



Configuring Local Area Bonjour in Unicast Mode for LAN Networks

Cisco Catalyst 9000 Series switches and Cisco Catalyst 9800 Series WLC introduce the unicast mode function in Local Area Bonjour network domain. The new enhanced gateway function at the first hop of wired and wireless networks communicates directly with any industry standard RFC 6762 compliant mDNS end point in Layer 2 unicast mode. The new unicast mode communication eliminates the Layer 2 mDNS flood challenge in large-scale enterprise-grade LAN and WLAN networks. The unicast mode provides enhanced security, bandwidth, scale, and performance within the network.

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Prerequisites for Local Area Bonjour in Unicast Mode for LAN Networks

You must ensure that the Cisco Catalyst devices are successfully configured and are operational prior to implementing Cisco Local Area Bonjour in unicast mode for LAN networks. The following are the prerequisites that need to be verified on a Cisco Catalyst Switch before deploying it in SDG-Agent mode or Service-Peer mode:

- Verify that the targeted Cisco Catalyst switch platform is supported in SDG-Agent or Service-Peer mode from the support matrix.
- Verify that the targeted Cisco Catalyst SDG-Agent and Service-Peer switch is running the minimum required Cisco IOS XE software version.
- The Cisco Catalyst switch in SDG-Agent and Service-Peer mode must have the valid Cisco DNA Advantage license installed and running.
- In a Multilayer network with Layer 2 unicast service-routing, ensure that the SDG-Agent in distribution-layer and Service-Peer are interconnected through a Layer 2 trunk in static mode.

- Ensure that the SDG-Agent and Service-Peer switches have IP reachability on the same IPv4 subnet in global routing.

Restrictions for Local Area Bonjour in Unicast Mode for LAN Networks

- Local Area Bonjour in Unicast Mode for LAN Networks is not supported on Cisco Catalyst 2900 Series, Cisco Catalyst 3850 Series, Cisco Catalyst 3650 Series, Cisco Catalyst 4500 Series, Cisco Catalyst 6500 Series, and Cisco Catalyst 6800 Series switches.
- Cisco SD-Access for wired and wireless networks is supported only for releases starting from Cisco IOS XE Amsterdam 17.3.3.
- Cisco Embedded Wireless Controller on a Cisco Catalyst Series switch is supported only for releases starting from Cisco IOS XE Amsterdam 17.3.3.
- The Cisco Bonjour gateway solution follows the industry standard RFC 6762 Multicast DNS (mDNS) guidelines and only supports wired or wireless end points that comply with unicast mode.
- The Catalyst Switch Management Port is not supported for local area service-routing.

Information About Local Area Bonjour in Unicast Mode for LAN Networks

The zero-configuration service discovery and distribution capabilities use the link-local mDNS protocol to discover rich services intuitively without extensive user knowledge and intervention. RFC 6762 provides guidelines to discover services via Layer 2 multicast or Layer 2 unicast in a local segment. The receiving end point may request service discovery over an IPv4 and IPv6 network to collect information prior to use. The Layer 2 multicast frames are broadcast-category packets in a LAN and WLAN environment. Thus, they are flooded based on the Layer 2 flood boundary size across the network.

The Layer 2 or Layer 3 network boundary varies broadly in an enterprise network for LAN and wireless designs. The Local Area Bonjour domain introduces two new unicast communication modes. The unicast communication modes prevent mDNS flooding in the network for any current or evolving network deployment models. The following are the two new aspects of Local Area Bonjour Unicast modes:

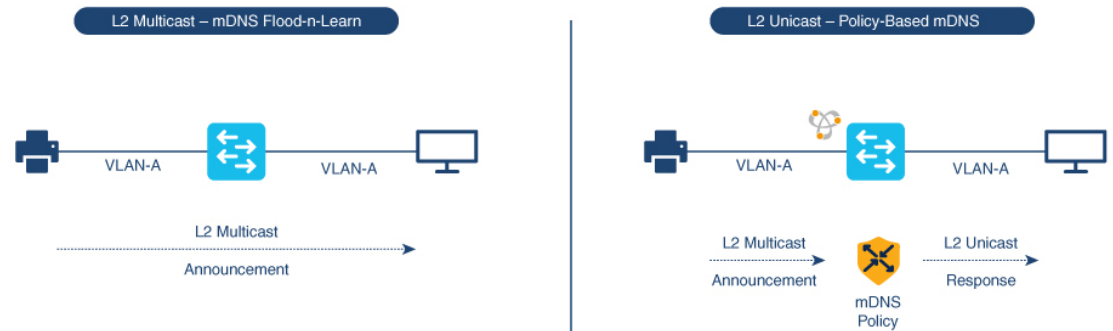
- Unicast mode end points
- Unicast mode Layer 2 network

End Points for Unicast Mode

Starting with Cisco IOS XE Amsterdam Release 17.3.2, Cisco Catalyst 9000 Series switches and Cisco Catalyst 9800 Series WLCs introduce Layer 2 unicast service gateway solution. The mDNS endpoint continues to advertise or query services over Layer 2 mDNS. However, with the unicast mode settings enabled, the incoming mDNS IPv4 and IPv6 frames are handled uniquely. The unicast technique eliminates the mDNS flood challenges and provides a policy-based service query response to the requesting end points over a unicast

MAC address. The following figure illustrates the functional difference between the new Layer 2 unicast (flood-free) and the traditional Layer 2 Multicast (flood) communication with wired and wireless end points.

Figure 1: Layer 2 Unicast Mode End Points



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Layer 2 Network for Unicast Mode

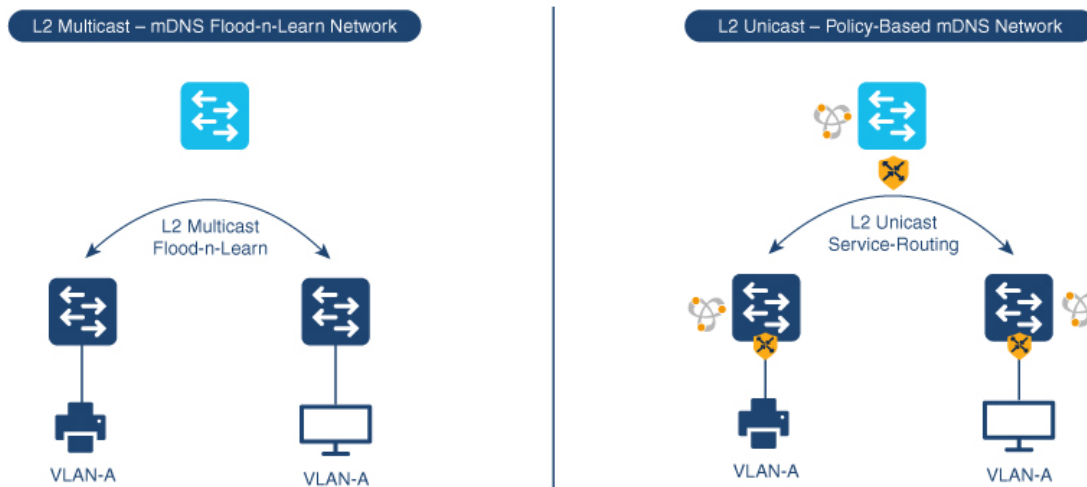
The Layer 3 boundary for wired and wireless networks can reside in the distribution layer with Layer 2 connections extended over trunk ports to an access layer switch or WLC. The association of the nonpruned or common VLAN ID to the trunk ports extends the Layer 2 flood boundary across the network.

Starting with Cisco IOS XE Amsterdam Release 17.3.2, Cisco Catalyst 9000 Series switches and Cisco Catalyst 9800 Series WLCs introduce the Service Peer role to eliminate transmitting mDNS flood over trunk ports. The Service Peer establishes a unicast Layer 3 IPv4-based service-routing session with the distribution layer system in Service Discovery Gateway (SDG) role. The Service Peer establishes the session over the existing Layer 2 trunk ports without modifying any existing Layer 2 VLAN configuration. The new mDNS trust port between access layer and distribution layer uses the existing out-of-band management network to statefully discover and distribute services (based on policies) to replace traditional flood-n-learn methods from the Layer 2 network.

If the Layer 3 boundary in a LAN environment is at the access layer, then the SDG mode provides integrated Service Peer role. Further, the SDG mode needs only Wide Area Bonjour with Cisco DNA Center for service-routing in a Layer 3 IP network.

The following figure illustrates a Layer 2 Network with the unicast mode and a traditional Layer 2 network with mDNS flood:

Figure 2: Unicast Mode Layer 2 Network



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How to Configure Local Area Bonjour Unicast Mode for LAN Networks

This section shows how to configure the first-hop Layer 2 LAN access switch in Service Peer mode, to enable mDNS gateway function with policies, and to enable peering with upstream Layer 3 gateway in SDG Agent mode. The procedure also applies to the first-hop Layer 3 LAN access switch and the first-hop Layer 3 gateway switch in SDG Agent mode.

Configuring mDNS Gateway Mode

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> <code>enable</code>	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# <code>configure terminal</code>	Enters global configuration mode.
Step 3	mdns-sd gateway Example: Device(config)# <code>mdns-sd gateway</code>	Enables mDNS on the Layer 2 switch and enters mDNS gateway configuration mode. Enter the following commands in mDNS gateway configuration mode to enable the respective functionalities:

	Command or Action	Purpose
		<ul style="list-style-type: none"> • air-print-helper: Enables communication between Apple iOS devices like iPhones and iPads to discover and use older printers that do not support driverless AirPrint function. • cache-memory-max: Configures the percentage memory for cache. • rate-limit: Enables rate limiting of incoming mDNS packets. • service-announcement-count: Configures maximum service announcement count per scheduler to upstream SDG-Agent or Cisco DNA Center controller. Service advertisement count ranges from 10 to 500. • service-announcement-timer periodicity: Configures service advertisement time scheduler in seconds to upstream SDG-Agent or Cisco DNA Center controller. The value ranges from 5 to 36000 seconds. • service-query-count: Configures maximum service query request count per scheduler to upstream SDG-Agent or Cisco DNA Center controller. The value ranges from 10 to 500 service query count. • service-query-timer periodicity: Configures service query request time scheduler in seconds to upstream SDG-Agent or Cisco DNA Center controller. The value ranges from 5 to 36000 seconds.
<p>Step 4</p>	<p>mode service-peer</p> <p>Example:</p> <pre>Device(config-mdns-sd)# mode service-peer</pre>	<p>Configure mDNS gateway in either of the following modes based on system settings:</p> <ul style="list-style-type: none"> • service-peer: Enables the Layer 2 Catalyst Series switch in mDNS Service Peer mode. • sdg-agent: Enables the Layer 3 Catalyst Series switch in SDG Agent mode to peer with Cisco DNA Center controller for Wide Area Bonjour service-routing. <p>This is the default mode.</p>

	Command or Action	Purpose
Step 5	end Example: Device (config-mdns-sd) # end	Returns to privileged EXEC mode.

Configuring mDNS Service Policy

The mDNS service policy creates a service list that permits built-in or user-defined custom service-types. It then associates the service-list to a service-policy to enforce it in ingress or egress direction. It then applies the service-policy to the new VLAN configuration mode. This configuration remains the same on a Cisco Catalyst Series switch in both Service Peer and SDG Agent mode.

To configure an mDNS service policy and apply it on a target VLAN in Service Peer mode, perform the following steps:

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	mdns-sd service-list service-list-name {in out} Example: Device (config) # mdns-sd service-list VLAN100-LIST-IN in	Configures the incoming mDNS service list to classify one or more service types. A unique service list is required to process the incoming mDNS message and the outbound response to the requesting end points.
Step 4	match service-definition-name [message-type {any announcement query}] Example: Device (config-mdns-sl-in) # match APPLE-TV Device (config-mdns-sl-in) # match PRINTER-IPPS message-type announcement	Checks the inbound service-list. The switch either accepts or drops the incoming mDNS service type (like Apple TV) advertisement or query matching message type. The service list contains an implicit deny at the end. The default message-type is any .
Step 5	exit Example: Device (config-mdns-sl-in) # exit	Returns to global configuration mode.
Step 6	mdns-sd service-list service-list-name {in out}	Configures the outgoing mDNS service list to classify one or more service types.

	Command or Action	Purpose
	Example: Device (config) # mdns-sd service-list VLAN100-LIST-OUT out	A unique service list is required to process the incoming mDNS message and the outbound response to the requesting end points.
Step 7	match <i>service-definition-name</i> [message-type { any announcement query }] [location-filter <i>location-filter-name</i>] [source-interface { <i>mDNS-VLAN-number</i> <i>mDNS-VLAN-range</i> }] Example: Device (config-mdns-sl-out) # match APPLE-TV Device (config-mdns-sl-out) # match PRINTER-IPPS	Checks the outgoing service-list. The switch provides a local service proxy function by responding with a matching service-type to the requesting end point. For example, the Apple-TV and Printer learned from VLAN 100 are distributed to the receiver in the same VLAN 100. The service-list contains an implicit deny at the end. The message-type for an outbound service list is optional.
Step 8	exit Example: Device (config-mdns-sl-out) # exit	Returns to global configuration mode.
Step 9	mdns-sd service-policy <i>service-policy-name</i> Example: Device (config) # mdns-sd service-policy VLAN100-POLICY	Creates a unique mDNS service-policy.
Step 10	service-list <i>service-list-name</i> { in out } Example: Device (config-mdns-ser-policy) # service-list VLAN100-LIST-IN in Device (config-mdns-ser-policy) # service-list VLAN100-LIST-OUT out	Configures an mDNS service policy to associate with the service list for each direction.
Step 11	exit Example: Device (config-mdns-ser-policy) # exit	Returns to global configuration mode.
Step 12	vlan configuration <i>vlan-id</i> Example: Device (config) # vlan configuration 100 Device (config) # vlan configuration 101-110, 200	Enables VLAN configuration for advanced service parameters. One or more VLANs can be created for the same settings.
Step 13	mdns-sd gateway Example: Device (config-vlan) # mdns-sd gateway	Enables the mDNS gateway on the specified VLAN IDs.

	Command or Action	Purpose
Step 14	service-policy <i>service-policy-name</i> Example: Device(config-vlan-mdns)# service-policy VLAN100-POLICY	Associates an mDNS service policy with the specified VLAN IDs.
Step 15	end Example: Device(config-vlan-mdns)# end	Returns to privileged EXEC mode.

Configuring mDNS Location-Filter

A Cisco Catalyst Series switch in Unicast network mode provides, by default, a local service proxy between the mDNS service provider and the receiver connected in the same Layer 2 VLAN. Additionally, you can configure the mDNS location filter to allow service discovery and distribution between locally configured VLAN IDs. The configuration remains the same for both Service Peer and SDG Agent modes.

To enable the local service proxy on the switch to discover mDNS services between local VLANs, perform the following steps:

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	mdns-sd location-filter <i>location-filter-name</i> Example: Device(config)# mdns-sd location-filter LOCAL-PROXY	Configures a unique location filter.
Step 4	match location { all default ID } vlan <i>vlan-id</i> Example: Device(config-mdns-loc-filter)# match location-group default vlan 100 Device(config-mdns-loc-filter)# match location-group default vlan 101	Configures the match criteria that mutually distribute permitted services between grouped VLANs.
Step 5	mdns-sd service-list <i>service-list-name</i> { in out }	Configures the outgoing mDNS service list to classify one or more service types.

	Command or Action	Purpose
	Example: <pre>Device(config)# mdns-sd service-list VLAN100-LIST-OUT out</pre>	A unique service list is required to process the incoming mDNS message and the outbound response to the requesting end points.
Step 6	match <i>service-definition-name</i> [message-type { any announcement query }] [location-filter <i>location-filter-name</i>] Example: <pre>Device(config-mdns-sl-out)# match APPLE-TV location-filter LOCAL-PROXY</pre>	<p>Checks the outgoing service-list. The switch provides a local service proxy function by responding with a matching service-type to the requesting end point. For example, the Apple-TV and Printer learned from VLAN 100 are distributed to the receiver on different VLAN 101.</p> <p>The service-list contains an implicit deny at the end.</p> <p>The message-type for an outbound service list is optional.</p>
Step 7	exit Example: <pre>Device(config-mdns-sl-out)# exit</pre>	Returns to global configuration mode.
Step 8	mdns-sd service-policy <i>service-policy-name</i> Example: <pre>Device(config)# mdns-sd service-policy VLAN100-POLICY</pre>	Creates a unique mDNS service-policy.
Step 9	service-list <i>service-list-name</i> { in out } Example: <pre>Device(config-mdns-ser-policy)# service-list VLAN100-LIST-OUT out</pre>	Configures an mDNS service-policy to associate with the service-list for each direction.
Step 10	exit Example: <pre>Device(config-mdns-ser-policy)# exit</pre>	Returns to global configuration mode.
Step 11	vlan configuration <i>vlan-id</i> Example: <pre>Device(config)# vlan configuration 100 Device(config)# vlan configuration 101-110, 200</pre>	Enables VLAN configuration for advanced service parameters. One or more VLANs can be created for the same settings.
Step 12	mdns-sd gateway Example: <pre>Device(config-vlan)# mdns-sd gateway</pre>	Enables the mDNS gateway on the specified VLAN IDs.
Step 13	service-policy <i>service-policy-name</i> Example:	Associates an mDNS service-policy with the specified VLAN IDs.

	Command or Action	Purpose
	Device (config) # service-policy VLAN100-POLICY	
Step 14	end Example: Device (config) # end	Returns to privileged EXEC mode.

Configuring custom Service Definition

Cisco IOS XE supports various built-in mDNS service definition types that map the key mDNS PTR records to user-friendly names. For example, a built-in Apple-TV service type is associated with `_airplay._tcp.local` and `_raop._tcp.local` PTR records to successfully enable the service in the network. You can create custom service-definitions with matching mDNS PTR records to enable mDNS service-routing in the network.

To create a custom service definition, associate it with the service list and discover mDNS services between local VLANs, perform the following steps:

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	mdns-sd service-definition <i>service-definition-name</i> Example: Device (config) # mdns-sd service-definition APPLE-CLASSROOM	Configures a unique location filter.
Step 4	match location {all default id} vlan <i>vlan-id</i> Example: Device (config-mdns-ser-def) # service-type _classroom._tcp.local	Configures two or more local VLANs and mutually distributes permitted services between the grouped VLANs.
Step 5	end Example: Device (config) # end	Returns to privileged EXEC mode.

Configuring service-routing on Service Peer

The Layer 2 Cisco Catalyst switch in service-peer mode builds service-routing with an upstream distribution-layer switch in SDG Agent mode. To build service-routing the Layer 2 Cisco Catalyst switch requires at least one interface with valid IP address to reach upstream SDG Agent Catalyst switch. The switch management port is unsupported.

Table X below provides step-by-step configuration guidelines to enable service-routing on Cisco Catalyst switch in service-peer mode and setup mDNS trust interface settings.

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.
Step 3	vlan configuration <i>vlan-id</i> Example: Device(config)# vlan configuration 100 Device(config)# vlan configuration 101-110, 200	Enables VLAN configuration for advanced service parameters. One or more VLANs can be created for the same settings.
Step 4	mdns-sd gateway Example: Device(config-vlan)# mdns-sd gateway	Enables the mDNS gateway on the specified VLAN IDs. Enter the following commands in mDNS gateway configuration mode to enable the respective functionalities: <ul style="list-style-type: none"> • active-query timer [sec] : Enables refresh of discovered services and their records with a periodic mDNS query message for the permitted service types. The value ranges from 60 to 3600 seconds. • service-mdns-query {ptr srv txt} : Permits processing a specific query type. The default value is ptr. • transport {ipv4 ipv6 both} : Permits processing for IPv4 traffic, IPv6 traffic, or both. We recommend that you add only one network type to reduce redundant

	Command or Action	Purpose
		processing and avoid responses with same information over two network types. The default value is ipv4 .
Step 5	source interface <i>interface-id</i> Example: Device(config-vlan-mdns-sd) # source-interface vlan 4094	Selects the interface with a valid IP address that sources the service-routing session with the upstream Cisco Catalyst SDG Agent switch. Typically, the management VLAN interface is used.
Step 6	sdg-agent <i>ipv4-address</i> Example: Device(config-vlan-mdns-sd) # sdg-agent 10.0.0.254	Configures the IPv4 address for the SDG Agent. Typically, the management VLAN gateway address is used. If FHRP mode is being used, then use the FHRP virtual IP address of the management VLAN.
Step 7	end Example: Device(config-vlan-mdns-sd) # end	Returns to privileged EXEC mode.

Configuring service-routing on Service Discovery Gateway

Cisco Catalyst 9000 Series switches at the distribution layer support SDG Agent mode. SDG Agent mode enables the unicast mode of Bonjour service-routing with downstream Layer 2 access layer Ethernet switches and Cisco Catalyst 9800 Series WLCs.

To enable policy-based service discovery and distribution between locally paired service peers network devices, perform the following steps:



Note Configure the mDNS service policy as described in [Configuring mDNS Service Policy, on page 6](#).

Procedure

	Command or Action	Purpose
Step 1	enable Example: Device> enable	Enables privileged EXEC mode. Enter your password, if prompted.
Step 2	configure terminal Example: Device# configure terminal	Enters global configuration mode.

	Command or Action	Purpose
Step 3	mdns-sd service-peer group Example: Device(config)# mdns-sd service-peer group	Configures a unique Service Peer group.
Step 4	peer-group group-id Example: Device(config-mdns-svc-peer)# peer-group 1	Assigns a unique peer group ID to pair the Service Peers that permit mDNS service discovery and allows distribution within assigned group list. The allowed peer group range is 1 to 1000 for every SDG Agent switch.
Step 5	service-peer [ipv4-address] location-group {all default id} Example: Device(config-mdns-svc-peer-grp)# service-peer 10.0.0.1 location-group default Device(config-mdns-svc-peer-grp)# service-peer 10.0.0.2 location-group default	Configures at least one Service Peer to accept mDNS service advertisement or query message. When grouped with more than one Service Peers, the SDG Agent provides Layer 2 unicast mode routing between the configured peers. For example, the SDG Agent provides unicast-based service gateway function between the two Layer 2 service peer switches (10.0.0.1 and 10.0.0.2) that match the associated service policy.
Step 6	end Example: Device(config)# end	Returns to privileged EXEC mode.

Verifying Local Area Bonjour in Unicast Mode for LAN Networks

This section provides information about verifying Local Area Bonjour in unicast mode for both Service Peer and SDG Agent modes.

Verifying a Service Peer Catalyst Switch in Local Area Bonjour Domain

The following **show** commands are used to verify the various Local Area Bonjour domain mDNS service configuration parameters, cache records, statistics, and other information on a Cisco Catalyst Series switch configured in Service Peer mode.

Table 1: Commands to Verify a Service Peer Catalyst Switch in Local Area Bonjour Domain

Command	Purpose
show mdns-sd cache { all interface mac name service-peer static type vlan }	<p>Displays the available mDNS cache records that support multiple variables and provides granular source details. The following variables are available:</p> <ul style="list-style-type: none"> • all: Displays all available cache records discovered from multiple source connections of a system. • interface: Displays the available cache records discovered from specified Layer 3 interface. • mac: Displays the available cache records discovered from the specified MAC address. • name: Displays the available cache records based on the name of the service provider announced. • service-peer: Displays available cache records discovered from the specified Layer 2 Service Peer. • static: Displays the locally configured static mDNS cache entries. • type: Displays the available cache records based on the specific mDNS record type (PTR, SRV, TXT, A, or AAAA). • vlan: Displays the available cache records discovered from the specified Layer 2 VLAN ID in unicast mode.
show mdns-sd service-definition { name type }	<p>Displays the built-in and user-defined custom service definitions and provides the mapping from service name to mDNS PTR records.</p> <p>The service definitions can be filtered by name or by type.</p>
show mdns-sd service-list { direction name }	<p>Displays the configured inbound and outbound service lists that classify matching service types for a service policy.</p> <p>The service lists can be filtered by name or by direction.</p>
show mdns-sd service-peer statistics	<p>Displays the detailed mDNS packet statistics (number of packets sent to and received from the client, number of packets sent to and received from SDG-agent, and so on) that is processed by the system, when mDNS is configured in service-peer mode.</p>

Command	Purpose
<code>show mdns-sd service-policy { interface name }</code>	Displays the list of mDNS service policies mapped with inbound and outbound service lists. The service policies list can be filtered by the associated interface or by name.
<code>show mdns-sd statistics { all cache debug interface service-list service-policy services vlan }</code>	Displays the detailed mDNS statistics processed bi-directionally by the system on each mDNS-gateway-enabled VLAN, when mDNS is configured in unicast mode. The keywords for the mDNS statistics provide a detailed view on the interface, policy, service list, and services.
<code>show mdns-sd summary { interface vlan }</code>	Displays the brief information about mDNS gateway and the key configuration status on all VLANs and interfaces of the system.

Verifying a Service Discovery Gateway Agent Catalyst Switch in Local Area Bonjour Domain

See [Table 1: Commands to Verify a Service Peer Catalyst Switch in Local Area Bonjour Domain, on page 14](#) for the complete list of **show** commands that are used to verify the various Local Area Bonjour domain mDNS service configuration parameters, cache records, statistics, and other information on a Cisco Catalyst Series switch configured in SDG Agent mode.

Additional References for Local Area Bonjour in Unicast Mode for LAN Networks

Related Topic	Document Title
Cisco Wide Area Bonjour Application on Cisco DNA Center User Guide	Cisco Wide Area Bonjour Application on Cisco DNA Center User Guide, Release 2.1.2
DNA Service for Bonjour Deployment on Cisco Catalyst 9800 WLCs	Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide

