Cisco DNA Service for Bonjour Solution Overview

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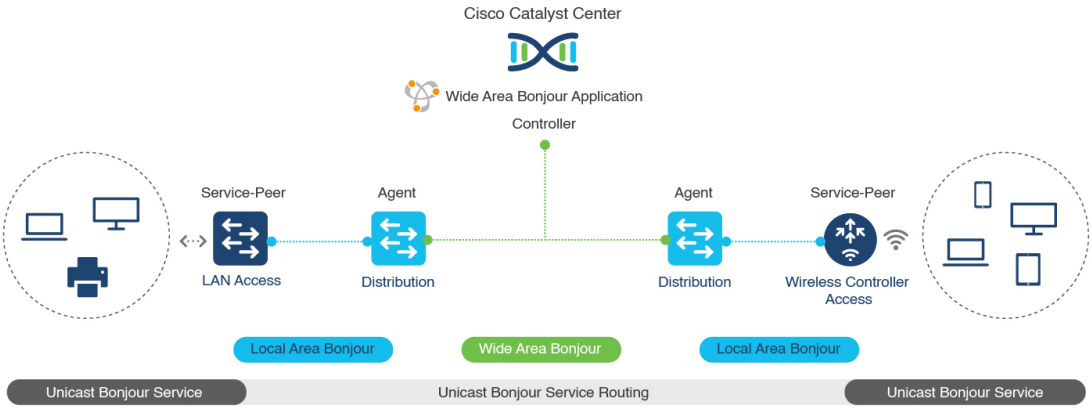
About the Cisco DNA Service for Bonjour Solution

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 DNA 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 DNA 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 2.3.7.6
Catalyst Center on ESXi	—	Catalyst Center, Release 2.3.7.6
Cisco Wide Area Bonjour application on Catalyst Center	—	2.4.718.75196
Cisco Wide Area Bonjour application on Catalyst Center on ESXi	—	2.718.77018

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	Cisco DNA Advantage	Cisco DNA Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9200L Series Switches	SDG agent Service peer	Cisco DNA Advantage	Cisco DNA Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9300 and 9300-X Series Switches	Service peer SDG agent	Cisco DNA Advantage	Cisco DNA Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9400 and 9400-X Series Switches	Service peer SDG agent	Cisco DNA Advantage	Cisco DNA Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9500 and 9500-X Series Switches	Service peer SDG agent	Cisco DNA Advantage	Cisco DNA Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9500 High Performance Series Switches	Service peer SDG agent	Cisco DNA Advantage	Cisco DNA Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9600 and 9600-X Series Switches	Service peer SDG agent	Cisco DNA Advantage	Cisco DNA Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9800 Wireless Controller	Service peer	Cisco DNA Advantage	Cisco DNA Advantage	Cisco IOS XE Release 17.11.1
Cisco Catalyst 9800-L Wireless Controller	Service peer	Cisco DNA Advantage	Cisco DNA Advantage	Cisco IOS XE Release 17.11.1
Cisco Nexus 9300 Series Switches	SDG agent	Cisco DNA Advantage	Cisco DNA Advantage	Cisco NX-OS Release 10.2(3)F

Supported Network Design

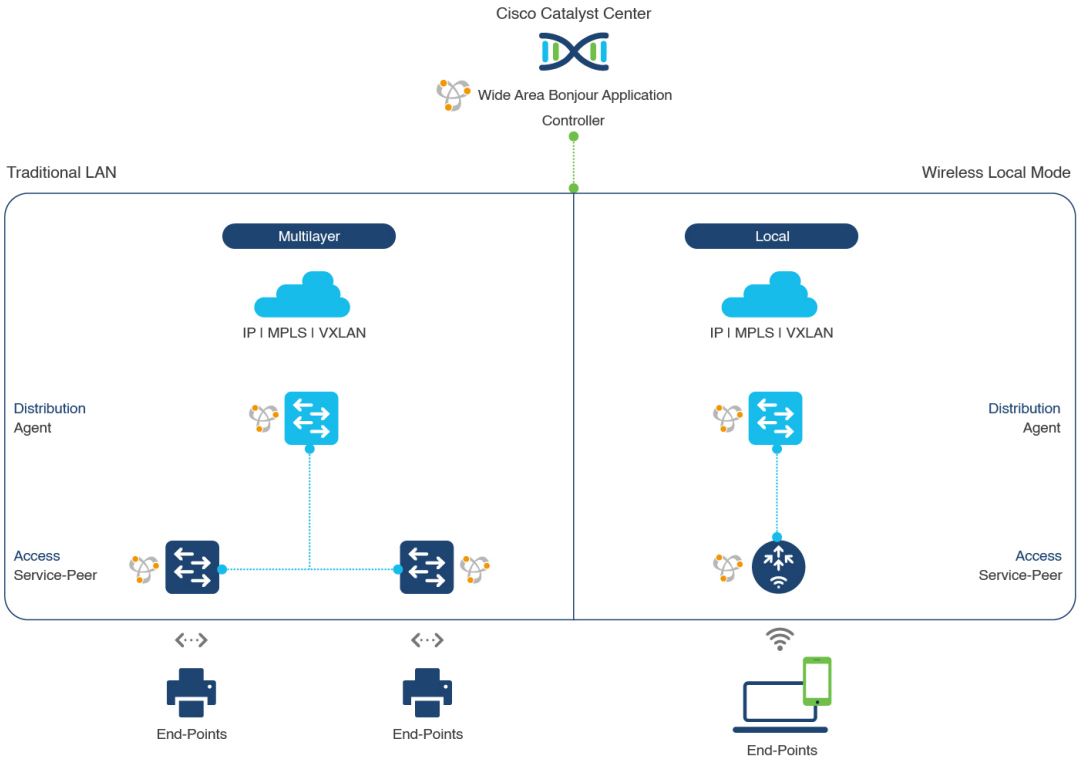
The Cisco DNA Service for Bonjour supports a broad range of enterprise-grade networks. The end-to-end unicast-based Bonjour service routing is supported on traditional, Cisco SD-Access, and BGP EVPN-enabled wired and wireless networks.

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 DNA 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.

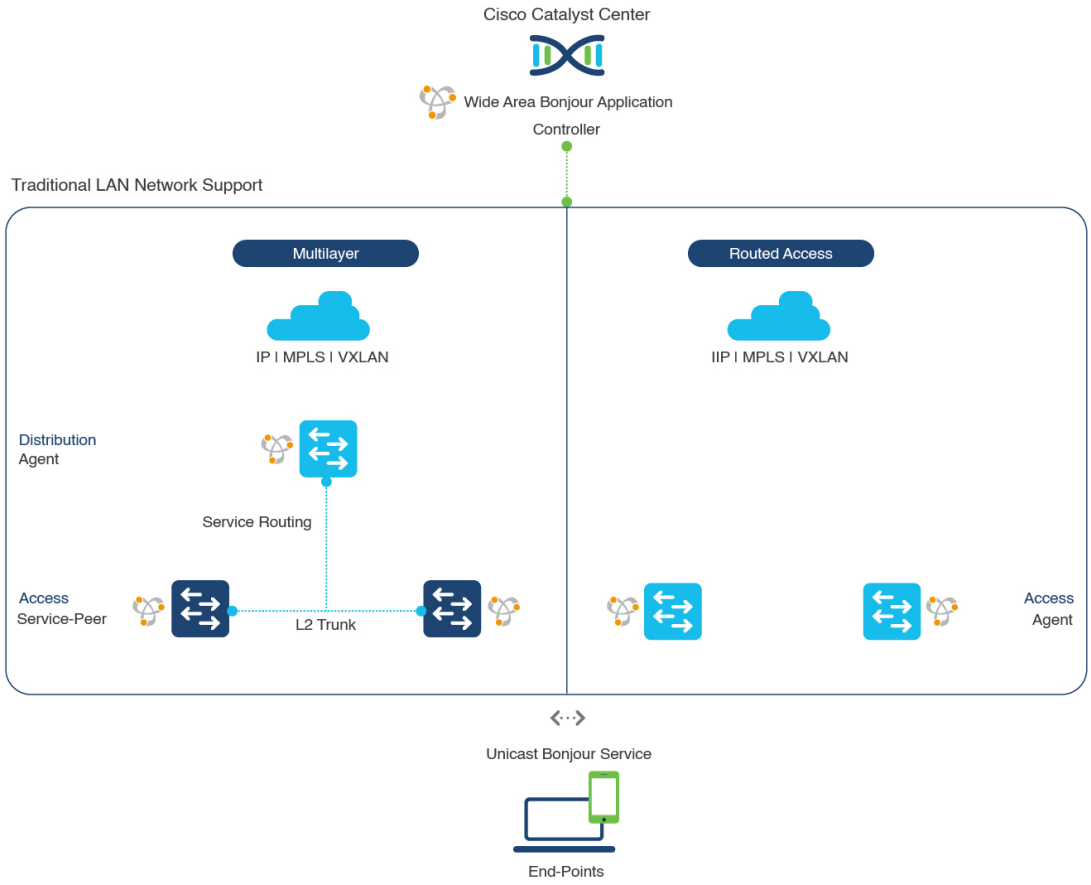
Figure 2: Enterprise Traditional LAN and Wireless Local Mode Network Design



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:

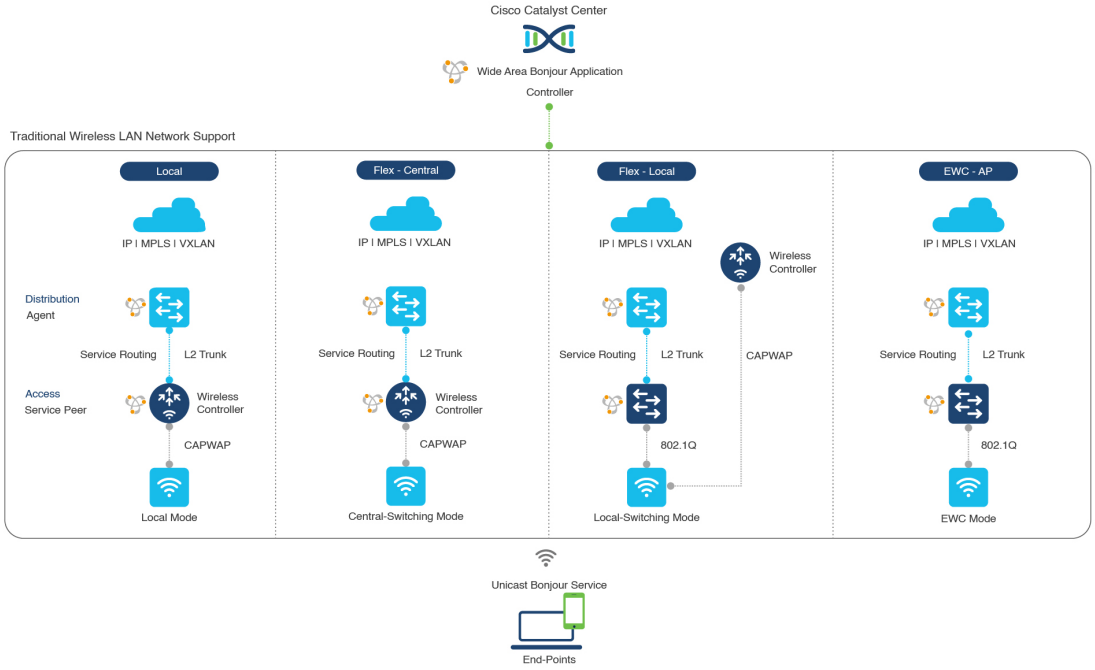
- **Multilayer LAN—Unicast Mode**: In this deployment mode, the Layer 2 access switch provides the first-hop mDNS gateway function to locally attached wired endpoints. In unicast mode, the mDNS services are routed to the distribution layer systems providing IP gateway and SDG agent mode. The policy-based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

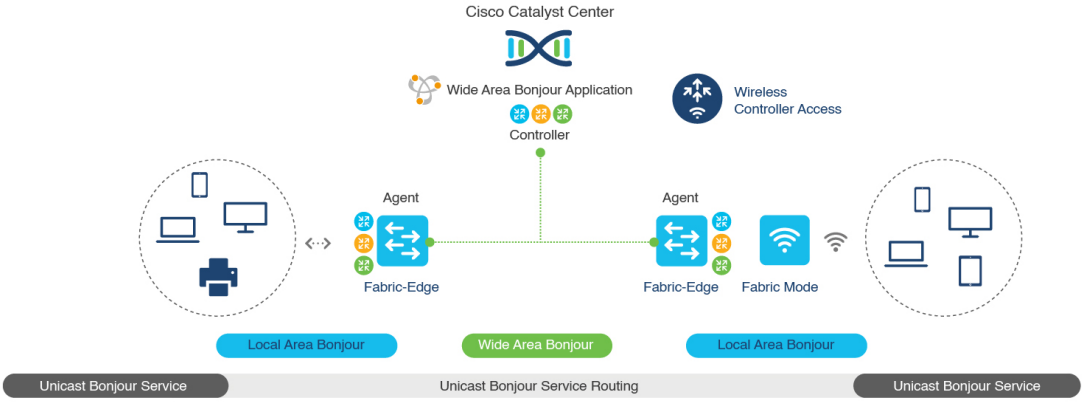
mDNS service-routing across all Layer 2 ethernet switches to support unicast-based service routing to LAN and wireless LAN user groups.

- **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

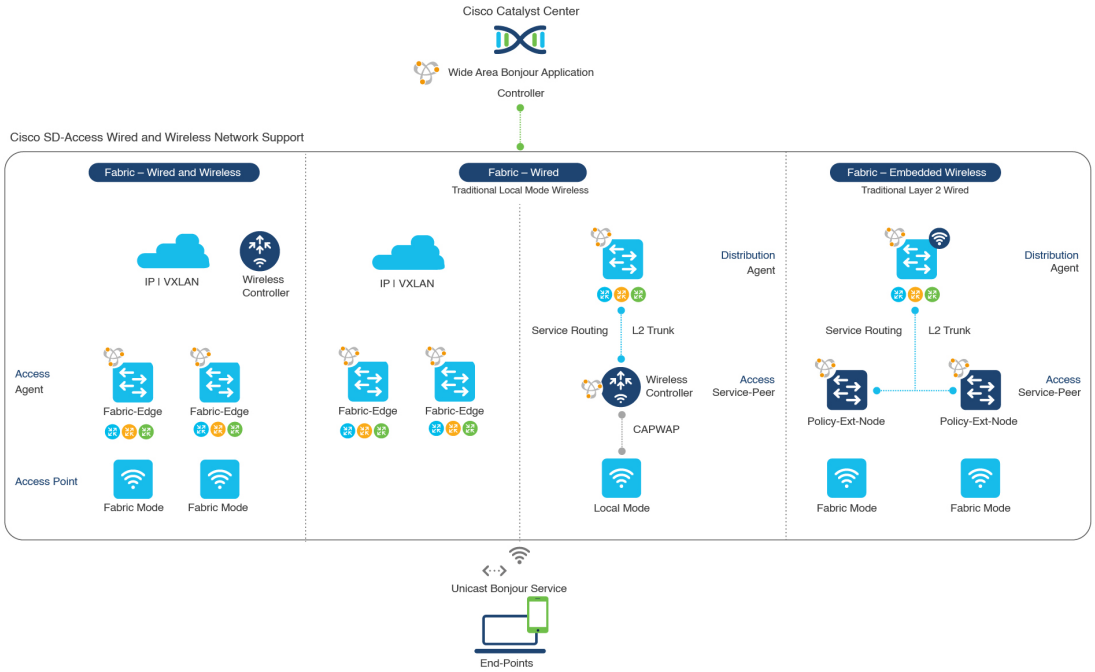
Cisco SD-Access-enabled wired and wireless networks support Cisco DNA Service for Bonjour across fabric networks. The Cisco Catalyst 9000 Series Switches support VRF-aware Wide Area Bonjour service routing to provide secure and segmented mDNS service discovery and distribution management for virtual 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 DNA 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.

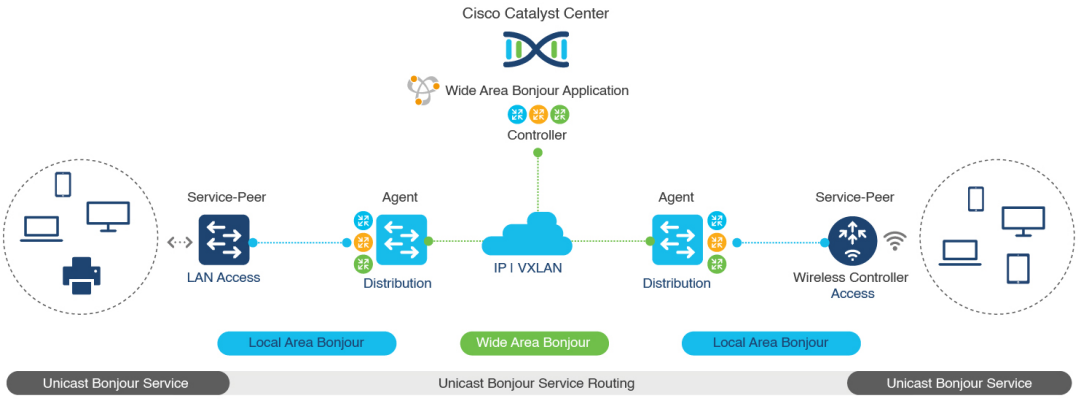
The Wide Area Bonjour communication between the SDG agent and controller takes place through the network underlay. Based on policies, the SDG agent forwards the endpoint announcements or queries to the Catalyst Center. After discovering a service, the endpoints can establish direct unicast communication 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.

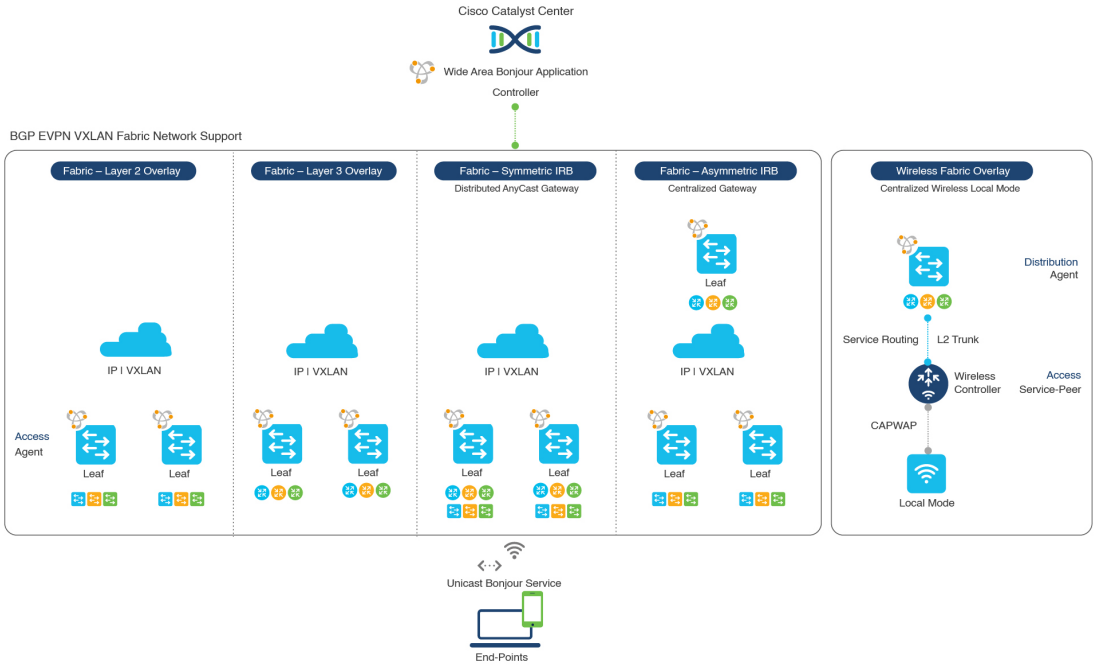
Figure 7: Overlay Bonjour Service for a BGP EVPN-Enabled Enterprise Network



Cisco DNA 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 DNA Service for Bonjour Configuration Guide, Cisco IOS XE Bengaluru 17.6.x (Catalyst 9600 Switches)*.