Cisco DNA Service for Bonjour Configuration Guide, Cisco IOS XE 17.14.x (Catalyst 9200 Switches)

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CONTENTS

Cisco Catalyst Center Service for Bonjour Solution Overview

About the Cisco Catalyst Center Service for Bonjour Solution

The Apple Bonjour protocol is a zero-configuration solution that simplifies rich services and enables intuitive experience between connected devices, services, and applications. Using Bonjour, you can discover and use IT-managed, peer-to-peer, audio and video, or Internet of Things (IoT) services with minimal intervention and technical knowledge. Bonjour is originally designed for single Layer 2 small to mid-size networks, such as home or branch networks. The Cisco Catalyst Center Service for Bonjour solution eliminates the single Layer 2 domain constraint and expands the matrix to enterprise-grade traditional wired and wireless networks, including overlay networks such as Cisco Software-Defined Access (SD-Access) and industry-standard BGP EVPN with VXLAN. The Cisco Catalyst 9000 Series LAN switches, Cisco Nexus 9300 Series Switches, and Cisco Catalyst 9800 Series Wireless Controller follow the industry standard, RFC 6762-based multicast DNS (mDNS) specification to support interoperability with various compatible wired and wireless consumer products in enterprise networks.

The Cisco Wide Area Bonjour application on Catalyst Center enables mDNS service routing to advertise and discover services across enterprise-grade wired and wireless networks. The new-distributed architecture is designed to eliminate mDNS flood boundaries and transition to unicast-based service routing, providing policy enforcement points and enabling the management of Bonjour services.

The following figure illustrates how the Cisco Wide Area Bonjour application operates across two integrated service-routing domains.

Figure 1: Cisco Wide Area Bonjour Solution Architecture
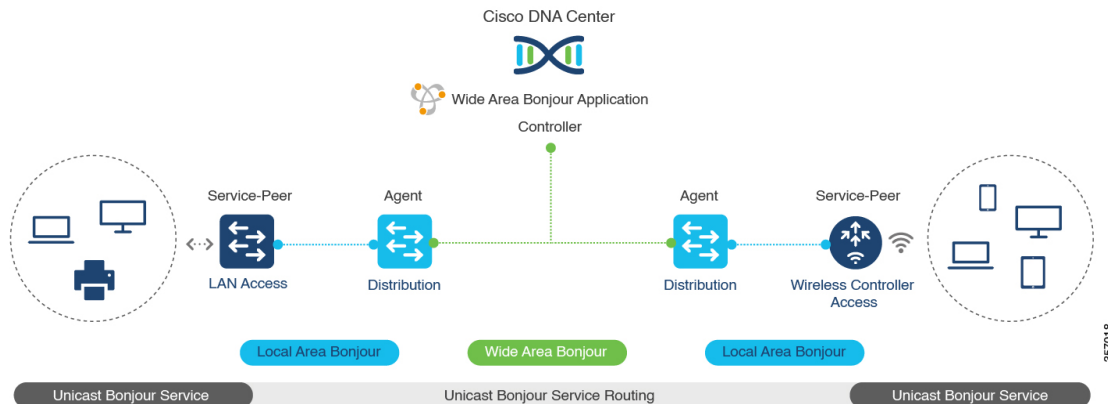
- **Local Area Service Discovery Gateway Domain - Unicast Mode**: The new enhanced Layer 2 unicast policy-based deployment model. The new mDNS service discovery and distribution using the Layer 2 unicast address enables flood-free LAN and wireless networks. Cisco Catalyst 9000 Series Switches and Cisco Catalyst 9800 Series Wireless Controller in Layer 2 mode introduce a new service-peer role, replacing the classic flood-n-learn, for new unicast-based service routing support in the network. The service-peer switch and wireless controller also replace mDNS flood-n-learn with unicast-based communication with any RFC 6762 mDNS-compatible wired and wireless endpoints.

- **Wide-Area Service Discovery Gateway Domain**: The Wide Area Bonjour domain is a controller-based solution. The Bonjour gateway role and responsibilities of Cisco Catalyst and Cisco Nexus 9300 Series Switches are extended from a single SDG switch to an SDG agent, enabling Wide Area Bonjour service routing beyond a single IP gateway. The network-wide distributed SDG agent devices establish a lightweight, stateful, and reliable communication channel with a centralized Catalyst Center controller running the Cisco Wide Area Bonjour application. The SDG agents route locally discovered services based on the export policy.

Note The classic Layer 2 multicast flood-n-learn continues to be supported on wired and wireless networks with certain restrictions to support enhanced security and location-based policy enforcement. The Cisco Catalyst and Cisco Nexus 9300 Series Switches at Layer 3 boundary function as an SDG to discover and distribute services between local wired or wireless VLANs based on applied policies.

Solution Components

The Cisco Catalyst Center Service for Bonjour solution is an end-to-end solution that includes the following key components and system roles to enable unicast-based service routing across the local area and Wide Area Bonjour domain:

- **Cisco Service Peer**: Cisco Catalyst Switches and Cisco Wireless Controllers in Layer 2 access function in service peer mode to support unicast-based communication with local attached endpoints and export service information to the upstream Cisco Catalyst SDG agent in the distribution layer.

Note Cisco Nexus 9300 Series Switches don't support unicast-based service routing with downstream Layer 2 access network devices.

- **Cisco SDG Agent**: Cisco Catalyst and Cisco Nexus 9300 Series Switches function as an SDG agent and communicate with the Bonjour service endpoints in Layer 3 access mode. At the distribution layer, the SDG agent aggregates information from the downstream Cisco service peer switch and wireless controller, or local Layer 2 networks, and exports information to the central Catalyst Center controller.

Note Cisco Nexus 9300 Series Switches don't support multilayer LAN-unicast deployment mode.

- **Catalyst Center controller**: The Catalyst Center controller builds the Wide Area Bonjour domain with network-wide and distributed trusted SDG agents using a secure communication channel for centralized services management and controlled service routing.

- **Endpoints**: A Bonjour endpoint is any device that advertises or queries Bonjour services conforming to RFC 6762. The Bonjour endpoints can be in either LANs or WLANs. The Cisco Wide Area Bonjour application is designed to integrate with RFC 6762-compliant Bonjour services, including AirPlay, Google Chrome cast, AirPrint, and so on.

Supported Platforms

The following table lists the supported controllers, along with the supported hardware and software versions.

Table 1: Supported Controllers with Supported Hardware and Software Versions

Supported Controller	Hardware	Software Version
Catalyst Center appliance	DN2-HW-APL DN2-HW-APL-L DN2-HW-APL-XL	Catalyst Center, Release 2.3.6
Cisco Wide Area Bonjour application	—	2.4.660.75403

The following table lists the supported SDG agents along with their licenses and software requirements.

Table 2: Supported SDG Agents with Supported License and Software Requirements

Supported Platform	Supported Role	Local Area SDG	Wide Area SDG	Minimum Software
Cisco Catalyst 9200 Series Switches	SDG agent Service peer	Catalyst Center Advantage	Catalyst Center Advantage	Cisco IOS XE Release 17.11.1

Supported Platform	Supported Role	Local Area SDG	Wide Area SDG	Minimum Software
Cisco Catalyst 9200L Series Switches	SDG agent Service peer	Catalyst Center Advantage	Catalyst Center Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9300 and 9300-X Series Switches	Service peer SDG agent	Catalyst Center Advantage	Catalyst Center Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9400 and 9400-X Series Switches	Service peer SDG agent	Catalyst Center Advantage	Catalyst Center Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9500 and 9500-X Series Switches	Service peer SDG agent	Catalyst Center Advantage	Catalyst Center Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9500 High Performance Series Switches	Service peer SDG agent	Catalyst Center Advantage	Catalyst Center Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9600 and 9600-X Series Switches	Service peer SDG agent	Catalyst Center Advantage	Catalyst Center Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9800 Wireless Controller	Service peer	Catalyst Center Advantage	Catalyst Center Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9800-L Wireless Controller	Service peer	Catalyst Center Advantage	Catalyst Center Advantage	Cisco IOS XE Release 17.11.1
Cisco Nexus 9300 Series Switches	SDG agent	Catalyst Center Advantage	Catalyst Center Advantage	Cisco NX-OS Release 10.2(3)F

Supported Network Design

The Cisco Catalyst Center Service for Bonjour supports a broad range of enterprise-grade networks. The end-to-end unicast-based Bonjour service routing is supported on traditional, Cisco SD-Access, and BGP EVPN-enabled wired and wireless networks.

Traditional Wired and Wireless Networks

Traditional networks are classic Layer 2 or Layer 3 networks for wired and wireless modes deployed in enterprise networks. Cisco Catalyst Center Service for Bonjour supports a broad range of network designs to enable end-to-end service routing and replace flood-n-learn-based deployment with a unicast mode-based solution.

The following figure illustrates traditional LAN and central-switching wireless local mode network designs that are commonly deployed in an enterprise.

Figure 2: Enterprise Traditional LAN and Wireless Local Mode Network Design
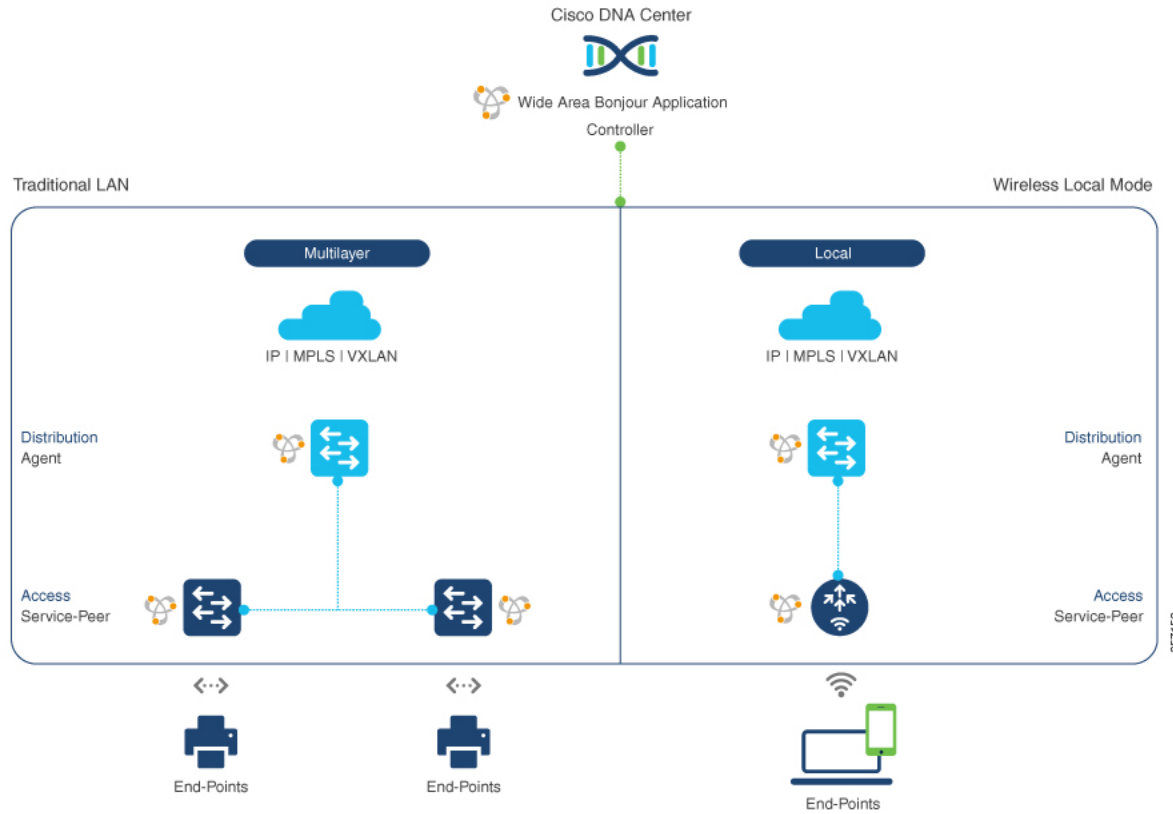
Wired Networks

The following figure shows the supported traditional LAN network designs that are commonly deployed in an enterprise.

Figure 3: Enterprise Wired Multilayer and Routed Access Network Design
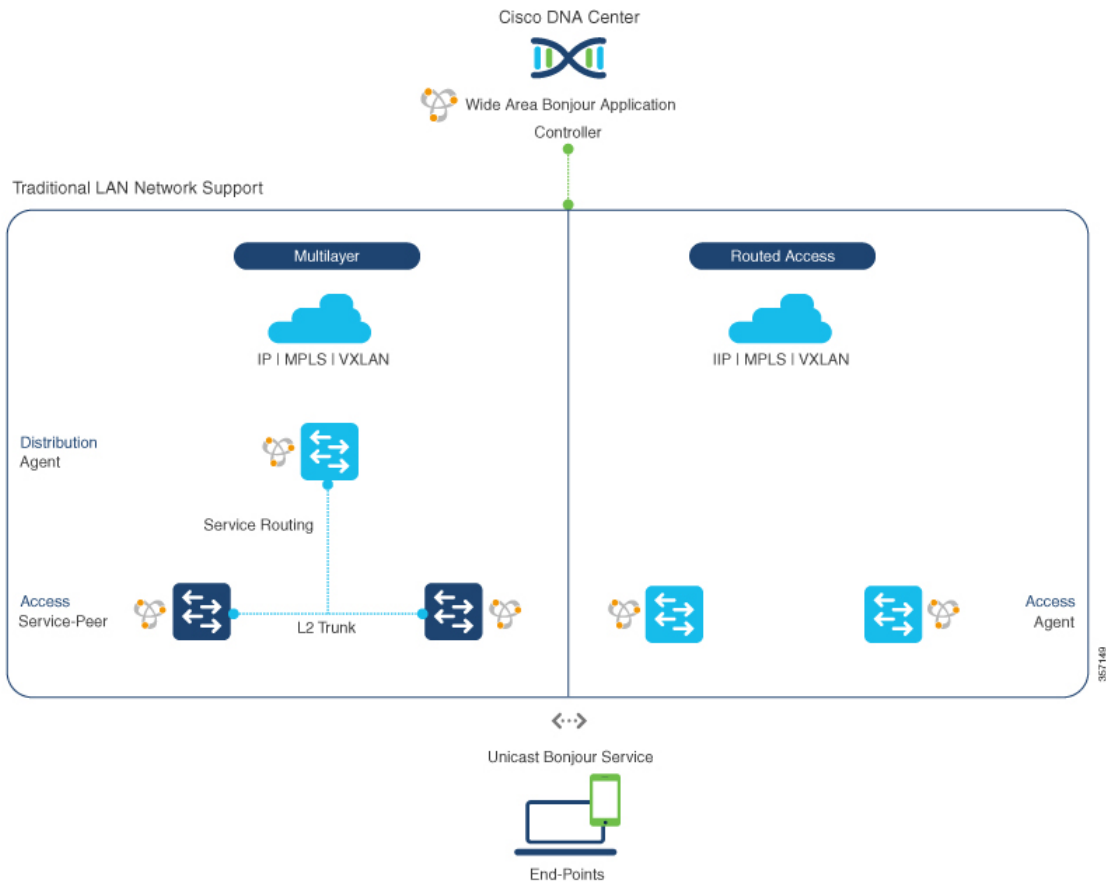
The Cisco Catalyst or Cisco Nexus 9300 Series Switches in SDG agent role that provide Bonjour gateway functions are typically IP gateways for wired endpoints that could reside in the distribution layer in multilayer network designs, or in the access layer in Layer 3 routed access network designs:

- **Multilayer LAN—Unicast Mode**: In this deployment mode, the Layer 2 access switch provides the first-hop mDNS gateway function to locally attached wired endpoints. In unicast mode, the mDNS services are routed to the distribution layer systems providing IP gateway and SDG agent mode. The policy-based service routing between the SDG agents is performed by the Catalyst Center controller.

- **Multilayer LAN—Flood-n-Learn Mode**: In this deployment mode, the Layer 2 access switch or wireless controller are in mDNS passthrough modes with the Cisco Catalyst or Cisco Nexus 9300 Series Switches operating in the SDG agent mode. The mDNS gateway function at distribution layer in a network enables inter-VLAN mDNS local proxy. It also builds stateful Wide Area Bonjour unicast service routing with the Catalyst Center to discover or distribute mDNS services beyond a single IP gateway.

- **Routed Access**: In this deployment mode, the first-hop Cisco Catalyst or Cisco Nexus 9300 Series Switch is an IP gateway boundary and, therefore, it must also perform the SDG agent role. The policy-based service routing between the SDG agents is performed by the Catalyst Center controller.

Wireless Networks

The Cisco Catalyst Center Service for Bonjour extends the single wireless controller mDNS gateway function into the Wide Area Bonjour solution. The mDNS gateway on Cisco Catalyst 9800 Series Wireless Controller can be deployed in an enhanced mode as a service peer. In this mode, the wireless controller builds unicast service routing with an upstream Cisco Catalyst gateway switch for end-to-end mDNS service discovery. It replaces the classic flood-n-learn mDNS services from wired network using mDNS AP or other methods.

The following figure shows the supported traditional wireless LAN network designs that are commonly deployed in an enterprise. Based on the wireless network design, the mDNS gateway function may be on the wireless controller, or first-hop Layer 2 or Layer 3 Ethernet switch of an Access Point in local-switching mode.

Figure 4: Enterprise Traditional Wireless LAN Network Design
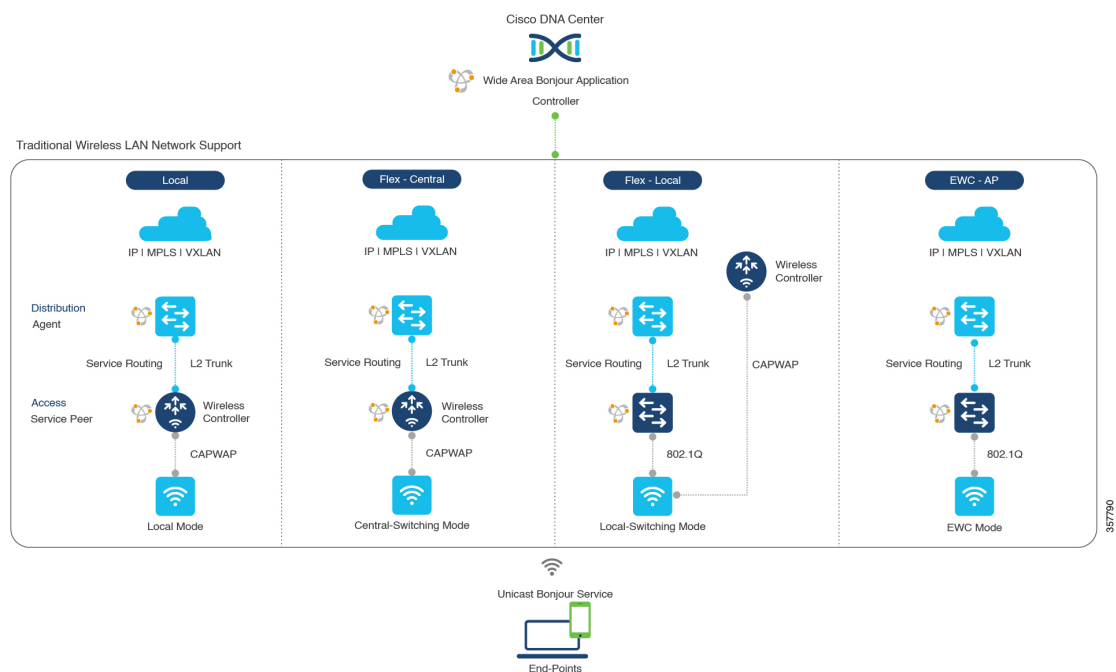
The Cisco Catalyst Center Service for Bonjour supports the following modes for wireless LAN networks:

- **Local Mode**: In the central switching wireless deployment mode, the m-DNS traffic from local mode Cisco access points is terminated on the Cisco Catalyst 9800 Series Wireless Controller. The Cisco Catalyst 9800 Series Wireless Controller extends the mDNS gateway function to the new service peer mode. The wireless controller can discover and distribute services to local wireless users and perform unicast service routing over a wireless management interface to the upstream Cisco Catalyst Switch in the distribution layer, which acts as the IP gateway and the SDG agent.

- **FlexConnect—Central**: The mDNS gateway function for Cisco access point in FlexConnect central switch SSID functions consistently as described in **Local Mode**. The new extended mDNS gateway mode on the Cisco Wireless Controller and upstream service routing with SDG agent operate consistently to discover services across network based on policies and locations.

- **FlexConnect—Local**: In FlexConnect local switching mode, the Layer 2 access switch in mDNS gateway service peer mode provides the policy-based mDNS gateway function to locally attached wired and wireless users. The Cisco Catalyst Switches in the distribution layer function as SDG agents and enable

mDNS service-routing across all Layer 2 ethernet switches to support unicast-based service routing to LAN and wireless LAN user groups.

- **Embedded Wireless Controller—Access Point**: The Layer 2 access switch in service peer mode provides unified mDNS gateway function to wired and wireless endpoints associated with Cisco Embedded Wireless Controller on Cisco Catalyst 9100 Series Access Points. The SDG agent in the distribution layer provides unicast service routing across all Layer 2 service peer switches in the Layer 2 network block without any mDNS flooding.

Cisco SD-Access Wired and Wireless Networks

Cisco SD-Access-enabled wired and wireless networks support Cisco Catalyst Center Service for Bonjour across fabric networks. The Cisco Catalyst 9000 Series Switches support VRF-aware Wide Area Bonjour service routing to provide secure and segmented mDNS service discovery and distribution management for virtual networks. The VRF-aware unicast service routing eliminates the need to extend Layer 2 flooding, and improves the scale and performance of the fabric core network and endpoints.

Figure 5: Cisco SD-Access Wired and Wireless Network Design
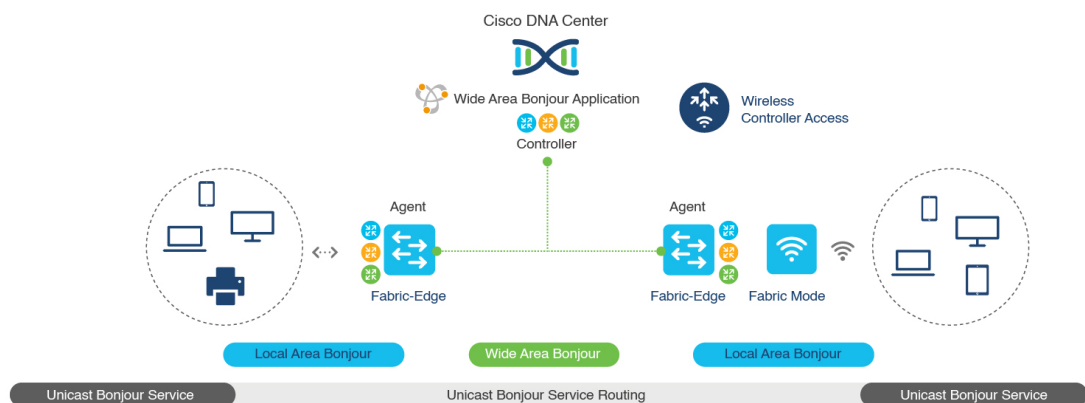
Cisco SD-Access supports flexible wired and wireless network design alternatives to manage fully distributed, integrated, and backward-compatible traditional network infrastructure. Wide Area Bonjour service routing is supported in all network designs providing intuitive user experience. The following figure illustrates the various SD-Access enabled wired and wireless network design alternatives.

Figure 6: Cisco SD-Access Wired and Wireless Network Design Alternatives
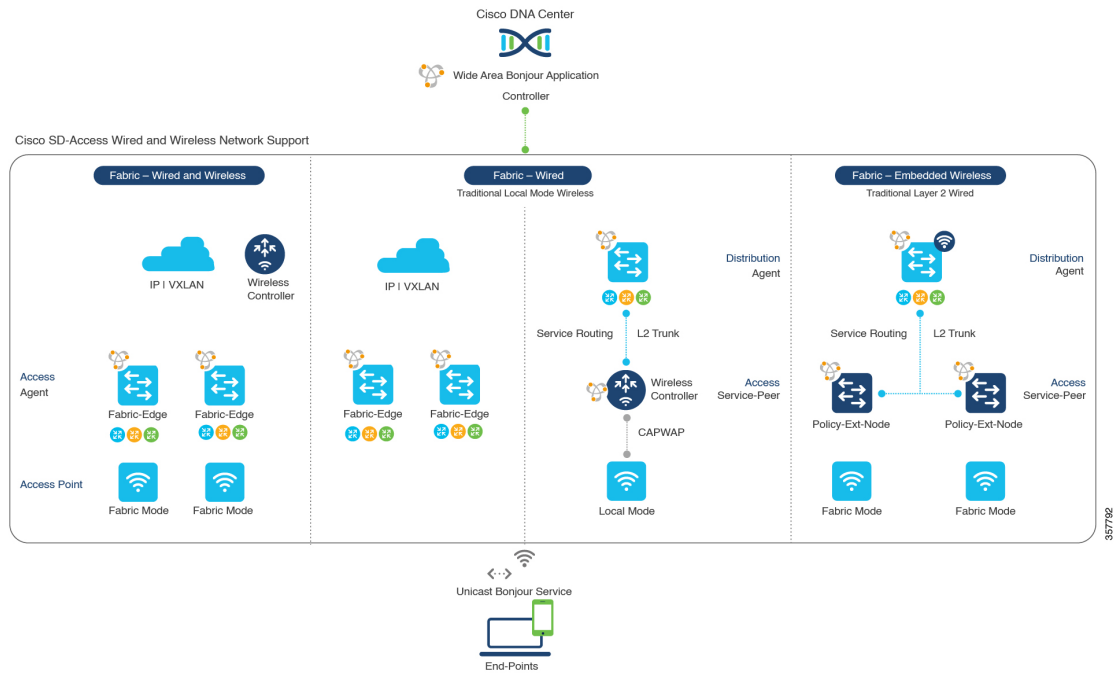
The Cisco Catalyst Center Service for Bonjour for SD-Access enabled wired and fabric, or traditional mode-wireless networks use two-tier service routing providing end-to-end unicast-based mDNS solution. Based on the network design, each solution component is enabled in a unique role to support the Wide Area Bonjour domain:

- **Fabric Edge SDG Agent**: The Layer 3 Cisco Catalyst Fabric Edge switch in the access layer configured as SDG agent provides unicast-based mDNS gateway function to the locally attached wired and wireless endpoints. The VRF-aware mDNS service policy provides network service security and segmentation in a virtual network environment. The mDNS services can be locally distributed and routed through centralized Catalyst Center.

- **Policy Extended Node**: The Layer 2 Cisco Catalyst access layer switch enables first-hop mDNS gateway function without flooding across the Layer 2 broadcast domain. The unicast-based service routing with upstream Fabric Edge switch in the distribution layer enables mDNS service routing within the same Layer 2 network block. It can also perform remote service discovery and distribution from centralized Catalyst Center.

- **Cisco Wireless Controller**: Based on the following wireless deployment modes, Cisco Wireless Controller supports unique function to enable mDNS service routing in Cisco SD-Access enabled network:

  - **Fabric-Enabled Wireless**: Cisco Wireless Controller doesn't require any mDNS gateway capability to be enabled in distributed fabric-enabled wireless deployments.

  - **Local Mode Wireless**: As Cisco Wireless Controller provides central control and data plane termination, it provides mDNS gateway in service peer mode for wireless endpoints. The wireless controller provides mDNS gateway between locally associated wireless clients. The wireless controller builds service routing with upstream SDG agent Catalyst switch providing IP gateway and service routing function for wireless endpoints.

- **Embedded Wireless Controller—Switch**: The Cisco Embedded Wireless Controller solution enables the lightweight integrated wireless controller function within the Cisco Catalyst 9300 Series Switch. The Cisco Catalyst switches in the distribution layer function as SDG agents to the wired and wireless endpoints. The SDG agent in the distribution layer provides unicast service routing across all wireless access points and Layer 2 service peer switches without mDNS flooding.

- **Catalyst Center Controller**: The Cisco Wide Area Bonjour application on Catalyst Center supports policy and location-based service discovery, and distribution between network-wide distributed Fabric Edge switches in SDG agent mode.

The Wide Area Bonjour communication between the SDG agent and controller takes place through the network underlay. Based on policies, the SDG agent forwards the endpoint announcements or queries to the Catalyst Center. After discovering a service, the endpoints can establish direct unicast communication through the fabric overlay in the same virtual network. The inter-virtual network unicast communication takes place through the Fusion router or external Firewall system. This communication is subject to the configured overlay IP routing and Security Group Tag (SGT) policies.

BGP EVPN Networks

The BGP EVPN-based technology provides a flexible Layer 3 segmentation and Layer 2 extension overlay network. The VRF and EVPN VXLAN-aware Wide Area Bonjour service routing provides secure and segmented mDNS service solution. The overlay networks eliminate mDNS flooding over EVPN-enabled Layer 2 extended networks and solve the service reachability challenges for Layer 3 segmented routed networks in the fabric.

The following figure shows the BGP EVPN leaf switch in the distribution layer, supporting overlay Bonjour service routing for a BGP EVPN-enabled traditional Layer 2 wired access switch and traditional wireless local mode enterprise network interconnected through various types of Layer 2 networks and Layer 3 segmented VRF-enabled networks.

Figure 7: Overlay Bonjour Service for a BGP EVPN-Enabled Enterprise Network
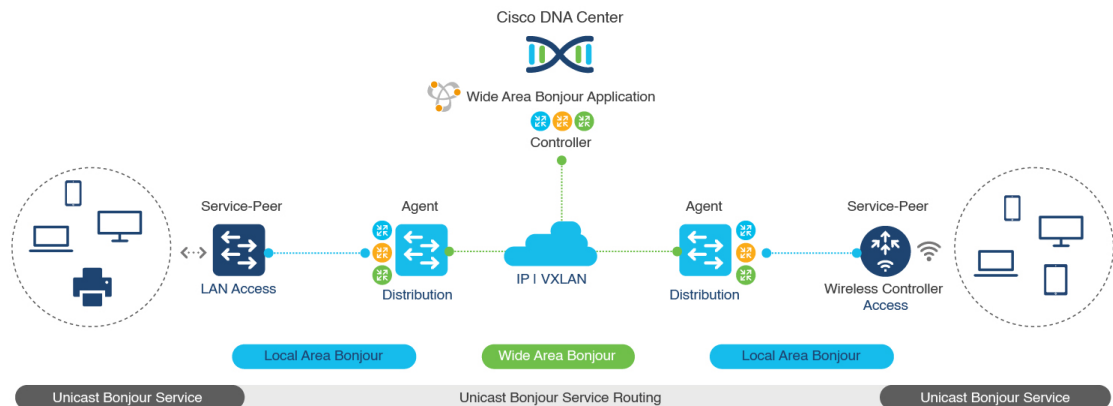
Cisco Catalyst Center Service for Bonjour supports all the industry-standard overlay network designs enabling end-to-end unicast-based mDNS service routing, and preventing flooding and service boundary limitation across wired and wireless networks.

The following figure illustrates the various BGP EVPN VXLAN reference overlay network design alternatives. This network design enables end-to-end mDNS service discovery and distribution based on overlay network policies.

Figure 8: BGP EVPN VXLAN Wired and Wireless Design Alternatives
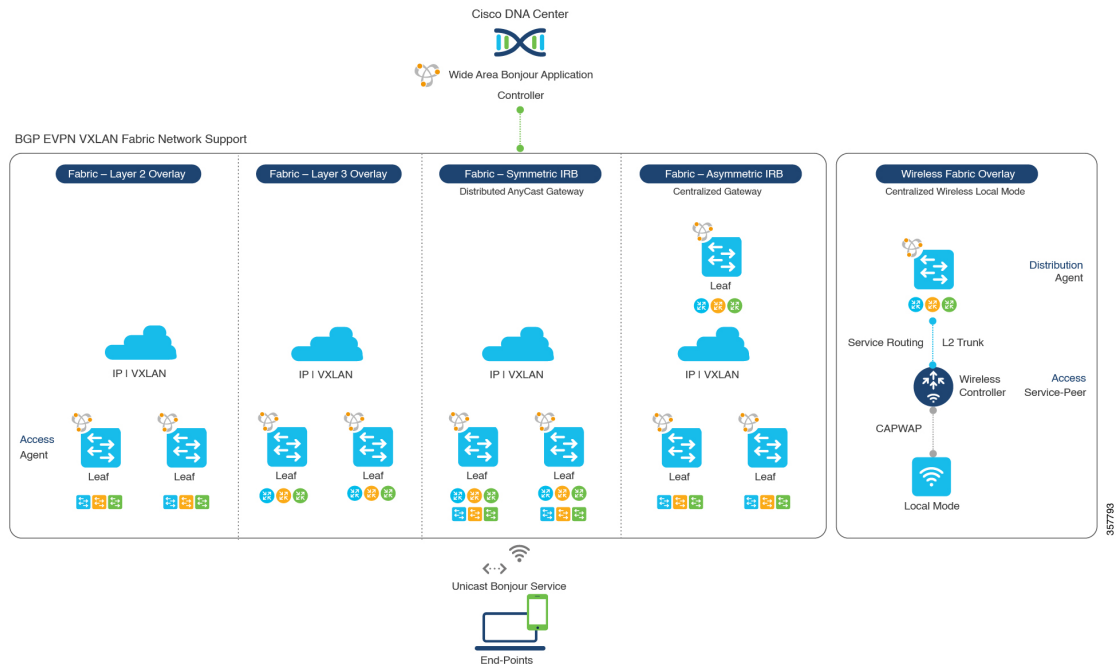
The Cisco Catalyst and Cisco Nexus 9000 Series Switches can be deployed in Layer 2 or Layer 3 leaf roles supporting mDNS service routing for a broad range of overlay networks. In any role, the mDNS communication is limited locally and supports end-to-end unicast-based service routing across Wide Area Bonjour domain:

- **Layer 2 Leaf SDG Agent**: The Cisco Catalyst or Cisco Nexus switches can be deployed as Layer 2 leaf supporting end-to-end bridged network with IP gateway within or beyond BGP EVPN VXLAN fabric network. By default, the mDNS is flooded as Broadcast, Unknown Unicast, Multicast (BUM) over the fabric-enabled core network. This mDNS flooding may impact network performance and security. The Layer 2 leaf, enabled as SDG agent, prevents mDNS flooding over VXLAN and supports unicast-based service routing.

- **Layer 3 Leaf SDG Agent**: The Cisco Catalyst or Cisco Nexus switches can be deployed as SDG agent supporting Layer 3 overlay network in BGP EVPN VXLAN fabric. The IP gateway and mDNS service boundary is terminated at the SDG agent switches and remote services can be discovered or distributed through centralized Catalyst Center.

- **Local Mode Wireless**: The centralized wireless local mode network can be terminated within or outside the EVPN VXLAN fabric domain to retain network segmentation and service discovery for wireless endpoints. The Cisco Catalyst 9800 Series Wireless Controller in service peer mode can build unicast service routing with distribution layer IP and SDG agent Cisco Catalyst switch to discover services from BGP EVPN VXLAN fabric overlay network.

- **Catalyst Center**: Catalyst Center supports Wide Area Bonjour capability to dynamically discover and distribute mDNS services based on Layer 2 or Layer 3 Virtual Network ID (VNID) policies to route the mDNS services between SDG agent switches in the network.

For more information about BGP EVPN networks, see *Cisco Catalyst Center Service for Bonjour Configuration Guide, Cisco IOS XE Bengaluru 17.6.x (Catalyst 9600 Switches)*.

Configuring Local Area Bonjour in Multicast DNS Mode for LAN and Wireless Networks

How to configure Multicast DNS Mode for LAN and Wired Networks

This section provides information about how to configure Local Area Bonjour in multicast DNS mode.

Enabling mDNS Gateway on the Device

To configure mDNS on the device, follow these 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 gateway** **Example:** Device(config)# **mdns-sd gateway**	Enables mDNS on the device and enters mDNS gateway configuration mode. Enter the following commands in mDNS gateway configuration mode to enable the respective functionalities:

	Command or Action	Purpose
		• **air-print-helper**: Enables IOS devices like iPADs to discover and use older printers that support Bonjour
		• **cache-memory-max**: Configures the percentage memory for cache
		• **ingress-client**: Configures Ingress Client Packet Tuners
		• **rate-limit**: Enables rate limiting of incoming mDNS packets
		• **service-announcement-count**: Configures maximum service advertisement count
		• **service-announcement-timer**: Configures advertisements announce timer periodicity
		• **service-query-count**: Configures maximum query count
		• **service-query-timer**: Configures query forward timer periodicity
		Note For **cache-memory-max**, **ingress-client**, **rate-limit**, **service-announcement-count**, **service-announcement-timer**, **service-query-count**, and **service-query-timer** commands, you can retain the default value of the respective parameter for general deployments. Configure a different value, if required, for a specific deployment.
Step 4	**exit** **Example:** `Device(config-mdns-sd)# exit`	Exits mDNS gateway configuration mode.

Creating Custom Service Definition

Service definition is a construct that provides an admin friendly name to one or more mDNS service types or PTR Resource Record Name. By default, a few built-in service definitions are already predefined and available for admin to use. In addition to built-in service definitions, admin can also define custom service definitions.

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** *service-definition-name* **Example:** Device(config)# **mdns-sd service-definition CUSTOM1**	Configures mDNS service definition. **Note** All the created custom service definitions are added to the primary service list. Primary service list comprises of a list of custom and built-in service definitions.
Step 4	**service-type** *string* **Example:** Device(config-mdns-ser-def)# **service-type _custom1._tcp.local**	Configures mDNS service type.
Step 5	Repeat step 4 to configure more than one service type in the custom service definition.	
Step 6	**exit** **Example:** Device(config-mdns-ser-def)# exit	Exit mDNS service definition configuration mode.

Creating Service List

mDNS service list is a collection of service definitions. To create a service list, follow these 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.

	Command or Action	**Purpose**
Step 3	**mdns-sd service-list** *service-list-name* {**in** | **out**} **Example:** Device(config)# **mdns-sd service-list VLAN100-list in**	Configures mDNS service list.
Step 4	**match** *service-definition-name* [**message-type** {**any** | **announcement** | **query**}] **Example:** Device(config-mdns-sl-in)# **match PRINTER-IPPS message-type announcement**	Matches the service to the message type. Here, *service-definition-name* refers to the names of services, such as, airplay, airserver, airtunes, and so on. **Note** To add a service, the service name must be part of the primary service list. If the mDNS service list is set to IN, the applicable command syntax is: **match** *service-definition-name* [**message-type** {**any** | **announcement** | **query**}]. If the mDNS service list is set to OUT, the applicable command syntax is: **match** *service-definition-name* [**message-type** {**any** | **announcement** | **query**}] [**location-filter** *location-filter-name*] [**source-interface** {*mDNS-VLAN-number* | *mDNS-VLAN-range*}].
Step 5	**exit** **Example:** Device(config-mdns-sl-in)# exit	Exits mDNS service list configuration mode.

Creating Service Policy

A Service Policy that is applied to an interface specifies the allowed Bonjour service announcements or the queries of specific service types that should be processed, in ingress direction or egress direction or both. For this, the service policy specifies two service-lists, one each for ingress and egress directions. In the Local Area Bonjour domain, the same service policy can be attached to one or more Bonjour client VLANs; however, different VLANs may have different service policies.

To configure service policy with service lists, follow these 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-policy** *service-policy-name* **Example:** Device(config)# **mdns-sd service-policy mdns-policy1**	Configures mDNS service policy.
Step 4	**service-list** *service-list-name* {**in**	**out**} **Example:** Device(config-mdns-ser-pol)# **service-list VLAN100-list in** Device(config-mdns-ser-pol)# **service-list VLAN300-list out**	Configures service lists for IN and OUT directions.
Step 5	**exit** **Example:** Device(config-mdns-ser-pol)# exit	Exits mDNS service policy configuration mode.

Associating Service Policy to an Interface

To configure mDNS on the device, follow these 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	**interface** *interface-name* **Example:** Device(config)# **interface Vlan 601**	Enters interface mDNS configuration mode and enables interface configuration.

	Command or Action	Purpose
Step 4	**mdns-sd gateway** **Example:** Device(config-if)# **mdns-sd gateway**	Configures mDNS gateway on the interface. Enter the following commands in the interface mDNS gateway configuration mode to enable the respective functionalities:

- **active-query**: Sets the time interval for SDG agent to refresh the active status of connected Bonjour client services. The timer value ranges from 60 to 3600 seconds.

Note	This configuration is mandatory only on VLANs whose Bonjour policy is configured to accept Bonjour service announcements from connected Bonjour clients. If the VLAN is configured to only accept Bonjour queries but not Bonjour service announcements, this configuration is optional.

- **service-instance-suffix**(Optional) : Appends the service instance suffix to any announced service name that is forwarded to the controller.

- **service-mdns-query** [**ptr** | **all**]: Configures mDNS query request message processing for the specified query types.

  If the **service-mdns-query** command is used without any keyword, then all Bonjour query types (PTR, SRV, and TXT) are processed by default. It is recommended to use the **service-mdns-query ptr** command.

- **service-policy** *policy-name*: Attaches the specified service policy to the VLAN. Bonjour announcements, and queries received by and sent from the VLAN are governed by the policies configured in the service policy. This configuration is mandatory for all VLANs.

Note	Service policies can only be attached at interface level.

	Command or Action	Purpose
		• **transport** [**all** | **ipv4** | **ipv6**] (Optional): Configures BCP parameter. It is recommended to use **transport ipv4** command, except in those networks where the Bonjour clients send only IPv6 announcements and queries.
Step 5	**exit** **Example:** `Device(config-if-mdns-sd)# exit`	Exits mDNS gateway configuration mode.

How to Configure Local Area Bonjour in Multicast DNS Mode for Wireless Networks

The configuration of local area Bonjour on a switch that acts as the SDG Agent in a wireless network involves the same set of procedures that are used to configure local area Bonjour on a switch that acts as the SDG Agent in a wired network.

The Bonjour protocol operates on service announcements and queries. Each query or advertisement is sent to the mDNS IPv4 address 224.0.0.251 and IPv6 address FF02::FB. The mDNS messages are carried over well-known industry standard UDP port 5353, over both Layer 3 transport types.

The Layer 2 address used by the Bonjour protocol is link-local multicast address and therefore it's only forwarded to the same Layer 2 network. As multicast DNS (mDNS) is limited to a Layer 2 domain, for a client to discover a service, it has to be a part of the same Layer 2 domain. This isn't always possible in a large-scale deployment or enterprise.

To enable mDNS communication between Wireless endpoints and Cisco Catalyst switch that acts as an SDG Agent, the intermediate WLC must transparently allow the network to transmit and receive mDNS messages.

Hence, for a Multicast DNS Mode Wireless network deployment, disable the mDNS Snooping on Cisco AireOS based WLC and enable mDNS Gateway feature on Cisco Catalyst 9800 series WLC and set the AP Multicast Mode to Multicast.

Figure below illustrates a prerequisite configuration for Wireless network to enable seamless communication between SDG-Agent switches and Wireless endpoints.
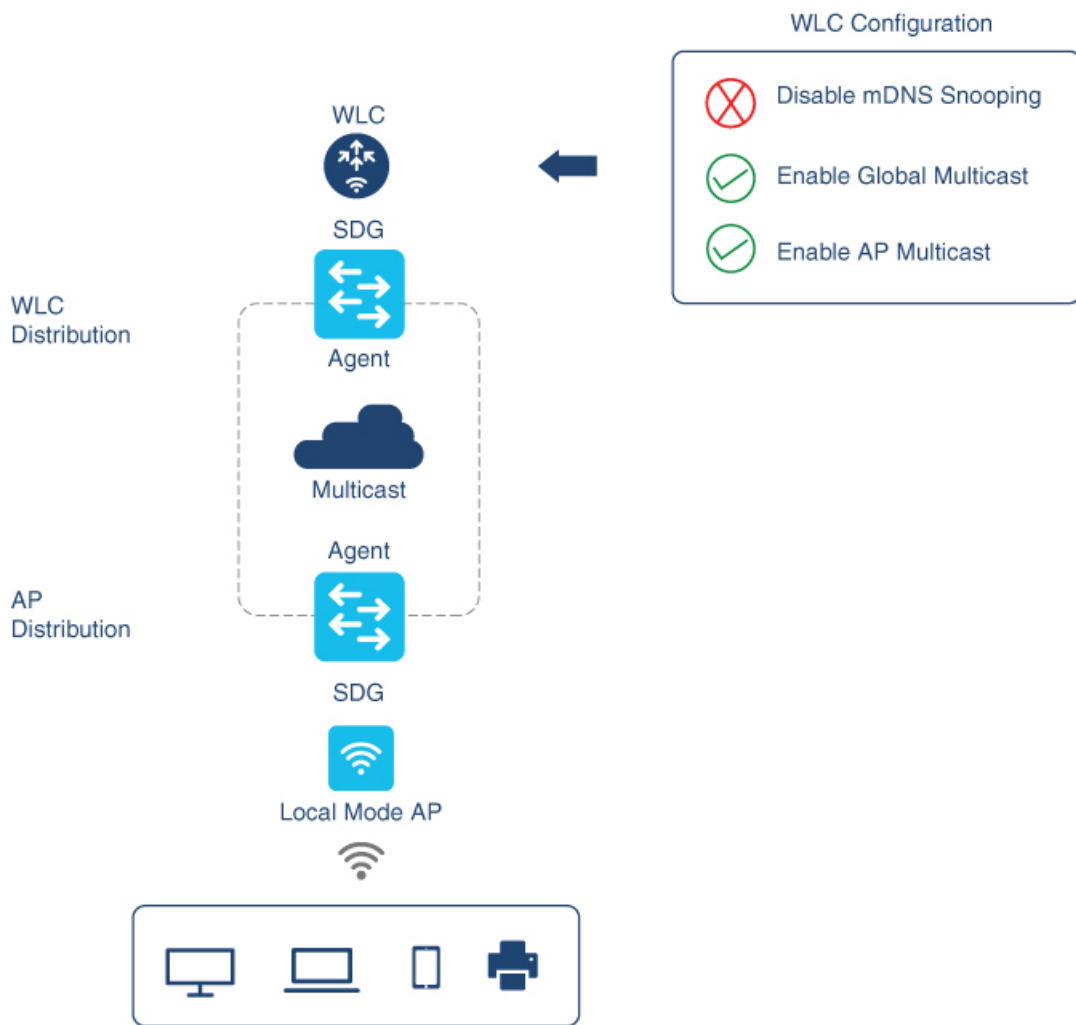
The Cisco WLC and Access Points by default prevent the forwarding of Layer 2 or Layer 3 Multicast frames between Wireless and Wired network infrastructure. The forwarding is supported with stateful capabilities enabled using AP Multicast. The network administrator must globally enable Multicast and configure a unique Multicast Group to advertise in the network. This multicast group is only required for Cisco Access Points to enable Multicast over Multicast (MCMC) capabilities across the LAN network. The Bonjour solution doesn't require any Multicast requirements on Wireless Client VLAN; thus, it's optional and applicable only for other Layer 3 Multicast applications.

The core network must be configured with appropriate Multicast routing to allow the Access Points to join WLC Multicast Group. The Multicast configuration must be enabled on Cisco WLC management VLAN and on the Cisco Access Points of their respective distribution layer switch.

Enabling mDNS Gateway on the Device

To configure mDNS on the device, follow these steps:

Procedure

	Command or Action	**Purpose**
Step 1	**enable**	Enables privileged EXEC mode.
	Example:	Enter your password, if prompted.
	Device> **enable**	
Step 2	**configure terminal**	Enters global configuration mode.
	Example:	
	Device# **configure terminal**	
Step 3	**mdns-sd gateway**	Enables mDNS on the device and enters mDNS gateway configuration mode.
	Example:	Enter the following commands in mDNS gateway configuration mode to enable the respective functionalities:
	Device(config)# **mdns-sd gateway**	• **air-print-helper**: Enables IOS devices like iPADs to discover and use older printers that support Bonjour
		• **cache-memory-max**: Configures the percentage memory for cache
		• **ingress-client**: Configures Ingress Client Packet Tuners
		• **rate-limit**: Enables rate limiting of incoming mDNS packets
		• **service-announcement-count**: Configures maximum service advertisement count
		• **service-announcement-timer**: Configures advertisements announce timer periodicity
		• **service-query-count**: Configures maximum query count
		• **service-query-timer**: Configures query forward timer periodicity
		Note For **cache-memory-max**, **ingress-client**, **rate-limit**, **service-announcement-count**, **service-announcement-timer**, **service-query-count**, and **service-query-timer** commands, you can retain the default value of the respective parameter for general deployments. Configure a different value, if required, for a specific deployment.

	Command or Action	Purpose
Step 4	**exit** **Example:** Device(config-mdns-sd)# exit	Exits mDNS gateway configuration mode.

Creating Custom Service Definition

Service definition is a construct that provides an admin friendly name to one or more mDNS service types or PTR Resource Record Name. By default, a few built-in service definitions are already predefined and available for admin to use. In addition to built-in service definitions, admin can also define custom service definitions.

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** *service-definition-name* **Example:** Device(config)# **mdns-sd service-definition CUSTOM1**	Configures mDNS service definition. **Note** All the created custom service definitions are added to the primary service list. Primary service list comprises of a list of custom and built-in service definitions.
Step 4	**service-type** *string* **Example:** Device(config-mdns-ser-def)# **service-type _custom1._tcp.local**	Configures mDNS service type.
Step 5	Repeat step 4 to configure more than one service type in the custom service definition.	
Step 6	**exit** **Example:** Device(config-mdns-ser-def)# exit	Exit mDNS service definition configuration mode.

Creating Service List

mDNS service list is a collection of service definitions. To create a service list, follow these 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**	Configures mDNS service list.

Step 4	**match** *service-definition-name* [**message-type** {**any** | **announcement** | **query**}]
	
	Example:
	
	Device(config-mdns-sl-in)# **match PRINTER-IPPS message-type announcement**
		Matches the service to the message type. Here, *service-definition-name* refers to the names of services, such as, airplay, airserver, airtunes, and so on.
		
		Note To add a service, the service name must be part of the primary service list.
		
		      If the mDNS service list is set to IN, the applicable command syntax is: **match** *service-definition-name* [**message-type** {**any** | **announcement** | **query**}].
		
		      If the mDNS service list is set to OUT, the applicable command syntax is: **match** *service-definition-name* [**message-type** {**any** | **announcement** | **query**}] [**location-filter** *location-filter-name*] [**source-interface** {*mDNS-VLAN-number* | *mDNS-VLAN-range*}].

Step 5	**exit** **Example:** Device(config-mdns-sl-in)# exit	Exits mDNS service list configuration mode.

Creating Service Policy

A Service Policy that is applied to an interface specifies the allowed Bonjour service announcements or the queries of specific service types that should be processed, in ingress direction or egress direction or both. For this, the service policy specifies two service-lists, one each for ingress and egress directions. In the Local Area Bonjour domain, the same service policy can be attached to one or more Bonjour client VLANs; however, different VLANs may have different service policies.

To configure service policy with service lists, follow these steps:

Procedure

	Command or Action	**Purpose**
Step 1	**enable**	Enables privileged EXEC mode.
	Example:	Enter your password, if prompted.
	Device> **enable**	
Step 2	**configure terminal**	Enters global configuration mode.
	Example:	
	Device# **configure terminal**	
Step 3	**mdns-sd service-policy** *service-policy-name*	Configures mDNS service policy.
	Example:	
	Device(config)# **mdns-sd service-policy mdns-policy1**	
Step 4	**service-list** *service-list-name* {**in** | **out**}	Configures service lists for IN and OUT directions.
	Example:	
	Device(config-mdns-ser-pol)# **service-list VLAN100-list in**	
	Device(config-mdns-ser-pol)# **service-list VLAN300-list out**	
Step 5	**exit**	Exits mDNS service policy configuration mode.
	Example:	
	Device(config-mdns-ser-pol)# **exit**	

Verifying Local Area Bonjour in Multicast DNS Mode for LAN and Wireless Networks

This section shows how to verify Local Area Bonjour in Multicast DNS mode for LAN and Wireless networks.

Verifying SDG-Agent Status

The following is a sample output of the **show mdns-sd service-list** *service-list-name* {**in** \| **out**} command.

```
Name            Direction  Service   Message-Type    Source
=============================================================
VLAN100-list    In         Printer   Announcement     -
                In         Airplay   Query            -
                In         CUSTOM1   Any              -
VLAN300-list    Out        Printer   Announcement     Vl200
```

The following is a sample output of the **show mdns-sd service-definition***service-definition-name* **service-type** {*custom | built-in*} command.

```
Service                 PTR                     Type
==============================================================================
apple-tv                _airplay._tcp.local       Built-In
                         _raop._tcp.local
apple-file-share        _afpovertcp._tcp.local    Built-In
CUSTOM1                 _custom1._tcp.local       Custom
CUSTOM2                 _customA._tcp.local       Custom
                         _customA._tcp.local
```

The following is a sample output of the **show mdns-sd** *service-policy-name* **interface** *interface-name* command.

```
Name    Service-List-In   Service-List-Out
==================================================
mdns-policy-1  VLAN100-list   VLAN300-list
mdns-policy-2  VLAN400-list   VLAN400-list
```

The following is a sample output of the **show mdns-sd summary** command.

```
mDNS Gateway: Enabled
Mode: Service Peer
Service Announcement Periodicity(in seconds): 30
Service Announcement Count: 50
Service Query Periodicity(in seconds): 15
Service Query Count: 50
Active Response Timer (in seconds): Disabled
ANY Query Forward: Disabled
SDG Agent IP: 9.8.57.10
Active Query Periodicity (in minutes): 30
mDNS Query Type: PTR only
Transport Type: IPv4
mDNS AP service policy: default-mdns-service-policy
```

The following is a sample output of the **show mdns-sd sp-sdg statistics** command.

```
mDNS SP Statistics
last reset time: 07/27/21 15:36:33
Messages sent:
Query : 122
ANY query : 35
Advertisements : 12
```

```
Advertisement Withdraw : 1
Service-peer cache clear : 0
Resync response : 3
Srvc Discovery response : 0
Keep-Alive : 2043
Messages received:
Query response : 0
ANY Query response : 0
Cache-sync : 9
Get service-instance : 0
Srvc Discovery request : 0
Keep-Alive Response : 2042
```

Verifying Wide Area Bonjour Controller Status

The following is a sample output of the **show mdns controller summary** command.

```
Device# show mdns controller summary

Controller Summary
======================================
 Controller Name   :   Cisco Catalyst Center-BONJOUR-CONTROLLER
 Controller IP     :   10.104.52.241
 State             :   UP
 Port              :   9991
 Interface         :   Loopback0
 Filter List       :   policy1
 Dead Time         :   00:01:00
```

The following is a sample output of the **show mdns controller export-summary** command.

```
Device# show mdns controller export-summary

Controller Export Summary
==========================
 Controller IP     :   10.104.52.241
 State             :   UP
 Filter List       :   policy1
 Count             :   100
 Delay Timer       :   30 seconds
 Export            :   300
 Drop              :   0
 Next Export       :   00:00:01
```

The following is a sample output of the **show mdns controller statistics** command.

```
Device# show mdns controller statistics

Total BCP message sent          : 47589
  Total BCP message received      : 3
  Interface WITHDRAW messages sent : 0
  Clear cache messages sent       : 0
  Total RESYNC state count        : 0
  Last successful RESYNC          : Not-Applicable
```

```
   Service Advertisements:
    IPv6 advertised                   : 0
    IPv4 advertised                   : 300
    Withdraws sent                    : 0
    Advertisements Filtered           : 0
    Total service resynced            : 0

   Service Queries:
    IPv6 queries sent                 : 0
    IPv6 query responses received     : 0
    IPv4 queries sent                 : 0
    IPv4 query responses received     : 0
```

The following is a sample output of the **show mdns controller detail** command.

```
Device# show mdns controller detail

Controller : Cisco Catalyst Center-BONJOUR-CONTROLLER
 IP : 10.104.52.241, Dest Port : 9991, Src Port : 0, State : UP
 Source Interface : Loopback0, MD5 Disabled
 Hello Timer 0 sec, Dead Timer 0 sec, Next Hello 00:00:00
 Uptime 00:00:00
Service Announcement :
 Filter : policy1
 Count 100, Delay Timer 30 sec, Pending Announcement 0, Pending Withdraw
 0
 Total Export Count 300, Next Export in 00:00:16
Service Query :
 Query Suppression Disabled
 Query Count 50, Query Delay Timer 15 sec, Pending 0
 Total Query Count 0, Next Query in 00:00:01
```

Verifying Local Area Bonjour Configuration for LAN and Wireless Networks

The following is a sample output of the **show run** command.

```
mdns-sd gateway

mdns-sd service-definition custom1
 service-type _airplay._tcp.local
 service-type _raop._tcp.local


mdns-sd service-list list1 IN
 match custom1
mdns-sd service-list list2 OUT
 match custom1


mdns-sd service-policy policy1
```

```
service-list list1 IN
service-list list2 OUT


service-export mdns-sd controller Cisco Catalyst Center-CONTROLLER-POLICY
controller-address 99.99.99.10
controller-service-policy policy1 OUT
controller-source-interface Loopback0
```

Configuring VRF-Aware Local Area Bonjour Services

Beginning from Cisco IOS XE Bengaluru 17.4.1, Cisco Catalyst 9000 Series switches supports Virtual Routing and Forwarding-Aware (VRF-Aware) services in Local Area Bonjour domain. VRF-Aware Local Area Bonjour services provide boundary-based service discovery for Layer 3 segmented IPv4 and IPv6 network and support policy-based (secure) routing services for Wired and Wireless networks. VRF-Aware Local Area Bonjour service is supported on enterprise-grade, traditional, and next-generation fabric-based deployment models as described in Cisco DNA Service for Bonjour Solution Overview.

Prerequisites for VRF-Aware Local Area Bonjour Services

- You must understand the mDNS service segmentation capabilities to implement, manage, and troubleshoot the proxy service in Local Area Bonjour domain.

- Ensure that the Cisco Catalyst 9000 Series switch is configured in SDG-Agent mode. VRF-Aware Local Area Bonjour service is supported on first-hop IP gateway of switches configured in SDG-Agent mode in Wired and Wireless networks.

- Ensure that the software version installed on the Cisco Catalyst 9000 Series switch is Cisco IOS XE Bengaluru 17.4.1 or higher.

- Ensure that all required IP VRF with IPv4 or IPv6 address-family configurations is completed. These configurations are required to activate VRF on the switch configured in SDG-Agent mode.

- Ensure that the IP VRF configured to a local SVI interface supports IP gateway so that the mDNS Wired and Wireless endpoint can be attached directly or remotely.

- To activate mDNS gateway in Unicast mode for a VLAN, ensure that the mDNS gateway and service policy is configured after enabling the VLAN using the **vlan configuration** *id* command.

- Ensure that all configurations for IPv4 or IPv6-based data routing and forwarding both within the same VRF or different VRFs are complete including network requirements such as stateful firewall configuration, route-leaking configuration and so on.

Restrictions for VRF-Aware Local Area Bonjour Services

- VRF-Aware Local Area Bonjour service is not supported on a Layer 2 Cisco Catalyst 9000 Series switch or a Layer 2 Cisco Catalyst 9800 WLC in Service-Peer mode.

- VRF-Aware Local Area Bonjour services are configured to provide mDNS service discovery information between Layer 3 segments within the same or different IP VRF, or share services from non-VRF enabled networks only. Any additional IP routing and data forwarding configurations are beyond the scope of this implementation.

Information about VRF-Aware Local Area Bonjour Services

The Cisco DNA Service for Bonjour solution provides end-to-end service-routing for enterprise-grade Wired and Wireless networks. The enterprise network builds secure and segmented networks that protect IT-managed infrastructure and shares services and resources among trusted and untrusted user group. The physical infrastructure can be logically virtualized into a private networking space that supports secure communication services within closed user groups and conditionally extends boundary services based on business and technical demands.

VRF-Aware Local Area Bonjour gateway services allow to dynamically discover and distribute mDNS services on the same VRF segmented Layer 3 overlay networks based on policy. You can also build an Extranet network using the mDNS location-filter policy that supports proxy services among multiple logical VRF or a global IP routing domain on a local system. The Layer 3 VRF segmented networks can also be configured to route in overlay using any next-generation overlay networks such as Cisco SD-Access, BGP EVPN VXLAN or classic technologies such as Multi-VRF, MPLS.

Figure illustrates the Cisco DNA Service for Bonjour solution configured with VRF-Aware services for enterprise-grade Wired and Wireless networks.

Figure 9: Cisco DNA Service for Bonjour with VRF-Aware Services
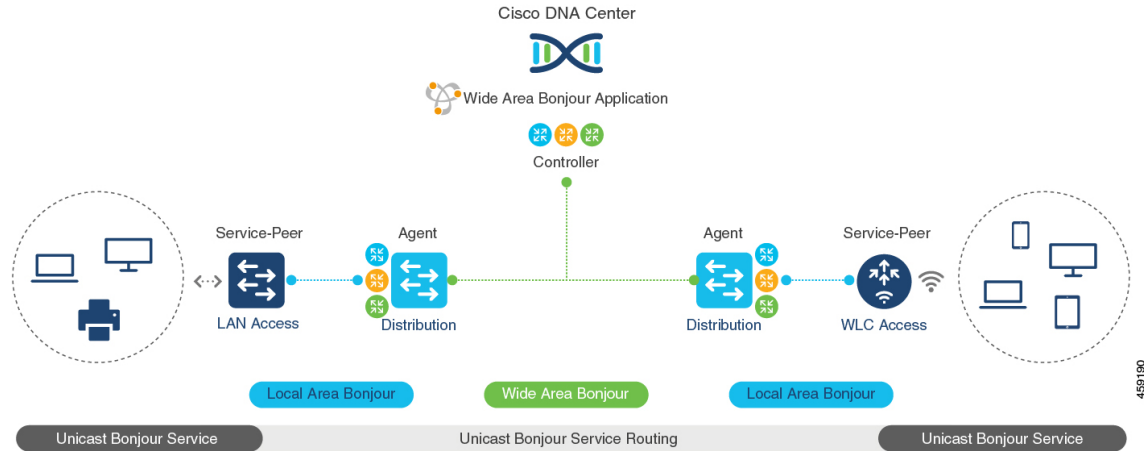
Gateway Modes for VRF-Aware Bonjour Services

VRF is a Layer 3 specific virtual routing function and therefore it is implemented on Layer 3 Ethernet switches with first-hop IP gateways that can directly or remotely attach mDNS endpoints.

Figure illustrates the Cisco Catalyst 9000 Series switch in SDG-Agent mode supporting VRF-Aware services in Layer 3 access mode and in multi-layer network deployment mode. In multi-layer network deployment mode, the gateway to the distribution layer provides a Layer 2 or Layer 3 boundary to a downstream Layer 2 Cisco Catalyst 9000 Series switch and Cisco Catalyst 9800 WLC for local proxy service with local VLANs.

Figure 10: Gateway Modes for VRF-Aware Services
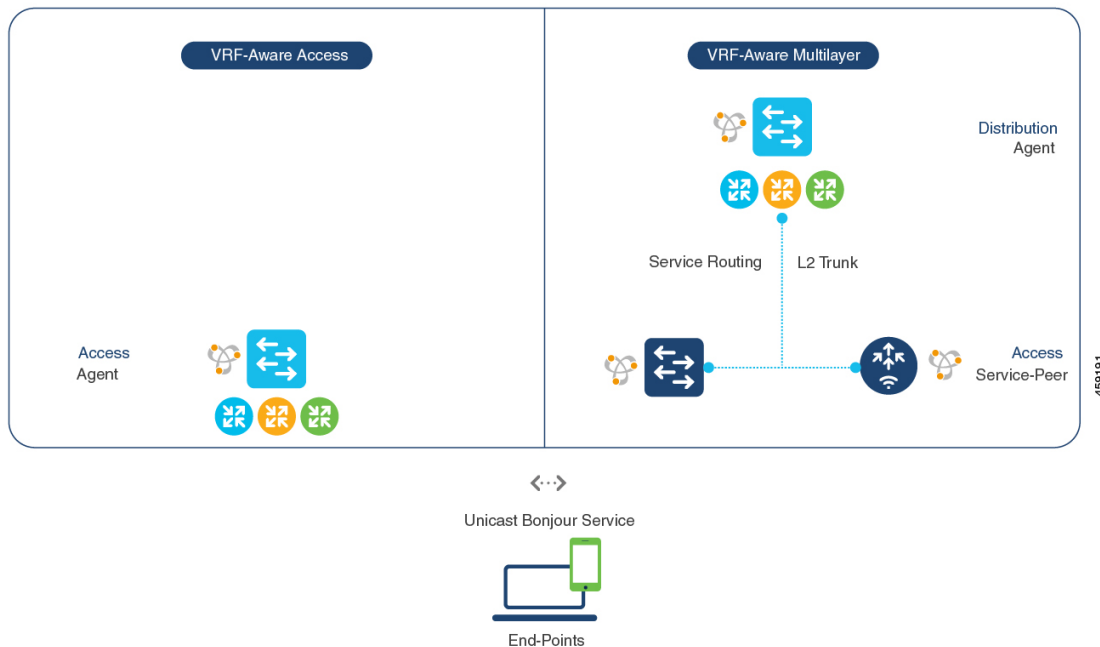
- **VRF-Aware Routed Access**: The Cisco Catalyst 9000 Series switch can be deployed as an IP gateway for directly attached Wired or Wireless mDNS endpoints. The Cisco Wireless SSID can be configured as fabric-enabled or as FlexConnect with local switching that provides local termination point to a first-hop Ethernet switch that supports Layer 3 overlay networks such as Cisco SD-Access or BGP EVPN based-fabric networks. A Cisco Catalyst 9000 Series switch configured in SDG-Agent mode provides unicast-based mDNS gateway services to directly attached Wired and Wireless endpoints within the same or different virtual routing network space or a default global IP network.

- **VRF-Aware Multilayer**: The Cisco Catalyst 9000 Series Switch can be deployed as an IP gateway for remotely attached Wired or Wireless mDNS endpoints through an intermediate Layer 2 Cisco Catalyst 9000 Series switch or Cisco Catalyst 9800 Series WLC. A Cisco Catalyst 9000 Series switch, configured in SDG-Agent mode and in the distribution layer, provides VRF-Aware mDNS gateway services, while the Layer 2 Ethernet switch and Cisco WLC in Unicast mode provides local proxy services to directly attached Wired and Wireless endpoints within the same or different VLAN.

Understanding VRF-Aware Wide Area Bonjour Services

The VRF-Aware service discovery and distribution can be implemented across multiple switches in SDG-Agent mode on an IP, MPLS, or VXLAN-enabled network with Wide Area Bonjour. The Cisco DNA-Center Wide Area Bonjour application supports granular and policy-based routing services that allow discovery and distribution of mDNS services dynamically over overlay networks. You can build a global policy combining one or more source and receiver SDG-Agents that allow distributing or advertising services from a specific IPv4 or even an IPv6 network mapped to the VRF.

The network wide and distributed switches in SDG-Agent mode transport locally discovered or requested mDNS service information over lightweight unicast routing services to a centralized Cisco DNA-Center controller in an underlay IPv4 network. These switches must be configured with a unified service-export policy for local networks mapped to one or more VRFs or to a global IP routing domain.

Figure illustrates VRF-Aware Wide Area Bonjour services for IP, MPLS, or VXLAN enabled overlay networks.

Figure 11: VRF-Aware Wide Area Bonjour Services
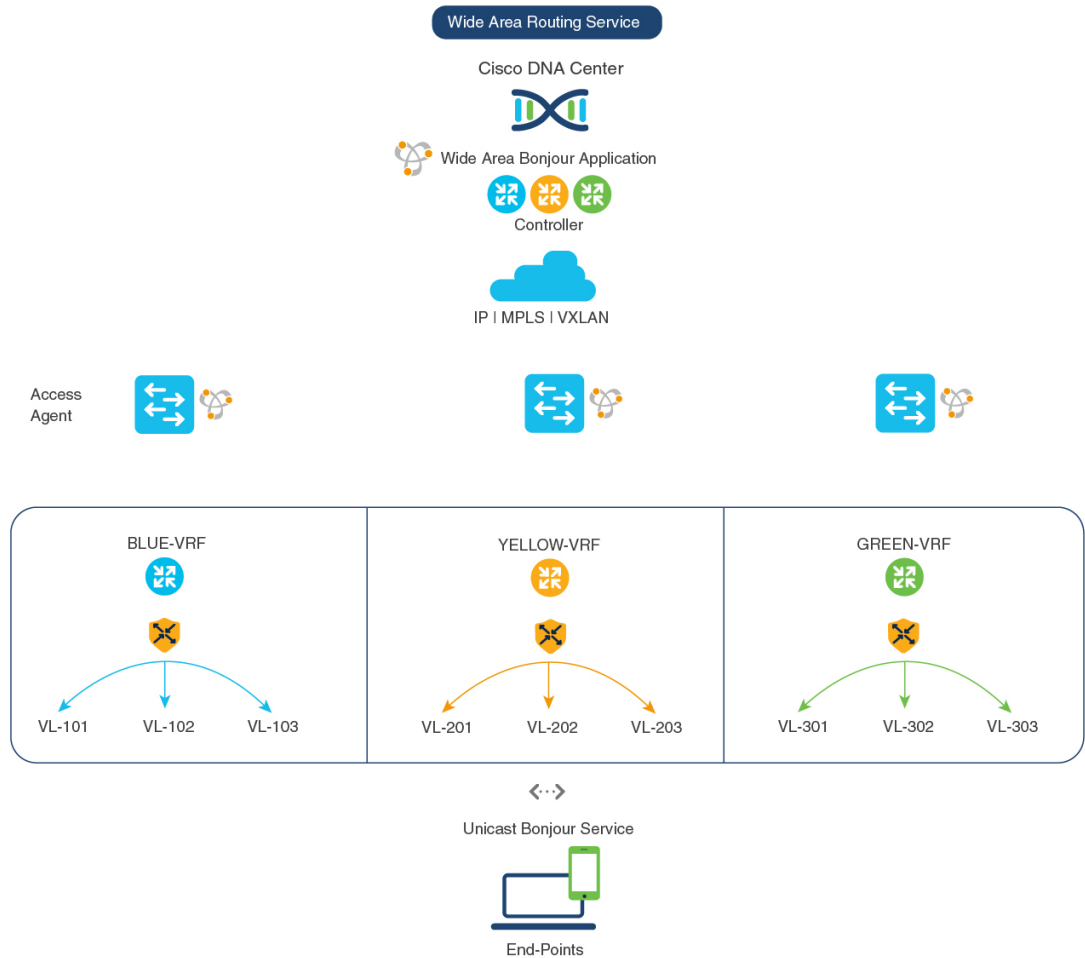
Understanding VRF-Aware Service on Multilayered Wired and Wireless Networks

The Cisco Catalyst 9000 Series switches support VRF-Aware service for multilayered Wired and central-switching Wireless-enabled networks. The Layer 2 or Layer 3 network boundary to the Cisco Catalyst 9000 Series switches is extended at the distribution layer with an intermediate Layer 2 Cisco Catalyst 9000 Series switch or Cisco Catalyst 9800 Series WLC and directly attached to the Wired and central-switching Wireless endpoints. As the IP gateway shifts, the Cisco Catalyst 9000 Series switches in the distribution layer must be configured in SDG-Agent mode and the downstream Layer 2 switch and WLC network devices must be configured in Service-Peer mode to support mDNS proxy services to locally attached endpoints.

The VRF-Aware service configured on a switch, in SDG-Agent mode and in the distribution layer, follows configuration and operation guidelines for Wired and central-switching Wireless as described in Understanding

VRF-Aware Wide Area Bonjour Services, on page 32. The Layer 2 switch and WLC network devices remains transparent to VRF-Aware services and continues to provide local proxy services to locally attached users in the same or different VLANs.

The VRF-Aware service discovery and distribution can be implemented across multiple switches in SDG-Agent mode on an IP, MPLS, or VXLAN-enabled network with Wide Area Bonjour. The Cisco DNA-Center Wide Area Bonjour application supports granular and policy-based routing services that allow discovery and distribution of mDNS services dynamically for overlay networks. You can build a global policy combining one or more source and receiver SDG-Agent that allow distributing or advertising services from a specific IPv4 or even an IPv6 network mapped to the VRF.

Figure illustrates end-to-end VRF-Aware on multilayered Wired and Wireless networks across Wide Area Bonjour domain with Cisco DNA-Center.

Figure 12: VRF-Aware on Multilayered Wired and Wireless Network
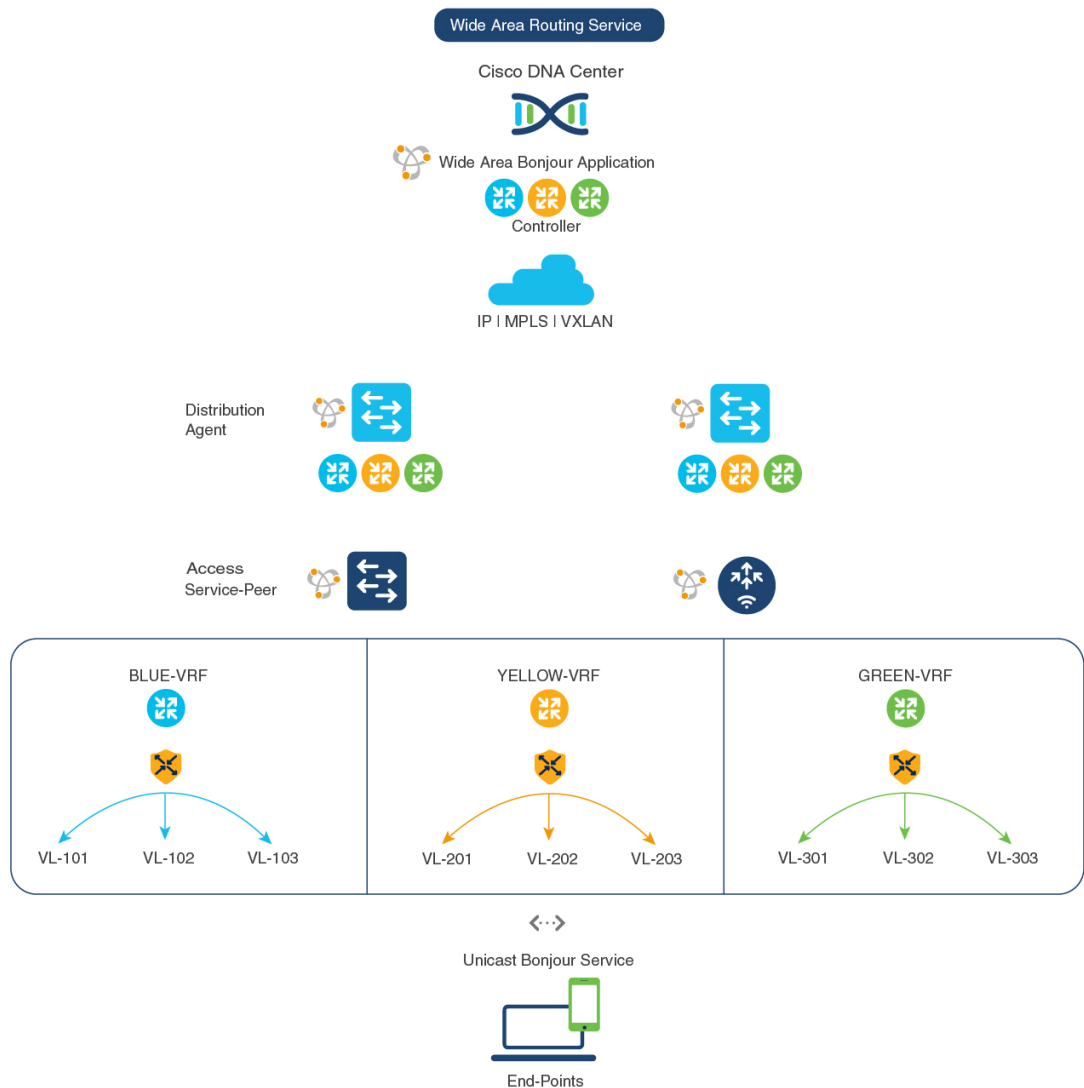
How to configure Intra-Virtual Network Proxy Service on Local Area Bonjour Domain

Intra-Virtual Network (Intra-VN) Proxy Service is a policy-based VRF-Aware service discovery and distribution implemented on the IP VRF of a switch in SDG-Agent mode connected to multiple IP networks.

Beginning from Cisco IOS XE Bengaluru 17.4.1, the Cisco Catalyst 9000 Series switches support mDNS gateway service as the default on each VRF. You must build a mDNS service policy that implicitly allows required mDNS service types and mapping services to endpoint facing VLANs. The Cisco Catalyst 9000 Series switch can automatically discover VRF associations to a VLAN interface without additional configurations.

The Cisco Catalyst 9000 Series switch in SDG-Agent mode dynamically discovers mDNS services from a local network and automatically builds VRF-aware service information. To enable Layer 3 segmented proxy service by default, the SDG-Agent provides limited mDNS service proxy response to endpoints in other VLANs mapped with the same VRF.

Figure illustrates VRF-Aware enabled on an Intra-VN proxy service.

Figure 13: Intra-VN Service Proxy

How to configure Inter-Virtual Network Proxy Service on Local Area Bonjour Domain

Inter-VN Proxy Service is a policy-based VRF-Aware service discovery and distribution implemented on multiple IP VRFs or on a global IP routing domain of a switch in SDG-Agent mode connected to multiple IP networks.

Beginning from Cisco IOS XE Bengaluru 17.4.1, the Cisco Catalyst 9000 Series switches support mDNS service discovery and distribution between IP VRFs or on a global routing domain based on the configured mDNS location-filter policy. The existing location-filter configuration on an SDG-Agent permits mDNS service information between configured VLANs and records discovery and distribution on the mapping table. Although configuring inter-VN provides Extranet mDNS proxy services between Wired and Wireless networks, additional methods such as stateful firewall, route-leaking and so on must also be configured to handle the data transfer between Inter-VN or VRF to global IP routing.

Figure shows Inter-VN proxy service for Extranet network.

Figure 14: Inter-VN Proxy Service
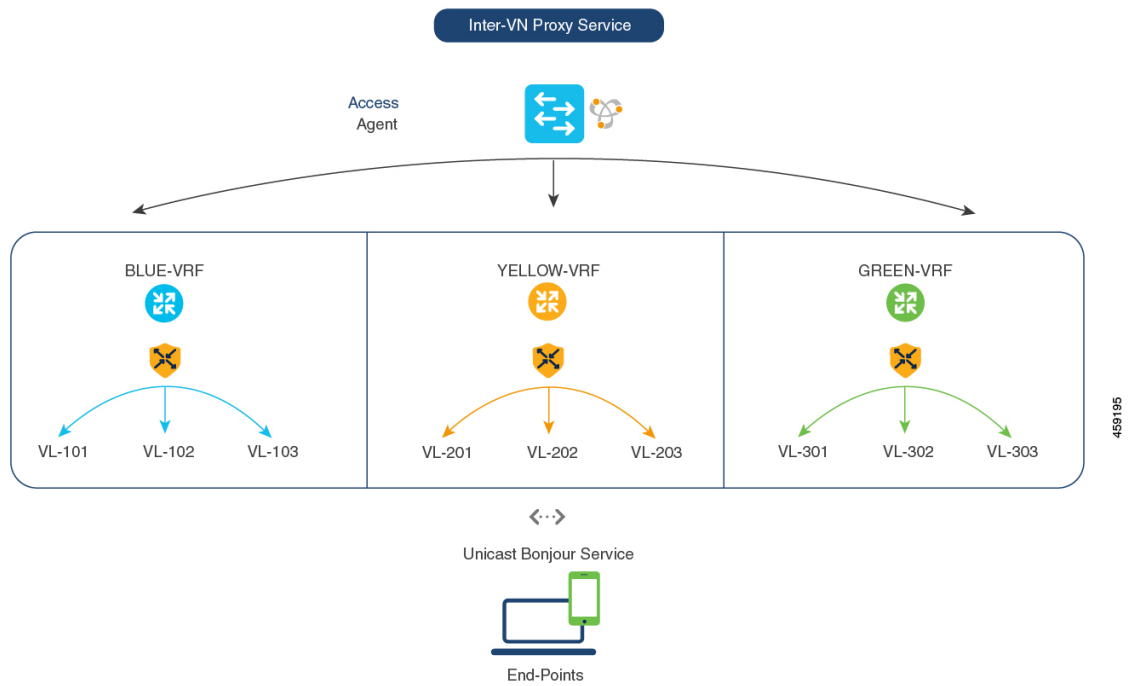
Configuring Inter-Virtual Network Location-Filter

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**	Enables privileged EXEC mode.
	Example:	Enter your password, if prompted.
	Device> **enable**	
Step 2	**configure terminal**	Enters global configuration mode.
	Example:	

	Command or Action	**Purpose**
	`Device# configure terminal`	
Step 3	**vlan** *ID*	Configures a VLAN ID in local database for overlay mDNS endpoints.
	Example:	

	`Device(config)# vlan 101`
	`Device(config-vlan)# name BLUE-VRF`
	`Device(config)# vlan 201`
	`Device(config-vlan)# name YELLOW-VRF`
	`Device(config)# vlan 301`
	`Device(config-vlan)# name GREEN-VRF`	

Step 4	**mdns-sd location-filter** *location-filter-name*	Configures a unique location-filter.
	Example:	
	`Device(config)# mdns-sd  location-filter` ` INTER-VN-LOCAL-PROXY`	
Step 5	**match location** {**all** | **default** | **ID**} **vlan** [**ID**]	Configures the match criteria that mutually distribute permitted services between grouped VLANs.
	Example:	

	`Device(config-mdns-loc-filter)# match`
	`location-group default vlan 101`
	`Device(config-mdns-loc-filter)# match`
	`location-group default vlan 201`
	`Device(config-mdns-loc-filter)# match`
	`location-group default vlan 301`	

Step 6	**mdns-sd service-list** *service-list-name* {**in** | **out**}	Configures mDNS service-list to classify one or more service-types. Unique service-list is required to process incoming mDNS message and the outbound response to the requesting end points.
	Example:	
	`Device(config)# mdns-sd service-list` `BLUE-VRF-LIST-OUT out`	
Step 7	**match** *service-destination-name* [**message-type** {**any** | **announcement** | **query**}]	Associates the location-filter to one or more service-types to enable local proxy between local VLANs. For example, the Apple-TV learned from the YELLOW-VRF VLAN 201 and the GREEN-VRF VLAN 301 will be distributed to the receiver in the BLUE-VRF VLAN 101.
	Example:	

	`Device(config)# mdns-sd service-list`
	`BLUE-VRF-LIST-OUT out`
	`Device(config-mdns-sl-out)# match`
	`APPLE-TV location-filter LOCAL-PROXY`
		The service-list contains implicit deny at the end.

		The message-type for outbound service-list is not required.
Step 8	**mdns-sd service-policy** *service-policy-name*	Creates a unique mDNS service-policy.
	Example:	
	`Device(config)# mdns-sd service-policy` ` BLUE-VRF-POLICY`	

	Command or Action	Purpose

Step 9	**service-list** *service-list-name* {**in** | **out**}
	
	Example:
	
	`Device(config)# mdns-sd service-policy BLUE-VRF-POLICY`
	`Device(config-mdns-ser-policy)# service-list BLUE-VRF-LIST-OUT out`
		Configures an mDNS service policy to associate with the service-list for each direction.

Step 10	**vlan configuration** *ID* **Example:** `Device(config)# vlan configuration 101-103`	Enables VLAN configuration for advanced service parameters. One or more VLANs can be created for the same settings. For example, the VLAN configuration range 101-110 or 200 allows to configure consecutive and nonconsecutive VLAN IDs.
Step 11	**mdns-sd gateway** **Example:** `Device(config-vlan)# mdns-sd gateway`	Enables the mDNS gateway on the specified VLAN IDs.
Step 12	**service-policy BLUE-VRF-POLICY** **Example:** `Device(config-vlan-mdns)# service-policy BLUE-VRF-POLICY`	Associates an mDNS service-policy with the specified VLAN IDs.
Step 13	**end** **Example:** `Device(config-vlan-mdns)# end`	Returns to privileged EXEC mode.

Verifying VRF-Aware Local Area Bonjour Services

The dynamically discovered VRF-Aware service information can be verified on Cisco Catalyst 9000 Series switch in SDG-Agent mode by including the **vrf** keyword on the existing **show mdns-sd** command. You can verify each VRF-service record information based on the unique VRF name.

The following is an example of the command that displays the dynamically discovered mDNS service records in the BLUE-VRF:

```
Device# show mdns-sd cache vrf BLUE-VRF


                                                   mDNS CACHE
=========================================================================================
[<NAME>]                                    [<TYPE>]    [<TTL>/Remaining] [Vlan-Id/If-name]
 [Mac Address]         [<RR Record Data>]


RTP-ATV-1._device-info._tcp.local           TXT         4500/4495         511
   a018.28f2.9889      (13)'model=J33iAP'
_airplay._tcp.local                         PTR         4500/4495         511
   a018.28f2.9889      RTP-ATV-1._airplay._tcp.local
```

```
_raop._tcp.local                                    PTR         4500/4495           511
    a018.28f2.9889        A01828F29889@RTP-ATV-1._raop._tcp.local
RTP-ATV-1._airplay._tcp.local                       SRV         4500/4495           511
    a018.28f2.9889      0           0                   7000            RTP-ATV-3.local
A01828F29889@RTP-ATV-1._raop._tcp.local             SRV         4500/4495           511
    a018.28f2.9889      0           0                   7000            RTP-ATV-3.local
RTP-ATV-1.local                                     AAAA        4500/4495           511
    a018.28f2.9889        2001:10:153:2:C2F:9445:7062:5C3C
RTP-ATV-1.local                                     A           4500/4495           511
    a018.28f2.9889        10.155.1.17
RTP-ATV-1._airplay._tcp.local                       TXT         4500/4495           511
    a018.28f2.9889
(208)'deviceid=A0:18:28:F2:98:89''features=0x5A7FFFF7,0x1E''flags=0x44''model=~'~
A01828F29889@RTP-ATV-1._raop._tcp.local             TXT         4500/4495           511
    a018.28f2.9889
(177)'cn=0,1,2,3''da=true''et=0,3,5''ft=0x5A7FFFF7,0x1E''md=0,1,2''am=AppleTV3,2'~
```

Use the following commands in privileged EXEC mode on a Cisco Catalyst 9000 Series switch configured in SDG-Agent mode to verify various Local Area Bonjour domain mDNS parameters such as service configuration, cache records, statistics, and so on.

Table 3: Commands to Verify VRF-Aware Services

Command	Purpose
show mdns-sd cache {**all** | **interface** | **mac** | **name** | **service-peer** | **static** | **type** | **vlan** | **vrf**}	Displays all available mDNS cache record that supports multiple variables and provides granular source details. The following variables are available: • **all**: Displays all available cache records discovered from multiple source connections of a system. • **interface**: Displays the available cache records discovered from a specified Layer 3 interface. • **mac**: Displays the available cache records discovered from the specified MAC address. • **name**: Displays the available cache records based on service provider announced name. • **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. • **vrf**: Displays each VRF available cache records based on the specific mDNS record type (PTR, SRV, TXT, A, or AAAA).
show mdns-sd service-definition {**name** | **type**}	Displays the built-in and user-defined custom service definitions and provides the mapping from service name to mDNS PTR records. The service-definition can be filtered by name or type.
show mdns-sd service-list {**direction** | **name**}	Displays the configured inbound or outbound service-list that classifies matching service types for a service policy. The service lists can be filtered by name or specific direction.

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

Feature History for Cisco DNA Service for Bonjour

Feature History for Cisco DNA Service for Bonjour

The following table provides release information about the feature or features described in this module. This table lists only the software release that introduced support for a given feature in a given software release train. Unless noted otherwise, subsequent releases of that software release train also support that feature.

Release	Modification
Cisco IOS 15.2(6) E2	Cisco DNA Service for Local Area Bonjour and Wide Area Bonjour (Multicast DNS Mode only), was introduced on the following platforms: • Cisco Catalyst 2960-X Series Switches • Cisco Catalyst 2960-XR Series Switches
Cisco IOS 15.5(1)SY4	Cisco DNA Service for Local Area Bonjour and Wide Area Bonjour (Multicast DNS Mode only) was introduced on Cisco Catalyst 6800 Series Switches.
Cisco IOS XE 3.11.0 E	Cisco DNA Service for Local Area Bonjour and Wide Area Bonjour (Multicast DNS Mode only) was introduced on the following platforms: • Cisco Catalyst 4500-E Series Switches • Cisco Catalyst 4500-X Series Switches

Release	Modification
Cisco IOS XE Gibraltar 16.11.1	Cisco DNA Service for Local Area Bonjour and Wide Area Bonjour (Multicast DNS Mode only) was introduced on the following platforms: • Cisco Catalyst 3650 Series Switches • Cisco Catalyst 3850 Series Switches • Cisco Catalyst 9300 Series Switches • Cisco Catalyst 9400 Series Switches • Cisco Catalyst 9500 Series Switches • Cisco Catalyst 9500 Series Switches - High Performance • Cisco Catalyst 9600 Series Switches • Cisco Catalyst 9800 Series Wireless Controllers • Cisco 5500 Series Wireless Controllers • Cisco 8540 Wireless Controllers • Cisco 4000 Series Integrated Services Routers (ISR)
Cisco IOS XE Amsterdam 17.1.1	Cisco DNA Service for Local Area Bonjour was introduced on Cisco Catalyst 9200 Series Switches.
Cisco IOS XE Amsterdam 17.2.1	Introduced Cisco DNA Service for Bonjour support for the following: • SD-Access network • Unicast mode for LAN network
Cisco IOS XE Amsterdam 17.3.2a	Introduced Cisco DNA Service for Bonjour support for the following: • Multilayer networks • Location grouping in wired networks • mDNS AP group in wireless networks

Release	Modification
Cisco IOS XE Bengaluru 17.6.1	Introduced support for the following features for Local Area Bonjour in Unicast Mode for LAN networks: • HSRP-aware mDNS Service-Routing • mDNS Service-Gateway SSO Support • Default mDNS Service-list and policy support. The following commands have been modified: • **active-query timer**: Global configuration mode support is introduced. • **active-query timer**: Second-based configuration support is replaced with minute-based global timer setting support. • **service-mdns-query** : Global configuration mode support is introduced
Cisco IOS XE Bengaluru 17.6.2	Configuration of Cisco Wide Area Bonjour requires you to configure the Cisco Catalyst Series switch in SDG Agent mode and optionally build a custom service policy in Wide Area Bonjour application of Cisco DNA Center. If you do not build a custom service policy, then the default service policy is build into the Wide Area Bonjour application. The following commands are modified: • **mdns-sd controller service-list** *controller-service-list-name* • **match** {**all**|*service-definition-name* [**message-type** {**any**| **announcement**|**query**}] [**source-interface** {*mDNS-VLAN-number* | *mDNS-VLAN-range*}] } • **mdns-sd controller service-policy** *controller-service-policy-name* • **service-list** *controller-service-list-name* • **controller-service-policy** *controller-service-policy-name*

Release	Modification
Cisco IOS XE Cupertino 17.7.1	This feature was implemented on supervisor modules C9400X-SUP-2 and C9400X-SUP-2XL, which were introduced in this release.
Cisco IOS XE Cupertino 17.9.1	The following commands are introduced in the **mdns-sd gateway** command: • **active-response timer** • **service-receiver purge** • **query-response mode** • **service-record ttl** The **invalid** keyword is introduced in the **show mdns-sd cache** command.
Cisco IOS XE Dublin 17.10.1	Cisco DNA Service for Wide Area Bonjour (Multicast DNS Mode only) and Local Area Bonjour in Unicast Mode for Multi-Layer Network and Routed Access Network was introduced on C9500X-28C8D model of Cisco Catalyst 9500 Series Switches, and Cisco Catalyst 9600 Series Supervisor 2 Module (C9600X-SUP-2).
Cisco IOS XE Dublin 17.11.1	Use the **mdns-sd gateway** command instead of **service-routing mdns-sd** command to configure mDNS on the device. The command **service-routing mdns-sd** will be deprecated.
	Cisco DNA Service for Local Area Bonjour in Unicast Mode was introduced on Cisco Catalyst 9200 Series Switches and Cisco Catalyst 9200CX Compact Switches.
Cisco IOS XE Dublin 17.12.1	Cisco DNA Service for Wide Area Bonjour was introduced on Cisco Catalyst 9200 Series Switches, Cisco Catalyst 9200L Series Switches, and Cisco Catalyst 9200CX Compact Switches.

Release	Modification
Cisco IOS XE 17.13.1	The command **service-routing mdns-sd** is deprecated from this release onwards. Use the **mdns-sd gateway** command instead.
	A new service definition, apple air-drop, is introduced.
	Service types, multifunction-printer and home sharing, are removed from the default service list.