

Exhibit 5 - U.S. Patent No. 7,885,243 (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 1-7, 9-13 (the “Asserted Claims”) of U.S. Patent No. 7,885,243 (the “’243 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 ’243 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 ’243 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 1-7, 9-13 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 ’243 Patent since 2009 when Cisco executives

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 *Brunfield v. IBG LLC*, 97 F.4th 854 (Fed. Cir. 2024).

² See, e.g., https://www.cisco.com/c/dam/en_us/about/ciscoitwork/downloads/ciscoitwork/pdf/Richardson_Topology.pdf.

met with MeshDynamics to discuss partnering opportunities and the application that would result in the '243 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 '243 Patent, or in the alternative was willfully blind to the '243 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 infringed the '243 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 '243 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 '243 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 the 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's Wireless Mesh Network with Catalyst and Aironet Access Points
(1pre) A wireless mesh network comprising:	Cisco's Wireless Mesh Network (a component of the Cisco Unified Wireless Network solution) comprises Wi-Fi relay or mesh nodes (e.g., Cisco Catalyst 9100 and Aironet Access Points) and additional components, including controllers and software. 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>

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>

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:

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>

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/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:

Mesh Network Components

This section describes the mesh network components.

The Cisco wireless mesh network has four core components:

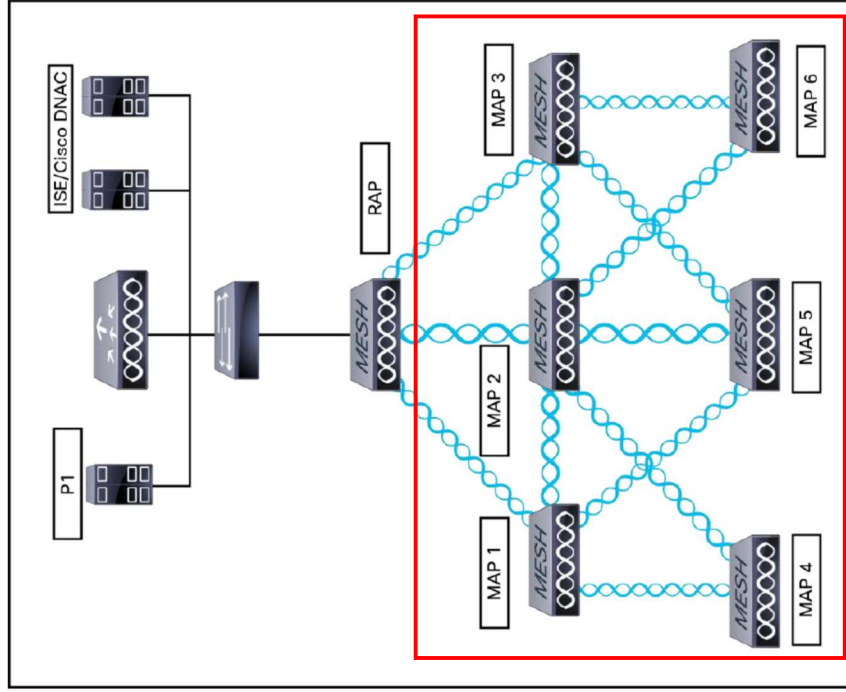
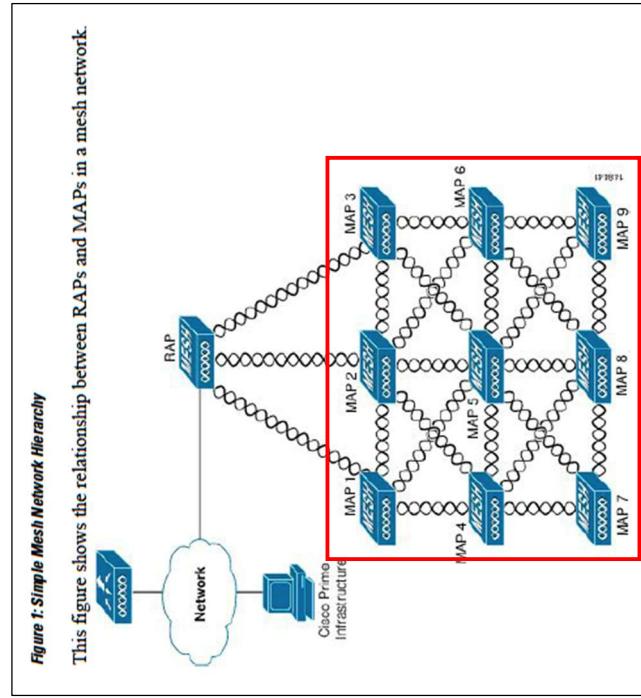
- Cisco C9800 and IOS-XE 17.1
- Cisco Aironet and Catalyst series access points
- Cisco PI and Cisco DNA Center
- Mesh software architecture

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>

Cisco's Wireless Mesh Network comprises one or more, or a plurality of, access points, e.g., Cisco Catalyst 9100 and Aironet Access Points, 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>

(1a) an access server wherein the access server sets one or more functioning parameters of

Cisco's Wireless Mesh Network comprises an access server (e.g., Catalyst 9800 series wireless controllers or other Cisco Wireless LAN Controllers (WLCs)) wherein the access server sets one or more functioning parameters of the wireless mesh network.

the wireless mesh network;

Mesh network components

The Cisco wireless mesh network has four core components:

- Cisco Catalyst 9800 Series and Cisco IOS XE.
- Cisco Aironet and Catalyst access points.
- Cisco Prime Infrastructure and Cisco DNA Center.
- Mesh software architecture.

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

Mesh access point roles

Mesh networking employs Cisco Aironet outdoor mesh APs and indoor mesh APs along with the Cisco WLC and Cisco Prime Infrastructure 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.

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

Embedded wireless controller (e.g., access server) mesh deployment is also supported in the 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-cfe-en.html>

The access server provides the framework for access points to communicate and choose optimal paths, including setting the functioning parameters of the wireless mesh network. For example, Cisco sets or recommends the number of hops or number of mesh access points (MAPs) per root access point (RAP).

Note

With two spatial streams, the MRC gain is halved, that is the MRC gain is reduced by 3 dB. This is because the system has $10 \log(3/2 \text{ SS})$ instead of $10 \log(3/1 \text{ SS})$. If there were to have been 3 SS with 3 RX, then the MRC gain would have been zero.

- Number of backhaul hops is limited to eight but we recommend three to four hops.

The number of hops is recommended to be limited to three or four primarily to maintain sufficient backhaul throughput, because each mesh access point uses the same radio for transmission and reception of backhaul traffic, which means that throughput is approximately halved over every hop. For example, the maximum throughput for 24 Mbps is approximately 14 Mbps for the first hop, 9 Mbps for the second hop, and 4 Mbps for the third hop.

- Number of MAPs per RAP.

There is no current software limitation on how many MAPs per RAP you can configure. However, it is suggested that you limit the number to 20 MAPs per RAP.

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

The controller can also configure mesh parameters, including setting global mesh parameters such as the maximum range between RAP and MAPs, and setting the data rate.

Configuring Global Mesh Parameters

This section provides instructions to configure the mesh access point to establish a connection with the controller including:

- Setting the maximum range between RAP and MAP (not applicable to indoor MAPs).
- Enabling a backhaul to carry client traffic.
- Defining if VLAN tags are forwarded or not.
- Defining the authentication mode (EAP or PSK) and method (local or external) for mesh access points including security settings (local and external authentication).

You can configure the necessary mesh parameters using either the GUI or the CLI. All parameters are applied globally.

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

Configuring Wireless Backhaul Data Rate

Backhaul is used to create only the wireless connection between the access points. The backhaul interface vary between 802.11a/n/ac/ax rates depending upon the access point. The rate selection is important for effective use of the available RF spectrum. The rate can also affect the throughput of client devices, and throughput is an important metric used by industry publications to evaluate vendor devices.

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/8-10/config-guide/b_cg810.pdf

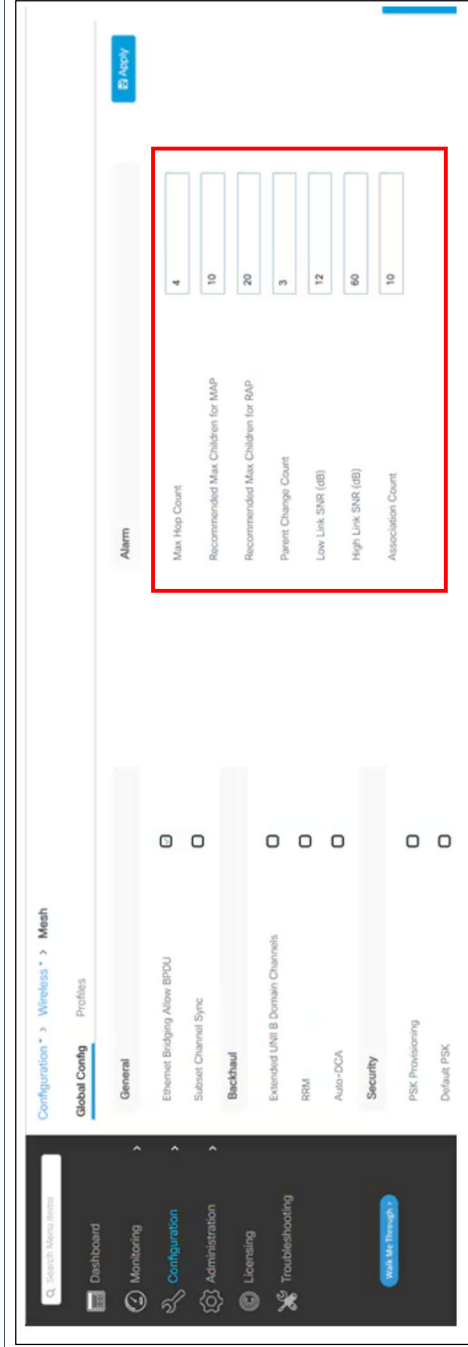
The setting of the global parameters at the controller, including max hop count and low and high link signal-to-noise ratio (“SNR”) are shown in the screenshots below:

C9800 Mesh Configuration Workflow – Mesh

5. Configure Global Mesh Settings and e.g. PSK Provisioning. C9800 will support PSK based authentication for Mesh Access Points (MAP). Mesh APs with default 'cisco' PSK will join to the Wireless Controller, when the security method is configured as PSK.

Configure Global Mesh Parameters and choose e.g. PSK Provisioning with configured PSK Key

Source: <https://www.youtube.com/watch?v=ESNFzIGTueU>



Source: <https://www.cisco.com/c/en/us/support/docs/wireless/embedded-wireless-controller-on-catalyst-9124ax-access-points/221557-configure-point-to-point-mesh-link-with.html>

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of establishing one or more functioning parameters of the wireless mesh network in the same way by using a controller to set recommended or global parameters for the wireless mesh network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. To the extent Cisco argues the controller is not the claimed “access server,” for example, a person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor.

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.

Cisco Catalyst 9100 and Aironet Access Points in Cisco’s Wireless Mesh Network comprise one or more root nodes (e.g., “Root APs” or RAPs) connected to said access server (e.g., Cisco WLC) and an external network.

Cisco Catalyst 9100 and Aironet Access Points are RAPs and MAPs in the Cisco Wireless Mesh Network. The RAPs have a wired connection to the controller and external network via the controller, and the MAPs have wireless connections to the controller via the RAP or another MAP.

(1b) one or more root nodes connected to said access server and an external network;

For Mesh mode, an AP should be configured with Bridge mode. Access points within a mesh network operate in one of the following two ways:

- Root AP (RAP)
- Mesh AP (MAP)

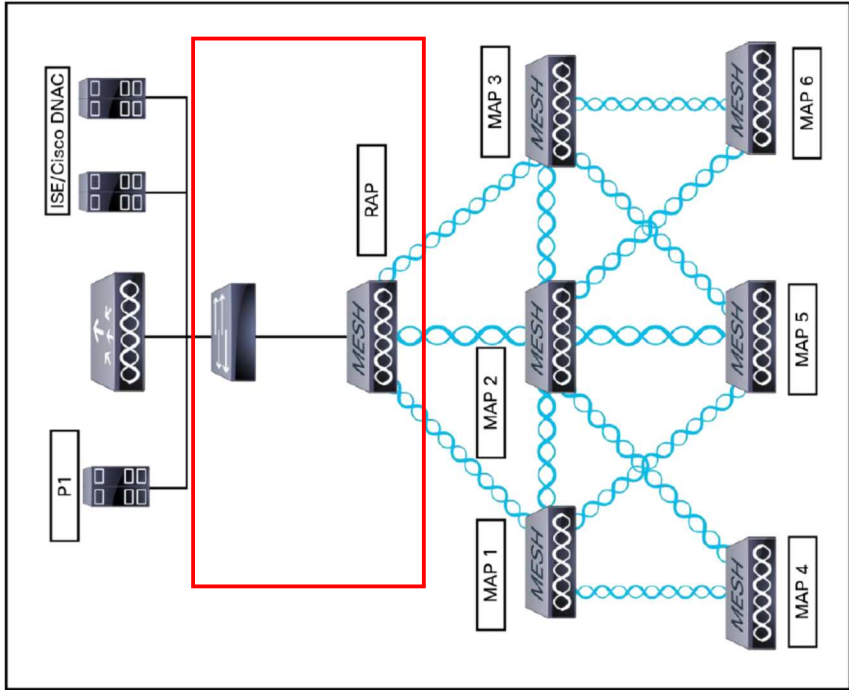
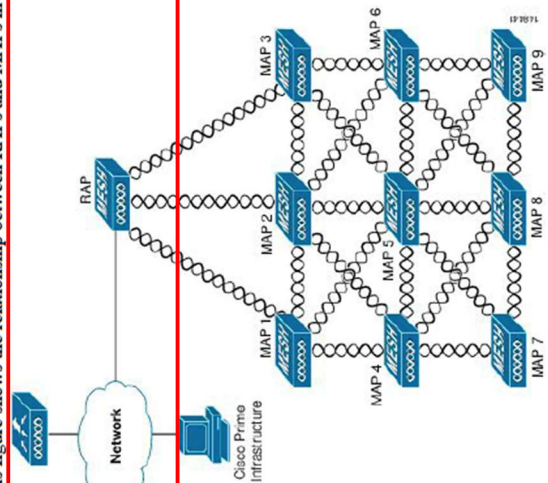
Note: All APs are configured and shipped as mesh APs. To use an APs as a RAP, you must reconfigure the mesh AP as a RAP. In all mesh networks, ensure that there is at least one RAP.

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#12Mesh>

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; https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh In Cisco's Wireless Mesh Network, Ethernet bridging also allows RAPs to connect to wired networks while also acting as a bridge for wireless traffic from MAPs. Source: https://www.cisco.com/c/en/us/td/docs/wireless/technology/mesh/8-4/b_mesh_84/Mesh_Deployment_Modes.pdf If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of connecting the mesh network to the external network in the same way by using a root access point and achieves the same result of creating a wireless mesh network. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The RAP connects the wireless mesh network to the wired network, providing access to the external network, such as the Internet. The RAP is directly connected via a wired connection to a Cisco WLC. This controller is typically located within the wired network. A person skilled in the relevant art would consider any difference between the claimed invention and the accused product to be minor. 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.
(1c) one or more AP nodes wherein each AP node is in wireless two-way data communication with an associated parent node wherein said associated parent node is selected from all available parent nodes wherein an available parent node is another AP node within wireless communication range of the AP node and the	Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network comprise one or more AP nodes (e.g., MAPs as shown above) wherein each AP node is in wireless two-way data communication with an associated parent node (e.g., RAPs or MAPs) wherein said associated parent node is selected from all available parent nodes wherein an available parent node is another AP node within wireless communication range of the AP node and the associated parent node is an available parent node meeting one or more communication criteria (e.g., an ease calculation criteria) or the associated parent node is a root node (e.g., RAP) within wireless communication range. The Cisco Catalyst 9100 and Aironet Access Points (e.g., MAPs) are in wireless two-way data communication with a parent node. A parent can be either the RAP itself or another MAP. MAPs communicate with each other and the RAP using wireless 802.11 backhaul channels, and 802.11 request/response protocol.

associated parent node is an available parent node meeting one or more communication criteria or the associated parent node is a root node within wireless communication range;

For Mesh mode, an AP should be configured with Bridge mode. Access points within a mesh network operate in one of the following two ways:

- Root AP (RAP)
- Mesh AP (MAP)

Note: All APs are configured and shipped as mesh APs. To use an APs as a RAP, you must reconfigure the mesh AP as a RAP. In all mesh networks, ensure that there is at least one 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.

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.

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

The parent node is selected from all available parent nodes using Adaptive Wireless Path Protocol (AWPP) and wherein an available parent node is another AP node within wireless communication range of the AP node and the associated parent node is an available parent node meeting one or more communication criteria (e.g., AWPP ease calculation criteria) or the associated parent node is a root node (e.g., RAP) within wireless communication range.

Cisco Catalyst 9100 and Aironet Access Points in Cisco Wireless Mesh Networks use AWPP to determine the best path through the mesh access points back to the RAP and controller. This includes selection of parents, establishing a parent-child relationship, and meeting one or more communication criteria to choose the best parent (e.g., AWPP ease calculation criteria), or the associated parent node is a RAP within wireless communication range.

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/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

Criteria to Choose the Best Parent

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

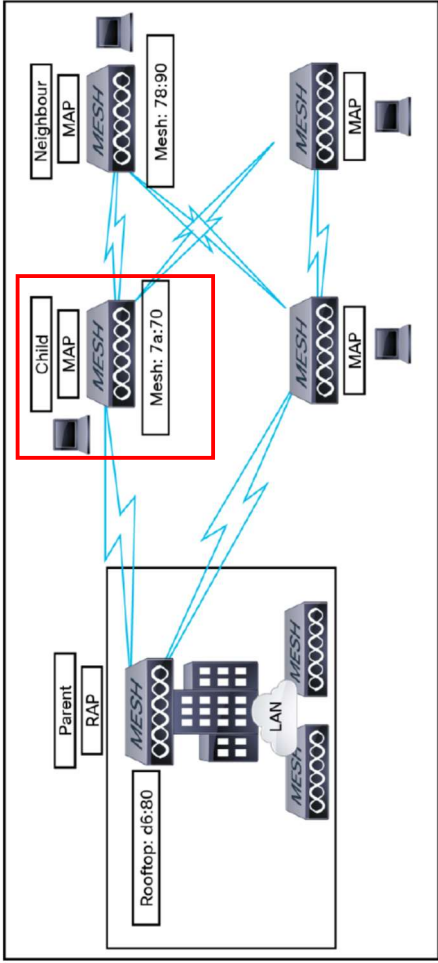
- A list of channels with neighbors is generated by passive scanning in the *scan* state, which is a subset of all backhaul channels.
- The channels with neighbors are sought by actively scanning in the *seek* state and the backhaul channel is changed to the channel with the best neighbor.
- The parent is set to the best neighbor and the parent-child handshake is completed in the *seek* state.
- 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 is usually followed by CAPWAP network and controller discovery. All neighbor protocol frames carry the channel information.

Parent maintenance occurs by the child node sending a directed NEIGHBOR_REQUEST to the parent and the parent responding with a NEIGHBOR_RESPONSE.

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 access point 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/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; <i>see also</i> 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. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by using criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWP process uses criteria to select the best parent. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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. Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network comprise wherein an AP node (e.g., MAP) is in wireless communication with zero or more clients (e.g., laptops) as shown in Cisco's documentation:
(1d) wherein an AP node is in wireless communication with zero or more clients; and	 The diagram illustrates a Cisco Wireless Mesh Network topology. It features a central 'Parent RAP' (Radio Access Point) connected to a 'Child MAP' (Mesh Access Point) and a 'Neighbour MAP'. The 'Child MAP' is highlighted with a red box. The 'Parent RAP' is connected to a 'Rooftop' node (labeled 'd6:80') and a 'LAN'. The 'Child MAP' is connected to the 'Parent RAP' and the 'Neighbour MAP'. The 'Neighbour MAP' is connected to the 'Child MAP' and another 'MAP' node. The diagram shows a mesh network structure with multiple nodes and connections, including a 'MESH' label and a 'MAP' label. Source: https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh
(1e) wherein an AP node includes a means for switching two-way data	Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network comprises wherein an AP node includes a means for switching two-way data communication (e.g., through an Adaptive Wireless Path Protocol (AWPP) process) from a first associated parent node to a second associated parent node based on the functioning parameters of

communication from a first associated parent node to a second associated parent node based on the functioning parameters of the wireless mesh network and wherein an AP node contains one or more datasets;

the wireless mesh network and wherein an AP node contains one or more datasets (e.g., a dataset comprising “the best path back to a RAP,” using AWPP and soliciting neighbors to learn and determine the best path, and additional datasets identified *infra*).

Catalyst 9100 and Aironet Access Points in Cisco Wireless Mesh Networks use AWPP to determine the best path through the mesh access points to the controller and switch the two-way data communications from an associated parent to another associated parent. This algorithm is run at start up and whenever a parent is lost or does not exist; and includes selection of parents based on functioning parameters of the network, including the number of hops and SNR. AWPP on the access points also continuously monitors conditions and changes routes to reflect changes in conditions.

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/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

Criteria to Choose the Best Parent

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

- A list of channels with neighbors is generated by passive scanning in the *scan* state, which is a subset of all backhaul channels.
- The channels with neighbors are sought by actively scanning in the *seek* state and the backhaul channel is changed to the channel with the best neighbor.
- The parent is set to the best neighbor and the parent-child handshake is completed in the *seek* state.
- 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 is usually followed by CAPWAP network and controller discovery. All neighbor protocol frames carry the channel information.

Parent maintenance occurs by the child node sending a directed NEIGHBOR_REQUEST to the parent and the parent responding with a NEIGHBOR_RESPONSE.

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 access point 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/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; *see also* <https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

As confirmed in Cisco's documentation, and on information and belief as shown in Cisco's proprietary code, a list of potential parents/neighbors (*e.g.*, dataset) is obtained and maintained on each MAP, *e.g.*, from background scanning or "AWPP – Neighbor Delivery Request/Response (NDRReq/NDRResp)" messages.

Background scanning on Wave-2 APs

The Mesh Background Scanning and Auto parent selection will improve convergence times and parent selection reliability and stability. A MAP should be able to find and connect with a better potential parent across any channels and maintain its uplink with a best parent all the time.

With background scanning disabled, whenever a Mesh AP detects a parent loss, it has to scan all the channels of the regulatory domain to find a new parent and then has to get authenticated through the selected parent to the C9800. This will take a longer time for the mesh AP to connect back to the C9800.

With background scanning enabled, after the detection of parent loss, a mesh AP can avoid scan to find a best parent across other channels. It can directly select a best parent from the neighbor list and establish the AWPP link.

A child MAP maintains its uplink with its parent using AWPP - Neighbor Discovery Request/Response (NDRReq/NDRResp) messages which are acting as keep-alives. If there are consecutive losses of NDRResp messages, a parent is declared to be lost and the child MAP tries to find its new parent. A MAP maintains a list of neighbors of current on-channel, and on losing its current parent, it will try roaming to next best potential neighbor in the same serving channel.

But if there are no other neighbors found in same channel, it has to do scan/seek across all/subset channels to find a parent. Each off-channel list node will have a neighbor list managing all neighbors heard in that channel. Upon each off-channel NDRReq broadcasts, the neighbors will be updated with latest SNR values based on their NDRResp packets.

Mesh background scanning tries to avoid finding a parent across other channels by scan/seek which are time consuming, but keeps the child MAP updated with all the neighbors across all channels and will help just 'switching' to a neighbor of any channel and use him as its next parent for its uplink.

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

Cisco's command line manual and mesh guide further show that the access points have a dataset showing what is surrounding the node, including neighbors and child node(s) identified with "Child" as the State field:

show wireless mesh neighbor

To see the neighbors of all connected mesh APs, use the **show wireless mesh neighbor** command.

show wireless mesh neighbor [chassis {chassis-number | active | standby} R0]

AP Name/Radio	Channel	Rate	Link-snr	Flags	State

AP Name : Mesh-AP01					
54:9f:c6:fa:5c:71	149	auto	0	40	
b0:c5:3c:e5:d9:71	149	auto	22	49	UPDATED NEIGH
e8:eb:34:d5:88:d1	149	auto	0	40	
e8:eb:34:d5:8d:d1	149	auto	18	49	UPDATED CHILD

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/cmd-ref/b_wl_16_10_cr/show-commands.html#wp3747685901

• **show mesh neighbor summary** –Displays summary information about mesh neighbors. Neighbor information includes MAC addresses, parent-child relationships, and uplink and downlink (SNRUp, SNRDown).

```
(Cisco Controller) > show mesh neighbor summary ap1500:62:39:70
AP Name/Radio Mac Channel Snr-Up Snr-Down Link-Snr Flags State
mesh-45-rap1 165 15 18 16 0x86b UPDATED NEIGH PARENT BEACON
00:0B:85:80:ED:D0 149 5 6 5 0x1a60 NEED UPDATE BEACON DEFAULT
00:17:94:FE:C3:5F 149 7 0 0 0x860 BEACON
```



Note

After review of the **show mesh** commands above, you should be able to see the relationships between the nodes of your network and verify the RF connectivity by seeing the SNR values for every link.

Viewing Security Settings and Statistics

Use this command to view security settings and statistics:

• **show mesh security-stats *AP_name*** —Shows packet error statistics and a count of failures, timeouts, and successes with respect to associations and authentications as well as reassociations and reauthentications for the specified access point and its child.

(Cisco Controller) > **show mesh security-stats ap417**

```
AP MAC : 00:0B:85:5F:FA:F0
Packet/Error Statistics:
-----
Tx Packets 14, Rx Packets 19, Rx Error Packets 0
Parent-Side Statistics:
-----
Unknown Association Requests 0
Invalid Association Requests 0
Unknown Re-Authentication Requests 0
Invalid Re-Authentication Requests 0
Unknown Re-Association Requests 0
Invalid Re-Association Requests 0
Unknown Re-Association Requests 0
Invalid Re-Association Requests 0
```



Child-Side Statistics:

```
-----
Association Failures 0
Association Timeouts 0
Association Successes 0
Authentication Failures 0
Authentication Timeouts 0
Authentication Successes 0
Re-Association Failures 0
Re-Association Timeouts 0
Re-Association Successes 0
Re-Authentication Failures 0
Re-Authentication Timeouts 0
Re-Authentication Successes 0
```

Source: https://www.cisco.com/c/en/us/td/docs/wireless/technology/mesh/8-0/design/guide/mesh80/m_checking-the-health-of-the-network.html

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using parameters or criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and background scanning both assist the AP in maintaining a list of neighbors and switching to the best parent on-channel or off-channel.

	A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. To the extent this is considered an element under 35 U.S.C. §112 (¶ 6), in accordance with P.R. 3-1(c), the identity of the structure(s), act(s), or material(s) in the Accused Instrumentality that performs the claimed function include, <i>e.g.</i>, the software algorithms in Cisco’s proprietary AWPP protocol and mesh background scanning for parent selection identified above. MeshDynamics’s investigation into Cisco’s proprietary algorithms remains ongoing and MeshDynamics will supplement or amend its P.R. 3-1(c) identification following discovery and/or claim construction. 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.
(1f) wherein the communication criteria comprises instructions for the AP node to select the associated parent node wherein an available parent node is selected to become the associated parent node if the available parent node is in wireless communication with a root node or if a root node is contained in the available parent node’s route path dataset (<i>e.g.</i>, a dataset comprising “the best path back to a RAP,” which was received from a parent mesh access point). AWPP is designed specifically for wireless mesh networking and to dynamically find the best path back to the RAP. AWPP automatically defines the best path back to the RAP (“root node”) by calculating the cost of each path in terms of the signal strength and number of hops. AWPP uses ease to determine the best path back to the RAP; thus, AWPP’s communications criteria comprises instructions to select the parent node that is associated with a RAP or if the RAP is contained in the dataset comprising the best path back to the RAP.	Cisco Catalyst 9100 and Aironet Access Points in Cisco’s Wireless Mesh Network comprises wherein the communication criteria (<i>e.g.</i>, AWPP ease calculation criteria) comprises instructions for the AP node to select the associated parent node wherein an available parent node is selected to become the associated parent node if the available parent node is in wireless communication with a root node or if a root node is contained in the available parent node’s route path dataset (<i>e.g.</i>, a dataset comprising “the best path back to a RAP,” which was received from a parent mesh access point).

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/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

Criteria to Choose the Best Parent

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

- A list of channels with neighbors is generated by passive scanning in the *scan* state, which is a subset of all backhaul channels.
- The channels with neighbors are sought by actively scanning in the *seek* state and the backhaul channel is changed to the channel with the best neighbor.
- The parent is set to the best neighbor and the parent-child handshake is completed in the *seek* state.
- 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 is usually followed by CAPWAP network and controller discovery. All neighbor protocol frames carry the channel information.

Parent maintenance occurs by the child node sending a directed NEIGHBOR_REQUEST to the parent and the parent responding with a NEIGHBOR_RESPONSE.

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 access point 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/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; <i>see also</i> https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh Cisco's Wireless Mesh Network can also be configured as a static mesh configuration and the criteria and route path dataset may be provided by manually assigning parent-child and RAP relationships. Source: https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and criteria dynamically and automatically find the best path back to the RAP. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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.
(1g) wherein one of the datasets contained in an AP node comprises a route path dataset comprising an identifier for the associated parent node appended to the route path dataset for the associated parent node;	Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network comprises wherein one of the datasets contained in an AP node (<i>e.g.</i>, a dataset comprising "the best path back to a RAP") comprises a route path dataset comprising an identifier (<i>e.g.</i>, MAC address) for the associated parent node appended to the route path dataset for the associated parent node. AWPP determines the best path or route through the mesh access points back to the RAP and controller. A parent provides the best path back to the RAP. This includes selection of parents and establishing a parent-child relationship. The MAP learns of all the available neighbors back to a RAP and as discussed above, obtains and maintains a list of potential parents/neighbors (<i>e.g.</i>, dataset) on each MAP. Each RAP or MAP is identified by a MAC address. The routing information contains the MAC address of each hop to the RAP.

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/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

Criteria to Choose the Best Parent

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

- A list of channels with neighbors is generated by passive scanning in the *scan* state, which is a subset of all backhaul channels.
- The channels with neighbors are sought by actively scanning in the *seek* state and the backhaul channel is changed to the channel with the best neighbor.
- The parent is set to the best neighbor and the parent-child handshake is completed in the *seek* state.
- 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 is usually followed by CAPWAP network and controller discovery. All neighbor protocol frames carry the channel information.

Parent maintenance occurs by the child node sending a directed NEIGHBOR_REQUEST to the parent and the parent responding with a NEIGHBOR_RESPONSE.

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

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 access point can easily detect and discard routes that loop.

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

AWPP is described as a distance-vector database. On information and belief, as shown in Cisco's proprietary code, one of the datasets maintained on the AP is a route path dataset, *i.e.*, the best path back to the RAP, with the MAC address for the associated parent.

Source: <https://www.cisco.com/c/en/us/support/docs/wireless/embedded-wireless-controller-on-catalyst-9124x-access-points/221557-configure-point-to-point-mesh-link-with.html>

Cisco's command line manual further shows that the access points have a dataset with the route 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]
```

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/cmd-ref/b_wl_16_10_cr/show-commands.html#wp1177334405

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and criteria finds the best path back to the RAP, and the MAP learns all available neighbors and determines the route path to the RAP. The routing information

	contains the MAC address of each hop to the RAP. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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.
(1h) wherein one of the datasets contained in the AP node comprises an amount of AP data traffic wherein the amount of AP data traffic comprises the amount of data exchange between the AP node and the zero or more clients in communication with the node and wherein another of the datasets contained in the AP node comprises a maximum capacity amount of the AP node.	Cisco Catalyst 9100 and Aironet Access Points in Cisco’s Wireless Mesh Network comprises wherein one of the datasets contained in the AP node comprises an amount of AP data traffic wherein the amount of AP data traffic comprises the amount of data exchange between the AP node and the zero or more clients in communication with the node and wherein another of the datasets contained in the AP node comprises a maximum capacity amount of the AP node. Cisco’s Catalyst 9100 and Aironet Access Points also comprise datasets with the amount of data exchanged between the AP node and the clients as shown by the “config ap client-trace” command. The APs keep a log of client traffic, and the data exchanged between the node and the clients in communication with the node. config ap client-trace To configure client trace on the access point, use the config ap client-trace command. <pre> config ap client-trace {address {add clear-all delete} all-clients {enable disable} filter {all {enable disable} arp {enable disable} assoc {enable disable} auth {enable disable} dhcp {enable disable} eap {enable disable} icmp {enable disable} ndp {enable disable} probe {enable disable}} inline-mon {enable disable} output console-log start stop} </pre> Source: https://www.cisco.com/c/en/us/td/docs/wireless/access_point/ios-xe/command-reference/b-cisco-cat-ap-iosxe-cr/config_commands.pdf#page=1.30; see also https://www.cisco.com/c/en/us/td/docs/wireless/access_point/wave2-cr/command-reference/8-10/b-cisco-wave2-ap-cr-810/config_commands.html#config-ap-client-trace The existence of the claimed dataset comprising the amount of data exchanged between the AP node and the zero or more clients of the access points is further evidenced by at least the output of the “show ap <ap-name> mesh cac access” command, which displays “the number of active calls on access radio for a given AP and its Mesh tree.”

```
Device# show ap <ap-name> mesh cac access
```

Depth	AP Name	Slot	Radio	BW Used	Call
0	AALUKKAL-1562-RAP	0	802.11b/g	0	0
1	AP380E.4DBF.C6B0	0	802.11a	0	0
		0	802.11b/g	1072	2
		1	802.11a	0	0

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/17-3/cmd-ref/b_wl_17_3_cr/show-commands.html#wp1976338546

The existence of the claimed dataset comprising a maximum capacity amount of the AP node is evidenced by Cisco's Mesh Call Admission Control (CAC). Each access point determines whether it is capable of accommodating a particular call by looking at the bandwidth available.

Mesh CAC

The Call Admission Control (CAC) enables a mesh access point to maintain controlled quality of service (QoS) on the controller to manage voice quality on the mesh network. Bandwidth-based, or static CAC enables the client to specify how much bandwidth or shared medium time is required to accept a new call. Each access point determines whether it is capable of accommodating a particular call by looking at the bandwidth available and compares it against the bandwidth required for the call. If there is not enough bandwidth available to maintain the maximum allowed number of calls with acceptable quality, the mesh access point rejects the call.

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#mesh-cac

This evidence supports that, on information and belief, the Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network comprise datasets with an amount of data exchange between the AP node and the zero or more clients in communication with the node and a maximum capacity amount of the AP node.

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and criteria finds the best path back to the RAP, and the MAP learns all available neighbors and determines the route path to the RAP. AWPP's calculations are continuously updated, allowing network connectivity and paths to change as the traffic patterns on wireless links change.

	A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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 2 2. The wireless mesh network of claim 1 wherein one of the datasets contained in the AP node comprises a cost to connect and said cost to connect is calculated using the level of network congestion experienced by the available parent node.	Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network, in addition to the elements of claim 1 as shown above, comprises wherein one of the datasets contained in the AP node comprises a cost to connect and said cost to connect is calculated using the level of network congestion experienced by the available parent node. As shown in Cisco's documentation, AWPP uses ease to determine the preferred path, with ease considered the opposite of cost, such that the preferred path is the path with the highest ease/lowest cost. Cost is calculated at the AP in terms of signal strength and the hops to get back to the controller. The child node or MAPs continuously send NDRReq messages to the parent to determine the availability of the parent node to service them adequately. Criteria to Choose the Best Parent AWPP follows this process in selecting parents for a RAP or MAP with a radio backhaul: • A list of channels with neighbors is generated by passive scanning in the <i>scan</i> state, which is a subset of all backhaul channels. • The channels with neighbors are sought by actively scanning in the <i>seek</i> state and the backhaul channel is changed to the channel with the best neighbor. • The parent is set to the best neighbor and the parent-child handshake is completed in the <i>seek</i> state. • Parent maintenance and optimization occurs in the <i>maintain</i> state. This algorithm is run at startup and whenever a parent is lost and no other potential parent exists, and is usually followed by CAPWAP network and controller discovery. All neighbor protocol frames carry the channel information. Parent maintenance occurs by the child node sending a directed NEIGHBOR_REQUEST to the parent and the parent responding with a NEIGHBOR_RESPONSE. 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 access point 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.

The mesh access point can also operate as a relay node for other access points not directly connected to a wired network. Intelligent wireless routing is provided by the Adaptive Wireless Path Protocol (AWPP). This Cisco protocol enables each mesh access point to identify its neighbors and intelligently choose the optimal path to the wired network by calculating the cost of each path in terms of the signal strength and the number of hops required to get to a controller.

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

“Load value” (e.g., network or parent capacity) is also considered in calculating the “ease” value and cost to connect.

This feature tries to avoid finding a parent across other channels by scan/seek which are time consuming, but keeps the child MAP updated with all the neighbors across all channels and will help 'switching' to a neighbor of any channel and use him as its next parent for its uplink. This 'switching' parent procedure need not be a triggered event like parent loss detection, but also on identifying a better parent using 'Auto parent selection algorithm' when the child MAP still has its current parent uplink active. The "Auto Parent selection algorithm" is based on the new "ease" values. For better convergence calculation in rel 8.3 a new "Ease" value introduced for smoother and faster parent or neighbor finding and auto parent connection algorithm. The Ease value is based on SNR, number of Hops, Timers and load values. For the off-channel neighbors the AdjustedEase value will be used and a best neighbor per off-channel shall be identified based on its highest AdjustedEase value. StickyEase shall be applicable only for on-channel parent.

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

AWPP's and the AP's focus on factors like link quality/signal strength, reducing the number of hops and load value helps to minimize and avoid congestion in the mesh network. For example, lower throughput is an indication of congestion. By choosing the “best” path to the wired network based on these criteria, AWPP's route path dataset addresses the level of network congestion experienced by an available parent node.

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and criteria finds the best path back to the RAP, and the MAP learns all available neighbors and determines the route path to the RAP. AWPP's calculations are

	continuously updated, allowing network connectivity and paths to change as the traffic patterns on wireless links change. AWPP thus inherently addresses network congestion by selecting parents and paths that are less utilized and more reliable. This reduces the likelihood of bottlenecks and improves overall network performance. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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 3 3. The wireless mesh network of claim 1 wherein the communication criteria comprises instructions for the AP node to select the associated parent node wherein the cost to connect of the associated parent is the lowest of all available parent nodes.	Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network, in addition to the elements of claim 1 as shown above, comprise wherein the communication criteria comprises instructions for the AP node to select the associated parent node wherein the cost to connect of the associated parent is the lowest of all available parent nodes. As shown in Cisco's documentation, AWPP uses ease (<i>e.g.</i>, communication criteria) to determine the preferred path, with ease considered the opposite of cost, such that the preferred path (and parent) is the path with the highest ease/lowest cost (<i>e.g.</i>, "the cost to connect of the associated parent is the lowest of all available parent nodes"). Criteria to Choose the Best Parent AWPP follows this process in selecting parents for a RAP or MAP with a radio backhaul: • A list of channels with neighbors is generated by passive scanning in the <i>scan</i> state, which is a subset of all backhaul channels. • The channels with neighbors are sought by actively scanning in the <i>seek</i> state and the backhaul channel is changed to the channel with the best neighbor. • The parent is set to the best neighbor and the parent-child handshake is completed in the <i>seek</i> state. • Parent maintenance and optimization occurs in the <i>maintain</i> state. This algorithm is run at startup and whenever a parent is lost and no other potential parent exists, and is usually followed by CAPWAP network and controller discovery. All neighbor protocol frames carry the channel information. Parent maintenance occurs by the child node sending a directed NEIGHBOR_REQUEST to the parent and the parent responding with a NEIGHBOR_RESPONSE. 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 access point 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.

	The mesh access point can also operate as a relay node for other access points not directly connected to a wired network. Intelligent wireless routing is provided by the Adaptive Wireless Path Protocol (AWPP). This Cisco protocol enables each mesh access point to identify its neighbors and intelligently choose the optimal path to the wired network by calculating the cost of each path in terms of the signal strength and the number of hops required to get to a controller. Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; <i>see also</i> 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. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and criteria finds the best path back to the RAP, and the MAP learns all available neighbors and determines the route path to the RAP. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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 4 4. The wireless mesh network of claim 1 wherein the communication criteria comprises instructions for the AP node to associate with an available parent node wherein the amount of AP data traffic is less than the sum of the maximum capacity amount of the available parent node and the	Cisco Catalyst 9100 and Aironet Access Points in Cisco’s Wireless Mesh Network, in addition to the elements of claim 1 as shown above, comprises wherein the communication criteria comprises instructions for the AP node to associate with an available parent node wherein the amount of AP data traffic is less than the sum of the maximum capacity amount of the available parent node and the available parent amount of AP data traffic. As discussed above, a parent offers the best route back to the RAP based on its ease values (e.g., “communication criteria”). AWPP will calculate the best path back to the RAP.

available parent amount of AP data traffic.

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.

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

“Load value” (e.g., network or parent capacity) is also considered in calculating the “ease” value and cost to connect.

This feature tries to avoid finding a parent across other channels by scan/seek which are time consuming, but keeps the child MAP updated with all the neighbors across all channels and will help just 'switching' to a neighbor of any channel and use him as its next parent for its uplink. This 'switching' parent procedure need not be a triggered event like parent loss detection, but also on identifying a better parent using 'Auto parent selection algorithm' when the child MAP still has its current parent uplink active. The " Auto Parent selection algorithm" is based on the new "ease" values. For better convergence calculation in rel 8.3 a new "Ease" value introduced for smoother and faster parent or neighbor finding and auto parent connection algorithm. The Ease value is based on SNR, number of Hops, Timers and load values. For the off-channel neighbors the AdjustedEase value will be used and a best neighbor per off-channel shall be identified based on its highest AdjustedEase value. StickyEase shall be applicable only for on-channel parent.

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. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and criteria finds the best path back to the RAP, and the MAP learns all available neighbors and determines the route path to the RAP. AWPP's calculations are continuously updated, allowing network connectivity and paths to change as the traffic patterns on wireless links change. AWPP contributes to load balancing by selecting the path with the best quality and minimizing the number of hops. This

	helps to distribute traffic more effectively across the mesh network and potentially reduces congestion. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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 5	5. The wireless mesh network of claim 4 wherein the communication criteria comprises instructions for the AP node to associate with a single suitable parent node wherein a parent node is suitable if the throughput capacity of the parent node is the highest of all available parent nodes. Cisco Catalyst 9100 and Aironet Access Points in Cisco’s Wireless Mesh Network, in addition to the elements of claim 4 as shown above, comprises wherein the communication criteria comprises instructions for the AP node to associate with a single suitable parent node wherein a parent node is suitable if the throughput capacity of the parent node is the highest of all available parent nodes. AWPP determines the parent that offers the best route back to the RAP based on ease values (e.g., “communication criteria”). Ease is calculated by using, <i>inter alia</i>, the link hop value. The parent with a higher ease value is selected. The parent with the lower number of hops will be chosen as the highest throughput capacity. If defined as “throughput,” signal strength can also be used and the parent with the highest signal strength is chosen. 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.

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

Note With two spatial streams, the MRC gain is halved, that is the MRC gain is reduced by 3 dB. This is because the system has $10 \log(3/2 \text{ SS})$ instead of $10 \log(3/1 \text{ SS})$. If there were to have been 3 SS with 3 RX, then the MRC gain would have been zero.

- Number of backhaul hops is limited to eight but we recommend three to four hops.

The number of hops is recommended to be limited to three or four primarily to maintain sufficient backhaul throughput, because each mesh access point uses the same radio for transmission and reception of backhaul traffic, which means that throughput is approximately halved over every hop. For example, the maximum throughput for 24 Mbps is approximately 14 Mbps for the first hop, 9 Mbps for the second hop, and 4 Mbps for the third hop.

- Number of MAPs per RAP.

There is no current software limitation on how many MAPs per RAP you can configure. However, it is suggested that you limit the number to 20 MAPs per RAP.

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

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;

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using the number of hops or signal strength as criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and criteria finds the best path back to the RAP and chooses the parent with the least number of hops available. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor.

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 6

6. The wireless mesh network of claim 1 wherein one of the datasets contained in an AP node comprises a throughput capacity of the AP node.

Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network, in addition to the elements of claim 1 as shown above, comprises wherein one of the datasets contained in an AP node comprises a throughput capacity of the AP node.

AWPP is run on an access point and automatically determines the best path back to the RAP for that access point by calculating the cost of the path in terms of signal strength and number of hops ("dataset contained in an AP node comprises a throughput capacity of the AP node"). AWPP continuously monitors conditions and changes routes, if necessary, based on the changes in the conditions. On information and belief, a MAP node contains a dataset with its throughput capacity based on its number of hops or signal strength/distance from the RAP so it can determine whether a better path exists.

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/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. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using the number of hops or signal strength as criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and criteria finds the best path back to the RAP and chooses the parent with the least number of hops available.

	A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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 7 7. The wireless mesh network of claim 1 wherein the means for switching two-way data communications selects the second associated parent node when the first associated parent node amount of AP data traffic approaches the parent node maximum capacity amount within a congestion value set by the access server.	Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network, in addition to the elements of claim 1 as shown above, comprises wherein the means for switching two-way data communications selects the second associated parent node when the first associated parent node amount of AP data traffic approaches the parent node maximum capacity amount within a congestion value set by the access server. As discussed above, AWPP's and the AP's focus on factors like link quality/signal strength and reducing the number of hops and load value helps to minimize and avoid congestion in the mesh network. As also discussed above, parameters set at the access server, including number of hops, link SNR, global mesh parameters, and data rate, address congestion in the mesh network. By choosing the "best" path to the wired network based on these criteria, AWPP's route path dataset addresses the level of congestion experienced by an available parent node. 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_mesh_88.pdf;
<https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

Criteria to Choose the Best Parent

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

- A list of channels with neighbors is generated by passive scanning in the *scan* state, which is a subset of all backhaul channels.
- The channels with neighbors are sought by actively scanning in the *seek* state and the backhaul channel is changed to the channel with the best neighbor.
- The parent is set to the best neighbor and the parent-child handshake is completed in the *seek* state.
- 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 is usually followed by CAPWAP network and controller discovery. All neighbor protocol frames carry the channel information.

Parent maintenance occurs by the child node sending a directed NEIGHBOR_REQUEST to the parent and the parent responding with a NEIGHBOR_RESPONSE.

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 access point 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/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; *see also* <https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

Cisco's mesh access points will monitor throughput and will steer to another node as a part of load balancing, including client connection limits set at the controller:

show wireless load-balancing

To display the status of the load-balancing feature, use the **show wireless load-balancing** command in privileged EXEC mode.

> **show wireless load-balancing**

```
Aggressive Load Balancing.....: per WLAN enabling
Aggressive Load Balancing Window (clients).....: 5
Aggressive Load Balancing Denial Count.....: 3
```

Statistics

```
Total Denied Count (clients).....: 0
Total Denial Sent (messages).....: 0
Exceeded Denial Max Limit Count (times).....: 0
None 5G Candidate Count (times).....: 0
None 2.4G Candidate Count (times).....: 0
```

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/cmd-ref/b_wl_16_10_cr/show-commands.html#wp3747685901l; see also https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/config-guide/b_wl_16_10_cg/client-load-balancing.pdf

As confirmed in Cisco's documentation, and on information and belief as shown in Cisco's proprietary code, a list of maximum capacity amounts and congestion threshold values are obtained and maintained on the access points.

Background scanning on Wave-2 APs

The Mesh Background Scanning and Auto parent selection will improve convergence times and parent selection reliability and stability. A MAP should be able to find and connect with a better potential parent across any channels and maintain its uplink with a best parent all the time.

With background scanning disabled, whenever a Mesh AP detects a parent loss, it has to scan all the channels of the regulatory domain to find a new parent and then has to get authenticated through the selected parent to the C9800. This will take a longer time for the mesh AP to connect back to the C9800.

With background scanning enabled, after the detection of parent loss, a mesh AP can avoid scan to find a best parent across other channels. It can directly select a best parent from the neighbor list and establish the AWPP link.

A child MAP maintains its uplink with its parent using AWPP - Neighbor Discovery Request/Response (NDRReq/NDRResp) messages which are acting as keep-alives. If there are consecutive losses of NDRResp messages, a parent is declared to be lost and the child MAP tries to find its new parent. A MAP maintains a list of neighbors of current on-channel, and on losing its current parent, it will try roaming to next best potential neighbor in the same serving channel.

But if there are no other neighbors found in same channel, it has to do scan/seek across all/subset channels to find a parent. Each off-channel list node will have a neighbor list managing all neighbors heard in that channel. Upon each off-channel NDRReq broadcasts, the neighbors will be updated with latest SNR values based on their NDRResp packets.

Mesh background scanning tries to avoid finding a parent across other channels by scan/seek which are time consuming, but keeps the child MAP updated with all the neighbors across all channels and will help just 'switching' to a neighbor of any channel and use him as its next parent for its uplink.

Source: <https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf>; see also <https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>; 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. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by using parameters or criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AWPP process and criteria finds the best path back to the RAP, and the MAP learns all available neighbors and determines the route path to the RAP. AWPP's calculations are continuously updated, allowing network connectivity and paths to change as the traffic patterns on wireless links change. AWPP thus inherently addresses congestion by selecting parents and paths that are less utilized and more reliable. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor.

To the extent this is considered an element under 35 U.S.C. §112 (¶ 6), in accordance with P.R. 3-1(c), the identity of the structure(s), act(s), or material(s) in the Accused Instrumentality that performs the claimed function include, e.g., the software algorithms in Cisco's proprietary AWPP protocol and mesh background scanning for parent selection identified above. MeshDynamics's investigation into Cisco's proprietary algorithms remains ongoing and MeshDynamics will supplement or amend its P.R. 3-1(c) identification following discovery.

	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	
A wireless mesh network comprising:	<i>See (1pre) above, the contents of which are incorporated herein by reference.</i>
an access server wherein the access server sets one or more functioning parameters of the wireless mesh network;	<i>See (1a) above, the contents of which are incorporated herein by reference.</i>
one or more root nodes connected to said access server and an external network;	<i>See (1b) above, the contents of which are incorporated herein by reference.</i>
one or more AP nodes wherein each AP node is in wireless two-way data communication with an associated parent node wherein said associated parent node is selected from all available parent nodes wherein an available parent node is another AP node within wireless communication range of the AP node and the associated parent node is an available parent node meeting one or more communication criteria or the associated parent node is a root node	<i>See (1c) above, the contents of which are incorporated herein by reference.</i>

within wireless communication range;	
wherein an AP node is in wireless communication with zero or more clients; and	<i>See (1d) above, the contents of which are incorporated herein by reference.</i>
wherein an AP node includes a means for switching two-way data communication from a first associated parent node to a second associated parent node based on the functioning parameters of the wireless mesh network and wherein an AP node contains one or more datasets	<i>See (1e) above, the contents of which are incorporated herein by reference.</i>
wherein one of the datasets contained in an AP node comprises a route path dataset comprising an identifier for the associated parent node appended to the route path dataset for the associated parent node	<i>See (1g) above, the contents of which are incorporated herein by reference.</i>
wherein the communication criteria comprises instructions for the AP node to select the associated parent node wherein an available parent node is	<i>See (1f) above, the contents of which are incorporated herein by reference.</i>

selected to become the associated parent node if the available parent node is in wireless communication with a root node or if a root node is contained in the available parent node's route path dataset; and	
wherein one of the datasets contained in an AP node comprises a dataset of child node identifiers wherein the dataset of child node identifiers is a dataset identifying each AP node in wireless communication with the AP.	Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network comprises wherein one of the datasets contained in an AP node comprises a dataset of child node identifiers wherein the dataset of child node identifiers is a dataset identifying each AP node in wireless communication with the AP. As confirmed in Cisco's documentation, and on information and belief as shown in Cisco's proprietary code, a list of nodes (<i>e.g.</i>, dataset) identifying each AP node in RF range, including those in wireless communication, is obtained and maintained on each MAP, including those off-channel that will have a neighbor list as well, <i>e.g.</i>, from background scanning or "AWPP – Neighbor Delivery Request/Response (NDRReq/NDRResp)" messages. Background scanning on Wave-2 APs The Mesh Background Scanning and Auto parent selection will improve convergence times and parent selection reliability and stability. A MAP should be able to find and connect with a better potential parent across any channels and maintain its uplink with a best parent all the time. With background scanning disabled, whenever a Mesh AP detects a parent loss, it has to scan all the channels of the regulatory domain to find a new parent and then has to get authenticated through the selected parent to the C9800. This will take a longer time for the mesh AP to connect back to the C9800. With background scanning enabled, after the detection of parent loss, a mesh AP can avoid scan to find a best parent across other channels. It can directly select a best parent from the neighbor list and establish the AWPP link. A child MAP maintains its uplink with its parent using AWPP - Neighbor Discovery Request/Response (NDRReq/NDRResp) messages which are acting as keep-alives. If there are consecutive losses of NDRResp messages, a parent is declared to be lost and the child MAP tries to find its new parent. A MAP maintains a list of neighbors of current on-channel, and on losing its current parent, it will try roaming to next best potential neighbor in the same serving channel. But if there are no other neighbors found in same channel, it has to do scan/seek across all/subset channels to find a parent. Each off-channel list node will have a neighbor list managing all neighbors heard in that channel. Upon each off-channel NDRReq broadcasts, the neighbors will be updated with latest SNR values based on their NDRResp packets. Mesh background scanning tries to avoid finding a parent across other channels by scan/seek which are time consuming, but keeps the child MAP updated with all the neighbors across all channels and will help just 'switching' to a neighbor of any channel and use him as its next parent for its uplink.

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

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.

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

Cisco uses Address Resolution Protocol (ARP) to find hardware addresses of a host from a known IP address. This will show what nodes that the APs have communicated with.

show arp

To view the ARP table, use the **show arp** command.

show arp

Syntax Description

arp	Shows ARP table
------------	-----------------

Command Modes

User EXEC (>)

Privileged EXEC (#)

Command History

Release	Modification
8.1.1.11.0	This command was introduced.

The following example shows a sample output of the command:

```
cisco-ap# show arp
Address Age (min) Hardware Addr
9.11.8.1 0 84:80:2D:A0:D2:E6
9.11.32.111 0 3C:77:E6:02:33:3F
```

Source: https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/ipaddr_arp/configuration/xe-3s/arp-xe-3s-book/arp-config-arp.pdf

Cisco's command line manual further shows that the access points have a dataset showing what is surrounding the node, including child node identifies with "Child" as the State field:

show wireless mesh neighbor

To see the neighbors of all connected mesh APs, use the **show wireless mesh neighbor** command.

```
show wireless mesh neighbor [ chassis {chassis-number | active | standby} R0 ]
```

AP Name/Radio	Channel	Rate	Link-snr	Flags	State

AP Name : Mesh-AP01					
54:9f:c6:fa:5c:71	149	auto	0	40	
b0:c5:3c:e5:d9:71	149	auto	22	49	UPDATED NEIGH
e8:eb:34:d5:88:d1	149	auto	0	40	
e8:eb:34:d5:8d:d1	149	auto	18	49	UPDATED CHILD

Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/9800/cmd-ref/b_wl_16_10_cr/show-commands.html#wp3747685901

• **show mesh neighbor summary** –Displays summary information about mesh neighbors. Neighbor information includes MAC addresses, parent-child relationships, and uplink and downlink (SNRUp, SNRDown).

```
(Cisco Controller) > show mesh neighbor summary ap1500:62:39:70
AP Name/Radio Mac Channel Snr-Up Snr-Down Link-Snr Flags State
mesh-45-rap1 165 15 18 16 0x86b UPDATED NEIGH PARENT BEACON
00:0B:85:80:ED:D0 149 5 6 5 0x1a60 NEED UPDATE BEACON DEFAULT
00:17:94:FE:C3:5F 149 7 0 0 0x860 BEACON
```



Note

After review of the **show mesh** commands above, you should be able to see the relationships between the nodes of your network and verify the RF connectivity by seeing the SNR values for every link.

Viewing Security Settings and Statistics

Use this command to view security settings and statistics:

- **show mesh security-stats** *AP_name* —Shows packet error statistics and a count of failures, timeouts, and successes with respect to associations and authentications as well as reassociations and reauthentications for the specified access point and its child.

(Cisco Controller) > **show mesh security-stats** *ap417*

```
AP MAC : 00:0B:85:5F:FA:F0
Packet/Error Statistics:
-----
Tx Packets 14, Rx Packets 19, Rx Error Packets 0
Parent-Side Statistics:
-----
Unknown Association Requests 0
Invalid Association Requests 0
Unknown Re-Authentication Requests 0
Invalid Re-Authentication Requests 0
Unknown Re-Association Requests 0
Invalid Re-Association Requests 0
Unknown Re-Association Requests 0
Invalid Re-Association Requests 0
```



Child-Side Statistics:

```
-----
Association Failures 0
Association Timeouts 0
Association Successes 0
Authentication Failures 0
Authentication Timeouts 0
Authentication Successes 0
Re-Association Failures 0
Re-Association Timeouts 0
Re-Association Successes 0
Re-Authentication Failures 0
Re-Authentication Timeouts 0
Re-Authentication Successes 0
```

Source: https://www.cisco.com/c/en/us/td/docs/wireless/technology/mesh/8-0/design/guide/mesh80/m_checking-the-health-of-the-network.html

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using the number of hops or signal strength as criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. Each MAP in the wireless mesh network, on the channel and off-channel, is maintaining a list of nodes within the RF range of each other

	and thus includes all child nodes in the network. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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	10. The wireless mesh network of claim 9 wherein the dataset of child node identifiers is accessible to each child node. Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network, in addition to the elements of claim 9 as shown above, comprises wherein the dataset of child node identifiers is accessible to each child node. As discussed above, each MAP in the wireless mesh network, on the channel and off-channel, is maintaining a list of nodes within the RF range of each other, and on information and belief, in wireless communication, and thus includes all child nodes in the network. MAPs communicate among themselves, and on information and belief, the list (e.g., dataset) of child node identifiers that identifies each AP node in wireless communication with the AP is accessible to each child node. • show mesh neighbor summary –Displays summary information about mesh neighbors. Neighbor information includes MAC addresses parent-child relationships, and uplink and downlink (SNRUp, SNRDown). <pre>(Cisco Controller) > show mesh neighbor summary ap1500:62:39:70 AP Name/Radio Mac Channel Snr-Up Snr-Down Link-Snr Flags State mesh-45-rap1 165 15 18 16 0x86b UPDATED NEIGH PARENT BEACON 00:0B:85:80:ED:D0 149 5 6 5 0x1a60 NEED UPDATE BEACON DEFAULT 00:17:94:FE:C3:5F 149 7 0 0 0x860 BEACON</pre>  Note After review of the show mesh commands above, you should be able to see the relationships between the nodes of your network and verify the RF connectivity by seeing the SNR values for every link.

Viewing Security Settings and Statistics

Use this command to view security settings and statistics:

- **show mesh security-stats *AP_name*** —Shows packet error statistics and a count of failures, timeouts, and successes with respect to associations and authentications as well as reassociations and reauthentications for the specified access point and its child.

(Cisco Controller) > **show mesh security-stats ap417**

```
AP MAC : 00:0B:85:5F:FA:F0
Packet/Error Statistics:
-----
Tx Packets 14, Rx Packets 19, Rx Error Packets 0
Parent-Side Statistics:
-----
Unknown Association Requests 0
Invalid Association Requests 0
Unknown Re-Authentication Requests 0
Invalid Re-Authentication Requests 0
Unknown Re-Association Requests 0
Invalid Re-Association Requests 0
Unknown Re-Association Requests 0
Invalid Re-Association Requests 0
```



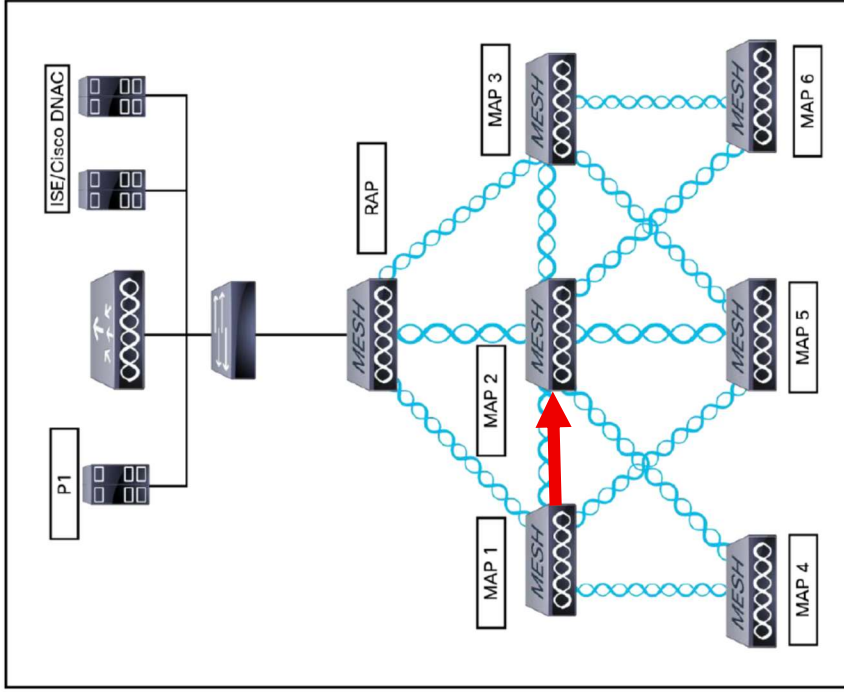
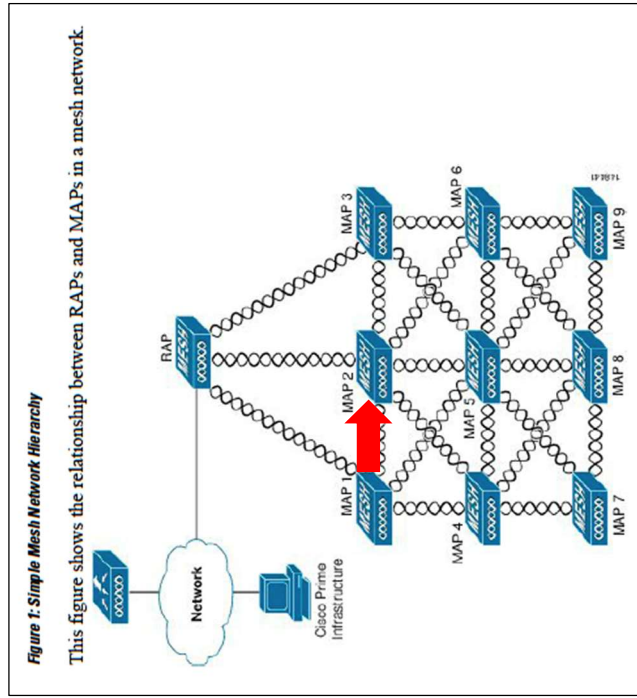
Child-Side Statistics:

```
-----
Association Failures 0
Association Timeouts 0
Association Successes 0
Authentication Failures 0
Authentication Timeouts 0
Authentication Successes 0
Re-Association Failures 0
Re-Association Timeouts 0
Re-Association Successes 0
Re-Authentication Failures 0
Re-Authentication Timeouts 0
Re-Authentication Successes 0
```

Source: https://www.cisco.com/c/en/us/td/docs/wireless/technology/mesh/8-0/design/guide/mesh80/m_checking-the-health-of-the-network.html

	For Mesh mode, an AP should be configured with Bridge mode. Access points within a mesh network operate in one of the following two ways: • Root AP (RAP) • Mesh AP (MAP) Note: All APs are configured and shipped as mesh APs. To use an APs as a RAP, you must reconfigure the mesh AP as a RAP. In all mesh networks, ensure that there is at least one 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#12Mesh If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using the number of hops or signal strength as criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. Each MAP in the wireless mesh network, on the channel and off-channel, is maintaining a list of nodes within the RF range of each other and thus includes all child nodes in the network. MAPs communicate among themselves. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor. 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 11. The wireless mesh network of claim 10 wherein the AP node dataset of child nodes contains two or more child nodes wherein the zero or more clients in communication with a first child node sends data wherein a	Cisco Catalyst 9100 Access Points in Cisco’s Wireless Mesh Network, in addition to the elements of claim 10 as shown above, comprises wherein the AP node dataset of child nodes contains two or more child nodes wherein the zero or more clients in communication with a first child node sends data wherein a destination of the data is a second child node, the first child node sends the data directly to the second child node. As discussed above, MAPs are aware of neighbors and thus can communicate directly over wireless. In the figures below, the client (<i>e.g.</i> Laptop) within the first child node (MAP 1) will send data to a destination within a second child node (MAP 2) and that data will go directly from MAP 1 to MAP 2.

destination of the data is a second child node, the first child node sends the data directly to the second child node.



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 this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of sending data traffic through mesh network in same way by maintaining a list of neighbors and finding the best path to the data traffic destination and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. Rather than forcing data back up the hierarchical chain to a root node, and then back down the chain to a destination child node, the mesh is cooperative and since it is aware of the destination node will take the quickest path there (*i.e.*, directly from MAP1 to MAP2). A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor.

	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 12	
A wireless mesh network comprising:	<i>See (1pre) above, the contents of which are incorporated herein by reference.</i>
an access server wherein the access server sets one or more functioning parameters of the wireless mesh network;	<i>See (1a) above, the contents of which are incorporated herein by reference.</i>
one or more root nodes connected to said access server and an external network	<i>See (1b) above, the contents of which are incorporated herein by reference.</i>
one or more AP nodes wherein each AP node is in wireless two-way data communication with an associated parent node wherein said associated parent node is selected from all available parent nodes wherein an available parent node is another AP node within wireless communication range of the AP node and the associated parent node is an available parent node meeting one or more communication criteria or the associated parent node is a root node	<i>See (1c) above, the contents of which are incorporated herein by reference.</i>

within wireless communication range;	
wherein an AP node is in wireless communication with zero or more clients; and	<i>See (1d) above, the contents of which are incorporated herein by reference.</i>
wherein an AP node includes a means for switching two-way data communication from a first associated parent node to a second associated parent node based on the functioning parameters of the wireless mesh network and wherein an AP node contains one or more datasets	<i>See (1e) above, the contents of which are incorporated herein by reference.</i>
wherein one of the datasets contained in an AP node comprises a route path dataset comprising an identifier for the associated parent node appended to the route path dataset for the associated parent node	<i>See (1g) above, the contents of which are incorporated herein by reference.</i>
wherein the communication criteria comprises instructions for the AP node to select the associated parent node wherein an available parent node is selected to	<i>See (1f) above, the contents of which are incorporated herein by reference.</i>

become the associated parent node if the available parent node is in wireless communication with a root node or if a root node is contained in the available parent node's route path dataset; and wherein the communication criteria further comprises instructions for the AP node to associate with a single suitable parent node wherein the route path dataset of the parent node (e.g., a dataset comprising "the best path back to a RAP") is the shortest route path dataset (e.g., the route path dataset with the lowest number of hops back to the RAP) of all available parent nodes.	Cisco Catalyst 9100 and Aironet Access Points in Cisco's Wireless Mesh Network comprises wherein the communication criteria further comprises instructions for the AP node to associate with a single suitable parent node wherein the route path dataset of the parent node (e.g., a dataset comprising "the best path back to a RAP") is the shortest route path dataset (e.g., the route path dataset with the lowest number of hops back to the RAP) of all available parent nodes. The AWP criteria to choose the best parent includes instructions for the MAP or child node to associate with a RAP or parent, which on information and belief, as shown in Cisco's proprietary code, is the shortest route or path, e.g., the best route with the least number of hops back to the RAP. 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.
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Source: https://www.cisco.com/c/en/us/td/docs/wireless/controller/technotes/8-8/b_mesh_mesh_88.pdf;
<https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

Criteria to Choose the Best Parent

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

- A list of channels with neighbors is generated by passive scanning in the *scan* state, which is a subset of all backhaul channels.
- The channels with neighbors are sought by actively scanning in the *seek* state and the backhaul channel is changed to the channel with the best neighbor.
- The parent is set to the best neighbor and the parent-child handshake is completed in the *seek* state.
- 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 is usually followed by CAPWAP network and controller discovery. All neighbor protocol frames carry the channel information.

Parent maintenance occurs by the child node sending a directed NEIGHBOR_REQUEST to the parent and the parent responding with a NEIGHBOR_RESPONSE.

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 access point 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/td/docs/wireless/controller/technotes/8-8/b_mesh_88.pdf; *see also* <https://www.cisco.com/c/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

Cisco's Wireless Mesh Network can also be configured as a static mesh configuration and the criteria and route path dataset may be provided by manually assigning parent-child and RAP relationships.

Source: <https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf>

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using the number of hops or signal strength as criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AP node in a Cisco Wireless Network is associated with a single suitable parent node when the route path of the parent node is the best path of all available parent nodes. It is the best path and shortest when it is the least number of hops, for example. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor.

	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 13	
A wireless mesh network comprising:	<i>See (1pre) above, the contents of which are incorporated herein by reference.</i>
an access server wherein the access server sets one or more functioning parameters of the wireless mesh network;	<i>See (1a) above, the contents of which are incorporated herein by reference.</i>
one or more root nodes connected to said access server and an external network;	<i>See (1b) above, the contents of which are incorporated herein by reference.</i>
one or more AP nodes wherein each AP node is in wireless two-way data communication with an associated parent node wherein said associated parent node is selected from all available parent nodes wherein an available parent node is another AP node within wireless communication range of the AP node and the associated parent node is an available parent node meeting one or more communication	<i>See (1c) above, the contents of which are incorporated herein by reference.</i>

criteria or the associated parent node is a root node within wireless communication range;	
wherein an AP node is in wireless communication with zero or more clients; and	<i>See (1d) above, the contents of which are incorporated herein by reference.</i>
wherein an AP node includes a means for switching two-way data communication from a first associated parent node to a second associated parent node based on the functioning parameters of the wireless mesh network and wherein an AP node contains one or more datasets	<i>See (1e) above, the contents of which are incorporated herein by reference.</i>
wherein one of the datasets contained in an AP node comprises a route path dataset comprising an identifier for the associated parent node appended to the route path dataset for the associated parent node	<i>See (1g) above, the contents of which are incorporated herein by reference.</i>
wherein the communication criteria comprises instructions for the AP node to select the associated parent node	<i>See (1f) above, the contents of which are incorporated herein by reference.</i>

wherein an available parent node is selected to become the associated parent node if the available parent node is in wireless communication with a root node or if a root node is contained in the available parent node's route path dataset; and	
wherein the access server functioning parameters includes a latency modifier wherein the AP node means for switching from the first associated parent node to a second associated parent node result in selection of the second associated parent wherein the route path of the second associated parent node is shorter than the first associated route path by a value related to the latency modifier. As discussed above, functioning parameters set at the access server includes the signal strength and number of hops (“latency modifier”). The AWP algorithm results in the selection of a parent with a best or shorter route path shorter by signal strength and number of hops. AWP determines the lowest cost in terms of signal strength and number of hops. 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.	Cisco Catalyst 9100 and Aironet Access Points in Cisco’s Wireless Mesh Network comprises wherein the access server functioning parameters includes a latency modifier wherein the AP node means for switching from the first associated parent node to a second associated parent node result in selection of the second associated parent wherein the route path of the second associated parent node is shorter than the first associated route path by a value related to the latency modifier.

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

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/en/us/products/collateral/wireless/unified-wireless-network-sg.html#12Mesh>

Cisco's Wireless Mesh Network can also be configured as a static mesh configuration and the criteria and route path dataset may be provided by manually assigning parent-child and RAP relationships.

Source: <https://www.cisco.com/c/dam/en/us/td/docs/wireless/controller/9800/17-1/deployment-guide/c9800-mesh-rel-17-1.pdf>

If this claim element is not literally infringed, it is infringed under the doctrine of equivalents. The Cisco Wireless Mesh Network performs the same function of selecting a parent for a mesh access point in the same way by maintaining a list of neighbors and using the number of hops or signal strength as criteria to find the best path back to the external network and achieves the same result by creating a wireless mesh network with optimal performance. Any differences between the accused Cisco Wireless Mesh Network and the claimed element are insignificant or insubstantial. The AP node in a Cisco Wireless Network is associated with a single suitable parent node when the route path of the parent node is the best path of all available parent nodes. It is the best path and shortest when it is the least number of hops such as when a MAP can connect directly to a RAP, for example. This path would be the shortest number of hops and the least latency. A person skilled in the relevant art would consider any difference between the claimed invention and the accused network to be minor.

	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.
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