</i>   <b>all</b>   <b>none</b>   [ <b>add</b>   <b>except</b>   <b>remove</b> { <i>vlan-list</i> }]}	Designates the port profile as trunking and defines VLAN access to it as follows: <ul style="list-style-type: none"> <li>• <b>allowed vlan</b>—Defines VLAN IDs that are allowed on the port.</li> <li>• <b>add</b>—Lists VLAN IDs to add to the list of those allowed on the port.</li> <li>• <b>except</b>—Lists VLAN IDs that are not allowed on the port.</li> <li>• <b>remove</b>—Lists VLAN IDs whose access is to be removed from the port.</li> <li>• <b>all</b>—Indicates that all VLAN IDs are allowed on the port, unless exceptions are also specified.</li> <li>• <b>none</b>—Indicates that no VLAN IDs are allowed on the port.</li> </ul> <p>If you do not configure allowed VLANs, then the default VLAN 1 is used as the allowed VLAN.</p>
<b>Step 6</b>	switch(config-port-prof)# <b>no shutdown</b>	Changes the port to administrative status so that system VLAN can be configured.  <b>Note</b> If you do not change the port state, then you will see the following error when you try to configure system VLAN: ERROR: Cannot set system vlans. Change port admin status to 'no shutdown' and retry.
<b>Step 7</b>	switch(config-port-prof)# <b>state enabled</b>	Enables the port profile and applies its configuration to the assigned ports.
<b>Step 8</b>	switch(config-port-prof)# <b>system vlan</b> <i>vlan-id-list</i>	Adds system VLANs to this port profile.

	Command or Action	Purpose
<b>Step 9</b>	switch(config-port-prof)# <b>publish port-profile</b> <name>	Publishes port profile to Cisco Prime Network Services Controller.
<b>Step 10</b>	switch(config-port-prof)# <b>show port-profile</b> [brief   <b>expand-interface</b>   usage] [name profile-name]	(Optional) Displays the configuration for verification.
<b>Step 11</b>	switch(config-port-prof)# <b>copy running-config startup-config</b>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to create a system port profile:

```
switch# configure terminal
switch(config)# port-profile port-profile type vethernet Trunk_To_Cloud
switch(config-port-prof)# switchport mode trunk
switch(config-port-prof)# switchport trunk allowed vlan 72,2315-2350
switch(config-port-prof)# no shutdown
switch(config-port-prof)# state enabled
switch(config-port-prof)# max ports 64
switch(config-port-prof)# system vlan 72
switch(config-port-prof)# publish port-profile
switch(config-port-prof)#
```

## Modifying the System VLANs in a Trunk Mode Port Profile

You can use the following procedures to change the set of system VLANs in a trunk mode port profile without removing all system VLANs.

### Before You Begin

- You are logged in to the Cisco Nexus 1000V InterCloud VSM CLI in EXEC mode.
- You know the VLAN ID of a system VLAN in your network. It does not matter which system VLAN it is.
- You know the VLAN IDs of the system VLANs required for the port profile you are modifying.

### Procedure

- 
- Step 1** In the Cisco Nexus 1000V VSM in the enterprise, shut off the switch port used by the InterCloud VSM's management port.
  - Step 2** Log in to the console of Cisco Nexus 1000V InterCloud VSM and convert the port profile to an access profile with a system VLAN.
  - Step 3** Convert the access port profile back to a trunk profile.
  - Step 4** In the Cisco Nexus 1000V VSM in the enterprise unshut the switch port used by the Cisco Nexus 1000V InterCloud VSM's management port.

The VEMS are reconnected to the VSM.

## Converting a Port Profile to an Access Profile with a System VLAN

You can use this procedure to change the set of system VLANs in a trunk mode port profile without removing all system VLANs.

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile</b> [ <b>type vethernet</b> ] <i>name</i>	Enters port profile configuration mode for the named port profile. If the port profile does not already exist, it is created using the following characteristics: <ul style="list-style-type: none"> <li>• <i>name</i>—The port profile name can be up to 80 characters and must be unique for each port profile on the Cisco Nexus 1000V.</li> <li>• <b>type</b>—(Optional) The port profile type is vEthernet.</li> </ul>
<b>Step 3</b>	switch(config-port-prof)# <b>no system vlan</b>	Remove the system VLAN from a port profile.
<b>Step 4</b>	switch(config-port-prof)# <b>switchport mode access</b>	Sets port mode access.
<b>Step 5</b>	switch(config-port-prof)# <b>switchport access vlan</b> <i>vlan-id</i>	Set the access mode of an interface.
<b>Step 6</b>	switch(config-port-prof)# <b>no shutdown</b>	Changes the port to administrative status so that system VLAN can be configured. <p><b>Note</b> If you do not change the port state, then you will see the following error when you try to configure system VLAN:ERROR: Cannot set system vlans. Change port admin status to 'no shutdown' and retry.</p>
<b>Step 7</b>	switch(config-port-prof)# <b>system vlan</b> <i>vlan-id-list</i>	Adds system VLANs to this port profile.

The trunk port profile is converted to an access port profile with a system VLAN.

This example shows how to convert a trunk port profile to an access port profile.

```
switch# configure terminal
switch(config)# port-profile Trunk_System_Prof
switch(config-port-prof)# no system vlan
switch(config-port-prof)# switchport mode access
```

```
switch(config-port-prof) # switchport access vlan 300
switch(config-port-prof) # system vlan 300
switch(config-port-prof) #
```

## Converting an Access Port Profile to a Trunk Port Profile

### Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile</b> [ <b>type vethernet</b> }] <i>name</i>	Enters port profile configuration mode for the named port profile. If the port profile does not already exist, it is created using the following characteristics: <ul style="list-style-type: none"> <li>• <i>name</i>—The port profile name can be up to 80 characters and must be unique for each port profile on the Cisco Nexus 1000V.</li> <li>• <b>type</b>—(Optional) The port profile is vEthernet.</li> </ul>
<b>Step 3</b>	switch(config-port-prof)# <b>switchport mode trunk</b>	Designates that the interfaces are to be used as a trunking ports.  A trunk port transmits untagged packets for the native VLAN and transmits encapsulated, tagged packets for all other VLANs.
<b>Step 4</b>	<b>system vlan</b> <i>vlan-id-list</i>	Adds system VLANs to this port profile.
<b>Step 5</b>	switch(config-port-prof)# <b>show port-profile</b> [ <b>brief</b>   <b>expand-interface</b>   <b>usage</b> ] [ <i>name profile-name</i> ]	(Optional) Displays the configuration for verification.
<b>Step 6</b>	switch(config-port-prof)# <b>copy running-config startup-config</b>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to convert an access port profile to a trunk port profile.

```
switch# config terminal
switch(config)# port-profile Trunk_System_Prof
switch(config-port-prof) # switchport mode trunk
switch(config-port-prof) # system vlan 114,115
switch(config-port-prof) # show port-profile name Trunk_System_Prof
switch(config-port-prof) # copy running-config startup-config
```



# Modifying System VLANs in an Access Mode Port Profile

You can use this procedure to change the set of system VLANs in an access port profile without removing all system VLANs.

## Before You Begin

- You are logged in to the Cisco Nexus 1000V InterCloud VSM CLI in EXEC mode.
- You know the VLAN IDs of the system VLANs required for the port profile you are modifying.
- In the Cisco Nexus 1000V VSM in the enterprise, shut the switchport used by Cisco Nexus 1000V InterCloud VSM's management port.

## Procedure

	Command or Action	Purpose
<b>Step 1</b>	switch# <b>configure terminal</b>	Enters global configuration mode.
<b>Step 2</b>	switch(config)# <b>port-profile [type vethernet] name</b>	Enters port profile configuration mode for the named port profile. If the port profile does not already exist, it is created using the following characteristics: <ul style="list-style-type: none"> <li>• <b>name</b>—The port profile name can be up to 80 characters and must be unique for each port profile on the Cisco Nexus 1000V.</li> <li>• <b>type</b>—(Optional) The port profile type is vEthernet.</li> </ul>
<b>Step 3</b>	switch(config-port-prof)# <b>system vlan vlan-id-list</b>	Adds system VLANs to this port profile.
<b>Step 4</b>	switch(config-port-prof)# <b>show port-profile [brief   expand-interface   usage] [name profile-name]</b>	(Optional) Displays the configuration for verification.
<b>Step 5</b>	switch(config-port-prof)# <b>copy running-config startup-config</b>	(Optional) Saves the change persistently through reboots and restarts by copying the running configuration to the startup configuration.

This example shows how to change the set of system VLANs in an access port profile without removing all system VLANs.

```
switch# configure terminal
switch(config)# port-profile Access_System_Prof
switch(config-port-prof)# system vlan 114,115
switch(config-port-prof)# show port-profile name Access_System_prof
switch(config-port-prof)# copy running-config startup-config
```

**What to Do Next**

In the Cisco Nexus 1000V VSM in the enterprise unshut the switch port used by the Cisco Nexus 1000V InterCloud VSM's management port.

## Feature History for System Port Profiles

Feature Name	Release	Feature Information
System Port Profiles	Release 5.2(1)IC1(1.1)	This feature was introduced.



## Verifying the Port Profile Configuration

This chapter contains the following sections:

- [Verifying the Port Profile Configuration, page 27](#)
- [Feature History for Port Profile Verification, page 27](#)

### Verifying the Port Profile Configuration

Use one of the following commands to verify the configuration:

- `show port-profile [brief | expand-interface | usage] [name profile-name]`
- `show port-profile-role [name port-profile-role-name]`
- `show running-config port-profile [profile-name]`
- `show port-profile-role users`
- `show port-profile sync-status [interface if-name]`
- `show port-profile virtual usage [name profile-name]`
- `show running-config port-profile [prof-name]`

### Feature History for Port Profile Verification

Feature Name	Releases	Feature Information
Port Profile verification	Release 5.2(1)IC1(1.1)	This feature was introduced.





## Port Profile Configuration Limits

---

This chapter contains the following sections:

- [Port Profile Configuration Limits, page 29](#)

### Port Profile Configuration Limits

The configuration limits are documented in the *Cisco Nexus 1000V InterCloud Verified Scalability Reference*

