UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CISCO SYSTEMS, INC.,
Petitioner

IPR2026-00008
Patent No. 8,520,691

PETITION FOR *INTER PARTES* REVIEW UNDER 35 U.S.C. § 312 AND 37 C.F.R. § 42.104

TABLE OF CONTENTS

PETITIONER'S EXHIBIT LIST

Ex.1001	U.S. 8,520,691
Ex.1002	Prosecution History of U.S. 8,520,691
Ex.1003	Declaration of Christopher Hansen, Ph.D. under 37 C.F.R. § 1.68
Ex.1004	*Curriculum Vitae* of Christopher Hansen, Ph.D.
Ex.1005	U.S. Patent Publication No. 2006/0215581 to Castagnoli
Ex.1006	U.S. Patent Publication No. 2007/0140239 to Bauer
Ex.1007	U.S. Patent Publication No. 2009/0213730 to Zeng et al.
Ex.1008	U.S. Patent No. 7,852,819 to Gil et al.
Ex.1009	U.S. Patent Publication No. 2008/0214175 to Papadoglou et al.
Ex.1010	U.S. Provisional App. No. 61/148,803
Ex.1011	IEEE Standard 802.11-1999
Ex.1012	Complaint, *Dynamic Mesh Networks, Inc. d/b/a MeshDynamics v. Cisco Systems, Inc*., No. 2:25-cv-00472, Dkt. no. 1 (E.D. Tex. May 5, 2025).
Ex.1013	Infringement Contentions for U.S. Patent No. 8,520,691, *Dynamic Mesh Networks, Inc. d/b/a MeshDynamics v. Cisco Systems, Inc.*, No. 2:25-cv-00472 (E.D. Tex.).
Ex.1014	A. S. Tanenbaum, Computer Networks, 4th ed. (Prentice Hall PTR) (selected pages)
Ex.1015	J. Henry, 802.11s Mesh Networking (White paper) (The Certified Wireless Network Professional (CWNP) Program)
Ex.1016	U.S. Patent Publication No. 2006/0047835 to Greaux
Ex.1017	U.S. Patent Publication No. 2005/0253722 to Droms et al.
Ex.1018	U.S. Patent Publication No. 2003/0033393 to Larson et al.
Ex.1019	U.S. Patent Publication No. 2008/0013474 to Nagarajan et al.
Ex.1020	U.S. Patent Publication No. 2007/0271372 to Deninger et al.

I. Introduction

Pursuant to 35 U.S.C. §§311, 314(a), and 37 C.F.R. §42.100, Cisco Systems, Inc. ("Petitioner") respectfully requests that the Board review and cancel as unpatentable under (pre-AIA) 35 U.S.C. §103(a) claims 1, 9-11, 15-16, 18-19, and 35 (hereinafter, the "Challenged Claims") of U.S. 8,520,691 (the "'691 patent," Ex.1001).

The '691 patent is directed to technology for a wireless mesh network. Ex.1001, Abstract. The claims describe a mesh network where a cluster of nodes forms a tree-like connection topology. Ex.1001, Abstract. The tree-like topology is maintained even when the cluster of nodes become isolated from an external network. Ex.1001, Abstract, claim 1. Connectivity also remains uninterrupted when the network regains a connection to the external network. Ex.1001, claim 1.

These ideas were not new as of the earliest effective filing date. Other prior art patent applicants had already described mesh nodes arranged in a tree-like topology that provides in-network communications even when isolated from an external network. It was also known in the art to smoothly transition to and from such an isolated network configuration so that communications would be uninterrupted.

Because the Challenged Claims merely recite an obvious combination of known concepts, Petitioner asks the Board to institute trial and find the claims

unpatentable.

II. Grounds for Standing

Petitioner certifies that the ’691 patent is eligible for IPR and that Petitioner is not barred or estopped from requesting IPR of the Challenged Claims.

III. Note

Petitioner cites to exhibits’ original page numbers. **Emphasis** in quoted material has been added. Claim terms are presented in *italics*.

IV. Background

Dr. Hansen’s declaration (Ex.1003) provides a technology background, where he discusses the 802.11 networking standard and mesh networks. Ex.1003, ¶¶27-30 (citing Ex.1014; Ex.1015).

V. Summary of the ’691 Patent

The ’691 patent purports to address the issue of maintaining client connectivity as a mesh network loses or gains a connection to an external network. Ex.1001, 3:66-4:17. The patent acknowledges that mesh networks were generally known and provided “additional functionality not available using other network topologies.” Ex.1001, 1:40-60. A mesh network that is formed from “[m]esh nodes implemented with [] a multi-radio backhaul” and has “a hierarchical tree-like network topology [is] called a ‘[s]tructured [m]esh’” network. Ex.1001, 3:9-11. The node radios utilize distinct uplink and downlink frequencies or channels.

Ex.1001, 13:6-13. In one-radio mesh networks, mesh nodes have a single radio that "utilize[s] separate frequencies for uplink and downlink connections[.]" Ex.1001, 6:30-35. Each mesh node of a mesh network "contains connectivity logic which allows the node to adopt one or more…contention resolution policies." Ex.1001, 16:23-25.

In summary, the '691 patent merely combines known elements—multi-radio mesh networking, distinct uplink and downlink frequency channels, and a connectivity logic that implements node contention resolution policies—into one system. This agglomeration of known ideas did not advance human knowledge or understanding, and the '691 patent claims should not have been allowed to issue. Ex.1003, ¶¶31-38.

VI. Prosecution History

The '691 patent application was filed on January 29, 2010 and claims priority to a provisional application filed on January 30, 2009. Ex.1002, 137; Ex.1010. The '691 patent application also claims priority to a series of continuation-in-part filings dating as far back as May 8, 2003. Ex.1001, 1 (field 63).

In prosecution, the presented claims were rejected as obvious over various prior art references. Ex.1002, 77-108. In response, the applicants amended the independent claims to recite several additional limitations relating to (1)

transitioning from an isolated network configuration to a connected network configuration, and (2) using distinct downlink frequencies. Ex.1002, 49-63. The claims were then allowed. Ex.1002, 27-30.

VII. Effective Priority Date

The ’691 patent claims priority as a continuation-in-part of non-provisional applications filed on May 8, 2003; March 17, 2005; and January 12, 2009. Ex.1001, 1 (field 63).

The Challenged Claims are not entitled to an effective priority date of any of these earlier non-provisional applications. In order for an application to be entitled to an earlier date, the earlier application must meet the written description requirement for the claimed subject matter. See *New Railhead Mfg., L.L.C. v. Vermeer Mfg. Co*., 298 F.3d 1290, 1294 (Fed. Cir. 2002) (to be entitled to the filing date of an earlier application, the earlier application must “contain a written description of the invention and the manner and process of making and using it, in such full, clear, concise, and exact terms”); *see also* Pre-AIA 35 U.S.C. §112 ¶1.

The claims of the ’691 patent recite subject matter that was not present in any of the earlier applications. For example, independent claim 1 recites that “*said client connectivity is uninterrupted during any transition from the isolated configuration to the first connected configuration*.” There is no discussion of such a concept in the earlier non-provisional applications. Similarly, independent claim

1 recites that "*in the second isolated configuration none of the structured mesh nodes' uplink radio comprises a connection to an external network, and one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root node as isolated root children nodes forming a tree configuration*." Again, there is no discussion of such a concept in the earlier non-provisional applications

The '691 patent also claims the benefit of a provisional application filed January 30, 2009. It is unnecessary to determine whether the '691 patent is entitled to this date in this proceeding as all relied-upon prior art predates January 30, 2009. Petitioner does not waive any right or opportunity to dispute the '691 patent's potential benefit of this provisional application in this or another forum.

VIII. Level of Ordinary Skill in the Art

A Person of Ordinary Skill in The Art ("POSITA") in January 2009[1] would have had a working knowledge of the wireless networking art that is pertinent to the '691 patent, including familiarity with standards such as IEEE 802.11. Ex.1003, ¶20 (citing Ex.1011, 3). A POSITA would have had a bachelor's degree in

[1] The level of skill in the art would be the same as for the earlier non-provisional applications, though the '691 Patent is not entitled to an effective priority date of any of these earlier non-provisional applications, as explained above in §VII.

computer science, electrical engineering, or equivalent training, and approximately two years of professional experience working in the field of network communications. Additional work experience could have been substituted for educational experience, and vice versa. Ex.1003, ¶21.

IX. Claim Construction

Claim terms in IPR are construed according to their "ordinary and customary meaning" to those of skill in the art. 37 C.F.R. § 42.100(b). The Board needs to construe terms "only to the extent necessary" to decide a disputed issue. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

For the purposes of this proceeding and the grounds presented herein, Petitioner proposes that no claim terms require formal construction.

X. Relief Requested and Reasons Therefore

Petitioner asks that the Board institute a trial for *inter partes* review and cancel the Challenged Claims in view of the analysis below.

XI. Identification of How the Claims are Unpatentable

A. Challenged Claims

Petitioner challenges claims 1, 9-11, 15-16, 18-19, and 35. In a complaint for infringement (now dismissed) against Petitioner, Patent Owner has alleged that Petitioner infringes "at least claim 1." Ex.1012, ¶113. Patent Owner's infringement

contentions in that now-dismissed case alleged that claims 1, 9-11, 15-16, 18-19, and 35 were infringed. Ex.1013, 1. Here, petitioner challenges each of the claims from the now-dismissed case. A finding that the Challenged Claims are unpatentable in this proceeding is expected to resolve the parties' dispute in the co-pending litigation and obviate any need for a trial regarding the '691 patent, substantially reducing the time and expense of that litigation for all parties.

XII. Statutory Grounds

Grounds	Claims	Basis
#1	1, 18, 35	35 U.S.C. §103 (Pre-AIA) over Castagnoli, Bauer, and Gil
#2	9-11, 15-16	35 U.S.C. §103 (Pre-AIA) over Castagnoli, Bauer, Gil, and Zeng
#3	19	35 U.S.C. §103 (Pre-AIA) over Castagnoli, Bauer, Gil, and Papadoglou

U.S. Pub. 2006/0215581 to Castagnoli (Ex.1005) was filed August 26, 2005 and published September 28, 2006.

U.S. Pub. 2007/0140239 to Bauer (Ex.1006) was filed December 19, 2006 and published June 21, 2007.

U.S. Pub. 2009/0213730 to Zeng et al. (Ex.1007) was filed February 21, 2008 and published August 27, 2009.

U.S. Patent No. 7,852,819 to Gil et al. (Ex.1008) was filed February 28, 2008 and issued December 14, 2010.

U.S. Patent Publication No. 2008/0214175 to Papadoglou et al. (Ex.1009) PCT was filed May 16, 2005, has a 371(c) date of Dec. 12, 2007, and issued September 4, 2008.

Castagnoli and Bauer are prior art under 35 U.S.C. §102(a), (b), and (e). Zeng and Gil are prior art under 35 U.S.C. §102(e). Papadoglou is prior art under 35 U.S.C. §102(a), (e).

Petitioner's §103 obviousness grounds rely on the combined teachings of the references and not on a physical incorporation of elements. *See In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012).

Petitioner also cites below to additional prior art as evidence of the background knowledge of a POSITA and to provide contemporaneous context to support Petitioner's assertions regarding what a POSITA would have understood from the prior art in the grounds. *See Yeda Research v. Mylan Pharm. Inc.*, 906 F.3d 1031, 1041-1042 (Fed. Cir. 2018) (affirming the use of "supporting evidence relied upon to support the challenge"); 37 C.F.R. § 42.104(b); *see also K/S HIMPP v. Hear-Wear Techs., LLC*, 751 F.3d 1362, 1365-66 (Fed. Cir. 2014); *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1363 (Fed. Cir. 2016).

A. Statement of Material Facts

1. A DHCP server assigning random IP addresses to clients was well-known in the prior art. Ex.1016, [0005] ("This Invention solves that problem by

using ODIPA (Outernet Dynamic IP Allocation). ODIPA allocates IP addresses in a two stage approach; where first stage uses **standard DHCP to allocate a random IP Address** from a large Private Address Space…"); Ex.1017, [0130] ("DHCP and DNS can accomplish provisioning based on location. **The DHCP server could return a "random" address** from a pool of addresses and also could return a specific host name to the RFID reader."); Ex.1018, [0002] ("Alternatively, **dynamic host configuration protocol (DHCP) could be used to get a random address**, but this requires that the proper subnet mask be preset.").

2. It was well-known in the art for IP addresses to be composed of numerals. Ex.1019, [0035] ("the term '**Internet Protocol (IP) address**' refers to a layer 3 address, and can be a **number** which identifies each sender or receiver of information packets across the Internet."); Ex.1020, [0008] ("The current IP standard is IP version 4 (or IPv4). An **IP address** in IPv4 is a four-byte (32-bit) **number combination** in the format of AAA.BBB.CCC.DDD. For example, 64.236.16.20 is the IPv4 address for CNN.com.").

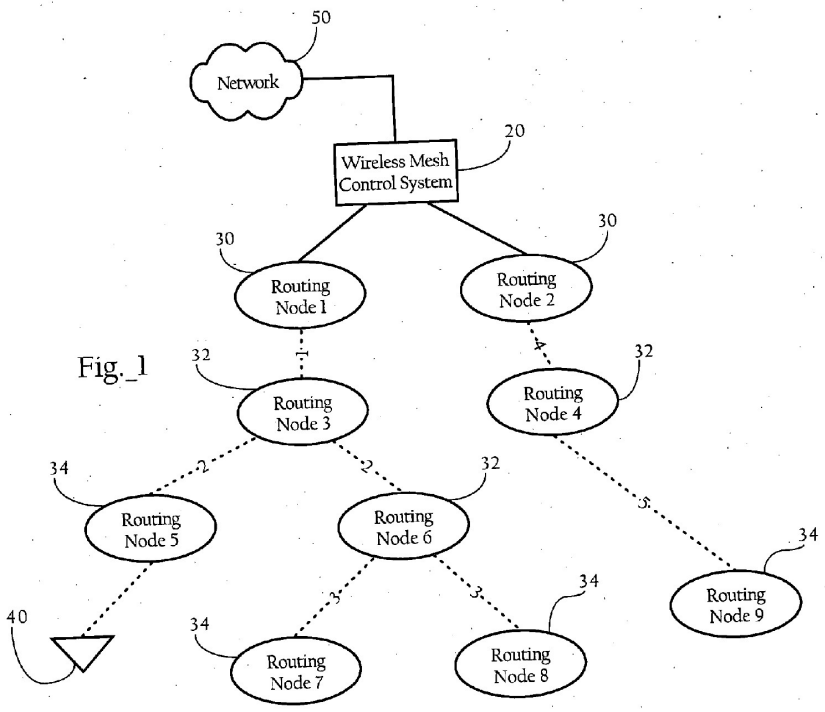
B. Ground 1

1. Castagnoli

Castagnoli is analogous art because Castagnoli describes techniques for mobile mesh network communications. For example, Castagnoli describes "an efficient failure recovery mechanism in hierarchical wireless mesh networks."

Ex.1005, Abstract. This subject matter falls in the same field of endeavor as the '691 patent, which describes a "structured wireless mesh network" that "becomes isolated." Ex.1001, Abstract; Ex.1003, ¶50.

Castagnoli further describes structured wireless mesh networks operating in a tree-like connection topology. Castagnoli explains that "[w]ireless mesh communication networks typically consist of a plurality of wireless routing nodes that operate in a peer-to-peer fashion to establish communication paths to one another for the purposes of providing network access to wireless clients or mobile stations." Ex.1005, [0007]. Castagnoli specifically contemplates hierarchical wireless mesh networks in tree structures, "with the routing nodes that bridge wireless traffic onto a wired network at the top of the hierarchy," e.g., network 50. Ex.1005, [0007], [0033] ("In the wireless mesh network illustrated in FIG. 1, the routing nodes are arranged in two hierarchical tree structures"). An example of two hierarchical wireless mesh networks—where "one root node is routing node 1, while the other root node is routing node 2"—are shown in Figure 1, below. Ex.1005, [0033]; Ex.1003, ¶¶44-45.



Ex.1005, Fig. 1.

Castagnoli illustrates a hierarchical wireless mesh network that includes "a plurality of routing nodes," explaining that "a hierarchical architectural overlay is imposed on the mesh network of routing nodes to create a downstream direction towards leaf routing nodes 34, and an upstream direction toward the root routing nodes 30." Ex.1005, [0033]. Castagnoli's hierarchical wireless mesh network "is used in routing packets between wireless clients 40, or between wireless clients 40 and network 50." Ex.1005, [0033]; Ex.1003, ¶46.

Castagnoli explains that the routing nodes within the hierarchical wireless mesh network "generally comprises routing node control processor 70, wireless backbone interface unit 60, and WLAN interface unit 80." Ex.1005, [0037].

Castagnoli explains that the routing nodes "can be one-, two-, or multiple radio systems including omni-directional and/or directional antennas." Ex.1005, [0038], [0007]. These routing nodes also include a "routing node control processor 70," which includes "hardware modules (e.g., processor, memory), software modules (e.g., drivers, etc.) and data structures (e.g., frame buffers, queues, etc.) that control operation of the routing node." Ex.1005, [0041]; Ex.1003, ¶47.

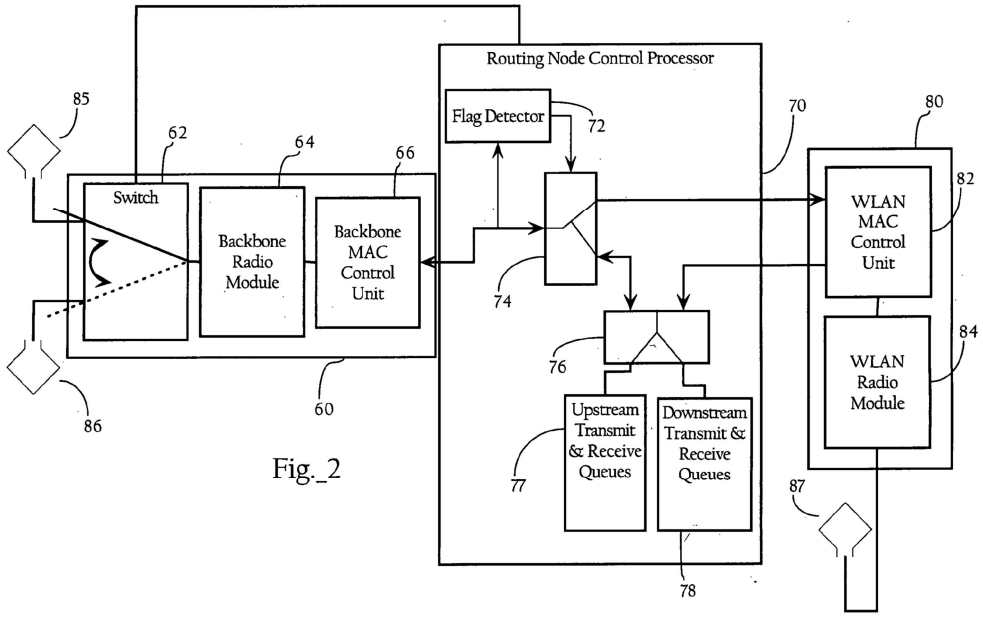


Fig._2

Ex.1005, Fig. 2.

Castagnoli's routing nodes use separate antennas (in the case of one-radio systems) or separate radio systems (in the case of two-radio systems) to communicate with parent and child routing nodes. Ex.1005, [0007], [0042]. Castagnoli explains that "each routing node in the mesh network…is operative to transmit and receive packets from other routing nodes according to a mesh routing

hierarchy" and that "for a given routing node, the operating channel for upstream data transfer…is different than the operating channel used for downstream data transfer." Ex.1005, [0035]-[0036]; Ex.1003, ¶48.

While Castagnoli seeks to "mitigate[] the effect of synchronization loss between a parent and child node on the hierarchical wireless mesh network," Castagnoli pertains to loss of connection between two nodes, rather than between the hierarchical wireless mesh network and the external network to which it bridges wireless traffic. Ex.1005, [0010], Claim 1; Ex.1003, ¶49.

2. Bauer

Like Castagnoli and the '691 patent, Bauer describes useful communication techniques for use in a wireless "mesh network." Ex.1006, Abstract; [0002]-[0004]. Bauer explains that such networks provide communications using Internet Protocol (IP), and thus they support "IP-based applications." Ex.1006, [0002]. These applications, in turn, may require "centralized IP services such as the Network Time Protocol (NTP), the Domain Name System (DNS), and the Dynamic Host Configuration Protocol (DHCP)." Ex.1006, [0002]. These services may not be available, however, when a mesh network "operates in a stand-alone manner disconnected from the infrastructure." Ex.1006, [0004]; Ex.1003, ¶52.

Bauer addresses that shortcoming by having mesh nodes "dynamically switch to providing the IP services locally in the mesh network when the Internet

infrastructure is not accessible." Ex.1006, [0005]. As reflected in Figure 1, Bauer illustrates "computing devices that are capable of sending, receiving, and forwarding IP packets directly to other nodes." Ex.1006, [0023]. These "nodes" 1-4 communicate either "directly with other nodes," or "indirectly to other nodes through one or more intermediary nodes that relay the IP communications to the destination node," e.g., routing nodes. Ex.1006, [0024]; Ex.1003, ¶53.

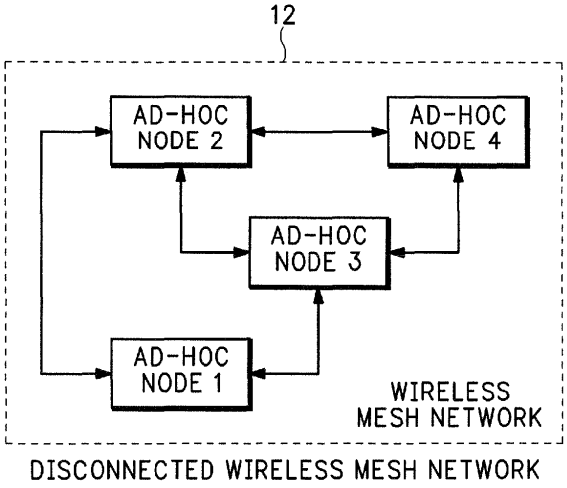


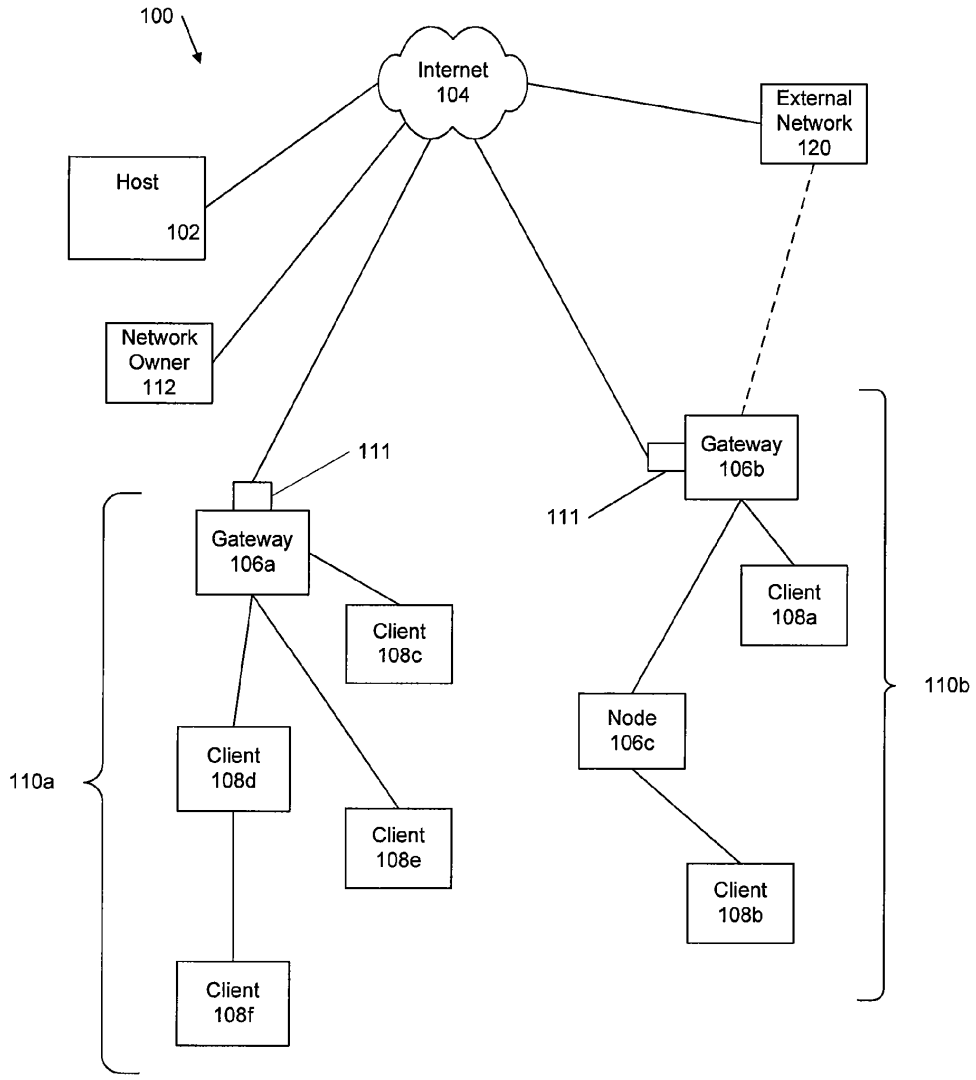
FIG.1

Ex.1006, Fig. 1.

3. Gil

Gil provides further details regarding wireless mesh networks, such as the types of networks contemplated by Castagnoli. Gil explains that "[w]ireless computer networks comprise mesh networks that include at least one node connecting the mesh network to a wide area network (WAN) through a backhaul connection. The WAN can comprise, for example, the Internet, and the backhaul

connection node is referred to as a gateway." Ex.1008, 1:26-30. Like Castagnoli, Gil explains that "nodes of the wireless network typically comprise wireless access points that communicate with the backhaul connection." Ex.1008, 1:33-35; *see* Ex.1005, [0007] ("In one-radio systems, the radio unit is used for purposes of **acting as an access point to its clients**, as well as acting as a **backhaul to a parent routing node**. In two-radio systems, one radio unit typically provides **access point service to wireless clients as well as child routing nodes**, while the other radio unit is used as a **backhaul to a parent routing node**."). However, Gil notes that "[d]eployment of wireless networks is hindered by the requirement for the wired backhaul connection node." Ex.1008, 1:45-46. Gil seeks to address the "need for wireless access points that can be more easily and economically used in connection with more than one network." Ex.1008, 2:8-11. Accordingly, Gil provides a solution where "[t]he external connection between" a gateway node and an external network "can comprise…a wireless connection." Ex.1008, 4:29-31. This is reflected in Figure 1, below, which shows a dotted line signifying a connection between Gateway 106b and External Network 120. Ex.1003, ¶54.



Ex.1008, Fig. 1.

4. Reasons to Combine Castagnoli and Bauer

A POSITA would have combined Castagnoli and Bauer because both references relate to networking, and more specifically, to the operation of mesh networks in different failure situations. Castagnoli provides recovery mechanisms for when a mesh network experiences a failure of a connection between two nodes

of the network. Ex.1005, Abstract. And Bauer teaches mesh network operation when the connection to an external network is not present, e.g., when the connection is lost. Ex.1006, Abstract; Ex.1003, ¶55.

More specifically, Castagnoli is concerned with "providing an efficient failure recovery mechanism in hierarchical wireless mesh networks." Ex.1005, Abstract. Castagnoli explains that it "mitigates the effect of synchronization loss between a parent and child node on the hierarchical wireless mesh network." Ex.1005, Abstract. Because of the dependencies of hierarchical wireless mesh networks, a failure event with a node "will generally cause its child nodes to seek to re-acquire another parent node." Ex.1005, [0010]. Such failure events propagate down the network in situations where a child node, seeking to re-acquire another parent node, stops servicing its own child nodes, causing them to seek another parent node as well. Ex.1005, [0010]. Accordingly, Castagnoli provides a solution to mitigate failure when a node loses synchronization with its parent. Ex.1005, [0146]; Ex.1003, ¶56.

Thus, while Castagnoli focuses on mitigating failure between nodes, Bauer provides details concerning how hierarchical wireless mesh network should respond in instances where the connection between a mesh network to an external network is lost. Ex.1006, [0005], [0023], [0025]. Accordingly, a POSITA would have looked to teachings addressing other types of failure situations, such as those

described in Bauer, because Castagnoli emphasizes why mesh network failure is undesirable. Ex.1005, [0010]; Ex.1003, ¶57.

More specifically, Bauer teaches "[n]odes in a mesh network [] configured to access centralized Internet Protocol (IP) services when the Internet infrastructure is accessible [which] dynamically switch to providing the IP services locally in the mesh network when the Internet infrastructure is not accessible." Ex.1006, [0005]. Bauer explains that a "mesh network 12 over its lifetime may be connected or disconnected from an Internet infrastructure." Ex.1006, [0023]; Ex.1003, ¶58.

Bauer also discusses the operation of devices on a mesh network. Bauer discusses a mesh network comprising "nodes 1-4", explaining that each of the nodes are "computing devices…that are capable of sending, receiving, and forwarding IP packets directly to other nodes." Ex.1006, [0023]. Bauer explains that the nodes may be "Personal Computers (PCs), Personal Digital Assistants (PDAs), cellular telephones with IP capabilities, digital pagers, or any other IP device that may need to operate in a mesh network." Ex.1006, [0023]. These devices are connected "through one or more intermediary nodes that relay the IP communications to the destination node." Ex.1006, [0024]. In this way, some of Bauer's "nodes 1-4" correspond to Castagnoli's "client devices" (e.g., when a Bauer node is an endpoint of a communication) and some of the other "nodes 1-4"

correspond to Castagnoli's "routing nodes" (e.g., when a Bauer node is relaying a communication). Ex.1003, ¶59.

A POSITA would have been motivated to combine the teachings of Castagnoli and Bauer and doing so would have been within the POSITA's skillset. The combination would have been obvious because it represents merely the use of a known technique (providing the IP services locally in a mesh network when the external network is not accessible) to improve similar devices (Castagnoli's hierarchical wireless mesh network) in the same way (enabling dynamically switching operation of Castagnoli's hierarchical wireless mesh network when a an external network is connected or disconnected, per Bauer) to yield predictable results. Castagnoli provides extensive disclosure about mesh network operation and failure recovery, but focuses on node-to-node failures. Ex.1005, [0010], [0146]-[0150]. Bauer discloses additional details relevant to a different type of failure that can occur in Castagnoli's network, i.e., in the connection to the external network. Ex.1006, Abstract, [0023]-[0025]; Ex.1003, ¶60.

In the combination, routing nodes within Castagnoli's hierarchical wireless mesh network would maintain operations as disclosed, including regular operations to maintain network connectivity and operation when two nodes lose connection within the network. However, when a connection is instead lost at the root node,

i.e., between the root node and external network, Bauer's teachings regarding the provision of IP services locally would be implemented. Ex.1003, ¶61.

A POSITA would have had a reasonable expectation of success in combining Castagnoli and Bauer because the teachings of Castagnoli and Bauer are complimentary; each providing handling for different failure events within a mesh network. Further, the teachings of Castagnoli and Bauer focus on different aspects of a mesh network: Castagnoli describes routing node operation and connectivity to parent routing nodes, while Bauer describes dynamically switch to providing IP services locally or through Internet infrastructure, depending on the connectivity to the external network. As such, a POSITA would have recognized how Bauer's teachings of maintaining network operation when connection to an external network is lost would apply to Castagnoli's hierarchical wireless mesh network. Additionally, such combination would be desirable because it would allow for the client devices within Castagnoli's hierarchical wireless mesh network to maintain functionality, and the routing nodes to maintain synchronization, until the connection to the external network is restored, limiting the impacts of an external network failure. Ex.1003, ¶62.

5. Reasons to Combine Castagnoli, Bauer, and Gil

A POSITA would have combined Castagnoli and Bauer with Gil because each of the references relates to networking, and more specifically, to

implementation details of a wireless mesh network. Castagnoli provides recovery mechanisms for when a mesh network experiences a failure of a connection between two nodes of the network. Ex.1005, Abstract. Bauer teaches mesh network operation when the connection to an external network is not present, e.g., when the connection is lost. Ex.1006, Abstract. And Gil provides further implementation details regarding the connection of a mesh network to an external network, explaining that such connections can be a wired connection or a wireless connection. Ex.1008, 4:29-31; Ex.1003, ¶63.

A POSITA would have been motivated to combine the teachings of Castagnoli and Bauer with Gil and doing so would have been within the POSITA's skillset. The combination would have been obvious because it represents merely the use of a known technique (connecting a wireless mesh network to an external network using a wireless connection) to improve similar devices (Castagnoli's hierarchical wireless mesh network) in the same way (enabling Castagnoli's root routing nodes to utilize uplink radios that are already included as part of the node to connect with external networks wirelessly, per Gil) to yield predictable results. Castagnoli notes that in a hierarchical wireless mesh network, "the routing nodes bridge wireless traffic onto a wired network at the top of the hierarchy" without explaining the types of connections that would be utilized. Ex.1005, [0007]. Gil

provides further teachings to suggest using a wireless connection instead. Ex.1008, 4:25-31; Ex.1003, ¶64.

A POSITA would have been motivated to combine the teachings of Castagnoli and Bauer with Gil and doing so would have been obvious to try. While Castagnoli does not explain how exactly a root routing node would be connected to an external network, Gil presents known and finite alternatives for such connections: (1) a wired connection, or (2) a wireless connection. Ex.1005, [0007]; Ex.1008, 4:25-31. Indeed, Gil's teaching directly solves the known issue that "[d]eployment of wireless networks is hindered by the requirement for the wired backhaul connection node" by instead allowing a wireless connection between networks. Ex.1008, 1:45-46. In the combination, Castagnoli's hierarchical wireless mesh network would maintain operations, bridging traffic to an external network by implementing Gil's teaching of doing so via a wireless link. Ex.1003, ¶65.

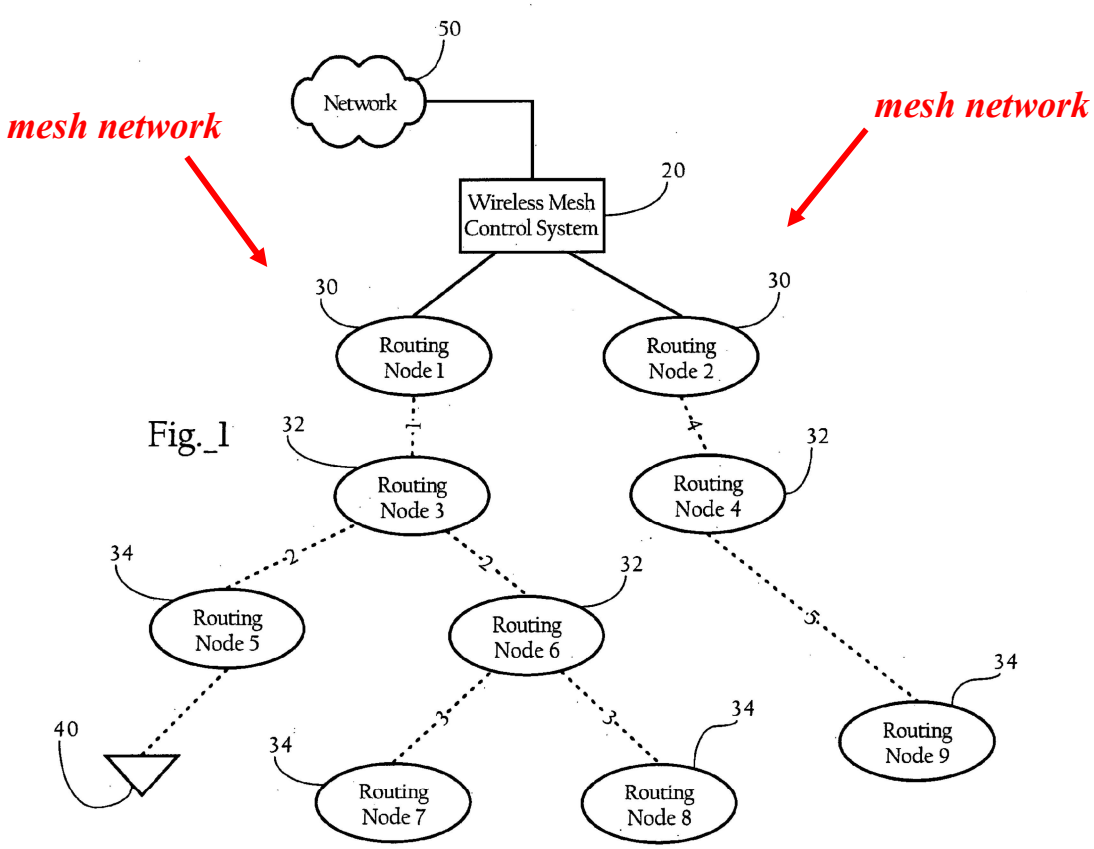
A POSITA would have had a reasonable expectation of success in combining Castagnoli, Bauer, and Gil because the teachings of Castagnoli, Bauer, and Gil are complimentary; each providing teachings regarding the operations of a wireless mesh network. Further, the teachings of Castagnoli, Bauer, and Gil focus on different aspects of a network: Castagnoli describes routing node operation and connectivity to parent routing nodes, Bauer describes dynamically switching to providing IP services locally or through Internet infrastructure, depending on the

connectivity to the external network, and Gil provides additional teachings regarding the mechanisms for connecting a mesh network to an external network. Additionally, such combination would be desirable because it would allow for the root routing node within Castagnoli's hierarchical wireless mesh network to connect to another network using its uplink radio, allowing for broader deployment and mobility of the mesh network. Ex.1003, ¶66.

6. Claim 1

[1.0] A structured mesh network capable of isolated operation, comprising:

First, Castagnoli details a "hierarchical wireless mesh network," two examples of which are illustrated in Figure 1, below. Ex.1005, [0033]. Ex.1003, ¶¶67-68.

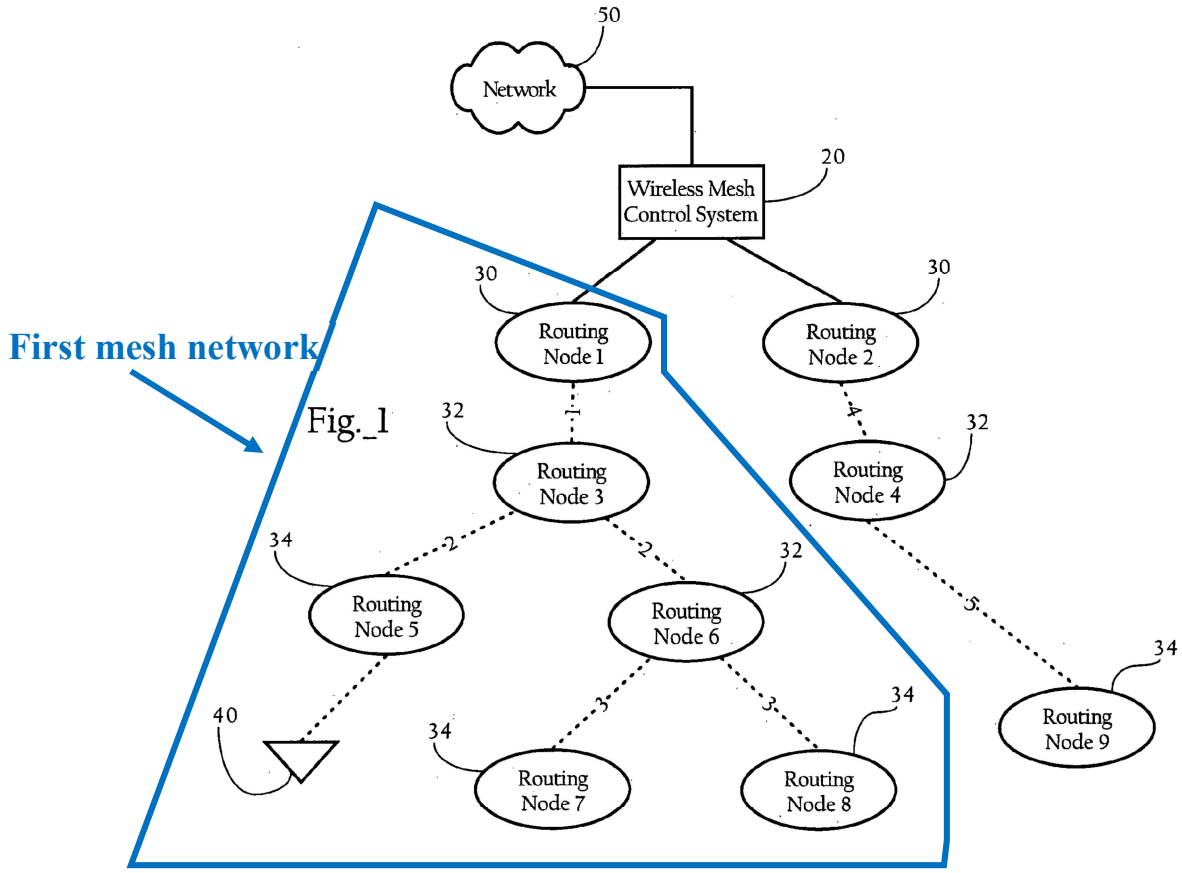


Ex.1005, Fig. 1 (annotated); Ex.1003, ¶68.

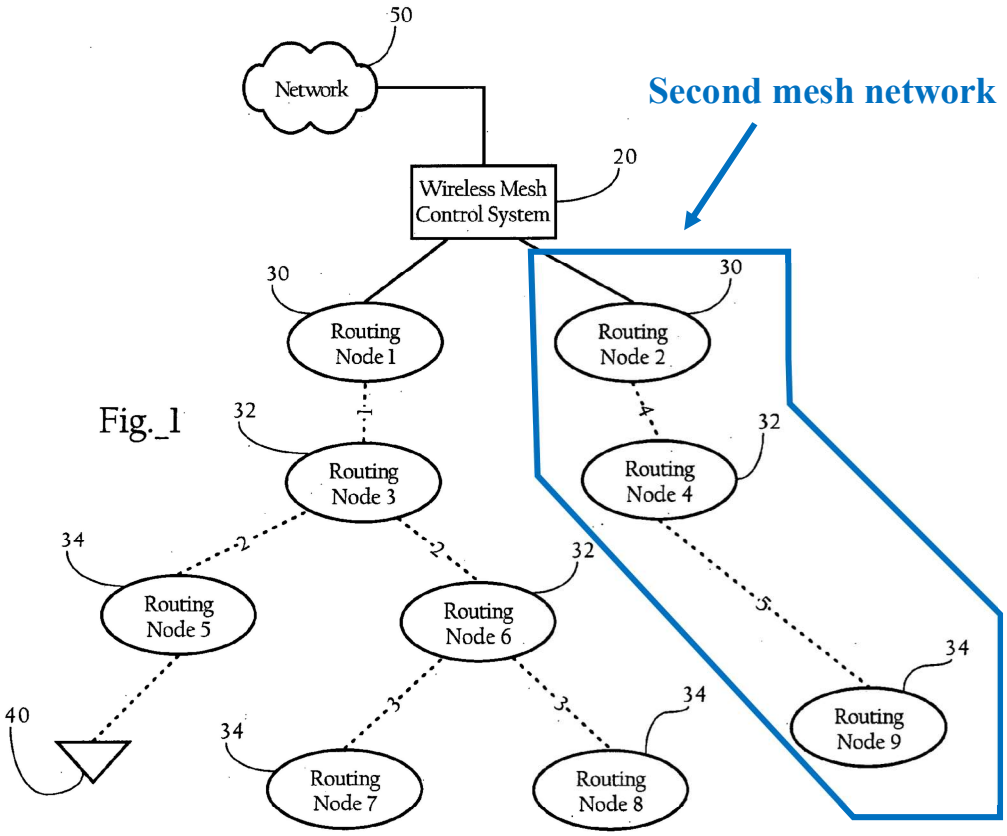
Castagnoli's hierarchical wireless mesh network is *a structured mesh network* because it is a "hierarchical wireless mesh network" that "can operate in a wide variety of hierarchical mesh network configurations." Ex.1005, [0033]. Figure 1 shows "a hierarchical architectural…[with] a downstream direction towards leaf routing nodes 34, and an upstream direction toward the root routing nodes 30." Ex.1005, [0033]; Ex.1003, ¶69.

More specifically, Castagnoli illustrates two hierarchical wireless mesh networks—a first mesh network with root routing node 1 (left side in Fig. 1,

above), and a second mesh network with root routing node 2 (right side in Fig. 1, above). Each of Castagnoli's hierarchical wireless mesh networks (*a structured mesh network*) includes "routing nodes that bridge wireless traffic onto a wired network at the top of the hierarchy," e.g., network 50. Ex.1005, [0007]. As illustrated in Figure 1, each routing node 3-9 is wirelessly connected via respective uplink radios to root routing node 1 or root routing node 2, either directly or through connections to parent routing nodes, to create "an upstream direction toward the root routing nodes 30." Ex.1005, [0033], Fig. 1. Root routing node 1 and root routing node 2, in turn, "bridge wireless traffic onto a wired network at the top of the hierarchy," e.g., network 50, for their respective hierarchical wireless mesh networks. Ex.1005, [0007]. Each annotated Figure 1 below reflects the respective hierarchical wireless mesh networks illustrated by Castagnoli. Ex.1003, ¶70.



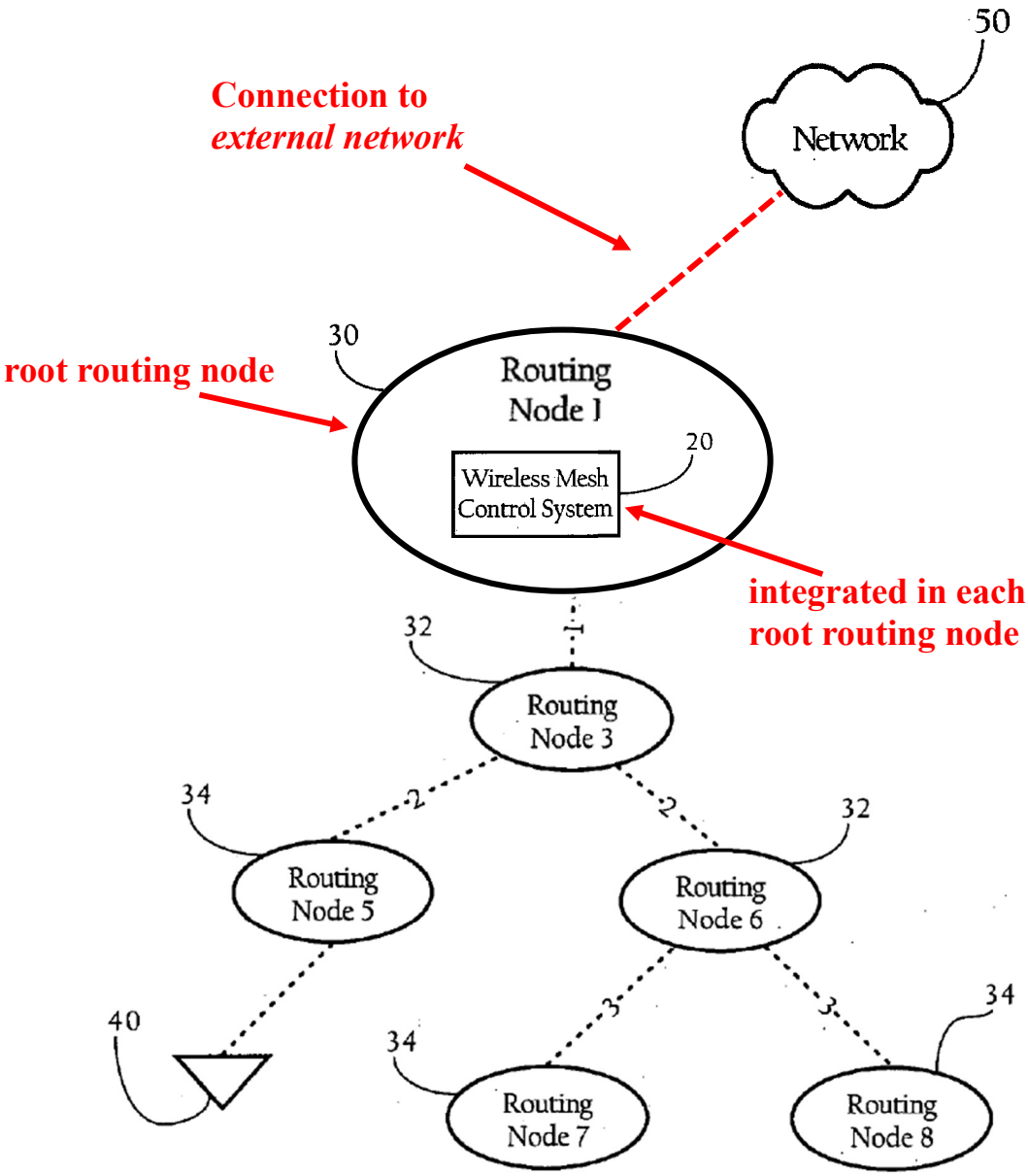
Ex.1005, Fig. 1 (annotated); Ex.1003, ¶70.



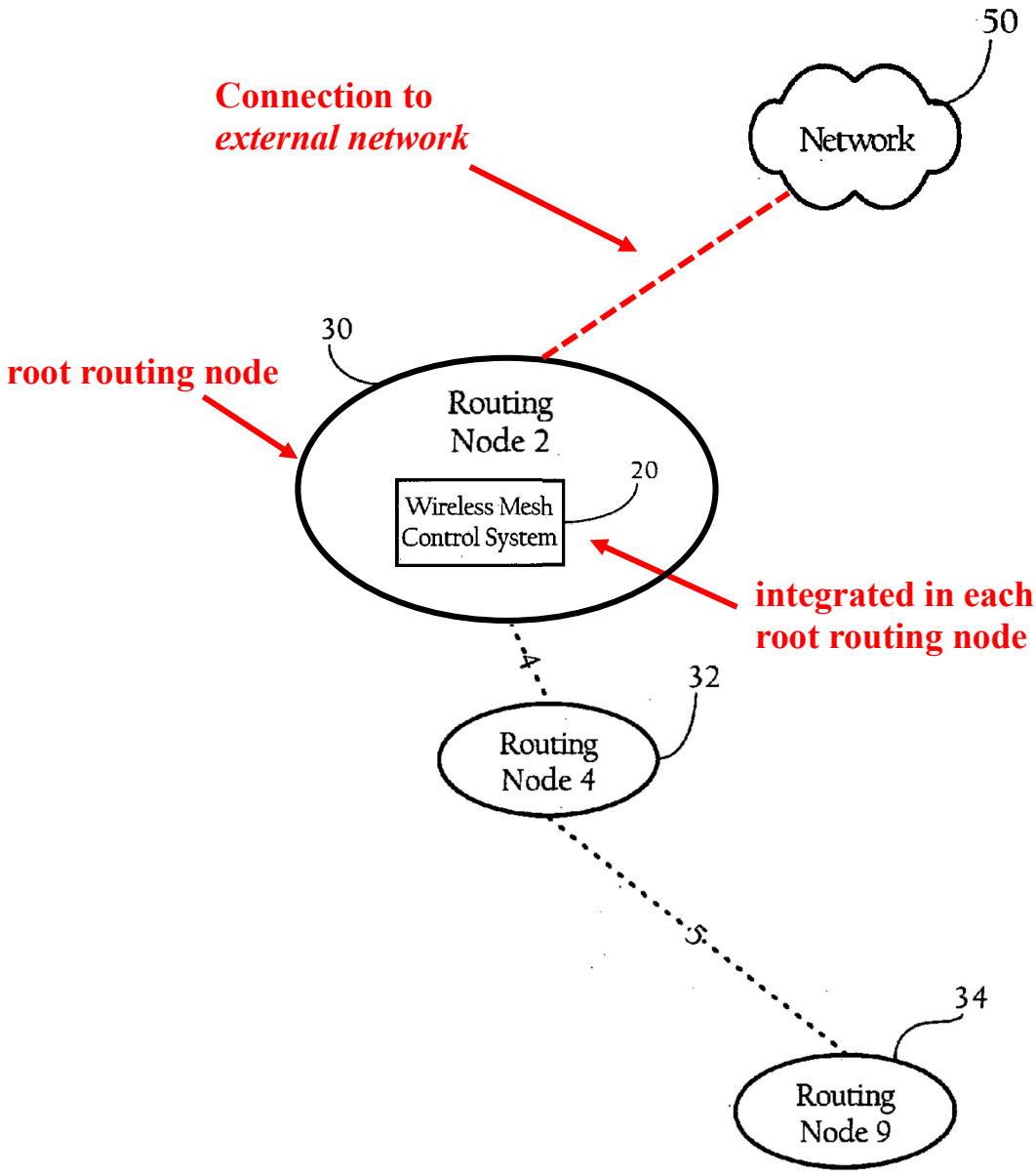
Ex.1005, Fig. 1 (annotated); Ex.1003, ¶70.

Further, Castagnoli's Figure 1 illustrates a "wireless mesh control system 20" above the hierarchical wireless mesh network. Castagnoli explains that wireless mesh control system 20 may perform various functions related to message routing, packet headers, client association with routers, route discovery, and monitoring the network. Ex.1005, [0155], [0153], [0035]. While Figure 1 illustrates a single wireless mesh control system 20, Castagnoli explains that "the functionality of mesh network control system 20 may be integrated into other network devices, such as root routing nodes 30." Ex.1005, [0156]. Accordingly, in

such instances, each root routing node is the link that bridges traffic to the external network 50. Ex.1003, ¶71. Each annotated Figure 1 below, modified in view of Castagnoli's teaching of integrating the wireless mesh control system 20 into the root routing nodes, reflects the respective hierarchical wireless mesh networks illustrated by Castagnoli:



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶71.



Ex.1005, Fig. 1 (modified, annotated); EX.1003, ¶71.

The '691 patent explains that it is "based on a two-radio mesh network," where mesh nodes "form a hierarchical tree-like network topology called a 'Structured Mesh'[.]" This was a known design for wireless mesh networks, and the nodes in Castagnoli's wireless mesh network are similarly arranged in "hierarchical tree structures." Ex.1005, [0033]. Thus, each of Castagnoli's

hierarchical wireless mesh networks (reflected in the modified Figure 1 annotations, above)[2] renders obvious the claimed *structured mesh network*. Ex.1003, ¶72.

Second, the combination of Castagnoli and Bauer renders obvious *a structured mesh network capable of isolated operation* as discussed in further detail in the analysis of [1.7] below (addressing *the second isolated configuration*). As discussed in Section XII.B.3 above, a POSITA would have been motivated to combine Castagnoli and Bauer to implement Bauer's teachings of providing IP services locally when Castagnoli's hierarchical wireless mesh network loses connection to the external network 50. Ex.1003, ¶73.

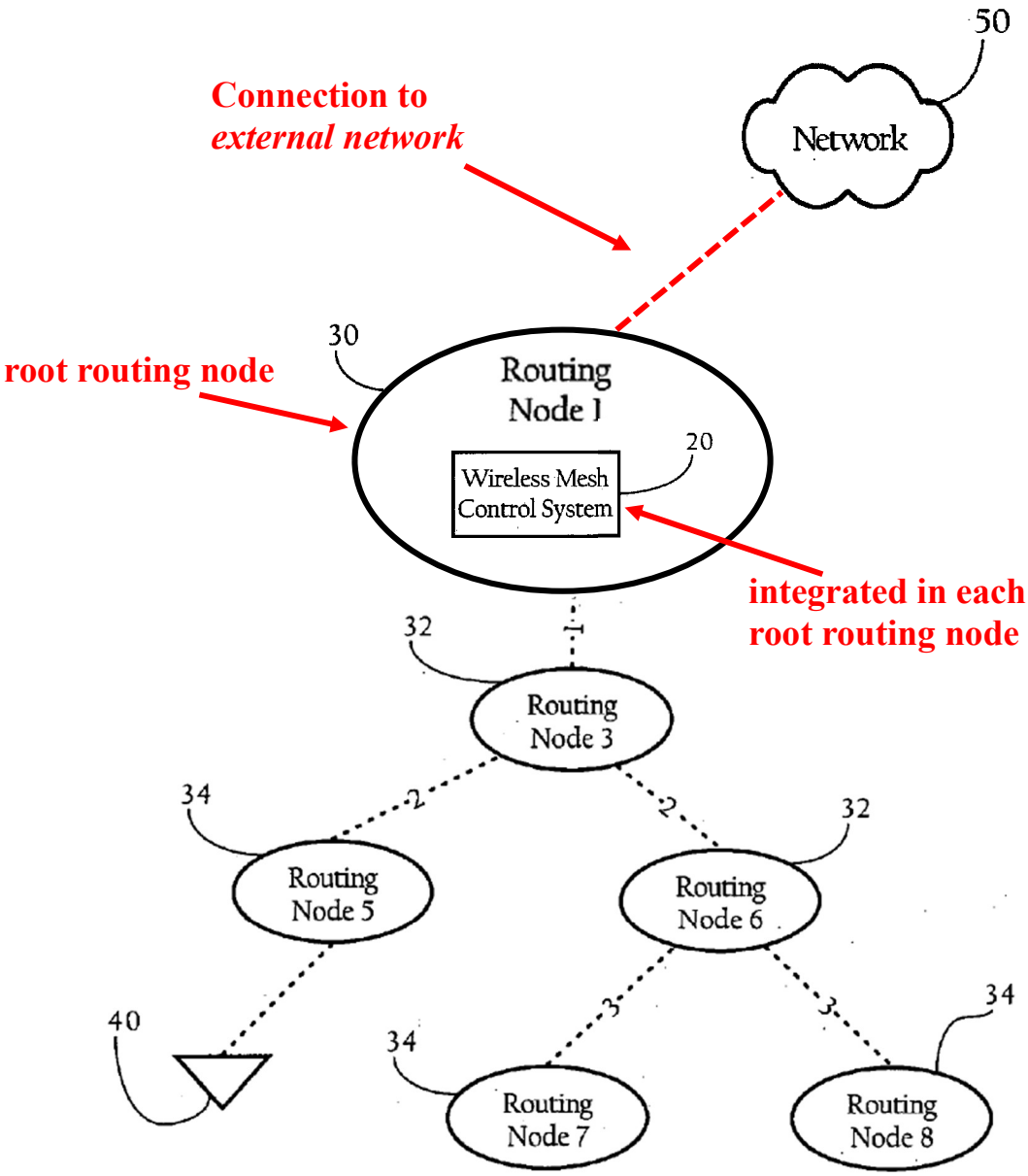
Bauer explains that when the mesh network is "disconnected from an Internet infrastructure," wireless clients such as "computing devices [] are capable of sending, receiving, and forwarding IP packets directly to other nodes." Ex.1006, [0023]. In this disconnected state, the wireless clients within Castagnoli's

[2] While the two hierarchical wireless mesh networks illustrated by Castagnoli (with root routing node 1, and with root routing node 2) are each *a structured mesh network*, the analysis of claim 1 focuses on the hierarchical mesh network with root routing node 1 when discussed with respect to the claimed *structured mesh network*.

hierarchical wireless mesh network "communicate indirectly to other nodes through one or more intermediary nodes that relay the IP communications to the destination node," e.g., through routing nodes. Ex.1006, [0024]; *see also* Ex.1006, Abstract (nodes are configured to "provid[e] the IP services locally in the mesh network when the Internet infrastructure is not accessible"). Thus, Castagnoli in view of Bauer renders obvious *a structured mesh network* (Castagnoli's wireless mesh network) *capable of isolated operation* (the mesh network maintains IP connectivity when a connection to the outside network is lost, per Bauer). Ex.1003, ¶¶74-75.

[1.1] at least two structured mesh nodes;

Castagnoli discloses or renders obvious this limitation because Castagnoli illustrates "a plurality of routing nodes" in each hierarchical wireless mesh network. Ex.1005, [0033]. As shown in modified Figure 1, below, Castagnoli's wireless mesh networks include a "plurality of routing nodes." Ex.1005, [0033]; Ex.1003, ¶76.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶76.

More specifically, Castagnoli discloses "root routing nodes 30," "intermediary routing node[s] 32," and "leaf routing nodes 34," as indicated in modified Figure 1 above. Ex.1005, [0033]. Further, as discussed in [1.0], Castagnoli's wireless mesh network is a *structured mesh network*. Similarly, the nodes that form the wireless mesh network are *at least two structured mesh nodes*

because "the routing nodes are arranged in [a] hierarchical tree structure[]" and operate as a root node, intermediary nodes, or leaf nodes within the hierarchy. Ex.1005, [0033]; Ex.1003, ¶¶77-78.

[1.2] wherein each structured mesh node comprises at least a connectivity logic;

Castagnoli discloses or renders obvious this limitation because each of the routing nodes include routing node control processors that control operations of the respective node. Castagnoli illustrates "the logical and/or operating components" of a routing node configuration. Ex.1005, [0037]. Castagnoli explains that "a mesh routing node generally comprises routing node control processor 70[.]" Ex.1005, [0037]; Ex.1003, ¶79.

As reflected in Figure 2, below, routing node control processor 70 includes "hardware modules (e.g., processor, memory), software modules (e.g., drivers, etc.) and data structures (e.g., frame buffers, queues, etc.) that **control operation of the routing node**." Ex.1005, [0041]; Ex.1003, ¶80.

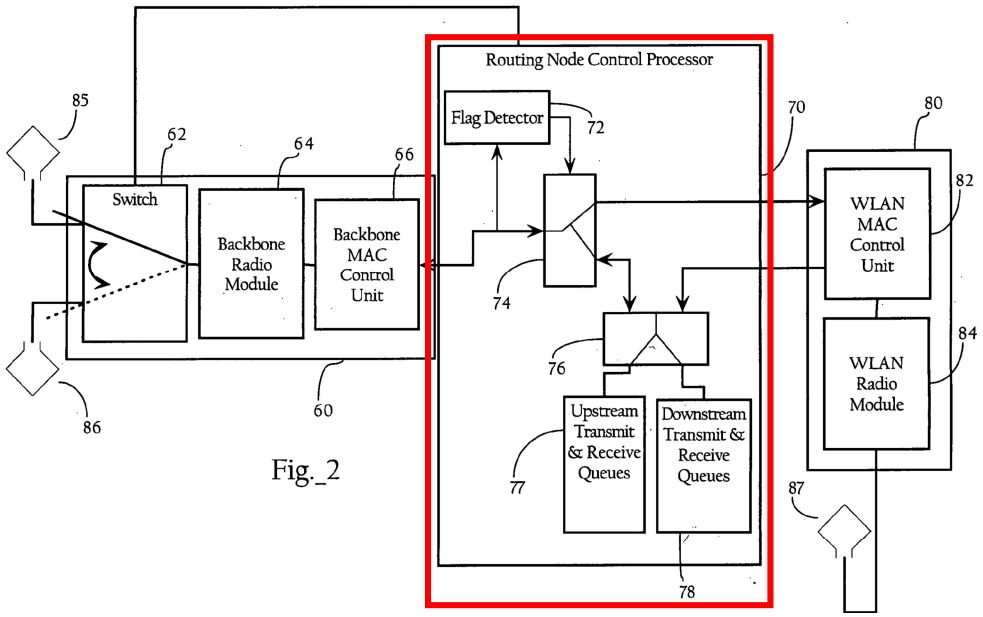


Fig._2

Ex.1005, Fig. 2 (annotated); Ex.1003, ¶80.

The routing node control processor controls the operation of its routing node. For instance, the routing node control processor can include "a routing node application" that allow the routing node to "transmit scheduling messages to at least one child routing node," "maintain synchronization with the parent routing node," "attempt to re-acquire the parent routing node," and "select a neighboring routing node as a tentative parent node." Ex.1005, Claims 10-11, 14; *see* Ex.1005, [0054]-[0107] (discussing "Neighbor Maintenance State"), [0108]-[0144] (discussing "Slot-Based Transmission Scheduling Mechanism"), [0145]-[0155] (discussing "Mitigation of Synchronization Loss"); Ex.1003, ¶81.

Thus, each routing node including a routing node control processor 70 operating to control operation of the respective routing node—scheduling with

child nodes, acquiring parent nodes, and maintaining synchronization with parent nodes—discloses or renders obvious that *each structured mesh node comprises at least a connectivity logic*. Ex.1003, ¶82.

[1.3] an uplink radio operating on an uplink frequency and a downlink radio operating on a distinct downlink frequency;

Castagnoli renders obvious this limitation because Castagnoli describes two-radio systems and multi-radio systems where one radio is used as a backhaul to its parent routing node (*an uplink radio*) and a second radio provides service to clients and child routing nodes (*a downlink radio*). Ex.1003, ¶83.

First, Castagnoli discloses *an uplink radio…and a downlink radio* because Castagnoli explains that the "wireless mesh routing nodes can be…two-radio systems" where "one radio unit typically provides access point service to wireless clients as well as child routing nodes, while the other radio unit is used as a backhaul to a parent routing node." Ex.1005, [0007]. The radio providing a connection to the parent node is *an uplink radio*, and the radio providing a connection to clients and child routing nodes is *a downlink radio*. Ex.1003, ¶84.

Figure 2, below, reflects a two-antenna arrangement in the wireless mesh nodes, where "**[f]irst antenna 85…can be used for data transfer with a parent routing node**, while **second antenna 86 can be used for transfer with one or more child routing nodes**." Ex.1005, [0042]; Ex.1003, ¶85.

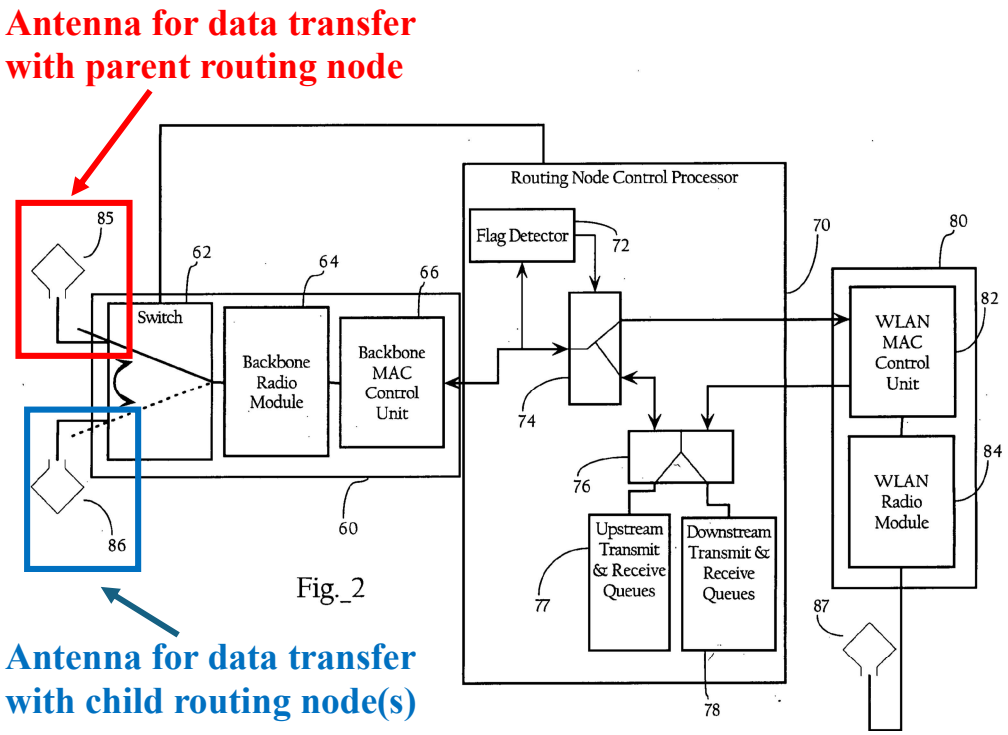


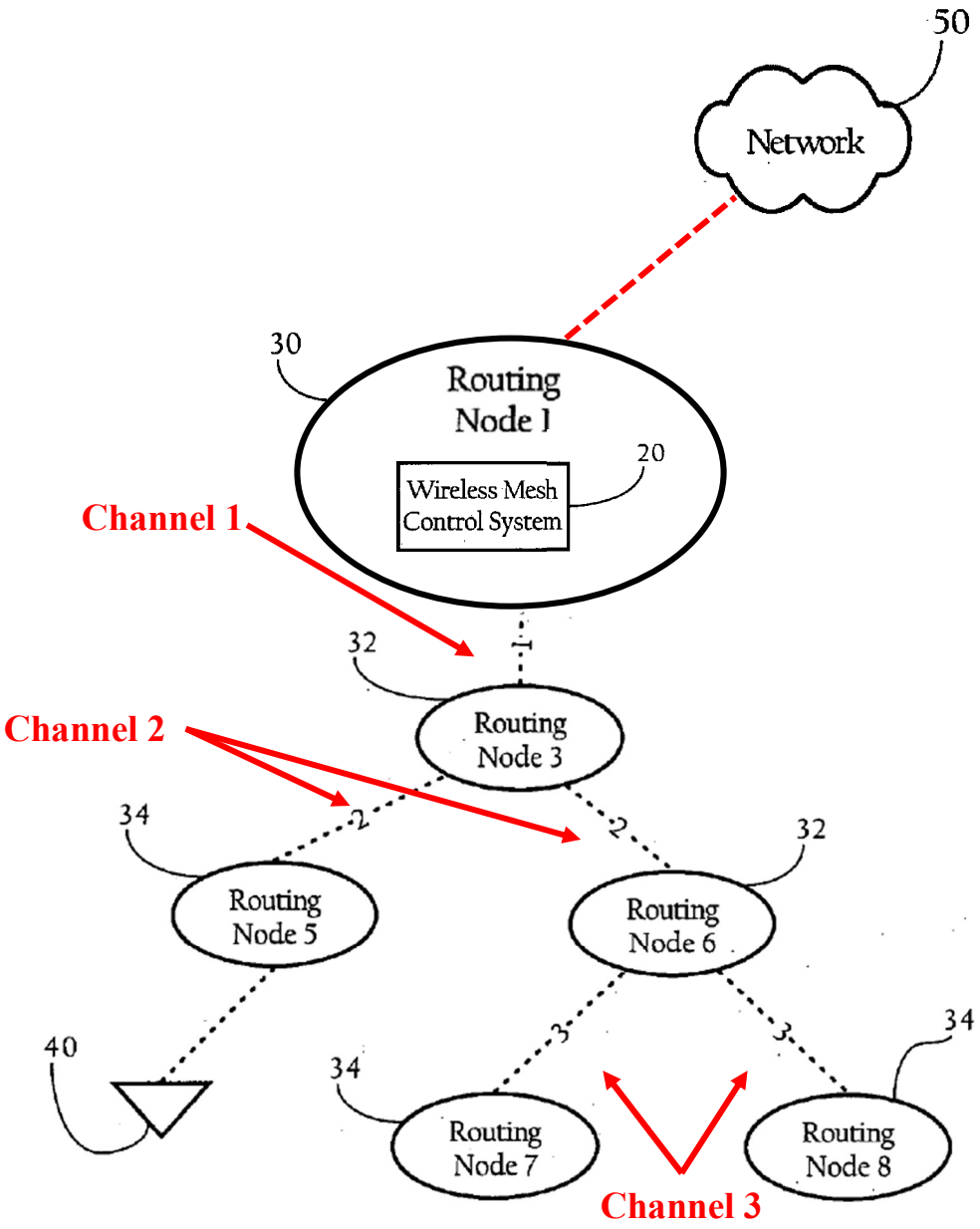
Fig._2

Ex.1005, Fig. 2 (annotated); Ex.1003, ¶85.

While Figure 2 shows a single-radio implementation with two antennas, it would have been obvious to have each disclosed antenna operate in conjunction with its own respective radio in the two-radio systems contemplated by Castagnoli. *See* Ex.1005, Fig. 2, [0007], [0042]. Further, such multi-radio systems, where distinct radios were dedicated to uplink and downlink connections within the systems, were well-known and would have been an obvious choice in view of Castagnoli's explicit disclosure of such systems. *See* Ex.1005, [0007]. Thus, Castagnoli discloses or renders obvious *an uplink radio* (a first radio used as a backhaul to a parent routing node, operating using first antenna 85) and *a downlink radio* (a second radio unit providing access point service to wireless clients and

child routing nodes, operating using second antenna 86). Ex.1003, ¶86.

Second, Castagnoli's uplink and downlink radios operate *on an uplink frequency* and *on a distinct downlink frequency* respectively because Castagnoli explains that each routing node uses different, non-overlapping channels across different radio frequencies for upstream data transfer and downstream data transfer. As Figure 1 illustrates below, Castagnoli explains that different, non-overlapping channels are used for upstream data transfer and downstream data transfer, such that each node has its own distinct downlink channel. Ex.1005, [0035] ("the operating channel for upstream data transfer, in one implementation, **is different** than the operating channel used for downstream data transfer" where "the upstream and downstream channels assigned to a given routing node are **non-overlapping channels**"). It would have been obvious to a POSITA for Castagnoli's non-overlapping channels to correspond to non-overlapping radio frequencies because Castagnoli describes how nodes in a wireless mesh network communicate via multiple radio frequencies. Ex.1003, ¶87; Ex.1005, [0007] ("**Multiple radio designs** typically dedicate one radio for access, one or more to service the backhaul, and may also dedicate a radio for the purposes of monitoring the RF environment and other conditions **on multiple radio frequencies**.").



Ex.1005, Fig. 1 (modified, annotated); Ex.1993, ¶87.

Thus, Castagnoli renders obvious *an uplink radio operating on an uplink frequency* (a radio is used as a backhaul to its parent routing node on one channel) *and a downlink radio operating on a distinct downlink frequency* (a radio provides service to clients and child routing nodes on a different, non-overlapping channel).

Ex.1003, ¶88.

[1.4] wherein the connectivity logic determines whether each[3] structured mesh node connects with an external network or another node using its uplink radio and client devices or other mesh nodes connect to each node using each node's downlink radio;

Castagnoli renders obvious this limitation because, as discussed above in the analysis of [1.2], Castagnoli discloses or renders obvious that *each structured mesh node comprises at least a connectivity logic*, and Castagnoli further renders obvious that each node's routing node control processor controls the operation of its routing node, including connections with other nodes as parent nodes (*determines whether each structured mesh node connects with…another node using its uplink radio*) and connections with other nodes as child nodes (*determines whether…other mesh nodes connect to each node using each node's downlink*

[3] The term "the connectivity logic" finds antecedent basis in limitation [1.2], which recites *wherein each structured mesh node comprises at least a connectivity logic*. Accordingly, limitation [1.4] is interpreted as referring to the instance of *the connectivity logic* for each respective node, where the recitation of "each" within this limitation refers to the respective node for that specific instance of the connectivity logic. In other words, the connectivity logic for a specific node determines that specific node's connections using its uplink radio and downlink radio.

radio). Ex.1003. ¶89.

As noted above in the analysis of limitation [1.2], Castagnoli's routing node control processor can include "a routing node application" that allow the routing node to "transmit scheduling messages to at least one child routing node" (*connect to* a child node via the *node's downlink radio*), "maintain synchronization with the parent routing node" (*connect with* a parent node *using its uplink radio*), "attempt to re-acquire the parent routing node" (*connect with* a parent node *using its uplink radio*), and "select a neighboring routing node as a tentative parent node" (*connect with* a parent node *using its uplink radio*). Ex.1005, Claims 10-11, 14. Further, each mesh routing node is "operative to establish and maintain wireless connections to one or more wireless client devices 40" (*client devices…connect to each node using each node's downlink radio*). Ex.1005, [0036]; Ex.1003, ¶90.

Because Castagnoli teaches that the routing node control processor controls the selection of parent and child nodes, and the nodes are further operative to establish connections with wireless clients, Castagnoli renders obvious this limitation. Ex.1003, ¶91.

[1.5] wherein the structured mesh network functions in two configurations selected depending on whether a connection to an external network is present;

Castagnoli in view of Bauer renders obvious *the structured mesh network functions in two configurations selected depending on whether a connection to an external network is present*, as discussed in further detail below in [1.6] and [1.7].

Specifically, Castagnoli details *the first connected configuration* (*see* [1.6] below), where Castagnoli's hierarchical wireless mesh network operates as normal while a connection to an external network is maintained. Additionally, Castagnoli in view of Bauer renders obvious *the second isolated configuration* (*see* [1.7] below), where Castagnoli's hierarchical wireless mesh network operates without a connection to an external network, maintaining communication between client devices as taught by Bauer. Ex.1003, ¶92.

Further, Castagnoli in view of Bauer renders obvious *select[ing]* the operating configuration based on a connection to an external network. Specifically, Bauer explains that a "mesh network 12 over its lifetime may be connected or disconnected from the Internet 14." Ex.1006, [0025]. The mesh nodes within a mesh network "know when they are part of a connected or disconnected mesh network 12 through the use of routing and data distribution software[.]" Ex.1006, [0026]; *see also* Ex.1006, [0027] ("These previously described utilities also allow nodes to determine whether the mesh network they are currently part of is either connected to or disconnected from the Internet infrastructure."). Bauer further explains that "many well known IP-based applications rely on centralized IP services such as the Network Time Protocol (NTP), the Domain Name System (DNS), and the Dynamic Host Configuration Protocol (DHCP)." Ex.1006, [0002]. However, "[t]hese centralized IP services are not always available in a wireless

mesh network," e.g., when disconnected from the infrastructure. Ex.1006, [0004]; Ex.1003, ¶93.

Accordingly, centralized IP services, such as Network Time Protocol services, are provided (*selected*) using an Internet-based time server when the mesh network is connected to the Internet (*the first connected configuration*), while the IP services are provided locally (*selected*) using a node configured as a Reported Node Time Server, per Bauer, when the mesh network loses connectivity to the Internet (*the second connected configuration*). Ex.1006, Abstract, [0003]. [0028]-[0029], [0032]; *see infra* Claim 2; Ex.1003, ¶94.

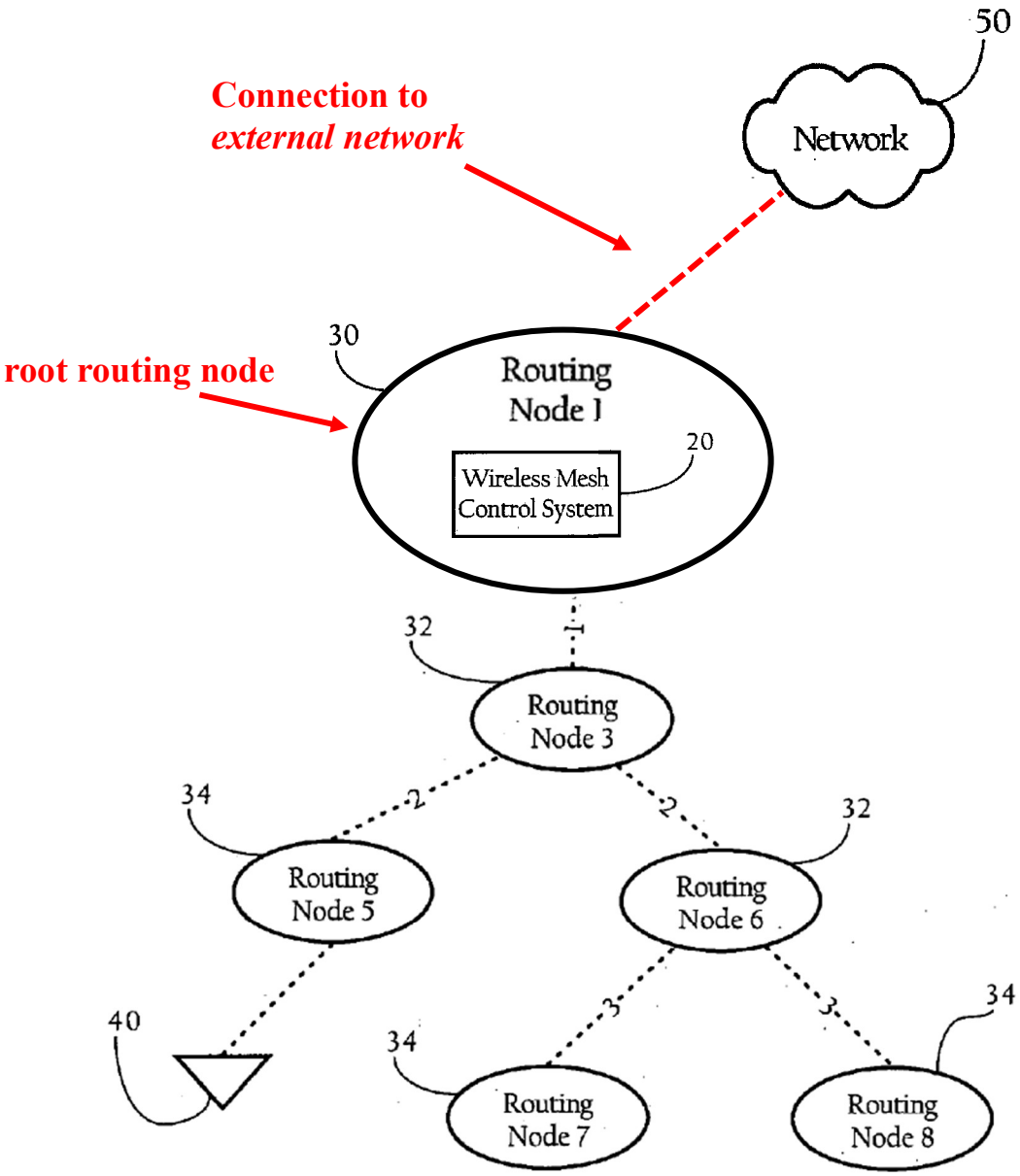
Thus, by providing "access [to] centralized Internet Protocol (IP) services" for Castagnoli's hierarchical wireless mesh network "whenever the Internet infrastructure is accessible and then dynamically switch[ing] to providing the IP services locally in the mesh network when the Internet infrastructure is not accessible," Castagnoli in view of Bauer renders obvious this limitation. Ex.1006, Abstract; Ex.1003, ¶95.

[1.6] in the first connected configuration the structured mesh network includes at least one structured mesh node's uplink radio comprising a connection to an external network; and

First, Castagnoli discloses *the first connected configuration* because Castagnoli explains that its hierarchical wireless mesh network connects to an external network through a root routing node 30 and provides network access to

clients and other mobile stations. Ex.1003, ¶96.

Castagnoli's wireless mesh network (*the structured mesh network*) includes "routing nodes that bridge wireless traffic onto a wired network at the top of the hierarchy," e.g., network 50. Ex.1005, [0007]. As illustrated in modified Figure 1, each routing node 3 and 5-8 is wirelessly connected via respective uplink radios to root routing node 1, either directly or through connections to parent routing nodes, to create "an upstream direction toward the root routing nodes 30." Ex.1005, [0033], Fig. 1. Root routing node 1, in turn, "bridge[s] wireless traffic onto a wired network at the top of the hierarchy," e.g., network 50, for the hierarchical wireless mesh network. Ex.1005, [0007]. "[T]his hierarchical relationship is used in routing packets…between wireless clients 40 and network 50." Ex.1005, [0033]; Ex.1003, ¶97.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶97.

Second, Castagnoli in view of Gil renders obvious *at least one structured mesh node's uplink radio comprising a connection to an external network* because Castagnoli teaches that a hierarchical wireless mesh network is connected to an external network, and Gil describes connecting a mesh network to an external network wirelessly. Ex.1003, ¶98.

Castagnoli notes that in a hierarchical wireless mesh network, "the routing nodes bridge wireless traffic onto a wired network at the top of the hierarchy," e.g., network 50. Ex.1005, [0007]. While the external network is described as "wired," Castagnoli does not describe whether the connection to the external network is itself wired or wireless. Gil explains that "network traffic devices (nodes)…can be provided with the ability to communicate with external networks," where "[t]he external network connection between the" node and external network "can comprise…a wireless connection." Ex.1008, 4:25-31; Ex.1003, ¶99.

Castagnoli further explains that "each root or leaf routing node can include all the essential physical functionality discussed above, and be configured to operate in a root or leaf routing mode (as appropriate), where the downstream/upstream synchronization functionality is disabled." Ex.1005, [0045]. This includes the node design described with respect to Figure 2, including the uplink and downlink radios discussed above with respect to limitation [1.3]. Ex.1003, ¶100.

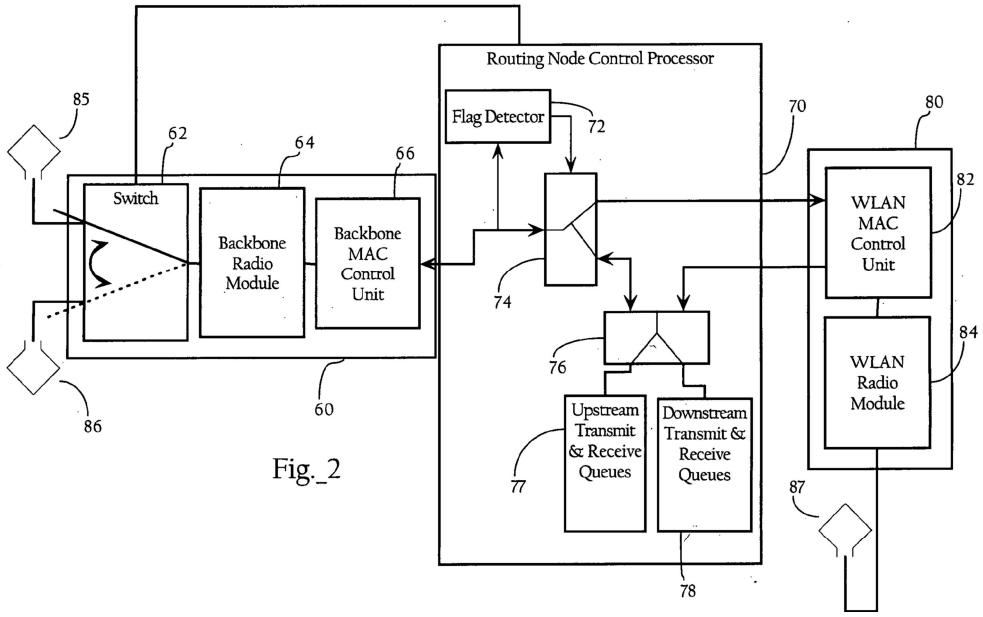
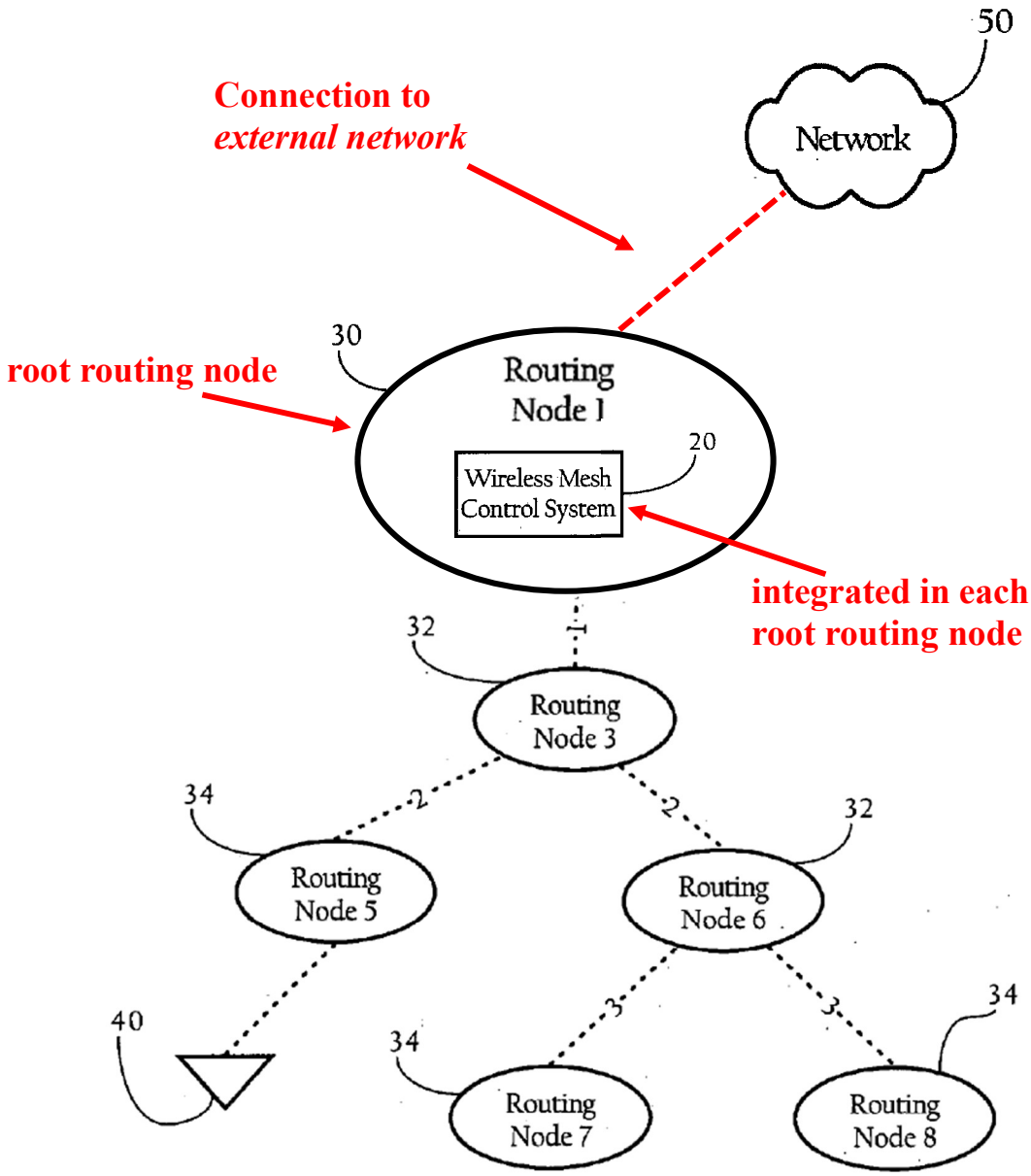


Fig._2

Ex.1005, Fig. 2.

Further, while Castagnoli explains that "upstream synchronization functionality is disabled" for the root routing node, this makes sense as the root routing node does not have a mesh network parent node that would require such upstream synchronization functionality. Ex.1005, [0045]; *see* Ex.1005, [0120] (discussing "maintaining timing synchronization with its parent node"), [0123] (the routing node enters a re-synchronization phase to re-acquire a parent node"). And as discussed above in Section XII.B.5, connecting to an external network using a wireless connection is a simple design decision that a POSITA would have been motivated to implement within Castagnoli's hierarchical wireless mesh network root routing nodes. Accordingly, in the combination, Castagnoli's root routing

nodes would utilize the respective uplink radios to connect with external networks, such as network 50, as reflected in Castagnoli's Figure 1. *See* Ex.1005, Fig. 1; Ex.1008, 4:25-31. Further, as noted above in [1.0], Castagnoli is clear that "the functionality of mesh network control system 20 may be integrated into other network devices, such as root routing nodes 30." Ex.1005, [0156]. Accordingly, in such implementations where the functionality of mesh network control system 20 is integrated into root routing nodes, the root routing nodes for each hierarchical wireless mesh network would directly connect to the external network, using a wireless connection as taught by Gil. *See* Ex.1008, 4:25-31; Ex.1003, ¶101.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶101.

Thus, Castagnoli renders obvious *in the first connected configuration* (hierarchical wireless mesh network connected to an external network) *the structured mesh network includes at least one structured mesh node's uplink radio comprising a connection to an external network* (the root node connects to an external network via its uplink radio unit). Ex.1003, ¶102.

[1.7] in the second isolated configuration none of the structured mesh nodes' uplink radio comprises a connection to an external network, and one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root node as isolated root children nodes forming a tree configuration;

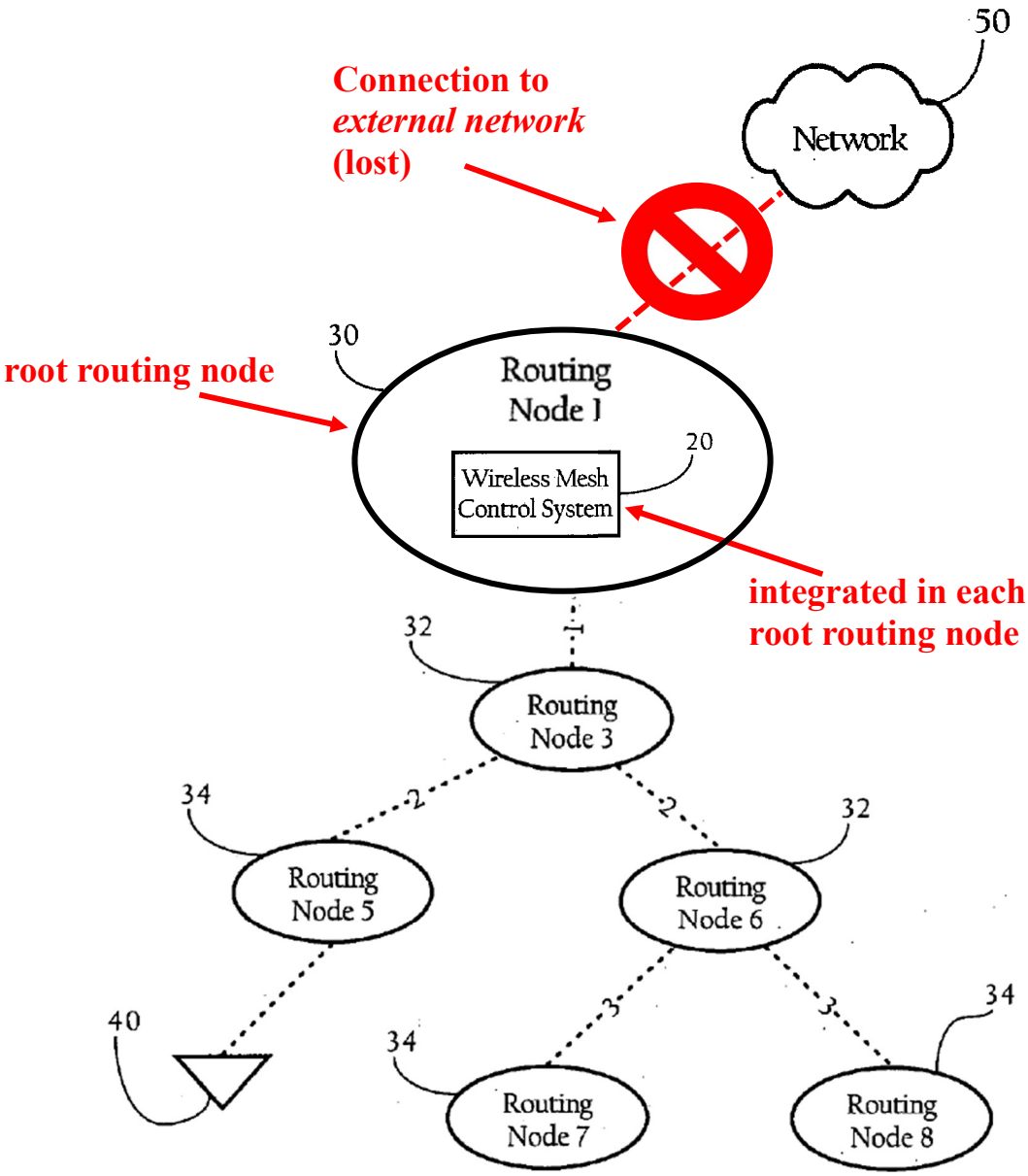
First, Castagnoli in view of Bauer renders obvious *the second isolated configuration* because in the combination, Castagnoli's wireless mesh hierarchy retains its structure and functionality between nodes and clients while maintaining operations when an external network connection is lost, as taught by Bauer. Ex.1003, ¶103.

As an initial matter, Castagnoli primarily focuses on "an efficient failure recovery mechanism in hierarchical wireless mesh networks" when synchronization is lost between a parent and child node. Ex.1005, Abstract, [0146]-[0147]. And Castagnoli notes "the overhead and delay associated with having a failure event propagate down the hierarchy are undesirable," extending time to recover from a failure event. Ex.1005, [0010]; Ex.1003, ¶104.

Bauer provides additional details for the continued operation of a mesh network in other failure events, explaining that when the mesh network is "disconnected from an Internet infrastructure," wireless clients such as "computing devices [] are capable of sending, receiving, and forwarding IP packets directly to other nodes." Ex.1006, [0023]. And as discussed above in Section XII.B.4, a POSITA would have been motivated to combine Castagnoli and Bauer to enable

continued operation of Castagnoli's hierarchical wireless mesh network when a connection to an external network is lost, per Bauer. Ex.1003, ¶105.

In this disconnected state, the wireless clients within Castagnoli's hierarchical wireless mesh network "communicate indirectly to other nodes through one or more intermediary nodes that relay the IP communications to the destination node," e.g., through routing nodes. Ex.1006, [0024]; *see also* Ex.1006, Abstract (nodes are configured to "provid[e] the IP services locally in the mesh network when the Internet infrastructure is not accessible"). As reflected in modified Figure 1 below, this would occur when a connection to network 50 is lost, such as due to a failure between root routing node 1 and the network 50 where the connection to the external network is lost for all routing nodes (i.e., *none of the structured mesh nodes' uplink radio comprises a connection to an external network*). Ex.1003, ¶¶106-107.



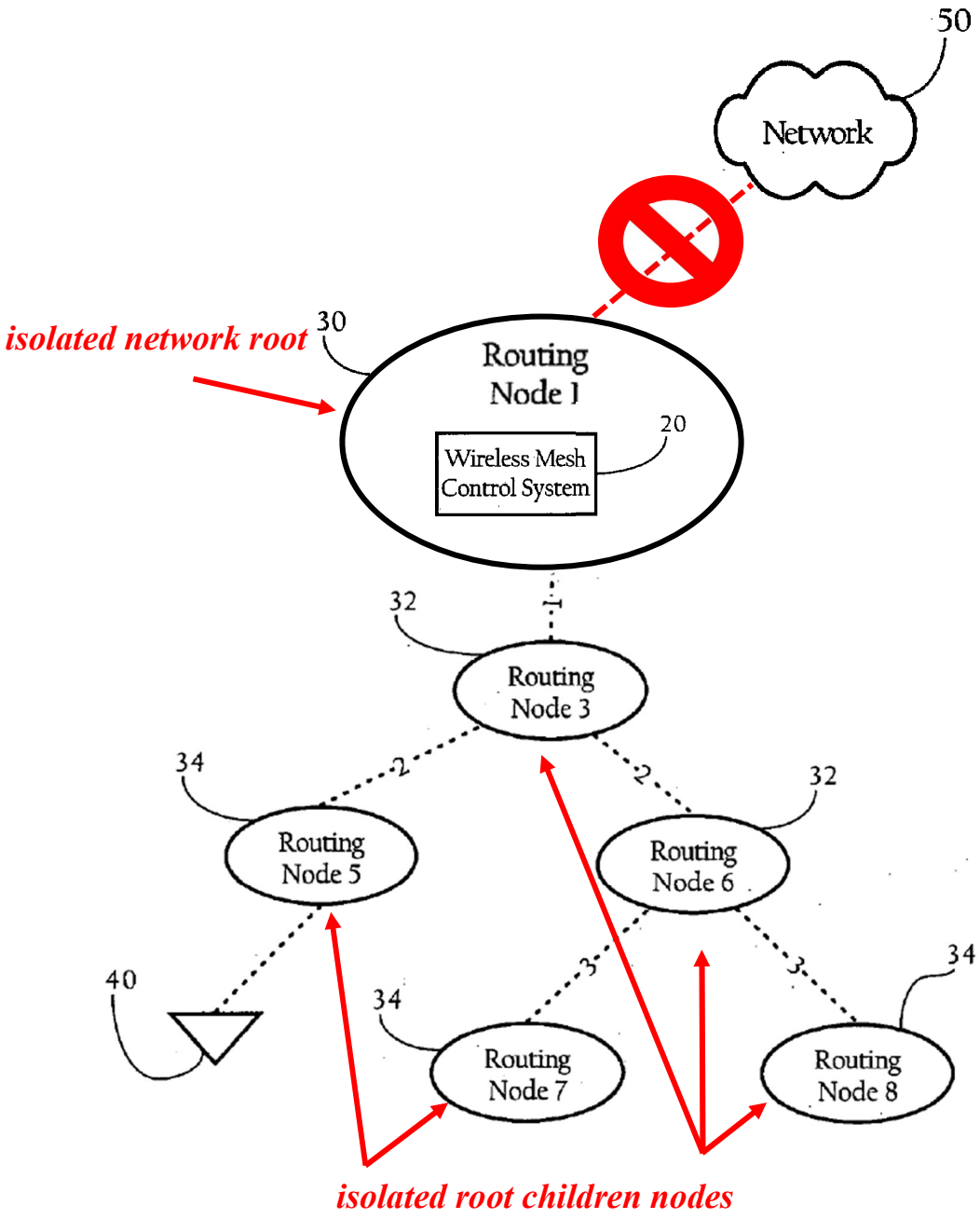
Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶106.

Second, Castagnoli in view of Bauer renders obvious *one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root node as isolated root children nodes forming a tree configuration* because Castagnoli teaches that the hierarchical wireless mesh network forms a "hierarchical tree structure" with "a

downstream direction towards leaf routing nodes 34, and an upstream direction toward the root routing nodes 30." Ex.1005, [0033]. Further, Bauer illustrates "dynamically switch[ing] to providing the IP services locally in the mesh network when the Internet infrastructure is not accessible" where the network maintains the same structure. Ex.1006, Abstract, Fig. 1 (disconnected wireless mesh network), Fig. 2 (connected wireless mesh network with the same structure as the disconnected wireless mesh network in Fig. 1); *see also* Ex.1006, [0002] (explaining that "many well known IP-based applications rely on centralized IP services such as the Network Time Protocol (NTP), the Domain Name System (DNS), and the Dynamic Host Configuration Protocol (DHCP)"), [0004] ("These centralized IP services are not always available in a wireless mesh network," e.g., when disconnected from the infrastructure). It would have been obvious to retain Castagnoli's hierarchical tree structure when the external network is not accessible because Castagnoli seeks to avoid the impacts of failure events within a hierarchical wireless mesh network. Ex.1005, [0010] (explaining that it is "undesirable" to have "a failure event propagate down the hierarchy"); Ex.1003, ¶108.

Annotated and modified Figure 1, below, provides an example of *the second isolated configuration*, where Castagnoli's hierarchical wireless mesh network does not have a connection with network 50. In the example below, root routing

node 1 *acts as an isolated network root of the isolated configuration*, retaining the same root routing node for the hierarchical wireless mesh network as in the connected configuration discussed in [1.6]. Further, each of the children nodes of routing node 1 *connect to the isolated network root node as isolated root children nodes*. Because root routing node 1 is not connected to the network 50, the root routing node and each of its children routing nodes do not have *a connection to an external network* through any of the respective nodes' *uplink radio*. The hierarchical wireless mesh network operates to provide IP services locally, per Bauer, until a connection to network 50 can be restored for root routing node 1. Ex.1003, ¶¶109-110.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶109.

[1.8] wherein clients of nodes of the structured network in a second isolated configuration retain full connectivity within the structured network during the isolated configuration and

Castagnoli in view of Bauer renders obvious this limitation because Castagnoli teaches that the hierarchical wireless mesh network is used in routing packets between wireless devices, and Bauer provides specific implementation details for maintaining such routing despite a lack of external network connectivity. Ex.1003, ¶111.

Specifically, Castagnoli explains that the hierarchical wireless mesh network "is used in routing packets between wireless clients 40." Ex.1005, [0033]. Similarly, Bauer teaches that wireless clients such as "Personal Computers (PCs), Personal Digital Assistants (PDAs), cellular telephones with IP capabilities, digital pagers," or other computing devices "are capable of sending, receiving, and forwarding IP packets directly to other" wireless clients when the mesh network is "disconnected from an Internet infrastructure." Ex.1006, [0023]. By allowing wireless clients to communicate with each other regardless of whether a connection to an external network exists, per Bauer, Castagnoli's wireless clients *retain full connectivity within the structured network during the isolated configuration*. Ex.1003, ¶¶112-113.

[1.9] wherein said client connectivity is uninterrupted during any transition from the isolated configuration to the first connected configuration;

Castagnoli in view of Bauer renders obvious this limitation because Bauer teaches that client connectivity is not interrupted by changes in the connection status to an external network. Indeed, Bauer illustrates that the network

composition remains the same between the disconnected wireless mesh network (Fig. 1) and connected wireless mesh network (Fig. 2), except for a connection between one or more nodes and the external network. *See* Ex.1005, Figs. 1, 2.

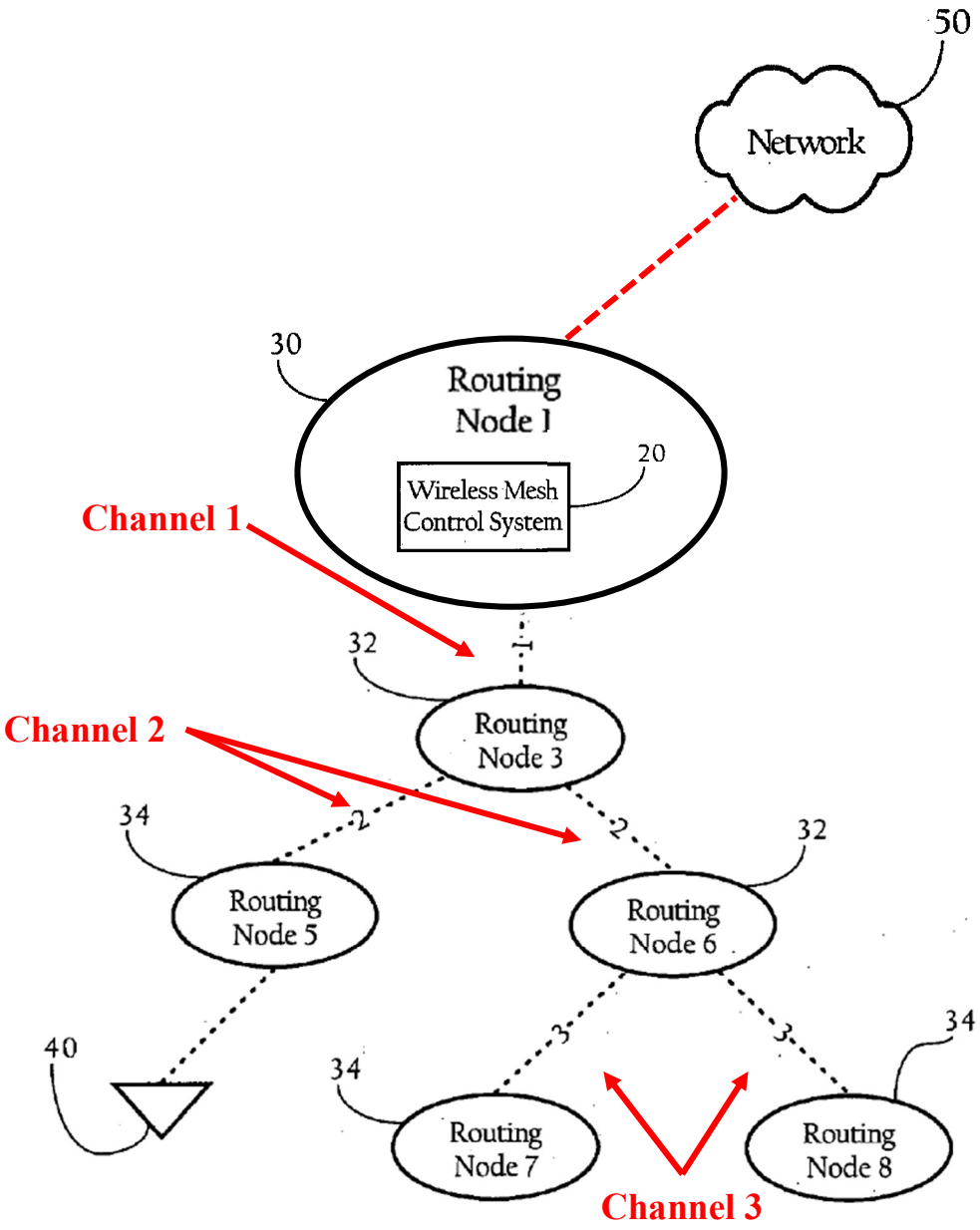
Bauer further explains that when the mesh network is reconnected to the internet, each of the client devices "may choose to resynchronize with the publicly available [Network Time Protocol] server 32 directly" for clock synchronization purposes. Ex.1006, [0036]. Synchronizing clocks after the network reconnection shows ongoing client connectivity, as the clients would communicate with the Network Time Protocol server to compare their clocks to the server's clock. *See* Ex.1006, [0036]. Alternatively, Bauer's statement that client devices "**may** choose" to resynchronize suggests that the devices may continue to send time queries to the Reported Node Time Server. Those continued queries sent between Bauer's mesh network devices also show that "*client connectivity is uninterrupted*." Ex.1003, ¶¶114-115.

[1.10] wherein distinct downlink frequencies are used by nodes for communication with one or more nodes lower on the tree configuration.

Castagnoli discloses or renders obvious this limitation because each routing node uses distinct channels for uplink and downlink communications with other nodes. Ex.1003, ¶116.

As reflected in annotated and modified Figure 1 below, Castagnoli teaches that "for a given routing node, the operating channel for upstream data transfer, in

one implementation, is different than the operating channel used for downstream data transfer" for the wireless hierarchical mesh network. Ex.1005, [0035]. For instance, "wireless transmissions between routing node 1 and routing node 3 occur on channel 1, while routing node 3 communicates with routing node 5 and routing node 6 on channel 2." Ex.1005, [0035]. Accordingly, each of routing nodes 1, 3, and 6 use *distinct downlink frequencies* for data transfer with respective child nodes in the wireless hierarchical mesh network with root routing node 1. Similarly, each of routing nodes 2 and 4 use *distinct downlink frequencies* for data transfer with respective child nodes in the wireless hierarchical mesh network with root routing node 2. In both cases, no channels are repeated or reused as downlink frequencies for any other routing nodes, as reflected in Figure 1, below. Ex.1003, ¶¶117-118.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶117.

7. Claim 18

[18.0] The structured mesh network of claim 1 wherein each network node further comprises a DHCP server used to assign addresses to client devices communicating with the node using the node's downlink radio.

Bauer describes how a mesh network operating without an external network

connection provides DHCP services by having each of the mesh nodes act as a DHCP server to DHCP clients. Ex.1006, [0056]. Specifically, Bauer explains that there is "DHCP service on each mesh node" such that when a device "operat[ing] as a DHCP client" enters a mesh network, "mesh nodes 2-4 act as DHCP servers, responding to DHCP client requests 112 from" the device entering the mesh network. Ex.1006, [0056], [0055] ("DHCP client"). Each of Castagnoli's routing nodes implementing Bauer's teaching of mesh nodes providing a DHCP service to DHCP clients renders obvious *each network node further comprises a DHCP server used to…to client devices*. Ex.1003, ¶¶119-120, 122.

Using DHCP to assign IP addresses to clients was well-known in the art. Ex.1006, [0003] ("Nodes also use the DHCP service to set IP addresses"). Thus, a DHCP server in each mesh node that provides DHCP services to DHCP clients such as setting IP addresses renders obvious *a DHCP server used to assign addresses to client devices*. Ex.1003, ¶¶121-122.

It would have been obvious to a POSITA for a mesh node to provide DHCP services to a client *communicating with the node using the node's downlink radio* because clients communicate with a mesh node via the node's downlink radio, as discussed above at [1.4]. Ex.1003, ¶123.

The DHCP service is an example of an IP service. Ex.1006, [0002]. As discussed in Section XII.B.4 above, a POSITA would have been motivated to

combine Castagnoli and Bauer to implement Bauer's teachings of providing IP services locally when Castagnoli's hierarchical wireless mesh network loses connection to the external network 50. Ex.1003, ¶¶124-125.

8. Claim 35

[35.0] A structured mesh network capable of isolated operation, comprising:

See [1.0]. Ex.1003, ¶¶126-127.

[35.1] at least two structured mesh nodes;

See [1.1]. Ex.1003, ¶¶126, 128.

[35.2] wherein each structured mesh node comprises at least a connectivity logic

See [1.2]. Ex.1003, ¶¶126, 129.

[35.3] and a radio operating on an uplink frequency and a distinct downlink frequency;

First, Castagnoli discloses that its wireless mesh nodes comprise *a radio* because Castagnoli illustrates an implementation where "[t]he routing nodes in the mesh network…include one radio[.]" Ex.1005, [0034]. Figure 2 below shows that Castagnoli's wireless mesh nodes include a wireless backbone interface unit 60, which includes a backbone radio module 64. Ex.1005, [0034]. The wireless backbone interface unit 60 also includes "a single omni-directional antenna" or two antennas, a "[f]irst antenna 85…for data transfer with a parent routing node, [and a] second antenna 86…for transfer with one or more child routing nodes." Ex.1005, [0038], [0042]; Ex.1003, ¶¶130-131.

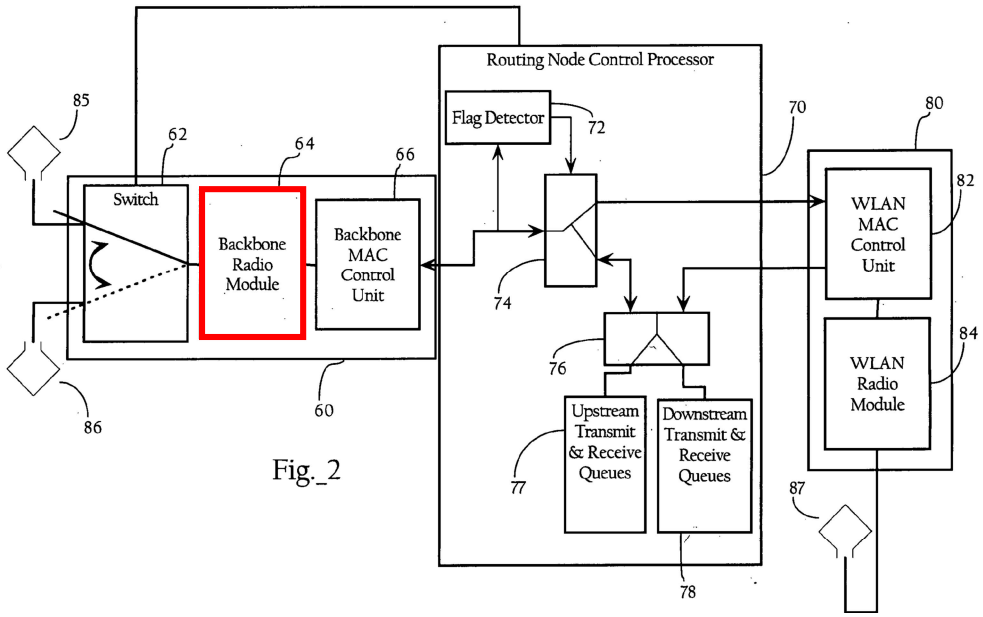
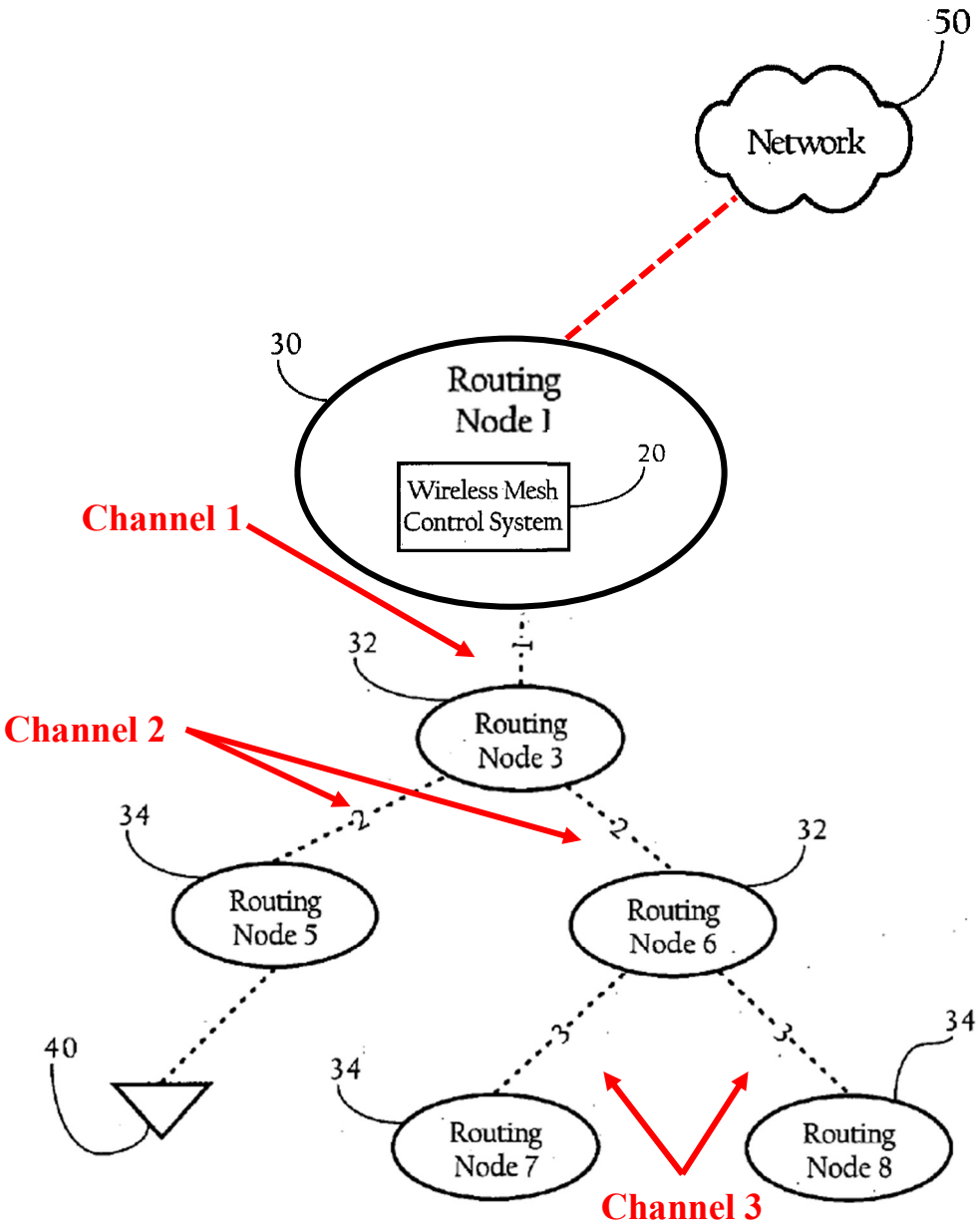


Fig._2

Ex.1005, Fig. 2 (annotated); Ex.1003, ¶131.

Second, Castagnoli's wireless mesh node radio operates *on an uplink frequency* and *on a distinct downlink frequency* respectively because Castagnoli explains that each routing node uses different, non-overlapping channels for upstream data transfer and downstream data transfer. Specifically, Castagnoli describes that "for a given routing node, the operating channel for upstream data transfer…is different than the operating channel used for downstream data transfer," as illustrated in modified Figure 1 below. Ex.1005, [0035]. Further, "the upstream and downstream channels assigned to a given routing node are non-overlapping channels." Ex.1005, [0035]; *see also* XII.B.6.[1.3]; Ex.1003, ¶132.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶132.

Thus, Castagnoli discloses or renders obvious *a radio operating on an uplink frequency* (a radio is used as a backhaul to its parent routing node on one channel) *and a distinct downlink frequency* (the radio also provides service to clients and child routing nodes on a different, non-overlapping channel). Ex.1003,

¶133.

[35.4] wherein the connectivity logic determines whether each structured mesh node connects with an external network or another node on the uplink frequency and client devices or other mesh nodes connect to each node on the downlink frequency;

Limitation [35.4] is the same as limitation [1.4] except for the use of "frequency" rather than "radio," and would have been obvious for the reasons discussed above. Ex.1005, [0007]; Ex.1003, ¶134.

[35.5] wherein the connectivity logic in each node contains a distributed routing table;

Castagnoli explains that each of its routing nodes "maintains a table of routing nodes in the adjacency data structure" (*contains a distributed routing table*). Ex.1005, [0072]. These routing tables maintain information based on information passed in "neighbor response packets" and maintains information about possible parent nodes as well as "whether any child nodes have been added or deleted[.]" Ex.1005, [0059], [0063]-[0064]; *cf.* Ex. 1001, 3:15-19. Further, this information would have been maintained in the routing node control processor of each respective node (*the connectivity logic in each node*) because Castagnoli explains that the routing node control processor includes "hardware modules (e.g., processor, memory), software modules (e.g., drivers, etc.) and **data structures** (e.g., frame buffers, queues, etc.) **that control operation of the routing node**." Ex.1005, [0041]; Ex.1003, ¶¶135-137.

[35.6] wherein the structured mesh network functions in two configurations selected depending on whether a connection to an external network is present;

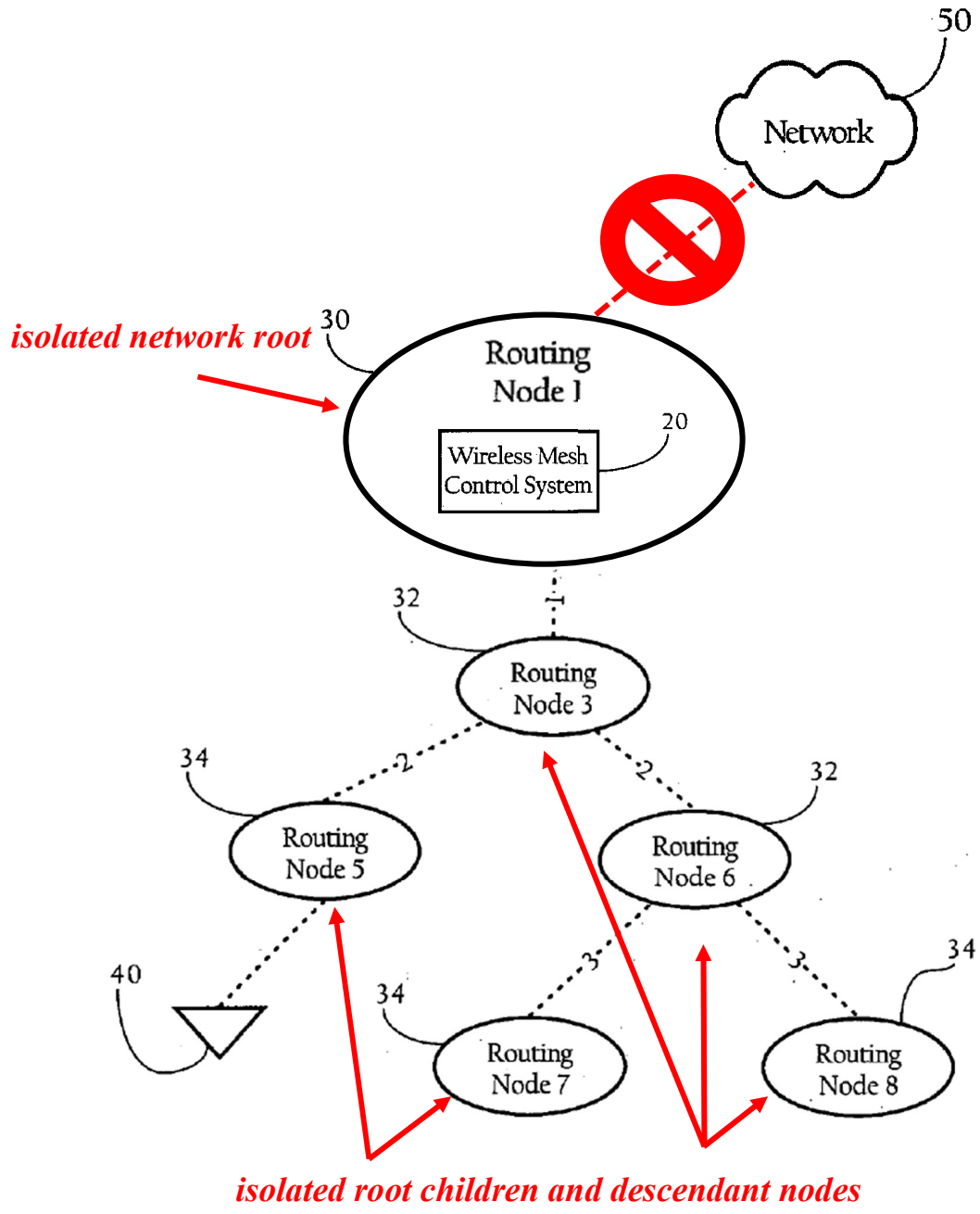
See [1.5]. Ex.1003, ¶¶126, 138.

[35.7] in the first connected configuration the structured mesh network includes at least one structured mesh node's uplink connection comprising a connection to an external network; and

Limitation [35.7] is substantially similar to limitation [1.6] except for the use of "uplink connection" rather than "uplink radio," and would have been obvious for the reasons discussed above. Ex.1005, [0007]; Ex.1003, ¶139.

[35.8] in the second isolated configuration none of the structured mesh nodes' uplink connections comprises a connection to an external network, and one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root node as isolated root children and descendant nodes forming a tree configuration;

Limitation [35.8] is substantially similar to limitation [1.7], except it recites "connections" instead of "radio" and contains additional language regarding "descendent nodes." The analysis provided for claim 1 with respect to the routing nodes' uplink and downlink radios is applicable to the recited "connections" in claim 35. Additionally, as explained at [1.7] and reflected in modified Figure 1 below, Castagnoli's root routing node 30 connects to the other routing nodes in the hierarchical wireless mesh network either directly, *as isolated root children*, or indirectly, as *descendant nodes* of the direct child nodes. Ex.1003, ¶140.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶140.

Accordingly, limitation [35.8] and would have been obvious for the reasons discussed above with respect to limitation [1.7]. Ex.1003, ¶141.

[35.9] wherein clients of the at least two structured mesh nodes in a second isolated configuration retain full connectivity within the structured network during the isolated configuration and

Limitation [35.9] is substantially similar to limitation [1.8], except it recites "the at least two structured mesh nodes" instead of "nodes of the structured network." Because the recited "nodes of the structured network" in limitation [1.8] refers to "at least two structured mesh nodes," limitation [35.9] would have been obvious for the reasons discussed above with respect to limitation [1.8]. Ex.1003, ¶142.

[35.10] wherein said client connectivity is uninterrupted during any transition from the isolated configuration to the first connected configuration;

See [1.9]. Ex.1003, ¶¶126, 143.

[35.11] wherein distinct downlink frequencies are used by nodes for communication with one or more nodes lower on the tree configuration.

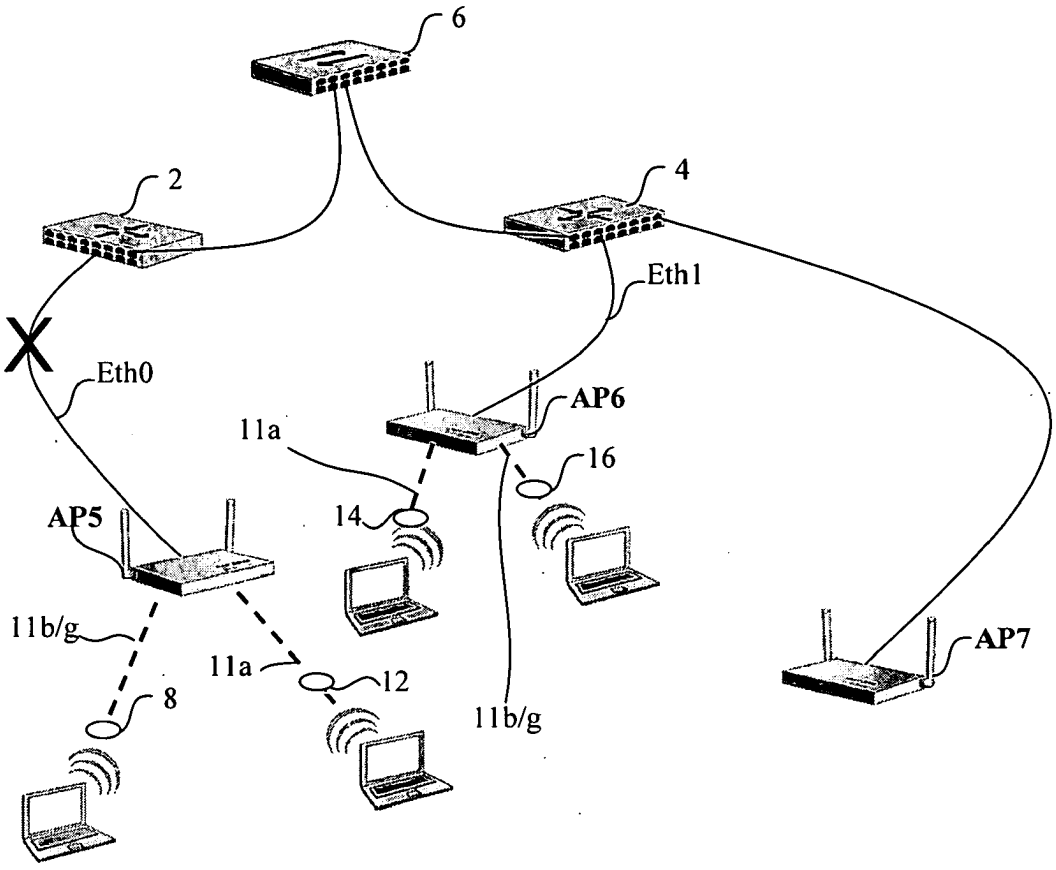
See [1.10]. Ex.1003, ¶¶136, 144.

C. Ground 2

1. Zeng

Zeng details "[a] method and corresponding system for providing for recovering from a failure" of an external network link "used for communication between the first access point and a wired network." Ex.1007, Abstract. More specifically, Zeng contemplates "a known backhaul network topology 10 for connecting all access points in a wireless access network to a backhaul network,"

where access points at the top of the network hierarchy "each have a wired backhaul connection to an external backhaul network, such as a local area network (LAN) or the Internet." Ex.1007, [0002]. Zeng's Figure 4, below, "illustrates an exemplary failure state prior to recovery" of a network where "[t]he wired link between a first access point AP5 and a backhaul switch 2 of the wired backhaul network is lost…such that there is no path between AP4 and the wired network." Ex.1007, [0019], Fig. 4; Ex.1003, ¶¶145-146.



Ex.1007, Fig. 4.

When "a determination is made [that] the wired link is lost, indicating there may be failure," Zeng explains that one of the "radio[s] of the first access point is reconfigured in a backhaul mode[.]" Ex.1007, [0028]. The access point "broadcast[s] a request for backhaul connectivity to neighboring APs," "detects whether any neighboring AP responds to the backhaul connectivity request," and "selects a responding neighboring AP based on at least one predetermined criteria." Ex.1007, [0030]-[0032]. A wireless link is established between the access point and a suitable neighbor to establish "a communication path to the wired network via a first radio wireless link, a second radio wireless link, and selected neighboring access point's wired link." Ex.1007, [0036]; Ex.1003, ¶147.

2. Reasons to Combine Castagnoli, Bauer, Gil, and Zeng

A POSITA would have combined Castagnoli, Bauer, and Gil with Zeng because each of the references relates to networking, and more specifically, to different failure situations faced by wireless networks. Castagnoli provides recovery mechanisms for when a mesh network experiences a failure of a connection between two nodes of the network. Ex.1005, Abstract. Bauer teaches mesh network operation when the connection to an external network is not present, e.g., when the connection is lost. Ex.1006, Abstract. Gil provides further implementation details regarding the connection of a mesh network to an external network, explaining that such connections can be a wired connection or a wireless

connection. Ex.1008, 4:29-31. And Zeng provides a method of recovering from failure of a link to an external network, e.g., when a second connected network is available to provide a communications path. Ex.1007, Abstract; Ex.1003, ¶148.

A POSITA would have been motivated to combine the teachings of Castagnoli and Bauer with Zeng and doing so would have been within the POSITA's skillset. The combination would have been obvious because it represents merely the use of a known technique (enabling a radio for backhaul communications when a node loses its external network connection) to improve similar devices (Castagnoli's hierarchical wireless mesh network) in the same way (enabling Castagnoli's root routing nodes to utilize uplink radios to search for an external network, per Zeng) to yield predictable results. Castagnoli provides extensive disclosure about mesh network operation and failure recovery, but focuses on node-to-node failures. Ex.1005, [0010], [0146]-[0150]. And while Bauer provides details regarding maintaining network operations when a connection is lost, Bauer does not focus on restoring the lost external network connectivity. Ex.1006, Abstract, [0023]-[0025]. Gil teaches that external network connections can be wired or wireless. Ex.1008, 4:29-31. Zeng in turn provides recovery methods for a node when an external network link failure occurs. Ex.1007, Abstract, [0026]-[0036]; Ex.1003, ¶149.

In the combination, Castagnoli's hierarchical wireless mesh network would

maintain operations while implementing Bauer's teachings regarding the provision of IP services locally when a connection is lost at the root node, as discussed above in Section XII.B.4. Further, when a connection is lost at the root node, the root node would use its uplink radio and search for another network to provide additional communication paths and connectivity to child nodes. Ex.1003, ¶150.

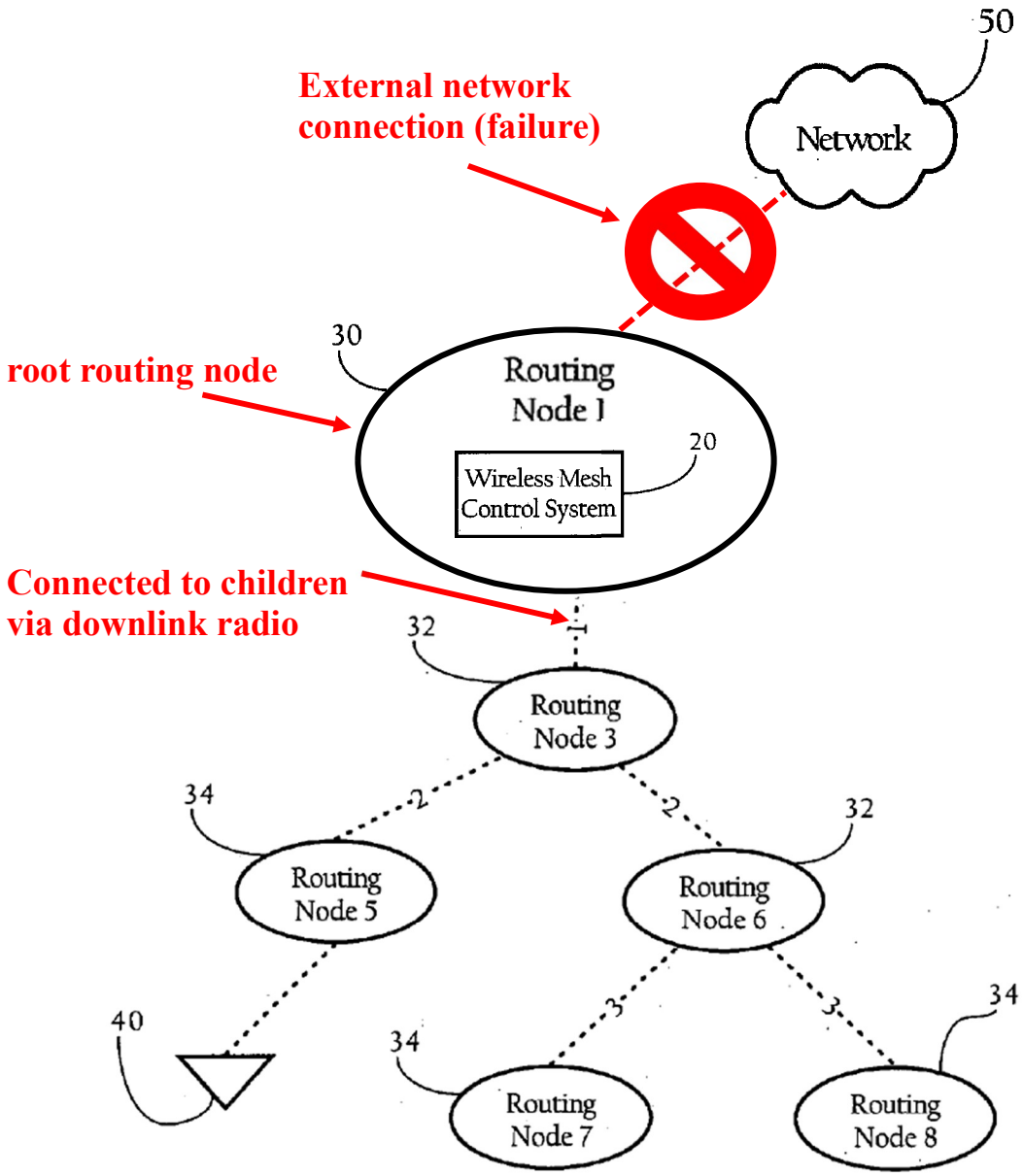
A POSITA would have had a reasonable expectation of success in combining Castagnoli, Bauer, Gil, and Zeng because the teachings of Castagnoli, Bauer, and Zeng are complimentary; each providing handling for different failure events within a network, and Gil merely provides additional implementation details regarding the external network connections contemplated by each of Castagnoli, Bauer, and Zeng. Further, the teaching of Castagnoli, Bauer, Gil, and Zeng focus on different aspects of a network: Castagnoli describes routing node operation and connectivity to parent routing nodes; Bauer describes dynamically switching to providing IP services locally or through Internet infrastructure, depending on the connectivity to the external network; Gil provides additional teachings regarding the mechanisms for connecting a mesh network to an external network; and Zeng focuses on the operation of a node that loses its wired connection to an external network. As such, a POSITA would have recognized how Zeng's teachings of recovering from a failure of a connection to an external network would apply to Castagnoli's hierarchical wireless mesh network, for both wired and wireless

connections that may be utilized, per Gil. Additionally, such combination would be desirable because it would allow for the root routing node within Castagnoli's hierarchical wireless mesh network to seek out and connect to another network when its external network connection fails, allowing for the continued provision of wireless network access to children nodes. Ex.1003, ¶151.

3. Claim 9

[9.0] The structured mesh network of claim 1 wherein the connectivity logic contained by the nodes realigns connections between the nodes upon detection of an external network connection to form the connected configuration.

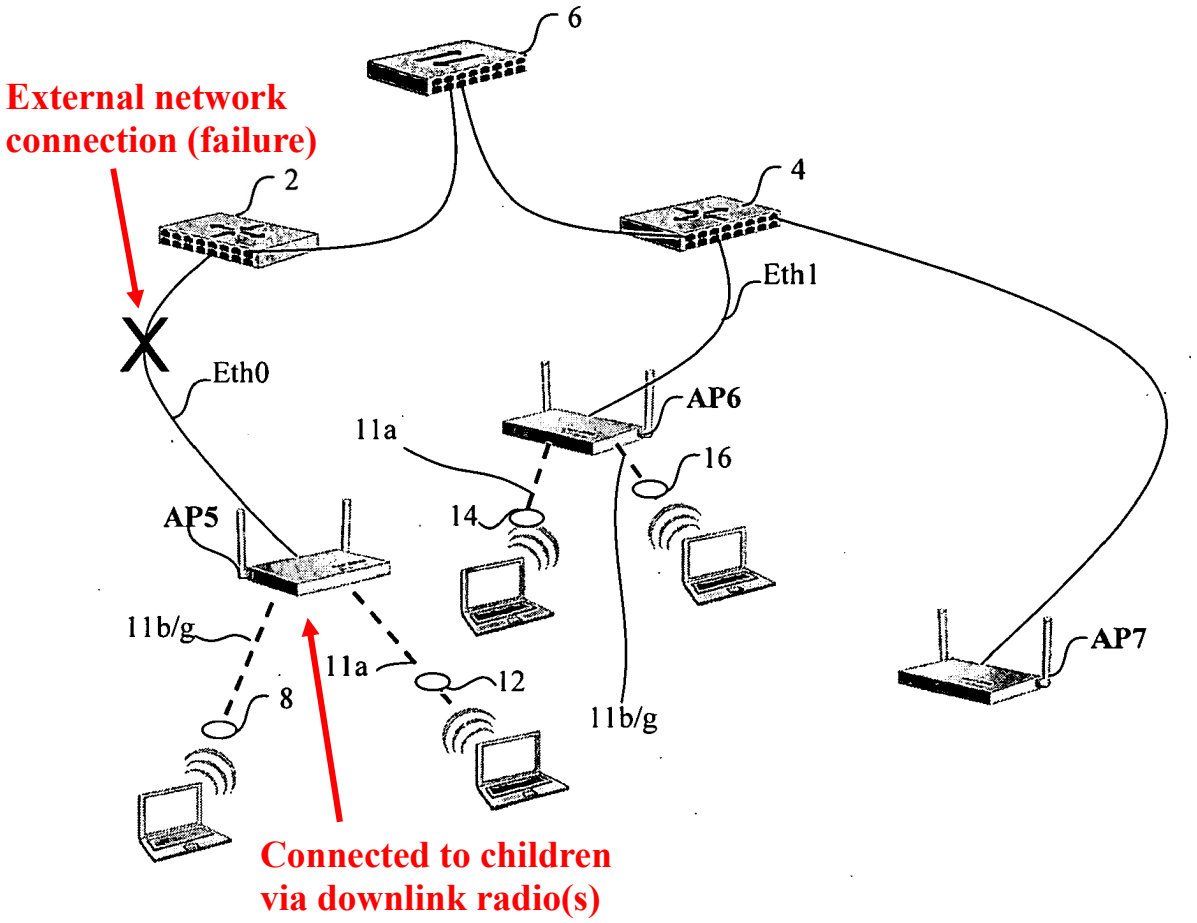
As discussed at [1.2], each of Castagnoli's routing nodes includes a routing node control processor (*connectivity logic contained by the nodes*). And modified Figure 1, below, provides an example of Castagnoli's hierarchical wireless mesh network, where root routing node 1 loses its connection to network 50, e.g., due to failure of its connection to the external network. *See* [1.7] (discussing a disconnected state in Castagnoli's hierarchical wireless mesh network). More specifically, as noted above in [1.0], Castagnoli's Figure 1 shows two different hierarchical wireless mesh networks—a first mesh network with root routing node 1, and a second mesh network with root routing node 2. Ex.1003, ¶¶152-153.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶153.

Likewise, Zeng contemplates a scenario where an access point loses its connection to an external network. Zeng's Figure 4, below, "illustrates an exemplary failure state prior to recovery" where the "link between a first access point AP5 and a backhaul switch 2 of the wired backhaul network is lost…such that there is no path between AP4 and the wired network." Ex.1007, [0019], Fig. 4.

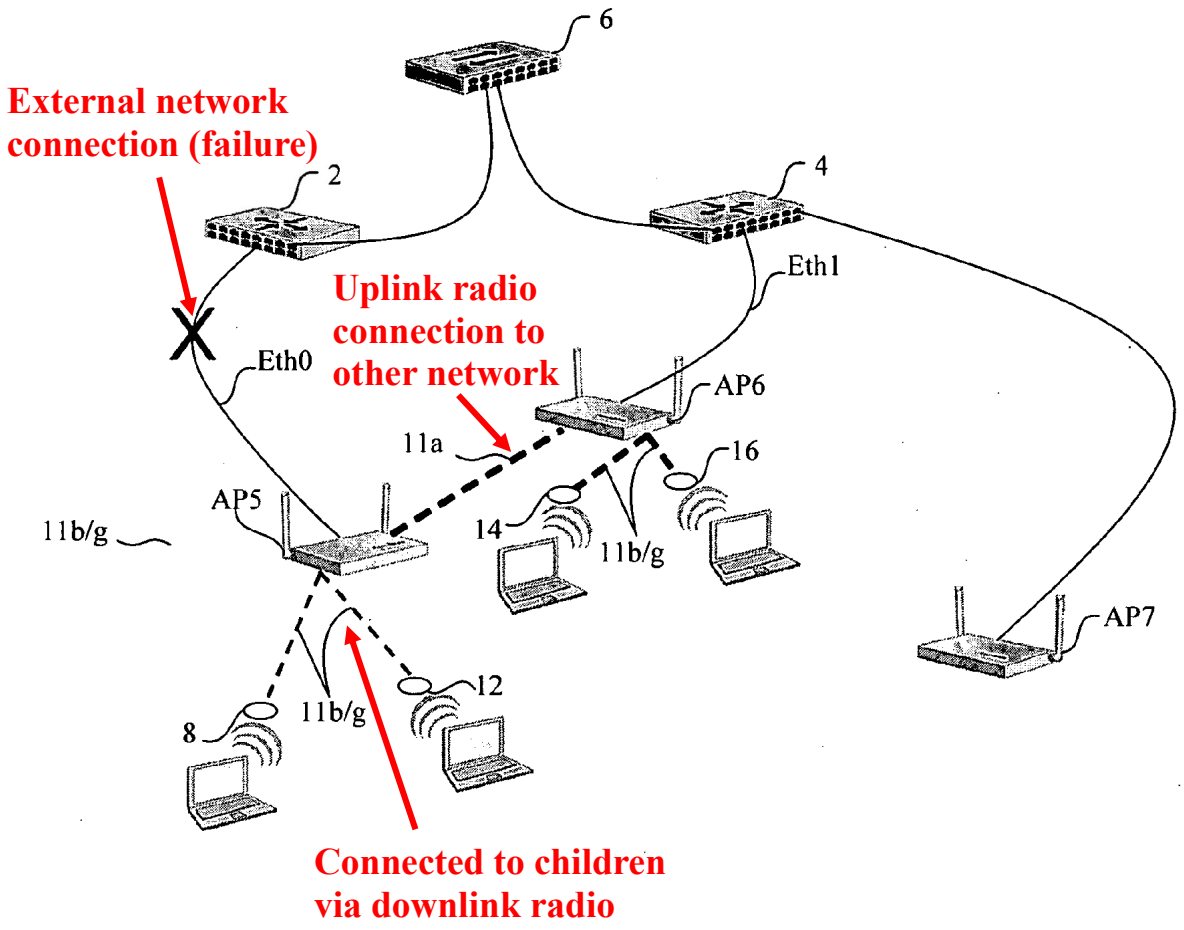
Like Castagnoli's Figure 1 above, Zeng's Figure 4 below shows multiple networks—a first network with root access point 5 (left side), a second network with root access point 6 (middle), and a third network with root access point 7 (right side). Ex.1003, ¶154.



Ex.1007, Fig. 4 (annotated); Ex.1003, ¶154.

Zeng teaches "recovering from a failure of a wired link." Ex.1007, Abstract. Zeng explains that "a determination is made whether the wired link [from an access point] is lost, indicating there may be failure." Ex.1007, [0027]. If a failure

is detected, the access point reconfigures a radio in backhaul mode and "broadcast[s] a request for backhaul connectivity to neighboring APs." Ex.1007, [0028], [0030]. When an acceptable neighboring access point is found, a wireless link between the two access points is established which "enables AP5 to detect the wired network connected to AP6." Ex.1007, [0035]. As reflected in Figure 5 below, connection 11a between AP5 and AP6 allows for a communication path from AP5 and its children to the wired network, despite the failure of AP5's wired link Eth0. Ex.1007, [0035]-[0036]; Ex.1003, ¶155.



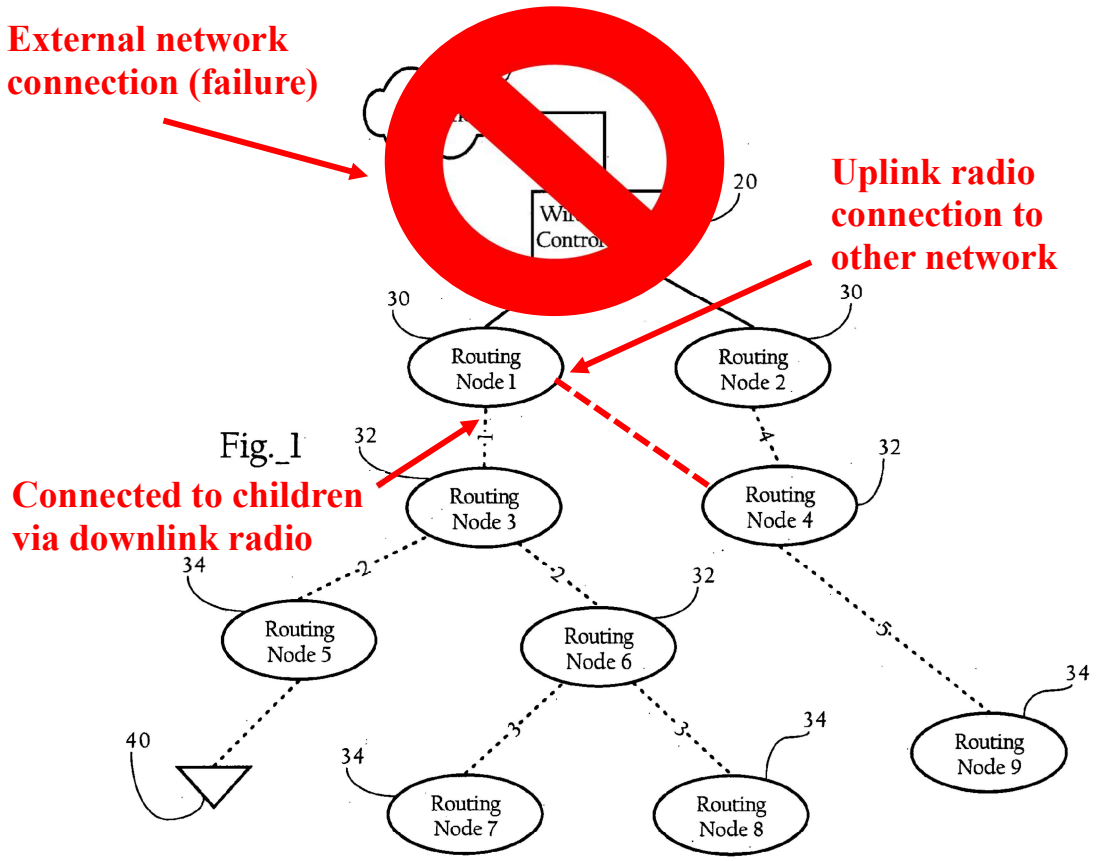
Ex.1007, Fig. 5 (annotated); Ex.1003, ¶155.

While Zeng specifically contemplates the loss of a wired connection, as discussed above in §XII.C.2, a POSITA would have been motivated to implement Zeng's teachings in scenarios where a root node loses its connection to an external network, regardless of whether the connection is wired or wireless. Ex.1003, ¶156.

In the combination, Castagnoli implements Zeng's teaching of enabling an uplink radio to search for and connect to other networks when a node's connection to an external network is lost. Indeed, Castagnoli explains that root routing nodes

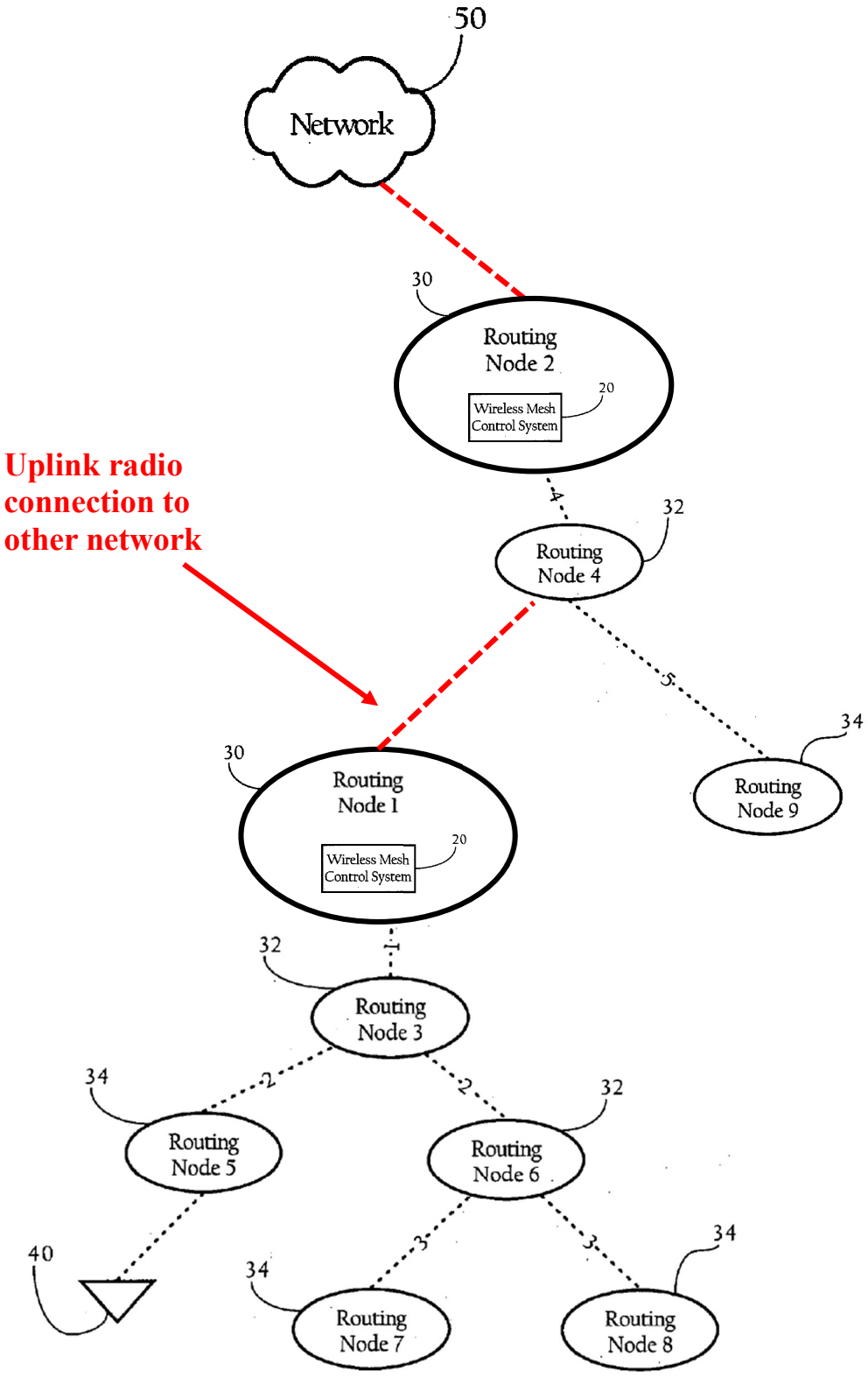
"include all the essential physical functionality discussed" with respect to each of the routing nodes in the network, where unused functionality is disabled. Ex.1005, [0045]. Accordingly, such nodes include the capability of being used for backhaul purposes, such as Zeng contemplates, in situations where the root node loses its connection to network 50. By connecting with another network (e.g., as reflected in annotated Figure 1[4] of Castagnoli, below), the hierarchical wireless mesh network *form[s] the connected configuration* because it is connected to the network 50 via the backhaul connection to routing node 4, which is in turn connected to root node 2 and network 50. Ex.1003, ¶157.

[4] While annotated Figure 1 below shows wireless mesh control system 20 under the crossed out connection to the external network, as discussed above in [1.0], the wireless mesh control system would be integrated into each routing node. Figure 1 is presented below in an unmodified form for purposes of clarity regarding the relationship between the two hierarchical wireless mesh networks.



Ex.1005, Fig. 1 (annotated); Ex.1003, ¶157.

As Dr. Hansen explains, modified Figure 1 of Castagnoli, below, provides a logical representation of the combined hierarchical wireless mesh network after root routing node 1 connects to a routing node within the second hierarchical wireless mesh network, such as routing node 4. Ex.1003, ¶158.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶158.

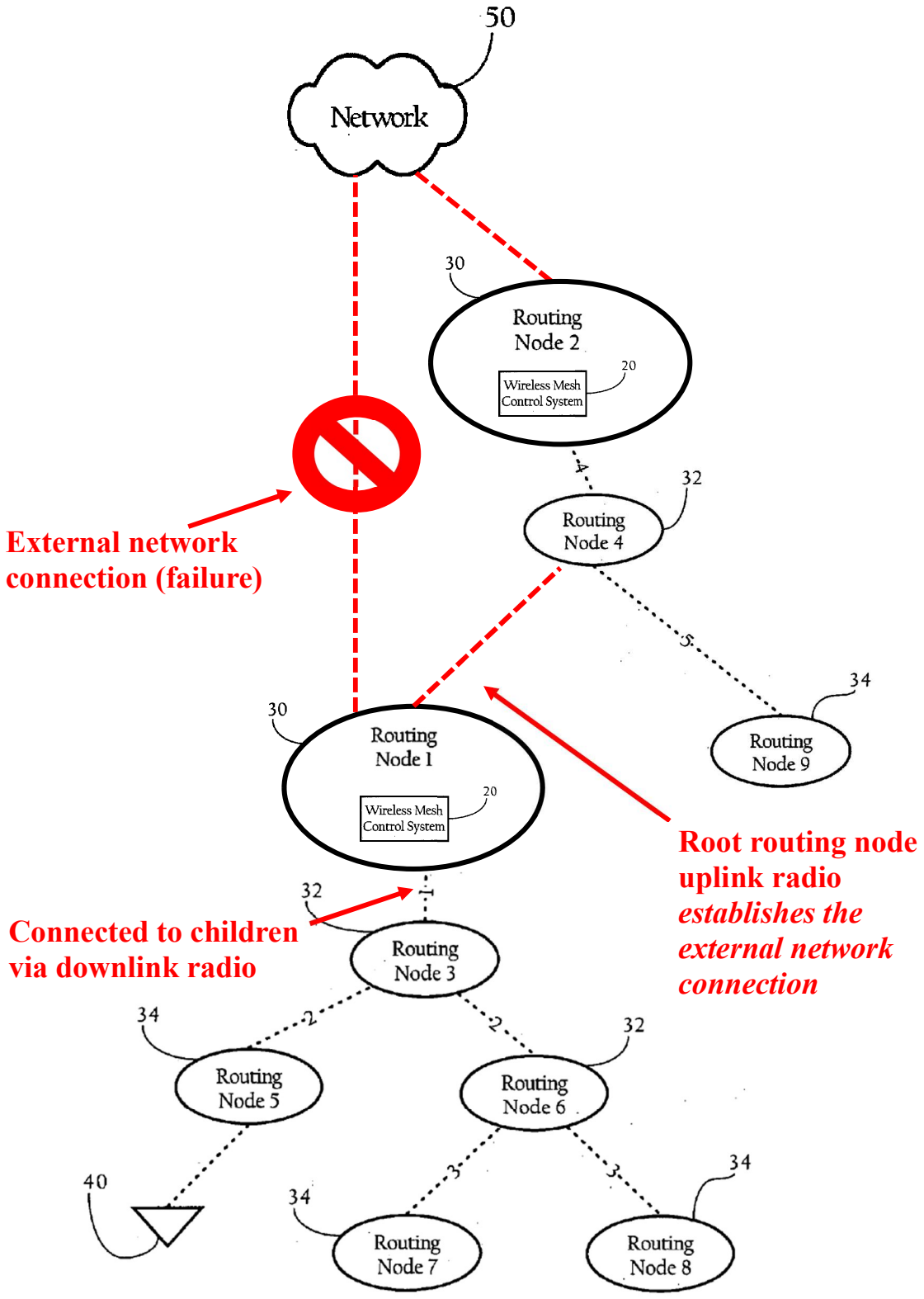
As discussed at [1.4], Castagnoli renders obvious that *the connectivity logic contained by the nodes* determines the connections between the nodes because each node's routing node control processor controls the operation of its routing node. *See also* Ex.1005, [0036], Claims 10-11, 14. By implementing Zeng's teachings to search for (*detection of an external network connection*) and connect to another hierarchical wireless mesh network (*to form the connected configuration*), the routing node control processor of the root routing node *realigns connections between the nodes*. Ex.1003, ¶¶159-160.

4. Claim 10

[10.0] The structured mesh network of claim 9 wherein solely the isolated network root node logic searches for the external network connection and establishes the external network connection.

It would have been obvious that in the combination, *solely the isolated network root node logic searches for the external network connection* because Zeng teaches that the node which loses its connection to the external network is the node that *searches for the external network connection*. More specifically, Zeng explains that when a node loses its external network link, it configures a radio for backhaul and broadcasts requests for backhaul connectivity to neighboring nodes. Ex.1007, [0027]-[0030]. Because only one node within the wireless network is connected to an external network (i.e., root routing node 1 for Castagnoli's first hierarchical wireless mesh network discussed in claim 9, above), and Zeng teaches

that the node that loses its external network link searches for another network, the combination renders obvious that *solely the isolated network root node logic searches for the external network connection*. And as discussed above at [9.0], the root routing node further *establishes the external network connection* by connecting to another network using its uplink radio. Ex.1003, ¶¶161-163.

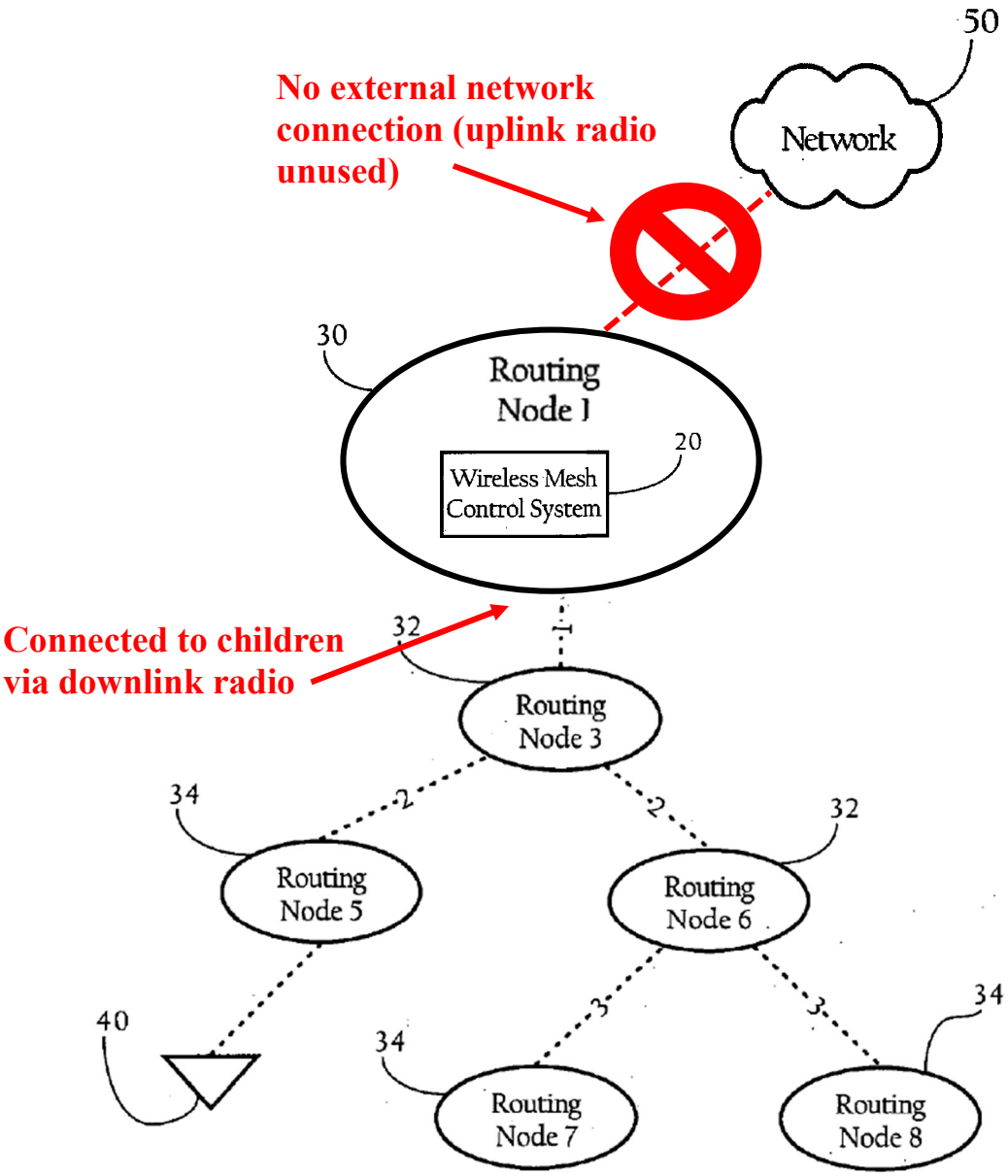


Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶162.

5. Claim 11

[11.0] The structured mesh network of claim 10 wherein the previously unused uplink radio of the isolated network root node is used to connect to the external network.

Castagnoli further renders obvious that the uplink radio of root routing node 1 is a *previously unused uplink radio of the isolated network root node*. More specifically, when operating in the isolated configuration (as discussed in [1.7] above), Castagnoli's root routing node is not connected to an external network and the hierarchical wireless mesh network is instead providing IP services locally, per Bauer. Ex.1006, Abstract, [0023], Fig. 1; *see also* Ex.1005, [0010], [0033]; Ex.1006, [0002]. Instead, as reflected in Castagnoli's modified Figure 1, the root routing node is connected to children via its downlink radio, while the uplink radio is *unused* because it does not have a connection to the external network or other APs. Ex.1005, Fig. 1; Ex.1003, ¶¶164-166.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶166.

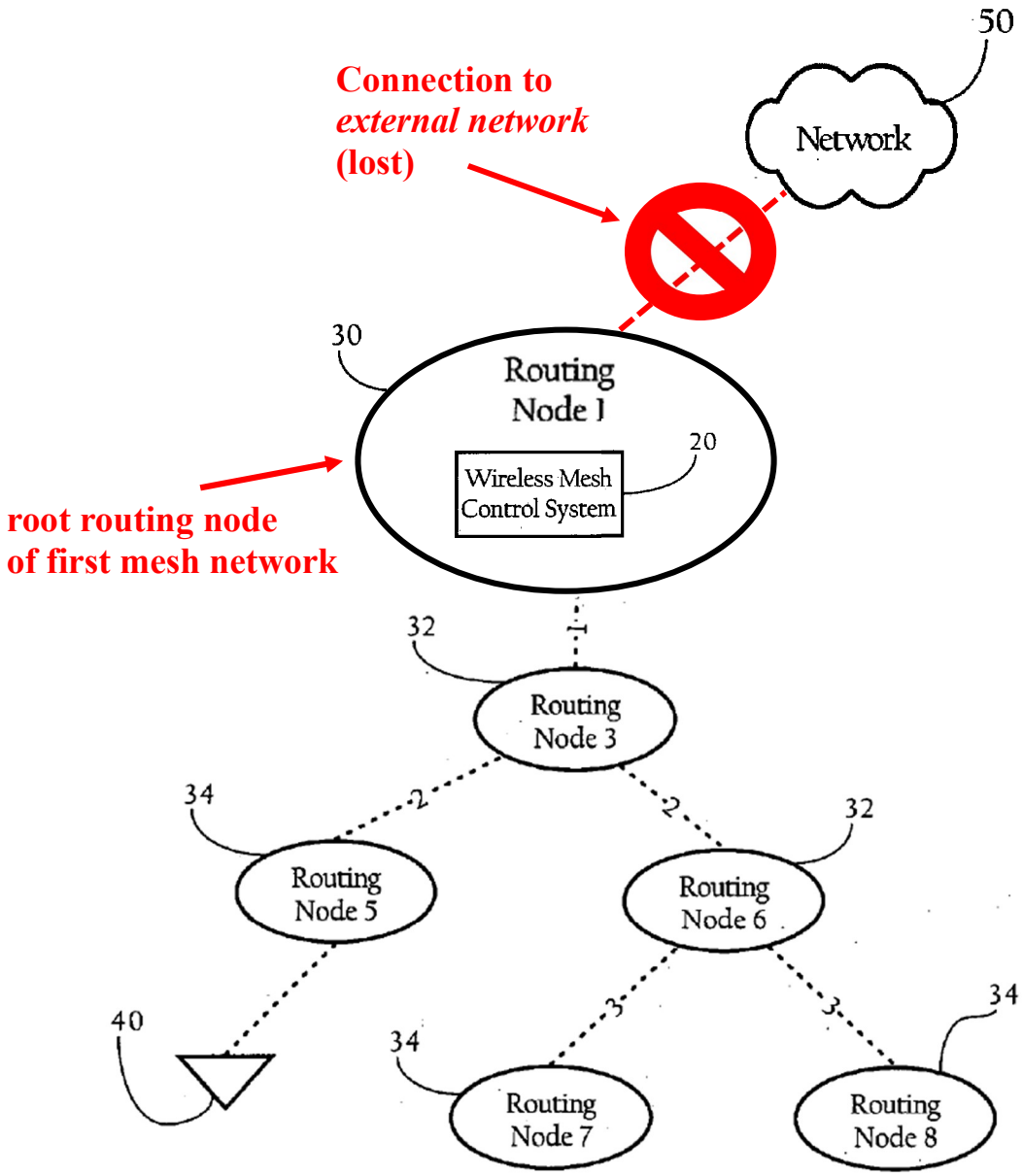
Further, Zeng teaches enabling an uplink radio and using it for backhaul to connect to another network when an external network connection fails. Ex.1007, [0028], [0030]. Accordingly, in the combination, Castagnoli's root routing node 1 (*the isolated network root node*) would enable its unused uplink radio (*the previously unused uplink radio*) and search for and connect to a second hierarchical

wireless mesh network, per Zeng (*is used to connect to the external network*). Ex.1003, ¶¶167-169.

6. Claim 15

[15.0] The structured mesh network of claim 1 wherein a first mesh network in the isolated configuration comprises an isolated root node and one or more isolated children nodes and

As discussed at [1.7], Castagnoli in view of Bauer renders obvious *a first mesh network* (Castagnoli's hierarchical wireless mesh network with root routing node 1) *in the isolated configuration* (operating where the connection is interrupted between root routing node 1 and network 50) *comprises an isolated root node* (root routing node 1) *and one or more isolated children nodes* (e.g., routing nodes 3 and 5-8). Ex.1003, ¶¶170-172.

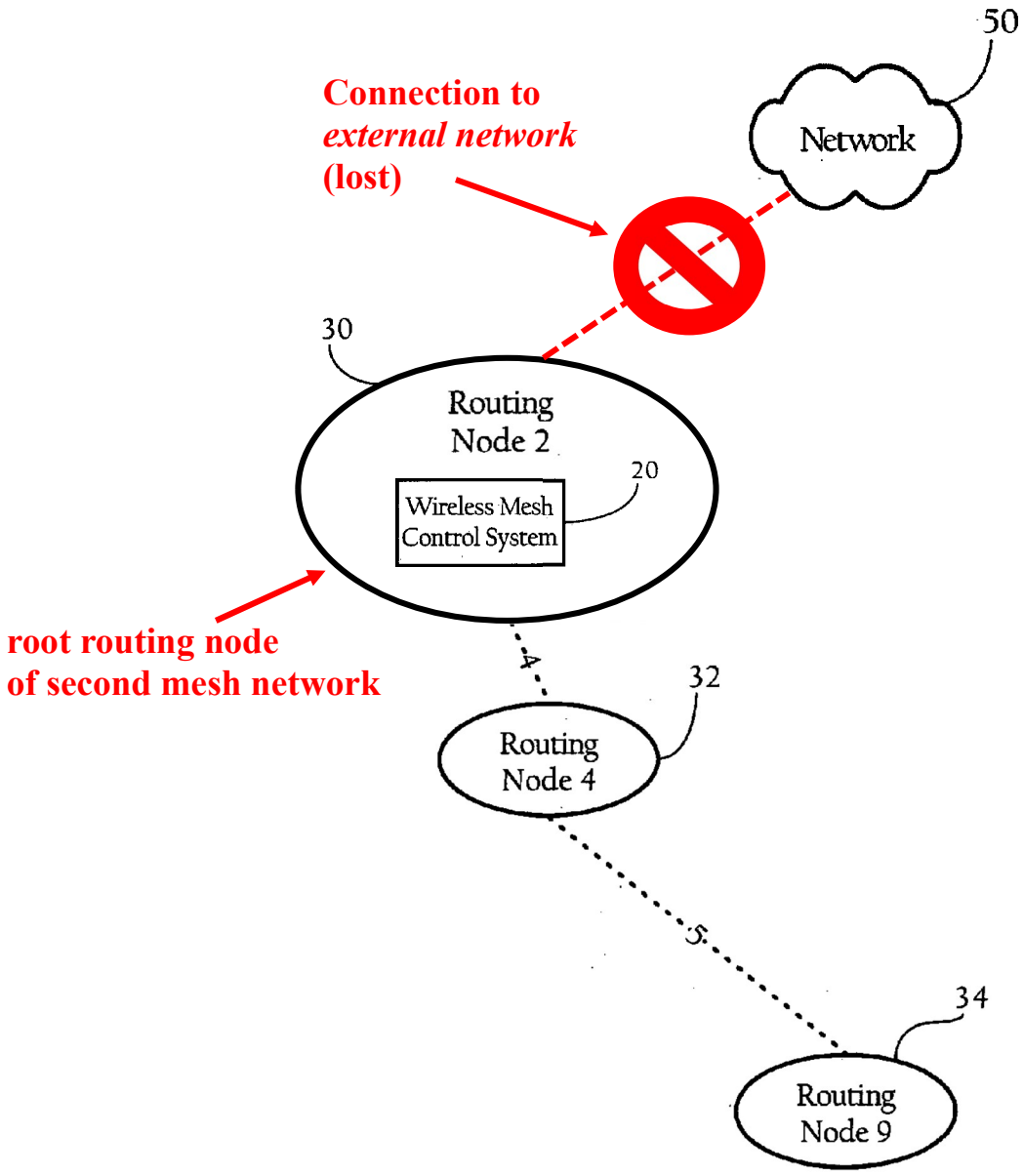


Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶171.

[15.1] a second mesh network in the isolated configuration comprises an isolated root node and at least one or more isolated children nodes and

Castagnoli contemplates multiple hierarchical wireless mesh networks. For instance, as discussed at [9.0], in Figure 1 Castagnoli shows a first hierarchical wireless mesh network with root routing node 1 and a second hierarchical wireless

mesh network with root routing node 2, where each mesh network is connected to network 50. Accordingly, for the same reasons as discussed at [1.7] and [15.0], Castagnoli in view of Bauer renders obvious *a second mesh network* (Castagnoli's hierarchical wireless mesh network with root routing node 2) *in the isolated configuration* (operating where the connection is interrupted between root routing node 2 and network 50) *comprises an isolated root node* (root routing node 2) *and at least one or more isolated children nodes* (e.g., routing nodes 4 and 9). Ex.1003, ¶¶173-175.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶174.

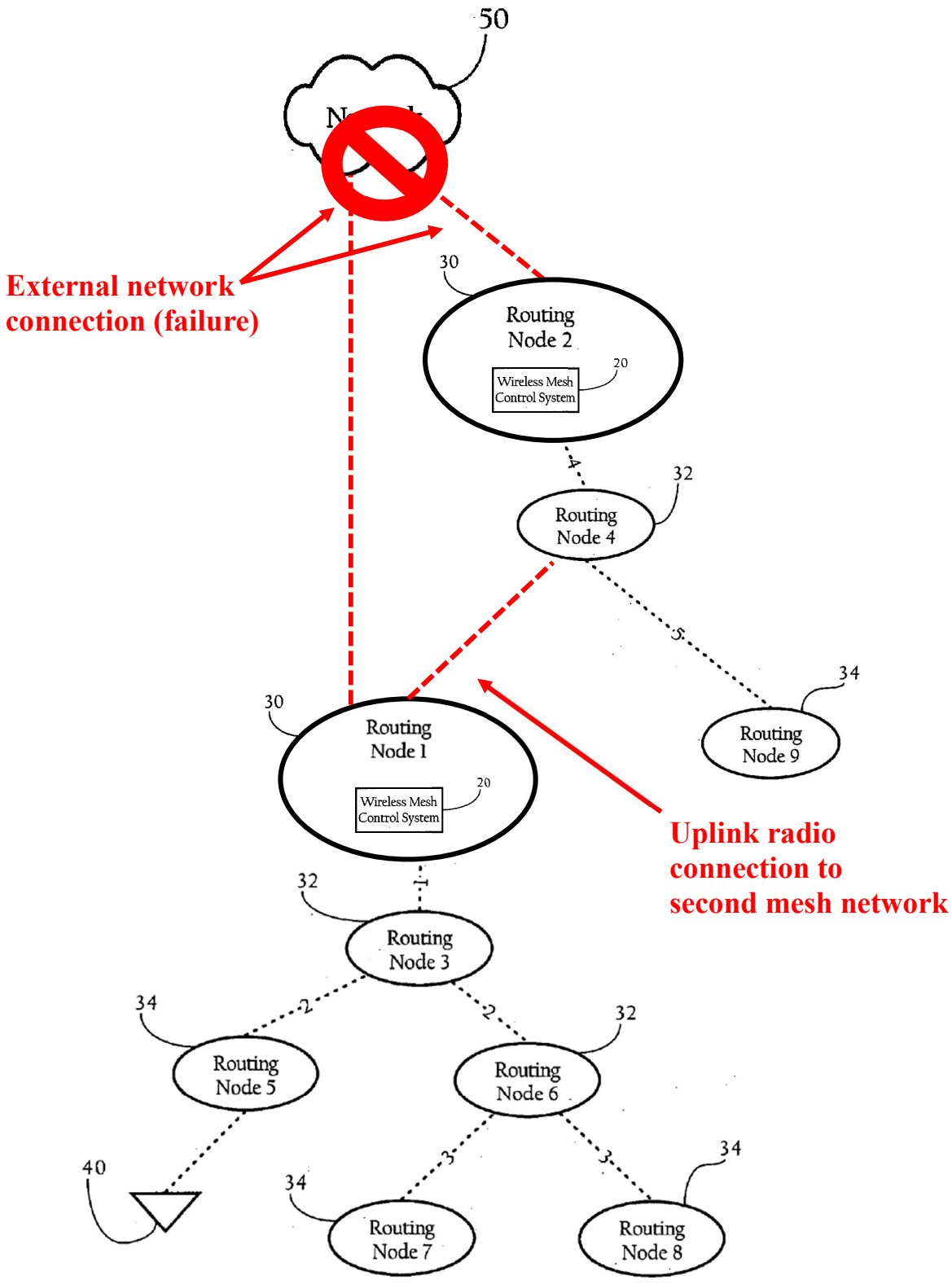
[15.2] the root node of the first network establishes communication with a child node of the second network, thereby the root node of the first network becomes a child node of the second network.

Castagnoli in view of Bauer and Zeng renders obvious *the root node of the first network establishes communication with a child node of the second network* because in the combination, Castagnoli's root routing node 1 searches for and

connects to a node in the second hierarchical wireless mesh network. Ex.1003, ¶176.

As discussed at [9.0], in the combination, Castagnoli implements Zeng's teaching of using an uplink radio to search for and connect to other networks when a node's external network connection is lost. Accordingly, when the connection between root routing node 1 and network 50 is lost, root routing node 1 would use its uplink radio to "broadcast a request for backhaul connectivity to neighboring APs," per Zeng. Ex.1007, [0030]. Zeng explains that the node "detects whether any neighboring AP responds to the backhaul connectivity request" and "selects a responding neighboring AP based on at least one predetermined criteria." Ex.1007, [0031]-[0032]. Accordingly, it would have been obvious in the combination to locate various access points within wireless communication range of one another, as taught by Zeng, to facilitate using Zeng's technique for recovering from a failed external network link, based on factors such as "signal power…to ensure that the transmission between the two access points meets a predetermined threshold." Ex.1007, [0034]. Further, Castagnoli's Figure 1 is "a functional block diagram that illustrates a hierarchical wireless mesh network according to an implementation of the present invention," and thus a POSITA would have appreciated that it does not depict the relative positions of the nodes with respect to one another, and thus each of routing nodes 4 and 9 would be understood to be viable candidates for neighbor

selection. Ex.1005, [0012], [0033]; Ex.1003, ¶¶177-178.



Ex.1005, Fig. 1 (modified, annotated); Ex.1003, ¶177.

7. Claim 16

[16.0] The structured mesh network of claim 15 wherein the unused uplink radio on the root node of the first network is used to connect to the child node of the second network.

As discussed at [15.2], Castagnoli's root routing node 1 (*root node of the first network*) connects to a node in the second hierarchical wireless mesh network (*connect to the child node of the second network*). And as discussed at [11.0], Castagnoli further renders obvious that the uplink radio of root routing node 1 is an *unused uplink radio on the root node of the first network* because it is not connected to an external network (and as the root is not connected to another AP) when providing IP services locally, per Bauer. Ex.1006, Abstract, [0023], Fig. 1; *see also* Ex.1005, [0010], [0033]; Ex.1006, [0002]; Ex.1003, ¶¶179-181.

D. Ground 3

1. Papadoglou

Papadoglou provides further details regarding the relationship between an access point and a client device. More specifically, Papadoglou "relates to a method of and apparatus for transmitting data between devices." Ex.1009. [0001]. Papadoglou describes "[a] communications device (1) communicates with an access point (7) to gateway (21) and local area network (13) by a wired or wireless communications link (9)." Ex.1009, Abstract. Communications devices include "mobile (cellular) telephones, personal digital assistance (PDAs), laptop computers

or the like." Ex.1009, [0014]. Papadoglou explains that when a device "has been connected to the access point 7 it is assigned a random IP address by the Dynamic Host Configuration Protocol (DHCP) server 11 of the local area network (LAN) 13[.]" Ex.1009, [0016]; Ex.1003, ¶182.

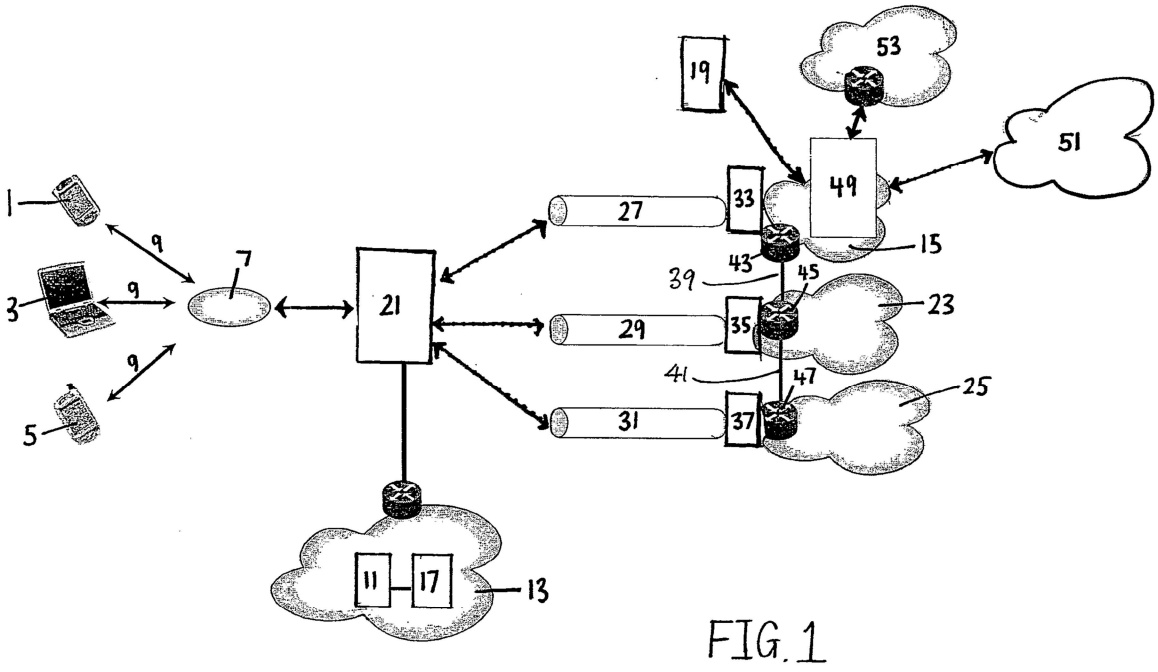


FIG. 1

Ex.1009, Fig. 1.

2. Reasons to Combine Castagnoli, Bauer, Gil, and Papadoglou

A POSITA would have combined Papadoglou with Castagnoli, Bauer, and Gil because Papadoglou merely provides additional details regarding conventional implementation of the connection of client devices to an access point. As discussed above in [18.0], Bauer describes how a mesh network operating without an external network connection provides DHCP services, and confirms that IP

addresses would be assigned to clients. Ex.1006, [0056], [0002]-[0003], [0055]. Papadoglou provides additional implementation details regarding such IP address assignment. More specifically, Papadoglou teaches that "a random IP address" is assigned "by the Dynamic Host Configuration Protocol (DHCP) server" when a client device connects to an access point, such as a routing node in Castagnoli's hierarchical wireless mesh network. Ex.1009, [0016]; *see also* Material Fact #1, Material Fact #2; Ex.1003, ¶183.

A POSITA would have been motivated to combine the teachings of Castagnoli, Bauer, and Gil with Papadoglou and doing so would have been within the POSITA's skillset. The combination would have been obvious because it represents merely the use of a known technique (random IP address assignment) to improve similar devices (Castagnoli's hierarchical wireless mesh network, using DHCP to assign IP addresses per Bauer) in the same way (assigning **random** IP addresses to client devices using DHCP, per Papadoglou) to yield predictable results. In the combination, each routing node, acting as a DHCP server per Bauer (Ex.1006, [0056]), would assign random IP addresses to client devices as taught by Papadoglou. A POSITA would have had a reasonable expectation of success in the combination because Papadoglou merely teaches conventional IP address assignment practices (i.e., random IP address assignment to client devices) that was well known in the art. Material Fact #1, Material Fact #2. And Papadoglou, like

Bauer, teaches assigning IP addresses using a DHCP server. Ex.1009, [0016]; Ex.1005, [0056], [0002]-[0003]; *see* [18.0]; Ex.1003, ¶184.

3. Claim 19

[19.0] The structured mesh network of claim 18 wherein the DHCP server within each node assigns IP addresses to client devices containing one or more random numbers within the IP addresses.

As discussed in [18.0], Bauer renders obvious *wherein the DHCP server within each node assigns IP addresses to client devices*. Further, it would have been obvious that *each node assigns IP addresses…containing one or more random numbers*, as taught by Papadoglou. Ex.1003, ¶¶185-186.

Papadoglou teaches that when a user terminal—e.g., a mobile phone, PDA, laptop computer, or the like—connects to an access point, "it is **assigned a random IP address by the Dynamic Host Configuration Protocol (DHCP) server** 11 of the local area network[.]" Ex.1009, [0016], [0014]. This is consistent with Bauer, which similarly teaches the assignment of IP address using DHCP servers, as discussed above in [18.0]. Ex.1006, [0056], [0002]-[0003]. Indeed, it was well-known in the art for a DHCP server to assign random IP addresses to clients and for the IP addresses to be composed of numerals. Material Fact #1, Material Fact #2; Ex.1003, ¶¶187-189.

XIII. Conclusion

Petitioner has established a reasonable likelihood that the Challenged Claims

are unpatentable.

Respectfully submitted,

Dated: October 10, 2025
HAYNES AND BOONE, LLP
2801 N. Harwood St., Suite 2300
Dallas, Texas 75201
Customer No. 27683

/Theodore M. Foster/
Theodore M. Foster
Lead Counsel for Petitioner
Registration No. 57,456

XIV. Mandatory Notices

A. Real Party-in-Interest

Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner certifies that the real party-in-interest is Cisco Systems, Inc.

B. Related Matters

Pursuant to 37 C.F.R. § 42.8(b)(2), to the best knowledge of the Petitioner, the '691 Patent is or was involved in the following cases:

Case Heading	Number	Court	Filed
Dynamic Mesh Networks, Inc. d/b/a MeshDynamics v. Cisco Systems, Inc.	2:25-cv-00472	E.D. Tex.	5/5/2025 (dismissed 8/4/2025)
Cisco Systems, Inc. v. Dynamic Mesh Networks, Inc. d/b/a MeshDynamics	3:25-cv-06441	N.D. Cal.	7/31/2025
Dynamic Mesh Networks, Inc. d/b/a MeshDynamics v. Cisco Systems, Inc.	2:25-cv-00781	E.D. Tex.	8/12/2025

C. Lead and Back-up Counsel and Service Information

Lead Counsel
Theodore M. Foster
HAYNES AND BOONE, LLP
2801 Harwood St. Suite 2300
Dallas, TX 75201
Phone: (303) 382-6205
Fax: (214) 200-0853
ipr.theo.foster@haynesboone.com
USPTO Reg. No. 57,456

Back-up Counsel

David L. McCombs
HAYNES AND BOONE, LLP
2801 Harwood St. Suite 2300
Dallas, TX 75201
Phone: (214) 651-5533
Fax: (214) 200-0853
david.mccombs.ipr@haynesboone.com
USPTO Reg. No. 32,271

Calmann J. Clements
HAYNES AND BOONE, LLP
2801 Harwood St. Suite 2300
Dallas, TX 75201
Phone: (972) 739-8638
Fax: (214) 200-0853
calmann.clements.ipr@haynesboone.com
USPTO Reg. No. 66,910

Matthew Beck
HAYNES AND BOONE, LLP
2801 Harwood St. Suite 2300
Dallas, TX 75201
Phone: (202) 654-4573
Fax: (202) 654-4501
matthew.beck.ipr@haynesboone.com
USPTO Reg. No. 79,791

Dagim Tilahun
HAYNES AND BOONE, LLP
2801 Harwood St. Suite 2300
Dallas, TX 75201
Phone: (202) 654-4582
Fax: (202) 654-4501
dagim.tilahun.ipr@haynesboone.com
USPTO Reg. No. 75,722

Brett Bostrom
HAYNES AND BOONE, LLP
2801 Harwood St. Suite 2300
Dallas, TX 75201
Phone: (720) 484-3715
Fax: (214) 200-0853
brett.bostrom.ipr@haynesboone.com
USPTO Reg. No. 73,009

Please address all correspondence in this proceeding to lead and back-up counsel. Petitioner consents to service in this proceeding by email at the addresses above.

CLAIMS APPENDIX

[1.0] A structured mesh network capable of isolated operation, comprising:

[1.1] at least two structured mesh nodes;

[1.2] wherein each structured mesh node comprises at least a connectivity logic;

[1.3] an uplink radio operating on an uplink frequency and a downlink radio operating on a distinct downlink frequency;

[1.4] wherein the connectivity logic determines whether each structured mesh node connects with an external network or another node using its uplink radio and client devices or other mesh nodes connect to each node using each node's downlink radio;

[1.5] wherein the structured mesh network functions in two configurations selected depending on whether a connection to an external network is present;

[1.6] in the first connected configuration the structured mesh network includes at least one structured mesh node's uplink radio comprising a connection to an external network; and

[1.7] in the second isolated configuration none of the structured mesh nodes' uplink radio comprises a connection to an external network, and one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root

node as isolated root children nodes forming a tree configuration;

[1.8] wherein clients of nodes of the structured network in a second isolated configuration retain full connectivity within the structured network during the isolated configuration and

[1.9] wherein said client connectivity is uninterrupted during any transition from the isolated configuration to the first connected configuration;

[1.10] wherein distinct downlink frequencies are used by nodes for communication with one or more nodes lower on the tree configuration.

[9.0] The structured mesh network of claim 1 wherein the connectivity logic contained by the nodes realigns connections between the nodes upon detection of an external network connection to form the connected configuration.

[10.0] The structured mesh network of claim 9 wherein solely the isolated network root node logic searches for the external network connection and establishes the external network connection.

[11.0] The structured mesh network of claim 10 wherein the previously unused uplink radio of the isolated network root node is used to connect to the external network.

[15.0] The structured mesh network of claim 1 wherein a first mesh network in the isolated configuration comprises an isolated root node and one or more

isolated children nodes and a second mesh network in the isolated configuration comprises an isolated root node and at least one or more isolated children nodes and the root node of the first network establishes communication with a child node of the second network, thereby the root node of the first network becomes a child node of the second network.

[16.0] The structured mesh network of claim 15 wherein the unused uplink radio on the root node of the first network is used to connect to the child node of the second network.

[18.0] The structured mesh network of claim 1 wherein each network node further comprises a DHCP server used to assign addresses to client devices communicating with the node using the node's downlink radio.

[19.0] The structured mesh network of claim 18 wherein the DHCP server within each node assigns IP addresses to client devices containing one or more random numbers within the IP addresses.

[35.0] A structured mesh network capable of isolated operation, comprising:

[35.1] at least two structured mesh nodes;

[35.2] wherein each structured mesh node comprises at least a connectivity logic

[35.3] and a radio operating on an uplink frequency and a distinct downlink frequency;

[35.4] wherein the connectivity logic determines whether each structured mesh

node connects with an external network or another node on the uplink frequency and client devices or other mesh nodes connect to each node on the downlink frequency;

[35.5] wherein the connectivity logic in each node contains a distributed routing table;

[35.6] wherein the structured mesh network functions in two configurations selected depending on whether a connection to an external network is present;

[35.7] in the first connected configuration the structured mesh network includes at least one structured mesh node's uplink connection comprising a connection to an external network; and

[35.8] in the second isolated configuration none of the structured mesh nodes' uplink connections comprises a connection to an external network, and one of the structured mesh nodes acts as an isolated network root of the isolated configuration and all remaining nodes connect to the isolated network root node as isolated root children and descendant nodes forming a tree configuration;

[35.9] wherein clients of the at least two structured mesh nodes in a second isolated configuration retain full connectivity within the structured network during the isolated configuration and

[35.10] wherein said client connectivity is uninterrupted during any transition from the isolated configuration to the first connected configuration;

[35.11] wherein distinct downlink frequencies are used by nodes for communication with one or more nodes lower on the tree configuration.

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), Petitioner hereby certifies, in accordance with and reliance on the word count provided by the word-processing system used to prepare this Petition, that the number of words in this paper is 13,850. Pursuant to 37 C.F.R. § 42.24(d), this word count excludes the table of contents, table of authorities, mandatory notices under § 42.8, certificate of service, certificate of word count, appendix of exhibits, and any claim listing.

Dated: October 10, 2025

/Theodore M. Foster/
Theodore M. Foster
Lead Counsel for Petitioner
Registration No. 57,456

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e) and 37 C.F.R. § 42.105, the undersigned certifies that a true and correct copy of the foregoing was served on the Patent Owner as detailed below:

Date of service	October 10, 2025
Manner of service	FedEx
Documents served	**Petition for *Inter Partes* Review Under 35 U.S.C. § 312 AND 37 C.F.R. § 42.104;** **Petitioner's Power of Attorney;** **Exhibit List; and** **Exhibits Ex.1001-Ex.1020**
Persons Served	Michael J. Cherskov Szymon M. Gurda 903 Commerce Dr., Suite 310 Oak Brook, IL 60523

/Theodore M. Foster/
Theodore M. Foster
Lead Counsel for Petitioner
Registration No. 57,456