# Layer 3 Routing User's Manual

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www.moxa.com/product

# Layer 3 Routing User's Manual



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# 1

# Introduction to Layer 3 Switches

Moxa offers Layer-3 switches that perform data switching on the Network Layer (Layer 3) of the ISO's OSI layer model. Unlike Layer-2 switching, which uses the MAC address for exchanging data, a Layer-3 switch uses the IP address to represent the destination of a data packet.

## The Layer 3 Switching Concept

IP (Internet Protocol) is a protocol defined on layer 3 of the 7-layer OSI model. The IP address is used to address data packets on the Network Layer, and is not tied to the hardware of a device or PC. The IP address can be assigned by the system operator or network administrator.

Since Layer 2 switches use the MAC address to determine the destination of transmitted data packets, and Layer 3 switches use the IP address, some mechanism is needed to associate MAC addresses with IP addresses. This is done by ARP (Address Resolution Protocol), which creates a table that matches MAC addresses to IP addresses.

When a PC sends out an ARP request, which is just a broadcast packet requiring the IP address owner to send back his MAC address, two situations could occur:

- If your PC and the IP address owner are on the same subnet, the IP address owner will use a unicast packet, which contains his MAC address, to reply to your PC. Thereafter your PC will use this MAC address to transmit to the IP address owner directly.
- If your PC and the IP address owner are not on the same subnet, your PC will not receive a reply, so it will ask for the MAC address of the Layer-3 switch (gateway/ router). To transmit data packets to the IP address owner, your PC packs the data packet with the IP address, and sends the packet to the Layer-3 switch (gateway/router) using its MAC address. The Layer-3 switch (gateway/router) receives the data packet, re-packs it, and then forwards it to the next hop according to the routing rules.

## Static Routing and Dynamic Routing

The Moxa Layer 3 switch supports two routing methods: static routing and dynamic routing. Dynamic routing makes use of RIP V1/V1c/V2, and OSPF. You can either choose one routing method, or combine the two methods to establish your routing table.

A routing entry includes the following items: the destination address, the next hop address (which is the next router along the path to the destination address), and a metric that represents the cost we need to pay to access a different network.

### Static Routing

You can define the routes yourself by specifying what is the next hop (or router) that the Layer 3 switch forwards data for a specific subnet. The settings of the Static Route will be added to the routing table and stored in the Layer 3 switch.

# Dynamic Routing with RIP (Routing Information Protocol)

RIP is a distance vector-based routing protocol that can be used to automatically build up a routing table in the Moxa Layer 3 switch.

The Moxa Layer 3 switch can efficiently update and maintain the routing table, and optimize the routing by identifying the smallest metric and most matched mask prefix.

# Dynamic Routing with OSPF (Open Shortest Path First)

The Moxa Layer 3 switch also supports OSPF (open shortest path first), which uses "Link State" instead of "hop count" to determine the network route. OSPF is more complicated than RIP. However, compared to RIP, OSPF has faster network convergence and results in less network traffic. Both RIP and OSPF are usually referred to as Interior Gateway Protocols (IGP).

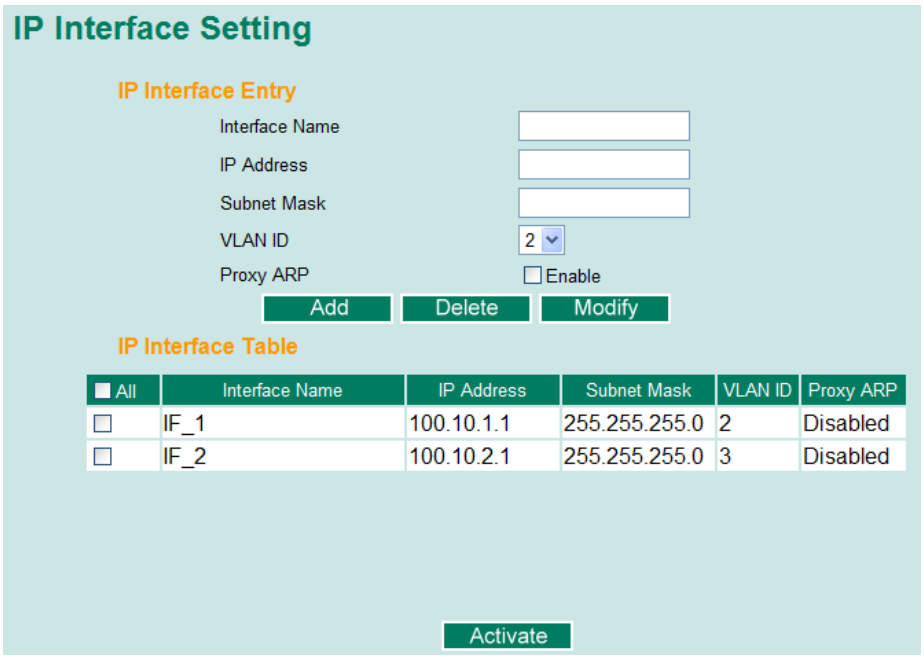
# 2

# IP Interface

Before configuring the routing protocols, we first need to set the correct IP interfaces for the network.

## IP Interface Setting

The IP Interface Setting page is used to assign the interface.




***Interface Name***

Used to describe this interface (max. of 30 characters.)

***IP Address***

This option is used to specify the IP address of this interface.

***Subnet Mask***

This option is used to specify the subnet mask for this IP address.

***VLAN ID***

| Setting | Description | Factory Default |
|---|---|---|
| ID numbers | Display all available VLAN IDs that you have set in the Virtual LAN. To establish an interface, you must first assign an available ID to this interface. If a VLAN ID is assigned twice, a warning message will appear. | None (if no VLAN ID is available) |

***Proxy ARP***

| Setting | Description | Factory Default |
|---|---|---|
| Enable/Disable | This option is used to enable or disable the Proxy ARP. | Disabled |

There are three action buttons for setting up the **IP Interface Table**:

***Add***

To add a entry into the IP Interface Table

***Delete***

To remove the selected entries from the IP Interface Table

***Modify***

To modify the content of a selected entry in the IP Interface Table

**NOTE** The entries in the IP Interface Table will not be added to the Moxa Layer 3 switch's interface table until you click the Activate button.

# 3

# Routing Protocols

Moxa Layer 3 switches support two routing methods: static routing and dynamic routing. Dynamic routing makes use of RIP V1/V1c/V2, or OSPF. You can either choose static routing only, or combine static routing and one of the dynamic routing methods to establish your routing table.

A routing entry includes the following items: the destination address, the next hop address (which is the next router along the path to the destination address), and a metric that represents the cost we need to pay to access a different network.

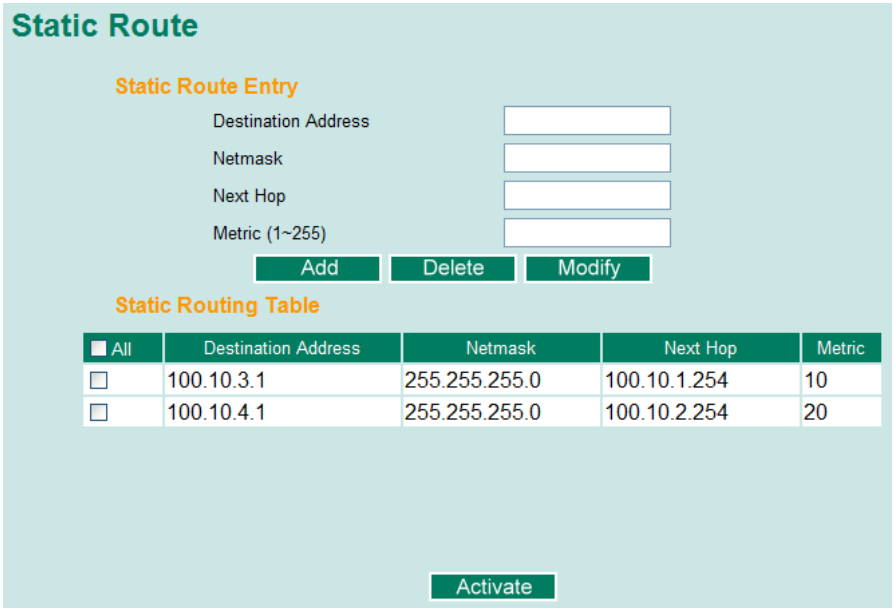
Moxa Layer 3 switches also support two multicast routing protocols: DVMRP and PIM-DM.

# Static Routing

You can define the routes yourself by specifying what is the next hop (or router) that the Layer 3 switch forwards data for a specific subnet. The settings of the Static Route will be added to the routing table and stored in the Layer 3 switch.

## Static Route Settings

The **Static Route** page is used to set up the static routing table for the Moxa Layer 3 switch.




### Static Route Entry

***Destination Address***

You can specify the destination's IP address.

***Netmask***

This option is used to specify the subnet mask for this IP address.

***Next Hop***

This option is used to specify the next router along the path to the destination.

***Metric***

This option is a value assigned to an IP route for a particular network interface. The value identifies the cost associated with using that route to access the neighboring network.

**NOTE** After inputting all of the information for a static routing configuration, click the **Add** button to add it to the static routing table.

### Static Routing Table

There are two action buttons for setting up the **Static Routing Table**:

***Delete***

To remove the selected entries from the Static Routing Table

***Modify***

To modify the contents of a selected entry in the Static Routing Table

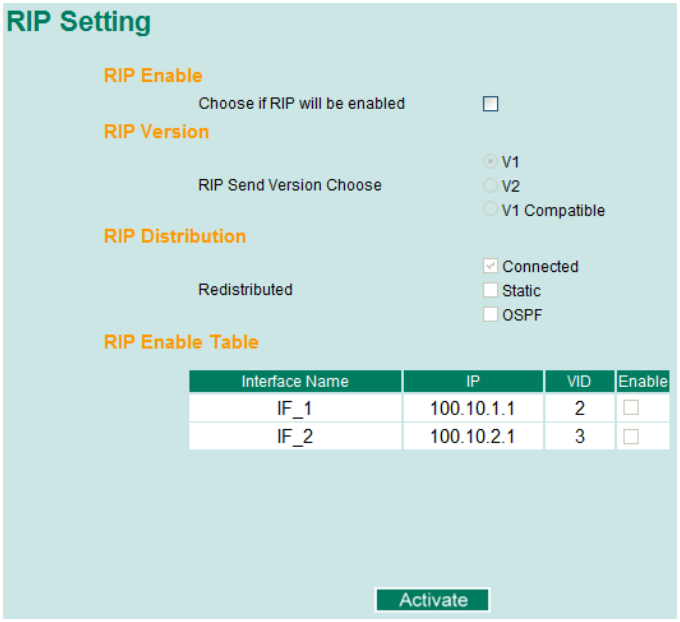
**NOTE** The entries in the Static Routing Table will not be added to the Moxa Layer 3 switch's routing table until you click the Activate button.

# Dynamic Routing with RIP (Routing Information Protocol)

RIP is a distance vector-based routing protocol that can be used to automatically build up a routing table in the Moxa Layer 3 switch. The Moxa Layer 3 switch can efficiently update and maintain the routing table, and optimize the routing by identifying the smallest metric and most matched mask prefix.

## RIP Settings

RIP is a distance-vector routing protocol that employs the hop count as a routing metric. RIP prevents routing loops by implementing a limit on the number of hops allowed in a path from the source to a destination. The RIP page is used to set up the RIP parameters.




***RIP Enable***

| Setting | Description | Factory Default |
|---|---|---|
| Enable/Disable | This option is used to enable or disable the RIP function globally. | Disabled |

***RIP Version***

You can specify which version the RIP should follow. You can also select V1 Compatibility to make sure the RIP packet of Version 1 can be received as well.

***RIP Distribution***

| Setting | Description | Factory Default |
|---|---|---|
| Connected | The entries that are learned from the directly connected interfaces will be re-distributed if this option is enabled. | Unchecked (disabled) |
| Static | The entries that are set in a static route will be re-distributed if this option is enabled. | Unchecked (disabled) |
| OSPF | The entries that are learned from the OSPF will be re-distributed if this option is enabled. | Unchecked (disabled) |

***RIP Enable Table***

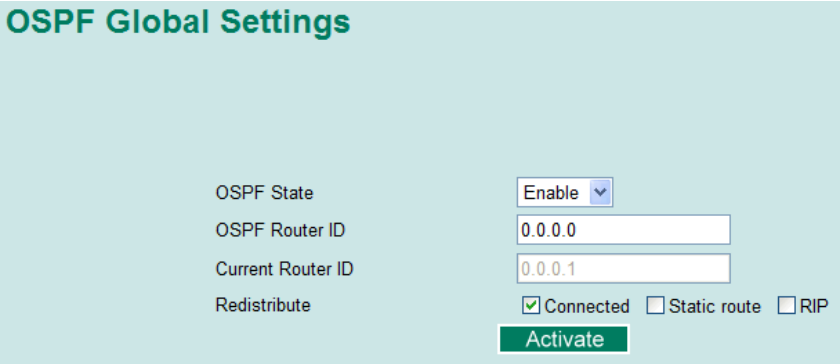
This is a table showing the entries learned from RIP.

**NOTE** The RIP settings will not function until you click the Activate button.

# Dynamic Routing with OSPF (Open Shortest Path First)

OSPF (Open Shortest Path First) is a dynamic routing protocol for use in Internet Protocol (IP) networks. Specifically, it is a link-state routing protocol and falls into the group of interior gateway protocols, operating within a single autonomous system. As a link-state routing protocol, OSPF establishes and maintains neighbor relationships in order to exchange routing updates with other routers. The neighbor relationship table is called an adjacency database in OSPF. OSPF forms neighbor relationships only with the routers directly connected to it. In order to form a neighbor relationship between two routers, the interfaces used to form the relationship must be in the same area. An interface can only belong to a single area. With OSPF enabled, the Moxa Layer 3 switch is able to exchange routing information with other L3 switches or routers more efficiently in a large system. The OSPF Settings page is used to set up OSPF configurations.

# OSPF Settings

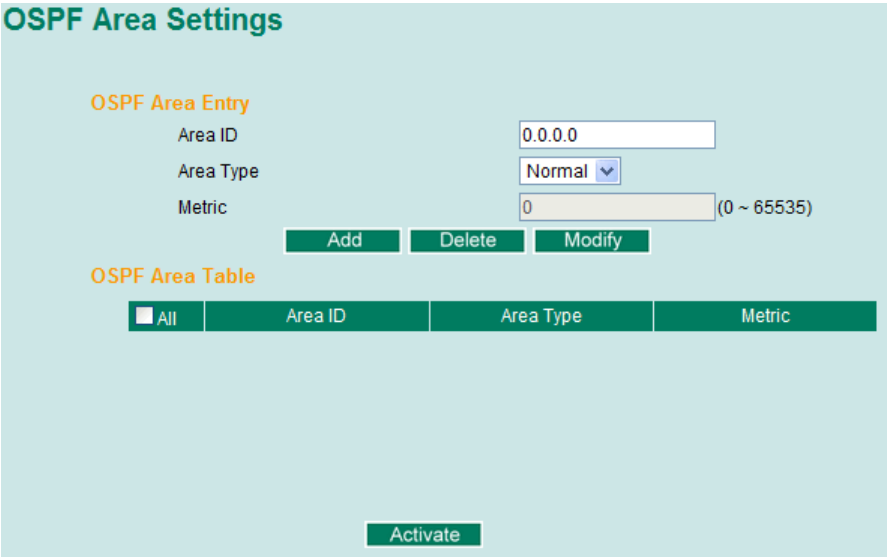



Each L3 switch/router has an OSPF router ID, customarily written in the dotted decimal format (e.g., 1.2.3.4) of an IP address. This ID must be established in every OSPF instance. If not explicitly configured, the default ID (0.0.0.0) will be regarded as the router ID. Since the router ID is an IP address, it does not have to be a part of any routable subnet in the network.

***OSPF State, OSPF Router ID, Current Router ID, Redistribute***

| Setting | Description | Factory Default |
|---|---|---|
| OSPF State | Select the option to enable/disable the OSPF Function. | Disable |
| OSPF Router ID | Set the L3 switch's Router ID. | 0.0.0.0 |
| Current Router ID | Show the current L3 switch's Router ID. | 0.0.0.0 |
| Redistribute | Redistribute routing information to other protocols | Connected |

## OSPF Area Settings




An OSPF domain is divided into areas that are labeled with 32-bit area identifiers which are commonly written in the dot-decimal notation of an IPv4 address. Areas are used to divide a large network into smaller network areas. They are logical groupings of hosts and networks, including their routers having interfaces connected to any of the included networks. Each area maintains a separate link state database whose information may be summarized towards the rest of the network by the connecting router. Thus, the topology of an area is unknown outside of the area. This reduces the amount of routing traffic between parts of an autonomous system.

### OSPF Area Entry

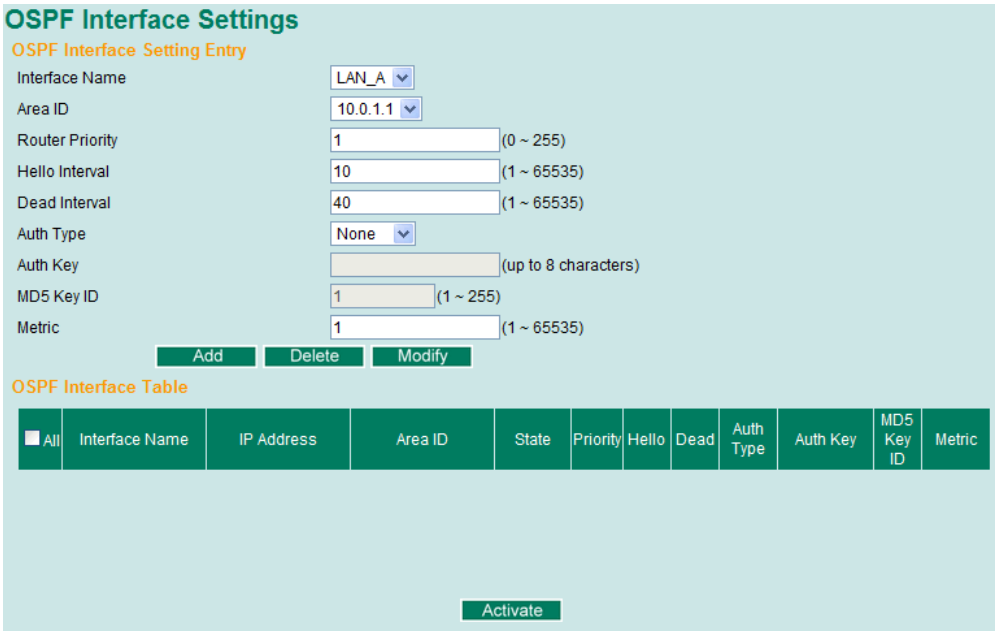
***Area ID, Area Type, Metric***

| Setting | Description | Factory Default |
|---|---|---|
| Area ID | Define the areas that this L3 switch/router connects to. | 0.0.0.0 |
| Area Type | Define the area type, Stub Area or NSSA. | Normal |
| Metric | Define the metric value. | 0 |

### OSPF Area Table

Shows the current OSPF area table in the L3 switch/router.

## OSPF Interface Settings




Before using OSPF, we have to assign an interface for each area. Also the detailed information of the interface can be defined in this section. See the details in the following descriptions:

### OSPF Interface Setting Entry

***Configuration details***

| Setting | Description | Factory Default |
|---|---|---|
| Interface Name | Define the interface name. | N/A |
| Area ID | Define the Area ID. | N/A |
| Router Priority | Define the L3 switch/router's priority. | 1 |
| Hello Interval | Hello packets are packets that an OSPF process sends to its OSPF neighbors to maintain connectivity with those neighbors. The hello packets are sent at a configurable interval (in seconds). The value of all hello intervals must be the same within a network. | 10 |
| Dead Interval | The dead interval is also a configurable interval (in seconds), and defaults to four times the value of the hello interval. | 40 |
| Auth Type | OSPF authentication allows the flexibility to authenticate OSPF neighbors. Users can enable authentication to exchange routing update information in a secure manner. OSPF authentication can either be none, simple, or MD5. However, authentication is not necessary to be set. If it is set, all L3 switches / routers on the same segment must have the same password and authentication method. | None |

| | | |
|---|---|---|
| Auth Key | Authentication key means the clear-text password when using "Simple" method of the authentication type or MD5 encrypted password when using MD5 of authentication type. | N/A |
| MD5 Key ID | MD5 authentication provides higher security than plain text authentication. This method uses the MD5 to calculate a hash value from the contents of the OSPF packet and the authentication key. This hash value is transmitted in the packet, along with a key ID. | 1 |
| Metric | Manually set Metric / Cost of OSPF. | 1 |

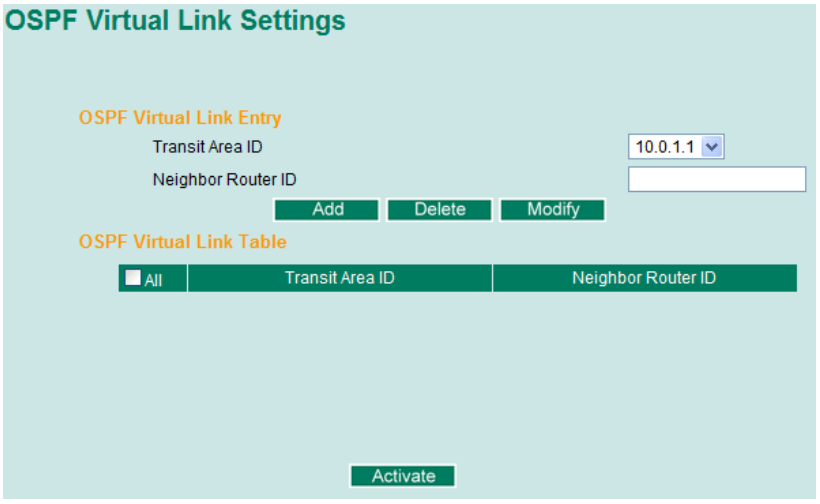
### OSPF Interface Table

Shows the current OSPF interface table in a list.

***Area ID, Area Type, Metric***

| Setting | Description | Factory Default |
|---|---|---|
| Area ID | Define the areas that this L3 switch/router connects to. | 0.0.0.0 |
| Area Type | Define the area type, Stub Area or NSSA. | Normal |
| Metric | Define the metric value. | 0 |

## OSPF Virtual Link Settings




All areas in an OSPF autonomous system must be physically connected to the backbone area (Area 0.0.0.0). However, this is impossible in some cases. For those cases, users can create a virtual link to connect to the backbone through a non-backbone area and also use virtual links to connect two parts of a partitioned backbone through a non-backbone area.

### OSPF Virtual Link Entry

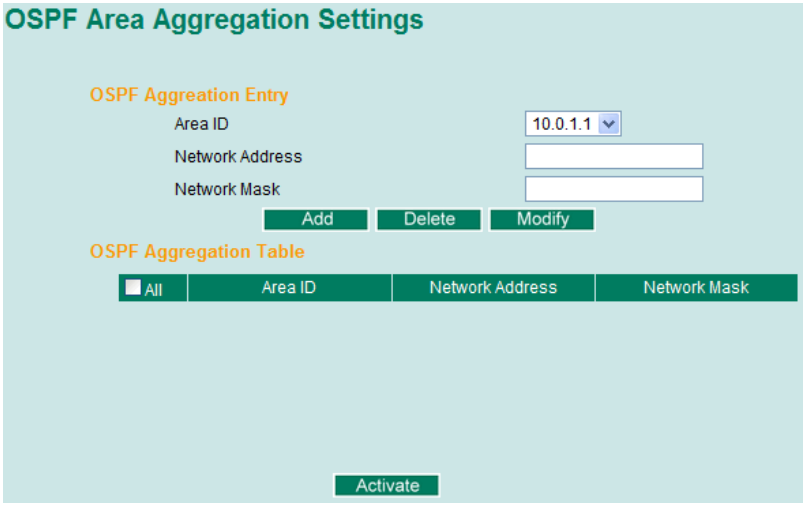
***Configuration details***

| Setting | Description | Factory Default |
|---|---|---|
| Transit Area ID | Define the areas that this L3 switch/router connects to. | N/A |
| Neighbor Router ID | Define the neighbor L3 switch/route's ID. | N/A |

### OSPF Virtual Link Table

Shows the current OSPF virtual link table.

# OSPF Area Aggregation Settings




Each of OSPF areas which consist of a set of interconnected subnets and traffic across areas is handled by routers attached to two or more areas, known as Area Border Routers (ABRs). With OSPF aggregation function, users can combine groups of routes with common addresses into a single routing table entry. The function is used to reduce the size of routing tables.

## OSPF Aggregation Entry

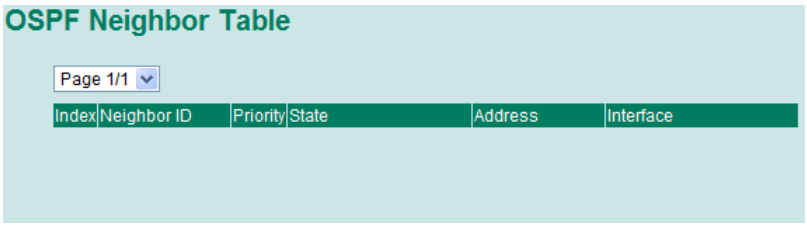
***Configuration details***

| Setting | Description | Factory Default |
|---|---|---|
| Area ID | Select the Area ID that you want to configure. | N/A |
| Network Address | Fill in the network address in the area. | N/A |
| Network Mask | Fill in the network mask. | N/A |

## OSPF Aggregation Table

Shows the current OSPF aggregation table.

# OSPF Neighbor Table



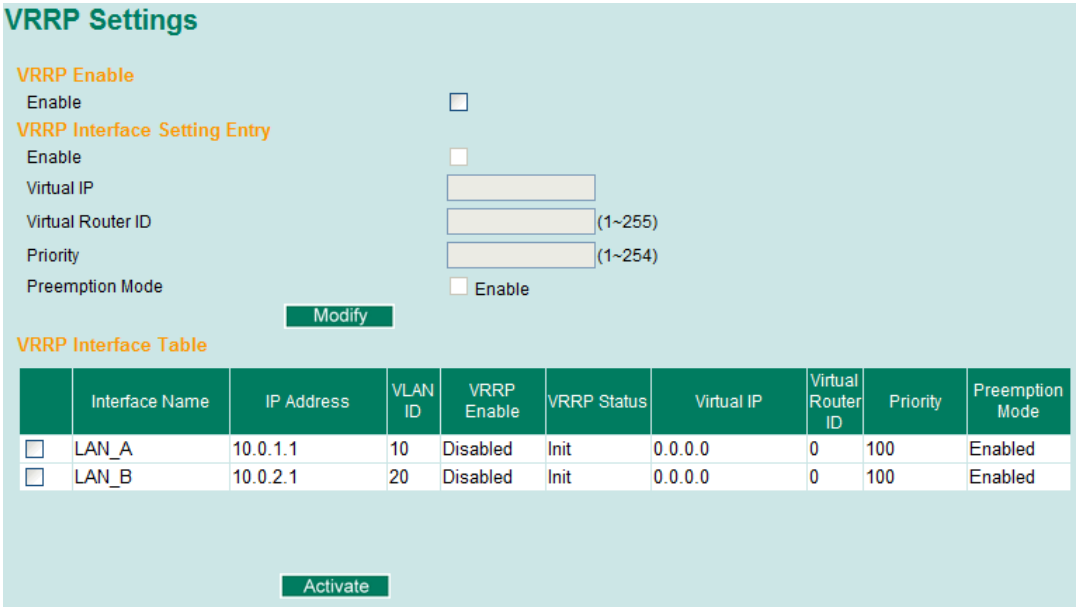

Shows the current OSPF neighbor table.

# OSPF Database Table


Shows the current OSPF database table.

# Gateway Redundancy

## VRRP Settings




The Virtual Router Redundancy Protocol (VRRP) feature can solve the static configuration problem. VRRP enables a group of routers to form a single virtual router with a virtual IP address. The LAN clients can then be configured with the virtual router's virtual IP address as their default gateway. The virtual router is the combination of a group of routers, and also known as a VRRP group.

***Enable***

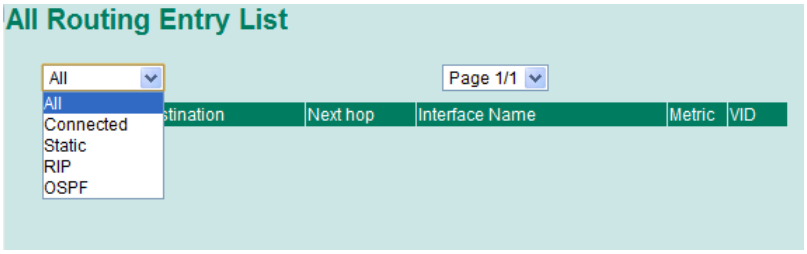
| Setting | Description | Factory Default |
|---|---|---|
| Enable | Checkmark the checkbox to enable the VRRP. | N/A |

***VRRP Interface Setting Entry***

| Setting | Description | Factory Default |
|---|---|---|
| Enable | Determines to enable the VRRP entry or not. | Disabled |
| Virtual IP | L3 switches / routers in the same VRRP group must have the identical virtual IP address like VRRP ID. This virtual IP address must belong to the same address range as the real IP address of the interface. | 0.0.0.0 |
| Virtual Router ID | Virtual Router ID is used to assign a VRRP group. The L3 switches / routers, which operate as master / backup, should have the same ID. Moxa L3 switches / routers support one virtual router ID for each interface. The usable range of ID is 1 to 255. | 0 |
| Priority | Determines priority in a VRRP group. The priority value range is 1 to 255 and the 255 is the highest priority. If several L3 switches / routers have the same priority, the router with higher IP address has the higher priority. The usable range is "1 to 255". | 100 |
| Preemption Mode | Determines whether a backup L3 switch / router will take the authority of master or not. | Enabled |

# Routing Table

The **Routing Table** page shows all routing entries used by the Moxa Layer 3 switch.




***All Routing Entry List***

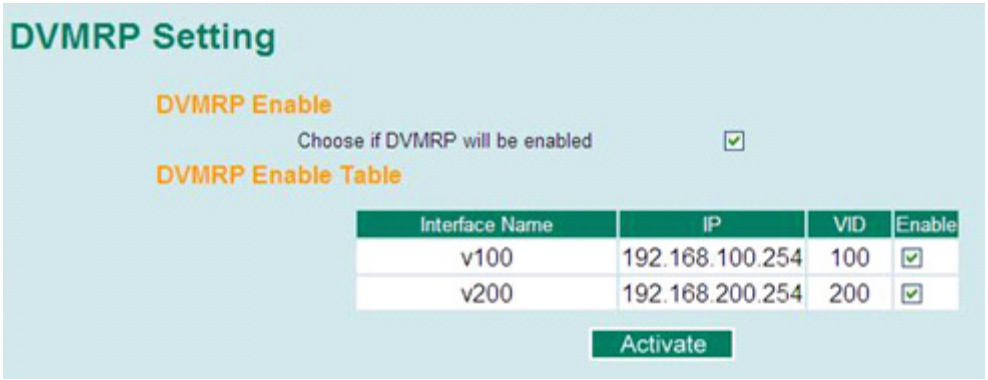
| Setting | Description | Factory Default |
|---|---|---|
| All | Show all routing rules | N/A |
| Connected | Show connected routing rules | N/A |
| Static | Show static routing rules | N/A |
| RIP | Show RIP exchanged routing rules | N/A |
| OSPF | Show OSPF exchanged routing rules | N/A |

# Distance Vector Multicast Routing Protocol (DVMRP)

Distance Vector Multicast Routing Protocol (DVMRP) is used to build multicast delivery trees on a network. When a layer 3 switch receives a multicast packet, DVMRP will provide a routing table for the relevant multicast group, and include distance information on the number f devices between the router and the packet destination. The multicast packet will then be forwarded through the Layer 3 switch interface specified in the multicast routing table.

## DVMRP Settings

The **DVMRP** page is used to set up the DVMRP table for Moxa Layer 3 switches.




***DVMRP Enable***

Enable or disable DVMRP globally.

**NOTE** Two different multicast routing protocols can NOT both be enabled on the same Moxa Layer 3 switch. Only either DVMRP or PIM-DM can be enabled, not both.

***DVMRP Enable Table***

Enable or Disable the DVMRP by selected interface.

## DVMRP Routing Entry List


Shows the current DVMRP Routing Entry List

## DVMRP Neighbors List


Shows the current DVMRP neighbors list

## DVMRP Multicast Routing Entry List

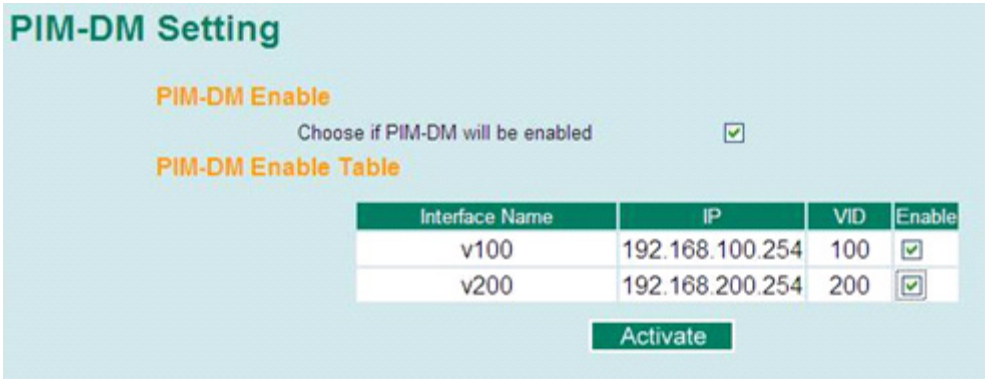

Shows the current DVMRP Multicast Routing Entry List

# Protocol Independent Multicast, Dense Mode (PIM-DM)

Protocol Independent Multicast (PIM) is a method of forwarding traffic to multicast groups over the network using any pre-existing unicast routing protocol, such as RIP or OSPF, set on routers within a multicast network. PIM Dense Mode (PIM-DM) protocol will flood multicast traffic on the network and revise the multicast routing table based on the responses.

## PIM-DM Settings

The **PIM-DM** page is used to set up the PIM-DM table for Moxa Layer 3 switch.




***PIM-DM Enable***

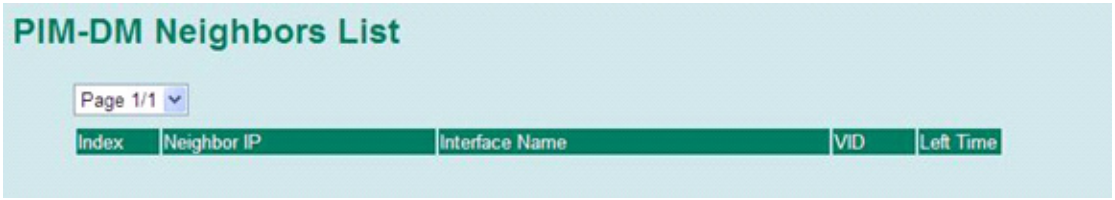
Enable or Disable PIM-DM protocol globally.

**NOTE** Two different multicast routing protocols can NOT both be enabled on the same Moxa Layer 3 switch. Only either DVMRP or PIM-DM can be enabled, not both.

***PIM-DM Enable Table***

Enable or Disable the PIM-DM by selected interface.

# PIM-DM Neighbors List




Shows the current PIM-DM Neighbors List

# PIM-DM Multicast Routing Entry List


Shows the current PIM-DM Multicast Routing Entry List