Exhibit 9 – U.S. Patent No. 8,520,691 (Cisco Wireless Mesh Networks with Catalyst and Aironet Access Points)

Cisco Systems, Inc. ("Cisco") has made, used, sold, offered for sale, and/or imported the Cisco Wireless Mesh Network including but not limited to Cisco's Catalyst and Aironet Access Points, with related controllers and software (the "Cisco Accused Products," *see* Exhibit 11), and infringed at least Claims 1, 9-11, and 35 (the "Asserted Claims") of U.S. Patent No. 8,502,691 (the "'691 Patent").[1]

Cisco has infringed (literally and/or under the doctrine of equivalents), directly and/or through subsidiaries, agents, representatives, or intermediaries, one or more claims of the '691 Patent by making, using, testing, supplying, causing to be supplied, importing, selling, and/or offering for sale in the United States the Cisco Accused Products.

Cisco directly infringed under 35 U.S.C. § 271(a) by making, using, selling, offering for sale and importing the Cisco Accused Products. Cisco further directly infringed by testing, setting up, and using Cisco Wireless Mesh Networks on Cisco's campuses and locations throughout the United States,[2] and/or assisting customers in setting up and servicing their Cisco Wireless Mesh Networks. On information and belief, Cisco has partnered with several customers to set up an infringing Cisco Wireless Mesh Network in the United States.

Cisco indirectly infringed under 35 U.S.C. § 271(b) by providing specific guidance and instructions to its customers and end users on how to infringe the '691 Patent and make and use the infringing Cisco Wireless Mesh Network. Specifically, Cisco's Wireless Mesh Access Points, Design and Deployment Guides, Technical Assistance Center, Cisco Tech Talks, technical support, Cisco Community, presentations, and technical documentation on Cisco's website identified in the chart *infra* provide design and deployment guidelines for the deployment of, *e.g.*, secure enterprise, campus, and metropolitan Wi-Fi networks within the Cisco Wireless Mesh Network solutions. These guides and instructions specifically teach and describe each and every claim element of Claims 1, 9-11, and 35 as demonstrated *infra*, including the necessary components to make and use the infringing Cisco Wireless Mesh Network, and the infringing configuration and operation of the controller, access points, and software that comprise the infringing Cisco Wireless Mesh Network. These guides and instructions were published and distributed by Cisco for its customers for the sole purpose to instruct and encourage its customers to purchase the Cisco components to make and use the infringing Cisco Wireless Mesh Network (and directly infringe literally and/or under the doctrine of equivalents). Cisco has had knowledge of the '691 Patent and/or its predecessors

[1] The identified Accused Products also include Cisco's products, services, and systems that are considered sold or related to the infringement in the United States and subject to a reasonable royalty according to the Federal Circuit's decisions in *Carnegie Mellon Univ. v. Marvell Tech. Group. Ltd.*, 807 F.3d 1283 (Fed. Cir. 2015), *Cal. Inst. of Tech. v. Broadcom Ltd*., 25 F.4th 976 (Fed. Cir. 2022), and *Brumfield v. IBG LLC*, 97 F.4th 854 (Fed. Cir. 2024).

[2] *See, e.g.*, https://www.cisco.com/c/dam/en_us/about/ciscoitatwork/downloads/ciscoitatwork/pdf/Richardson_Topology.pdf.

since 2009 when Cisco executives met with MeshDynamics to discuss partnering opportunities and discussed the application that would result in the '691 Patent. MeshDynamics further put Cisco on actual notice of its infringement by its making, using, selling, offering for sale and importing the Cisco Accused Products that comprise the Cisco Wireless Mesh Networks in 2022. Cisco has knowingly and intentionally induced its customers to infringe the '691 Patent, or in the alternative was willfully blind to the '691 Patent and the infringement, following the MeshDynamics meeting in 2009.

Cisco further indirectly infringed under 35 U.S.C. § 271(c) by supplying the components used in the infringing Cisco Wireless Mesh Network, with knowledge of its infringing use (as discussed *supra*) and without substantial non-infringing uses. Further, the Cisco Accused Products were designed specifically to be used in a manner that infringes the '691 Patent. Cisco Accused Products come enabled as a mesh access point and automatically connect to the controller to establish an infringing wireless mesh network. Certain Cisco access points and proprietary software are particular suited for Cisco's Wireless Mesh Network, and Cisco provides specific instructions and guides on how to make and use the Cisco Wireless Mesh Network using the Cisco Accused Products. As a result of Cisco's selling and/or offering for sale of the Cisco Accused Products to other entities, the other entities use these products for their intended purpose and according to their instructions with the result that such entities directly infringe the '691 Patent, literally or under the doctrine of equivalents, for the reasons stated *infra*. Cisco's Accused Products are specially made and adapted for this use in an infringing manner, are not staple articles of commerce, and do not have substantial non-infringing uses.

MeshDynamics asserts that the Cisco Accused Products literally infringed the Asserted Claims of the '691 Patent. With respect to any claim limitation that may be found not to be literally infringed, MeshDynamics contends in the alternative that Cisco Accused Products infringed such claim limitations under the doctrine of equivalents and that any claim element not found to be literally met is equivalently met because any difference between the claim limitation and Cisco Accused Products is not a substantial difference. Accordingly, MeshDynamics contends that if any Cisco Accused Products is found not to have infringed any Asserted Claims literally it is nevertheless embodied by Cisco Accused Products under an operative doctrine of equivalents test (*e.g.*, function-way-result or insubstantial difference).

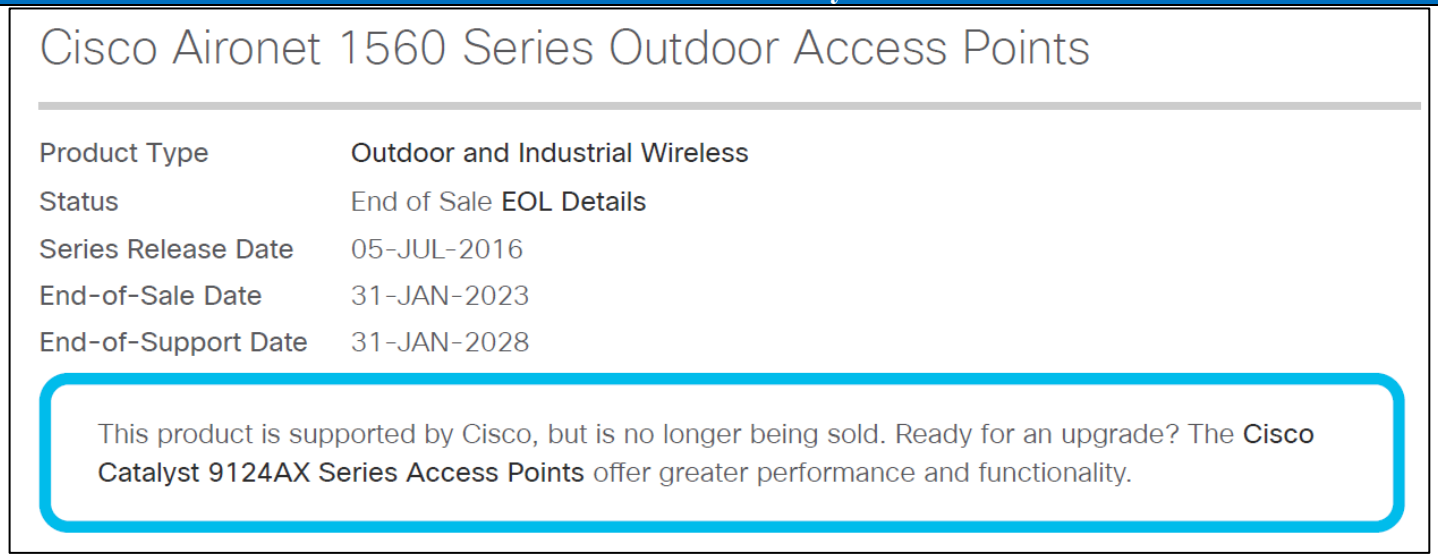
The below chart presents MeshDynamics's preliminary infringement analysis of Cisco Accused Products based solely on public information. MeshDynamics has not received any discovery from Cisco, including any confidential information or source code demonstrating the operation and structure of the Cisco Accused Products. All information contained in this disclosure is the result of publicly available information regarding the Cisco Accused Products. Based on these circumstances, MeshDynamics presents these infringement allegations reflecting its analysis of the facts

presently known to it. To the best of MeshDynamics's knowledge, information, and belief, formed after an inquiry that is reasonable under the circumstances, the information contained in this disclosure is correct.

Certain information about Cisco Accused Products is not available without discovery, such as proprietary source code, documents, and deposition testimony, from Cisco. Accordingly, MeshDynamics reserves the right to supplement and/or amend this infringement contention claim chart as new information becomes available and as MeshDynamics has the opportunity to review Cisco document productions, including information related to the implementation of Cisco Accused Products, relationships with other parties who participated or contributed to the operation of Cisco Accused Products, and/or elements of Cisco Accused Products that cannot be fully examined based solely on publicly available information. Infringement investigations are ongoing, and MeshDynamics anticipates that additional facts and relevant documents will be uncovered and disclosed that create cause for supplementation and/or amendment.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
1pre: A structured mesh network capable of isolated operation, comprising:	Cisco's Wireless Mesh Network (a component of the Cisco Unified Wireless Network solution) is a structured mesh network capable of isolated operation, (*e.g.*, fault tolerant resilient mode), which comprises a plurality of Wi-Fi nodes (*e.g.*, Cisco Catalyst 9100 and Aironet Series Access Points). Cisco Catalyst 9100 and Aironet Access Points support Wi-Fi capabilities. The Catalyst series is a follow-up from the Cisco Aironet series access points, and the Aironet and Catalyst Access Points contain the same mesh networking capabilities, as shown below in Cisco's documentation and guides that apply to both product lines: Q. Which Cisco access points support Wi-Fi 6? A. Cisco Catalyst 9100 enterprise-class access points support Wi-Fi 6 capabilities, extending the power of intent-based networking with hardware and software innovations. The Cisco Catalyst 9100 APs offer resiliency and security while enabling intelligence at the network edge. Q. What is the portfolio transition from the Cisco Aironet Series to the Cisco Catalyst 9100 platform? A. The Cisco Catalyst 9100 Access Points consist of the Cisco Catalyst 9105, 9115, 9120, 9130, 9136, 9162, 9164, 9166 and 9166D1, and outdoor 9163E Series. These access points are the follow-ups to the Cisco Aironet 1815, 1850, 2800, and 3800 Series Access Points, respectively. The Cisco Catalyst 9100 Access Points come equipped with Wi-Fi 6/6E capabilities, a better industrial design, and improved RF performance, and deliver reliability, security, and intelligence at scale. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9100ax-access-points/nb-06-802-11ax-faq-cte-en.html

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points



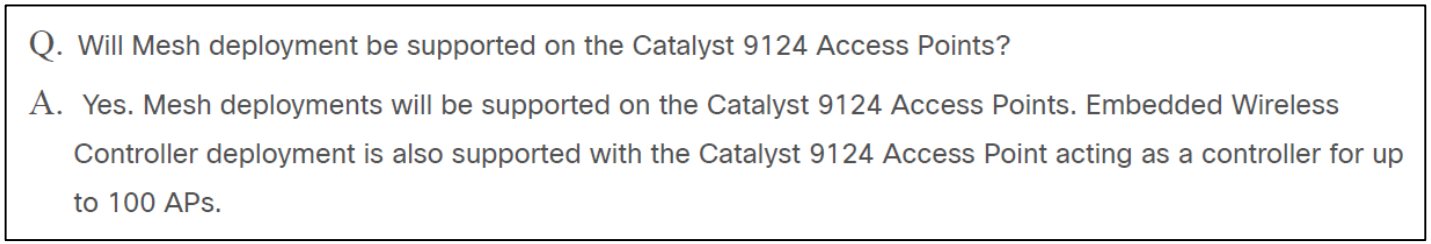
Cisco Aironet 1560 Series Outdoor Access Points

Product Type	Outdoor and Industrial Wireless
Status	End of Sale **EOL Details**
Series Release Date	05-JUL-2016
End-of-Sale Date	31-JAN-2023
End-of-Support Date	31-JAN-2028

This product is supported by Cisco, but is no longer being sold. Ready for an upgrade? The **Cisco Catalyst 9124AX Series Access Points** offer greater performance and functionality.

Source: https://www.cisco.com/c/en/us/support/wireless/aironet-1560-series/series.html

Mesh deployments are supported on the Cisco Catalyst 9100 Access Points:



Q. Will Mesh deployment be supported on the Catalyst 9124 Access Points?

A. Yes. Mesh deployments will be supported on the Catalyst 9124 Access Points. Embedded Wireless Controller deployment is also supported with the Catalyst 9124 Access Point acting as a controller for up to 100 APs.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9100ax-access-points/nb-06-802-11ax-faq-cte-en.html

In addition to the Wave 1 and Wave 2 access points, mesh deployments are supported on the Cisco Catalyst 9100 Access Points, including, *e.g.*, Catalyst 9124 Access Points, Catalyst 9130 Access Points and "AX" access points:

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Families of mesh APs

The two families of mesh APs available are the Cisco Wave 1 APs and the Cisco Wave 2 APs + the AX APs. These two families of mesh APs have different capabilities and features, and they are not fully compatible with each other. The Cisco Wave 1 APs do not support the same feature set as the Cisco Wave 2 + AX APs.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/17-15/config-guide/b_wl_17_15_cg/m_mesh_ewlc.html; see also https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/16-12/config-guide/b_wl_16_12_cg/mesh-access-points.html

From this release, mesh support is included in the Cisco Catalyst 9130AX Series Access Points. All traditional capabilities of mesh are included in the Cisco Catalyst 9130AX Series APs operating in Cisco IOS XE Dublin 17.12.1.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/ewc/17-13/config-guide/ewc_cg_17_13/mesh_access_points.html

Cisco Catalyst 9100 and Aironet Access Points can be deployed in a Cisco Wireless Mesh Network with a controller and software, such as the Catalyst 9800 Controller and Cisco DNA and Prime Infrastructure:

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Mesh Network Components

This section describes the mesh network components.

The Cisco wireless mesh network has four core components:

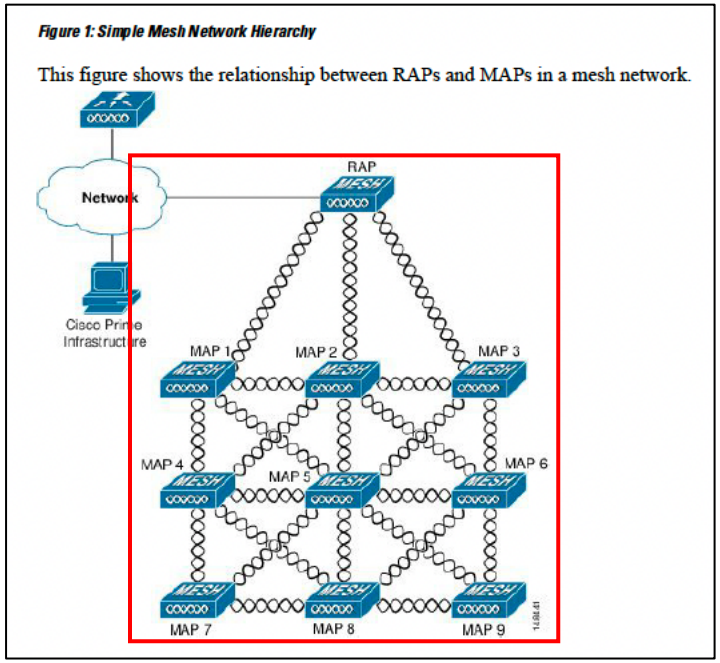
- Cisco C9800 and IOS-XE 17.1
- Cisco Aironet and Catalyst series access points
- Cisco PI and Cisco DNA Center
- Mesh software architecture

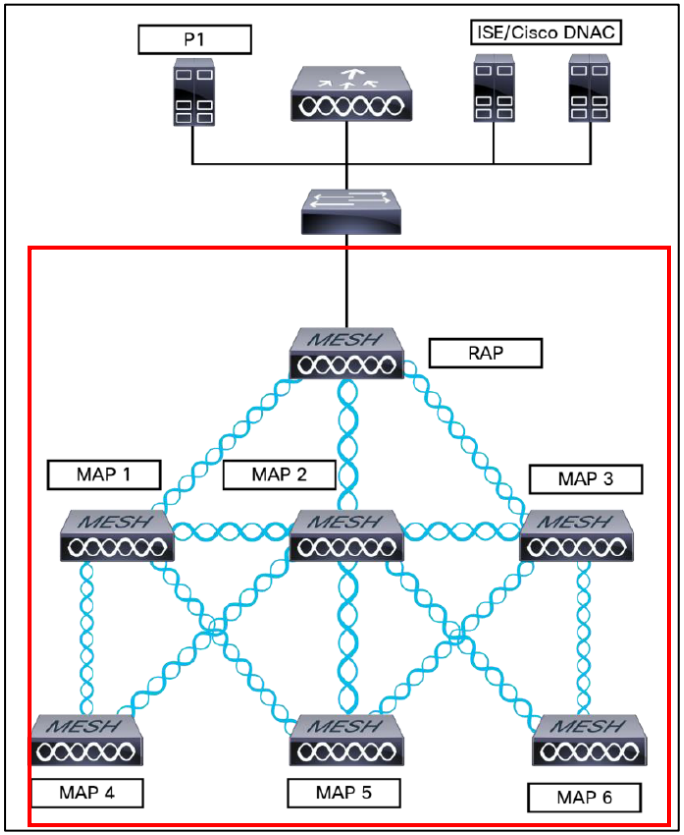
Mesh networking employs Cisco Aironet 1540, 1560, or 1570 Series access points and the latest Catalyst 9124AX Series outdoor mesh access points; Catalyst 9800 Series wireless controllers; and Cisco DNA Center to provide scalable, central management and mobility between indoor and outdoor deployments. The CAPWAP protocol manages the connection of mesh access points to the network.

- Cisco Aironet Wave 1 indoor APs: 1700, 2700, and 3700 series.
- Cisco Aironet Wave 2 indoor APs: 1815i, 1815m, 1830, 1850, 2800, 3800, and 4800 Series.

Source: https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh; *see also* https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	Cisco Wireless Mesh Networks organize the wireless access points in a structured mesh network and tree-like configuration with root access point(s) ("RAP") connected to the external network and mesh access points ("MAPs") connected to the RAP, as shown in red below:





Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

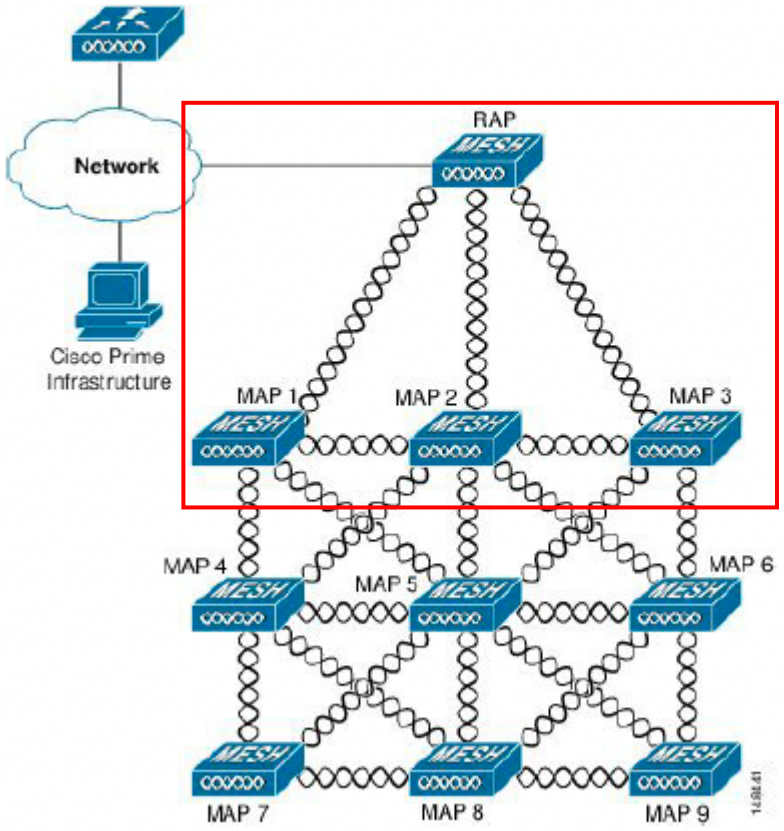
If the mesh network is isolated from the controller (and the external network), the mesh network is capable of continued operation in different modes, *e.g.*, Flex + Bridge mode and/or fault tolerant resilient mode:

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	A Control and Provisioning of Wireless Access Points protocol (CAPWAP) Access Point (AP) can be configured to operate in two different modes: • FlexConnect mode • Bridge/Mesh mode The following are the bridging features for Flex+Bridge mode: • The Flex+Bridge mode supports the centrally switched 802.11 WLAN. Traffic for this tunneled WLAN is forwarded to and from a CAPWAP controller over an IP tunnel. • The Flex+Bridge mode supports the Root Ethernet VLAN Bridging. A root AP bridges the traffic for bridged 802.11 WLANs and secondary Ethernet LANs to a local Ethernet LAN over its root Ethernet port. • The Flex+Bridge mode bridging is supported on Secondary Ethernet Access Ports and Secondary Ethernet VLAN Trunk Ports. • Fault Tolerant Resilient Mode enables an AP to continue bridging traffic when the connection to the CAPWAP controller is lost. Both mesh and non-mesh root APs continue to bridge traffic. A child mesh AP (MAP) maintains its link to a parent AP and continues to bridge traffic till the parent link is lost. A child mesh AP cannot establish a new parent or child link till it reconnects to the CAPWAP controller. Existing wireless clients on the locally switching WLAN can stay connected with their AP in this mode. Their traffic will continue to flow through the Mesh and wired network. No new or disconnected wireless client can associate to the Mesh AP in this mode. Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/8-5/config-guide/b_cg85/flexconnect.html.
1(a): at least two structured mesh nodes; wherein each structured mesh node comprises at least a connectivity logic;	Cisco's Wireless Mesh Network comprises at least two structured mesh nodes (*e.g.*, Cisco Catalyst 9100 and Aironet Series Access Points) wherein each structured mesh node comprises at least a connectivity logic. Catalyst 9100 and Aironet Access Points (two or more) in Cisco Wireless Mesh Networks use connectivity logic, for example, in the Adaptive Wireless Path Protocol (AWPP) to determine the best path through the mesh access points to the controller. This includes selection of the best path for each MAP to the RAP. The AWPP is specifically designed for wireless mesh networks and to maintain the tree-like topology.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Figure 1: Simple Mesh Network Hierarchy

This figure shows the relationship between RAPs and MAPs in a mesh network.



Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Adaptive Wireless Path Protocol

The Adaptive Wireless Path Protocol (AWPP) is designed specifically for wireless mesh networking to provide ease of deployment, fast convergence, and minimal resource consumption.

AWPP takes advantage of the CAPWAP WLAN, where client traffic is tunneled to the controller and is therefore hidden from the AWPP process. Also, the advance radio management features in the CAPWAP WLAN solution are available to the wireless mesh network and do not have to be built into AWPP.

AWPP enables a remote access point to dynamically find the best path back to a RAP for each MAP that is part of the RAP's bridge group (BGN). Unlike traditional routing protocols, AWPP takes RF details into account.

To optimize the route, a MAP actively solicits neighbor MAP. During the solicitation, the MAP learns all of the available neighbors back to a RAP, determines which neighbor offers the best path, and then synchronizes with that neighbor. The path decisions of AWPP are based on the link quality and the number of hops.

AWPP automatically determines the best path back to the CAPWAP controller by calculating the cost of each path in terms of the signal strength and number of hops. After the path is established, AWPP continuously monitors conditions and changes routes to reflect changes in conditions. AWPP also performs a smoothing function to signal condition information to ensure that the ephemeral nature of RF environments does not impact network stability.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Each structured mesh node comprises at least a conectivity logic (*e.g.*, runs the Adaptive Wireless Path Protocol).

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

AWPP

Each AP runs the Adaptive Wireless Path Protocol (AWPP)-a new protocol designed from the ground up by Cisco specifically for the wireless environment. This protocol allows RAPs to communicate with each other to determine the best path back to the wired network via the RAP. Once the optimal path is established, AWPP continues to run in the background to establish alternative routes back to the RAP just in case the topology changes or conditions cause the link strength to weaken. This protocol takes into consideration things like interference and characteristics of the specific radio so that the mesh can be self-configuring and self-healing. AWPP actually has the ability to consider all relevant elements of the wireless environment so that the mesh network's functionality isn't disrupted and can provide consistent coverage.

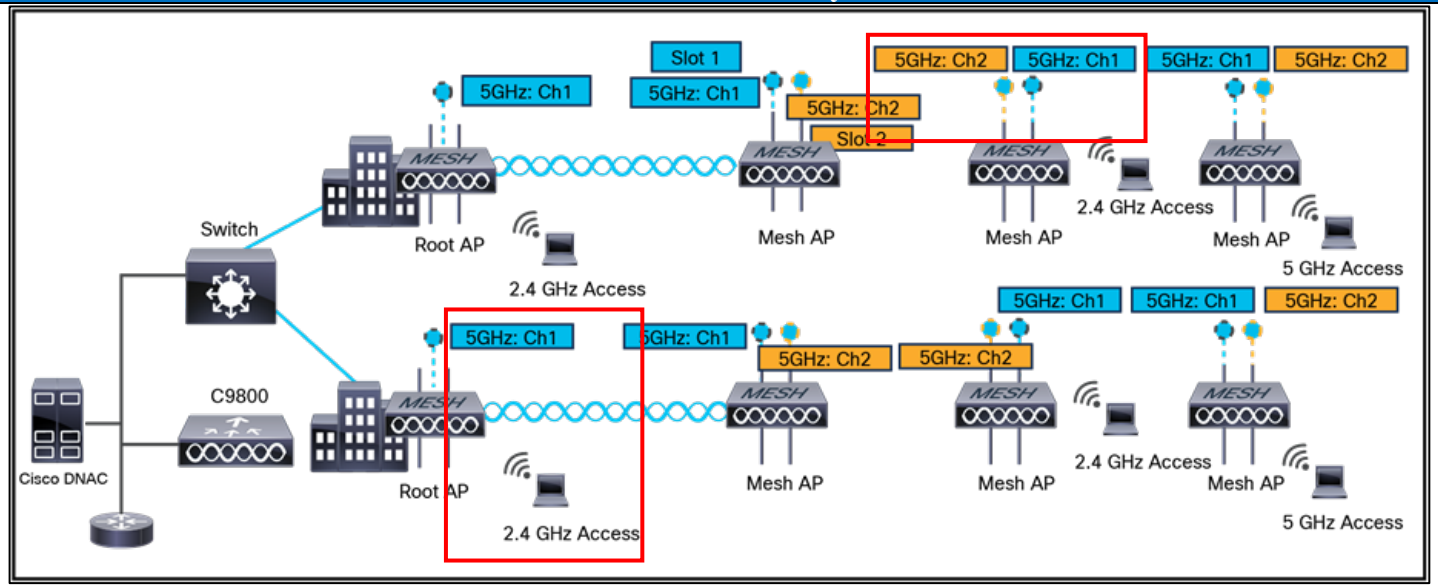
Source: https://www.learncisco.net/courses/cisco-ccna/part-13-wireless-networks/ciscos-wireless-solutions.html.

On information and belief, the connectivity logic may also encompass firmware, software, and/or user interface component—whether automated or administrator-controlled—on the access point that facilitates connectivity decisions within the mesh network, to client devices, or to the external network, as will be shown in Cisco's proprietary code and information.

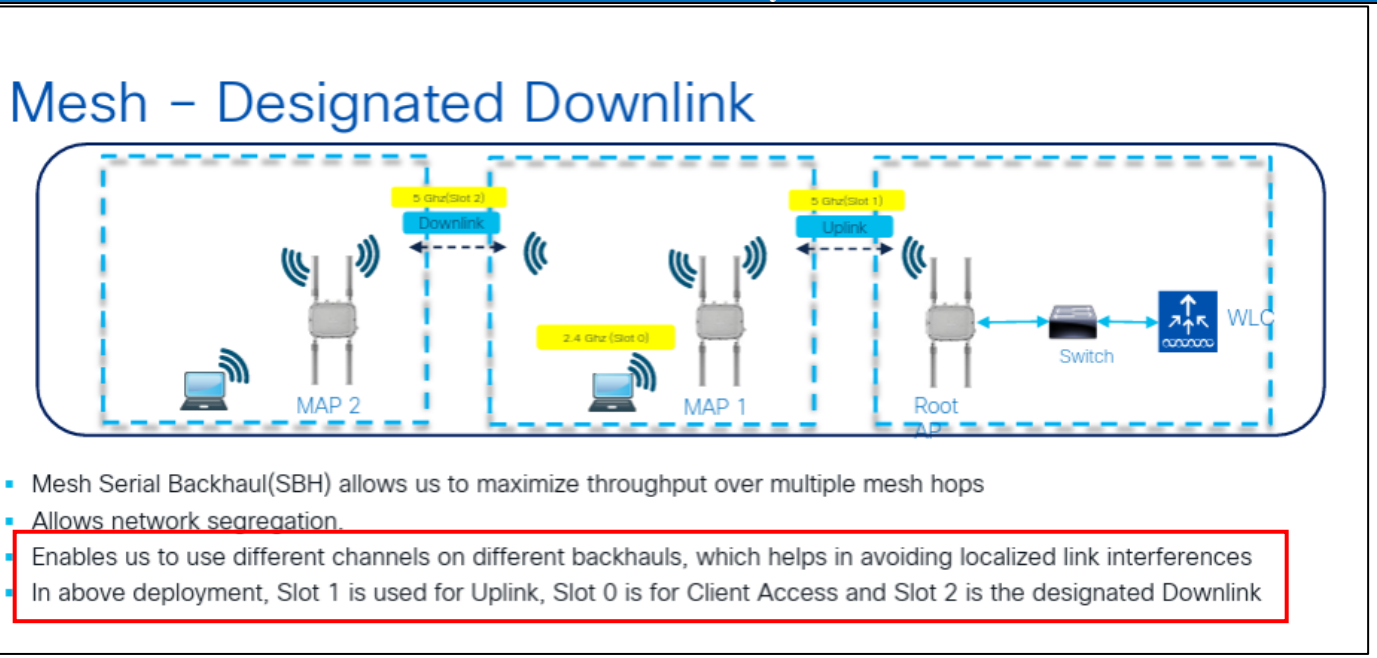
If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's solution achieves the same function (*e.g.*, determining whether a node connects to an external network or another mesh node), by substantially the same way (*e.g.*, through the AWPP algorithm executing either locally or as part of a centralized control scheme, as part of an overlayed SDN system such as Catalyst Center, or as part of the underlying architecture of each node), and yields the same result (*e.g.*, establishing uplink/downlink relationships and maintaining tree-based topology). This overarching behavior is functionally equivalent, and any implementation difference is insubstantial. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial.

MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.

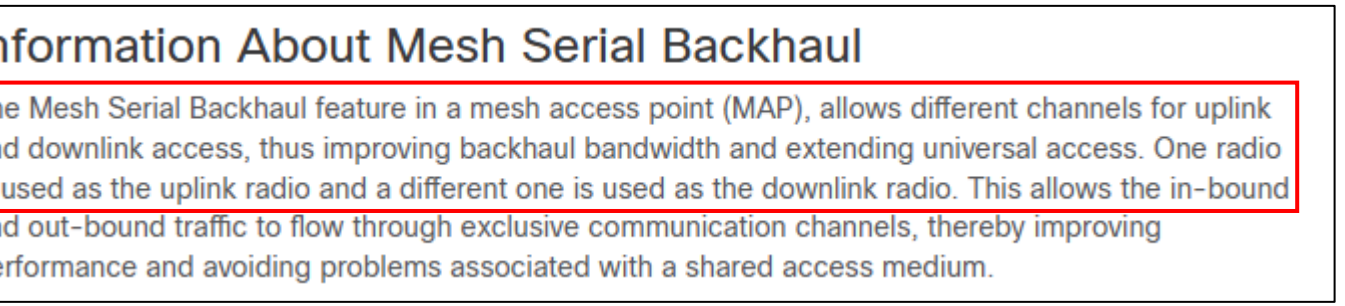
Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
1(b): an uplink radio operating on an uplink frequency and a downlink radio operating on a distinct downlink frequency;	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network comprise an uplink radio operating on an uplink frequency and a downlink radio operating on a distinct downlink frequency. Each access point contains at least two radios supporting distinct 5GHz and 2.4 GHz frequencies for backhaul (*e.g.*, uplink or downlink) and client access (*e.g.*, downlink). If Universal Backhaul Access is enabled, both 5 GHz and 2.4 GHz can be used for client access as well as backhaul. Enterprise 11n/ac mesh is added to the Catalyst 9800 controller features to work with the 802.11n/ac APs. Enterprise 11ac/ax mesh features are compatible with non-802.11ac mesh but add higher backhaul and client access speeds. The 802.11ac indoor APs are two-radio Wi-Fi infrastructure devices for select indoor deployments. One radio can be used for local (client) access for the AP, and the other radio can be configured for wireless backhaul. If Universal Backhaul Access is enabled, the 5-GHz and 2.4-GHz radios in Release 17.1 can be used for local (client) access as well as backhaul. Enterprise 11ac mesh supports point-to-point, point-to-multipoint, and mesh types of architectures. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh .The Cisco indoor mesh access points are equipped with the following two simultaneously operating radios: • From rel 8.2 2.4 GHz radio used for data backhaul and client access if UBA is enable • 5-GHz radio used for data backhaul and client access if Universal Backhaul Access is enabled The 5-GHz radio supports the 5.15 GHz, 5.25 GHz, 5.47 GHz, and 5.8 GHz bands. Source: https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/technotes/8-5/cisco-enterprise-mobility-design-guide-8-5.pdf Mesh Serial Backhaul and Universal Backhaul Access allow for the radios either operate at 5 GHz or 2.4 GHz or at different channels, *e.g.*, distinct uplink and downlink frequencies as shown below:

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	 Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. Furthermore, Mesh Serial Backhaul and Universal Backhaul Access allow for distinct frequencies or channels to be assigned to different slots designated for Uplink, Downlink, or Client Access.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points



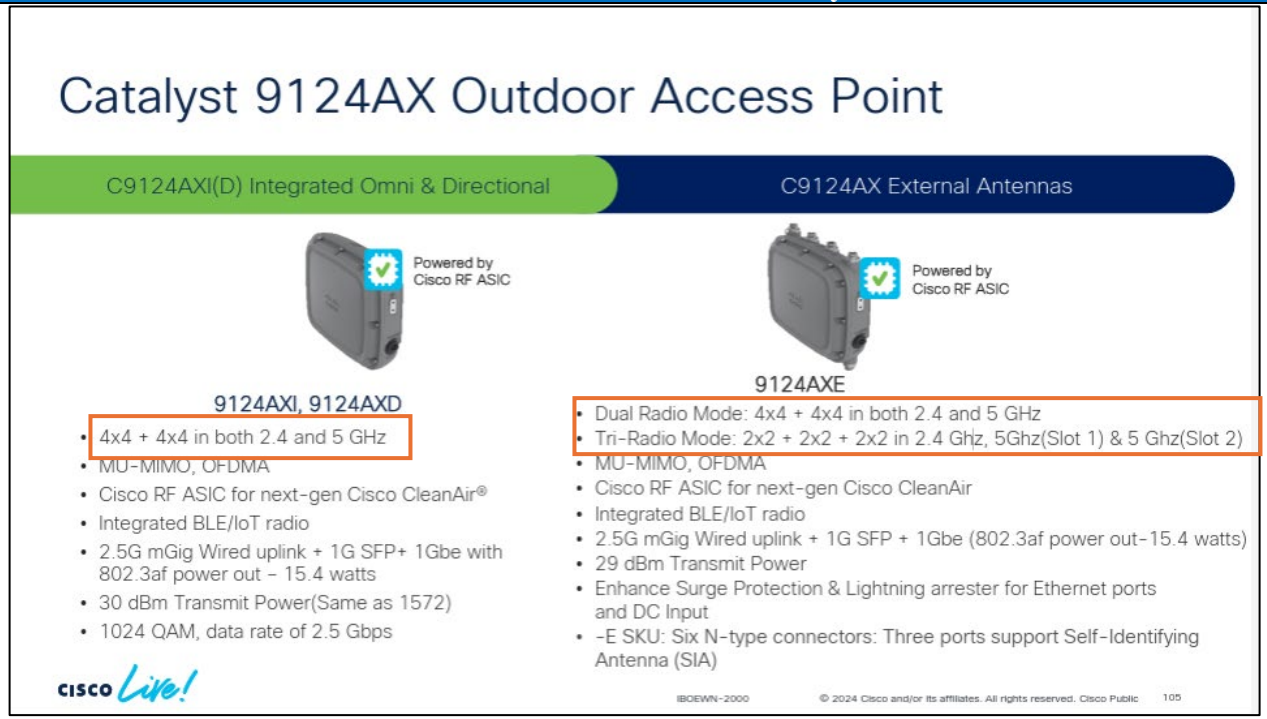
Source: https://www.ciscolive.com/c/dam/r/ciscolive/emea/docs/2024/pdf/IBOEWN-2000.pdf.



Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/17-12/config-guide/b_wl_17_12_cg/m_mesh_ewlc.html

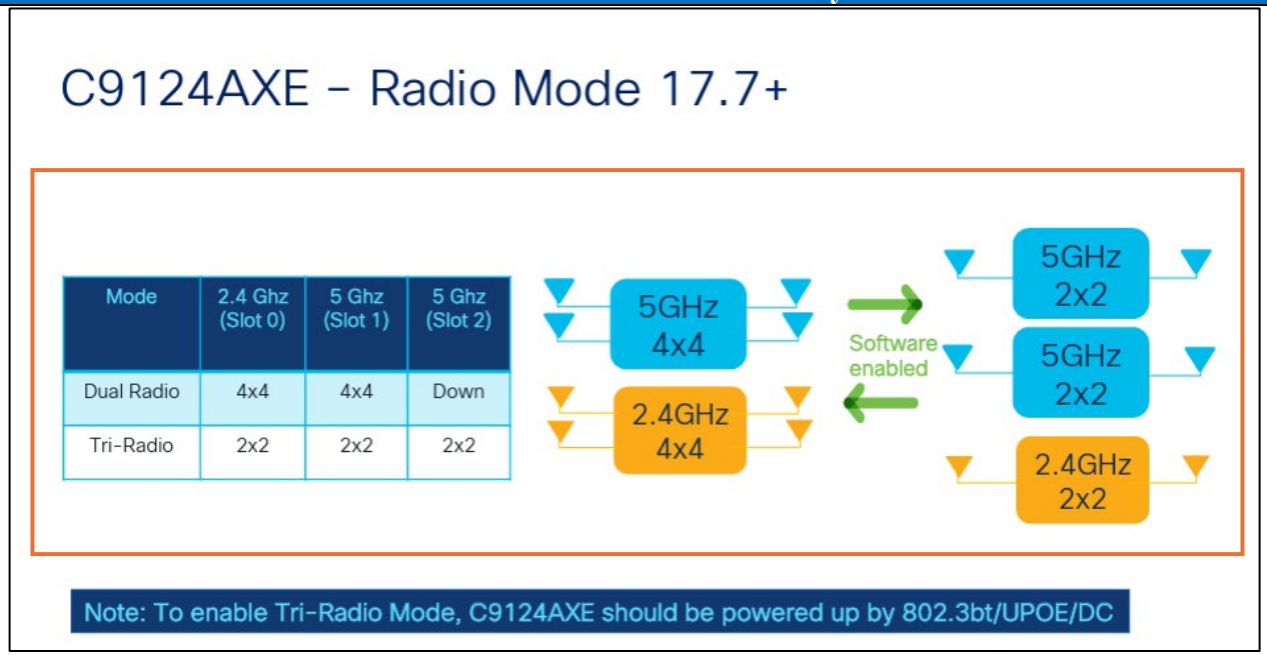
The accused products support different radio modes (*e.g.*, dual-radio, tri-radio, and quad-radio modes), in which an uplink radio can be assigned to operate on one frequency and a downlink radio can be assigned to a distinct frequency.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points



Source: https://www.ciscolive.com/c/dam/r/ciscolive/emea/docs/2024/pdf/IBOEWN-2000.pdf.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points



Source: https://www.ciscolive.com/c/dam/r/ciscolive/emea/docs/2024/pdf/IBOEWN-2000.pdf.

Flexible Radio Assignment (FRA) with quad-radio mode (with future software SW upgrade)

FRA allows the access points to intelligently determine the operating mode of serving radios based on the RF environment and traffic demands. The access points can operate in the following modes:

- Tri-radio mode: One 4x4 6-GHz radio, one 8x8 5-GHz radio, and one 4x4 2.4-GHz radio.
- Quad-radio mode: One 4x4 6-GHz radio, Dual 4x4 5-GHz radios, and one 4x4 2.4-GHz radio. With four total 4x4 radios (quad-radio) inside the access point, client device capacity can be increased on demand.

The access point's default mode is tri-radio with 8x8 5-GHz and 4x4 for 6-GHz and 2.4-GHz. It has the ability to split the 8x8 radio into two separate 4x4 5-GHz radios through a future software upgrade, thereby enabling the benefits of FRA while allowing the 2.4- and 6-GHz radios to remain active.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/catalyst-9100ax-access-points/nb-06-cat9136-access-point-ds-cte-en.html?oid=dstwls028547.

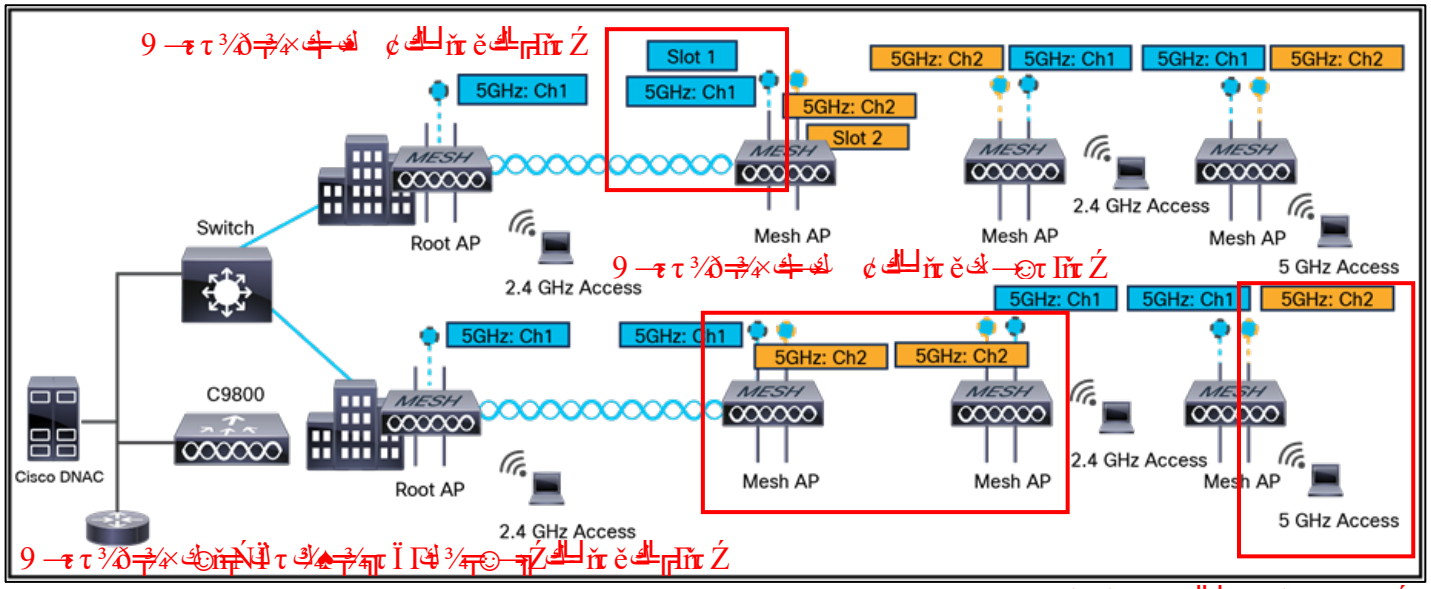
AWPP will scan and switch to a parent off-channel to find the best path back to the RAP; thus, AWPP will look to connect (*i.e.*, uplink) with nodes operating on other frequencies.

	Parent Loss Detection/ Keep Alive Timers	Channel Scan/Seek	DHCP/CAPWAP Information	Time per hop (sec)
Standard	21 / 3 sec	Scan/Seek all 2.4 and 5 Ghz Channels	Renew / Restart CAPWAP	48.6*
Fast	7 / 3 sec	Scan/Seek only channels found in same bridge group	Maintain DHCP and CAPWAP	20.5*
Very Fast	4 / 1.5 sec	Scan/Seek only channels found in same bridge group	Maintain DHCP and CAPWAP	15.9*
CCN/BG Scan Fast/VF	4 / 3 sec for 50ms	Scan/Seek only channels found in same bridge group	Maintain DHCP and CAPWAP	8-10 sec

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's mesh solution achieves the same function (*e.g.*, separating uplink and downlink communication paths), by substantially the same means (*e.g.*, assigning non-overlapping 5GHz sub-bands such as 5.15 GHz and 5.8 GHz for uplink and downlink use), and yields the same result (*e.g.*, enabling duplex communication and reducing interference). Even if both radios operate within a broader 2.4GHz or 5GHz band, this is an insubstantial difference and functionally equivalent to the claim requirement. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial.

MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
1(c): wherein the connectivity logic determines whether each structured mesh node connects with an external network or another node using its uplink radio and client devices or other mesh nodes connect to each node using each node's downlink radio;	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network comprise a connectivity logic, wherein the connectivity logic determines whether each structured mesh node connects with an external network or another node using its uplink radio and client devices or other mesh nodes connect to each node using each node's downlink radio. For example, as shown below, and in the Cisco documentation, the connectivity logic in Cisco's Catalyst 9100 and Aironet Access Points determine whether each access point connects with the external network (*e.g.*, is a MAP connecting to an external network via a RAP and controller) or another access point (*e.g.*, is a MAP connecting to a RAP or another MAP) using the uplink radio. Similarly, the logic determines when and whether the downlink radio is connected to another mesh node (*e.g.*, MAP) or a client device (*e.g.*, a smartphone or laptop).  Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. The connectivity logic (*e.g.*, AWPP) determines the best path back to the controller for the mesh network, and therefore determines whether a mesh node connects to the controller or a RAP or another MAP using its uplink or downlink radio:

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Adaptive Wireless Path Protocol

The Adaptive Wireless Path Protocol (AWPP) is designed specifically for wireless mesh networking to provide ease of deployment, fast convergence, and minimal resource consumption.

AWPP takes advantage of the CAPWAP WLAN, where client traffic is tunneled to the controller and is therefore hidden from the AWPP process. Also, the advance radio management features in the CAPWAP WLAN solution are available to the wireless mesh network and do not have to be built into AWPP.

AWPP enables a remote access point to dynamically find the best path back to a RAP for each MAP that is part of the RAP's bridge group (BGN). Unlike traditional routing protocols, AWPP takes RF details into account.

To optimize the route, a MAP actively solicits neighbor MAP. During the solicitation, the MAP learns all of the available neighbors back to a RAP, determines which neighbor offers the best path, and then synchronizes with that neighbor. The path decisions of AWPP are based on the link quality and the number of hops.

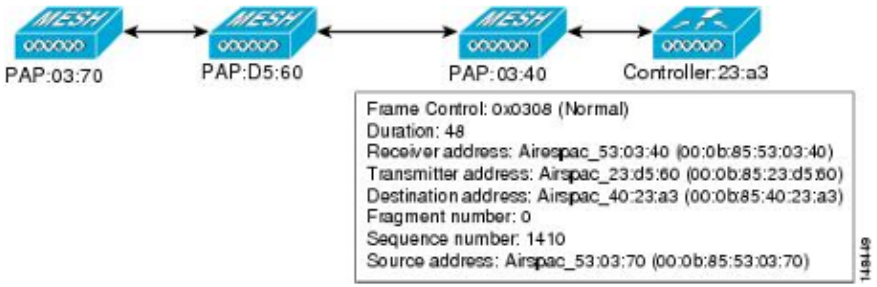
AWPP automatically determines the best path back to the CAPWAP controller by calculating the cost of each path in terms of the signal strength and number of hops. After the path is established, AWPP continuously monitors conditions and changes routes to reflect changes in conditions. AWPP also performs a smoothing function to signal condition information to ensure that the ephemeral nature of RF environments does not impact network stability.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Additionally, the connectivity logic (*e.g.*, AWPP) determines whether each structured mesh node connects with an external network or another node on a hop-by-hop basis.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Figure 4: Wireless Mesh Frame



As this frame is sent, the transmitter and receiver addresses change on a hop-by-hop basis. AWPP is used to determine the receiver address at each hop. The transmitter address is known because it is the current mesh access point. The source and destination addresses are the same over the entire path.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf

The connectivity logic (*e.g.*, AWPP) may also determine whether each node connects with an external network to exit the isolated configuration (*e.g.*, move from standalone mode to connected mode after a connection is lost and restablished):

- After moving back to connected mode, from standalone mode, best neighbor selection timer and BGN timer will be restarted, so allow the child mesh AP to roam to the best possible neighbor.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf

The mesh system supports various user-defined and preset configurations for backhaul and client communications (*e.g.*, Mesh Serial Backhaul, Universal Backhaul Access) enabling the connectivity logic to determine whether each structured mesh node (*e.g.*, RAP or MAP) connects to an external network or another mesh node using its uplink radio, and whether client devices or other mesh nodes connect to each node using its downlink radio.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Information About Mesh Serial Backhaul

The Mesh Serial Backhaul feature in a mesh access point (MAP), allows different channels for uplink and downlink access, thus improving backhaul bandwidth and extending universal access. One radio is used as the uplink radio and a different one is used as the downlink radio. This allows the in-bound and out-bound traffic to flow through exclusive communication channels, thereby improving performance and avoiding problems associated with a shared access medium.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/17-12/config-guide/b_wl_17_12_cg/m_mesh_ewlc.html.

Enterprise 11n/ac mesh is added to the Catalyst 9800 controller features to work with the 802.11n/ac APs. Enterprise 11ac/ax mesh features are compatible with non-802.11ac mesh but add higher backhaul and client access speeds. The 802.11ac indoor APs are two-radio Wi-Fi infrastructure devices for select indoor deployments. One radio can be used for local (client) access for the AP, and the other radio can be configured for wireless backhaul. If Universal Backhaul Access is enabled, the 5-GHz and 2.4-GHz radios in Release 17.1 can be used for local (client) access as well as backhaul. Enterprise 11ac mesh supports point-to-point, point-to-multipoint, and mesh types of architectures.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh

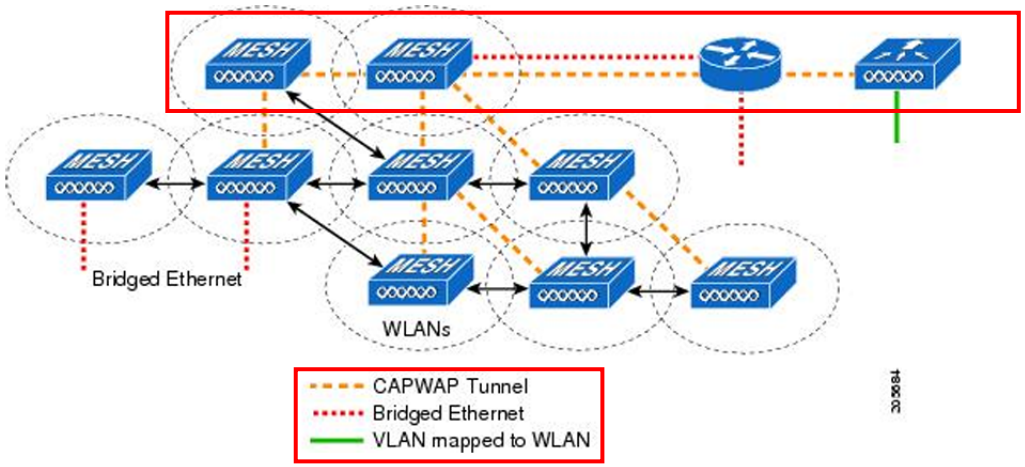
.The Cisco indoor mesh access points are equipped with the following two simultaneously operating radios:

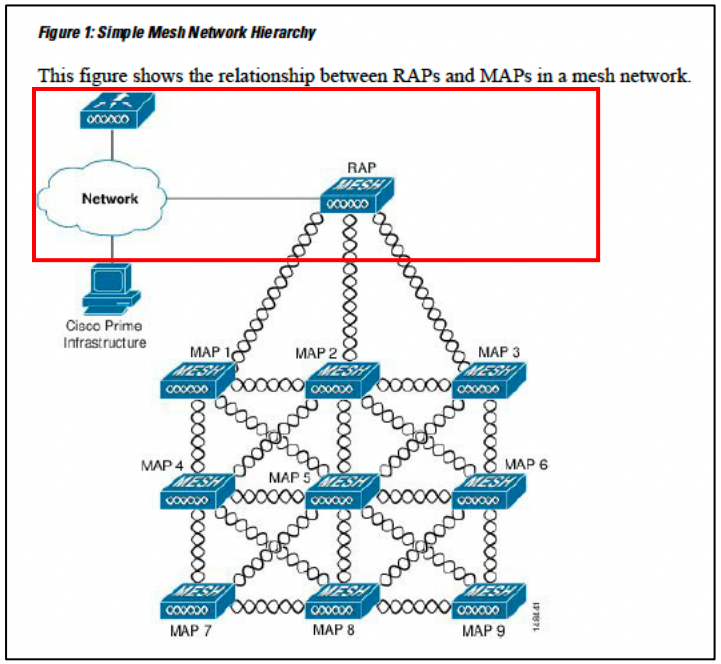
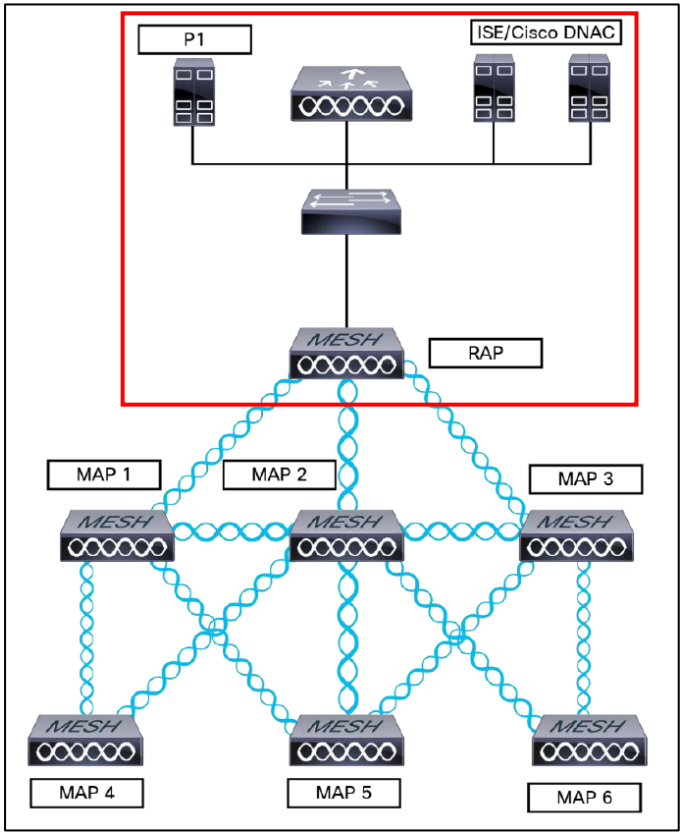
- From rel 8.2 2.4 GHz radio used for data backhaul and client access if UBA is enable
- 5-GHz radio used for data backhaul and client access if Universal Backhaul Access is enabled

The 5-GHz radio supports the 5.15 GHz, 5.25 GHz, 5.47 GHz, and 5.8 GHz bands.

Source: https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/technotes/8-5/cisco-enterprise-mobility-design-guide-8-5.pdf

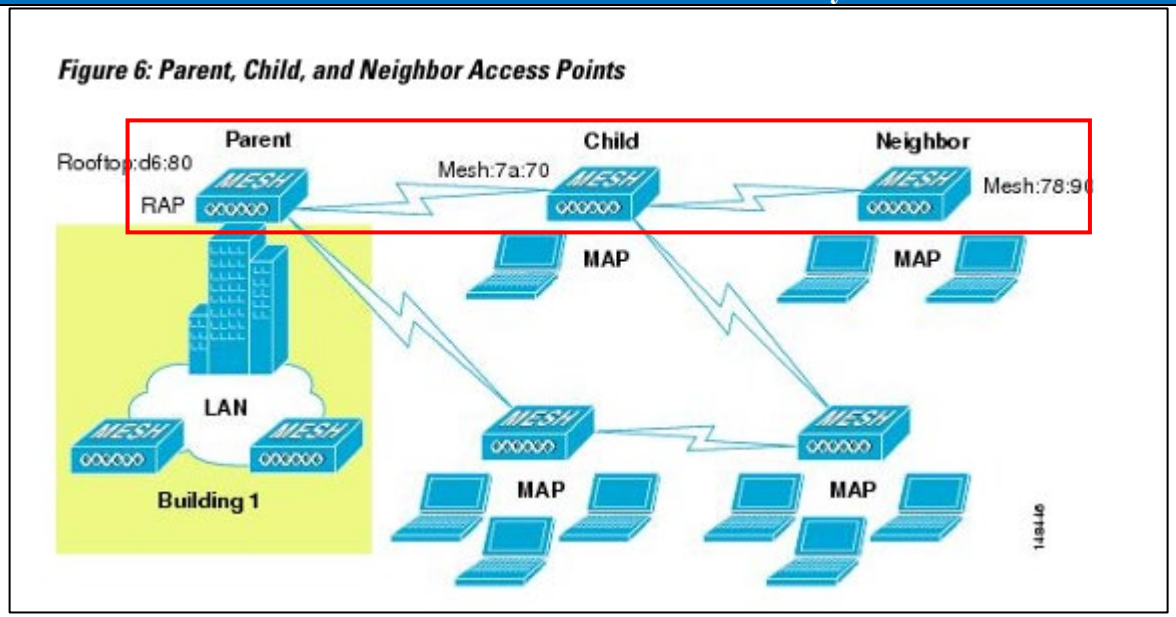
If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's implementation using AWPP and CAPWAP with VLAN tunneling performs the same function (*e.g.*, routing traffic between mesh nodes and the external network), in substantially the same way (*e.g.*, by dynamically selecting the next hop toward a RAP whose traffic is tunneled to a controller mapped to an external VLAN), and achieves the

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	same result (*e.g.*, establishing and managing a connection between mesh nodes and external networks). Connection to an external network via VLAN tunneling is an insubstantial difference from determining external and mesh connections via internal logic. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial. Each mesh access point within the mesh forms an CAPWAP session with a controller. WLAN traffic is encapsulated inside CAPWAP and is mapped to a VLAN interface on the controller. Bridged Ethernet traffic can be passed from each Ethernet interface on the mesh network and does not have to be mapped to an interface on the controller (see Figure 5: Logical Bridge and WLAN Mapping, on page 12). ***Figure 5: Logical Bridge and WLAN Mapping***  Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf. MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.
1(d): wherein the structured mesh network functions in two configurations selected depending on whether a connection to an external network is present;	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network function in two configurations (*e.g.*, a "first connected configuration" wherein the connection to the external network via the controller is not lost, and an "isolated configuration" wherein the connection to the external network via the controller is lost) selected depending on whether a connection to an external network is present.

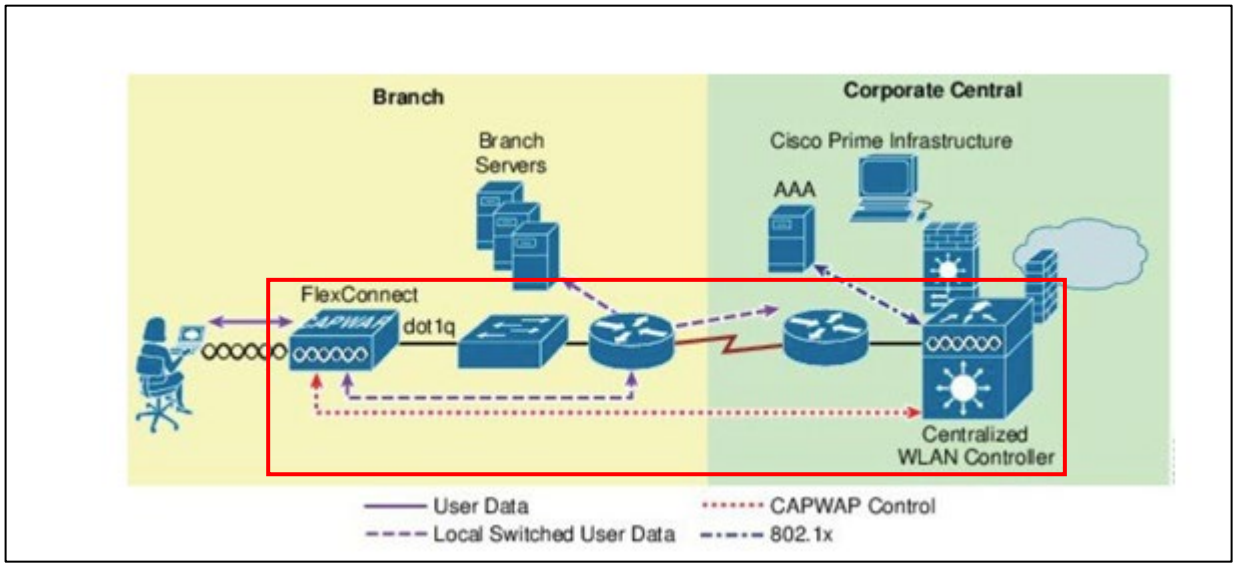
Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
in the first connected configuration the structured mesh network includes at least one structured mesh node's uplink radio comprising a connection to an external network;	In normal operation, the Cisco Wireless Mesh Network is connected to an external network (to make/facilitate additional connections to outside networks and destinations, for example to connect clients to an external network). When so connected, the system is configured to pass information from inside the network via the uplink radio of at least one structured mesh node (*i.e.*, RAP), as shown below and in Cisco's documentation:   Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. In some cases, the typical operating mode is explicitly referred to as "connected mode."

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	Connected mode A Wave 2 Flex+Mesh AP (RAP or child MAP) is in connected mode when it can access and join the Catalyst 9800 and can exchange periodic keep-alive messages with the Catalyst 9800. In this mode, a Flex+Mesh AP will be able to support locally and centrally switched WLANs. It will allow regular client and child mesh APs to join. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. The mesh nodes have a wireless connection to the controller (and the external network) via the RAP: While the RAPs have wired connections to their controller, MAPs have wireless connections to their controller via the RAP or another MAP. MAPs communicate among themselves and back to the RAP using wireless connections over the 802.11a/n/ac/ax radio backhaul. MAPs use the Cisco Adaptive Wireless Path Protocol (AWPP) to determine the best path through the other mesh access points to the controller. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html. If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's system achieves the same function (external network connectivity), in substantially the same way (via the mesh node's uplink radio establishing a path to a controller), to yield the same result (connectivity beyond the local mesh network). Whether or not the controller itself is considered part of the "external network," the resulting connectivity functionally extends beyond the mesh. Thus, the functional result of enabling external network communication is preserved, the means of accomplishing it (radio-based upstream communication and/or tunneling) are insubstantially different, and the manner of establishing that connectivity (through AWPP-determined routing and/or controller tunneling) fulfills the same claimed operation. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points



Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf.



Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf. MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.
1(e): and in the second isolated configuration none of the structured mesh nodes' uplink radio comprises a connection to an external network, and one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root node as isolated root children nodes forming a tree configuration;	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network function in the second isolated configuration (*e.g.*, fault tolerant resilient mode) where none of the structured mesh nodes' uplink radio comprises a connection to an external network, (*e.g.*, when Cisco's Catalyst 9100 and Aironet Access Points fails to connect to an external network via the controller) and one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root node (*e.g.*, a Cisco's Catalyst 9100 and Aironet Access Points operating as a RAP prior to a loss of connection to the controller) as isolated root children nodes (*e.g.*, a Cisco's Catalyst 9100 and Aironet Access Points operating as MAPs) forming a tree configuration. When the Cisco Wireless Mesh Network is not connected to an external network, the network is capable of functioning in a variety of localized modes. Cisco's Catalyst 9100 and Aironet Access Points are access points that can operate in several different modes, including, for example, Flex + Mesh mode, fault tolerate resistance mode, and standalone mode. Each of these modes maintain the connectivity of mesh access points when the connection to the controller (and thus to the external network) is lost. These modes can switch client data traffic locally when a connection to the controller is lost. As shown below and in Cisco's documentation, the tree structure is maintained, as a child access point (MAP) remains connected to a parent access point (another MAP or a RAP) in the second isolated configuration. **Cisco outdoor mesh access points** In addition to the mesh mode, the mesh APs can operate in the following modes: • **Local mode:** In this mode, the AP can handle clients on its assigned channel or while monitoring all channels on the band over a 180-second period. During this time, the AP listens on each channel for 50 ms for rogue client beacons, noise floor measurements, interference, and IDS events. The AP also scans for CleanAir interference on the channel. • **FlexConnect mode:** FlexConnect mode enables you to configure and control APs in a branch or remote office from the corporate office through a WAN link without having to deploy a controller in each office. This mode can switch client data traffic locally and perform client authentication locally when the connection to the controller is lost. When connected to the controller, an AP in FlexConnect mode can also tunnel traffic back to the controller. • **Flex+Mesh mode:** In this mode, both the FlexConnect and Bridge mode configuration options are available on the access point.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. **Connected mode** A Wave 2 Flex+Mesh AP (RAP or child MAP) is in connected mode when it can access and join the Catalyst 9800 and can exchange periodic keep-alive messages with the Catalyst 9800. In this mode, a Flex+Mesh AP will be able to support locally and centrally switched WLANs. It will allow regular client and child mesh APs to join. **Standalone mode** A Wave 2 Flex+Mesh AP is in standalone mode if it loses connection to the controller but can access the local gateway. In this mode, the Wave 2 Flex+Mesh AP will disable all the centrally switched WLANs and keep the locally switched WLANs up and running. It will also allow new clients to join on locally switched WLANs using local authentication if the authentication server is reachable in the local network. Child mesh APs will NOT be allowed to join in this mode. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. uplink to the core network in a 'Root' AP or RAP mode. The AP is still managed by a centralized controller over CAPWAP. The AP however is capable of moving to a standalone mode where the AP will be able to continue to serve the 802.11 clients depending on the data switching method of the WLAN configured on the AP. The data can be centrally or locally switched. When data is centrally switched, all data is sent to the WLC that does the switching further. In a local switch network, the data is sent to RAP where RAP switches locally on the wired uplink. There is no difference to the central and local switched WLAN configurations and Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

A Control and Provisioning of Wireless Access Points protocol (CAPWAP) Access Point (AP) can be configured to operate in two different modes:

- FlexConnect mode
- Bridge/Mesh mode

The following are the bridging features for Flex+Bridge mode:

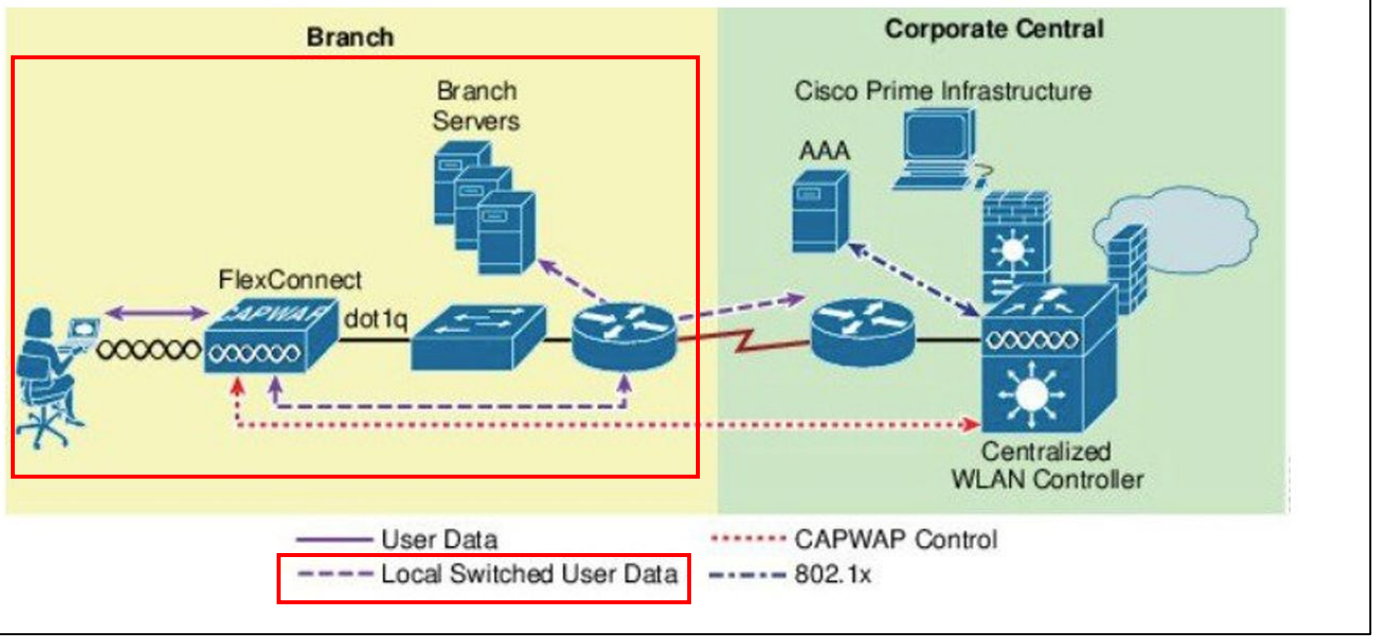
- The Flex+Bridge mode supports the centrally switched 802.11 WLAN. Traffic for this tunneled WLAN is forwarded to and from a CAPWAP controller over an IP tunnel.
- The Flex+Bridge mode supports the Root Ethernet VLAN Bridging. A root AP bridges the traffic for bridged 802.11 WLANs and secondary Ethernet LANs to a local Ethernet LAN over its root Ethernet port.
- The Flex+Bridge mode bridging is supported on Secondary Ethernet Access Ports and Secondary Ethernet VLAN Trunk Ports.
- Fault Tolerant Resilient Mode enables an AP to continue bridging traffic when the connection to the CAPWAP controller is lost. Both mesh and non-mesh root APs continue to bridge traffic. A child mesh AP (MAP) maintains its link to a parent AP and continues to bridge traffic till the parent link is lost. A child mesh AP cannot establish a new parent or child link till it reconnects to the CAPWAP controller. Existing wireless clients on the locally switching WLAN can stay connected with their AP in this mode. Their traffic will continue to flow through the Mesh and wired network. No new or disconnected wireless client can associate to the Mesh AP in this mode.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/8-5/config-guide/b_cg85/flexconnect.html.

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's system achieves the same function (maintaining mesh connectivity when the connection to the external network is lost), in substantially the same way (via a mesh node acting as parent or root node), to yield the same result (continuing to bridge traffic with wireless clients staying connected). Thus, the functional result of enabling external network communication is preserved, the means of accomplishing it (radio-based upstream communication and/or tunneling) are insubstantially different, and the manner of establishing that connectivity (through AWPP-determined routing and/or controller tunneling) fulfills the same claimed operation. A person skilled in the relevant art would

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial. MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.
1(f):wherein clients of nodes of the structured network in a second isolated configuration retain full connectivity within the structured network during the isolated configuration and wherein said client connectivity is uninterrupted during any transition from the isolated configuration to the first connected configuration wherein distinct downlink frequencies are used by nodes for communication with one or more nodes lower on the tree configuration.	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network function in the second isolated configuration wherein clients of nodes of the structured network in a second isolated configuration retain full connectivity (*e.g.*, when the locally switched WLANs are up and running despite the loss of a connection to the controller) within the structured network during the isolated configuration (*e.g.*, fault tolerant resilient mode) and wherein said client connectivity is uninterrupted during any transition from the isolated configuration to the first connected configuration; wherein distinct downlink frequencies are used by nodes for communication with one or more nodes lower on the tree configuration. As shown below, and in the Cisco documentation, client data traffic is switched locally when a connection to the controller is lost. Clients stay connected with their AP and traffic will continue to flow. The AP moves to standalone mode and will continue to serve clients: Below is a general FlexMesh architecture. The CAPWAP AP is in Flex connect + Bridge mode with a wired uplink to the core network in a 'Root' AP or RAP mode. The AP is still managed by a centralized controller over CAPWAP. The AP however is capable of moving to a standalone mode where the AP will be able to continue to serve the 802.11 clients depending on the data switching method of the WLAN configured on the AP. The data can be centrally or locally switched. When data is centrally switched, all data is sent to the WLC that does the switching further. In a local switch network, the data is sent to RAP where RAP switches locally on the wired uplink. There is no difference to the central and local switched WLAN configurations and functionality between a Flex-Connect and Flex+Mesh mode AP. Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points



Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf.

As shown above, a child access point (MAP) remains connected to a parent access point (another MAP or a RAP).

As shown below, the distinct downlink frequencies used by nodes for communication with one or more nodes lower on the tree configuration are enabled through Cisco features such as Mesh Serial Backhaul, and Universal Backhaul Access, which assign different frequencies on a per-hop basis,

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Information About Mesh Serial Backhaul

The Mesh Serial Backhaul feature in a mesh access point (MAP), allows different channels for uplink and downlink access, thus improving backhaul bandwidth and extending universal access. One radio is used as the uplink radio and a different one is used as the downlink radio. This allows the in-bound and out-bound traffic to flow through exclusive communication channels, thereby improving performance and avoiding problems associated with a shared access medium.

The Mesh Serial Backhaul feature is supported in the controller from Cisco IOS XE Cupertino 17.7.1 onwards, for Cisco Catalyst 9124AXE outdoor APs. A new knob is introduced under the radio profile, and that radio profile is associated with a radio frequency (RF) tag to enable the Mesh Serial Backhaul feature. When you enable this feature, the mesh configuration is shared by all the APs that share the same mesh profile. Radio configuration is shared by all the APs that are configured with the same radio profile.

Basic client access functionality is offered on the 2.4-GHz radio and the 5-GHz radio, which are not used in serial backhaul. Universal access is made available on the downlink radio.

Note Slot 1 and slot 0 are supported as mesh backhaul. Slot 2 is not supported as a mesh backhaul. You can utilize slot 2 for client serving or for serial backhaul downlink.

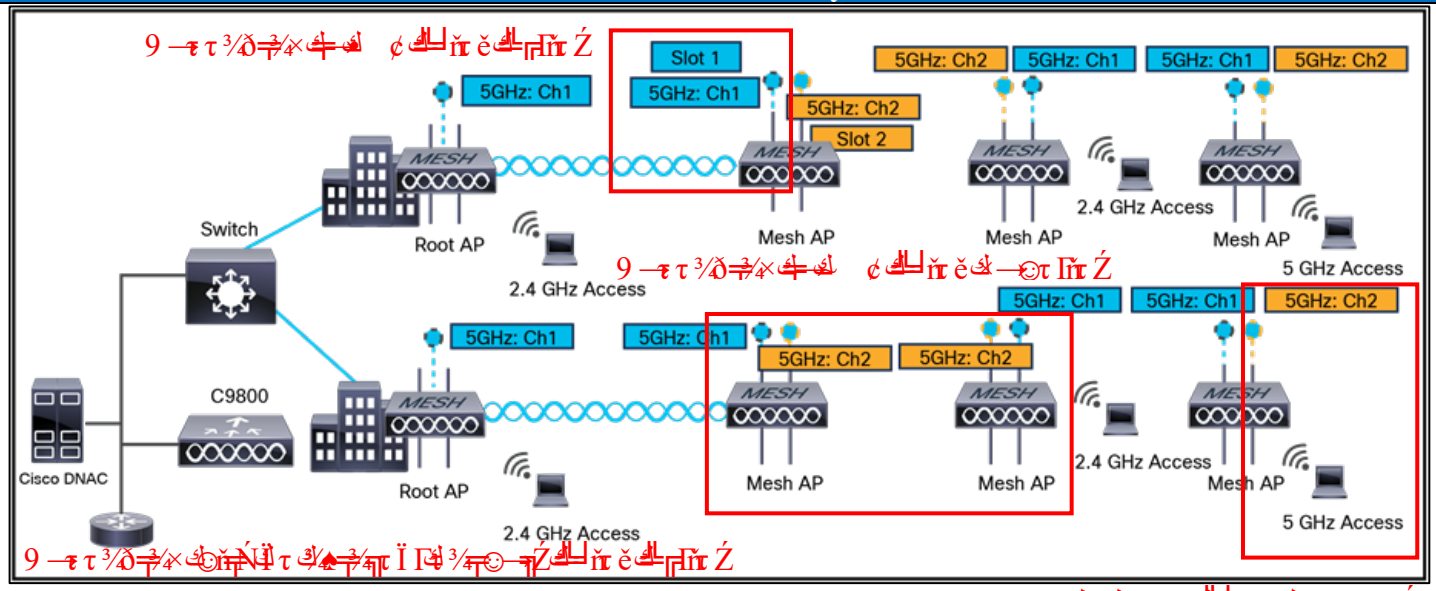
Channel Assignment

For the Mesh Serial Backhaul feature, channels are assigned according to the following rules:

- Uplink and downlink channels are different.
- All the 5-GHz radios maintain a frequency guard between their operating channels. For example, 100-MHz channel spacing between radios in Cisco Catalyst 9124AXE outdoor APs.
- Dynamic Frequency Selection (DFS) channels are supported.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/17-12/config-guide/b_wl_17_12_cg/m_mesh_ewlc.html.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points



Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

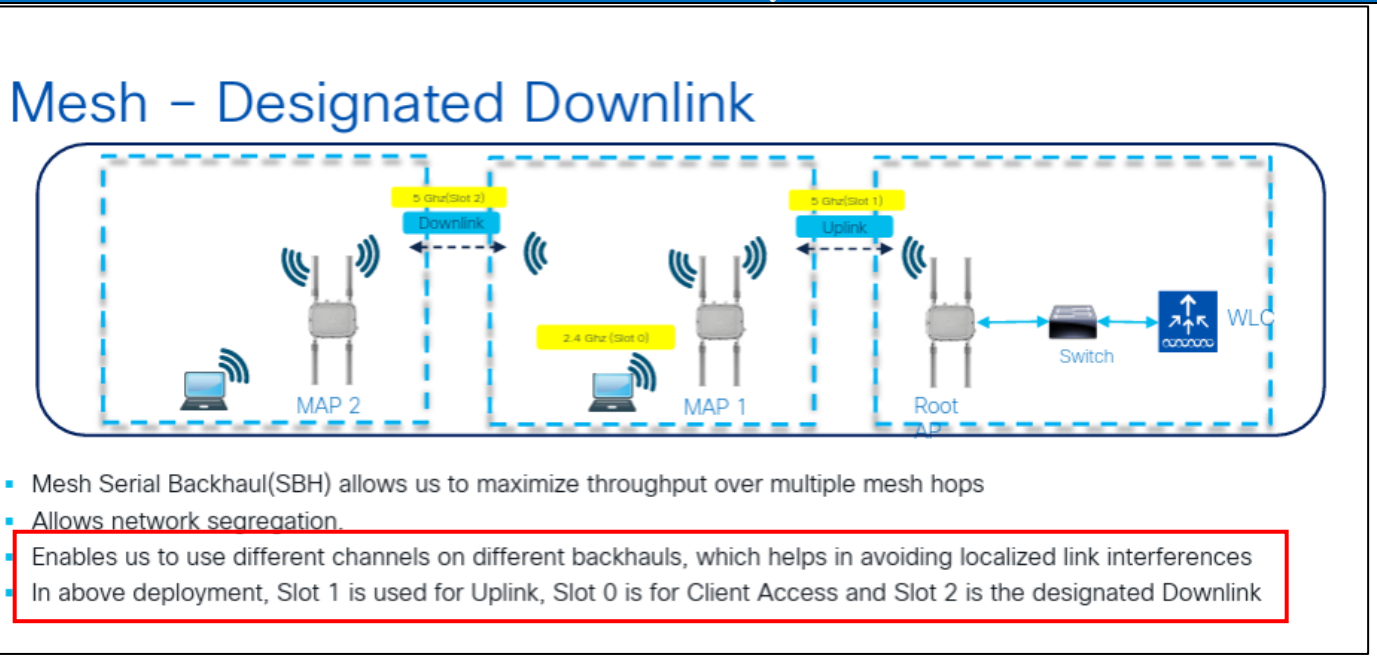
Furthermore, Mesh Serial Backhaul and Universal Backhaul Access allow for distinct frequencies or channels to be assigned to different slots designated for Uplink, Downlink, or Client Access.

Information About Mesh Serial Backhaul

The Mesh Serial Backhaul feature in a mesh access point (MAP), allows different channels for uplink and downlink access, thus improving backhaul bandwidth and extending universal access. One radio is used as the uplink radio and a different one is used as the downlink radio. This allows the in-bound and out-bound traffic to flow through exclusive communication channels, thereby improving performance and avoiding problems associated with a shared access medium.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/17-12/config-guide/b_wl_17_12_cg/m_mesh_ewlc.html.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points



Source: https://www.ciscolive.com/c/dam/r/ciscolive/emea/docs/2024/pdf/IBOEWN-2000.pdf.

On information and belief, the client connectivity is uninterrupted during any transition from an isolated configuration back to the first connected configuration. Resiliency is a design feature of the Cisco Wireless Mesh Network. Clients do not disconnect from an access point if the connection to the controller and the external network fails.

Claim 1	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

High availability

High availability has been a requirement on WLCs to minimize downtime in live networks. This section describes the theory of operation and configuration for Catalyst 9800 Series WLCs as it pertains to supporting stateful switchover of Access Points and clients (AP and client SSO). The Catalyst 9800 Series is the next generation in wireless controllers and can run on multiple platforms with different scalability goals, from low to high scale. AP and client SSO is supported on the physical appliances and the virtual cloud platforms of the Catalyst 9800 Series, namely the 9800-L, 9800-40, 9800-80, and 9800-CL. The underlying SSO functionality is the same on all platforms, with some differences in the setup process.

The high availability SSO capability on WLCs allows the AP to establish a CAPWAP tunnel with the active WLC and the active WLC to share a mirror copy of the AP and client database with the standby WLC. The APs do not go into the discovery state, and clients do not disconnect when the active WLC fails and the standby WLC takes over the network as the active WLC. Only one CAPWAP tunnel is maintained at a time between the AP and the wireless controller that is in an active state. Release 16.10 supports full AP and client SSO. Client SSO is supported for clients that have already completed the authentication and DHCP phase and have started passing traffic. With client SSO, a client's information is synced to the standby WLC when the client associates to the WLC or the client's parameters change. Fully authenticated clients, that is, the ones in the run state, are synced to the standby WLC, and thus client reassociation is avoided on switchover, making the failover seamless for the APs as well as for the clients, resulting in zero client service downtime and zero SSID outage. The overall goal in adding AP and client SSO support to the Catalyst 9800 Series WLCs is to reduce major downtime in wireless networks due to failure conditions that may occur due to box failover, network failover, or a power outage at the primary site.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's system achieves the same function (maintaining mesh connectivity when the connection to the external network is lost), in substantially the same way (via a mesh node acting as parent or root node), to yield the same result (continuing to bridge traffic with wireless clients staying connected). Thus, the functional result of enabling external network communication is preserved, the means of accomplishing it (radio-based upstream communication and/or tunneling) are insubstantially different, and the manner of establishing that connectivity (through AWPP-determined routing and/or controller tunneling) fulfills the same claimed operation. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial.

MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.

Claim 9	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
The structured mesh network of claim 1 wherein the connectivity logic contained by the nodes realigns connections between the nodes upon detection of an external network connection to form the connected configuration.	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network function in the structured mesh network of claim 1 wherein the connectivity logic contained by the nodes realigns connections between the nodes upon detection of an external network connection to form the connected configuration. In addition to the elements in claim 1 above, AWPP continually monitors and scans conditions (*e.g.*, addition or removal of RAPs, ease values, etc.) and changes routes to reflect changes in conditions such as detection of an external network connection (*e.g.*, establishing a path to the CAPWAP controller). **Adaptive Wireless Path Protocol** The Adaptive Wireless Path Protocol (AWPP) is designed specifically for wireless mesh networking to provide ease of deployment, fast convergence, and minimal resource consumption. AWPP takes advantage of the CAPWAP WLAN, where client traffic is tunneled to the controller and is therefore hidden from the AWPP process. Also, the advance radio management features in the CAPWAP WLAN solution are available to the wireless mesh network and do not have to be built into AWPP. AWPP enables a remote access point to dynamically find the best path back to a RAP for each MAP that is part of the RAP's bridge group (BGN). Unlike traditional routing protocols, AWPP takes RF details into account. To optimize the route, a MAP actively solicits neighbor MAP. During the solicitation, the MAP learns all of the available neighbors back to a RAP, determines which neighbor offers the best path, and then synchronizes with that neighbor. The path decisions of AWPP are based on the link quality and the number of hops. AWPP automatically determines the best path back to the CAPWAP controller by calculating the cost of each path in terms of the signal strength and number of hops. After the path is established, AWPP continuously monitors conditions and changes routes to reflect changes in conditions. AWPP also performs a smoothing function to signal condition information to ensure that the ephemeral nature of RF environments does not impact network stability. Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. AWPP uses ease values to realign connections between the nodes to offer the best route back to the RAP.

Claim 9	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Mesh neighbors, parents, and children

Relationships among mesh APs are as a parent, child, or neighbor (see Figure 73).

- A parent AP offers the best route back to the RAP based on its ease values. A parent can be either the RAP itself or another MAP.
  - Ease is calculated using the SNR and link hop value of each neighbor. Given multiple choices, generally an AP with a higher ease value is selected.
- A child AP selects the parent AP as its best route back to the RAP.
- A neighbor AP is within RF range of another AP but is not selected as its parent or a child because its ease value is lower than that of the parent.
- Mesh networks are half duplex, meaning after the first hop (RAP to MAP) overall throughput is decreased by 50% for each additional hop (MAP to MAP). Where Ethernet bridging clients are used in MAPs and heavy traffic is passed, high throughput consumption nay result, which may cause the downlink MAPs to disassociate from the network due to throughput starvation.

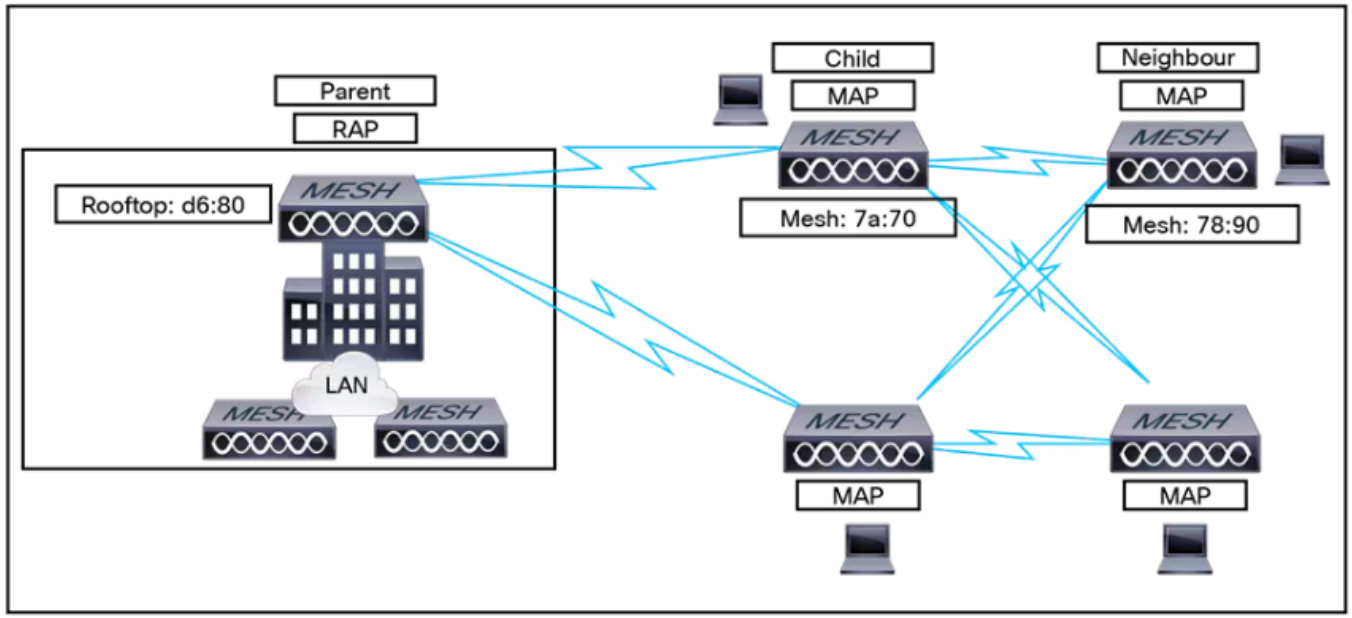
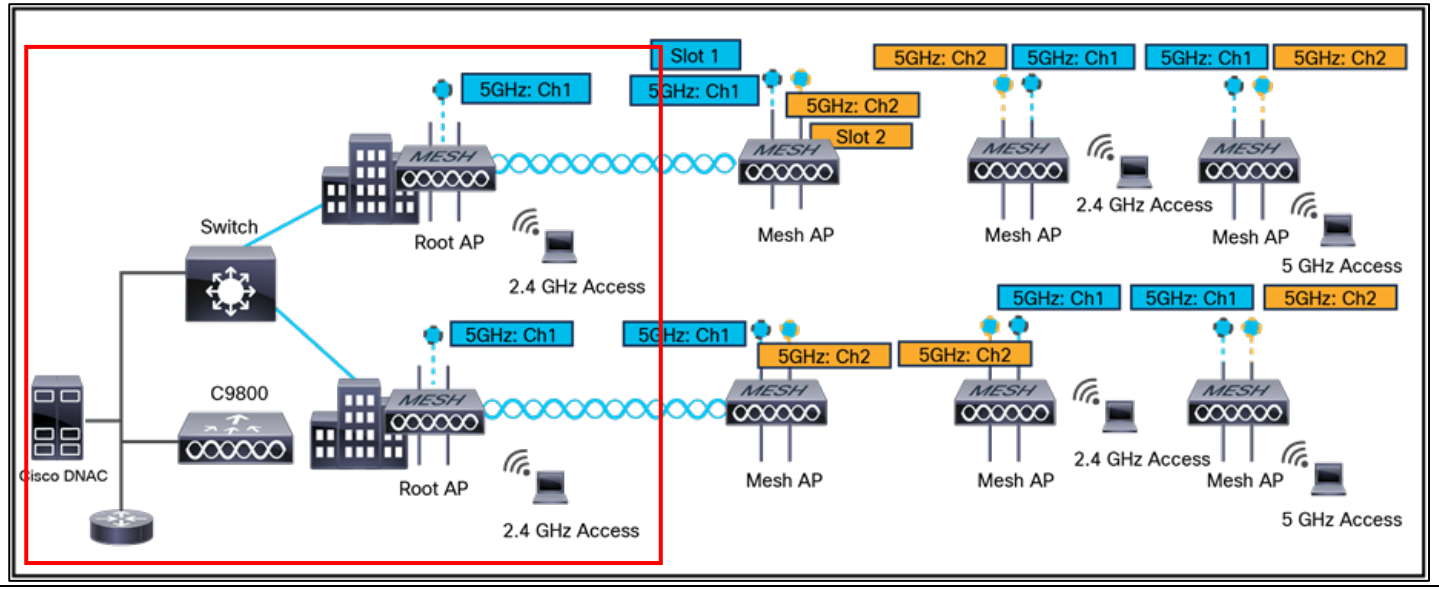


Figure 73.

Parent, child, and neighbor relationships

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Claim 9	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's mesh network achieves the same function (*e.g.*, restructuring network topology in response to external connectivity), by substantially the same way (*e.g.*, using AWPP and ease-based path selection to reassign parent-child relationships and rebuild the mesh tree toward a RAP), and yields the same result (*e.g.*, creating a converged mesh topology linked to an external network). The use of dynamic ease-based reassignment is an insubstantial difference. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial. MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.

Claim 10	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
The structured mesh network of claim 9 wherein solely the isolated network root node logic searches for the external network connection and establishes the external network connection.	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network functions in the structured mesh network of claim 9 wherein solely the isolated network root node logic searches for the external network connection and establishes the external network connection. In the first configuration, the root node (*e.g.*, the Root AP (RAP)) is directly connected to the external network. 

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Only nodes connected to the network via Ethernet uplink are designated as the Root AP (RAP) and would search to establish the external network connection.

Mesh background scanning

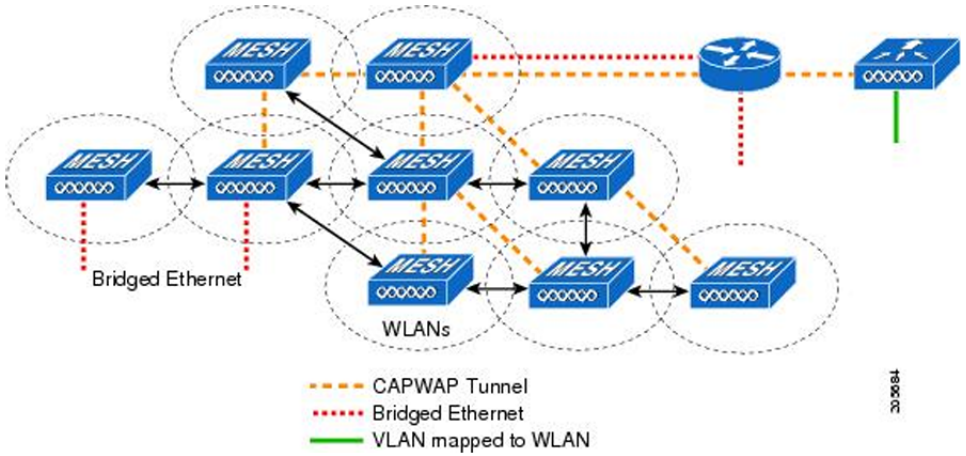
Cisco MAPs are interconnected over wireless links in a spanning tree-like topology. A MAP connected to the network via Ethernet uplink is designated as the root AP. AWPP is used to maintain and form the tree. When a MAP comes up, it tries to look for another MAP (parent) to join to reach the gateway eventually via a RAP. The same happens when a MAP lose connectivity with its existing parent. This procedure is known as mesh tree convergence. This feature aims to make the convergence procedure faster and more robust.

This procedure is time consuming. To simplify the process, we have introduced mesh background scanning and automatic parent selection. This feature is available in Cisco IOS XE starting with Release 17.11.1 in the Aironet 1562 and Catalyst 9124AX APs. This mechanism allows the MAP to find and connect faster to a better potential parent across channels and always maintain its uplink with the best parent.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Each mesh access point within the mesh forms an CAPWAP session with a controller. WLAN traffic is encapsulated inside CAPWAP and is mapped to a VLAN interface on the controller. Bridged Ethernet traffic can be passed from each Ethernet interface on the mesh network and does not have to be mapped to an interface on the controller (see Figure 5: Logical Bridge and WLAN Mapping, on page 12).

Figure 5: Logical Bridge and WLAN Mapping



Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf.

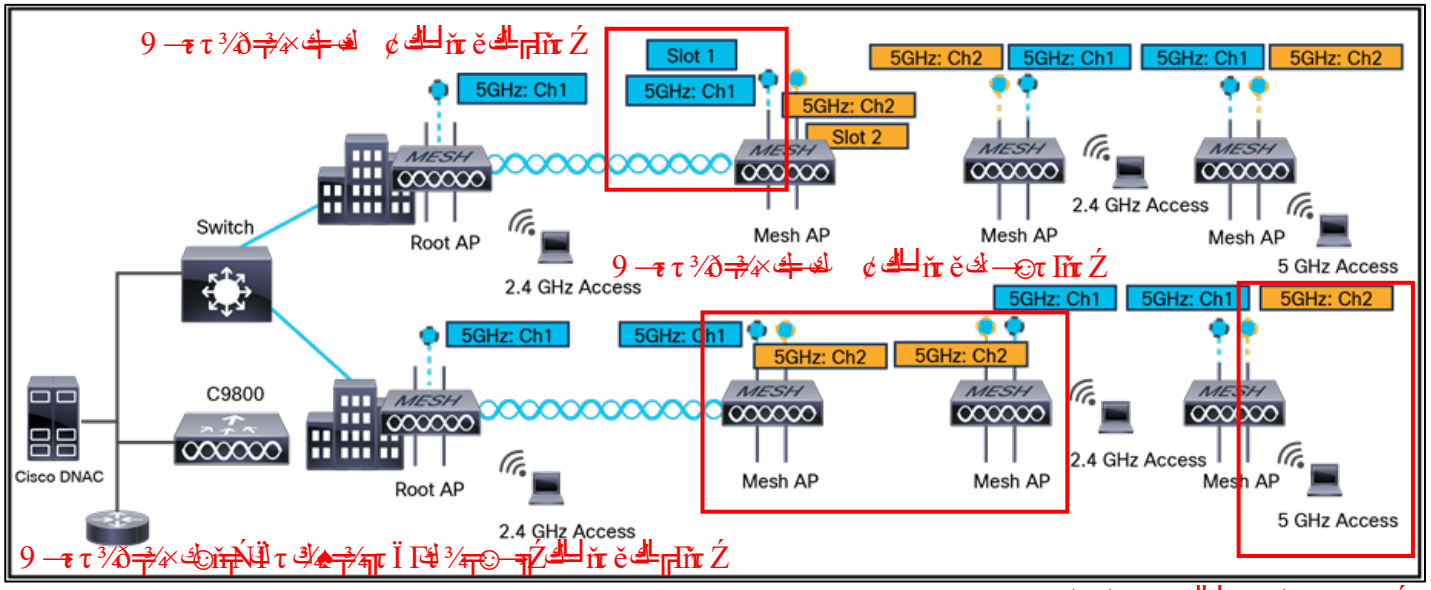
If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's RAP (Root Access Point) performs the same function (*e.g.*, initiating discovery of and establishing connectivity with an external controller), by substantially the same means (*e.g.*, using CAPWAP discovery via a static IP or assigned controller), and achieves the same result (*e.g.*, re-establishing external network communication for the mesh). The RAP remains the sole node initiating and negotiating the external connection. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial.

MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.

Claim 11	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
The structured mesh network of claim 10 wherein the previously unused uplink radio of the isolated network root node is used to connect to the external network.	Cisco's Catalyst 9100 Access Points in the Cisco Wireless Mesh Network functions in the structured mesh network of claim 10 wherein the previously unused uplink radio of the isolated network root node is used to connect to the external network. As shown in Cisco's documentation, when an AP operates in standalone mode, it may lose its connection and enter an isolated configuration (*e.g.*, standalone mode). In that state, the RAP's uplink radio becomes unused with respect to the external network. While the RAPs have wired connections to their controller, MAPs have wireless connections to their controller via the RAP or another MAP. MAPs communicate among themselves and back to the RAP using wireless connections over the 802.11a/n/ac/ax radio backhaul. MAPs use the Cisco Adaptive Wireless Path Protocol (AWPP) to determine the best path through the other mesh access points to the controller. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. **Connected mode** A Wave 2 Flex+Mesh AP (RAP or child MAP) is in connected mode when it can access and join the Catalyst 9800 and can exchange periodic keep-alive messages with the Catalyst 9800. In this mode, a Flex+Mesh AP will be able to support locally and centrally switched WLANs. It will allow regular client and child mesh APs to join. **Standalone mode** A Wave 2 Flex+Mesh AP is in standalone mode if it loses connection to the controller but can access the local gateway. In this mode, the Wave 2 Flex+Mesh AP will disable all the centrally switched WLANs and keep the locally switched WLANs up and running. It will also allow new clients to join on locally switched WLANs using local authentication if the authentication server is reachable in the local network. Child mesh APs will NOT be allowed to join in this mode. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. In standalone mode, the RAP's uplink radio becomes unused with respect to the external network. Upon detecting a viable connection, the RAP re-establishes connectivity by using its previously unused uplink radio to reconnect to the external network and moves from standalone mode to connected mode. • After moving back to connected mode, from standalone mode, best neighbor selection timer and BGN timer will be restarted, so allow the child mesh AP to roam to the best possible neighbor.

Claim 11	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf[1] If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's RAP achieves the same function (*e.g.*, restoring connectivity to the external network), by substantially the same means (*e.g.*, activating an unused uplink interface that previously lost connection), and yields the same result (*e.g.*, establishing a connection between the mesh and external networks). The use of a wired connection instead of a radio is an insubstantial difference. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial. MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
35pre: A structured mesh network capable of isolated operation, comprising:	*See* Claim 1pre above, the contents of which are incorporated herein by reference.
35(a): at least two structured mesh nodes; wherein each structured mesh node comprises at least a connectivity logic and a radio operating on an uplink frequency and a distinct downlink frequency;	*See* Claim 1(a) and 1(b) above, the contents of which are incorporated herein by reference.
35(b): wherein the connectivity logic determines whether each structured mesh node connects with an external network or another node on the uplink frequency and client devices or other mesh	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network comprise a connectivity logic, wherein the connectivity logic determines whether each structured mesh node connects with an external network or another node on an uplink frequency and client devices or other mesh nodes connect to each node on an downlink frequency. For example, and as shown below, and in the Cisco documentation, the connectivity logic in Cisco's Catalyst 9100 and Aironet Access Points determine whether each access point connects with the external network (*e.g.*, is a MAP connecting to an external network via a RAP and controller) or another access point (*e.g.*, is a MAP connecting to a

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
nodes connect to each node on the downlink frequency;	RAP or another MAP) on an uplink frequency. Similarly, the logic determines when and whether the downlink frequency is connected to another mesh node (*e.g.*, MAP) or a client device (*e.g.*, a smartphone or laptop).  Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. The connectivity logic (*e.g.*, AWPP) determines the best path back to the controller for the mesh network, and therefore determines whether a mesh node connects to the controller or a RAP or another MAP on an uplink or downlink frequency:

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Adaptive Wireless Path Protocol

The Adaptive Wireless Path Protocol (AWPP) is designed specifically for wireless mesh networking to provide ease of deployment, fast convergence, and minimal resource consumption.

AWPP takes advantage of the CAPWAP WLAN, where client traffic is tunneled to the controller and is therefore hidden from the AWPP process. Also, the advance radio management features in the CAPWAP WLAN solution are available to the wireless mesh network and do not have to be built into AWPP.

AWPP enables a remote access point to dynamically find the best path back to a RAP for each MAP that is part of the RAP's bridge group (BGN). Unlike traditional routing protocols, AWPP takes RF details into account.

To optimize the route, a MAP actively solicits neighbor MAP. During the solicitation, the MAP learns all of the available neighbors back to a RAP, determines which neighbor offers the best path, and then synchronizes with that neighbor. The path decisions of AWPP are based on the link quality and the number of hops.

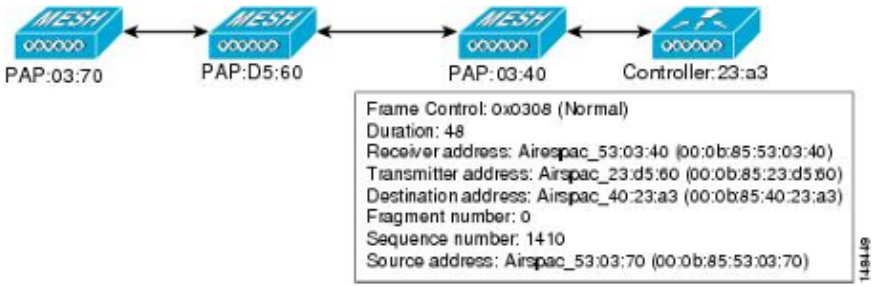
AWPP automatically determines the best path back to the CAPWAP controller by calculating the cost of each path in terms of the signal strength and number of hops. After the path is established, AWPP continuously monitors conditions and changes routes to reflect changes in conditions. AWPP also performs a smoothing function to signal condition information to ensure that the ephemeral nature of RF environments does not impact network stability.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Additionally, the connectivity logic (*e.g.*, AWPP) determines whether each structured mesh node connects with an external network or another node on a hop-by-hop basis.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Figure 4: Wireless Mesh Frame



As this frame is sent, the transmitter and receiver addresses change on a hop-by-hop basis. AWPP is used to determine the receiver address at each hop. The transmitter address is known because it is the current mesh access point. The source and destination addresses are the same over the entire path.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf[1]

The connectivity logic (*e.g.*, AWPP) may also determine whether each node connects with an external network to exit the isolated configuration (*e.g.*, move from standalone mode to connected mode after a connection is lost and restablished):

- After moving back to connected mode, from standalone mode, best neighbor selection timer and BGN timer will be restarted, so allow the child mesh AP to roam to the best possible neighbor.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf

The mesh system supports various user-defined and preset configurations for backhaul and client communications (*e.g.*, Mesh Serial Backhaul, Universal Backhaul Access) enabling the connectivity logic to determine whether each structured mesh node (*e.g.*, RAP or MAP) connects to an external network or another mesh node on an uplink frequency, and whether client devices or other mesh nodes connect to each node on a downlink frequency.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Information About Mesh Serial Backhaul

The Mesh Serial Backhaul feature in a mesh access point (MAP), allows different channels for uplink and downlink access, thus improving backhaul bandwidth and extending universal access. One radio is used as the uplink radio and a different one is used as the downlink radio. This allows the in-bound and out-bound traffic to flow through exclusive communication channels, thereby improving performance and avoiding problems associated with a shared access medium.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/17-12/config-guide/b_wl_17_12_cg/m_mesh_ewlc.html.

Enterprise 11n/ac mesh is added to the Catalyst 9800 controller features to work with the 802.11n/ac APs. Enterprise 11ac/ax mesh features are compatible with non-802.11ac mesh but add higher backhaul and client access speeds. The 802.11ac indoor APs are two-radio Wi-Fi infrastructure devices for select indoor deployments. One radio can be used for local (client) access for the AP, and the other radio can be configured for wireless backhaul. If Universal Backhaul Access is enabled, the 5-GHz and 2.4-GHz radios in Release 17.1 can be used for local (client) access as well as backhaul. Enterprise 11ac mesh supports point-to-point, point-to-multipoint, and mesh types of architectures.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh

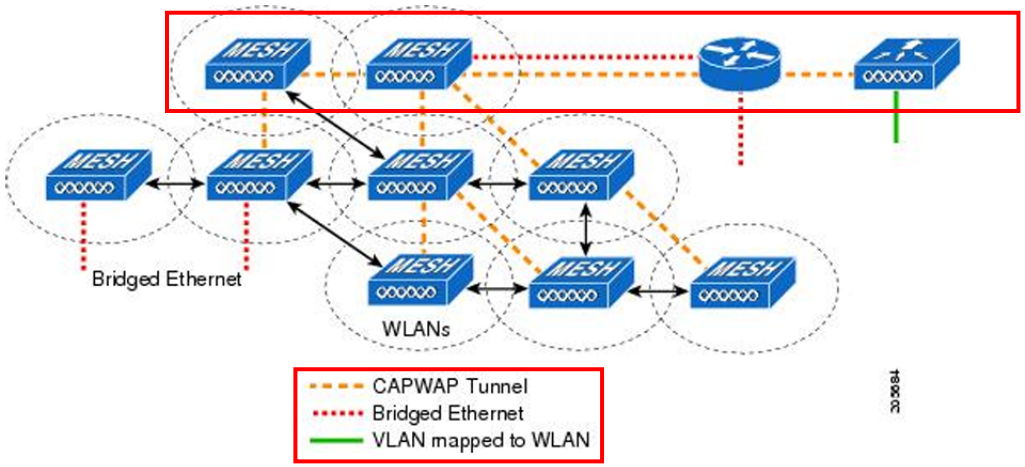
.The Cisco indoor mesh access points are equipped with the following two simultaneously operating radios:

- From rel 8.2 2.4 GHz radio used for data backhaul and client access if UBA is enable
- 5-GHz radio used for data backhaul and client access if Universal Backhaul Access is enabled

The 5-GHz radio supports the 5.15 GHz, 5.25 GHz, 5.47 GHz, and 5.8 GHz bands.

Source: https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/technotes/8-5/cisco-enterprise-mobility-design-guide-8-5.pdf

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's implementation using AWPP and CAPWAP with VLAN tunneling performs the same function (*e.g.*, routing traffic between mesh nodes and the external network), in substantially the same way (*e.g.*, by dynamically selecting the next hop toward a RAP whose traffic is tunneled to a controller mapped to an external VLAN), and achieves the

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	same result (*e.g.*, establishing and managing a connection between mesh nodes and external networks). Connection to an external network via VLAN tunneling, is an insubstantial difference from determining external and mesh connections via internal logic. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial. Each mesh access point within the mesh forms an CAPWAP session with a controller. WLAN traffic is encapsulated inside CAPWAP and is mapped to a VLAN interface on the controller. Bridged Ethernet traffic can be passed from each Ethernet interface on the mesh network and does not have to be mapped to an interface on the controller (see Figure 5: Logical Bridge and WLAN Mapping, on page 12). ***Figure 5: Logical Bridge and WLAN Mapping***  Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf. MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
35(c): wherein the connectivity logic in each node contains a distributed routing table;	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network function wherein the connectivity logic in each node contains a distributed routing table. The documentation below outlines functionality that is indicative of a distributed routing table on each node, as it demonstrates the ability of each node to independently evaluate, select, and adjust paths within the mesh network based on dynamic conditions: The description of background scanning and MAP Fast Ancestor finding shows that each node independently discovers and evaluates connections to other nodes and maintains their topology by using AWPP (*e.g.*, connectivity logic), implying each has awareness of available paths—a foundational component of a routing table. **Background scanning and MAP fast ancestor find mode (Concept)** Cisco mesh access points (MAPs) perform the following functions: • Interconnects over wireless links in a tree topology, • Uses Adaptive Wireless Path Protocol (AWPP) to create and maintain their topology, and • Supports additional features: Background Scanning and MAP Fast Ancestor Finding. When a MAP comes up, it tries to look for another MAP (parent) to join and reach the gateway through a RAP. The same happens when a MAP loses connectivity with its existing parent. This procedure is known as mesh tree convergence. https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/17-12/config-guide/b_wl_17_12_cg/m_mesh_ewlc.html The Adaptive Wireless Path Protocol (AWPP) enables each MAP to dynamically determine the best path back to a RAP evaluation of network path metrics, such as ease values and hop counts, a decision-making process indicative of the use of a distributed routing table, *e.g.*, wherein the connectivity logic in each node contains a distributed routing table.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Adaptive Wireless Path Protocol

The Adaptive Wireless Path Protocol (AWPP) is designed specifically for wireless mesh networking to provide ease of deployment, fast convergence, and minimal resource consumption.

AWPP takes advantage of the CAPWAP WLAN, where client traffic is tunneled to the controller and is therefore hidden from the AWPP process. Also, the advance radio management features in the CAPWAP WLAN solution are available to the wireless mesh network and do not have to be built into AWPP.

AWPP enables a remote access point to dynamically find the best path back to a RAP for each MAP that is part of the RAP's bridge group (BGN). Unlike traditional routing protocols, AWPP takes RF details into account.

To optimize the route, a MAP actively solicits neighbor MAP. During the solicitation, the MAP learns all of the available neighbors back to a RAP, determines which neighbor offers the best path, and then synchronizes with that neighbor. The path decisions of AWPP are based on the link quality and the number of hops.

AWPP automatically determines the best path back to the CAPWAP controller by calculating the cost of each path in terms of the signal strength and number of hops. After the path is established, AWPP continuously monitors conditions and changes routes to reflect changes in conditions. AWPP also performs a smoothing function to signal condition information to ensure that the ephemeral nature of RF environments does not impact network stability.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Mesh neighbors, parents, and children

Relationships among mesh APs are as a parent, child, or neighbor (see Figure 73).

- A parent AP offers the best route back to the RAP based on its ease values. A parent can be either the RAP itself or another MAP.
  - Ease is calculated using the SNR and link hop value of each neighbor. Given multiple choices, generally an AP with a higher ease value is selected.
- A child AP selects the parent AP as its best route back to the RAP.
- A neighbor AP is within RF range of another AP but is not selected as its parent or a child because its ease value is lower than that of the parent.
- Mesh networks are half duplex, meaning after the first hop (RAP to MAP) overall throughput is decreased by 50% for each additional hop (MAP to MAP). Where Ethernet bridging clients are used in MAPs and heavy traffic is passed, high throughput consumption nay result, which may cause the downlink MAPs to disassociate from the network due to throughput starvation.

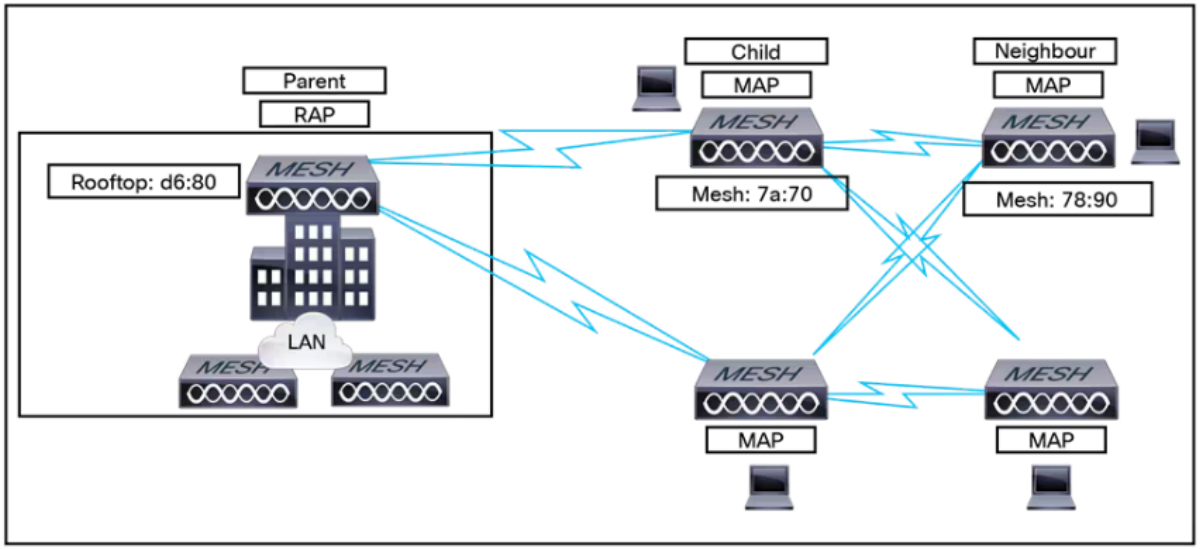


Figure 73.

Parent, child, and neighbor relationships

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

Criteria for choosing the best parent

AWPP follows this process in selecting parents for a RAP or MAP with a radio backhaul:

1. A list of channels with a neighbor is generated by passive scanning in the scan state, which is a subset of all backhaul channels.
2. The channels with a neighbor are sought by actively scanning in the seek state, and the backhaul channel is changed to the channel with the best neighbor.
3. The parent is set to the best neighbor, and the parent-child handshake is completed in the seek state.
4. Parent maintenance and optimization occurs in the maintain state.

This algorithm is run at startup and whenever a parent is lost and no other potential parent exists, and it is usually followed by CAPWAP network and controller discovery. All neighbor protocol frames carry the channel information.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Parent decision

A parent mesh AP is chosen by using the adjusted ease, which is the ease of each neighbor divided by the number of hops to the RAP: Adjusted ease = Min (ease at each hop) Hop count.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

The node-initiated NEIGHBOR_REQUEST and evaluation of neighbor responses show that routing decisions are made locally at each node, based on real-time link assessments using AWPP. This further supports the existence of node-specific routing data contained in the connectivity logic.

Parent optimization and refresh occurs by the child node sending a NEIGHBOR_REQUEST broadcast on the same channel on which its parent resides, and by evaluating all responses from neighboring nodes on the channel.

A parent mesh AP provides the best path back to a RAP. AWPP uses ease to determine the best path. Ease can be considered the opposite of cost, and the preferred path is the path with the higher ease.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Each mesh access point maintains routing data—specifically, it checks for routing loops by comparing route information (including MAC addresses of each hop to the root access point) against its own MAC address. This

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

further suggests that each node stores and processes routing information locally, consistent with maintaining a routing table to support AWPP (Adaptive Wireless Path Protocol) operations.

> **Loop prevention**
>
> To ensure that routing loops are not created, AWPP discards any route that contains its own MAC address. That is, routing information apart from hop information contains the MAC address of each hop to the RAP; therefore, a mesh AP can easily detect and discard routes that loop.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

The connectivity logic in each node containing a distributed routing table is further shown by the show command line interface manual and the "show ap name mesh path" command, which retrieves the mesh AP's path.

show ap name mesh path

To see information about the mesh AP's path, use the **show ap name** *ap-name* **mesh path** command.

show ap name *ap-name* **mesh path** [**chassis** {*chassis-number* | **active** | **standby**} **R0**]

Syntax Description

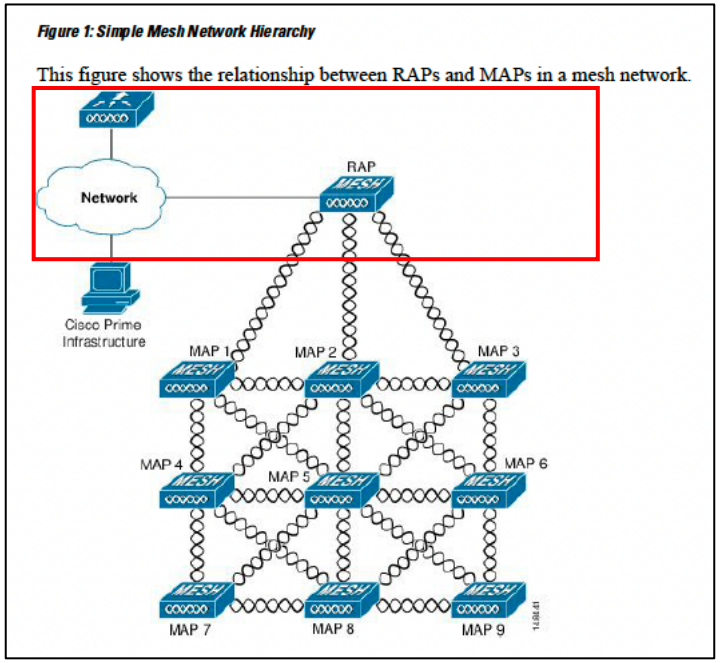
chassis-number	Enter the chassis number as either 1 or 2.
active R0	Active instance of the AP filters in Route-processor slot 0.
standby R0	Standby instance of the AP filters in Route-processor slot 0.

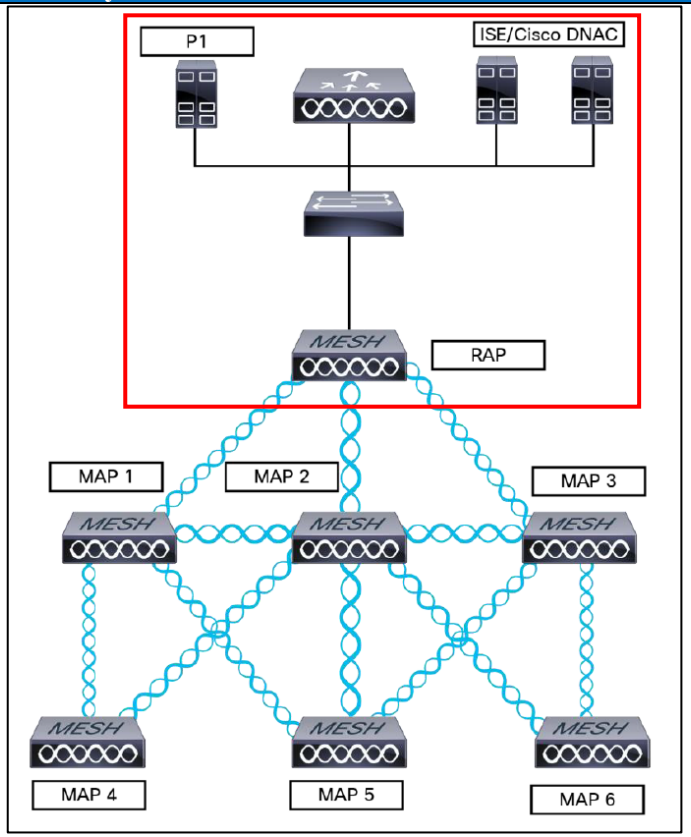
Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/cmd-ref/b_wl_16_10_cr/show-commands.html#wp5155031900

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's MAPs and RAPs achieve the same function (*e.g.*, enabling dynamic path selection and routing decisions across the mesh), by substantially the same means (*e.g.*, storing and updating neighbor information, signal quality, and hop metrics locally at each node, or referencing routing decisions derived from a centralized routing table maintained on the controller and communicated to the APs), and yield the same result (*e.g.*, establishing and maintaining optimized

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	routes through the mesh network). The absence of a formal data structure labeled as a "routing table" is an insubstantial difference. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial. MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.
35(d): wherein the structured mesh network functions in two configurations selected depending on whether a connection to an external network is present; in the first connected configuration the structured mesh network includes at least one structured mesh node's uplink connection comprising a connection to an external network; and	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network function in two configurations (*e.g.*, a "first connected configuration" wherein the connection to the external network via the controller is not lost, and an "isolated configuration" wherein the connection to the external network via the controller is lost) selected depending on whether a connection to an external network is present. In normal operation, the Cisco Wireless Mesh Network is connected to an external network (to make/facilitate additional connections to outside networks and destinations, for example to connect clients to an external network). When so connected, the system is configured to pass information from inside the network via the uplink connection of at least one structured mesh node (*i.e.*, RAP), as shown below and in Cisco's documentation:

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points





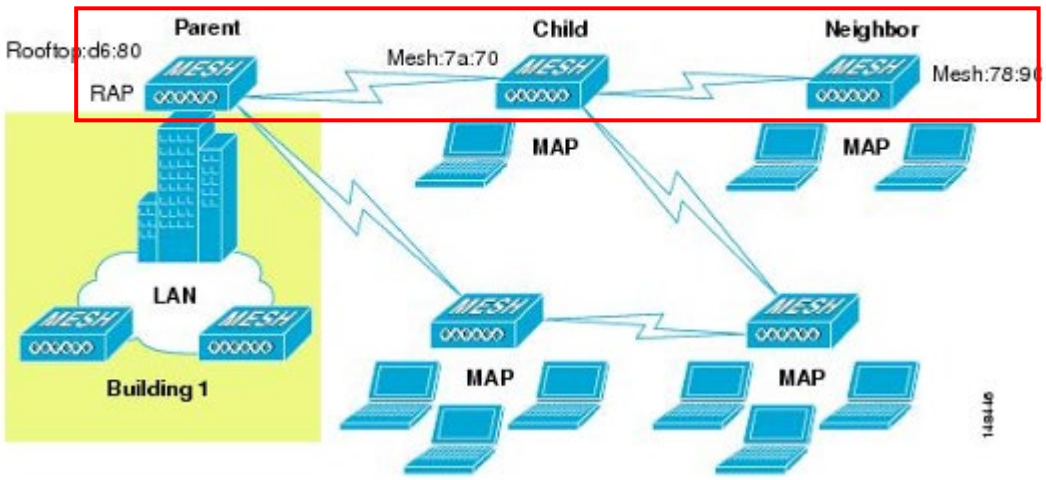
Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

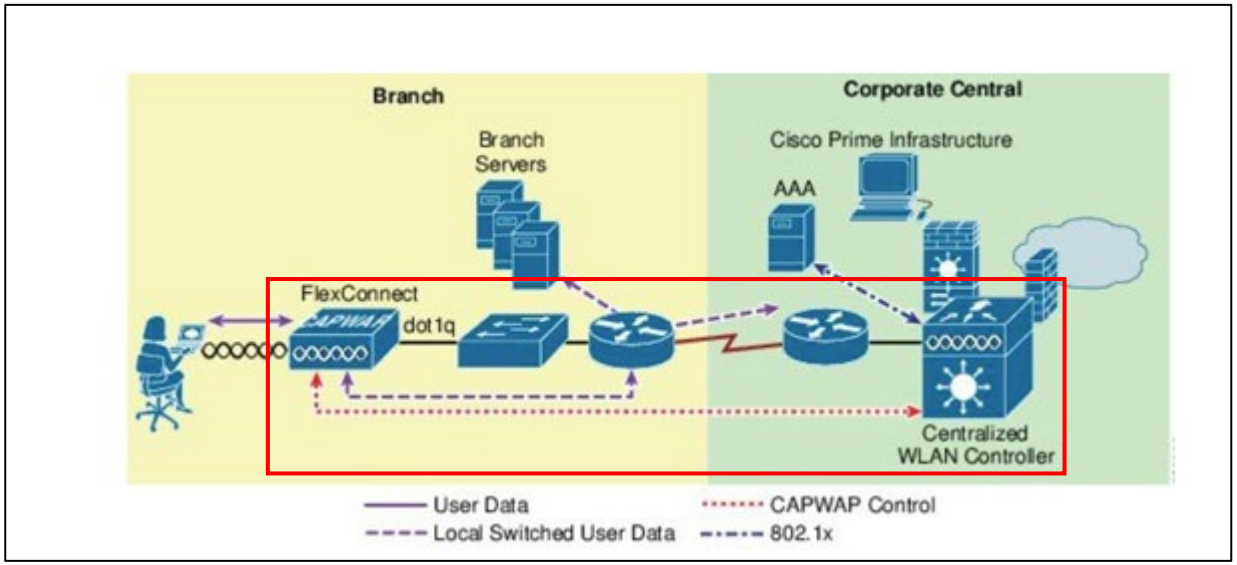
In some cases, the typical operating mode is explicitly referred to as "connected mode."

Connected mode

A Wave 2 Flex+Mesh AP (RAP or child MAP) is in connected mode when it can access and join the Catalyst 9800 and can exchange periodic keep-alive messages with the Catalyst 9800. In this mode, a Flex+Mesh AP will be able to support locally and centrally switched WLANs. It will allow regular client and child mesh APs to join.

Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	The mesh nodes have a wireless connection to the controller (and the external network) via the RAP: While the RAPs have wired connections to their controller, MAPs have wireless connections to their controller via the RAP or another MAP. MAPs communicate among themselves and back to the RAP using wireless connections over the 802.11a/n/ac/ax radio backhaul. MAPs use the Cisco Adaptive Wireless Path Protocol (AWPP) to determine the best path through the other mesh access points to the controller. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html. If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's system achieves the same function (external network connectivity), in substantially the same way (via the mesh node's uplink connection establishing a path to a controller), to yield the same result (connectivity beyond the local mesh network). Whether or not the controller itself is considered part of the "external network," the resulting connectivity functionally extends beyond the mesh. Thus, the functional result of enabling external network communication is preserved, the means of accomplishing it (upstream communication) are insubstantially different, and the manner of establishing that connectivity (through AWPP-determined routing and/or controller tunneling) fulfills the same claimed operation. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial. *Figure 6: Parent, Child, and Neighbor Access Points* 

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf.  Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf. MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.
35(e): in the second isolated configuration none of the structured mesh nodes' uplink connections comprises a connection to an external network, and one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root	Cisco's Catalyst 9100 and Aironet Access Points in the Cisco Wireless Mesh Network function in the second isolated configuration (*e.g.*, fault tolerant resilient mode) where none of the structured mesh nodes' uplink connection comprises a connection to an external network, (*e.g.*, when Cisco's Catalyst 9100 and Aironet Access Points fails to connect to an external network via the controller) and one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root node (*e.g.*, a Cisco's Catalyst 9100 and Aironet Access Points operating as a RAP prior to a loss of connection to the controller) as isolated root children nodes (*e.g.*, a Cisco's Catalyst 9100 and Aironet Access Points operating as MAPs) forming a tree configuration. When the Cisco Wireless Mesh Network is not connected to an external network, the network is capable of functioning in a variety of localized modes. Cisco's Catalyst 9100 and Aironet Access Points are access points that can operate in several different modes, including, for example, Flex + Mesh mode, fault tolerate resilient mode, and

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
node as isolated root children and descendant nodes forming a tree configuration;	standalone mode. Each of these modes maintain the connectivity of mesh access points when the connection to the controller (and thus to the external network) is lost. These modes can switch client data traffic locally when a connection to the controller is lost. As shown below and in Cisco's documentation, the tree structure is maintained, as a child access point (MAP) remains connected to a parent access point (another MAP or a RAP) in the second isolated configuration. **Cisco outdoor mesh access points** In addition to the mesh mode, the mesh APs can operate in the following modes: • **Local mode:** In this mode, the AP can handle clients on its assigned channel or while monitoring all channels on the band over a 180-second period. During this time, the AP listens on each channel for 50 ms for rogue client beacons, noise floor measurements, interference, and IDS events. The AP also scans for CleanAir interference on the channel. • **FlexConnect mode:** FlexConnect mode enables you to configure and control APs in a branch or remote office from the corporate office through a WAN link without having to deploy a controller in each office. This mode can switch client data traffic locally and perform client authentication locally when the connection to the controller is lost. When connected to the controller, an AP in FlexConnect mode can also tunnel traffic back to the controller. • **Flex+Mesh mode:** In this mode, both the FlexConnect and Bridge mode configuration options are available on the access point. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh. **Connected mode** A Wave 2 Flex+Mesh AP (RAP or child MAP) is in connected mode when it can access and join the Catalyst 9800 and can exchange periodic keep-alive messages with the Catalyst 9800. In this mode, a Flex+Mesh AP will be able to support locally and centrally switched WLANs. It will allow regular client and child mesh APs to join. **Standalone mode** A Wave 2 Flex+Mesh AP is in standalone mode if it loses connection to the controller but can access the local gateway. In this mode, the Wave 2 Flex+Mesh AP will disable all the centrally switched WLANs and keep the locally switched WLANs up and running. It will also allow new clients to join on locally switched WLANs using local authentication if the authentication server is reachable in the local network. Child mesh APs will NOT be allowed to join in this mode. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points

uplink to the core network in a 'Root' AP or RAP mode. The AP is still managed by a centralized controller over CAPWAP. The AP however is capable of moving to a standalone mode where the AP will be able to continue to serve the 802.11 clients depending on the data switching method of the WLAN configured on the AP. The data can be centrally or locally switched. When data is centrally switched, all data is sent to the WLC that does the switching further. In a local switch network, the data is sent to RAP where RAP switches locally on the wired uplink. There is no difference to the central and local switched WLAN configurations and

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf.

A Control and Provisioning of Wireless Access Points protocol (CAPWAP) Access Point (AP) can be configured to operate in two different modes:

- FlexConnect mode
- Bridge/Mesh mode

The following are the bridging features for Flex+Bridge mode:

- The Flex+Bridge mode supports the centrally switched 802.11 WLAN. Traffic for this tunneled WLAN is forwarded to and from a CAPWAP controller over an IP tunnel.
- The Flex+Bridge mode supports the Root Ethernet VLAN Bridging. A root AP bridges the traffic for bridged 802.11 WLANs and secondary Ethernet LANs to a local Ethernet LAN over its root Ethernet port.
- The Flex+Bridge mode bridging is supported on Secondary Ethernet Access Ports and Secondary Ethernet VLAN Trunk Ports.
- Fault Tolerant Resilient Mode enables an AP to continue bridging traffic when the connection to the CAPWAP controller is lost. Both mesh and non-mesh root APs continue to bridge traffic. A child mesh AP (MAP) maintains its link to a parent AP and continues to bridge traffic till the parent link is lost. A child mesh AP cannot establish a new parent or child link till it reconnects to the CAPWAP controller. Existing wireless clients on the locally switching WLAN can stay connected with their AP in this mode. Their traffic will continue to flow through the Mesh and wired network. No new or disconnected wireless client can associate to the Mesh AP in this mode.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/8-5/config-guide/b_cg85/flexconnect.html.

Claim 35	Cisco Wireless Mesh Network with Catalyst and Aironet Access Points
	If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. Cisco's system achieves the same function (maintaining mesh connectivity when the connection to the external network is lost), in substantially the same way (via a mesh node acting as parent or root node), to yield the same result (continuing to bridge traffic with wireless clients staying connected). Thus, the functional result of enabling external network communication is preserved, the means of accomplishing it (upstream communication and/or tunneling) are insubstantially different, and the manner of establishing that connectivity (through AWPP-determined routing and/or controller tunneling) fulfills the same claimed operation. A person skilled in the relevant art would consider any difference between the claimed invention and the Cisco Accused Products to be minor and insubstantial. MeshDynamics asserts that this claim element is a software limitation. Pursuant to P.R. 3-1(g) and Judge Schroeder's standard discovery order, MeshDynamics will identify what Cisco source code satisfies this limitation 30 days after Cisco's complete production of source code or at such other time as the parties may agree to.
35(f): wherein clients of the at least two structured mesh nodes in a second isolated configuration retain full connectivity within the structured network during the isolated configuration and wherein said client connectivity is uninterrupted during any transition from the isolated configuration to the first connected configuration; wherein distinct downlink frequencies are used by nodes for communication with one or more nodes lower on the tree configuration.	*See* Claim 1(f), the contents of which are incorporated herein by reference.