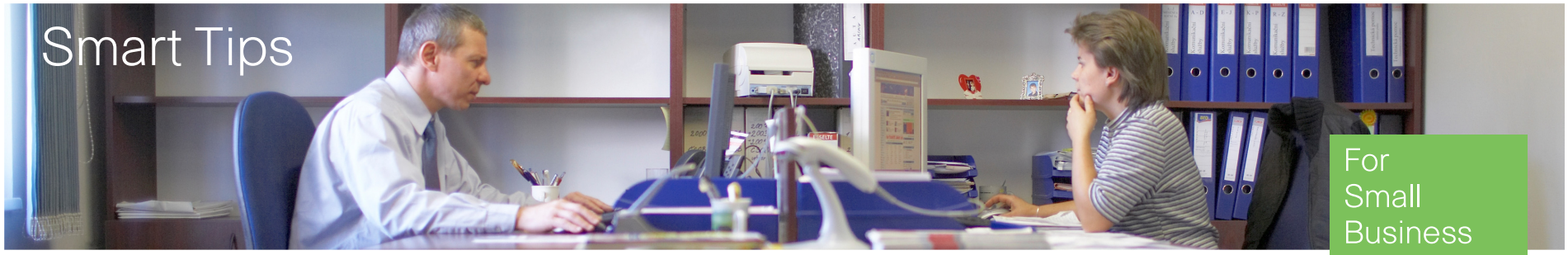


Cisco Small Business 300/200 Series Switch-to-Switch Link Aggregation

This Smart Tip describes interconnecting the Cisco Small Business 300/200 Series Managed Switches using the aggregation method called Link Aggregation Group (LAG). LAG can also be used to connect to network devices such as Network Attached Storage (NAS), routers, and so on. This Smart Tip focuses on how to configure LAG between two switches.

Why Link Aggregation?

Link Aggregation optimizes port usage by linking a group of physical ports together to form a single aggregated group for increased bandwidth between two switches, thus called Link Aggregation Group or LAG. In addition to increasing port capacity, LAGs also provide link redundancy and load balancing for high availability of the communications channel between the switches. If one link fails between these two switches, the other links in the LAG interface take over the traffic and the connection is maintained.

LAG provides the following important benefits:

- Increased link capacity
- Higher link availability
- Improvements obtained using existing hardware (no upgrading to higher-capacity link technology is necessary)

Featured Products

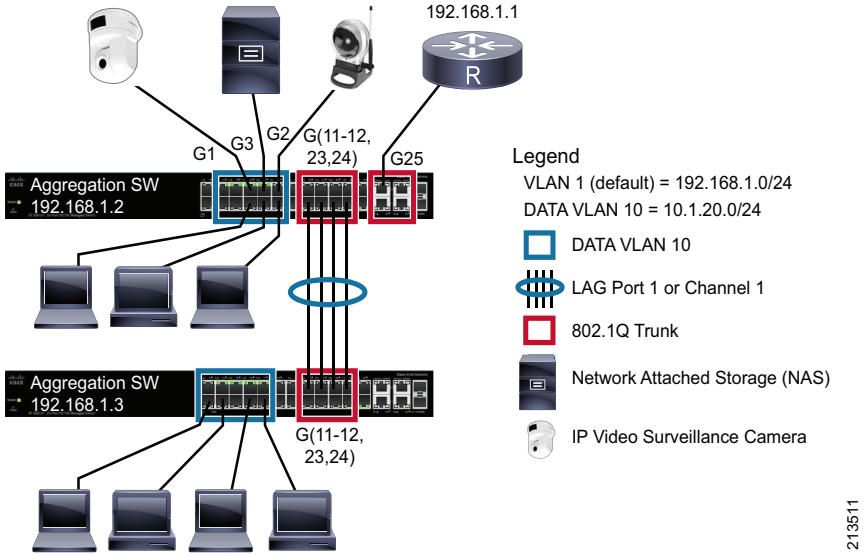
This Smart Tip describes the use of a Cisco Small Business 300 Series Managed Switch with various Power over Ethernet (PoE) and non-PoE switch ports. For details about other Cisco 300 Series Managed Switches, visit: http://www.cisco.com/go/smallbusiness, click the **Routers and Switches** link, and search for the specific switch name.

LAG Network Design

Network Topology

The descriptions in this document are based on the network topology shown in Figure 1. It consists of two Cisco Small Business 300 or 200 Series switches directly connected using a 4-port link aggregation to form a logical interface or LAG group. It is configured as a 802.1Q trunk to carry traffic for multiple VLANs.

Figure 1 Small Business Link Aggregation Group (LAG) Topology



Some of the network-connected devices such as IP video surveillance camera, network-attached storage (NAS), laptop, and PCs are shown on the network for the sake of simulating a typical small business network. However, this document presents only the configuration of LAG only on the switches.

LAG Design Tips

Consider the following design tips before deploying LAG in a small business network using the Cisco 300/200 Series switches:

- Before configuring LAG, make sure that ports are not physically connected to the other end. Connect the ports only after all LAG configuration have been completed on both switches to avoid causing an STP loop.
- In an existing network, making changes to a LAG channel disrupts network services until all the ports have been configured and the proper VLANs have been applied.
- All ports in a LAG must be of the same media type, speed, and so on. Note that SFP fiber takes precedence over copper when both types are being used.
- When adding ports to a LAG, the ports cannot belong to any VLAN except the default VLAN. Ports in a LAG must not be assigned to another LAG.
- No more than eight ports are assigned to a static LAG, and no more than 16 ports can be candidates for a dynamic LAG.
- All the ports in a LAG must have auto-negotiation disabled, although the LAG can have auto-negotiation enabled.
- When a port is added to the original configuration of the LAG, the configuration that existed for the port is no longer applied, and the configuration of the LAG applies to the port. When the port is removed from the LAG, its original configuration is reapplied.
- Protocols, such as Spanning Tree Protocol (STP), consider all the ports in the LAG to be one port.
- All the ports in the LAG must have the same 802.1p priority.
- Configure Rapid Spanning Tree Protocol (RSTP) on all switches to prevent Layer 2 loops. Note that RSTP is the default STP type for the Cisco 300/200 Series switches.
- This guide suggests manual configuration on both switches. However, you can also configure LAG on one side while LACP configures the other side of the link automatically. The latter configuration is not demonstrated in this guide, and should be done by more experienced users.

Key LAG Features

Link Aggregation

Link aggregation is a computer networking term that describes using multiple network cables/ports in parallel to increase the link speed beyond the limits of any one single cable or port, and to increase the redundancy for higher availability.

Other terms for link aggregation include Ethernet bonding, NIC teaming, trunking, port channel, link bundling, EtherChannel, GigaChannel, PortChannel, Multi-link trunking (MLT), NIC bonding, network bonding, and Network Fault Tolerance (NFT).

Link Aggregation Control Protocol (LACP)

Within the IEEE specification, the Link Aggregation Control Protocol (LACP) provides a method to control the bundling of several physical ports together to form a single logical channel. LACP allows a network device to negotiate an automatic bundling of links by sending LACP packets to the peer (directly connected device that also implements LACP).

Load Balancing

Traffic forwarded to a LAG is load balanced across the active member ports, thus achieving an effective bandwidth close to the aggregate bandwidth of all the active member ports of the LAG.

Traffic load balancing over the active member ports of a LAG is managed by a hash-based distribution function that distributes unicast traffic based on Layer 2 or Layer 3 packet header information. Multicast packets behave in the same way as unicast packets.

The Cisco 300/200 Series switches support two modes of load balancing:

- By MAC addresses—Based on the destination and source MAC addresses of all packets
- By IP and MAC addresses—Based on the destination and source IP addresses for IP packets, and destination and source MAC addresses for non-IP packets.

LAG Management

Active member ports in a LAG are defined statically by explicit user assignment or are dynamically selected by LACP. The LACP selection process selects the active member ports for the LAG after exchanging LACP information between the local and remote devices.

In general, a LAG is treated by the system as a single logical port. In particular, the LAG has port attributes similar to a regular port, such as state and speed.

Note For more technical details on LAG, visit http://www.cisco.com and search for the following key words: Link Aggregation Group (LAG), EtherChannel, PortChannel, and GigaChannel.

Configuration Tips

Pre-configuration Checklist

This configuration is based on an existing network conforming to topology shown in Figure 1, having the following features:

- A WAN router configured with default VLAN 1 and IP subnet 192.168.1.0/24. The WAN router initially, if attached to a switch before boot, can be used to assign IP address to the switch as well as used for a connectivity test to the Internet.
- The WAN router is configured for DHCP with a pool address of range 192.168.1.100–192.168.1.254.
- The LAG ports consist of four ports G11–12, 23–24, and configured as trunks. All port settings must be configured with the same parameters such as duplex, speed, and so on, before being added to the LAG.
- A parallel trunk is configured between the two switches via the uplink ports G25 on each switch.
- RSTP is configured on every switch in the network (by default).
- Optionally, quality of service (QoS) is configured according to *Configuring LAN QoS for Cisco IP Telephony*, available at the following URL: http://tools.cisco.com/s2slv2/ViewDocument?docName=EXT-AS-365917.
- To keep the changes after rebooting, the running configuration must be saved to the startup configuration file.
- If "Jumbo Frames" is enabled, the switch must be rebooted after saving the running configuration to startup configuration.

For a new configuration, see the *300 /200 Series Managed Switches Quick Start Guide* (QSG) to connect and prepare the switch for the LAG configuration: http://www.cisco.com/en/US/docs/switches/lan/csbms/sf30x_sg30x/quick_start/78-19252-01.pdf.

Configuring LAG on a Small Business Network

The following steps are needed to configure LAG for the topology shown in Figure 1:

1. Setting and verifying the basic port configuration for G11–12, 23–24.
2. Defining the LAG load balancing method
3. Configuring LAG settings for LAG 1
4. Defining ports G(11–12, 23–24) in LAG 1
5. Configuring LAG 1 to VLAN
6. Viewing VLAN membership for LAG 1
7. Configuring/verifying RSTP settings for LAG 1
8. Verifying dynamic addresses learned via LAG 1 using "Querying Dynamic Addresses"
9. Copying/saving the configuration from running to startup
10. Rebooting the switches for the jumbo frame configuration to take effect
11. Repeat all the above steps on the directly connected switch to be configured for LAG.

Setting and Verifying the Basic Port Configuration

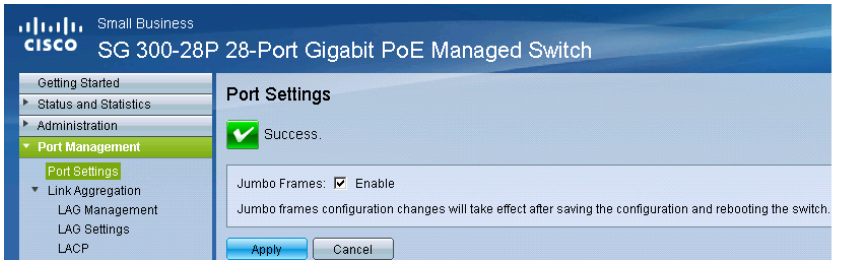
Before configuring LAG, make sure all the ports on both side of the link have the same properties such as speed and duplex, as indicated on the previous Configuration Tips section.

To configure port settings, complete the following steps:

Step 1 Click **Port Management > Port Settings**.

The Port Settings screen opens, as shown in Figure 2.

Figure 2 Port Settings Screen



Step 2 (Optional) Check the Jumbo Frames **Enable** checkbox to support packets of up to 10 Kb in size.

If "Jumbo Frames" is not enabled, the system supports packet size up to 1,632 bytes.

Step 3 Click **Apply** to update the global setting.

Note Jumbo frames configuration changes take effect only after the running configuration is explicitly saved to the startup configuration file, using the Copy/Save Configuration screen, and the switch is rebooted.

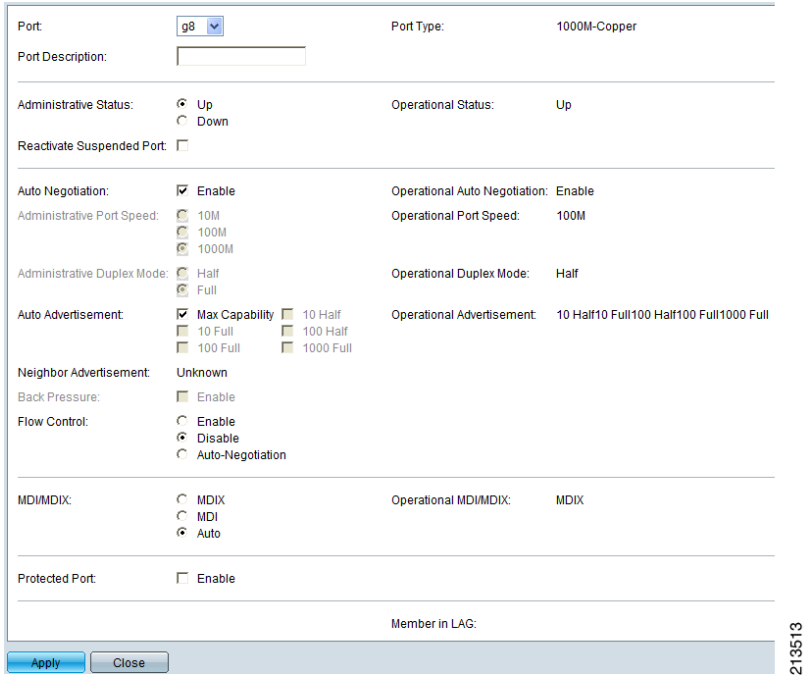
Step 4 To update the port settings in this topology (G12–13, 23–24), select the desired port (usually the first port, such as G12 in this topology), and click **Edit**.

The Edit Port Setting screen opens.

Step 5 Modify the parameters as shown in Figure 3

Note For more information on the parameters on the screen, see the Cisco 300/200 Series administration guide.

Figure 3 Edit Port Setting Screen



Step 6 Click **Apply**.

The Port Settings are modified, and the switch is updated.

Note Configure another port by selecting the desired port from the Port field at the top of the Edit Port Setting screen.

Defining the LAG Load Balancing Method

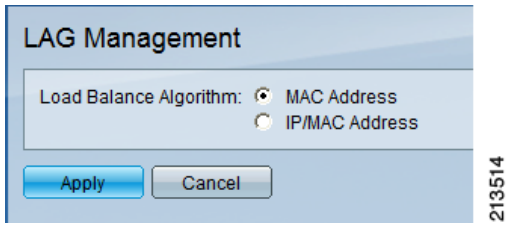
To configure LAG load balancing method, complete the following steps:

Step 1 Click **Port Management > Link Aggregation > LAG Management**.

The LAG Management screen opens.

Step 2 Select one of the Load Balance Algorithms, as shown in Figure 4.

Figure 4 LAG Management Screen



Step 3 Click **Apply**.

The Load Balance Algorithm is defined, and the switch is updated.

Configuring LAG Settings

The LAG Settings screen displays a table of current settings for all LAGs. You can configure the settings of selected LAGs and reactivate suspended LAGs by launching the Edit LAG Settings screen.

To configure LAG 1 from the LAG Settings screen, complete the following steps:

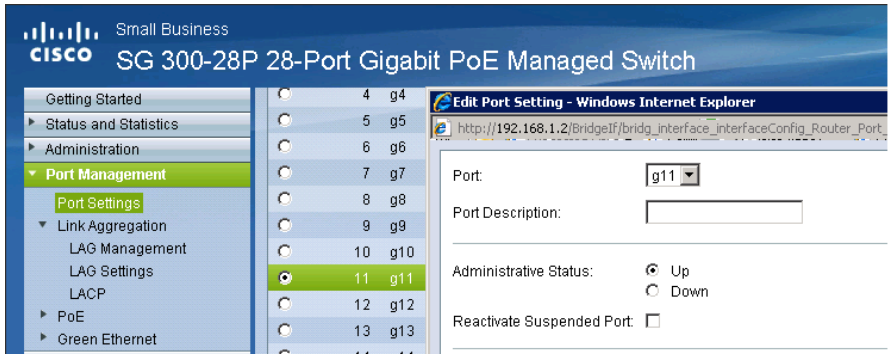
Step 1 Click **Port Management > Lag Management > LAG Settings**.

The LAG Settings screen opens.

Step 2 Select a LAG, and click **Edit**.

The Edit LAG Settings screen opens, as shown in Figure 5.

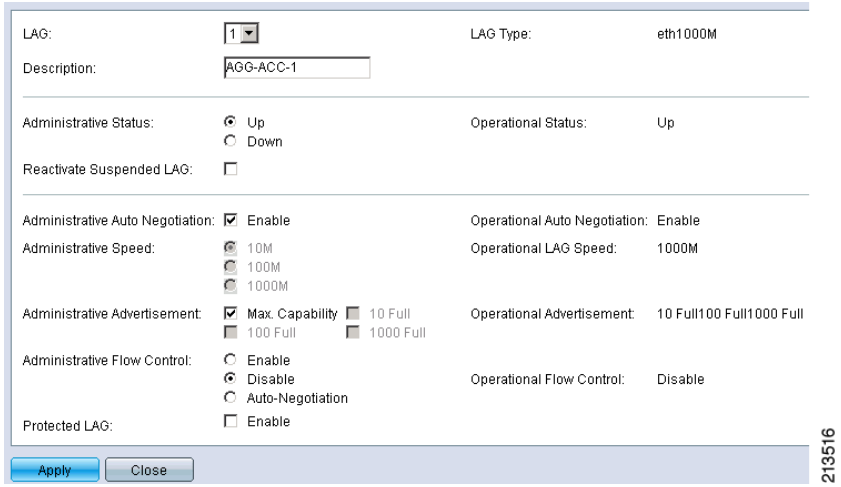
Figure 5 Edit LAG Settings Screen



Step 3 Enter the values for the fields shown in Figure 6.

Note For more information on the parameters on the screen, see the Cisco 300/200 Series administration guide.

Figure 6 Editing LAG Settings



Step 4 Click **Apply**.

The switch is updated.

Note Select another LAG for configuration by changing the LAG field.

Defining Member Ports in LAG 1

Use the LAG Management screen to define the member ports in LAG 1.

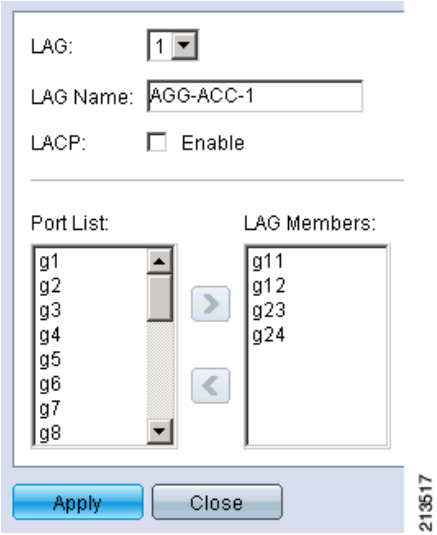
Step 1 Select **LAG 1** to be configured, and click **Edit**.

The Edit LAG Membership screen opens, as shown in Figure 7.

Step 2 Enter the values for the following fields:

- LAG—Select the LAG number.
- LAG Name—Enter the LAG name or a comment.
- LACP—Select to enable LACP on the selected LAG. This makes it a dynamic LAG.
- Port List—Move those ports that are to be assigned to the LAG from the Port List to the LAG Members list. Up to eight ports per static LAG can be assigned, and 16 ports can be assigned to a dynamic LAG.

Figure 7 Edit LAG Membership Screen



Step 3 Click **Apply**.

The LAG membership is defined, and the switch is updated.

Note Select another LAG for configuration by changing the LAG field.

Configuring LAG to a VLAN

Use the Port to VLAN screen to display and configure a VLAN and all its port members on a single page.

To map LAGs to a VLAN (VLAN 10 for example), complete the following steps:

Step 1 Click **VLAN Management > Port to VLAN**.

The Port to VLAN screen opens.

Step 2 Select **VLAN 10** and **LAG** as interface type, and click **Go** to display or to change the port characteristic with respect to the VLAN.

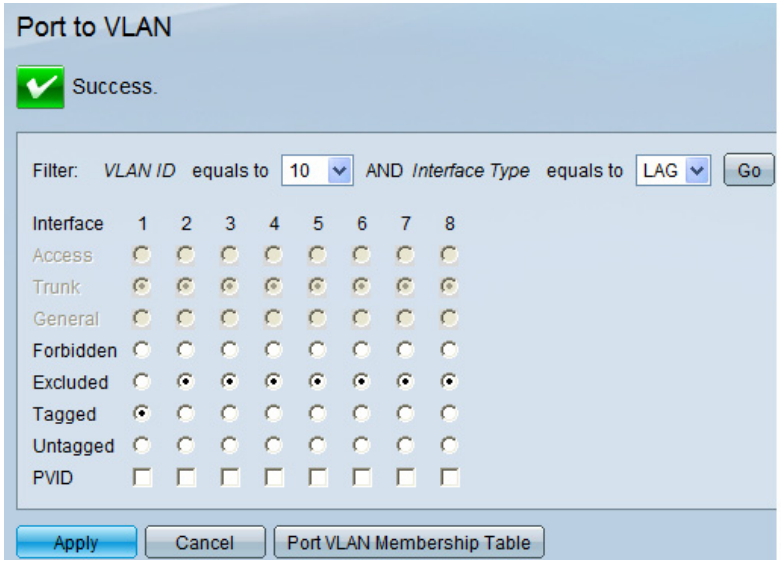
The port mode for LAG 1 is displayed with its current port mode (Access, Trunk or General) configured from the Interface Settings screen.

Each port or LAG is displayed with its current registration to the VLAN. In this screen, VLAN 10 is set as "Tagged" for LAG 1.

Step 3 Change the registration of an interface to VLAN 10 as "Tagged" by selecting the desired option from the list on the Port to VLAN screen, as shown in Figure 8.

Note See the administration guide for more information on the other options.

Figure 8 Port to VLAN Screen



Step 4 Click **Apply**.

The interface LAG 1 is assigned to VLAN 10 as Tagged, and the switch is updated.

Note To continue to display and/or configure the LAG membership of another VLAN, select another VLAN ID.

Viewing VLAN Membership for LAG 1

The Port VLAN Membership screen displays a list of VLANs to which each port/LAG belongs.

To view VLAN membership for LAG 1, complete the following steps:

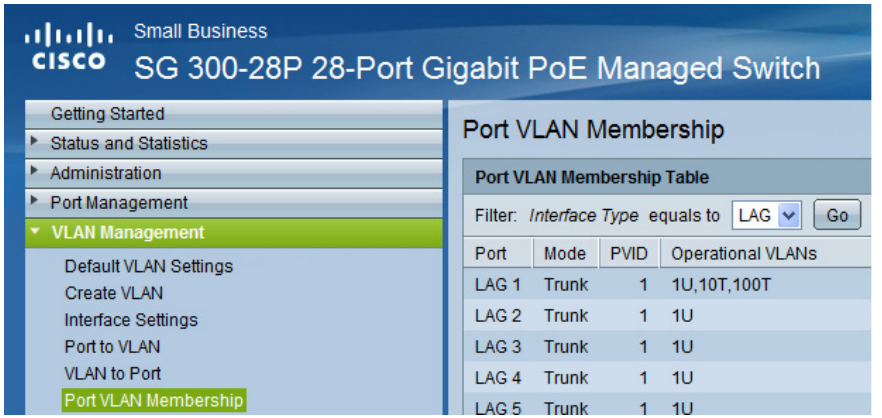
Step 1 Click **VLAN Management > Port VLAN Membership**.

The Port VLAN Membership screen opens.

Step 2 Select an interface type as **LAG**, and click **Go**.

The Port VLAN Membership screen displays the operational membership of the LAG 1, as shown in Figure 9.

Figure 9 Port VLAN Membership Screen



Note that LAG 1 is configured as a trunk with VLAN 1 (untagged) and 10, 100 (Tag).

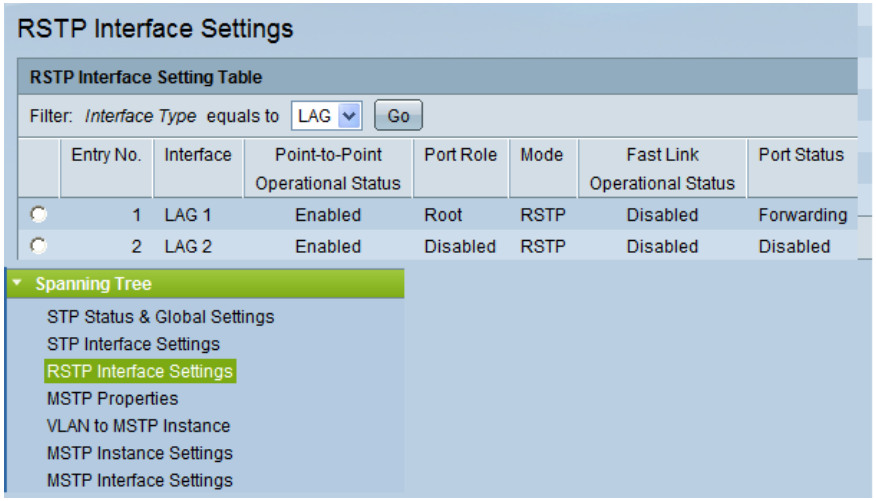
Configuring Rapid Spanning Tree Settings for LAG

RSTP is enabled by default on the Cisco 300/200 Series switches. To configure RSTP, see the 300 Series Switches administration guide. To view RSTP status on the switch for LAG 1, complete the following steps:

Step 1 Click **Spanning Tree > STP Status and Global Settings**.

The STP Status and Global Settings screen appears, as shown in Figure 10.

Figure 10 STP Status and Global Settings Screen



Viewing Dynamic Addresses Learned via LAG 1

To view or perform query dynamic addresses, complete the following steps:

Step 1 Click **MAC Address Tables > Dynamic Addresses.**

The Dynamic Addresses screen opens, as shown in Figure 11.

Step 2 In the Filter block, enter the following query criteria:

- VLAN ID—Enter the VLAN ID for which the table is queried.
- MAC Address—Enter the MAC address for which the table is queried.
- Interface—Select the interface for which the table is queried. The query can search for specific ports or LAGs.
- Dynamic Address Table Sort Key—Enter the field by which the table is sorted. The address table can be sorted by VLAN ID, MAC address, or interface.

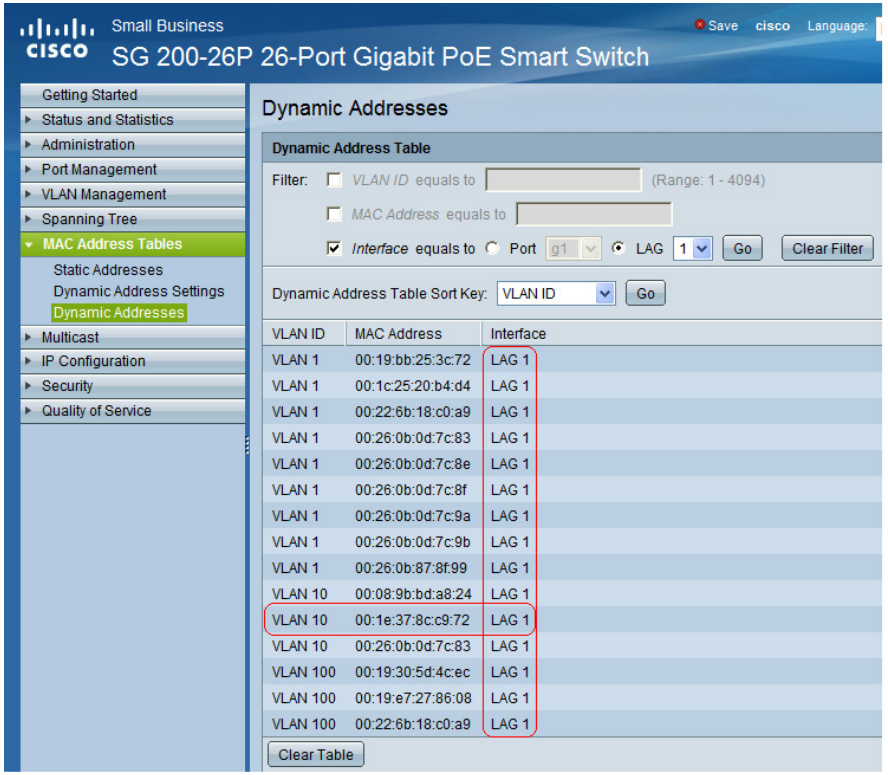
Step 3 Select the preferred option for sorting the addresses table in the Dynamic Address Sort Key.

Step 4 Click **Go**.

The Dynamic MAC Address Table is queried and the results are displayed.

Step 5 Click **Clear Table** to delete all of the dynamic MAC addresses.

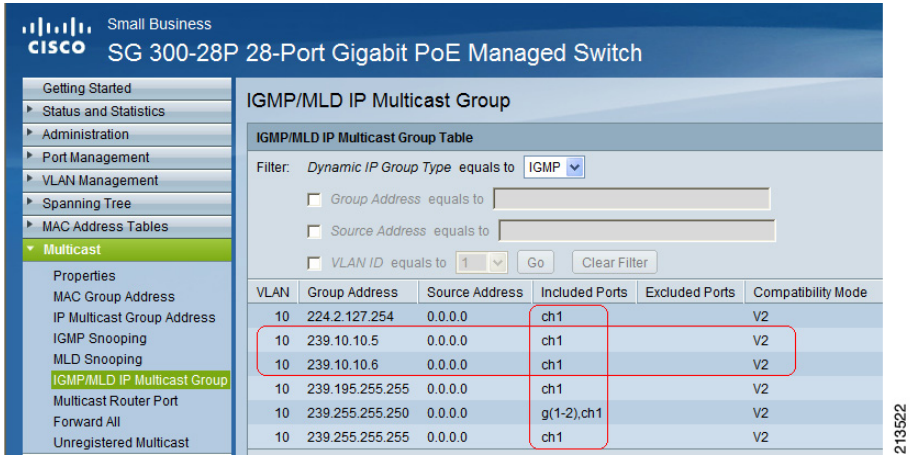
Figure 11 Dynamic Addresses Screen



Verifying Traffic using the LAG

In the topology of Figure 1, two of the IP video surveillance cameras in VLAN 10 with IP addresses 10.1.20.5 and 10.1.20.6 respectively are sending the video images via multicast groups 239.10.10.5 and 239.10.10.6 respectively. Figure 12 shows the multicast traffic using ch1 or LAG 1.

Figure 12 Multicast Traffic Using ch1



Note The multicast traffic streams for groups 239.10.10.5 and 239.10.10.6 in VLAN 10 with ch1 as "Included Ports".

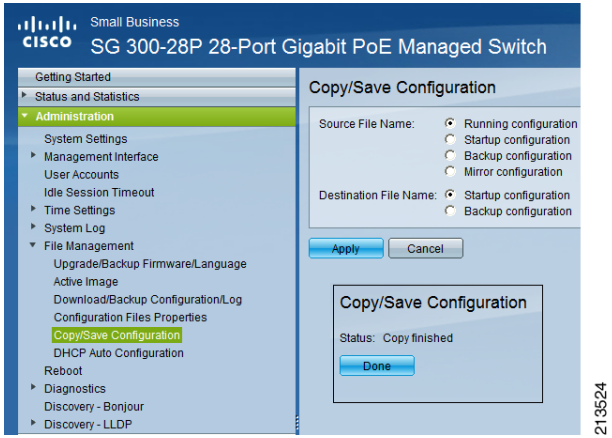
Copying/Saving the Configuration

To copy one configuration from one file type to another file type, complete the following steps:

Step 1 Click **Administration > File Management > Copy/Save Configuration**.

The Copy/Save Configuration screen appears, as shown in Figure 13.

Figure 13 Copy/Save Configuration Screen



Step 2 Select the Source File Name to be copied.

Only valid file types are displayed. (The file types are described in the Files and File Types section.)

Step 3 Select the Destination File Name to be overwritten by the source file.

Step 4 Click **Apply**.

The file is copied and switch is updated.

Rebooting the Switch

Some configuration changes, such as enabling jumbo frame support, require the system to be rebooted before they take effect. However, rebooting the switch deletes the running configuration, so it is critical that the running configuration is saved to the startup configuration before the switch is rebooted. Clicking Apply does not save the configuration to the startup configuration. For more information on configuration files and file types, see the administration guide for the Cisco 300/200 Series Switch.

To reboot the switch, complete the following steps:

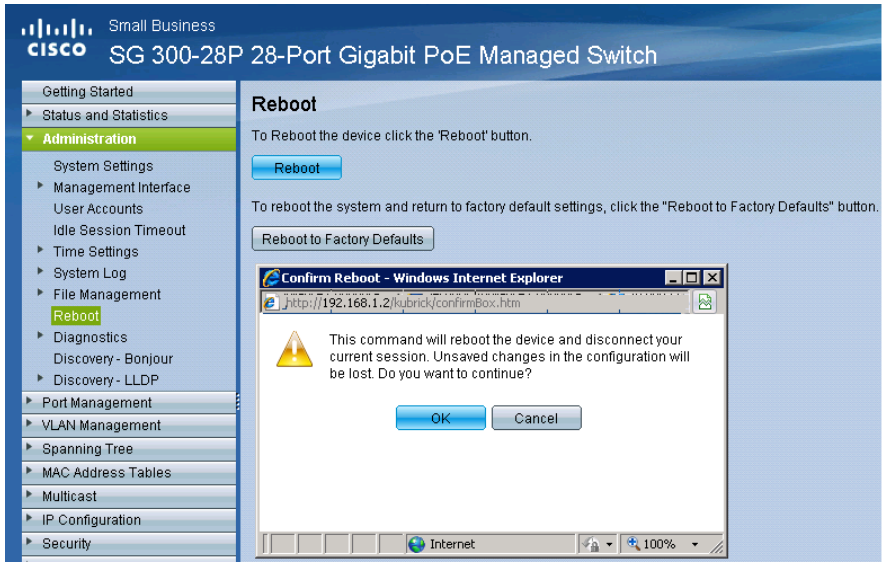
Step 1 Click **Administration > Reboot**.

The Reboot screen opens.

Step 2 Click one of the Reboot buttons.

See the administration guide for more information on the Reboot buttons.

Figure 14 Reboot Screen



The switch is rebooted.

References

For more information on configuring the Cisco 300/200 Series Managed Switches, see the administrator guide at the following URL: http://www.cisco.com/en/US/docs/switches/lan/csbms/sf30x_sg30x/administration_guide/78-19308.pdf

For details about other Cisco 300/200 Series Managed Switches, visit: http://www.cisco.com/go/300switches.

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